Paying for Private School Education: Maternal Employment and Savings over the Life-cycle

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Abstract

This paper builds and estimates a dynamic life-cycle model to investigate how mothers change their work and savings behavior in order to pay for private schooling for their children. The model incorporates the choice of private or public school for the child and allows risk aversion and savings to capture how mothers can plan for children's schooling in advance. Results show that mother's time with the child and private schooling are complements in producing child's cognitive skills and that the availability of private schooling leads to more work and savings among women with children of school-going age. Counterfactual simulations show that relaxing liquidity constraints for mothers increases private school enrollment, with larger effects for low-education women. I also find that subsidizing private schooling can reduce inequality in children's outcomes. However, these subsidies affect work and saving incentives of mothers, and lead to lower wages and asset accumulation among less educated females.

KEYWORDS: Private Schooling; Maternal Labor Supply; Household Saving; Time Allocation; Child Development; School Financing; Dynamic Structural Models.
JEL CLASSIFICATION: J13, J22, D1, D91.

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1 Introduction

Several studies have contributed to our understanding of the importance of early childhood investments, including schooling, parental time and other goods, in the development of cognitive and non-cognitive skills.[1] One such investment is private schooling. In the US, private schooling is an important part of the schooling landscape. One in ten children in the US, or roughly 5 million children, attend private schooling (Murnane and Reardon, 2018). Much research has examined its impacts on children's outcomes, especially relative to public school, showing positive returns for students along a number of dimensions.[2] While we know a lot about how private schooling affects children's outcomes, little is known about how parents change their economic behavior to pay for it. This is an important omission because private schooling is expensive, with tuition ranging from $5,000 to $40,000 per annum. Given the magnitude of costs, the private school investment may lead to shifts in labor supply and savings of parents, particularly mothers, during child's school-going age, but even before, including prior to a child's birth.

Seen this way, the private schooling decision constitutes an important additional dimension to the typical time investment trade-off that mothers face. Even without private schooling, mothers must choose between time investments versus working to afford monetary investments in an effort to develop their children's skills. The availability and cost of private schooling can affect this trade-off, with the direction of impact on mother's labor supply depending on whether private schooling is a complement or substitute for maternal time with the child. This link between private schooling and maternal labor supply and savings is potentially important but has not been examined in the literature. More broadly, adding this dimension to the mother's decision can help us understand how policies, such as private school vouchers or the recent Tax Cuts and Jobs Act that expands the use of 529 plans to pay for tuition expenses at private schools, can have impacts not only on children but also affect the life-cycle behavior of females, even before children are born.[3]

In this paper, I build and estimate a dynamic model of female's time allocation choice, wages, savings, and child's schooling decision to study how women shape their career path and asset accumulation to pay for private school education for their children. The effect of

[1] See Heckman and Carneiro (2003); Heckman and Masterov (2007); Heckman and Cunha (2007); Cunha, Heckman, and Schennach (2010); Heckman, Moon, Pinto, Savelyev, and Yavitz (2010);Aizer and Cunha (2012); Dahl and Lochner (2012).

[2] See Neal (1998) for a comprehensive summary of the literature on the effects of private schooling on child outcomes.

[3] The Tax Cuts and Jobs Act, which was signed into law in December 2017, allows families to use 529 plans to pay for up to $10,000 in tuition expenses at elementary or secondary public, private or parochial schools.

private schooling on female labor supply is theoretically ambiguous and depends on the interaction between woman's observed characteristics such as education and household income, her unobserved characteristics such as preferences and productivity at home and in the labor market, and the cost of private schooling. To empirically investigate this theoretical ambiguity, the structural model captures the following key features. First, it incorporates private schooling choice for the child into a framework linking child-related costs to female's career trajectories (Francesconi, 2002; Sheran, 2007; Attanasio, Low, and Sanchez-Marcos, 2008; Cascio, 2009; Eckstein and Lifshitz, 2011; Albanesi and Olivetti, 2016; Adda, Dustmann, and Stevens, 2017; Hotz and Miller, 1988). By incorporating private schooling into the mother's decision problem, separately from other goods investments in the child, I explicitly account for the trade-off between working to afford high cost private schooling and spending time with the child, that also increases child ability. Second, the model incorporates risk-aversion and savings to capture how forward-looking mothers can plan for child's schooling in advance and smooth their consumption after childbirth when the value of mothers' time at home is higher. Third, the structural model characterizes selection by allowing for permanent unobserved heterogeneity to affect child's schooling choice as well as all the endogenous decisions in the model. While male income, fertility and marriage are exogenous, they are driven by stochastic processes that depend on woman's observed characteristics, as in Blundell, Costa Dias, Meghir, and Shaw (2016). These variables are allowed to affect woman's preferences and budget constraint, thereby affecting all of the endogenous outcomes.

In studying how female labor supply links to private schooling, this paper contributes to two main literatures. The first one is on parental investment and child development (Becker, 1981; Becker and Tomes, 1986; Ermisch and Francesconi, 2005; Todd and Wolpin, 2007; Ramey and Ramey, 2010; Liu, Mroz, and Van der Klaauw, 2010; Del Boca, Flinn, and Wiswall, 2014).[4] One area receiving considerable attention is daycare for the child. The literature has generally found negative effects on child development of mothers increasing their labor supply (Bernal, 2008; Bernal and Keane, 2010, 2011; Baker, Gruber, and Milligan, 2008, 2015). This effect presumably arises because of low quality child care outweighing any reductions in maternal time investments but increases in goods investments. However, the

[4] Becker (1981) and Becker and Tomes (1986) are the seminal papers this literature, in which parents can affect child ability through monetary and time investments. More recent papers jointly estimate parent's time allocation decision and child ability production function to address the endogeneity of inputs in child ability. Joint estimation of mother's time allocation decision and child ability production function alleviates concerns about the endogeneity of the work decision. The endogeneity can arise due to two reasons: (1) women who work more may be systematically different from those who do not work, which may be correlated with the ability of the child, and (2) mother's work decision may depend on the child's ability itself, in that mothers may compensate a "low ability" child by spending more time with him, or she may choose to spend more time with a "high ability" child for reinforcement of skills.

existing analysis leaves out a critical dimension of investment in children: the quality of monetary investments. I add to this literature in two significant ways. First, I add private schooling choice for the child in the mother's optimization problem, which allows me to examine the role of different qualities of goods investments. Second, I cast this decision in a dynamic setting which endogenizes female's decision to spend time with the child, work hours choice, human capital accumulation, wages and savings decision. The setting allows me to quantify the career costs of children for mothers who make different choices for their child's schooling, and study how preference for private schooling for children manifests itself in women's employment and consumption decisions even before the child starts school.

Second, this paper contributes to the literature on the returns to private schooling, which finds that private schooling increases the probability of graduating high school and attending college as well as improve test scores and non-cognitive outcomes (Sander and Krautmann, 1995; Altonji, Elder, and Taber, 2005b,a; Evans and Schwab, 1995; Neal, 1997; Grogger, Neal, Hanushek, and Schwab, 2000; Jepsen, 2003; Mocan and Tekin, 2006). These studies only look at the ceteris paribus impact of private schooling. However, the impact of private schooling does not occur in isolation. The cost associated with private schooling can affect parental behavior and other investments. I add to this literature by linking private schooling choice for the child with the mother's optimization problem. This allows me to capture the mechanisms through which private schooling can positively affect child ability, taking into account not just the direct impact of schooling but also the effect on investments working through women's work choices and asset accumulation. This also means I can tie schooling policies to female decisions even before a child is born. In particular, the private schooling choice for children can affect mothers' work and consumption decisions before the child starts school, which will in turn affect monetary and time investments that mothers make in their children. Moreover, I am able to capture possible complementarities between inputs into the child ability production function, that can help explain why some children gain more from private schooling than others.[5]

For my study, I use three disparate sources of data, including the National Longitudinal Survey of Youth 1979 (NLSY79), Panel Study of Income Dynamics (PSID) Child Development Supplements (CDS-I and CDS-II), and the website `privateschoolreview.com`. I restrict attention to ever-married women and begin my analysis by presenting descriptive results on who sorts into private schools, and how the labor supply of women who send their

[5]This paper also adds to the literature on schooling and household decisions, which is not well-developed, though a few papers look at housing choices and school quality, showing that school quality affects household decisions in profound ways (Black, 1999). In a companion paper, I find that an increase in parents' wealth due to the housing demand shock of 2000-2006 led to an 18 percent increase in children's private school enrollment (Qayyum, 2018).

children to private school differs from public school mothers over the life-cycle. Using data from the NLSY79 and NLSY79 Child and Young Adult Survey, I show that more educated and high-income women are more likely to choose private schooling for their children. Additionally, I find that before childbirth, women who eventually select private schooling for their children work more, both at the extensive and the intensive margin, compared to public school mothers. However, this gap reverses after childbirth. Moreover, there is considerable heterogeneity across education and income groups in how private schooling interacts with labor supply. In particular, private school mothers with less education and lower levels of non-labor income work more than public school mothers throughout the child's life-cycle. On the other hand, women with higher education and non-labor income who send their child to private school work substantially less than public school mothers of similar education and income after childbirth.

These data patterns motivate the specification of the dynamic structural model. The model is estimated using the Method of Simulated Moments (MSM), using geographical and time variation in private school costs as one source of identification. Women are ex ante heterogeneous because of differing education and family background, which can affect their preferences, wages, budget constraint and responses to private schooling costs. The interaction between child's schooling costs and the observable individual type thus provides exogenous variation that I use in the estimation of the dynamic model.[6] The results of the structural estimation show that mother's time with the child and private schooling are complements, and that mother's time is most productive when the child is less than six years of age. The availability of private schooling leads to women and saving working more to afford private schooling for their children, with larger effects for low-educated women. I estimate the price elasticity of private school enrollment to be -0.25. Moreover, I show that a one standard deviation decrease in private school costs leads to a small decrease in the labor supply of incumbents. On the other hand, new entrants increase their labor supply by 7% to be able to afford subsidized private schooling. However, a three standard deviation decrease in tuition leads to even new entrants decreasing their labor supply.[7]

I then use the model to answer a number of important research questions. First, I conduct policy simulations to assess the impact of relaxing mothers' liquidity constraints. I find that a lump sum transfer amounting to the average cost of private schooling given annually since the child is of school-going age leads to a substantial increase in private school enrollment. Consistent with existing research on the role of credit constraints on human

[6] The underlying identification assumption is that a woman's observed characteristics are orthogonal to the price setting behavior of local private schools.

[7] I define incumbents as mothers who were already selecting private schooling and new entrants as mothers who choose private schooling after the subsidy

capital accumulation, I find that liquidity constraints matter the most for low-educated families. My model also allows me to study how subsidizing private school affects women's career paths and asset accumulation.[8] I find that subsidizing private schooling for women with low assets increases private school enrollment, and allows credit constrained women to afford private schooling for their child. However, the subsidy acts as a work disincentive for both incumbents and new entrants which results in wage losses for both groups of women.

Next, I give targeted subsidies of 25% to different education groups to assess how the same amount of money given to different groups of women results in different outcomes.[9] Results show that a 25% subsidy to the lowest-education group results in larger gains in children's test scores than the same subsidy for the highest education group. I also find that new entrant mothers increase their labor supply before the child starts school to top up the subsidies, with bigger increases in labor supply among the lowest education group. However, the subsidy acts as a work disincentive for low-educated females, resulting, ultimately, in lower wages and terminal assets for these women. On the other hand, the subsidy is a windfall for incumbent mothers belonging to all education groups, allowing them to accumulate higher assets over the life-cycle.

2 Background, Data, and Descriptive Evidence

This sections presents a brief background of private schooling in the US and a simple two-period model to discuss the theoretical implications of the availability of private schooling on female labor supply and savings. I then introduce the data set used in the analysis and show how child's schooling choice interacts with maternal labor supply and asset holdings.

2.1 Private Schooling in the US

Data from the National Center for Education Statistics shows that private school enrollment in the United States has been fairly constant over the last decade 10%, which translates to 5.4 million children. Private schools constitute 25% of all US schools (30,861 schools in 2011-2012 school year). Within grades, a higher percentage of students are enrolled in private schools offering Pre-K through grade 8 (12.8%) than in schools offering grades 9 through 12 (8.0%). Private schools are also a more popular choice in the Northeast, where

[8] These policy counterfactuals are similar in spirit to papers that use structural models of women's work choices and child care decisions to assess the impact of child care subsidies (Michalopoulos, Robins, and Garfinkel, 1992; Griffen, 2018).

[9] A 25% subsidy amounts to a one standard deviation decrease in private school costs.

14% of all enrolled students went to private school, as compared to the West, where only 8.0% of all enrolled students went to private school in 2011-12. Most private school students (79%) attend religiously-affiliated schools. While private school enrollment has not changed dramatically in the past decade, private school costs have risen substantially. Figure 1 shows how the national average inflation-adjusted tuition has been evolving over the years for different types of private schools. The average tuition across all grades was $6,820 in the 1999-2000 school year and $10,940 in the 2011-2012 school year, which is an increase of around 60% in a little more than a decade. The bar chart also shows that the average tuition charged for all types of school has been increasing over the years, with the steepest rise for non-sectarian private schools. Schools associated with a religious congregation charge, on average, less than non-sectarian private schools. In the 2011-2012 school year, the cost of Catholic schooling was $7,020, as compared with $21,910 for non-sectarian private schools. These figures show that private schools are charging a non-trivial amount and that these costs have been rising at a higher rate than inflation in the past decade.

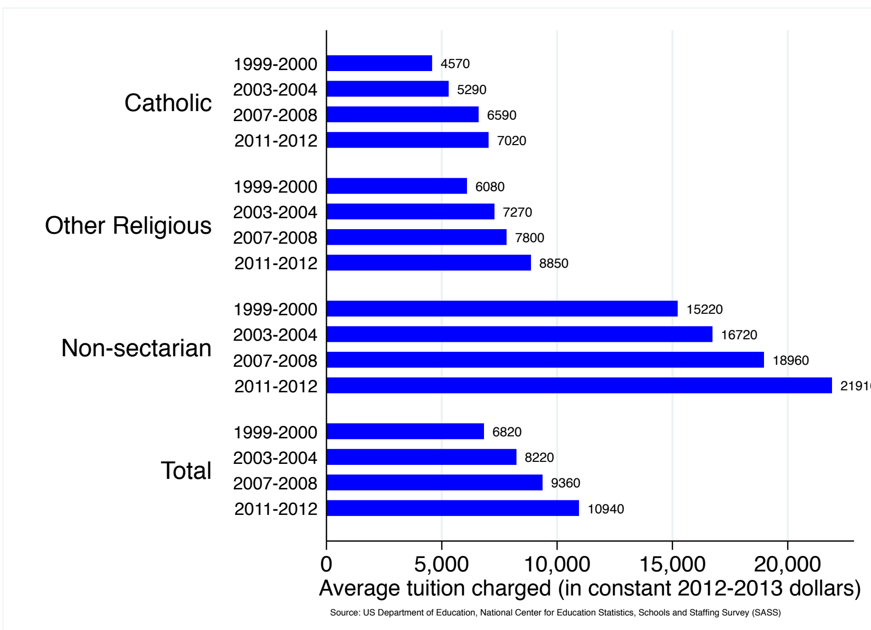


Figure 1: Average Tuition Costs over Time. The Figure plots average tuition costs for different types of private schools for four different time periods.

2.2 Theoretical Framework

In Appendix B, I present a simple stylized model of the effect of private schooling on maternal labor supply, savings and child outcomes which illustrates the trade-off women face between working and spending time with the child, and how that is affected by the availability and cost of private schooling. Theoretically, the introduction of private schooling into an environment where private schooling is not available as an option for child's schooling can lead to two possible labor supply responses from mothers. Mothers who choose private schooling have to fund tuition costs, which should result in an increase in their labor supply. However, we could observe a decrease in mother's labor supply after the introduction of private schools if mother's time with the child and private school are complements, and the disutility from lost wage income is less than the marginal utility from higher child ability when the child goes to private school.

Simply put, the mother is more likely to increase her labor supply and select private schooling for the child if private school quality is better than that in public school so that the higher school quality is enough to compensate for low maternal time investments. The female's time allocation decision also depends on the productivity of her time with the child. If mother's time with the child is not very productive, so that the drop in child ability is not large when the mother increases her labor supply, then the likelihood of working and selecting private schooling for the child would be higher. This effect is likely to be different for different women. For example, if we assume that mother's time with the child may be less productive for less educated females, we would expect to see these women work more when they send their child to private school. This is because the opportunity cost of staying at home for them is the highest (loss of wage earnings without a comparable boost in child ability). On the other hand, more educated mothers, who may be more productive at home with their child, may be more likely to stay at home with the child as the drop in child ability due to the mother spending less time with the child will be higher.

As for the causal effect of a decrease private school fee, theoretically, a decrease in private school fee would unambiguously increase private school enrollment. However, the effect on maternal labor supply is different for incumbent mothers and new entrants. For incumbents, a decrease in school fee should unambiguously result in a decrease in labor supply. However, the effect on the labor supply of new entrants is again theoretically ambiguous. These mothers will increase their labor supply if the marginal utility from higher child ability (due to the child attending good quality private school) is enough to compensate for the marginal disutility from lower net consumption. The direction of labor supply for new entrants will therefore depend on the magnitude of the fee decrease, as well as the complementarity between their time with the child and private schooling.

2.3 Private Schooling and Maternal Labor Supply: Descriptive and Reduced Form Evidence

To understand how mother's work decisions respond to child's school choice, I conduct a life-cycle analysis with panel data. The descriptive analysis reveals three key facts. First, we learn that women who send their children to private school are more educated and wealthier than women who send their children to public school. Second, there is a significant difference in the labor supply patterns of private and public school mothers, and this difference varies over the life-cycle. Third, I show that the labor supply response of mothers to private schooling is heterogeneous across education and income.

Sample and Summary Statistics

For my descriptive analysis, I use data from two main sources: NLSY79 and NLSY79 Child and Young Adult, and supplement it with time use data from the Panel Study of Income Dynamics (PSID) and private school fee data from `privateschoolreview.com`. Details on the variables constructed from the various data sources are presented in Appendix C. I restrict my sample to ever-married women in NLSY79.[10] I match the mothers in NLSY79 Child and Young Adult survey with the female respondents in NLSY79 so that my sample consists of all women in NLSY79 who have a child. I drop observations for which child's year of birth and schooling choice are not available and only follow women after 18 years of age. The unit of analysis is a mother-child pair followed over time, and my sample consists of an unbalanced panel of 3,610 unique child-mother observations, 2,208 unique mother observations, and 76,143 total child-mother-year observations. Since NLSY79 does not have information on what type of private school the child goes to, the private school variable includes Catholic schools, schools with other religious affiliations, as well as non-sectarian private schools.[11] Out of the 3,610 children in my sample, 770 (21.3%) go to private school.

Summary statistics presented in Table 1 show that private school mothers are observationally different from public school mothers. As expected, mothers of private school going children are more educated, earn more wage and salary income and have more annual non-labor income at their disposal.[12] Figure 2 shows that throughout the child's life-cycle, private

[10] I drop cohabiting mothers from the sample. There are 545 single or cohabiting mothers in the sample, which constitutes 12.4% of total mothers.

[11] For my analysis, I construct a dummy variable $P \in \{0, 1\}$, which takes the value 1 if the female's child goes to private school and 0 otherwise. See Appendix C for a detailed description of how this variable is constructed.

[12] Non-labor income is constructed by subtracting female's annual real wage income from annual real net family income.

Table 1: Summary Statistics

	Public					Private				
	Mean	S.d	Min	Max	N	Mean	S.d	Min	Max	N
Hispanic	0.07	0.26	0	1	59304	0.05	0.22	0	1	16839
Black	0.13	0.34	0	1	59304	0.06	0.23	0	1	16839
White	0.80	0.40	0	1	59304	0.89	0.31	0	1	16839
Urban	0.75	0.43	0	1	55447	0.84	0.37	0	1	15568
Protestant	0.05	0.21	0	1	59114	0.06	0.24	0	1	16795
Baptist	0.20	0.40	0	1	59114	0.12	0.32	0	1	16795
Episcopalian	0.02	0.12	0	1	59114	0.03	0.19	0	1	16795
Lutheran	0.07	0.25	0	1	59114	0.04	0.20	0	1	16795
Methodist	0.08	0.27	0	1	59114	0.05	0.23	0	1	16795
Presbyterian	0.03	0.17	0	1	59114	0.04	0.20	0	1	16795
Roman Catholic	0.31	0.46	0	1	59114	0.43	0.50	0	1	16795
Jewish	0.02	0.13	0	1	59114	0.03	0.17	0	1	16795
Other Religions	0.14	0.35	0	1	59114	0.14	0.34	0	1	16795
Less than High School	0.14	0.34	0	1	59304	0.02	0.14	0	1	16839
High School	0.41	0.49	0	1	59304	0.25	0.43	0	1	16839
College	0.26	0.44	0	1	59304	0.23	0.42	0	1	16839
More than College	0.19	0.39	0	1	59304	0.50	0.50	0	1	16839
Age	30.0	7.92	18	53	57532	30.6	8.42	18	53	16190
Age at First Marriage	23.4	4.34	18	50	58946	25.0	4.38	18	46	16778
Age at First Birth	22.9	4.06	13	40	43309	26.2	4.43	13	41	9655
No. of Children	2.82	1.19	1	10	59304	2.88	1.35	1	10	16839
Child Age	7.92	5.78	0	18	37512	7.77	5.55	0	18	8161
Child Care 1^{st} year	0.48	0.50	0	1	56693	0.48	0.50	0	1	15652
Child Care 2^{nd} year	0.52	0.50	0	1	55849	0.54	0.50	0	1	14956
Child Care 3^{rd} year	0.54	0.49	0	1	55048	0.54	0.50	0	1	14873
Annual Wage Income	13.2	12.8	0	194.04	44011	17.6	20.2	0	194.04	13769
Annual Family Income	42.0	64.7	0	1168.3	48281	68.9	108.5	0	1168.3	13629
Annual Non-labor Income	29.6	56.7	-71.5	1167.8	38207	49.2	97.2	-71.9	1167.5	11871
Spouse's Annual Earnings	32.3	26.5	0	219.78	29040	48.3	42.0	0	219.8	8989
Total Assets	28.6	146.2	0	5955.6	23506	58.6	221.3	0	4637.1	8394
Net Worth	75.8	190.4	-1015	2093.2	35259	148.5	283.2	-605.1	2093.3	9672
Annual Hours	1237.9	932.8	0	8736	56858	1287.1	928.1	0	7950	15985
Annual Employment Rate	0.78	0.41	0	1	56858	0.81	0.39	0	1	15985
Full-time Work	0.43	0.50	0	1	56858	0.45	0.50	0	1	15985
Part-time Work	0.35	0.48	0	1	56858	0.36	0.48	0	1	15985
No Work	0.22	0.41	0	1	56858	0.19	0.39	0	1	15985
Spouse's Annual Hours	2198.2	677.5	0	8736	34409	2325.1	675.9	0	8736	10172
PIAT - Math	103.7	13.6	65	135	9,528	109.2	12.2	65	135	1,752
PIAT - Reading Recognition	106.6	14.4	65	135	9,481	112.0	12.1	65	135	1,749
PPVT	96.9	18.2	0	158	6,215	105.2	17.5	20	158	687
Test Score	219.7	81.0	0	424	11,748	261.9	59.1	95	428	1,756
Private School Fee						8.96	3.87	2.13	26.82	76143

Notes: Family Income, Wage Income, Non-labor Income, Spouses' Annual Earnings, Total Assets, Net Worth and Private School Fee are in constant 1990 dollars (using the Bureau of Labor Statistics Consumer Price Index - All Urban Consumers (CPI-U)). The values have also been divided by 1000. All summary statistics are weighted using the sampling weights provided by NLSY79. Annual Employment Rate reports the average of a dummy which is 1 if the respondent has worked more than 6 weeks in the past calendar year. The respondent is considered as having worked full-time if she worked more than 1600 hours in the past calendar year, part-time if she worked less that 1600 hours but more than 6 weeks, and unemployed (no work) if she worked less than or equal to 6 weeks in the past calendar year.

