The Effect of Social Fathers on the Cognitive Skills of Out-of-Wedlock Children

Chan, Kwok Ho and Fung, Ka Wai Terence

United Interntional College - Beijing Normal University and Hong Kong Baptist University, United Interntional College - Beijing Normal University and Hong Kong Baptist University

May 2013

The Effect of Social Fathers on the Cognitive Skills of Out-of-Wedlock Children

Kwok Ho Chan[+]
and
Ka Wai Terence Fung[++]

Abstract

There are two competing views regarding the presence of social fathers on childrens' cognitive ability: either the social father provides more financial need to the children or the mother with new partners may shift the focus away from the children. Previous research focused more on such effect on older children or adolescents and ignored the self-selection problem. We use data from the Fragile Families and Child Wellbeing Study (FFCWS), and a sample of younger children. Assuming that self-selection is based on observables and using ordinary least square, propensity score matching method (nonparametric methods), we find that children with social fathers scored around three points less in a cognitive ability test than children living only with biological mothers. The result remains the same when using a control-function analysis (parametric method).

JEL Codes: J12; J13
Keywords: Child Welfare; Family Structure; Fragile Families; Non-Marital Childbearing

[+] Corresponding author. Division of Business and Management, United International College- Beijing Normal University. Hong Kong Baptist University, Zhuhai, China
kwokho1419@gmail.com
(852)56461419
[++] Division of Business and Management, United International College- Beijing Normal University. Hong Kong Baptist University, Zhuhai, China
econfkw@hotmail.com

We are especially grateful to Donald Cox, Arthur Lewbel and Zhijie Xiao for their valuable advice. We would also like to thank Wei Sun for helpful comments. All errors are ours.

1 Introduction

Delays and declines in marriages raise the number of women who may be more likely to have non-marital births (Carlson *et al.* 2004). The proportion of children born to unmarried parents has increased considerably in the past forty years. In 1970, only 12 percent of newborns occurred outside marriage (Sigle-Rushton and McLanahan 2002). In 2010, the figure increased to about 40 percent (Hamilton *et al.* 2011)[1]. Around 4.2 million children under age 18 in the United States were living with biological mother and a social father, as showed by data from the 2004 Survey of Income and Program Participation (Sweeney 2010). Non-marital births are usually associated with socioeconomic disadvantages and family instability. This raises the interest of researchers to study non-marital births and other related issues.

Meanwhile, the increasing out-of-wedlock childbearing contributes to the prevalence of social fathers - defined as either the mother marrying to a new partner or the mother cohabiting with a new partner. Estimation in the 90's showed that a quarter of children would live with a stepparent at some point during childhood (Bumpass *et al.* 1995)[2]. The reason behind that trend is that children born to unmarried parents have a higher chance to experience the union dissolution of the biological parents. The parents are more likely to form romantic relationship with new partners. Many single mothers choose to cohabit with new partner or remarry (Osborne and McLanahan 2007). Children would have to live with mothers' new partners following their mothers' decisions.

How the presence of social fathers affects the unrelated children, especially the young children, is not thoroughly studied. Coleman et al. (2000) demonstrate that the presence of social fathers has some degree of negative effect on the biological children of their partners. Children and adolescents living with a social father and the biological mother are more likely to demonstrate inferior outcome compared to those living with two biological parents (Brown 2004; Hofferth 2006; Manning and Lamb 2003; Thomson *et al.* 1994), although these results may due to the benefit of having both biological parents in the family. The main objective of this study is to examine the impact of the presence of social fathers on the cognitive ability of young out-of-wedlock children.

The present study is different from the current literature in several aspects. The aforementioned research focused more on how social fathers affect older children and adolescents. By focusing on older children or adolescents, those studies failed to separate the impact of family structure from the impact of family instability. Most of the older children and adolescents may have gone through divorce and remarriage of the biological parents. For children born to unmarried parents, the presence of social fathers may occur very early in the children's life. It is less common for those children to experience the divorce of biological parents. According to Bzostek (2008), younger children may show less resistance towards social fathers because they may not be mature enough to understand the difference between biological fathers and social fathers. In contrast, older children and adolescents are mature enough to know the difference. They may show larger resistance towards the existence of social fathers. Because of the different degree of resistance, younger children and older children should show quite different responses to the existence of social fathers. It would be interesting to examine whether social

[1] The rate of non-marital births seemed to have stabilized from 2007 to 2010 at around 40 percent

[2] The percentage is very likely to be higher because of larger number of non-marital birth at present

fathers have any beneficial or detrimental effect on the well-being of younger children.

This study examines questions about the impact of social father presence on children's wellbeing: (1) Is the existence of social fathers beneficial to the children because children fare better if a mother and non-biological father dwell together? (2) Is the presence of social fathers associated with lower cognitive ability because the mothers will be distracted and eventually reducing parenting quality? We address these questions using data from the Fragile Families and Child Wellbeing Study (FFCWS). Cognitive ability is measured using the score from the Peabody Picture Vocabulary Test (PPVT) (Dunn and Dunn, 1997). The PPVT score is widely used to measure verbal ability and receptive hearing in children and adults. It is a very good assessment of children's language development. In order to identify the effect of social father on the children, We compare out-of-wedlock children in family with biological mother and social father to out-of-wedlock children in family only with biological mother.