Test Score is a composite measure of test score for the children of NLSY79, which is created by averaging over the standardized PIAT-Math, PIAT-Reading Recognition and PPVT scores.

school mothers have higher net worth than public school mothers. This reflects the difference in the savings and asset accumulation behavior of the two groups of women. There is also some evidence of positive assortative mating among private school parents, since spouse's annual earnings are higher, on average, for private school mothers.[13] The key variables of interest are mothers' employment rates and work hours. On average, private school mothers work more hours annually than public school mothers, an effect not being driven solely by a few women working more, since the annual employment rate of the former is 2% higher as well. Lastly, the standardized PPVT, PIAT-M, and PIAT-R scores, as well as the composite Test Score are higher for children who go to private schools.[14]

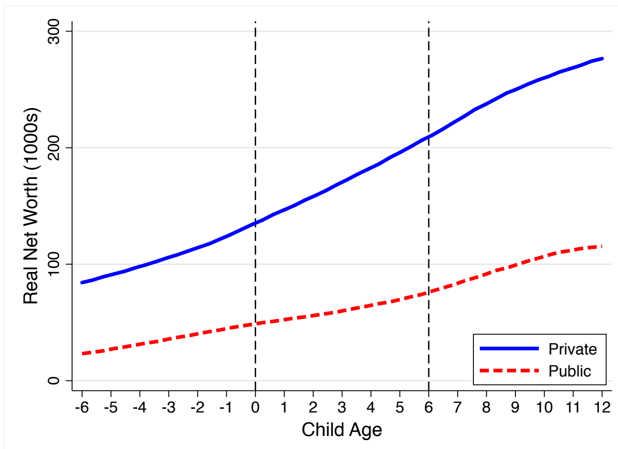


Figure 2: Real Net Worth. The Figure plots average real net worth for private and public school mothers. The x-axis is child's age, with negative ages denoting years before childbirth.

In Table 2, I show predictors of private schooling and female labor supply and document the direction of correlation between child's private school choice and maternal labor supply. Column (1) shows that the probability of choosing private school for the child increases with mother's age, education level, and non-labor income, but goes down with child age. As compared with African American women, Hispanic and white women are more likely to choose private school for their children. Consistent with previous research (Cohen-Zada and Sander, 2008), I also find that women who report some religion have a higher probability of choosing private school. Columns (2) and (5) show that annual hours worked and the employment rate of women increase at a decreasing rate with age and increase with female's education level. Married women and women with higher non-labor income work fewer hours

[13]See Murnane and Reardon (2018) for a description of trends in private elementary school enrollment by family income from 1968-2013.

[14]The composite test score for each child is calculated by averaging the test scores available for each child. This ensures that I don't loose observations due to missing values of either test for any child.

annually, and both the extensive and intensive margin labor supply response also decreases with the number of children in the household. In Columns (3) and (6), I add the private school dummy as a regressor in the labor supply regressions and find that private schooling negatively impacts mothers' labor supply, both at the extensive and the intensive margin, which is opposite in sign to the average differences in labor supply of private and public school mothers evident in summary statistics.

Dynamic Interactions

The regression results suggest that women who choose private schooling for their children work less than public school mothers, which is surprising if we expect that the higher cost of private schooling may lead to mothers increasing their labor supply. However, this negative relationship does not capture how female labor supply responds to private school costs over the life-cycle. Labor supply patterns of females may differ over the life-cycle because the value of female's time at home varies around childbirth, and as child starts school. Before the child is born, the opportunity cost of working is just foregone leisure. After childbirth, we would expect the mother's labor supply to drop due to two possible reasons: (1) there is an additional opportunity cost of working due to daycare costs, and (2) mother's time input directly impacts child ability, due to which mothers may decrease labor supply and spend time with the child. Once the child starts school, mother's time input is not as important to the child's development process, and school costs may drive up labor supply. Alternatively, mother's time and child's school quality may be complements, in which case mothers may decrease labor supply to spend more time with their child to help with homework etc.[15]

To see how labor supply patterns of private and public school mothers evolve, I compare employment rates and average annual work hours of mothers over three phases of the life-cycle: (i) 6 years before childbirth till childbirth, (ii) after childbirth but before child starts school and (iii) after child starts school till age 12.[16] Figures 3 (a) and (b) plot the employment rate and annual work hours of private and public school mothers. The plots show that a higher percentage of mothers who send their children to private schools are employed 6 years before childbirth, with the employment gap between private and public school mothers around 7 percent. Employment rate declines sharply around two years before childbirth, reaching the lowest point one and a half years after birth.[17] The gap between the

[15]The increase in time spent with the child if the child attends private schooling may also be driven by mother's preference for spending time with the child which may be positively correlated with a preference for private school, independent of any complementarity between the two inputs.

[16]I run a kernel-weighted local polynomial regression of the dependent variable on child's age, and then present a non-parametric graph of the smoothed values.

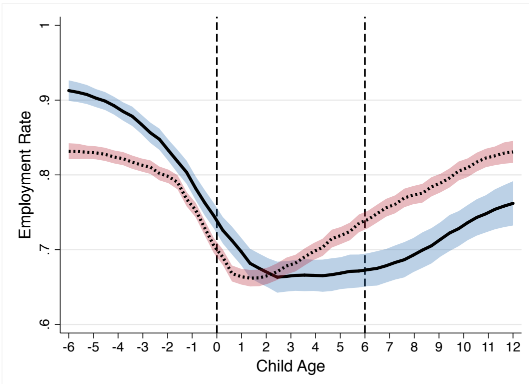
[17]The drop in employment rates before childbirth may be explained by timing of marriage; when females

Table 2: DESCRIPTIVE REGRESSIONS

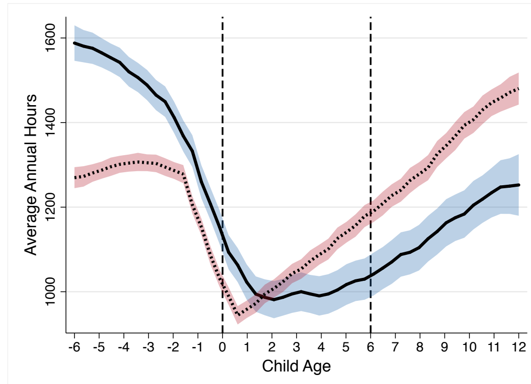
	Private	Annual Hours			Employment Rate		
		(1)	(2)	(3)	(1)	(2)	(3)
Private			-13.7	-38.1***		-0.10***	-0.15***
			(10.3)	(10.8)		(0.02)	(0.03)
Age	0.14***	207.3***		208.3***	0.28***		0.29***
	(0.00)	(4.41)		(4.42)	(0.011)		(0.011)
Age Square		-2.76***		-2.76***	-0.01***		-0.01***
		(0.07)		(0.07)	(0.00)		(0.00)
Married	0.01	-86.3***		-86.2***	-0.09***		-0.09***
	(0.02)	(9.63)		(9.64)	(0.025)		(0.03)
No. of Children	0.03***	-190.2***		-189.9***	-0.17***		-0.17***
	(0.01)	(4.81)		(4.81)	(0.010)		(0.01)
Child Age	-0.15***	5.46***		3.81***	0.01		-0.00
	(0.00)	(1.18)		(1.26)	(0.003)		(0.00)
Hispanic	0.26***	39.3***		40.8***	0.05		0.05
	(0.03)	(14.8)		(14.9)	(0.035)		(0.04)
White	0.39***	-73.1***		-70.2***	0.11***		0.13***
	(0.02)	(11.7)		(11.7)	(0.03)		(0.03)
High School	0.62***	191.0***		195.0***	0.30***		0.32***
	(0.03)	(14.9)		(15.0)	(0.031)		(0.031)
College	0.81***	140.2***		146.0***	0.39***		0.42***
	(0.03)	(15.5)		(15.5)	(0.03)		(0.04)
More than College	1.05***	190.5***		199.6***	0.47***		0.51***
	(0.04)	(17.8)		(18.0)	(0.04)		(0.04)
Non-Labor Income	0.01***	-7.90***		-7.77***	-0.02***		-0.015***
	(0.00)	(0.95)		(0.94)	(0.001)		(0.00)
Urban	0.18***	-19.3*		-17.7*	-0.01		0.00
	(0.02)	(10.5)		(10.5)	(0.03)		(0.03)
Protestant	0.12**	-37.1		-35.9	-0.06		-0.05
	(0.05)	(25.1)		(25.0)	(0.06)		(0.06)
Baptist	0.15***	157.4***		159.3***	0.07*		0.08*
	(0.04)	(17.8)		(17.8)	(0.04)		(0.04)
Episcopalian	0.28***	100.1***		103.2***	-0.014		-0.00
	(0.06)	(37.4)		(37.4)	(0.09)		(0.09)
Lutheran	-0.11**	173.6***		172.7***	0.36***		0.35***
	(0.05)	(21.6)		(21.6)	(0.07)		(0.07)
Methodist	-0.05	83.9***		83.6***	0.08		0.08
	(0.05)	(20.9)		(20.9)	(0.05)		(0.05)
Presbyterian	0.42***	76.6***		80.8***	0.20***		0.21***
	(0.05)	(26.1)		(26.1)	(0.08)		(0.08)
Roman Catholic	0.42***	76.2***		80.3***	0.11***		0.13***
	(0.04)	(16.8)		(16.8)	(0.04)		(0.04)
Jewish	0.08	-102.6**		-101.9**	-0.11		-0.10
	(0.07)	(42.4)		(42.6)	(0.10)		(0.10)
Other religions	0.35***	64.2***		67.6***	0.01		0.02
	(0.04)	(19.1)		(19.1)	(0.05)		(0.05)
N	47842	47842	47842	47842	47842	47842	47842

Notes: The dependent variables for each column, respectively, are: 1) An indicator variable for whether the respondent sends her child to a private school, 2) Annual hours worked by the respondent, and 3) an indicator variable for whether the respondent worked more than 6 weeks in the past calendar year. Total Assets, Wage Income, Non-Labor Income and Family Income have been divided by 10,000 and have been converted to constant 1990 dollars using BLS Consumer Price Index - Urban Workers (CPI-U). * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$; standard errors are given in parentheses.

employment rates for public and private school mothers then reverses. While employment rate for both groups of women is increasing, the increase is much steeper for public school mothers. Similarly, at the intensive margin, private school mothers work 400 hours more than public school mothers 6 years before birth, with the gap reversing when the child is approximately a year and a half.



(a) Annual Employment Rate



(b) Average Annual Hours

Figure 3: LABOR SUPPLY OVER THE LIFE-CYCLE. The solid lines with blue confidence intervals denote private school mothers while the dotted line with red confidence intervals denote public school mothers. The x-axis is child's age, with negative ages denoting years before childbirth.

Heterogeneity across Education and Income

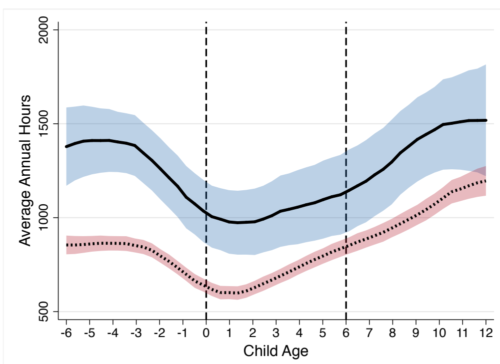
These patterns show that the interaction between private schooling and maternal labor supply varies over the different phases of the life-cycle. However, observed differences in labor supply of private and public school mothers can be explained by differences in education and income available from a spouse. Figure 4 presents a comparison of hours worked by the two groups of women belonging to different education groups.[18] I find that high school dropouts who eventually send their children to private school work more than public school mothers with the same level of education before and after childbirth. On the other hand, college graduates who send their children to private school substantially drop their labor supply

get married, they quit work or reduce hours of work. The sample includes mothers with multiple births, so labor supply patterns will be affected by the number of children and spacing between births. To formalize all results presented in the graphs, I also conduct a regression analysis presented in Appendix OA in which I control for the number of children, along with a host of other controls. I find that these patterns are robust to including various controls.

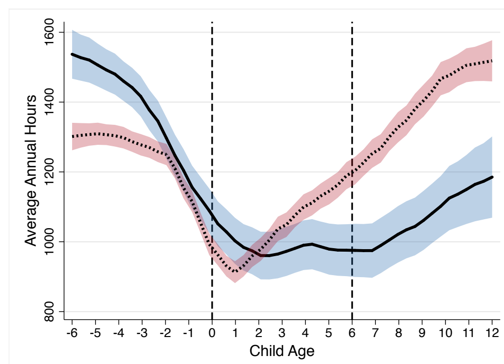
[18]Appendix OA presents a similar analysis for women belonging to different non-labor income groups. I divide non-labor income into four quartiles. In my sample, non-labor income is distributed as follows: Quantile 1: $\leq$ \$6,207, Quantile 2: Between \$6,208 and \$21,384, Quantile 3: Between 21,385 and \$36,731, and Quantile 4: Between \$36,732 and \$1,167,736.

after childbirth, particularly after the child starts school.

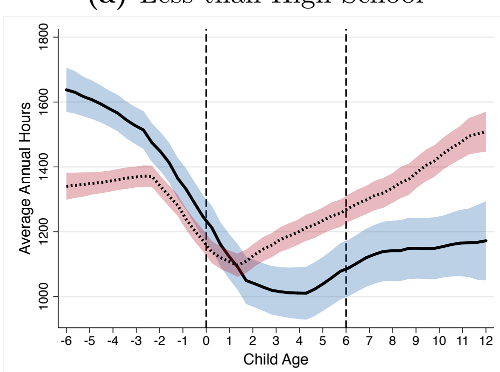
These patterns are informative about the trade-offs women with different levels of education face. More educated women, who may also have higher household income may be able to decrease their labor supply after childbirth and still afford expensive schooling for their children. For less educated and low-income mothers who choose private schooling for their child, increasing labor supply may be necessary to afford private schooling. The descriptive results highlight the complex interactions between private school choice, maternal labor supply, and women's characteristics. The observed choices women make in the data reflect differences in budget constraint variables (wages, non-labor income, and school fee), differences in initial child ability, the child ability production function or a difference in preferences. To disentangle these channels and estimate the causal effect of private schooling on women's career trajectories, I build a dynamic structural model in the next section which takes as ingredients the key lessons we learn from the descriptive analysis.



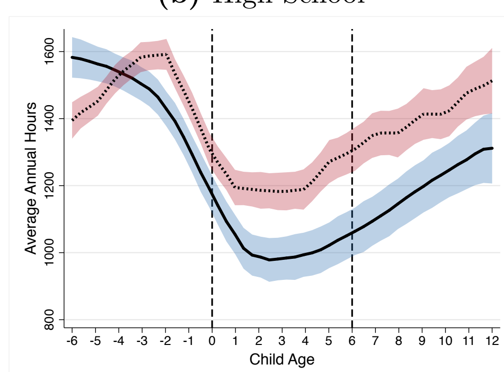
(a) Less than High School



(b) High School



(c) Some College



(d) College and More

Figure 4: Annual Hours Worked - Education Groups. The Figure plots average annual hours worked by private and public school mothers for four education groups. The solid lines with blue confidence intervals denote private school mothers while the dotted line with red confidence intervals denote public school mothers. The x-axis is child's age, with negative ages denoting years before childbirth.

3 Dynamic Structural Model

I now present a dynamic structural model of female labor supply, savings, and private school choice to empirically investigate the effect of the availability of private schooling on child ability and female life-cycle outcomes. The model follows the spirit of standard structural models of female labor supply as in Eckstein and Wolpin (1989); Heckman and Macurdy (1980); Van der Klaauw (1996); Hyslop (1999); Eckstein and Lifshitz (2011); Blundell, Costa Dias, Meghir, and Shaw (2016). As in these papers, I take women's fertility decisions to be exogenous. The novel ingredient in my framework is the introduction of child's schooling choice in the woman's problem. This allows me to capture the trade-off women face between working more to afford good quality monetary investments in their children and spending more time with the child. Additionally, it implements risk aversion and savings, thus taking into account the trade-off between building up assets before childbirth and take time off from work after childbirth. The key benefit of estimating the parameters of the structural model are that the model can be used to conduct counterfactual experiments that can be used to inform policy about private school subsidies and its effect on female labor supply and savings.

3.1 The Set-Up

The unit of analysis in the model is a single mother and child pair. Entry into and exit out of marriage, and fertility are exogenous, as is husband's labor supply. The transition probabilities for number of children and marriage are defined in Appendix OB. To see whether differences in labor supply also exist for husbands of private and public school mothers, I plot life-cycle labor supply for husbands in Figure A1. I find that there are significant differences in private and public school fathers only for the highest education group. This indicates that husband's labor supply, particularly for the highest education group, can affect female's labor supply and child's schooling decisions, particularly through labor earnings. [19] While I abstract away from endogenizing husband's labor supply decisions in the model, the exogenous process for marriage does allow for husbands to affect female's optimization problem. The presence of a husband adds male earnings to the woman's budget constraint, and affects woman's preferences and productivity of her time with the child. Similarly, I allow the number of other children to affect woman's preferences, productivity of her time at home, and her budget constraint, thereby affecting all the endogenous processes and

[19] The patterns plotted in Figure A1 don't control for other observable characteristics. Regressions controlling for demographic and family composition variable show that the differences observed for less educated groups are not significant.

decisions in the model.

The model begins six years before the birth of a child and ends when the child finishes high school i.e. eighteen periods after childbirth. Time is discrete, with each period representing one year, so that I follow women for twenty-five periods. In each period before childbirth, females choose consumption (and savings) and labor supply. If the woman works, she has to send her child to a daycare. In the sixth period, females have a child, who is born with initial ability k_0, and child ability enters the female's utility function. In the initial five years of the child's life, the child ability production function only takes in mother's time and goods investment as inputs. Five years after childbirth (in the twelfth period) mothers decide between private and public schooling for their child. Following that, the child ability production function takes as inputs mother's time, goods investment and schooling. Before childbirth females only have to allocate time between work and leisure, but after the birth of a child mother's time is allocated between work, leisure and time with the child. As in the descriptive analysis, I label the time periods before childbirth as phase 1, periods 6 to 11 as phase 2, and the time after the child starts school as phase 3.

3.2 Choice Set

In phase 1, which spans periods 1 to 6, females make decisions about how much to consume ($c_{it} \geq 0$) and how to allocate time between work (h_{it}) and leisure (l_{it}). After childbirth in phase 2, mothers allocate time between work, leisure and time with the child (τ_{it}). If the woman works when a child is present, she sends her child to daycare, which costs $\$cc_h$ per hour. Phase 3 starts In the twelfth period, five years after childbirth, when, in addition to the consumption and time allocation decisions, mothers make a decision about child's schooling, s_{it}, in each subsequent period and choose between private ($s_{it} = 1$) or public school ($s_{it} = 0$). Private and public schooling differ not just in terms of their price, but also in terms of their quality, which directly affects child ability. In each subsequent period, females continue to make consumption, time allocation and schooling choices.

In particular, the work alternatives for the female $d_{it}^h \in \mathcal{C}^h$ are defined as:

$$d_{it}^h = \begin{cases} 0 & \text{if } h_{it} = 0 \text{ hours} \\ 1 & \text{if } h_{it} = 1040 \text{ hours} \\ 2 & \text{if } h_{it} = 2080 \text{ hours} \end{cases}$$

where d_{it}^h is an indicator variable for hours worked. Before childbirth, the female's time allocation choices must satisfy the following constraint:

$$h_{it} + l_{it} = \bar{H} \equiv 2080 \tag{1}$$

After childbirth, the female's time constraint is given by:

$$h_{it} + l_{it} + \tau_{it} = \bar{H} \equiv 2080 \tag{2}$$

The mother now chooses her time at work, and the time spent with the child, for a total of 6 feasible time allocation choices:

$$d_{it}^h = \begin{cases} 0 & \text{if } h_{it} = 0 \text{ hours, } \tau_{it} = 0 \text{ hours} \\ 1 & \text{if } h_{it} = 1040 \text{ hours, } \tau_{it} = 0 \text{ hours} \\ 2 & \text{if } h_{it} = 2080 \text{ hours, } \tau_{it} = 0 \text{ hours} \\ 3 & \text{if } h_{it} = 0 \text{ hours, } \tau_{it} = 1040 \text{ hours} \\ 4 & \text{if } h_{it} = 1040 \text{ hours, } \tau_{it} = 1040 \text{ hours} \\ 5 & \text{if } h_{it} = 0 \text{ hours, } \tau_{it} = 2080 \text{ hours} \end{cases}$$

In order to make the choice set entirely discrete, I discretize the net savings choice $d_{it}^a \in \mathcal{C}^a$ so that the woman chooses one of 10 discrete alternatives $\Delta a_{it+1} = A_{it+1} - (1 + r)A_{it} = \{\underline{\Delta a}, \ldots, \overline{\Delta a}\}$ (Keane and Wolpin, 2001).[20] Finally, $d_{it}^s \in \mathcal{C}^s$ is an indicator variable for the child's schooling choice which is 1 when child goes to private school, and 0 otherwise. The choice set $\mathcal{C}$ in each period is constructed by the Cartesian product of the set of discrete alternatives ($\mathcal{C}^h \times \mathcal{C}^a$ in phases 1 and 2, and $\mathcal{C}^h \times \mathcal{C}^a \times \mathcal{C}^s$ in phase 3). This means that the woman has 30 choices in phase 1, 60 choices in phase 2, and 120 choices in phase 3.

3.3 State Space

At the start of each period, agents take as given the variables that form their state space. For ease of writing the value functions, I define three state vectors, one for each phase of the woman's life-cycle. For the first phase, the state vector is defined as:

$$\Omega_{it}^1 = \left\{ A_{it}, H_{it}, n_{it}^k, educ_i, race_i, \mu_i, \Psi, \xi_{it}, \xi_{it}^h \right\} \tag{3}$$

[20] I set $\underline{\Delta a} = -\$5,000$ and $\overline{\Delta a} = \$20,000$ and evenly distribute the rest of the net savings alternatives between these extremes. Through her choice of net savings, the woman also decides her consumption level in period t.

where A_{it} is the asset stock available at the start of the period, H_{it} is the stock of human capital up till period t, and n^k_{it} is the number of children at period t. The state space vector also includes time-invariant unobserved type, a vector of iid shocks to preferences affecting female's decisions, collected in Ψ, and shocks to the female's wage and husband's earnings process, ξ_{it} and ξ^h_{it}.

In the second phase of the life-cycle, child ability enters the utility function so that the state vector during this phase is defined as:

$$\Omega^2_{it} = \Big\{A_{it}, H_{it}, k_{it}, n^k_{it}, educ_i, race_i, \mu_i, \Psi, \xi_{it}, \xi^h_{it}, \eta_{it}\Big\} \tag{4}$$

where k_{it} is child cognitive ability in period t and η_{it} is an iid shock to child ability.

In the third phase, schooling choice also enters the optimization problem, and private school fee p_{it} is added to the state space:

$$\Omega^3_{it} = \Big\{A_{it}, H_{it}, k_{it}, n^k_{it}, p_{it}, educ_i, race_i, \mu_i, \Psi, \xi_{it}, \xi^h_{it}, \eta_{it}\Big\} \tag{5}$$

See Table OB1 for a list of all state space variables in the three phases.

3.4 Preferences

I assume that utility is intertemporally separable and that per period utility defines the woman's preferences over l_{it}, c_{it}, k_{it} and s_{it}, given her information set at time period t, I_{it}. The woman's instantaneous utility is given by:

$$\begin{aligned} U_{it}(c_{it}, l_{it}, k_{it}, s_{it}; I_{it} \in \{\Omega^{phase}_{it}\}) = f^c(X_{it}, \mu_i)\frac{\left(\frac{c_{it}}{e_{it}}\right)^{\alpha_1}}{\alpha_1} + f^h(X_{it}, \mu_i) l_{it} + f^k(X_{it}, \mu_i)\mathbf{1}\{a_t > 0\}\Big(\frac{k_t^\lambda - 1}{\lambda}\Big) \\ + f^s(X_{it}, \mu_i)\mathbf{1}\{a_t \geq 5\}\mathbf{1}\{s_{it} = 1\} \end{aligned} \tag{6}$$

Instantaneous utility is separable between consumption and leisure. The equivalence scale for consumption is given by e_{it}, which depends on the age and number of children in the household. I use the McClements scale to determine e (Attanasio, Low, and Sanchez-Marcos, 2008).[21] The utility from consumption has an augmented CRRA form, with the constant relative risk-aversion parameter given by $1 - \alpha_1$, while f^c reflects how the marginal utility of consumption is affected by differences in observable and unobservable characteristics of the females (Keane and Wolpin, 2001; Attanasio, Low, and Sanchez-Marcos, 2008; Adda,

[21] According to the McClements scale, a childless couple is equivalent to 1.67 adults. A couple with one child is equivalent to 1.9 adults if the child is under the age of 3, to 2 adults if the child is between 3 and 7, 2.07 adults if the child is between 8 and 12, and 2.2 adults if the child is between 13 and 18.

Dustmann, and Stevens, 2017; Blundell, Costa Dias, Meghir, and Shaw, 2016). Specifically, the function is defined as

$$f^c(X_{it}, \mu_i) = \exp\big(\gamma_0^c + \gamma_1^c \mathbf{1}\{a_t \leq 5\} + \gamma_2^c \mathbf{1}\{a_t \geq 6\} + \gamma_{3e}^c \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} \\ + \gamma_4^c n_{it}^k + \gamma_{5l}^c \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\}\big), \tag{7}$$

where a_t is child's age at time period t, e represents the education group the female belongs to, with $e = 1$ if the woman is a high school dropout, $e = 2$ if she finished high school, and $e = 3$ for some college or above, and n_{it}^k is the number of children individual i has at time t. Permanent unobserved heterogeneity enters the model through woman's latent type $\mu \in \{1, \ldots, L\}$, and captures individual's preference for leisure and saving.[22] The second component of instantaneous utility represents the utility from leisure. The function f^h represents how the marginal utility of leisure/marginal disutility of working changes with female's observed and unobserved characteristics. In particular, I specify

$$f^h(X_{it}, \mu_i, \epsilon_{it}^h) = \gamma_0^h + \gamma_1^h \mathbf{1}\{a_t \leq 5\} + \gamma_2^h \mathbf{1}\{a_t \geq 6\} + \gamma_{3e}^h \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} \\ + \gamma_4^h n_{it}^k + \gamma_{5h}^l \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\} + \sum_{r=1}^{H} \mathbf{1}\{d_{it}^h = r\}\epsilon_{it}^h, \tag{8}$$

where $H = 2$ for phase 1 and $H = 5$ for phases 2 and 3. Thus, $\epsilon_{it}^h \sim \mathcal{N}(0, \sigma_{\epsilon^h}^2)$ is an iid preference shock for the relevant time allocation decision. The third component of instantaneous utility is child's cognitive ability, k_t. Child's cognitive ability enters the utility function only after the child is born i.e. when child's age is non-negative. The mother gets utility from child ability according to a CRRA function with parameter λ, while f_t^k captures differences in the marginal utility from child ability due to differences in mother's observed and unobserved characteristics (Bernal, 2008). In particular,

$$f^k(X_{it}, \mu_i) = \gamma_0^k + \gamma_1^k \mathbf{1}\{a_t \leq 5\} + \gamma_2^k \mathbf{1}\{a_t \geq 6\} + \gamma_{3e}^k \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} \\ + \gamma_4^k n_{it}^k + \gamma_5^k m_{it} + \gamma_{6l}^k \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\}, \tag{9}$$

[22]The parameters on latent type affecting the marginal utility from consumption, leisure and private schooling essentially captures the correlation between unobserved preferences and labor market skill.

where m_{it} is the female's marital status with $m_{it} = 1$ if she is married and 0 otherwise. Finally, I introduce heterogeneity in the utility from private schooling through $f^s(X_{it}, \mu_i, \epsilon^s_{it})$, which is specified as:

$$f^s(X_{it}, \mu_i, \epsilon^s_{it}) = \gamma^s_0 + \gamma^s_{1e} \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \gamma^s_2 n^k_{it} + \gamma^s_{3l} \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\} + \epsilon^s_{it}, \tag{10}$$

where $\epsilon^s_{it} \sim \mathcal{N}(0, \sigma^2_{\epsilon^s})$ is an iid preference shock for private schooling.

3.5 Child's Cognitive Ability

I assume that a child is born with initial ability endowment of k_0, which is a function of mother's observed and unobserved characteristics. Specifically,

$$\ln(k_0) = \gamma^{k_0}_0 + \gamma^{k_0}_{1e} \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \gamma^{k_0}_2 \text{race} + \gamma^{k_3 l}_0 \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\}, \tag{11}$$

where child ability endowment is affected by mother's unobserved type, μ_i, as well as observed characteristics such as education and race.

Given the initial ability endowment of the child, I can now define the cognitive ability production function, which is a function of child ability stock till last period, mother's time with the child, goods inputs and schooling. I assume a modified translog for the child ability production function (Agostinelli and Wiswall, 2016), specified as:

$$\begin{aligned} \ln k_{it+1} = \beta_0 &+ \beta_1 \ln k_{it} + \beta_2(X_{it}, \mu_i) \ln \tau_{it} + \beta_3 \ln G_{it} \\ &+ \mathbf{1}\{a^k_t \geq 6\} \beta_4 s_{it} + \beta_5(\ln k_{it} \times \ln \tau_{it}) + \beta_6(\ln k_{it} \times \ln G_{it}) \\ &+ \beta_7(\ln \tau_{it} \times \ln G_{it}) + \mathbf{1}\{a^k_t \geq 6\} \Big(\beta_8(\ln k_{it} \times s_{it}) + \beta_9(\ln \tau_{it} \times s_{it}) \\ &+ \beta_{10}(\ln G_{it} \times s_{it}) \Big) + \eta_{it}, \end{aligned} \tag{12}$$

where

$$\begin{aligned} \beta_2(X_{it}, \mu_i) = \pi^\tau_0 + \pi^\tau_1 \mathbf{1}\{a_t \leq 5\} + \pi^\tau_2 \mathbf{1}\{a_t \geq 6\} + \pi^\tau_{3e} \sum_{e=1}^{3} \mathbf{1}\{\text{educ} = e\} \\ + \pi^\tau_4 m_{it} + \pi^\tau_5 n^k_{it} + \pi^\tau_{6l} \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\}. \end{aligned} \tag{13}$$

In equation (12), k_t is the child ability stock at time t, τ_{it} is mother's time investment in period t and G_{it} is the goods investment by parents. Since goods investment is not observed in the data or modeled as a choice, I assume that G_{it} is a fixed proportion α_G of family income (woman's wage income plus husband's income if married) which is estimated within the model. After five years of age, the child starts school and a dummy for private schooling is added to the production function as an input. The interaction terms between s_{it}, G_{it} and τ_{it} capture static complementarity i.e. returns to current investments should depend on other investments. By modeling the interaction between maternal investments and private schooling, I can show how the effect of private schooling on student achievement found in the literature work through mechanisms involving women's labor supply. The technology of child ability production also exhibits dynamic complementarity, which suggests that returns to current investment depend on $\ln k_{it-1}$. β_0 is a total factor productivity parameter and $\eta_{it} \sim \mathcal{N}(0, \sigma_\eta^2)$ is a time-varying idiosyncratic shock to child ability that is realized after the woman has made all her decisions. I allow the coefficient on $\ln \tau_{it}$ to be a function of female's observed and unobserved characteristics, which means that the productivity of mother's time with the child varies across females. The function $\beta_2(X_{it}, \mu_i)$ is specified in equation (13) and shows that mother's productivity with the child depends on her latent type, her education level, child's age, number of children and marital status.

3.6 Budget Constraint

The female maximizes her utility subject to a budget constraint that keeps evolving over the three phases of the woman's life-cycle. The budget constraint can be described in terms of the following asset evolution equation:

$$\begin{aligned} A_{it+1} = (1+r)A_{it} + h_{it}w_{it} + m_{it}(\text{earn}_{it}^h \times 52) - c_{it} - CC^k n_{it}^k \\ - \mathbf{1}\{a_t > 0\}G_{it} - \mathbf{1}\{0 \leq a_t < 5\}\Big(cc_h * h_{it}\Big) - \mathbf{1}\{s_{it} = 1\}p \end{aligned} \tag{14}$$

$$c_{it} \geq \underline{c} \tag{15}$$

$$A_{it+1} \geq \underline{b} \tag{16}$$

where A_t is the accumulated savings from the last period, r is the risk-free interest rate, w_{it} is the wage rate of the woman, while $earn_{it}^h$ denotes husband's weekly earnings. Equation 15 imposes the borrowing constraint which requires assets to stay above a non-positive number, $\underline{b}$, every period. The woman incurs childcare costs after childbirth and before the child starts school. cc_h is the hourly childcare rate so that her total childcare cost depends on total hours worked in the year. CC^k is the annual cost associated with other children in the household and includes goods investment, schooling costs (if any), as well as psychic costs.[23] Finally, p is private school fee, which is incurred only if the child goes to private school.[24] I also assume that there exists a consumption floor $\underline{c}$, such that any choice tuple $(d^h_{it}, d^a_{it}, d^s_{it})$ is feasible only if household consumption is above $\underline{c}$.

The woman's wage process can defined as an exponential function of the woman's ability, work status (part-time versus full-time), age, race, education, and experience stock. Specifically, the female wage process is given by:

$$\ln w_{it} = \gamma^w_0 + \gamma^w_{1e} \sum_{e=1}^{3} \mathbf{1}\{educ = e\} + \gamma^w_2 race_i + \gamma^w_3 \ln(H_{it} + 1)_{it} \qquad (17)$$
$$+ \gamma^w_4 (\ln(H_{it} + 1))^2_{it} + \gamma^w_{5l} \sum_{l=1}^{L} \mathbf{1}\{\mu_i = l\} + \xi_{it}, \qquad \xi_{it} \sim \mathcal{N}(0, \sigma^2_\xi)$$

$$H_{it} = H_{it-1} + h_{it} \qquad (18)$$

where H_{it} is the accumulated stock of experience and ξ_{it} is an iid shock to log wages. γ^w_3 and γ^w_4 captures the returns to experience, γ^w_7 reflects the impact of female's innate skill on her wage earnings and γ^w_4 captures differences in wage due to racial discrimination. The experience accumulation process is defined in equation (18).

I model the husbands' weekly earnings, $earn^h_{it}$ as an exogenous process that captures both their labor supply and wages. I assume that husband's earnings depends on the wife's observed and unobserved characteristics, as in Adda, Dustmann, and Stevens (2017), Sheran (2007) and Van der Klaauw (1996). This allows me to keep the state space small, yet also capture the essential ingredients of a model with marriage market, which would predict positive assortative mating and heterogeneity in female's marriage decisions. The husband's

[23]Since I do not have data on expenditure on children, or have data on schooling for every sibling, I am allowing for number of children to affect the budget constraint faced by the woman without explicitly modeling the school choice for each child. The current model explicitly models only one child and sidesteps the issue of mother's time allocation and schooling decisions for multiple children in the same household. The time the mother decides to spend with a child, and the type of school the child goes to, can be affected by the presence of other siblings in the household, which is captured by adding the number of children as utility and productivity shifters in the current model. A natural extension of the above model would be to model fertility and time allocation and schooling decisions across each child in a family explicitly.

[24]One limitation of the model is that it assigns zero cost for public schooling. However, areas with good quality public schools also have high property taxes, which effectively is the cost of public schooling. This means that for the group of women who are living in high property tax areas, the model will be overestimating the role of preferences in determining labor supply that is in fact a result of higher school cost.

earnings is given by:

$$
\begin{aligned}
earn_{it}^{h} = \gamma_0^{y^h} + \gamma_{1e}^{y^h}\sum_{e=2}^{3}\mathbf{1}\{\text{educ}=e\} + \gamma_2^{y^h} race_i + \gamma_3^{y^h} t + \gamma_3^{y^h} t^2 \\
+ \gamma_{5l}^{y^h}\sum_{l=1}^{L}\mathbf{1}\{\mu_i = l\} + \xi_{it}^{h}, \qquad\qquad \xi_{it}^{h} \sim \mathcal{N}(0,\sigma^2_{\xi^h})
\end{aligned} \tag{19}
$$

where $\gamma_1^{w^h}$ and $\gamma_2^{w^h}$ capture assortative mating on woman's education and race, $\gamma_3^{w^h}$ captures assortative mating on unobserved type, t is a time trend, and ξ_{it}^{h} is husband's earnings shock.

3.7 The Woman's Problem

I can now write down the woman's maximization problem given her choice set and preferences. The woman maximizes her expected lifetime utility, starting 6 years before birth at time period t_0, and ending 24 periods later when the child completes high school. Since the state space and choice set changes over the life-cycle, the woman's maximization problem is different for each of the three phases of the female's life-cycle. The value function for individual i in period t can be defined as:

$$V_t(\Omega_{it}^{phase}) = max_{\mathcal{C}} U_{it} + \beta E_t\Big[V_{t+1}(\Omega_{t+1}^{phase})\Big], \tag{20}$$

where β is the discount factor and E_t is the expectation operator conditional on information in period t. The expectation is taken over the vector of preference shocks, Ψ_{it+1}, future wage and earnings shocks ξ_{it+1} and ξ_{it+1}^{f}, and shocks to child ability η_{it}.[25]

The model ends when the child leaves high school at age 18, $T = 25$. The terminal value function consists of contemporaneous utility, and expected utility from child's lifetime earnings:

$$V_T(\Omega_{iT}^{3}) = U_{iT}(c_{iT}, h_{iT}, k_{iT}) + \gamma_1^{T} A_{iT} + \gamma_2^{T} k_{iT}. \tag{21}$$

where γ_1^{T} captures the value from accumulated assets in period T and γ_2^{T} captures the utility from child cognition in period T.

3.8 Unobserved Heterogeneity

Permanent unobserved heterogeneity among females, denoted by μ, affects the utility from leisure, consumption and private schooling as well as returns to work and time spent with

[25]All preference shocks follow Normal distribution with mean 0.

the child. μ captures the persistent heterogeneity that drives otherwise identical women to persistently behave differently across their choices and outcomes over time.[26] The heterogeneity is modeled as discrete mass points (Heckman and Singer, 1984), which are allowed to be functions of female's education level, given by:[27]

$$\pi_\mu = \frac{\exp(\alpha^{\mu}_{0j} + \alpha^{\mu}_{1je} \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\})}{1 + \sum_{l=2}^{L} \exp(\alpha^{\mu}_{0l} + \alpha^{\mu}_{1le} \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\})}, \qquad \forall \mu \in \{2, \ldots, L\} \tag{22}$$

$$\pi_1 = 1 - \sum_{\mu=2}^{L} \pi_\mu \tag{23}$$

4 Estimation and Results

In this section, I first outline the estimation procedure for the dynamic optimization problem, and then present the identification arguments. Next, I discuss the parameter estimates and show how child's schooling choice affects life-cycle female labor supply, asset distribution and the evolution of child ability.

4.1 Estimation Method and Moments

I use a two-step procedure to estimate the parameters of the structural model. In the first step, I estimate the probability of entry and exit into marriage and the transition in the number of children using data from NLSY79. In addition, I set the discount factor to 0.98, the risk-free interest rate to 0.02, and the hourly daycare cost to the national average obtained from the Bureau of Labor Statistics, \$9.77. In the second step, I estimate the remaining 107 parameters of the model using the Method of Simulated Moments (MSM). In this approach, the model is solved by backward induction (value function iterations) based on an initial set of parameters and then simulated for individuals over their life-cycle.

In particular, I first estimate the exogenous processes of marriage and fertility from the data and set the discount factor, interest rate and hourly daycare cost. Given these parameters and an initial guess of the remaining model parameters, I solve the life-cycle optimization problem of the woman by backward recursion. Backward recursion entails solving the model as a function of the entire state space for each period. More specifically, the solution requires finding values of $E_t\Big[V_{t+1}(\Omega_{t+1})\Big]$ at each point on the state space,

[26] The latent types capture both unobserved differences in productivity and unobserved differences in preferences.

[27] I assume that educational attainment of a woman is exogenous conditional on her latent type.

which is computationally burdensome. To reduce the computational burden, I discretize the continuous state variables A_{it}, H_{it}, k_{it} and p_{it} and use linear interpolation to extrapolate for any values that fall outside the state space grid. Calculation of $E_t\Big[V_{t+1}(\Omega_{t+1})\Big]$ also requires the calculation of multivariate integrals which is done by Monte Carlo integration.[28]

After solving the model, I simulate choices for 15,000 women (5 paths for each mother-child pair in the sample), reproducing the structure of the data, and calculate moments using the simulated data.[29] I then calculate the weighted average distance between the simulated moments and moments constructed from the sample data. This iterative process is repeated till the distance is minimized. Formally, let Θ denote the parameter vector, $M_S(\Theta)$ denote the vector of moments calculated using the simulated data and M_N denote the vector of moments from the observed data. Then, the estimated parameter vector $\hat{\Theta}$ solves the following objective function

$$\hat{\Theta} = \arg\min_{\Theta}(M_N - M_S(\Theta))' W_N (M_N - M_S(\Theta)), \tag{24}$$

where W_N is a positive-definite, symmetric weighting matrix.

While discretization makes the state space finite, it still remains large, making the estimation computationally infeasible. In order to further reduce the computational burden associated with the iterative process, I implement a Laplace Type estimator proposed in Chernozhukov and Hong (2003) that relies on Markov Chain Monte Carlo (MCMC) methods. The derivative-free procedure is computationally attractive and is less prone to getting stuck at local minima than standard hill-climbing estimators. The details of the algorithm are presented in Appendix OC.

As shown in Eisenhauer, Heckman, and Mosso (2015), method of simulated moments yields consistent estimates, though its finite distance properties depend on the choice of moments, the number of simulations, and the weighting matrix and that conditional dynamic moments are crucial to identifying the parameters of dynamic models such as the one specified in this paper. Therefore, I follow Eisenhauer, Heckman, and Mosso (2015) and weight the moments with a diagonal matrix that contains the inverse of the variances of the observed moments.[30] The moments used for estimation include the proportion of women employed in each time period, across child schooling groups and woman's education groups,

[28] See Keane, Todd, and Wolpin (2011) for details on various methods of obtaining approximate solutions to DDCP in labor economics.

[29] The estimation sample is a subset of the sample used for the descriptive and reduced form analysis. To construct the estimation sample for the structural estimation, I only keep mother-child pairs who I can follow for the entire 25 periods i.e. from six years before childbirth till the child is 18 years of age. This condition leaves me with a total of 3000 mother-child pairs.

[30] The vector M_N consists of a total of 448 moments that are used to identify 107 parameters.

work experience accumulated by private and public school mothers, and the proportion of women working full-time and part-time in each time period. The returns to private schooling parameters are identified by matching moments on the proportion of women sending their child to private school at each child age group by women's education, and the ratio of test scores of private and public school children. The parameters associated with mother's time with the child are identified by matching the proportion of mothers spending full-time, part-time or no time with their children, for different education and child age groups. Dynamic moments include transition rates between labor market status by child's schooling and phase, the correlation between wage at the start of each phase and an OLS regression of log wage on past and future wages.

4.1.1 Initial Conditions and Measurement Error

The initial conditions of the model consist of values of woman's education, race, the number of children she has, her state of residence, the level of net assets she holds, and the experience accumulated at t_0, which is six years before the birth of the child. Values of woman's education, race, state of residence, experience accumulated and level of net assets are taken as given in the data. For women whose net assets are missing six years before childbirth, I draw a value for net assets from the distribution of real net assets conditional on the woman's education level.

Data on private school costs faced by women is only available at the state level. However, due to the availability of financial aid as well as variation within a state in the sticker price for private schooling, the state level averages are not a good measure of the actual cost of private schools that mothers face. Therefore, I assume that tuition data I have is measured with error, so that the true tuition faced by mothers is given by:

$$p_{it}^{true} = \alpha^p + \beta^p p_{it}^{observed} + \eta_{it}^p, \quad \eta_{it}^p \sim \mathcal{N}(0, \sigma_p^2) \tag{25}$$

where α^p is the location parameter, β^p is the scale parameter and η^p is an iid shock that follows a Normal distribution with mean 0 and variance σ_p^2. Any measurement error in wages and in child ability is assumed to be captured by the idiosyncratic shocks ξ_{it} and η_{it}.

4.2 Identification

This section discusses sources of identification in the model. The identification of the parameters of the model relies on a combination of functional form and distributional assumptions, exclusion restrictions delivered by the structure of the model and arguably exogenous cross-sectional variation in private school fee.

One source of identification relies on exclusion restrictions delivered by the structure of the model. The first set of exclusion restrictions require that there must be at least one variable that enters the selection equations (e.g. work, private school, consumption), but does not affect the outcome equations (e.g. wages, child ability). For example, in the data, wage is observed for workers only. Endogeneity due to self-selection arises if the wage shock is correlated with other error terms in the model. In the model, unobserved heterogeneity takes the form of discrete types. The panel structure of the data is sufficient to identify the parameters of unobserved heterogeneity; nevertheless, exclusion restrictions in the model facilitate estimation. An example is the number of children a woman has, which shifts the marginal utility from leisure but does not enter the wage equation.[31] The second set of exclusion restriction necessitates that there must be one variable in the outcome equation that does not affect selection into certain states. In the model, experience, which enters the wage equation but does not affect the utility from leisure, serves as an example of the second set of exclusion restrictions. A similar argument can be made for the budget constraint parameters. Experience and race affect wage and husband's earnings, therefore affecting the budget constraint and the child ability production function, but does not affect the marginal utility from consumption, private schooling, and child ability.

The coefficient of relative risk aversion, α_1, which determines the curvature of the utility function and the intertemporal elasticity of substitution, is identified through differences in the net saving-child age profiles of women who are otherwise identical. I also specify the marginal utility of consumption as an exponential function, that aids in identification. Similarly, the CRRA parameter for child ability λ is identified through differences in maternal time investment in their children for women who have similar observed and unobserved characteristics. To identify the effect of private schooling on maternal labor supply and savings, I use cross-sectional variation in private school fee to instrument for private school enrollment. Figure OC1 plots the cross-sectional variation in private school fee and shows that, as expected, private school enrollment decreases as private school fee increases. The identification argument relies on the assumption that variation in private school fee should affect private school enrollment but should not be correlated with women's work decisions i.e. private school fee should effect female labor supply and savings only through its affect on private school enrollment. I also use the cross-sectional variation in private school fee to help identify λ and the unobserved preference for private schooling. Suppose two observably identical women are living in a different geographic area with different private school tuition, with one woman living in a high-cost area, and the other living in a low-cost area. If the

[31]While the number of children the woman has is endogenous, the arrival rate of children is exogenous.

woman living in the high-cost area is observed choosing private schooling yet the woman living in the low-cost area does not choose private schooling for her child, the difference in choices must be driven by a difference in preferences for private schooling and child ability.