This study also addresses the self-selection issue. Children are not randomly assigned to have social fathers. It is more likely to be the case of a self-selection of the mothers. The presence of social fathers may be correlated with the characteristics of the mothers, such as education, employment status, and income level. The outcome differences between children with social fathers and children without social fathers may be caused by those characteristics of the mothers regardless of the presence of social fathers. Simple comparison of the well-being of these two groups of children may lead to biased results. To address the selection issue, we use the propensity score matching (nonparametric)[3] to estimate the effect of social fathers on children's well-being. This method estimates the average treatment effect by constructing a setting similar to an experiment in which the treatment (the presence of social fathers in this study) is randomly assigned.

It is imperative to investigate how the presence of social fathers affects early cognitive development because the number of young children growing up in this family setting is increasing over time. Using a selected sample from FFCWS and the propensity score matching method, we found that the presence of social fathers have a negative effect on children's cognitive ability. Children aged three living in families with social fathers score around three points lower on the PPVT than those living only with their biological mothers. The results may only reflect part of the problems faced by children with social fathers. Due to the widespread of non-martial births, social fathers would still be very common in the future. The possible negative effect caused by social fathers will probably affect a large portion of child population.

2 Literature Review

Why are researchers interested in children's cognitive ability? Successful transition to formal schooling sets the stage for subsequent development and achievement. Moreover, there is evidence that cognitive ability is a strong predicting factor of future socio-economic outcomes. Schmidt et al. (1986) used path analysis to examine the impact of cognitive ability on job knowledge, performance capability as measured by job sample tests, and supervisory ratings of job performance. Cognitive ability significantly

[3] See Rosenbaum and Rubin (1983); Heckman, Ichimura and Todd (1998); Imbens (2004) for details of propensity score matching method.

increased job knowledge acquisition and (indirectly) the effect of ability on job sample performance holding job experience constant. This relationship was found to be stable over time. Yoshikawa (1995) is an extensive review of literature from criminology, psychology and education. The author examined childhood programs aiming to improve the cognitive and social skills of children in the U.S.A. He found evidence that early childhood programs were more cost-effective and efficient in ameliorating and preventing later antisocial and delinquent behavior. Lee and Burkam (2002) showed that there was substantial difference in children's initial cognitive ability when entering kindergarten. Using data of the U.S. Department of Education's Early Childhood Longitudinal Study, Kindergarten Cohort, they find that children with low cognitive skills begin in systematically lower-quality elementary schools than their more advantaged counterparts.

Cawley et al. (2001) analyzed the relationship between wages and measured cognitive ability. Wage variance across race and gender can be explained by difference in cognitive ability using U.S data. They found that personaltiy traits were strongly correlated to future earnings. Researchers also found significant correlation between PPVT score and scores from other achievement test and intelligence test[4] which eventually would affect future socio-economic outcomes and wage earnings. The effect of weak cognitive abilities on different outcomes has been proved persistent across the life course. Carneiro et al. (2007) used the National Child Development Study (NCDS) - a panel data for all U.K. children born at the same time (a single week in March 1958) - to esimate the impact of cognitive and social skills on various socio-economic outcomes. The authors contended that child cognitive ability depended strongly on family characterisitics and home learning environment, which were likely to be genetic factors. They found that children with better cognitive skills were more likely to achieve higher education degree, remain employed at age 42 and less likely to be heavy smokers.

Before the Fragile Families and Child Wellbeing Study (FFCWS) data were released, research on stepparents mostly focused on children who experienced the divorce of biological parents and the remarriage of the parents who lived with them. The availability of the FFCWS boosted a new wave of research on non-marital births. In the past, the lack of data similar to the FFCWS has limited the research on the well-being of children born to unmarried parents. The FFCWS contains detailed information on the developmental and health outcomes of the children. Research on the well-being of out-of-wedlock children using the FFCWS mainly focused on three broad areas: Child's Cognitive Development, Child's Behavior Problems and Child's Health. Those research mainly focused on examining how factors, such as family structure and family stability, affect the well-being of out-of-wedlock children. Nonetheless, the effect of social fathers on the cognitive ability of younger out-of-wedlock children is not well-studied.

There are two competing views regarding the presence of social fathers on childrens' cognitive ability. One hypothesis is that social fathers contribute to more social and economic resources to the family. The young children will be benefited in different ways. The social father will boost household resource endowments. The couples can share financial resources and diversify risk. Perceived paternal support (particularly emotional support) has also been associated with more positive maternal attitudes and practices. Mothers with more partner support tend to be less power-assertive (Brunelli et al. 1995)

[4] See Childers and Durham (1994); Smith, Smith and Dobbs (1991) for details.

and have better parenting quality[5]. The contrasting view is that, since the chance of multiple partnership tranisitons is higher for unmarried mothers, the children may go through more family conflicts before and after their parents' marriage dissolution. Social fathers can possibly invest less in their children than biological fathers do (Coleman et al. 2000). The new romantic relationship with the social father can possibly distract the mothers' attention from the children. Dating can reduce time spent with children or disrupt family routines. Unfortunately, the literature of how the presence of social fathers affects the cognitive development of younger children is rather limited[6].