The distribution of latent types and type-specific parameters are identified through the panel structure of the data. In particular, differences in choices and outcomes of observationally identical women over time identifies latent types. In order to identify the proportion of individuals in each latent type, I follow Adda, Dustmann, and Stevens (2017) and first regress log wages on experience and education and compute wage residuals for each individual. This residual contains information on unobserved skill or ability. I then use the cross-sectional variance of these wage residuals as a moment. As types cannot be identified without a normalization, I impose a ranking on the latent types in estimation. I assume type 1 women have the lowest latent ability endowment while type 3 women have the highest.

4.3 Parameter Estimates

I present estimates for the preference parameters in Table A1.[32] The CRRA parameter is estimated to be 0.354, which implies that the coefficient of relative risk aversion is $1 - \alpha_1 = 0.65$, and the coefficient of relative prudence is $2 - \alpha_1 = 1.65$ which is in line with other papers in the literature with borrowing constraints (Keane and Wolpin (2001); Imai and Keane (2004)).[33] Estimates also show that a larger number of children and having a child greater than six years of age increases the marginal utility from consumption. Having more children also increases the marginal utility from leisure. Estimates for the leisure preference parameters also show that mothers with older children value leisure more than mothers with younger children. Lastly, the private school preference parameters show that women with some college or more obtain higher utility from choosing private schooling for their child than women with only a high school degree.

Table A2, panel (a) shows the results for the wage equation. The parameters for the wage equation are consistent with those reported in the female labor supply literature. If females have some college, college or graduate degree, they earn approximately 46% higher

[32] Estimates from the first step of the estimation procedure outlined in Section 3 are presented in Appendix OC.3. Predicted probabilities based on these estimates are then used as an input for the second step of the estimation in which the life-cycle optimization problem is solved by value function iterations.

[33] The literature on the estimation of consumption Euler equation has estimated $\alpha_1 = -2$ (Hubbard, Skinner, and Zeldes, 1995; Kimball, 1990), which implies a lower willingness to substitute intertemporally and a higher degree of prudence than that estimated in this paper. Keane and Wolpin (2001) rationalize different estimates from the literature by noting that in models with income uncertainty and no borrowing constraints, a higher degree of prudence is required to explain why individuals with steep age-earnings profiles do not borrow when they are young.

wages than high school dropouts. Estimates for the polynomial in experience imply that a woman who has worked full-time for 10 years will be offered a wage that is 8.11% higher than a woman who has worked part-time for 10 years, keeping everything else constant. The estimates also show that black women earn 11% lower wages than women of other racial groups, which could be due to racial discrimination in the labor market or due to unobserved differences in black women's skill endowment not captured by the latent type.[34]

4.3.1 Child Ability

The CRRA parameter for child ability is estimated to be 0.49, which is in line with an estimate of 0.46 estimated by Bernal (2008). The parameter estimate implies that mothers get diminishing marginal utility from child ability and therefore have an incentive to make investments to compensate children born with low ability endowments. The preference parameters for child ability show that the marginal utility from child ability is higher when the child is less than six years of age (the first and formative phase of development), and that more educated mothers value higher child ability more than mothers who are high school dropouts. The presence of a husband also increases the marginal utility of children, while having more children decreases the utility from having a child.

Panel (f) of Table A1 shows the estimates of the child ability production function. Estimates show that the net effect of attending private school on child achievement is positive and depends on lagged ability, mother's time with the child and the level of goods investments. In particular, mother's time and private schooling are complements, which may be because mothers have to spend time with their children to help them with the private school curriculum. Using the estimates of the child ability production function, I can calculate the effect of private schooling on twelfth grade scores, and compare the results to those reported in Altonji, Elder, and Taber (2005b). In the simulated data, on average, mothers spend very little time with their child when the child is in twelfth grade[35]. Therefore, using the sample averages of test scores and log family income from Altonji, Elder, and Taber (2005b), the twelfth grade test score for a child with eleventh grade test score of 53.5 and whose parents have household income of $\$36,316$ would be 1.54% higher if he attends private school.[36] Increasing goods investment by 1% increases next period ability by 0.99% while

[34] Panel (c) of Table A2 shows that women cannot borrow more than \$41,520, and that they must maintain at least \$164 in consumption. The average cost of additional siblings in the household (including both monetary and psychic costs) is \$3,903 and households spend 3% of their income on their child, which is in addition to expenditure on child's school tuition.

[35] The average annual active time spent with the child is approximately 500 hours

[36] This estimate is slightly lower than the effect of private schooling on students' math scores found in Altonji, Elder, and Taber (2005b), who find that math scores increase by 1.14 points, which translates to a

increasing current period ability by 1% increases next period ability by 0.01%. The interaction terms between $\ln k_t$ and investments show evidence of dynamic complementarity for mother's time with the child and private schooling i.e. mother's time and private schooling are more productive for higher ability children. However, lagged cognition and goods investment are substitutes. Table A1, panel (g) shows how the productivity of mother's time is affected by her demographic characteristics. Mother's time is 22.7% more productive when the child is less than six years of age than when he is older. More educated mothers are also more productive at home, and the presence of a husband and having siblings also increases mother's productivity with the child. These results imply that mothers would make greater investments of their own time in producing child quality prior to and concurrent with schooling, which is consistent with the results reported in Chiswick (1986).[37] The results also underscore the importance of mother's time with the child when the child is young and is in the development phase, consistent with evidence from studies estimating the child skills production function (Cunha, Heckman, and Schennach, 2010; Del Boca, Flinn, and Wiswall, 2014).

4.3.2 The Role of Unobserved Heterogeneity μ

Latent heterogeneity plays an important role in the model, even after controlling for a rich set of observable characteristics. I allow for 3 types and impose an ordinal ranking on the types, ascending from type 1. Estimates imply that more educated mothers are more likely to be of type 3 while low education negatively predicts the probability of belonging to the highest type. On the other hand, being a high school graduate increases the probability of belonging to type 1. In the simulated data 47.1 percent of the females belong to type 1 (low type), 26.7 percent belong to type 2 (medium type) and 26.2 percent belong to type 3 (high type). Types differ substantially across various dimensions. Preference parameters show that the marginal utility from sending their child to private school is positive for women belonging to the high type and negative for the low and medium type. Initial ability endowment of children born to low type women is 33.5 percent lower than the initial endowment of children born to high type women. These differences persist as child ability evolves since mother's type also affects her productivity with the child. Increasing time with the child positively affects child ability for high type mothers, but has a negative effect for medium and low type mothers.

roughly 2.1% increase. My measure of test score combines english and math test scores, and Altonji, Elder, and Taber (2005b) find very small effects for english test scores, which could explain why I find smaller effects when I combine the two test scores together.

[37] Chiswick (1986) found stronger results for Jewish women, who are more educated, on average, than non-Jewish women.

Women's latent type also affects the wage they earn. Estimates for the wage equation show that women belonging to the high type earn wages that are roughly 80 percent higher than wages earned by type 1 and 48 percent higher than wages earned by type 2. Husband's earnings are also affected by the woman's observed and unobserved characteristics, and capture positive assortative mating on woman's education level and type. The labor market returns for a man married to a low type woman are higher than a man married to a high and medium type woman, indicating negative assortative mating on latent type.[38]

4.3.3 Goodness of Fit

Figure A2 (a) shows how well the model performs in replicating the average employment rate of women in the data. The model matches the overall U-shape of the employment rate over the life-cycle, although it over predicts employment rate before child birth. However, the model matches the human capital accumulation channel closely, as shown by the average experience profile in Figure A2 (b). I also evaluate the model's ability to reproduce the life-cycle wage profile and asset evolution observed in the data. These moments are not targeted directly in estimation, and provide an informal test of the model's ability to reproduce key data patterns from the data. Figure A2 (a) shows that the model matches the average life-cycle wage profile of women very well qualitatively. Quantitatively, the model over-predicts wages in the first five periods. This is because the model over-predicts employment during this time period, which is reflected in higher wages. However, the concave profile of wages over time is well-matched by the model. Figure A2 (b) shows asset accumulation over the life-cycle in the data and model. The model matches the overall profile of assets over time very well.

In Table OC2 of Appendix OC.3, I present results for the within sample fit of the simulated model to the life-cycle profile of females' work experience, private school choice, and the evolution of child ability. Results show that private school enrollment is slightly over-predicted in the model, particularly when the child is in primary school. This is partly because I have a very noisy measure private school costs, and the measurement system or tuition in the model possibly under-predicts primary school costs. However, the model does a good job of matching the ratio of private and public school students' cognition (as measured by test scores in the data) and the experience profiles of private and public school mothers. This shows that the model can replicate key features of women's life-cycle outcomes.

[38]This assumes that men don't earn lower wages just because they are married to high type women, but there is in fact a correlation between the man's latent type and his wife's type which is being captured by the type parameters.

5 Quantifying the Impact of Private Schooling

I now use the model to assess the impact of private schooling on female labor supply, asset accumulation, wages and its effect on child ability. I evaluate this impact by simulating life-cycle outcomes under two scenarios. In the first scenario, I simply use the estimated parameters to simulate life-cycle choices and outcomes for women and treat that as the baseline. Second, I simulate life-cycle outcomes under the scenario in which preference shocks and all parameters associated with private schooling are set to zero. Under this scenario, no one chooses private schooling. I present mean differences in female's decisions for the two scenarios along various dimensions to quantify the impact of private schooling on key life-cycle outcomes.

Time Allocation, Assets and Child Ability: Figure 5 (a) plots the difference in employment rate over the life-cycle between the two scenarios. Private schooling does not significantly affect female labor supply in phases 1 and 2, however, there is a decrease, on average, in the employment rate of mothers of up to 6% when we shut down private schooling in phase 3, which suggests that after the child starts school private schooling induces women to work more. At the intensive margin, women decrease average work hours in all three phases, with more significant changes after the child is three years of age.[39] Average annual work hours of women go down substantially when private schooling is shut down just when the child is of school-going age. This decrease in annual work hours is matched by an equivalent increase in time spent with the child, as shown in Figure 5 (c). In the absence of the choice to send your child to better quality private schooling, mothers choose instead to increase their time with the child on average.

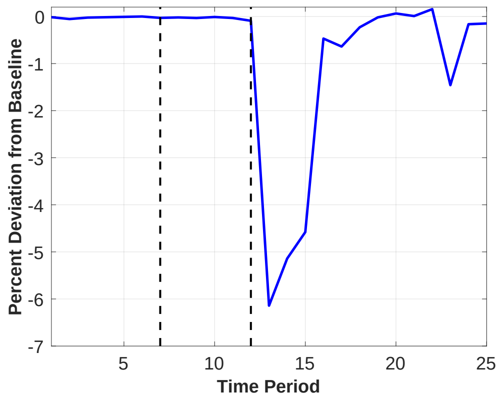
As a result of the drop in annual hours worked and because women do not face the cost of private schooling in the future, thereby eliminating the precautionary saving motive, women accumulate lower assets over the life-cycle, as shown in Figure 5 (d). Lastly, Figure 5 (e) shows how child ability will be affected under the no private schooling scenario. At age 6 and 7, child ability increases by roughly 0.4%, primarily due to mothers spending more time with the child to compensate for the non-availability of good quality schooling. However, the positive impact of higher mother's time fades away and we observe a drop in average child ability as child ability is not augmented due to private schooling. Therefore, terminal child ability is roughly 0.1% lower, on average, than in a scenario in which private schooling was available.

[39] The average deviation in work hours is small because the reported effect is averaging over all women in the sample. However, for women sending their children to public school in the baseline should see no differences in outcomes from the baseline. The change in outcomes is generated only by women sending their children to private school, which is only 27% of the population.

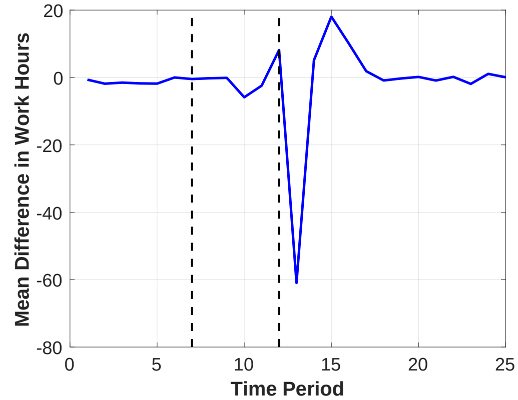
Figure 5 (e) plots the difference in log hourly wages (conditional on working) in the no private schooling scenario from the baseline scenario. On average, the average hourly wages in the no private schooling scenario are lower than in the baseline scenario, with the biggest drop in wages when the child is of school-going age. This shows that the choice of sending your child to private schooling increases female labor supply and also results in higher wages for private school mothers. This adds to the literature on female labor supply that has evaluated the selection of women into the labor market (Heckman, 1974; Blau and Kahn, 1996; Blundell, Gosling, Ichimura, and Meghir, 2007; Mulligan and Rubinstein, 2008; Adda, Dustmann, and Stevens, 2017). Using my model, I show that one of the reasons why women select into working is due to child's schooling.

Heterogeneity across Education: To explore the heterogeneous effect of private schooling on female's time allocation and asset accumulation, I plot females' life-cycle outcomes across different education groups in Figure 6. Figure 6 (a) shows how asset accumulation differs between two scenarios across education groups. When we shut down private schooling, women belonging to all education groups accumulate lower assets, with substantially large effects for high school graduates, and smallest effects for high school dropouts. This suggests that low-education females, particularly high school graduates, build up assets in response to a precautionary saving motive for private schooling. When the precautionary saving motive is shut down, they increase their consumption and accumulate lower savings over their life-cycle.

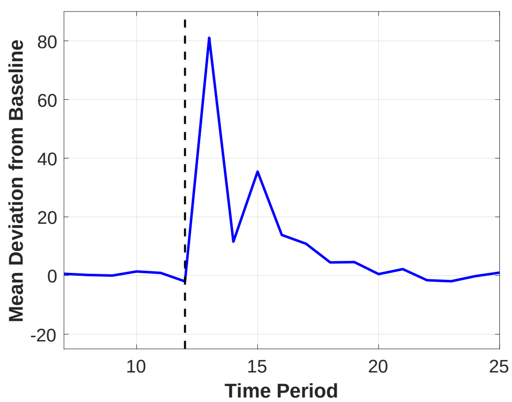
The labor supply response by education groups is plotted in Figure 6 (b). Figure 6 (b) shows that high school graduates experience the biggest drop in employment rates when the child starts school. In particular, employment rate of high school graduates drops up to 17% at the age the child starts school. Note that employment rates decrease in phases 1 and 2 as well, but the decrease is much smaller compared to the drop in phase 3. Consistent with Figure 4 (a), the biggest drop in labor supply is observed for less educated women, who earn lower wages and also have lower non-labor income due to positive assortative mating on education. Lastly, Figure 6 (c) shows how mothers belonging to different education groups change the amount of time they spend with their child when private schooling is not available. Mothers belonging to all education groups increase the amount of time they spend with their child, particularly when the child reaches school-going age. Low-education women increase their time the most, which implies that they need to compensate the most in terms of time investment for the lack of availability of good quality schooling.



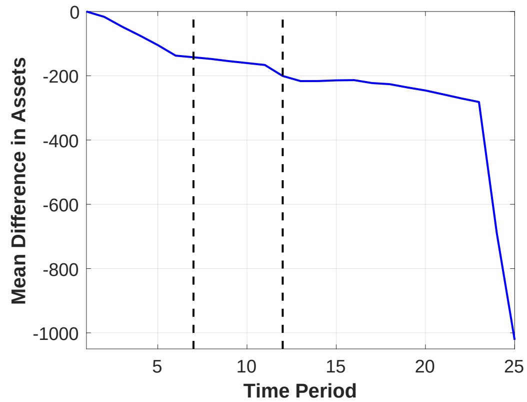
(a) Employment Rate



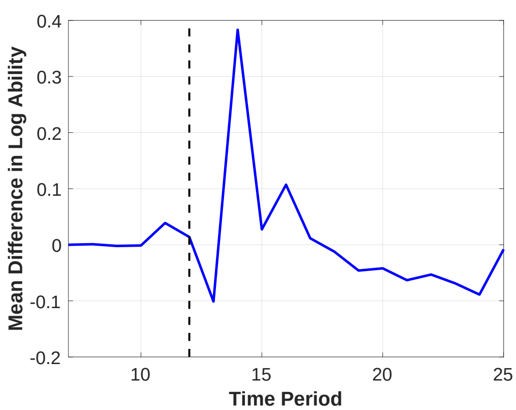
(b) Annual Work Hours



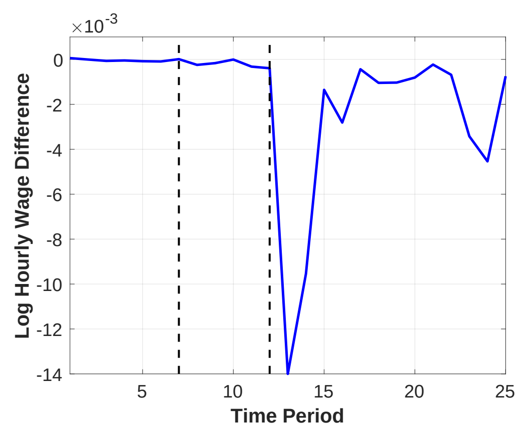
(c) Mother's Time with Child



(d) Net Assets

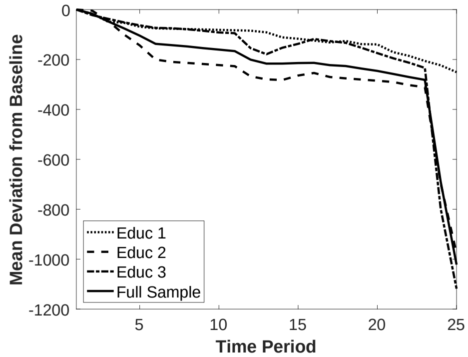


(e) Child Ability

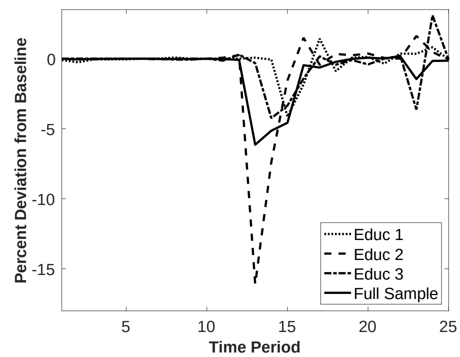


(f) Hourly Wage

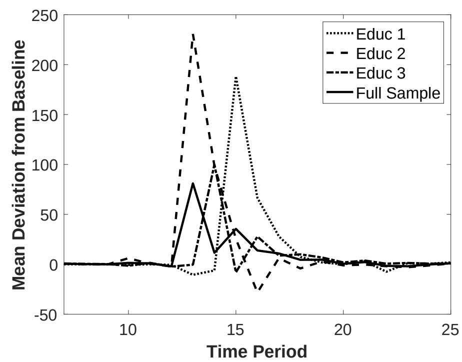
Figure 5: Shutting Down the Private Schooling Channel. The different panels display differences in outcomes between a baseline scenario and one where woman don't have the private school option for their child. Figure 5 (a) shows the percent change in employment rate from baseline, Figures 5 (b) shows the average change in hours worked conditional on working, Figure 5 (c) shows the change in mother's time with the child from baseline, Figure 5 (d) plots the difference in assets over the life-cycle, Figure 5 (e) plots the difference from baseline in log ability over the life-cycle, and Figure 5 (f) plots hourly log wage difference between the counterfactual and baseline.



(a) Assets by Education



(b) Employment Rate by Education



(c) Mother's Time with Child by Education

Figure 6: Shutting Down the Private Schooling Channel. Figure 6 (a) show the change in assets by education, Figure 6 (b) show the change in hours worked by education, and Figure 6 (c) plot the change in mother's time with the child from baseline by education.

5.1 Causal Effect of a Change in p

I now calculate the causal effect of a change in private school tuition on private school enrollment as well as female's life-cycle choices and outcomes. Figure 7 plots the elasticity of private school enrollment over different values of tuition. In line with estimates of private school elasticity in the literature, I estimate the private school elasticity to be -0.25 (Dynarski, Gruber, and Li, 2009; Hungerman and Rinz, 2016). However, using the model, I can calculate elasticity at different levels of private school fee. Results show that private school enrollment is more elastic at lower levels of fee, with a 1% increase in school fee leading to up to a 6% decrease in enrollment. At higher levels of fee, enrollment is less elastic. This suggests that parents who are sending their children to high cost private schools attach a higher valuation to private schooling (either due to higher returns or higher preference for private schooling) and are therefore less responsive to price increases.

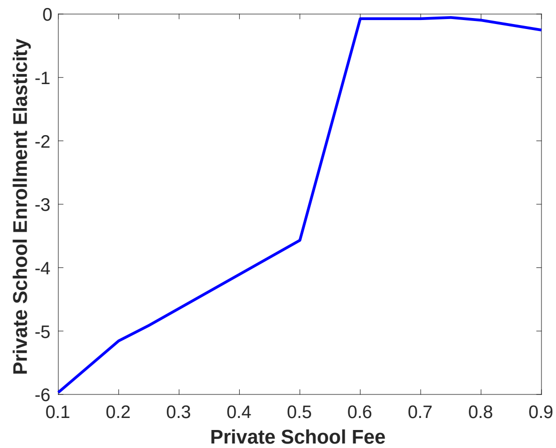


Figure 7: Price Elasticity of Private School Enrollment. Figure 7 plots the elasticity of private school enrollment for different levels of fee. The x-axis markers represent the percentage of observed fee at which the elasticity has been calculated.

Next, I study the impact of private school price decrease on female's and children's outcomes. I decrease tuition by 25 percent and 75 percent respectively, and document how life-cycle outcomes change. When tuition decreases by 25 percent, private school enrollment increases by 7.7%. The effect on other outcomes differs for incumbents and new entrants, as shown in Figure 8. The price drop pulls in children from the lower end of the ability distribution, who see gains in ability of 4.6% once they move to good quality private schooling, while incumbent children experience no gains in ability. New entrant mothers increase their labor supply as they now have to pay private school tuition. The increase in work hours translates to a 0.04% increase in terminal wages due to human capital accumulation over the life-cycle. While terminal assets of new entrants are not affected significantly, incumbents' terminal assets decrease by 1.2%, as they now need to save less for private school tuition. Incumbents also decrease their work hours by 0.01%, which leads to an average decrease of 0.1% in their terminal wages.

When price decreases by 75 percent private school enrollment increases by 52%. Terminal child ability for new entrants increases by 20%, on average. As a result of the generous subsidy, even new entrants decrease their work hours by 9%, along with incumbents decreasing work hours by 0.01%. This reduction in work hours for both groups of women leads to a drop in the wages these women earn. The anticipated fee subsidy diminishes the precautionary saving motive as well, and we see a much bigger drop in terminal assets for both new entrants and incumbents when tuition drops by 75%. Overall, these results show that a drop in private school fee always leads to a drop in incumbents' labor supply, and hence their wages and assets. However, the effect on new entrants' labor supply depends on the magnitude of the price change. For a small change in private school cost, new entrants still need to increase labor supply to top up the subsidized cost. This effect is reversed for larger decreases in private school cost.

Figure 8: Impact of Drop in Private School Fee. Figure 8 plots the percentage change in hours worked, hours with child, terminal wages, terminal asses, and terminal ability for new entrants and incumbents after a 25% and 75% price drop in private school tuition.

6 Policy Experiments

Having established the causal effect of private schooling on females' life-cycle outcomes, I now use the estimated parameters to conduct counterfactual policy exercises. First, I study the importance of liquidity constraints in determining private school enrollment.[40] Next, I compare the choices of women facing the baseline private school fee structure in the data with alternative hypothetical school fee structures that capture different subsidy schemes that can be designed for private schooling. The counterfactual highlights how changing the cost of private schooling affects not only private school enrollment and student achievement, but also impacts female labor supply, labor market returns and asset accumulation. I analyze

[40]See Lochner and Monge-Naranjo (2012) for a review of the importance of credit constraints on human capital accumulation.

the effect of different subsidy schemes. First, I study the effect of subsidy programs which require households to pass an income test in order to qualify for the subsidy. Next, I analyze how life-cycle outcomes are affected if targeted private school subsidies are given based on mother's education.

6.1 Relaxing Liquidity Constraints

To study the importance of liquidity constraints in determining private school enrollment, I give a lump sum transfer of $12,000 to all households every year starting when the child turns 5.[41] Figure 9 shows the effect of that transfer on different outcomes for three education groups. As a result of the transfer, private school enrollment increases for all education groups, with the effect decreasing in mother's education. Consistent with findings in Dahl and Lochner (2012), the results show that relaxing liquidity constraints can substantially increase investment in good quality schooling for children, with larger effects for low-education women.[42] The lump sum transfer also leads to large increases in terminal assets for all education groups. We see such large gains because not everyone who receives the lump sum transfer spends it on private school tuition - enrollment only doubles, at best. The remaining population treat this annual transfer as a windfall that they save over the life-cycle. Figure 9 shows that as a result of relaxing liquidity constraints, women belonging to all education groups decrease their labor supply, with bigger decreases for low-educated women. High-educated women increase their time with the child, a result driven by the fact that these women are most productive with their time with the child and have low preference for leisure. On the other hand, low-educated women decrease the time they spend with their child, since they can now augment child ability through private schooling and they obtain higher utility from leisure.

6.2 Subsidy with Asset Test

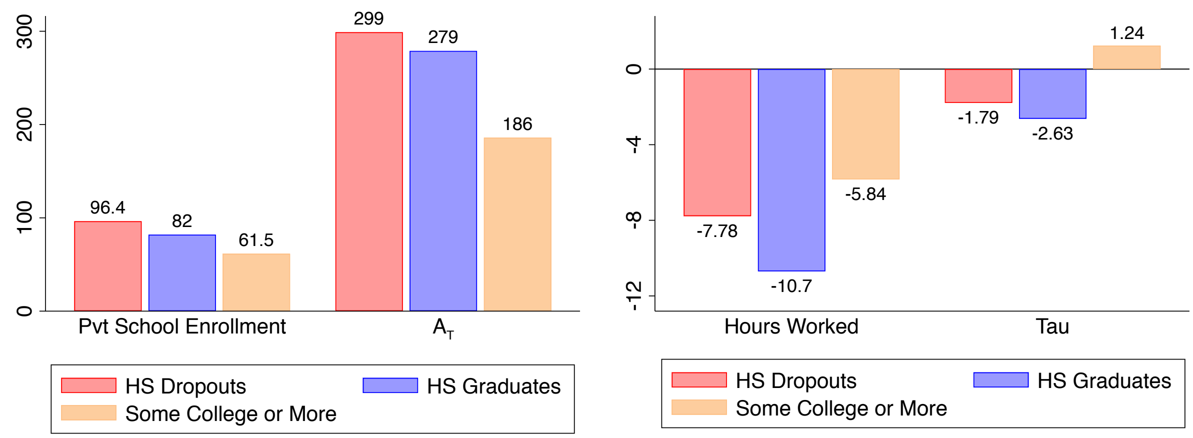
Private school vouchers have been one of the major education priorities of the new administration. The literature in the economics of education has mixed results on whether private school vouchers help improve academic achievement.[43] However, the literature on private

[41]The average estimated private school tuition is roughly $11,500.

[42]In another paper (Qayyum, 2018) I use the variation in the magnitude of the housing boom in the US in 2000s to show that increase in household wealth and income leads to an increase in private school enrollment.

[43]While a number of studies have found positive effects of vouchers on student achievement (Rouse, 1998; Wolf, Gutmann, Puma, Kisida, Rizzo, and Eissa, 2009; Wolf, Gutmann, Puma, Kisida, Rizzo, Eissa, and Carr, 2010; Howell, Wolf, Campbell, and Peterson, 2002), recent studies on the Louisiana Scholarship Program have found negative effects (Mills and Wolf, 2017; Abdulkadiroğlu, Pathak, and Walters, 2018). A

schools has ignored an important spectrum of subsidizing child's schooling working through parental labor supply and asset accumulation. Moreover, policy initiatives such as providing subsidies for private schooling can have lasting impact on female labor supply and career trajectories. Insofar as private school subsidies in the form of vouchers will affect the incentive to work and save for parents, which will in turn affect the resources that parents can invest in their children, the link between vouchers and maternal labor supply and savings is an important area of study.



(a) Enrollment and Terminal Assets **(b)** Time Allocation

Figure 9: Relaxing Liquidity Constraints. Figure 9 (a) compares the percentage change in average private school enrollment across and terminal assets, across education groups, after a lump sum transfer of \$12,000 is made. The change in private school enrollment is calculated by averaging over all time periods in which private school choice is made. Figure 9 (b) compares the percentage change in average hours worked and time spent with child over all time periods, across education groups, after the lump sum transfer.

I conduct an experiment in which women get subsidies for private schooling for their child depending on the level of assets. The asset test requires that assets be less than 300% of the Federal Poverty Guideline. If households pass the asset test, they are eligible for a private school voucher capped at $\$6,100$.[44] Results, reported in Table 3 show that as a result of the subsidy, average private school enrollment increased by 33%. Overall terminal child ability increased by 0.1%, with terminal log ability of new entrants increasing by 1% while that of incumbents increasing by 0.7%. The increase in child ability of new entrants is driven by access to better quality private schooling, despite a decrease in mother's active time with the child. Incumbent children see improvements in their test scores due to incumbent

few papers have also studied the political economy of private school vouchers (Brunner and Sonstelie, 2003; Brunner and Imazeki, 2008).

[44] \$6,100 is the median private school tuition in the private school data.

mothers working less and spending more time with their children. I also find due to the lower fee mothers of new entrants decrease their work hours on average by 7%. Finally, to see if the subsidy allowed mothers with low household resources to enroll their children in private schooling, I plot the distribution of assets at the time of child's entry into private schooling for the baseline and counterfactual in Figure A3. As a result of the asset test, mothers have lower accumulated assets at the time their child enrolls in private school which implies that the subsidy allows women with low assets to enroll their children in private schools.

Table 3: SUBSIDY WITH ASSET TEST

	Full Sample			New Entrants			Incumbents		
	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ
Private School	0.27	0.36	+33.3						
Log Ability	10.67	10.68	+0.09	10.5	10.6	+0.95	13.8	13.9	+0.72
Hours with Child	763.1	751.2	-12.4	1227	1200	-2.20	1427	1428	+0.07
Hours Worked (cond. on working)	1598	1581	+1.06	1626	1510	-7.12	1544	1543	-0.01
Terminal Assets	97.3	100.1	+2.88	79.9	70.3	-12.0	33.2	34.2	+3.08
Mean Wages	12.18	12.18	0.00	11.2	11.1	-0.89	12.4	12.4	-0.04

Notes: The table reports changes in life-cycle outcomes under the counterfactual experiment with subsidy with an asset test. Women with assets less than 300% of the federal poverty guideline are given a subsidy capped at $6,100. Baseline results are averages with estimated parameters and observed private school fee in the data. Results for log ability, assets and mean wages are calculated for period 25 (terminal period). Results for private schooling, hours with child and hours worked are calculated by averaging over all time periods.

6.3 Targeted Subsidies to Different Education Groups

Private school subsidies can have heterogenous effects on student achievement and mothers' career paths for women belonging to different education groups. To explore these differences in responses and outcomes, I conduct an experiment in which I give a 25% subsidy to (a) only high school dropouts, (b) only high school graduates and (c) only to women with some college or higher. Table 4 (a) shows that if women who are high school dropouts are given a subsidy to send their children to private school, overall private school enrollment increases by 7%. Child ability as measured by test scores goes up by 24% for new students who enter private schooling as a result of the subsidy. To top up subsidies, new entrant mothers increase their labor supply by 12% in phase 2, but then reduce their labor supply by 8% when the child starts school.

Next, in Table 4 (b), I show that a 25% subsidy given to mothers with high school degrees leads to an 18% increase in private school enrollment. Decomposition analysis reveals that this leads to a 38% increase in child ability of new entrants, with small gains for incumbent children. New entrant mothers increase their labor supply before the child starts school to afford the cost of private school, but decrease their labor supply once the child starts school. This change in work hours has dynamic effects on wages through the human

Table 4: Subsidizing Different Education Groups

(a) 25% Subsidy to High School Dropouts

	% Change		
	Full Sample	New Entrants	Incumbents
Private School Enrollment	+6.91		
Log Ability	+0.01	+24.4	+0.07
Phase 1 Hours Worked	-0.12	-0.21	-0.09
Phase 2 Hours Worked	+5.05	+12.2	+1.23
Phase 3 Hours Worked	+0.60	-7.90	-0.11
Terminal Assets	+4.87	−17.7	+5.53
Mean Wages	-0.09	-0.45	-0.01

(b) 25% Subsidy to High School Graduates

	% Change		
	Full Sample	New Entrants	Incumbents
Private School Enrollment	+18.0		
Log Ability	+0.05	+38.2	+0.12
Phase 1 Hours Worked	-0.13	-0.16	-0.09
Phase 2 Hours Worked	+5.05	+10.4	+1.25
Phase 3 Hours Worked	-3.19	-17.0	-0.08
Terminal Assets	+2.84	-31.4	+3.15
Mean Wages	-0.07	-0.60	-0.004

(c) 25% Subsidy to Women with Some College or More

	% Change		
	Full Sample	New Entrants	Incumbents
Private School Enrollment	+26.0		
Log Ability	+0.13	+6.12	+0.10
Phase 1 Hours Worked	-0.13	-0.25	-0.09
Phase 2 Hours Worked	+5.07	+10.2	+1.24
Phase 3 Hours Worked	+0.52	+0.68	-0.14
Terminal Assets	+5.01	+0.13	+4.80
Mean Wages	0.04	+0.16	0.00

Notes: The table reports changes in life-cycle outcomes under the counterfactual experiment with subsidy of 25% to different education groups. Counterfactual results are compared to the baseline with no subsidy. Results for log ability, assets and mean wages are calculated for period 25 (terminal period). Results for private schooling, hours with child and hours worked are calculated by averaging over all time periods.

capital accumulation channel, with terminal wages for this group of women 0.6% lower. Due to lower wage income and the subsidy these women also accumulate lower assets over the life-cycle, with terminal assets 32% lower than in a scenario with no subsidy. In contrast, incumbent mothers are able to accumulate higher assets due to the subsidy.

Lastly, in Table 4 (c), I show the effects of a 25% subsidy to women belonging to the highest education group. A subsidy for this group results in the biggest increase in private school enrollment, with enrollment increasing by 26%. Among new entrants, terminal child ability increases by 6%, while small effects on ability of incumbent children. Due to the subsidy, new entrant mothers increase their work hours in phase 2 and 3, suggesting that these women were at the margin of choosing private schooling for the child and can afford subsidized private schooling by increasing labor supply. As a result of the subsidy, these women are able to accumulate higher assets, on average, and see wage gains over the life-cycle.

In summary, these results suggest that targeted subsidies to different education groups can help women at the margin. The amount of subsidy given was not large, therefore, the biggest increase in enrollment was observed for children of high-educated women. This is expected, since high-educated women, who also have higher non-labor income and higher assets, are more capable of using their resources to top up subsidies and send their children to private school. The largest gains in child ability are observed for children belonging to disadvantaged backgrounds. While the subsidy resulted in gains for children of new entrants, it acted as a windfall for incumbent mothers, with small returns in terms of child ability or wage and asset growth for the mothers.

7 Summary and Conclusions

In this paper, I have focussed on the effect of the availability of private schooling on the trade-off that women face between working more to finance monetary investments in their children that augment child ability, or spend more time in child care activities at home. I showed that there is considerable observed and unobserved heterogeneity in who selects private schooling for their child, and that these systematic differences between individuals can also explain part of the differences in the observed labor supply patterns and effects of private schooling on child outcomes. Estimates of the child ability function showed that attending private school increases terminal ability by 1.5%, and that mother's time with the child and private schooling are complements. I also found that the private school enrollment is more elastic to price changes at lower levels of fee, and less elastic at higher levels of fee.

These complex interdependencies between female's work and savings choices and child's schooling imply that policies aimed at subsidizing private schooling can have effects beyond affecting student achievement. I illustrate that subsidizing private schooling for low income and low education women can result in gains in children's outcomes for women at the margin. Moreover, it leads to women working more before the child starts school, and affects their saving behavior. However, these subsidies act as windfalls for incumbent mothers, without any significant increase in child ability. The analysis in this paper suggests that evaluating policies only to the extent that they affect student achievement overlooks the impact of such policies on the entire household. The different subsidy schemes evaluated in the paper can be useful in designing subsidy programs that not only benefit children but also have positive impacts on female's career evolution and asset accumulation. Other policy reforms that can be evaluated using the model include giving subsidies declining in income. The model can also be used to evaluate which subsidy structure would maximize gain in child outcomes, holding constant total (new) government expenditures on subsidies.

This paper highlighted the connection between maternal labor supply and saving decisions and investment in private schooling. Due to data constraints, I was not able to model the choice between different types of private schools and the variation in their quality, that would affect not only child ability, but also mothers' valuation of private schools. Future research using detailed data that can distinguish between parochial non-sectarian schools would be more informative about the returns to private schooling, and its effect on female labor supply and savings.

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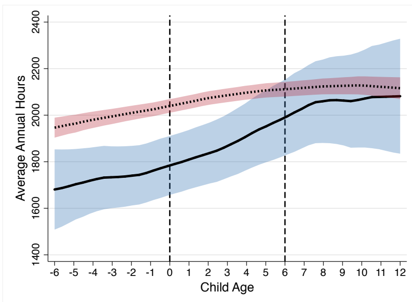
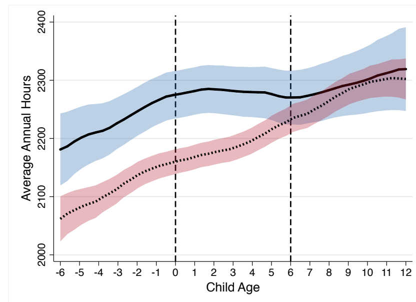
Appendices

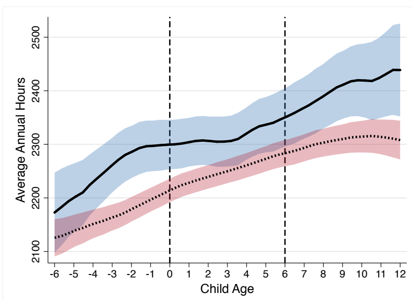
A Additional Figures and Tables



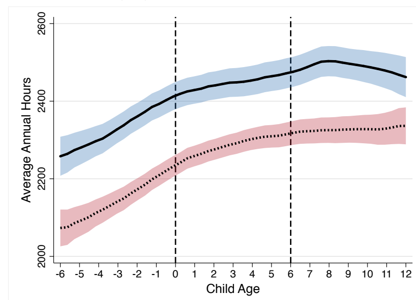
(a) Less than High School



(b) High School

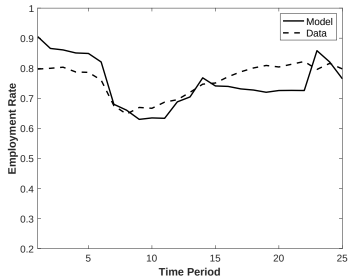


(c) Some College

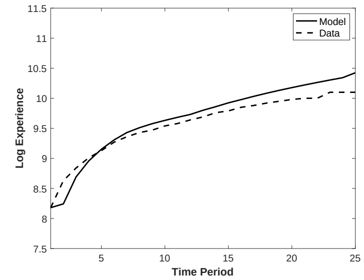


(d) College and More

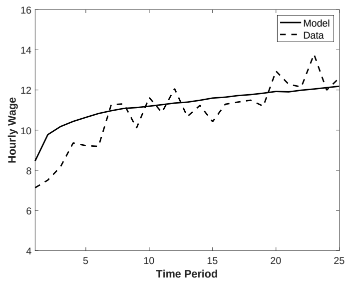
Figure A1: Husband's Annual Work Hours. The Figure plots average annual hours worked by private and public school fathers for four education groups. The solid lines with blue confidence intervals denote private school fathers while the dotted line with red confidence intervals denote public school fathers. The x-axis is child's age, with negative ages denoting years before childbirth.



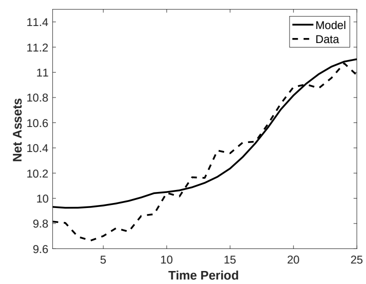
(a) Employment Rate



(b) Experience



(c) Hourly Wage



(d) Assets

Figure A2: Goodness of Fit. Figure A2 (a) shows the model simulation and data for employment rate, Figure A2 (b) shows the model simulation and data for log experience, Figure A2 (c) shows the model simulation and data hourly wage, while Figure A2 (b) shows the average simulated and data assets over the 25 time periods.

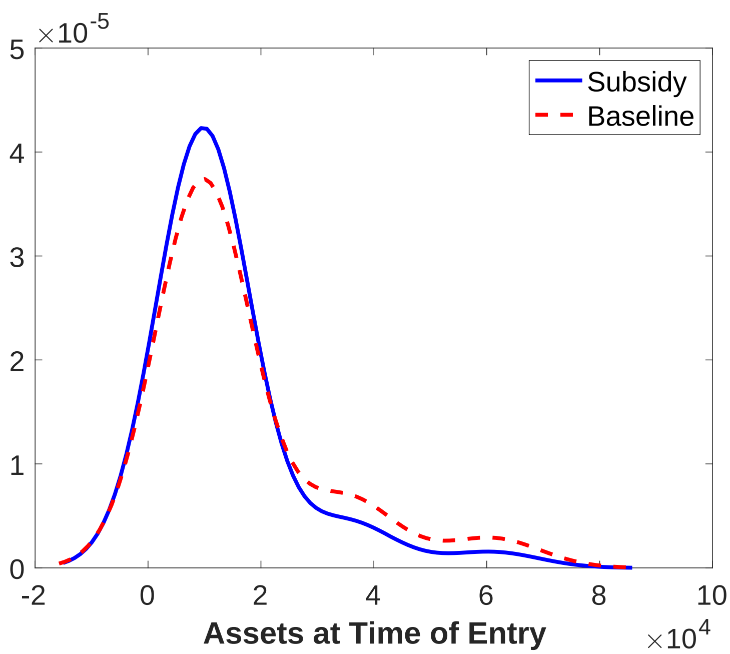


Figure A3: Asset Distribution at Time of Entry. Figure A3 plots the baseline and counterfactual asset distribution of mothers at the time of child's entry into private schooling.

Table A1: Preference Parameters

Parameter	Variable	Estimate	Std. Error	Parameter	Variable	Estimate	Std. Error
(a) Private School Preference Parameters				(e) Initial Child Ability			
γ_0^s	Constant	0.265	0.018	$\gamma_0^{k_0}$	Constant	1.493	0.935
γ_{12}^s	High School	0.130	0.037	$\gamma_{12}^{k_0}$	High School	0.648	0.144
γ_{13}^s	Some College or More	0.974	0.087	$\gamma_{13}^{k_0}$	Some College or More	0.611	0.201
γ_2^s	No. of children	0.015	0.018	$\gamma_2^{k_0}$	Black	-0.063	0.093
γ_{31}^s	Type 1	-0.764	0.448	$\gamma_{31}^{k_0}$	Type 1	-0.090	0.201
γ_{32}^s	Type 2	-0.246	0.313	$\gamma_{32}^{k_0}$	Type 2	0.033	0.002
γ_{33}^s	Type 3	0.414	0.056	$\gamma_{33}^{k_0}$	Type 3	0.425	0.071
(b) Consumption Preference Parameters				(f) Child Ability Production Function			
α_1	CRRA parameter	0.354	0.064	β_0	Total Factor Productivity	0.781	0.514
γ_0^c	Constant	0.585	0.076	β_1	$\ln k$	0.013	0.005
γ_1^c	Child age < 6	-0.091	0.016	β_3	$\ln G$	0.990	0.085
γ_2^c	Child age ≥ 6	0.089	0.010	β_4	s	0.012	0.004
γ_{32}^c	High School	0.404	0.115	β_5	$\ln k \times \ln \tau$	0.010	0.033
γ_{33}^c	Some College or More	0.602	0.045	β_6	$\ln k \times \ln G$	-0.010	0.090
γ_4^c	No. of children	0.307	0.202	β_7	$\ln \tau \times \ln G$	0.069	0.029
γ_{51}^c	Type 1	0.451	0.041	β_8	$\ln k \times s$	0.001	0.000
γ_{52}^c	Type 2	0.062	0.008	β_9	$\ln \tau \times s$	0.053	0.023
γ_{53}^c	Type 3	0.141	0.023	β_{10}	$\ln G \times s$	0.001	0.001
(c) Child Ability Preference Parameters				(g) Productivity of Mother's Time			
λ	CRRA parameter	0.489	0.116	π_0^τ	Constant	0.431	0.857
γ_0^k	Constant	-0.133	0.782	π_1^τ	Child age < 6	0.326	0.123
γ_1^k	Child age < 6	2.902	1.451	π_2^τ	Child age ≥ 6	0.099	0.035
γ_2^k	Child age ≥ 6	2.001	1.347	π_{32}^τ	High School	0.232	0.250
γ_{32}^k	High School	1.014	0.418	π_{33}^τ	Some College or More	0.227	0.101
γ_{33}^k	Some College or More	1.058	0.458	π_4^τ	Married	0.045	0.052
γ_4^k	No. of children	-0.015	0.161	π_5^τ	No. of Children	0.116	0.082
γ_5^k	Married	0.889	0.305	π_{61}^τ	Type 1	-0.209	0.803
γ_{61}^k	Type 1	0.321	0.554	π_{62}^τ	Type 2	-0.348	0.509
γ_{62}^k	Type 2	0.347	0.819	π_{63}^τ	Type 3	0.536	0.081
γ_{63}^k	Type 3	0.504	0.177	σ_η^2	Variance of ability shock	0.805	0.336
(d) Leisure Preference Parameters				(h) Type Parameters and Type Distribution			
γ_0^h	Constant	0.001	0.002	α_{02}^μ	Type 1 Constant	0.309	0.151
γ_1^h	Child age < 6	-1.505	0.856	α_{112}^μ	Type 1 High School	0.426	0.308
γ_2^h	Child age ≥ 6	0.001	0.000	α_{122}^μ	Type 1 Some College or More	0.195	0.024
γ_{32}^h	High School	0.002	0.001	α_{03}^μ	Type 3 Constant	-0.172	0.244
γ_{33}^h	Some College or More	0.001	0.002	α_{113}^μ	Type 3 High School	-0.006	0.004
γ_4^h	No. of children	0.006	0.002	α_{123}^μ	Type 3 Some College or More	0.335	0.080
γ_{51}^h	Type 1	0.001	0.002	π_{μ_1}	Proportion of Type 1	0.471	
γ_{52}^h	Type 2	0.002	0.004	π_{μ_2}	Proportion of Type 2	0.267	
γ_{53}^h	Type 3	0.001	0.000	π_{μ_3}	Proportion of Type 3	0.262	

Notes: The table reports preference parameters for the method of moment estimation. Standard errors are calculated by solving 10 chains length 8000 and using those estimates to calculate the variance of the parameters.