Craigie(2008) examined the effect of family structure and family stability on child cognitive development. The PPVT score at age three of the child is the variable of interest. For family structure, she distinguished between two-parent families and single-mother families. For family stability, she distinguished between stable families and unstable families. She found that family structure did not have any negative effect on the PPVT score as there was no significant difference in the score between children in stable two-parent families and stable single-mother families. Yet, she found that family stability had an adverse effect on the PPVT score as children in unstable families scored significantly lower in PPVT than children in stable single-mother families. Cooper *et al.* (2011) studied how mother's partnership instability affects the cognitive development of the child. The PPVT score at age five of the child is used to evaluate the child's cognitive development. Partnership instability was found to have detrimental effect on child's cognitive development as there was a negative relationship between child's PPVT score and the number of partnership transitions experienced by the mother after the child's birth.

Liu and Heiland (2012) investigated how the marriage of biological parents affects the cognitive performance of out-of-wedlock children. They compared two groups of children with similar characteristics and parental characteristics. The only difference between the two groups is whether the parents marry the biological fathers or not after the child was born. They found that the marriage of the biological parents significantly increased the child's cognitive performance in terms of the PPVT score at age three. Though both studies are similar, the present study is different from Liu and Heiland (2012) in an important aspect. Liu and Heiland studied the causal impact of unwed mothers marrying the biological father. The present study analyzes the effect of unwed mothers cohabiting with or marrying a new partner.

3 An Economic Model

In this section, we outline a model about how the presence of social fathers would affect the resources devoted to child's verbal and cognitive development. The following is a modified framework in the spirit of Ben-Porath (1967), Becker and Tomes (1979) and Checchi (2008). The control variable is the fraction of time (or endowment resources)

[5] Guterman et al. (2009) actually argued that fathers' availability and contributions to the family can lower the risk of child abuse.

[6] For a study of the impact of social fathers on child's behavioral and health outcomes, see Chan and Fung (2014). A related study by Ho (2014) demonstrated that even friendship structure can affect child well-being.

devoted to education[7] ($E_{i,t}$) at time t (youth). The decision is made by the parents in the first period. In this two-period intergenerational model, the parents are altruistic; they would leave bequest to the next generation. The children will make the decision when he reaches adulthood at $t+1$. We assume that there exists a perfect capital market[8] so that consumption smoothing is feasible[9].

Suppose that there are N idential consumers (indexed by $i=1,...,N$) and two goods in the economy (a consumption good (C_τ) and human capital ($H_{i,\tau}$), $\tau = t, t+1$), the time separable consumption function of the consumer[10] is given by

$$V_t = U(C_t) + \beta V_{t+1}$$

subject to

$$C_\tau = (1 - E_{i,\tau})\xi_\tau H_{i,\tau} - \theta_\tau E_{i,\tau}, \tau = t, t+1$$

where $U(.)$ is a continuous and twice differentiable function; β is the rate of impatience, ξ_τ is the private return to human capital[11], and θ_τ represents the cost of education; for instance, book fee and tuition. V_{t+1} is the value function of time $t+1$.There is no disutility derived from work; but the opportunity cost of forgone labor income is represented by $\xi_t E_{i,t}$. The human capital accumulation equation is characterized by:

$$H_{i,t+1} = H_{i,t}(1-\delta) + I_t^H$$

where δ is the constant deprecation rate, I_t^H is the human capital production at time t which takes the following form:

$$I_\tau^H = e^{\phi SF_i}(A_i E_{i,\tau} H_{i,\tau})^\alpha, \alpha < 1, \tau = t, t+1 \quad (1)$$

A_i is a measure of childrens' unobservable ability (A child with higher ability are advantaged in acquiring education because less effort is requried to achieve the same outcome), SF_i is an indicator function of the presence of social father. ϕ measures the impact of social father on the human capital production. The condition that $\alpha < 1$ implies diminishing returns of scale. A positive ϕ implies that the presence of social fathers boosts the accumulation of human capital, vice versa. To simplify our analysis, we assume that the utility function is linear in the amount of consumption goods. The objective function is:

$$\max_{E_{i,t}^*, E_{i,t+1}^*} V_t = (1 - E_{i,t})\xi_t H_{i,t} - \theta_t E_{i,t} + \beta((1 - E_{i,t+1})\xi_{t+1} H_{i,t+1} - \theta_{t+1} E_{i,t+1}) \quad (2)$$

The optimal fraction of time for human capital production ($E_{i,t+1}^*$) at $t+1$ is zero. A

---

[7] Education is a proxy of human capital production.

[8] It means that the individuals can use their human capital as a "collateral" to finance consumption and education in the first period.

[9] For a model of imperfect human capital market, see Galor and Zeira (1993).

[10] Since all individuals are identical and the utility function is linear in the amount of consumption goods, we can interpret the utility function as that of a representative consumer.