Table A2: Budget Constraint Parameters

Parameter	Variable	Estimate	Std. Error
(a) Wage Parameters			
γ_0^w	Constant	0.722	0.108
γ_{11}^w	High School	0.001	0.097
γ_{12}^w	Some College or More	0.458	0.217
γ_2^w	Black	-0.114	0.034
γ_3^w	Experience	0.111	0.013
γ_4^w	Experience Squared	0.001	0.000
γ_{51}^w	Type 1	0.022	0.053
γ_{52}^w	Type 2	0.340	0.168
γ_{53}^w	Type 3	0.825	0.086
σ_ξ^2	Wage shock variance	0.170	0.020
(b) Husband's Weekly Earnings Parameters			
$\gamma_0^{y^h}$	Constant	107.6	50.15
$\gamma_{11}^{y^h}$	High School	384.4	230.8
$\gamma_{12}^{y^h}$	College and More	111.9	123.4
$\gamma_2^{y^h}$	Black	-48.95	50.15
$\gamma_3^{y^h}$	t	277.1	162.5
$\gamma_4^{y^h}$	t squared	-2.759	0.016
$\gamma_{51}^{y^h}$	Type 1	319.0	708.2
$\gamma_{52}^{y^h}$	Type 2	300.6	33.60
$\gamma_{53}^{y^h}$	Type 3	-104.4	15.11
$\sigma_{\xi^h}^2$	Earnings shock variance	73.17	45.49
(c) Asset Evolution and Terminal Value Parameters			
$\underline{b}$	Assets lower bound	$-\$41,520$	51547
$\underline{c}$	Consumption lower bound	\$164	90.1
cost	Cost of other kids	$3,903$	1406
α_G	Proportion of family income	0.03	0.002
α^p	School fee intercept	3.584	2.713
β^p	School fee slope	0.958	0.259
σ_p^2	School fee error variance	0.217	0.235
γ_1^T	Value from assets in T	0.004	0.001
γ_2^T	Value from k in T	1.726	0.606

Notes: The table reports female's wage and husband's weekly earnings parameters, as well as the asset evolution equation parameters for the Method of Moment estimation. Standard errors are calculated by solving the model using the Monte Carlo Markov Chain method 50 times with different starting values and using those 50 estimates to calculate the variance of the parameters.

B Two Period Model

I develop a simple two period model to understand how an agent's labor supply decision responds to private school cost. I consider an economic environment which begins with the birth of a child with initial ability k_0. Period 1 child ability is a function of k_0 and mother's time with the child, m_1. In period 2, the mother chooses between sending her child to a public or private school. I define a variable s which is 1 if the child is sent to private school and 0 if the child goes to public school. Sending the child to private school incurs a cost p, while public schools are free of cost. Schooling is also added as an input to the second period child ability production function, in addition to mother's time with the child in period 2, m_2, and last period's child ability k_1. Let $h_t \in \{0, 1\}$ where $h_t = 1$ if the female works full-time and spends no time with the child, and $h_t = 0$ if the female does not work in period t. The female's maximization problem can then be written as:

$$V(c_1, c_2, k_1, k_2) = \underset{c_1, c_2, h_1, h_2, s}{max} U(c_1, k_1) + \beta U(c_2, k_2)$$

$$\begin{aligned}
&s.t \\
&c_2 + sp = R(w_1 h_1 + N - c_1) + w_2 h_2, && (26) \\
&k_1 = g_1(m_1, k_0), && (27) \\
&k_2 = g_2(s, m_2, k_1), && (28) \\
&1 = h_1 + m_1, && (29) \\
&1 = h_2 + m_2. && (30)
\end{aligned}$$

where w_1 and w_2 is market wage in period 1 and 2, and N is non-labor income. Equation (26) is the female's inter-temporal budget constraint and equations (27) and (28) define the child ability production function in periods 1 and 2. I assume that utility is concave in all its arguments, and that

$$g_1(1, k_0) > g_1(0, k_0), \tag{31}$$

$$g_2(1, 1, g_1(1, k_0)) > g_2(0, 1, g_1(1, k_0)) = g_2(1, 0, g_1(1, k_0)) > g_2(0, 0, g_1(1, k_0)), \tag{32}$$

$$g_2(1, 1, g_1(0, k_0)) = g_2(0, 1, g_1(1, k_0)), \tag{33}$$

$$g_2(1,0,g_1(1,k_0)) > g_2(0,1,g_1(0,k_0)) > g_2(0,0,g_1(0,k_0)). \tag{34}$$

We can analyze eight cases derived from the two period theoretical model:

Case 1: $h_1 = 1, h_2 = 1, s = 1$

$$V^1(c_1,c_2,k_1,k_2) = U(c_1^{1*}, g_1(0,k_0)) + \beta U(R(w_1+N-c_1^{1*}) + w_2 - p, g_2(1,0,g_1(0,k_0))), \tag{35}$$

Case 2: $h_1 = 1, h_2 = 0, s = 0$

$$V^2(c_1,c_2,k_1,k_2) = U(c_1^{2*}, g_1(0,k_0)) + \beta U(R(w_1+N-c_1^{2*}), g_2(0,1,g_1(0,k_0))), \tag{36}$$

Case 3: $h_1 = 1, h_2 = 0, s = 1$

$$V^3(c_1,c_2,k_1,k_2) = U(c_1^{3*}, g_1(0,k_0)) + \beta U(R(w_1+N-c_1^{3*}) - p, g_2(1,1,g_1(0,k_0))), \tag{37}$$

Case 4: $h_1 = 1, h_2 = 1, s = 0$

$$V^4(c_1,c_2,k_1,k_2) = U(c_1^{4*}, g_1(0,k_0)) + \beta U(R(w_1+N-c_1^{4*}) + w_2, g_2(0,0,g_1(0,k_0))), \tag{38}$$

Case 5: $h_1 = 0, h_2 = 1, s = 1$

$$V^5(c_1,c_2,k_1,k_2) = U(c_1^{5*}, g_1(1,k_0)) + \beta U(R(N-c_1^{5*}) + w_2 - p, g_2(1,0,g_1(1,k_0))), \tag{39}$$

Case 6: $h_1 = 0, h_2 = 1, s = 0$

$$V^6(c_1,c_2,k_1,k_2) = U(c_1^{6*}, g_1(1,k_0)) + \beta U(R(N-c_1^{6*}) + w_2, g_2(0,0,g_1(1,k_0))), \tag{40}$$

Case 7: $h_1 = 0, h_2 = 0, s = 1$

$$V^7(c_1,c_2,k_1,k_2) = U(c_1^{7*}, g_1(1,k_0)) + \beta U(R(N-c_1^{7*}) - p, g_2(1,1,g_1(1,k_0))), \tag{41}$$

Case 8: $h_1 = 0, h_2 = 0, s = 0$

$$V^8(c_1,c_2,k_1,k_2) = U(c_1^{8*}, g_1(1,k_0)) + \beta U(R(N-c_1^{8*}), g_2(0,1,g_1(1,k_0))), \tag{42}$$

where c_1^{j*} is the solution to the first order condition with respect to c_1 for case j.

Within this simple framework, a number of testable propositions emerge which are consistent with the observed data patterns.

Proposition 1. *The mother will choose to work full-time and send her child to private school over not working and sending her child to public school if the marginal utility from the difference in consumption – which includes monetary investments in the child – is greater than the marginal utility from the difference in child cognition between the two scenarios.*

Proposition 2. *A drop in p unambiguously increases the likelihood of choosing private schooling for the child.*

Proposition 3. *An increase in p leads to an increase in end of period 1 savings.*

Proposition 4. *For women switching from public to private school (i.e. women at the school choice margin), or for women who have chosen private schooling for their child, an increase in p will increase female labor supply if the change in utility from lower consumption is more than the change in utility from higher child ability.*

B.1 Proofs

Proof of Proposition 1:

Proof. The proof can be generalized to any of the eight cases presented above. The female opts for case i versus case j, $j \neq i$, if and only if

$$\begin{aligned}
&V^i(c_1, c_2, k_1, k_2) - V^j(c_1, c_2, k_1, k_2) > 0, \qquad (43)\\
&= U(c_1^{*i}, c_2^{*i}, k_1^{*i}, k_2^{*i}) - U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j}) > 0\\
&= U(c_1^{*j} + \Delta c_1, c_2^{*j} + \Delta c_2, k_1^{*j} + \Delta k_1, k_2^{*j} + \Delta k_2) - U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j}) > 0\\
&\approx \frac{\partial U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j})}{\partial c_1}\Delta c_1 + \frac{\partial U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j})}{\partial c_2}\Delta c_2 + \frac{\partial U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j})}{\partial k_1}\Delta k_1 + \frac{\partial U(c_1^{*j}, c_2^{*j}, k_1^{*j}, k_2^{*j})}{\partial k_2}\Delta k_2 > 0
\end{aligned}$$

where $c_1^{*k}, c_2^{*k}, k_1^{*k}$ and k_2^{*k} are the optimal values of consumption and child ability for case k. From equation (43), the female will choose case 1 over case 8 if and only if:

$$\begin{aligned}
&\frac{\partial U(c_1^{8*}, c_2^{8*}, k_1^{8*}, k_2^{8*})}{\partial c_1}[c_1^{1*} - c_1^{8*}] + \beta\frac{\partial U(c_1^{8*}, c_2^{8*}, k_1^{8*}, k_2^{8*})}{\partial c_2}[R(c_1^{8*} - c_1^{1*} + w_1) + w_2 - p] >\\
&\frac{\partial U(c_1^{8*}, c_2^{8*}, k_1^{8*}, k_2^{8*})}{\partial k_1}[g_1(1, k_0) - g_1(0, k_0)] + \beta\frac{\partial U(c_1^{8*}, c_2^{8*}, k_1^{8*}, k_2^{8*})}{\partial k_2}[g_2(0, 1, g_1(1, k_0)) - g_2(1, 0, g_1(0, k_0))]
\end{aligned} \qquad (44)$$

□

Proof of Proposition 2:

Proof. Let the difference between V^i and V^j, $j \neq i$, be:

$$D^i(c_1^i, c_2^i, k_1^i, k_2^i, c_1^j, c_2^j, k_1^j, k_2^j) = V^i(c_1, c_2, k_1, k_2) - V^j(c_1, c_2, k_1, k_2) \qquad (45)$$

From the envelope theorem

$$\frac{\partial D^i(c_1^i, c_2^i, k_1^i, k_2^i, c_1^j, c_2^j, k_1^j, k_2^j)}{\partial p} = \beta\Big[(-1)\frac{\partial U^i(c_1^{i*}, c_2^{i*}, k_1^{i*}, k_2^{i*})}{\partial p} - \frac{\partial U^j(c_1^{j*}, c_2^{j*}, k_1^{j*}, k_2^{j*})}{\partial p}\Big] \quad (46)$$

where case j is any case in which the child goes to public school and case i is any case in which the child goes to private school. Since in this scenario $\frac{\partial U^j(c_1^{j*}, c_2^{j*}, k_1^{j*}, k_2^{j*})}{\partial p} = 0$, a decrease in p will lead to an increase in period 2 consumption, so that the probability of switching the child from public school to private school increases. In particular, the probability of switching from any case in which the child is going to public school (cases 2, 4 ,6 and 8), to any of the cases in which the child is going to private school (cases 1, 3, 5 and 7) increases when p decreases. □

Proof of Proposition 3:

Proof. The proof extends from equation (44). Specifically, when switching from any case in which the mother chooses public schooling for her child (cases 2, 4, 6 and 8) to any case in which the child is sent to private school, the mother will choose case 1,3 or 5 over case 7 (not working in either period and sending her child to private school) if and only if the marginal utility from the increase in child ability due to the mother spending time with the child in both periods is lower than the marginal utility from higher consumption due to labor market earnings. □

Proof of Proposition 4:

Proof. End of period 1 savings, $a_1^{k*} = w_1 h_1^{k*} + N - c_1^{k*}$, and $\frac{\partial a_1^{k*}}{\partial p} = -\frac{\partial c_1^{k*}}{\partial p}$. When p decreases, we would expect period 1 consumption to change by a non-negative number, which would lead to a decrease in savings □

B.2 Comparative Statics with respect to w_1, w_2, and N

Increase in w_1 and w_2

From the envelope theorem

$$\frac{\partial D^i(c_1^i, c_2^i, k_1^i, k_2^i, c_1^j, c_2^j, k_1^j, k_2^j)}{\partial w_1} = \beta\Big[\frac{\partial U^i(c_1^{i*}, c_2^{i*}, k_1^{i*}, k_2^{i*})}{\partial w_1} - \frac{\partial U^j(c_1^{j*}, c_2^{j*}, k_1^{j*}, k_2^{j*})}{\partial w_1}\Big] \quad (47)$$

where case j is any case in which the female does not work in period 1 while case i is any case in which $h_1 = 1$. Under this scenario, an increase in w_1 leads to an unambiguous increase in the probability of switching to cases in which the mother is working in period 1 i.e. cases 1, 2, 3 and 4, since $\frac{\partial U^j(c_1^{j*},c_2^{j*},k_1^{j*},k_2^{j*})}{\partial w_1} = 0$ and an increase in period 1 earnings will lead to an increase in consumption, which raises the probability that the change in utility from higher consumption will exceed the loss in utility from lower child ability due to the mother spending less time with the child.

Conditional on working in the first period (cases 1-4), an increase in w_1 will increase period 1 and period 2 consumption, leading to an increase in the probability that the mother switches her child from public school to private school (since the extra earnings can be used for paying the higher school fee). Lastly, an increase in w_1 will increase period 1 savings if $\frac{\partial a_1^{k*}}{\partial w_1} = 1 - \frac{\partial c_1^{k*}}{\partial w_1} > 0$

Similarly, from the envelope theorem,

$$\frac{\partial D^i(c_1^i, c_2^i, k_1^i, k_2^i, c_1^j, c_2^j, k_1^j, k_2^j)}{\partial w_2} = \beta\Big[\frac{\partial U^i(c_1^{i*}, c_2^{i*}, k_1^{i*}, k_2^{i*})}{\partial w_2} - \frac{\partial U^j(c_1^{j*}, c_2^{j*}, k_1^{j*}, k_2^{j*})}{\partial w_2}\Big] \quad (48)$$

where case j is any case in which the female does not work in period 2 while case i is any case in which $h_2 = 1$. Under this scenario, an increase in w_2 will lead to an increase in the probability of switching to cases in which the mother is working in period 2 (cases 1, 4, 5 and 6), since $\frac{\partial U^j(c_1^{j*},c_2^{j*},k_1^{j*},k_2^{j*})}{\partial w_2} = 0$ and an increase in period 2 earnings will lead to an increase in consumption, which raises the probability that the change in utility from higher consumption will exceed the loss in utility from lower child ability due to the mother spending less time with the child in period 2.

Conditional on working in period 2, an increase in w_2 will result in a non-negative change in period 1 and period 2 consumption, leading to an increase in the probability that the mother sends her child to a private school instead of a public school (since the extra period 2 earnings can be used to pay the private school fee). Finally, $\frac{\partial a_1^{k*}}{\partial w_2} = -\frac{\partial c_1^{k*}}{\partial w_2}$ i.e. savings will decrease if period 1 consumption increases as a result of w_2 rising.

Increase in N

From the envelope theorem, an increase in N will increase the probability of switching from case j to case i if and only if

$$\frac{\partial D^i(c_1^i, c_2^i, k_1^i, k_2^i, c_1^j, c_2^j, k_1^j, k_2^j)}{\partial N} = R\beta\Big[\frac{\partial U^i(c_1^{i*}, c_2^{i*}, k_1^{i*}, k_2^{i*})}{\partial N} - \frac{\partial U^j(c_1^{j*}, c_2^{j*}, k_1^{j*}, k_2^{j*})}{\partial N}\Big] > 0 \quad (49)$$

As an example, consider the choice between case 7 and case 8. The labor supply pattern of the mother is the same for both cases, and the only difference is the choice of private school in case 7. When N increases, c_1^{7*} and c_2^{7*} increases, which decreases the consumption gap between case 8 and 7, and increases the probability that the additional utility from higher child ability will exceed the change in utility from higher consumption in case 8. Lastly, an increase in N will increase savings if $\frac{\partial a_1^{k*}}{\partial N} = 1 - \frac{\partial c_1^{k*}}{\partial N} > 0$.

C Data Appendix

I use data from two main sources: NLSY79 and NLSY79 Child and Young Adult, and supplement it with time use data from the Panel Study of Income Dynamics (PSID) and private school fee data from `privateschoolreview.com`. The NLSY79 Cohort is a longitudinal project that follows 12,686 American youth born between 1957-64, and were 14-22 year olds at the start of the survey. Around 52% of the individuals surveyed are women, and the survey was conducted annually through 1994, after which the survey was conducted on a biennial basis. The sample consists of a core random sample, and an oversample of blacks, Hispanics, poor whites and the military. Data is collected on respondents' schooling and employment, as well as marriage and fertility decisions. I use demographic data on the women of NLSY79 and construct the following key variables:

Labor Supply: NLSY79 collects data on annual hours worked by the respondent in the past calendar year. I use annual hours worked data to conduct analysis at the intensive margin. I also construct annual employment rates for each respondent for each year, where the respondent is counted as employed if she worked more than six weeks in the past calendar year.

Income: The NLSY reports the wage income and net family income in the past calendar year for each respondent. While total income from wages and salary in the past calendar year is self-reported, the net family income is a created variable, which is the sum of all sources of income for the family, including income from the spouse, farm income as well as welfare income.

Assets: NLSY started collecting data on savings and assets from 1985. The savings variable is an indicator variable which is an answer to whether the respondent or respondent's spouse has any cash kept in a safe place at home, or money in a savings or checking accounts, money market funds, credit unions, U.S. savings bonds, Individual Retirement Accounts (IRA or Keogh), certificates of deposit, personal loans to others or rights to an estate or an investment trust. In a follow-up question, respondents are asked the total amount of money assets altogether in these instruments. NLSY also contains a created variable on family net worth, that is available from 1985 onwards, and is constructed by summing all asset values and subtracting all debts. Missing assets and debt values are imputed.

Child's Schooling and Test Scores: A separate survey of all children born to the NLSY79 female respondents began in 1986, in which children were followed from the time of their birth. In addition to all the mother's information from NLSY79, the child survey includes information about the child's schooling, as well as demographic and development information collected from the mother and the child. In particular, the NLSY79 Child and Young Adult (C-NLSY79) survey contains information about the type of school the child studies in, which helps identify whether the child is going to a public school or private school. Additionally, C-NLSY79 also reports cognitive assessment scores for each child in the survey. I use the standardized scores on the Peabody Picture Vocabulary Test (PPVT), Peabody Individual Achievement Test-Reading Recognition subtest (PIAT-R) and the Peabody Individual Achievement Test - Mathematics subtest (PIAT-M) as measures of child's cognitive ability. Standardized scores are an age-specific transformation of the raw scores. The PPVT is a vocabulary test for standard American English and provides a quick estimate of verbal ability and scholastic aptitude for children less than 5 years of age. The PIAT-M measures attainment in mathematics. Finally the PIAT-R measures word recognition and pronunciation ability.

Time Use Data: Though NLSY79 and C-NLSY79 are a rich source of data on labor supply, wages and child development, it does not collect time use data for parents and children. To supplement data from NLSY79, I use time diary data from the Panel Study of Income Dynamics (PSID) Child Development Supplements (CDS-I and CDS-II). The PSID is a longitudinal dataset of a nationally representative sample of about 5000 American families that was started in 1968. In 1997, the PSID began collecting data for up to two children from a random sample of families that had children under the age of 13 in the Child Development Supplement (CDS-I). A follow-up survey was conducted in 2002-3 (CDS-II), when children were between 8-18 years of age. The entire CDS sample consists of 3,500 children residing in 2,400 families. The CDS collects extensive data on child development and time use. For two days per week (one weekday and either Saturday or Sunday), children (young children were aided by a primary care giver) filled out a detailed 24 hour time diary in which they recorded all activities during the day and who else (if anyone) participated with the child in these activities. At any point in time, the children recorded the intensity of participation for both parents. Parents could either be actively involved (active time use), or just be around without being engaged in any activity with the child (passive time use). I construct annual time use measures for the mother by summing both active and passive time for a day, multiplying the daily hours by 5 for the weekday and 2 for the weekend day to get a weekly measure (using a Saturday and Sunday report adjustment) and then multiplying by

52 for the annual measure.

Private School Fee: State level tuition data is obtained from `privateschoolreview.com`, a website that lists private schools in each state, gives information about the average tuition at the state and national level, as well as information on average acceptance rates, student body demographics and teacher student ratios. The website also hosts articles for parents on why they should send their child to private schools, and if they choose to do so, how they can pay for it. Data on tuition is available at the state level only for the school year 2014-2015. I extrapolate data for my sample years, I adjust the fee data by inflation.[45]

Construction of the Private School Variable

In order to construct the private school dummy, I use the question in which respondents are asked of the type of school their child goes to. The respondents can choose between private school, public school, home schooling and no school. This question was added to the NLSY79 after 1998, therefore, for some children, information about school type is available when they are older than 4-6 years of age (when children start primary school).

The private school variable is meant to capture the preference for better schooling and additional cost associated with it. I let the private school dummy to be 1 if the mother of the child has ever reported that her child goes to private school. This means that mothers of children who ever went to a private school (even if they, at some point, were going to a private school and switched to a private school, or vice versa), are coded as "private school mothers".

There are a total of 39 children who switch schools. Out of these 39 children, 9 switch from a private school at younger ages to public school when they are 12 or older, while the remaining 30 children switch from a public school to a private school. The ages of children for whom this question is answered for the first time range from 4 years of age till 14 years of age, so that the maximum extrapolation about child's school type is 8 years, which happens for 151 children (8.68% of individuals who respond to this question)). 71% of the children for whom this information is available for the first time are less than 12 years of age.

[45] Adjusting the 2014-2015 tuition data for inflation can be concerning since private school tuition rose more than inflation in the 1990s and 2000s. While I use the inflation-adjusted tuition data for the reduced-form analysis, I allow for measurement error in private school tuition data in the structural model.

Construction of the Aggregate Test Score

The PPVT is available for children who between four and five years of age, while the PIAT-R and PIAT-M are available for children of age five and above. There are, however, cases in which all three test scores are not available for the child. To avoid losing any information due to missing values, I follow Bernal and Keane (2010) and pool the three test scores available by averaging across all three age-adjusted standardized test scores.

D Reduced Form Analysis

The reduced form of the structural model can be obtained by noting that the woman's problem can be divided into three phases: before childbirth, after childbirth and before child starts school, and after child starts school. To capture the dynamic nature of the woman's optimization problem, I divide the problem into these three phases and estimate seven separate equations:

1. Multinomial logit for hours worked and schooling choice, HS (where $HS = 1$ if the woman does not work and sends her child to public school, $HS = 2$ if the woman works part-time (less than or equal to 1600 hours annually) and sends her child to public school, $HS = 3$ if the woman works full-time (greater than 1600 hours annually) and sends her child to public school, $HS = 4$ if the woman does not work and sends her child to private school, $H = 5$ if the woman works part-time and sends her child to private school, and $H = 6$ if the woman works full-time and sends her child to private school) for each of the three phases,

2. Regression of the family's net worth for each of the three phases,

3. Probit for school choice in the third phase.

Specifically, for the multinomial logit for hours and schooling choice, I let the linear predictor function for the outcomes, keeping not working and sending child to private school as the base category, in each phase be given by

$$\bar{h}_{it}^{H} = \pi_0^H + \pi_1^H p + \pi_2^H p^2 + \pi_1^H age + \pi_2^H age^2 + \pi_{3e}^H \sum_{e=2}^{4} \text{educ}_i + \pi_4^H \text{black}_i + \pi_5^H m_{it} + \pi_6^H N_{it} + \\ \pi_7^H AFQT_i + \pi_8^H n_{it}^k + + \pi_{10}^H w_{it} + \pi_{11}^H ldc_{st} + \pi_{12}^H sc_{st} + \pi_{13}^H HPI_{st} + \pi_{14}^H \text{urban}_{it} + \epsilon_{it}^H \tag{50}$$

where N_{it} is non-labor income, n_{it}^k is the number of children, ldc_{st} are the state and time specific local labor demand conditions, sc_{st} are the state level demographic and income controls, HPI is the house price index in the state at time t, urban is a dummy for whether the female lives in an urban area, p is the average private school fee in the woman's state of residence, and w_{it} is the estimated wage for the mother.[46] I include a quadratic in private school fee to capture the non-linearity in the relationship between the work-school choice and private school choice.

Similarly, the assets equation is given by:

$$\begin{aligned} A = \pi_0^A + \pi_1^A p + \pi_2^A p^2 + \pi_3^A p^3 + \pi_4^A age + \pi_5^A \mathbf{1}\{a_{it} \geq 6\} + \pi_{6e}^A \sum_{e=2}^{4} \text{educ}_i + \pi_7^A \text{black}_i + \pi_8^A m_{it} \\ + \pi_9^A N_{it} + \pi_{10}^A AFQT_i + \pi_{11}^A n_{it}^k + \pi_{12}^A w_{it} + \pi_{13}^A sc_{st} + \pi_{14}^A \text{urban}_{it} + \epsilon_{it}^A, \end{aligned} \tag{51}$$

where I include a cubic polynomial in private school fee. Lastly, I estimate a probit for private school decision that is a function of mother's observed characteristics, her wages, and a cubic in price of private schooling. I also include measures of public school quality in the woman's state of residence, and the supply of private schools.[47] In particular,

$$\begin{aligned} \Pr(s = 1|X, Z) = F(\pi_0^s + \pi_1^s p + \pi_2^s p^2 + \pi_3^s p^3 + \pi_{4e}^s \sum_{e=2}^{4} \text{educ}_i + \pi_5^s \text{black}_i + \pi_6^s m_{it} + \pi_7^s N_{it} \\ + \pi_8^s AFQT_i + \pi_9^s \text{No. of Children}_{it} + \pi_{10}^s w_{it} + \pi_{11}^s NP_{st} + \pi_{12}^s (Q_0)_{st} + \epsilon_{it}^s) \end{aligned} \tag{52}$$

where I assume normality for F. Q_0 is the quality of public schools in mother's state of residence and is measured by the average student-teacher ratio in public schools in the state,

[46] I use the state unemployment rate, median wages in the services sector and median wages in the manufacturing sector as the measure of local labor demand conditions. The annual unemployment rate for each state and year is obtained from the Bureau of Labor Statistics while the median wage rates are calculated using data from the Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC). State level demographic and income controls include time-varying state level poverty rate and the proportion of blacks in the state, both of which are constructed using data from the Census. A measure of the state level mean per capita income is calculated using data from the Bureau of Economic Analysis (BEA). The data for the House Price Index in the state comes from Federal Housing Finance Agency.

[47] The number of private schools in each state is calculated using data from the Private School Survey (PSS). The PSS is a biennial survey that has been conducted since the 1989-90 school year. The target population is all private schools in the United States that provide classroom instruction for one or more of grades K-12 or comparable ungraded levels, and has one or more teachers. Information is collected on the religious orientation of the school, level of school, size of school, total enrollment and number of teachers employed. As measure of public school quality, I calculate the the mean student-teacher ratio in public schools in the state using data from Common Core of Data (CCD). The CCD collects fiscal and descriptive data about students and staff annually about all public schools, public school districts and state education agencies in the United States.

and NP is the number of private schools in the state.

Since I observe wages only for workers, I estimate the following wage equation and then predict wages for everyone in the sample:

$$\ln w_{it} = \pi_0^w + \pi_{1e}^w \sum_{e=2}^{4} \mathbf{1}\{educ = e\} + \pi_2^w black_i + \pi_3^w \ln(H_{it} + 1) + \pi_4^w ur_{st} + \pi_5^w \text{services}_{st} + \pi_4^w \text{manufacturing}_{st} + \epsilon_{it}^w. \tag{53}$$

where ur_{st} is the unemployment rate in state s at time t, services_{st} is the share of the services sector in the state s at time t, and $\text{manufacturing}_{st}$ is the share of manufacturing sector in state s at time t.

I am using geographic and time variation in state level private school fee to identify the effect of private schooling on female labor supply, asset accumulation and private school enrollment, along with exclusion restrictions. For example, family composition variables affect women's labor supply and assets, but should not affect the wages women earn. On the other hand, local labor demand conditions should affect the wages women earn. In order to estimate the wage equation, I use state and time variation in unemployment rate, share of services sector and share of manufacturing sector as exclusion restrictions. The identifying assumption is that local labor demand conditions should determine wages and influence mother's time allocation decision due to their affect on the woman's budget constraint, but should be unrelated to the unobservable skill of the mother and the child. In the school choice equation the supply of private schools and quality of public schools are added as exclusion restrictions. The identifying assumption is that supply of private schools or the average quality of public schools in the state is not correlated with the unobserved skill of the child or the mother, and should therefore not affect wages.

I also use the introduction of large-scale voucher and tax credit programs that were introduced in various states to subsidize private school attendance. Following Hungerman and Rinz (2016), I focus on large-scale statewide subsidy programs that would have significant impacts on private school enrollment. In particular, I create a variable $index_{st}$, which counts the number of subsidy programs enacted in state s in year t. These include Individual Tax Credit program introduced in Arizona in 1997 and the Corporate Tax Credit in Arizona enacted in 2006; The McKay voucher program in Florida introduced in 1999 and the Florida Corporate Tax Credit introduced in 2001; Illinois' Individual Tax Credit enacted in year 1999; The Individual Tax Credit in Iowa expanded in the years 1998 and 2006, and finally, the Corporate Tax Credit introduced in Pennsylvania in the year 2001. In order to control for uncertainty in the actual timing of the roll-out, I also include a dummy for the year of enactment of the law, which is 1 in the first year after law enactment in state s, and is 0 otherwise. More details on the school subsidy laws can be found in Hungerman and Rinz (2016).

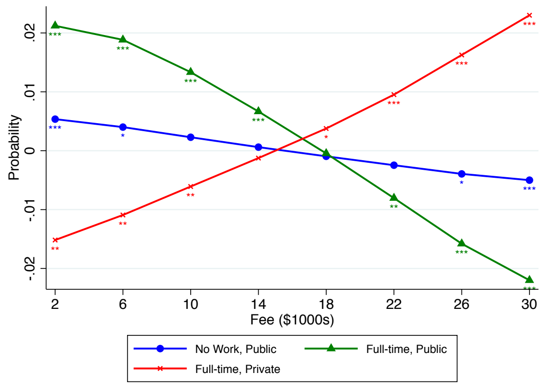
D.1 Estimates

The marginal effect of an increase in private school fee for the hours and schooling choice logit are plotted in Figure D1. In Figure D1, I plot the marginal effect of an increase in the private school fee on the probability of choosing the work-school options separately for all three phases. For clarity, I only plot statistically significant effects. Figure D1 (a) and (b) show how an increase in private school fee at different levels of fee affects the probabilities of working and choosing private schooling for the child in phases 1 and 2. In both phases, at values of private school fee less than \$10,000, an increase in private school fee leads to an increase in the probability of switching to public schooling and choosing to work full-time or staying at home.[48] However, this increase is decreasing in private school fee and almost all of the decline is explained by an increase in the probability of choosing private schooling for the child and working full-time or part-time. Figure D1 (c) shows that in phase 3, when the child starts school, an increase in private school fee at the lower end of the fee distribution leads to an increase in the probability of switching to public school and not working, however, at school fee higher than \$10,000, there is a decline in the probability of switching to public school as private school fee increases, while the probability of continuing to send the child to private school and working full-time increases.

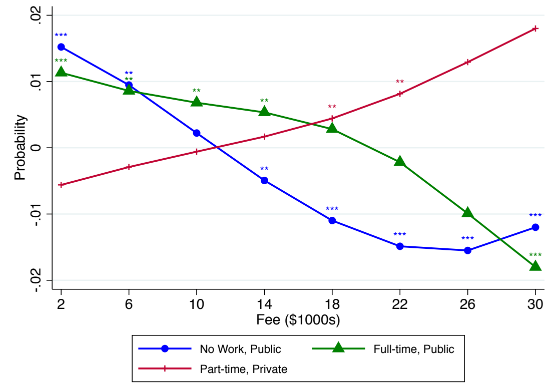
Next, I explore how the marginal effect of a private school fee increase varies for different education levels of mothers. Figure D2 (a) shows that in phase 1, at low levels of fee (less than or equal to \$10,000), females who have less than a high school degree are more likely to work full-time when they choose private schooling. However, at high levels of fee, these women choose instead to not work and send their child to public school in the future. Figure D3 (a) shows that an increase in private school costs at the lower end of the fee distribution increases the probability that less educated women would choose to not work and send their child to public schooling in the future. On the other hand, before the child starts school, women who have more than twelve years of education are more likely to choose public schooling in the future when private school feel increases at the lower end of the fee distribution, but choose

[48] The increase in the probability of working full-time and sending your child to public school in the future may arise due to two reasons: despite lower school costs (public school are free of cost), women may continue to work more because they get higher utility from increased consumption, or because they have a higher preference for working full-time. However, I cannot disentangle these two channels in the reduced-form analysis.

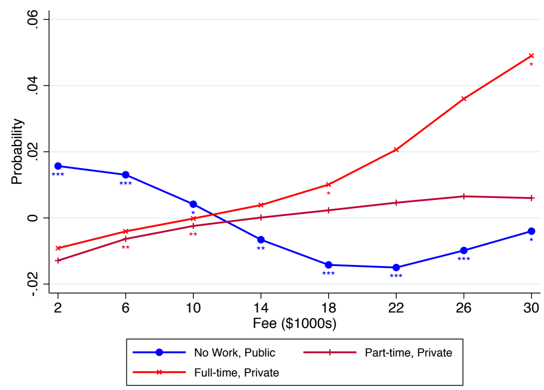
to increase labor supply and send child to private school in the future at the higher end of the fee distribution. Lastly, when the child starts school, women belonging to all three education groups exhibit similar behaviors. In response to an increase in private school fee, women choose to stay at home and send child to public school when private school fee increases at the lower end of the fee distribution.[49]



(a) Phase 1



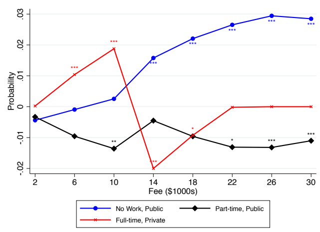
(b) Phase 2



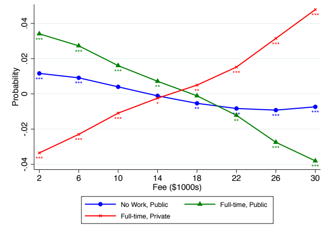
(c) Phase 3

Figure D1: Marginal Effect of Private School Fee on Work-School Probability. The Figure plots how the marginal effects of an increase in private school fee of $1000 on the probability of choosing the six work-school options varies over the level of tuition. Phase 1 covers the time period from six years before childbirth till before childbirth, phase 2 spans the period starting from the birth of the child till the child is five years of age and phase 3 covers the periods after the child starts primary school. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$. Only those choices that have statistically significant marginal effects are plotted.

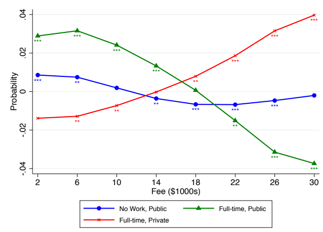
[49] I calculate the marginal effects of private school increase for different quantiles of non-labor income as well, and find that a private school fee increase leads to an increase in the probability of switching to public schools and not working in all three phases, particularly for women belonging to the upper end of the non-labor income distribution.



(a) Less than High School

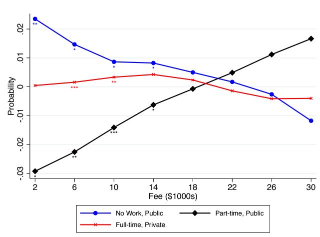


(b) High School

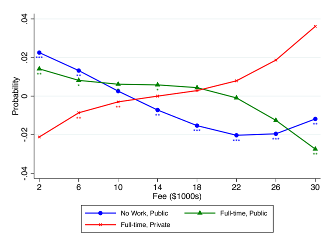


(c) College and Above

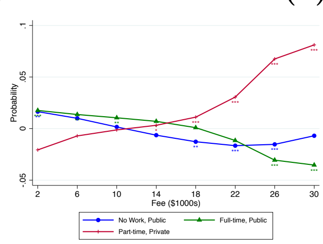
Figure D2: Marginal Effect of Private School Fee by Education (Phase 1). The Figure plots how the marginal effects of an increase in private school fee of $1000 on the probability of choosing the six work-school options in phase 1 varies over the level of tuition for different education groups. Phase 1 covers the time period from six years before childbirth till before childbirth. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$. Only those choices that have statistically significant marginal effects are plotted.



(a) Less than High School

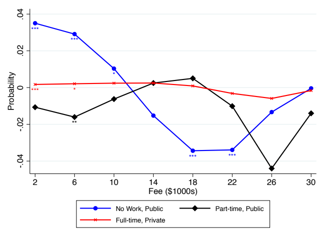


(b) High School

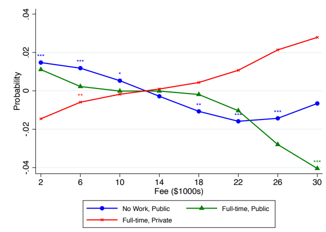


(c) College and Above

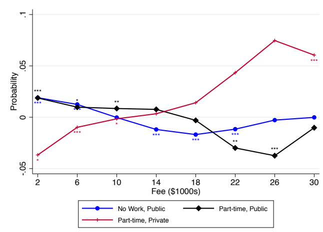
Figure D3: Marginal Effect of Private School Fee by Education (Phase 2). The Figure plots how the marginal effects of an increase in private school fee of $1000 on the probability of choosing the six work-school options in phase 2 varies over the level of tuition for different education groups. Phase 2 spans the period starting from the birth of the child till the child is five years of age. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$. Only those choices that have statistically significant marginal effects are plotted.



(a) Less than High School



(b) High School

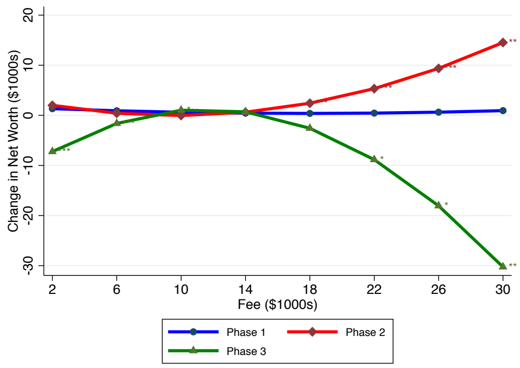


(c) College and Above

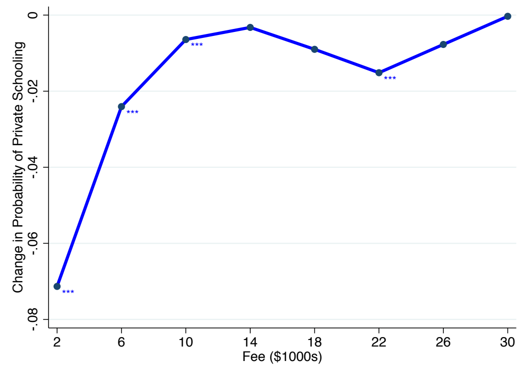
Figure D4: Marginal Effect of Private School Fee by Education (Phase 3). The Figure plots how the marginal effects of an increase in private school fee of \$1000 on the probability of choosing the six work-school options in phase 3 varies over the level of tuition for different education groups. Phase 3 covers the periods after the child starts primary school till age 18. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$. Only those choices that have statistically significant marginal effects are plotted.

Figure D5 (a) shows the marginal effect of private school fee increase on assets for different values of fee. In phase 1, an increase in private school fee has no significant effect on assets. However, in phase 2, an increase in private school fee leads to an increase in assets, particularly at the higher end of the fee distribution, while in phase 3 an increase in private school cost at all levels of fee leads to a decrease in mother's assets. This is reasonable as parents are expected to dip into their savings to fund high cost schooling, leading to a depletion in assets. Figure D5 (b) plots the marginal effect for the private school choice probit. For all levels of fee, an increase in private school fee leads to a decrease in the probability of sending the child to private school, however, the change in this probability increases and school fee increases. In particular, the probability of sending the child to private school decreases by about 7% for an increase in private school fee of \$1000 if the fee is \$2000. However, if the school fee is at the higher end of the distribution, then an increase in fee of \$1000 leads to an approximately 2% decline in the probability of choosing private schooling for the child.[50]

[50] Regression results of all 7 equations, including the wage equation, are available upon request.



(a) Net Worth



(b) Probability of Private Schooling

Figure D5: Marginal Effect of Private School Fee for Net Worth and Private Schooling. Figure D5 (a) plots how the marginal effects of an increase in private school fee of $1000 on the average net worth varies over the level of tuition for the three phases, while Figure D5 (b) plots the marginal effects of an increase in private school fee of $1000 on the probability of choosing private schooling for the child in phase 3. Phase 1 covers the time period from six years before childbirth till before childbirth, phase 2 spans the period starting from the birth of the child till the child is five years of age and phase 3 covers the periods after the child starts primary school till age 18. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$

Online Appendix for:
"Paying for Private School Education: Maternal Employment and Savings over the Life-cycle"

Appendices

OA Auxilliary Descriptive Analysis

I report additional descriptive statistics and regression results of the impact of private schooling decision on annual hours worked, probability of being employed and the probability of having savings. For the labor market results, I report the marginal effects of choosing private school for different sub-populations by stratifying on education and non-labor income quantiles.

OA.1 Descriptive Statistics

Table OA1: School Enrollment by Education and Household Income

(a) Mother's Education

	HSD	HS	College	> College
Public	94.3	85.3	77.5	54.9
Private	5.7	14.7	22.5	45.1

(b) Household Income

	Quantile 1	Quantile 2	Quantile 3	Quantile 4
Public	88.9	82.9	77.4	62.6
Private	11.1	17.1	22.6	37.4

Table OA1 shows that among the more educated mothers, a higher proportion send their child to private schools and that private school enrollment is higher among households with higher family income.[51] I also find the proportion of people who are sending their children to a private school in each county. In my NLSY79 sample, the counties with highest private school enrollment are Alexandria City, Virginia; Baltimore, Maryland; Hamilton,

[51] In the sample, non-labor income is distributed as follows: Quantile 1: $\leq$ \$6,207, Quantile 2: Between \$6,208 and \$21,384, Quantile 3: Between 21,385 and \$36,731, and Quantile 4: Between \$36,732 and \$1,167,736.

Indiana; Hamilton, Ohio and St. Joseph, Indiana.[52]

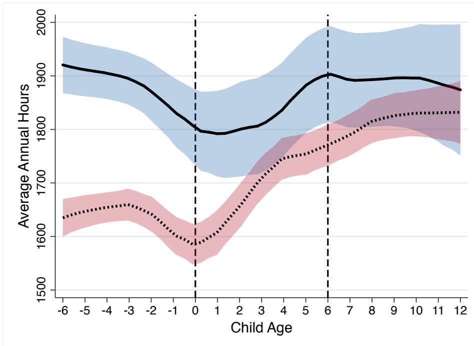
OA.2 Auxiliary Regressions

To capture the dynamics of maternal labor supply, I interact private school choice with six different periods of the female's life-cycle: (1) 4-6 years before the child is born, (2) 1-3 years before the child is born, (3) 0-2 years after childbirth, (4) 3-5 years after childbirth, (5) 6-8 years after childbirth, and (6) 9-11 years after childbirth. Table OA2 presents the results of the average marginal effect of choosing private schooling over different periods of the mother's life-cycle. The results mirror the patterns observed in the graphical analysis. Even after controlling for mother's education, non-labor income, and state fixed effects, I find that private school mothers are working significantly more before the child is born, and significantly less than public school mothers after childbirth.

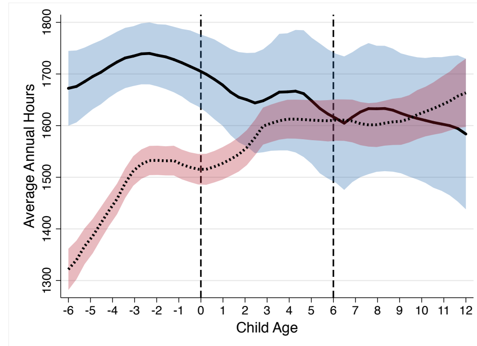
Table OA3 presents marginal effects of private schooling at the extensive margin. On average, the probability of being employed 4-6 years before birth is 5% higher for private school mothers, while after the child starts school, private school mothers are 9.3% less likely to be working. In Table OA4 and Table **??**, I present results for the marginal effect of choosing private schooling on the probability of having savings and asset holdings of females. After controlling for demographic, education and geographic controls that may affect the assets that households accumulate, I find that the probability of having savings 4-6 years before child's birth is 8.1% higher for private school mothers, and is 3.8% higher just before the child is about to start private schooling. I also find that asset holding of private school mothers is higher after the first two years of child's birth.

Finally, in Table OA5, I show how the labor supply and savings response of women belonging to different education and non-labor income sub-groups. The first column shows that for all values of non-labor income, private school mothers with lower education levels work more hours annually when the child is 3-8 years of age and work less after the child is 3 years of age as their education level rises. This is consistent with the graphical evidence presented earlier, which showed that private school mothers with less than a high school degree were working more hours that public school mothers, but more educated mothers were spending more time with their children after 3 years of age. Columns 2 and 3 show that higher educated private school mothers at all levels of non-labor income do hold more assets just before the child is about to start school.

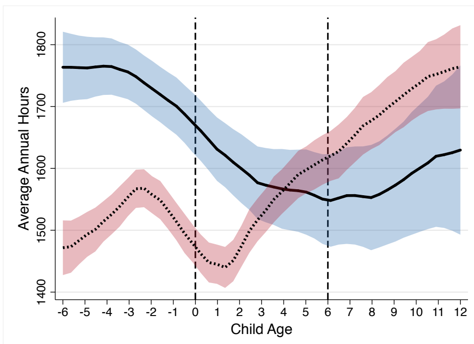
[52]Note that in order to calculate the proportion of children going to private school in each county, I exclude counties where less than 50 people are residing in my sample. I am also aggregating individuals over all years.



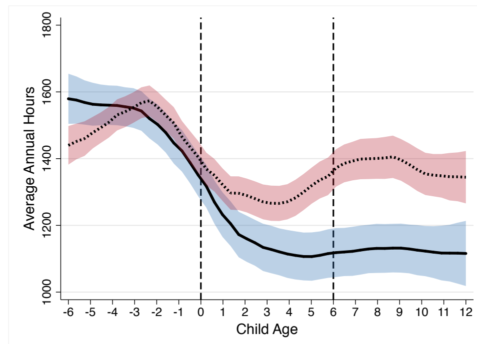
(a) Quantile 1



(b) Quantile 2



(c) Quantile 3



(d) Quantile 4

Figure OA1: Annual Hours Worked - Income Quantiles. The Figure plots average annual hours worked by private and public school mothers for non-labor income groups, where non-labor income is defined as family income minus the woman's wage income. The x-axis is child's age, with negative ages denoting years before childbirth.