[11] The private return of human capital is assumed the same for all individuals.

heuristic argument is that the agent cannot survive at the third period; it is better to receive more education during youth. The first order condition with respect to $E^*_{i,t}$ is

$$\xi_t H_{i,t} + \theta_t = \beta \xi_{t+1} \frac{\alpha I_t^H}{E^*_{i,t}} \tag{3}$$

Equation (3) simply equates the marginal cost (left hand side) and marginal benefit of human capital accumulation. $\xi_t H_{i,t}$ is the forgone labor income (implicit cost); θ_t is the cost of education (explicit cost). The marginal benefit is the discounted present value of earnings increase due to human capital accumulation. Rearranging terms, we get

$$E^*_{i,t} = \frac{\xi_{t+1}}{\xi_t} \beta \frac{\alpha e^{\phi SF_i} A_i H_{i,t}}{H_{i,t} + \frac{\theta_t}{\xi_t}} \tag{4}$$

Clearly, the impact of the presence of social fathers on the fraction of time devoted to child education (which eventually affects early childhood cognitive ability) depends on the sign of ϕ. Presumably, the mothers with new partners may spend less time or resources on the child due to the new romantic relationship (negative ϕ). Nonetheless, the social fathers may strengthen the financial position of the new familiy providing more resources and attention toward the kid (positive ϕ)[12]. Estimation of ϕ by OLS will be biased due to self-selection issue inherent in this model - mothers with certain characteristics are more likely to marry a social father; and these characteristics are systematcally correlated to the child's cognitive ability.

There is an alternative specification that gives the same conclusion. Readers should notice that the optimal fraction of time for human capital accumulation is positively correlated to the path of expected future private return ($\frac{\xi_{t+1}}{\xi_t}$). Suppose, the intertemporal relative return is state dependent. The state variable can be the presence of social fathers. The sign of the first derivative of $\frac{\xi_{t+1}}{\xi_t}(SF_i)$ will be a determining factor of how the child's schooling be affected by the presence of social fathers. A continuous model can be found in the appendix A.

4 Data

The data set used in this study is the FFCWS. The FFCWS follows a cohort of 4,898 children born between 1998 and 2000 in 20 U.S. cities[13]. Around 3,700 of them were born to unmarried parents as the study over-sampled out-of-wedlock children. A baseline interview was conducted at the time of childbirth. Both biological parents were interviewed at baseline interview[14]. They were re-interviewed when the child reached 1

[12] Another way to hypothesize this model is by adding a subsidy to out-of-pocket education expense, so the realized explicit cost will be $\theta_t + s$, where s denotes a subsidy.

[13] See Reichman, Teitler, Garfinkel and McLanahan (2001) for detailed description of the sample and design of the FFCWS.

[14] Not all the biological fathers are available for interviews.

and 3 years old. Information about the characteristics of the parents, relationship between the parents, parent-child relationship, socioeconomic activities, and child development were collected.

A supplementary survey, called the "36-Month In-Home Longitudinal Study of Pre-School Aged Children", was used to assess the children at age 3. This supplementary survey collected information from a random subsample[15] of the baseline respondents. Details such as child's behavior and living environment were recorded by the interviewers. The PPVT was administered by the interviewers at the children's residence as part of the supplementary survey (Dunn and Dunn 1997).

Two groups of children are sampled in this study. One group is out-of-wedlock children in family with biological mother and social father and the other group is out-of-wedlock children in family only with biological mother. The sample used in this study is selected with the following exclusion. PPVT scores are only available for those who participated in the supplementary survey. Those who are not in that random subsample are excluded (2,530 cases). Twin births are excluded from the sample since we want to focus on single child (51 cases). Children who did not live with the mothers most of the time are excluded since that may induce a negative effect on child's well-being (49 cases). This study focused on the well-being of out-of-wedlock children. Children were dropped if their biological parents were married at baseline (495 cases). In order to limit the influence of the biological father on the children, children whose biological parents were married at year 1 were dropped (127 cases). Biological fathers who were married to the mothers or living with the children at year 3 were also dropped (542 cases). Some more cases (242 cases) were excluded because of missing information on the dependent or independent variables. With all the exclusions, a sample of 862 children remained. Using the propensity score matching method, treatment is defined as the child living with biological mother and social father. We estimate the propensity score for which observations in the sample are selected into treatment. Observations with a propensity score falling outside the region of common support were dropped (29 cases). A final sample of 833 children was analyzed.

Variables on child characteristics are included in the analysis to control their effect on both the well-being of children and the presence of social fathers. The child's gender is included as it was found to have effect on the involvement of biological fathers[16]. This may then affect the parenting quality of social fathers. Medical and psychological research found consistent and rich evidence on the negative effect of low birth weight on cognitive performance (Hack *et al.*1995). Thus, whether the child is a low-birth-weight baby[17] is included in the analysis. Also, whether the child is his/her mother's first birth is also included as having other children before the focal child may increase the need of having a father figure in the household.

Characteristics of mother are expected to influence both the well-being of the child and the decision of having a social father. Most of the unwed parents are less educated, have lower income and are more likely to be black (McLanahan and Sandefur 1994). Demographics like age, race, education level, income, labor market participation, poverty level and religion are all included. Behaviors of the mothers may also have effect on the

[15] 2,368 children and their mothers participated in the supplementary survey.

[16] Read Lundberg, McLanahan and Rose (2007) for more details.

[17] Low-birth-weight baby is defined as baby weighing less than 5lbs 8 ounces at birth

child's well-being. The number of days per week that mother reads story to the child, Mother's PPVT score and whether the mother meets depression criteria are included in the analysis. Prenatal smoking and prenatal alcoholic consumption are included as they may have negative effects on child's cognitive abilities.

Factors affecting the presence of social fathers have to be included. One of those factors is how close the relationship between the biological father and the family is, including the biological mother and the child. Variables such as whether the biological parents are in romantic relationship at childbirth, whether the child uses biological father's last name, whether biological father's name is on the birth certificate and whether paternity is officially established are all included in the analysis. A detailed description of the independent variables are reported in the appendix B.

5 Estimation Strategy

To study the relationship between the presence of social fathers and the well-being (in this case PPVT score) of the child, the following model is defined:

$$Y_i = b_0 + b_1 F_i + \mathbf{b_2 X_i} + \varepsilon_i \tag{5}$$

$$F_i = I(c_0 + \mathbf{c_1 X_i} + \mu_i > 0) \tag{6}$$

where household is indexed by i. The variable indicating the cognitive skills of the child is denoted by Y_i. The variable F_i denotes the presence of social fathers. A value of one for F_i indicates a social father is living in the household. He can be a cohabiting partner of the mother or he has married the mother. A value of zero for F_i means a social father does not exist in the household. The vector $\mathbf{X_i}$ includes all other determining variables such as household characteristics. Both ε_i and μ_i are normally distributed error terms with mean zero. The coefficient b_1 captures the relationship between the presence of social fathers and the PPVT score of the child.

Selection issue happens because the presence of social father is not randomly assigned to the children. It is very likely that mothers who choose to be single are different from mothers who choose to cohabit with or marry to new partners. Some factors cause the mothers to remain single or accept a new partner. At the same time, these factors may also affect the well-being of the child. This will create the correlation between ε_i and μ_i. In the presence of correlation between ε_i and μ_i, using ordinary least squares to estimate the coefficient b_1 may result in biased estimation. Ordinary least squares cannot identify the pure effect of social fathers on the cognitive development of child. Other factors affecting the presence of social fathers in the first place also have their effects on the cognitive ability of child. The ordinary least squares estimate will be a combination of the effect of social fathers and the effect of those factors.

5.1 Non-Parametric Method

We use the propensity score matching method to identify the pure effect of having a social father on child's well-being. Under the context of propensity score matching method, having a social father is viewed as having a treatment. With experimental data,

outcomes between the treatment group and the control group can be compared directly. With observational data, the treatment group and the control group differ systematically because the treatment is the process of self-selection rather than a random assignment. A direct comparison of the average outcomes between the two groups cannot reveal the casual effect of the treatment on the outcome. Rather, the propensity score matching method uses the propensity score to match observations from the control group with observations from the treatment group. Observations are matched between the two groups in order to make the distribution of variables from the treatment group as similar as that of the control group. Matching is done by finding the match from the opposite group with similar propensity score. With the matching, the counterfactual outcome, in the form of the treated without treatment, is built. The counterfactual outcome is then used to compare with the outcome of the treatment group to identify the pure effect of treatment.

In our model, treatment is the presence of social father, denoted by F_i. The household with social father $(F_i = 1)$ is the treatment group while the household without social father $(F_i = 0)$ is the control group. The potential outcome of the child in household i if the child is under treatment is denoted by $Y_i(1)$. If the same child is not under treatment, the potential outcome is denoted by $Y_i(0)$. Only one of the potential outcomes, $Y_i(1)$ or $Y_i(0)$ can be observed for each child. Ordinary least squares estimates give us the simple average outcome difference between the treatment group and the control group: $b_{1OLS} = E[Y_i(1) \mid F_i = 1] - E[Y_i(0) \mid F_i = 0]$, which is the average treatment effect (ATE). As the treatment status is the result of self-selection rather than a random assignment, average treatment effect (ATE) is not able to identify the pure effect of treatment. Instead, we need to estimate the average treatment effect on the treated (ATET):

$$b_{1ATET} = E[Y_i(1) \mid F_i = 1] - E[Y_i(0) \mid F_i = 1] \tag{7}$$

for which is the difference between expected outcome of the child with the treatment and the expected outcome of the same child if the child receives no treatment.

In order to estimate the average treatment effect on the treated, we need both terms in equation (7). The first term can be observed directly from the data. The second term cannot be observed directly from the data. Instead, the outcome of the control group is used to estimate expected outcome of the child in the treatment group if the child receives no treatment. Using the propensity score matching method, a match from the control group is found for every observation in the treatment group.