Table OA2: Hours over the Life-cycle: Marginal Effects

	(1)	(2)	(3)	(4)
4-6 Years Before Birth × Private	286.7***	300.1***	201.9***	208.3***
	(23.98)	(42.20)	(47.44)	(47.12)
1-3 Years Before Birth × Private	142.4***	126.5***	92.94***	86.19**
	(26.34)	(32.33)	(35.06)	(34.62)
Child Age 0-2 × Private	53.52*	84.56***	41.52	45.02
	(28.49)	(27.42)	(31.00)	(30.46)
Child Age 3-5 × Private	-112.3***	-59.91**	-91.12***	-90.66***
	(31.66)	(30.36)	(35.13)	(34.52)
Child Age 6-8 × Private	-148.1***	-94.57***	-147.3***	-153.4***
	(35.75)	(34.24)	(36.97)	(36.60)
Child Age 9-11 × Private	-208.7***	-153.5***	-178.0***	-177.7***
	(39.37)	(37.71)	(40.70)	(40.09)
Demographic Controls	N	Y	Y	Y
Education Controls	N	N	Y	Y
Non-labor Income Controls	N	N	Y	Y
State Fixed Effects	N	N	N	Y
Obs.	59712	50091	32610	32409

Notes: *, **, *** denote p-value < 0.10, 0.05, and 0.01, respectively. Standard errors are given in parentheses. The table reports the average effect of choosing private school on mother's annual hours over different periods of the mother's life-cycle. Demographic controls include dummies for respondent's age at first birth, race and marital status, and controls for respondent's religion and number of children.

Table OA3: Employment over the Life-cycle: Marginal Effects

	(1)	(2)	(3)	(4)
4-6 Years Before Birth × Private	0.08***	0.13***	0.05***	0.05***
	(0.02)	(0.02)	(0.01)	(0.01)
1-3 Years Before Birth × Private	0.04***	0.04***	0.01	0.01
	(0.01)	(0.02)	(0.01)	(0.01)
Child Age 0-2 × Private	0.03*	0.03**	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Child Age 3-5 × Private	-0.04**	-0.03*	-0.04***	-0.04***
	(0.02)	(0.02)	(0.01)	(0.01)
Child Age 6-8 × Private	-0.08***	-0.07***	-0.10***	-0.09***
	(0.02)	(0.02)	(0.01)	(0.01)
Child Age 9-11 × Private	-0.07***	-0.06***	-0.08***	-0.06***
	(0.02)	(0.02)	(0.01)	(0.01)
Demographic Controls	N	Y	Y	Y
Education Controls	N	N	Y	Y
Non-labor Income Controls	N	N	Y	Y
State Fixed Effects	N	N	N	Y
Obs.	59712	50091	32610	32394

Notes: *, **, *** denote p-value < 0.10, 0.05, and 0.01, respectively. Standard errors are given in parentheses. The table reports the average effect of choosing private school on employment decision over different periods of the mother's life-cycle. The dependent variable is a dummy for whether the female was employed during the last year. If the female reports working for 6 weeks or less in the past calendar year, I code her as being unemployed. Demographic controls include dummies for respondent's age at first birth, race and marital status, and controls for respondent's religion and number of children.

Table OA4: Probability of Having Savings over the Life-cycle: Marginal Effects

	(1)	(2)	(3)	(4)
4-6 Years Before Birth × Private	0.16***	0.14***	0.09***	0.08***
	(0.01)	(0.02)	(0.03)	(0.03)
1-3 Years Before Birth × Private	0.18***	0.11***	0.04*	0.03
	(0.01)	(0.01)	(0.02)	(0.02)
Child Age 0-2 × Private	0.19***	0.10***	0.02	0.02
	(0.01)	(0.01)	(0.02)	(0.02)
Child Age 3-5 × Private	0.18***	0.09***	0.04**	0.04**
	(0.01)	(0.01)	(0.02)	(0.02)
Child Age 6-8 × Private	0.15***	0.05***	0.00	-0.00
	(0.01)	(0.02)	(0.02)	(0.02)
Child Age 9-11 × Private	0.15***	0.06***	0.02	0.02
	(0.01)	(0.02)	(0.02)	(0.02)
Demographic Controls	N	Y	Y	Y
Education Controls	N	N	Y	Y
Non-labor Income Controls	N	N	Y	Y
State Fixed Effects	N	N	N	Y
Obs.	46169	39002	24437	24210

Notes: *, **, *** denote p-value < 0.10, 0.05, and 0.01, respectively. Standard errors are given in parentheses. The table reports the average effect of choosing private school on the probability of having savings over different periods of the mother's life-cycle. Demographic controls include dummies for respondent's age at first birth, race and marital status, and controls for respondent's religion and number of children.

Table OA5: Labor Supply and Savings Response over Child's Life-cycle

	Annual Hours	Real Assets	Have Savings	Employed
4-6 Years Before Birth × Private × Educ × Non-Labor Inc	-0.254	-0.011*	0.004	0.004
	(0.415)	(0.006)	(0.003)	(0.003)
1-3 Years Before Birth × Private × Educ × Non-Labor Inc	-0.0348	0.015	0.002	0.002*
	(0.204)	(0.009)	(0.002)	(0.001)
Child Age 0-2 Years × Private × Educ × Non-Labor Inc	-0.226	0.019*	0.002	0.001*
	(0.171)	(0.010)	(0.002)	(0.000)
Child Age 3-5 Years × Private × Educ × Non-Labor Inc	-0.755***	0.052*	-0.001	-0.001
	(0.247)	(0.027)	(0.001)	(0.001)
Child Age 6-8 Years × Private × Educ × Non-Labor Inc	-0.782**	-0.040	0.002	-0.003***
	(0.363)	(0.039)	(0.002)	(0.001)
Child Age 9-11 Years × Private × Educ × Non-Labor Inc	-0.052	-0.007	-0.001	-0.000
	(0.744)	(0.026)	(0.002)	(0.001)
4-6 Years Before Birth	-565.2***	0.775	-0.310***	-0.070
	(27.68)	(0.915)	(0.076)	(0.072)
1-3 Years Before Birth	-408.0***	1.047	-0.353***	0.320***
	(21.46)	(0.849)	(0.076)	(0.058)
Child Age 0-2 Years	-414.3***	0.973	-0.372***	0.262***
	(19.31)	(0.875)	(0.085)	(0.046)
Child Age 3-5 Years	-280.9***	1.804*	-0.125**	0.384***
	(19.90)	(0.990)	(0.063)	(0.048)
Child Age 6-8 Years	-190.6***	0.192	-0.106*	0.324***
	(21.04)	(1.502)	(0.063)	(0.053)
Child Age 9-11 Years	-95.32***	1.099	-0.114	0.234***
	(31.15)	(1.157)	(0.070)	(0.055)
Years of Schooling	43.32***	-0.157	0.131***	0.088***
	(3.110)	(0.125)	(0.010)	(0.008)
Non-labor Income	-7.994	-0.528	0.084*	-0.006
	(5.003)	(0.349)	(0.049)	(0.010)
Years of Schooling × Non-Labor Inc	-2.642***	0.128***	-0.003	-0.004***
	(0.355)	(0.033)	(0.004)	(0.001)
Educ × Non-Labor Inc × 4-6 Years Before Birth	3.371***	-0.080***	-0.001	0.004***
	(0.270)	(0.020)	(0.002)	(0.001)
Educ × Non-Labor Inc × 1-3 Years Before Birth	3.155***	-0.096***	0.001	0.004***
	(0.216)	(0.021)	(0.002)	(0.000)
Educ × Non-Labor Inc × Child Age 0-2 Years	3.088***	-0.094***	0.003	0.004***
	(0.193)	(0.021)	(0.003)	(0.000)
Educ × Non-Labor Inc × Child Age 3-5 Years	3.003***	-0.091***	-0.001	0.004***
	(0.220)	(0.020)	(0.002)	(0.001)
Educ × Non-Labor Inc × Child Age 6-8 Years	2.789***	-0.018	-0.001	0.005***
	(0.256)	(0.044)	(0.002)	(0.001)
Educ × Non-Labor Inc × Child Age 9-11 Years	1.040	-0.035	0.000	0.001
	(0.660)	(0.032)	(0.002)	(0.001)
Private School	-42.30***	0.706	0.129***	-0.194***
	(16.37)	(0.594)	(0.048)	(0.036)
Demographic Controls	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y
Obs.	32334	18165	24158	32319

Notes: *, **, *** denote p-value < 0.10, 0.05, and 0.01, respectively. Standard errors are given in parentheses. The table reports the average effect of choosing private school over different periods of the mother's life-cycle for different education and non-labor income groups. Education is measured in years of schooling and non-labor income has been divided by 1000. The dependent variables are annual hours worked, real assets, a dummy for whether the household has savings in a checking, savings or money market account, and a dummy for whether the respondent is employed. Demographic controls include dummies for respondent's age at first birth, race and marital status, and controls for respondent's religion and number of children.

OB Transition Probabilities and State Space

OB.1 Number of Children

Fertility is treated as an exogenous process in the model, with one child entering deterministically in period 6. The other children in the household can enter the household at any time, and the transition in the number of children is modeled to match the dynamics in the data. To limit the size of the state space I cap the total number of children a woman can have to 2 (including the child that enters deterministically). The transition in the number of other children is specified as follows:

$$P(n^k_{it+1} = 1 | n^k_{it} = 0) = \frac{\exp(\delta^n_0 + \delta^n_1 age_{it} + \delta^n_2 \text{race} + \delta^n_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^n_4 m_{it})}{1 + \exp(\delta^n_0 + \delta^n_1 age_{it} + \delta^n_2 \text{race} + \delta^n_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^n_4 m_{it})}, \tag{54}$$

where the probability of having a child in the next period is a function of the woman's age, marital status, education and race.

OB.2 Marriage and Divorce

The probability of marriage in each period is a function of the woman's demographics $\tilde{X}_{it}$ which includes the woman's age, race, education and child's age and is defined as:

$$P(m_{it} = 1 | m_{it-1} = 0) = \frac{\exp(\delta^m_0 + \delta^m_1 (age_{it}) + \delta^m_2 \text{race} + \delta^m_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^m_4 \mathbf{1}\{a_t > 6\})}{1 + \exp(\delta^m_0 + \delta^m_1 (age_{it}) + \delta^m_2 \text{race} + \delta^m_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^m_4 \mathbf{1}\{a_t > 6\})}, \tag{55}$$

Conditional on being married, the probability of divorce is given by:

$$P(m_{it} = 0 | m_{it-1} = 1) = \frac{\exp(\delta^d_0 + \delta^d_1 (age_{it}) + \delta^d_2 \text{race} + \delta^d_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^d_4 \mathbf{1}\{a_t > 6\})}{1 + \exp(\delta^d_0 + \delta^d_1 (age_{it}) + \delta^d_2 \text{race} + \delta^d_3 \sum_{e=2}^{3} \mathbf{1}\{\text{educ} = e\} + \delta^d_4 \mathbf{1}\{a_t > 6\})}. \tag{56}$$

Table OB1: State Space

Variable	Description	Phase 1	Phase 2	Phase 3
(a) Time-invariant				
$educ_i$	Female's education level	✓	✓	✓
$race_i$	Female's race	✓	✓	✓
μ_i	Female's unobserved type	✓	✓	✓
(b) Time-varying				
A_{it}	Asset stock available at start of period t	✓	✓	✓
H_{it}	Stock of human capital at start of period t	✓	✓	✓
k_{it}	Child's cognitive ability in period t	✗	✓	✓
m_{it}	Marital status	✓	✓	✓
n_{it}^k	No. of children	✓	✓	✓
y_{it}	Husband's income	✓	✓	✓
a_{it}^k	Child's age	✗	✓	✓
p_{it}	Private school fee	✗	✗	✓
Ψ	Vector of iid shocks to preferences	✓	✓	✓
ξ_{it}	Idiosyncratic shock to female's wage	✓	✓	✓
ξ_{it}^f	Idiosyncratic shock to husband's earnings process	✓	✓	✓
η_{it}	Idiosyncratic shock to child ability	✓	✓	✓

Notes: The table lists all state space variables and their description. The checkmarks indicate the phases in which the variable is part of the state space.

OC Estimation Appendix

This section presents additional results from the structural estimation. Section OC.1 presents the algorithm employed for the Bayesian estimation. Next, I show additional results for goodness of fit.

OC.1 Solution Method for Structural Estimation

This section describes the Markov Chain Monto Carlo estimation procedure introduced in Chernozhukov and Hong (2003). The procedure transforms the Method of Simulated Moments objective function $\mathcal{G}(\Theta) = (M_N - M_S(\Theta))' W_N (M_N - M_S(\Theta))$ into a proper density over Θ,

$$\Pi(\Theta) = \frac{e^{\mathcal{G}(\Theta)}\pi(\Theta)}{\int e^{\mathcal{G}(\Theta)}\pi(\Theta)d\Theta}. \tag{57}$$

$\Pi(\Theta)$ is called a quasi-posterior since it uses the statistical distance criterion instead of the conditional density used in standard Bayesian approaches (Imai, Jain, and Ching, 2009; Norets, 2009). $\pi(\Theta)$ is a prior. Using the Metropolis-Hastings algorithm we can create chains $\left(\Theta^{(0)}, \ldots, \Theta^{(B)}\right)$ which converge in distribution to the quasi-posterior $\Pi(\Theta)$. In practice, I use a uniform prior $\pi(\Theta)$ and draw a candidate parameter vector from the proposal density $\Theta^{(s)*} \sim q(\Theta^{(s)*}|\Theta^{(s)})$, where $\Theta^{(s)}$ is the parameter at the s^{th} iteration, and q is assumed to follow the Gaussian distribution centered at $\Theta^{(s)}$. Now, form the acceptance probability

$$P = \min\{e^{\mathcal{G}(\Theta^{(s^*)}) - \mathcal{G}(\Theta^{(s)})}, 1\}. \tag{58}$$

We then accept $\Theta^{(s)*}$ with probability P, i.e.

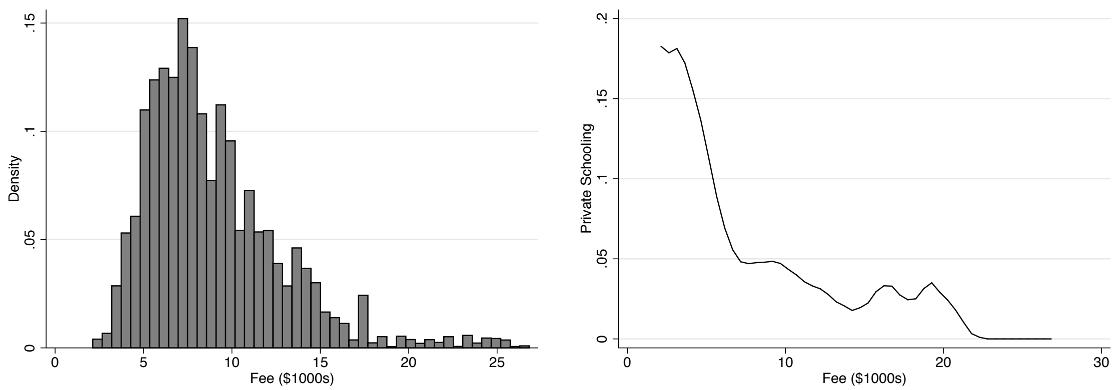
$$\Theta^{(s+1)} = \begin{cases} \Theta^{(s)*} & \text{with probability} \quad P \\ \Theta^{(s)} & \text{with probability} \quad 1 - P. \end{cases}$$

Chernozhukov and Hong (2003) show that a consistent estimator of Θ can be obtained as the simple mean of $\Pi(\Theta)$. In total, I simulate c= 10 chains of length B = 10000, where the first 2000 "burn-in" iterations are not used for averaging. Thus,

$$\hat{\Theta} = \frac{1}{8 * 10^4} \sum_{c=1}^{10} \sum_{k=1}^{8000} \Theta_c^{(k)}. \tag{59}$$

OC.2 Identification - IV

I present distribution plots showing the cross-section variation in private school fee that is used as an instrument for private schooling in the model. I also show the relationship between the instrument and private school choice.



(a) Private School Fee Distribution

(b) Private School Enrollment and Private School Fee

Figure OC1: DISTRIBUTION PLOTS. Figure OC1(a) plots the distribution of state-level private school tuition averages in the sample. Figure OC1 (b) plots the relationship between the probability of sending child to private school fee and private school tuition.

OC.3 Results

Table OC1 (a) reports logit coefficients used to calculate the transition probability for having a child in the next period. Estimates show that the probability of having a child goes down as a woman's age increases. However, compared with women who are high school dropouts, women belonging to higher education groups are more likely to have a child. Blacks and married women are also more likely to have child in the next period. Table OC1 (b) reports the logit coefficients for calculating the probability of entering into marriage conditional on being unmarried in the last period. Estimates show that the probability of marriage increases with education, but goes down with age and is also lower for blacks as compared to white and hispanic women. The probability of being married is also lower for women who have a child greater than six years of age. Finally, Table OC1 (c) shows that the probability of transitioning out of marriage increases with age, is higher for blacks, and goes down as education of the mother increases, and is higher if the woman has a child greater than six years of age.

Table OC1: First Step Estimates

Parameter	Variable	Estimate	Std. Error
(a) Number of Children Transition			
δ_0^n	Constant	-0.77***	0.07
δ_1^n	Age	-0.09***	0.00
δ_2^n	Black	0.18***	0.03
δ_{32}^n	High School	0.15***	0.04
δ_{33}^n	College	0.20***	0.04
δ_{34}^n	More than College	0.21***	0.05
δ_4^n	Married	1.51***	0.03
(b) Marriage Probabilities			
δ_0^m	Constant	-1.32***	0.09
δ_1^m	Age	-0.05***	0.00
δ_2^m	Black	-0.01	0.04
δ_{32}^m	High School	0.10***	0.05
δ_{33}^m	College	0.09**	0.05
δ_{34}^m	More than College	0.04	0.05
δ_4^m	Child > 6	-0.11**	0.06
(c) Divorce Probabilities			
δ_0^d	Constant	-3.92***	0.12
δ_1^d	Age	0.02***	0.00
δ_2^d	Black	0.19***	0.05
δ_{32}^d	High School	-0.28***	0.06
δ_{33}^d	College	-0.45***	0.06
δ_{34}^d	More than College	-1.06***	0.08
δ_4^d	Child > 6	1.12*	0.07

Notes: The table reports the logit estimates from the first step of the estimation, in which the exogenous transition probabilities of marriage, divorce and number of children is calculated using data from NLSY79. * $p < 0.10$,** $p < 0.05$, ***$p < 0.01$. Standard Errors in parentheses.

Table OC2 presents additional model fit results. Tables OC3 and OC4 show full results for the counterfactuals with drop in private school fee and relaxing liquidity constraints.

Table OC2: Model Fit

Child Age	Pvt School	Pvt/Pub $\ln k$	Exper Avg	Exper Pub	Exper Pvt
		Data			
-6			8.18	8.10	8.93
-5			8.63	8.47	9.12
-4			8.84	8.70	9.27
-3			9.01	8.88	9.40
-2			9.13	9.04	9.47
-1			9.27	9.18	9.58
0			9.36	9.29	9.62
1			9.43	9.36	9.69
2			9.47	9.42	9.72
3		1.09	9.54	9.49	9.76
4		1.11	9.58	9.52	9.81
5	0.17	1.13	9.64	9.59	9.85
6	0.18	1.12	9.69	9.64	9.90
7	0.17	1.01	9.76	9.71	9.94
8	0.20	1.00	9.79	9.74	9.98
9	0.19	1.01	9.85	9.81	10.0
10	0.22	1.03	9.88	9.83	10.1
11	0.20	1.08	9.92	9.88	10.1
12	0.23	1.10	9.95	9.91	10.1
13	0.21	1.06	9.98	9.95	10.1
14	0.23	1.08	10.0	9.98	10.2
15	0.21		10.0	10.0	10.1
16	0.21		10.1	10.0	10.2
17	0.19		10.1	10.1	10.2
18	0.18		10.1	10.1	10.2
		Model Simulation			
-6			8.18	8.14	8.40
-5			8.24	8.68	8.71
-4			8.69	8.92	8.92
-3			8.96	9.11	9.10
-2			9.15	9.27	9.25
-1			9.31	9.40	9,37
0			9.43	9.52	9.47
1			9.51	9.59	9.55
2			9.58	9.65	9.62
3		1.16	9.63	9.71	9.67
4		1.19	9.68	9.76	9.72
5	0.25	1.14	9.73	9.81	9.76
6	0.31	1.21	9.80	9.88	9.81
7	0.21	1.19	9.86	9.94	9.85
8	0.29	1.20	9.92	10.0	9.90
9	0.25	1.20	9.98	10.1	9.94
10	0.28	1.19	10.0	10.1	9.98
11	0.29	1.19	10.1	10.2	10.0
12	0.28	1.19	10.1	10.2	10.0
13	0.27	1.08	10.2	10.3	10.1
14	0.27	1.37	10.2	10.3	10.1
15	0.27		10.3	10.3	10.1
16	0.25		10.3	10.4	10.2
17	0.26		10.3	10.4	10.2
18	0.22		10.4	10.4	10.3

Notes: The table reports goodness of fit for the method of moment estimation.

Table OC3: Impact of Drop in Private School Fee

(a) 25% Decrease

	Full Sample			New Entrants			Incumbents		
	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ
Private School	0.27	0.29	+7.41						
Log Ability	11.4	11.4	+0.00	9.13	9.55	+4.60	13.0	13.0	+0.00
Hours with Child	763.1	760.1	-0.04	1384	1444	+4.34	1427	1427	+0.03
Hours Worked (cond. on working)	1201	1204	+0.25	1559	1665	+6.80	1545	1543	-0.01
Terminal Assets	97.3	96.5	-0.83	53.4	53.2	-0.40	33.2	32.8	-1.20
Mean Wages	12.2	12.2	0.01	11.2	11.2	+0.04	12.42	12.41	-0.01

(b) 75% Decrease

	Full Sample			New Entrants			Incumbents		
	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ	Baseline	Subsidy	%Δ
Private School	0.27	0.41	+51.9						
Log Ability	11.4	11.6	+1.75	9.97	12.0	+20.4	13.0	13.0	+0.00
Hours with Child	763.1	777.2	+1.85	1167	1153	-1.20	1427	1428	+0.08
Hours Worked (cond. on working)	1201	1190	-0.92	1535	1396	-9.06	1544	1542	-0.01
Terminal Assets	97.3	92.3	-5.14	106.1	93.3	-12.1	33.2	31.3	-5.72
Mean Wages	12.2	12.2	-0.01	12.1	12.0	-0.02	12.42	12.41	-0.01

Notes: The table reports changes in life-cycle outcomes under counterfactual scenarios with universal subsidies. Panel (a) reports results for the experiment in which everyone gets a 25% subsidy. Panel (b) reports results for the experiment in which everyone gets a 75% subsidy. Baseline results are averages with estimated parameters and observed private school fee in the data. Results for log ability, assets and mean wages are calculated for period 25 (terminal period). Terminal Assets are in $1000s. Results for private schooling, hours with child and hours worked are calculated by averaging over phase 3.

Table OC4: Relaxing Liquidity Constraints

	HS Dropouts			HS Graduates			Some College or More		
	Baseline	Transfer	%Δ	Baseline	Transfer	%Δ	Baseline	Transfer	%Δ
Private School	0.28	0.55	+96.4	0.28	0.52	+82.0	0.26	0.42	+61.5
Hours with Child	1449	1423	-1.79	1409	1372	-2.63	1287	1303	+1.24
Hours Worked (cond. on working)	1632	1505	-7.78	1666	1488	-10.7	1507	1419	-5.84
Terminal Assets	65.5	261.1	+299	72.3	274.2	+279	126.0	360.5	+186

Notes: The table reports changes in life-cycle outcomes under the counterfactual experiment in which everyone is given a lump sum transfer of $12,000 every year starting when the child is of school-going age. Baseline results are averages with estimated parameters and observed private school fee in the data. Results for private schooling, hours with child and hours worked are calculated by averaging over all time periods.