In order to estimate the average treatment effect, one needs the assumption that the treatment satisfies some form of exogeneity (Caliendo and Kopeinig 2008). Different versions of the assumption are referred to as unconfoundedness (Rosenbaum and Rubin, 1983), selection on observables (Heckman and Robb, 1985) or conditional independence assumption (CIA) (Lechner, 1999). Unconfoundedness can be written as

$$Y(0), Y(1) \coprod F \mid \mathbf{X} \tag{8}$$

where $\coprod$ denotes independence. It means that conditional on a set of observable

covariates $\mathbf{X}$, all potential outcomes $(Y(0), Y(1))$ are independent of the treatment status. Heckman et al. (1998) showed that the assumption of unconfoundedness is overly strong. Lechner (1999) proposed the conditional independence assumption (CIA), which is a weaker assumption than unconfoundedness. Conditional independence assumption (CIA) can be written as

$$Y(0) \coprod F \mid \mathbf{X}. \tag{9}$$

Conditional independence assumption (CIA) means that conditional on a set of observable covariates $\mathbf{X}$, the potential outcomes in the absence of treatment $Y(0)$ are independent of the treatment status. In other words, the outcome of the control group is what the outcome of the treatment group would have been if the treatment group did not receive the treatment. Caliendo and Kopeinig (2008) stated that for estimating the average treatment effect on the treated (ATET), we only need conditional independence assumption instead of unconfoundedness [18].

Caliendo and Kopeinig (2008) mention that there is a dimensionality problem for the matching procedure. Increasing the number of observable covariates will increase the number of possible matches exponentially. Rosenbaum and Rubin(1983) showed that if unconfoundedness holds for a set of observable covariates $\mathbf{X}$, unconfoundedness will also hold for some functions of $\mathbf{X}$. Propensity score, the probability of selection into treatment, is one of the possible functions of $\mathbf{X}$. Propensity score can thus reduce the dimensionality of matching procedure from a high dimension to a scalar in the form of probability, allowing the use of the propensity score matching method.

The conditional independence assumption (CIA) indicates that the covariates affecting the potential outcome and treatment status simultaneously must be observable. The conditional independence assumption (CIA) is non-testable. The richness of the data enables us to reduce selection bias generated by the unobservables and justify the use of propensity score matching method. The FFCWS contains detailed information of the out-of-wedlock children including characteristics of the biological parents, relationship between the parents, parent-child relationship, socioeconomic activities, and child development. Many important determinants of presence of social fathers are accounted for by the richness of the FFCWS. This provides some justifications of using the propensity score matching method. Apart from that, other studies rely on sensitivity analysis to assess whether the point estimates of the treatment effect are robust. The sensitivity analysis also provides some justifications on the assumption [19].

With the propensity score, the matching algorithm used in this analysis is the kernel matching. Kernel matching is a nonparametric matching estimator that uses a weighted average of almost all observations in the control group to create the counterfactual outcomes for the observations in the treatment group. The weights depend on the choice of the kernel. Smith and Todd (2005) stated that the weights depend on the propensity score distance between the observations in the control group and the targeted observation in the treatment group for which the counterfactual outcome is estimated. A symmetric, nonnegative, unimodal kernel gives higher weight to individuals with propensity scores closer to that of the targeted observation in the treatment group. At the same time, it gives

[18] Caliendo and Kopeinig (2008) used the name 'unconfoundedness' for controls to indicate conditional independence assumption (CIA).

[19] The details of sensitivity analysis in this study are in next section.

lower weight to individuals with propensity scores further away to that of the targeted observation in the treatment group.

For the propensity score matching method, several choices of kernel are used in this paper, including *Gaussian kernel*, *Epanechnikov kernel* and *uniform kernel*. Different kernels are used because this can show the robustness of the results. Apart from the choice of kernel, results may also be sensitive to the choice of bandwidth. According to Caliendo and Kopeinig (2008), a trade-off would arise depending on the choice of bandwidth. A high bandwidth gives an estimate with higher bias but lower variance while a low bandwidth gives an estimate with lower bias but higher variance. Two bandwidths were used for each kernel respectively. On the other hand, the matching method with replacement is used because of the small sample size. Caliendo and Kopeinig (2008) stated that matching with replacement lead to estimate with lower bias and higher variance.

5.2 Regression-Based Method

For comparison purpose and as a robustness check, we will present the findings of parametric estimation methods. To our knowledge, there is little literature on comparison between non-parametric and parametric estimation methods. In the latter case, assumptions on the self-selection process have to be made[20]. Consider the case that self-selection is based on observable characteristics of household i[21]; recasting the model in a switching regression form:

$$Y(0) = d_0 + \kappa_0 \tag{12}$$

$$Y(1) = d_1 + \kappa_1 \tag{13}$$

where d_0 and d_1 are the mean parameters. Let F be an indicator function of the presence of social father, combining equations (12) and (13), we get:

$$Y = d_0 + F(d_0 - d_1) + \kappa_0 + F(\kappa_1 - \kappa_0) \tag{14}$$

where Y is the realized outcome.

Proposition 1

Given equation (14), suppose that

(i) *CIA holds*

(ii) $E(\kappa_0 \setminus \mathbf{X}) = X\beta_0$ *and* $E(\kappa_1 \setminus \mathbf{X}) = X\beta_1$

(iii) $E(\kappa_0 \setminus \mathbf{X}) \neq E(\kappa_1 \setminus \mathbf{X})$

The OLS estimates of Y *on* F, $\mathbf{X}$ *and* $F(X - \mu_x)$ *will be unbiased and consistent for ATE and ATET, where* μ_x *is the mean vector of the explanatory variables.*

This is known as the control-function regression. In the homogeneous case ($E(\kappa_0 \setminus \mathbf{X}) = E(\kappa_1 \setminus \mathbf{X})$), the estimates are the same as OLS. In a heterogeneous setting

[20] For a review of parametric estimation method for self-selection, see Wooldridge (Chapter 18, 2002).

[21] Propensity score matching method is also based on observables.

($E(\kappa_0 \setminus \mathbf{X}) \neq E(\kappa_1 \setminus \mathbf{X})$), the ATE and ATET are not equivalent. The sample AET and ATET can be recovered easily the standard error can be estimated by bootstrapping and Jackknife methods. The control-function analysis hinges on the critical assumption of CIA, otherwise, the control-function estimates will be biased. If CIA does not hold, the valid assumption will be selection on unobservables that instrumental variables (z) will be used to derive unbiased and consistent estimates.

Proposition 2 *Given equation (14), suppose that*

(i) CIA does not hold

(ii) $\kappa_0 = X\beta_0 + \varepsilon_o$ *and* $\kappa_1 = X\beta_1 + \varepsilon_1$

(iii) $\varepsilon_0 = \varepsilon_1$

(iv) $E(\varepsilon_0 \setminus \mathbf{X}, \mathbf{z}) = E(\varepsilon_1 \setminus \mathbf{X}, \mathbf{z}) = 0$

An unbiased and consistent estimator for ATE and ATET can be derived in a two-step procedures:

1. Probit of F *on* X *and* z *and get* P_F *-probability of being a social father.*

2. Run a Two Stage Least Square (2SLS) regression of Y *on* F, $\mathbf{X}$ *and* $F(X - \mu_x)$ *using* $1, P_F, \mathbf{X}, P_F(X - \mu_x)$ *as instruments.*

The assumption that $\varepsilon_0 = \varepsilon_1$ can be relaxed from the above homogenous Probit-2SLS case. If **Proposition 2** *(iii)* holds, it will be denoted as homogeneuous case. If not, the ATET will be treated as heterogeneous case. Heckman, Lalonde and Smith (1999) propose a procedure that takes heterogeneity into account but no instrumental variable is required. The cost is stronger distributional assumptions. Efficiency can be improved by using robust standard error. The standard error can be derived by non-parametric methods such as bootstrap and Jacknife.

6 Effects of Social Father on Child's PPVT score

Descriptive statistics for all the aforementioned variables are reported in Table 1. Summary statistics are reported for the whole sample in the first column. Summary statistics are also reported separately for children with social fathers and children without social fathers in second column and third column respectively. In this sample, the mothers' average age tend to be low (23 years old); and 70% are black. About 44 percent did not graduate from high school. Less than 25 percent mothers are smokers and only 10 percent have drinking habits. Most of the household units (75 percent) are making less than $25,000; 75 percent children use the biological fathers' last name. These mothers' characteristics will be used as explanatory variables of the probit estimation.

The standardized PPVT score[22] of the child is the main variable of interest to measure the well-being of the child . Table 1 shows that the sample has a mean score of 83.9. Children with the presence of social fathers apparently have a lower score than

[22] Standardized PPVT score is used because it is adjusted for the mental age of the child.

those without social fathers (82 vs. 84.4)[23]. The presence of social fathers enters the analysis as the main determining variable. If the mother was married to a new partner or the mother was cohabiting with a new partner, we count these cases as the presence of social fathers. Among the sample of 833 children, 19.5 percent of them (163 children) were living under the presence of social fathers. The remaining 670 children are all living with the mothers without the presence of social fathers in the household.

There are some discernible differences between mothers with social fathers and children without social fathers in some independent variables. Mothers of children with social fathers are significantly younger and less educated than mothers of the children without social fathers. There are also some systematic differences between the two groups of children in terms of variables related to the biological father. For children without social fathers, their biological parent was significantly more likely to be in a romantic relationship when the child was born; more likely to have the biological father's name on the birth certificate and to have paternity established. These variables indicate that the relationship of the biological father with the biological mother was very close before and when the child was born. With a closer link with the biological father, the mother may be more reluctant to start a new relationship.

6.1 Propensity Score Method

Before discussing the findings of PSM, we first report the OLS results; which can be used to compare with results of other estimation methods. As shown in Table 2, if a social father is present in a family, the child's PPVT score drops, on average, by 2.955 points; and the coefficent is signficiant at 5 %. Obviously, other important factors include child's initial health condition (Child is of low birth weight), mother's cognitive ability (PPVT score o the mother), child's household income and the amount of time mother devoted to the kids (as proxied by Days in a week mother tells story).

The first step of the nonparametric analysis is to estimate the propensity scores for having a social father in the households for the sample. A probit model is used to estimate the propensity score, defined as the probability of having a social father in the household. All the aforementioned variables are included in the probit estimation.

A condition of common support is needed for using the propensity score matching. This can guarantee that the observations in the treatment group and those in the control group are comparable with sufficient overlap in their propensity scores. Observations having propensity scores outside the common support region are excluded from the analysis. The common support region has a lower and upper bound. The upper bound is defined as the highest propensity score obtained by the observations in the control group. The lower bound is defined as the lowest propensity score obtained by the observations in the treatment group [24]. Using this method, the common support region is [0.0299251,0.6773368]. A total of 833 observations have propensity scores falling within this region.

Table 3 summarizes the results from the probit estimation. The probit estimates show

[23] The difference in PPVT score has some predictive power in future's outcome. For example, Liu and Heiland(2012) found that a four-point positive difference in the PPVT score at age 3 may raise the odds of high school graduation by 2 percentage point.

[24] This method of defining a common support region of propensity score is also used in a study by Liu and Heiland(2012).

that several factors have significant effects on the presence of social fathers. For example, social father is less likely to be present if the child is his/her mother's first birth. The reason is that having other children before the focal child may increase the financial need of having a new partner in the household. Also, the child is less likely to have a social father if the biological parents were in a romantic relationship at childbirth. This is consistent with usual behavior as people need time to accept a new partner after just ending a romantic relationship.

The second step of the analysis is to find the estimated effect of having a social father in the household on the well-being of the child. The standardized PPVT score of the child is used as a measure of the child's cognitive development. Table 4 summarized the results on the estimated effect of social fathers on child's PPVT score. Column 1 of the table shows the ordinary least squares estimate for comparison purpose[25]. Column 2 to 7 shows the propensity score matching estimates using *Gaussian kernel*, *Epanechnikov kernel* and *uniform kernel*, each with two different bandwidths.

Using the propensity score matching method, we found that all model specifications uniformly report a negative social father –children PPTV relation. The PPVT scores of children in the household with social fathers are on average significantly lower than those of children in the household without social fathers by 2.7 to 3.7 points[26]. All coefficients are at least significant at 10 percent. The OLS estimates also showed similar results, though the magnitude of the estimate is generally smaller than that of the propensity score matching estimates[27]. Among the nonparametric estimation, the magnitude of social father effects tend to increase as the bandwidth is reduced.

6.2 Sensitivity analysis

In this section, we check the robustness of the results using a sensitivity analysis. The purpose of this analysis is to evaluate the change in the results under which the conditional independence assumption (CIA) does not hold. The analysis is not a test but it can provide some justifications of using the propensity score matching method. We follow the work of Ichino, Mealli and Nannicini (2008), who propose a method to evaluate the sensitivity of the estimates of propensity score matching method. They created different possible situations in which CIA does not hold. They proceed to derive the point estimates under those situations. If the estimates does not change by much under different situations, the estimates are deemed robust and it justifies the use of propensity score matching method.

The proposed method by Ichino, Mealli and Nannicini (2008) first assumed that the unobservables in the model can be summarized by a binary variable. They further assumed that the unobserved binary covariate U is related to both the treatment and the outcome for which is a deviation from CIA. The distribution of U is then characterized

[25] The detailed ordinary least squares estimate of all other variables on child's PPVT score are presented in the appendix.

[26] Liu and Heiland(2012) found that the marriage of biological parents after childbirth increased the PPVT score of the child by 3.5 to 4.4 points compared to the case if the biological parents had remained unmarried.

[27] The results became insignificant when the definition of social fathers changed by including those who are romantic partners of biological mothers but not living with them. Details on those results are available upon request.

by specifying some parameters. With the parameters, a predicted value of U is given for each observation, including those in the treatment group and those in the control group. Lastly, the treatment effect is re-estimated using the propensity score matching method by including the binary covariate U in the set of the independent variables. This method allows us to check the robustness of the estimate under different assumption of U.

In the sensitivity analysis, it is assumed that conditional independence assumption (CIA) does not hold. Yet, the CIA holds given the observables $\mathbf{X}$ and the binary covariate U:

$$Y(0) \coprod F \mid \mathbf{X}, U. \tag{10}$$

In order to characterize the distribution of U, the parameters that need to be specified are the probability that $U=1$ in each of the four groups defined by the outcome value and treatment status. The parameters are the following:

$$Pr(U=1 \mid F=i, Y^{*}=j, \mathbf{X}) = Pr(U=1 \mid F=i, Y^{*}=j) \equiv p_{ij} \tag{11}$$

with $i, j \in [0,1]$. When the outcome is a continuous variable, a binary transformation of the outcome is needed in which $Y^{*}=1$ if the outcome is above the mean. By choosing the four parameters p_{ij}, one can specify the binary covariate U to have a negative effect on the outcome of the control group $(p_{01} - p_{00} < 1)$ [28] and have a positive effect on the selection into the treatment group $(p_{1.} - p_{0.} > 0)$. This specification of U might influence the estimates of average treatment effect on the treated (ATET) [29]. According to Ichino et al.(2008), the sensitivity analysis included the estimation of the odds ratio of U in the logit model of $Pr(Y^{*}=1 \mid F=0, U, \mathbf{X})$, defined as Γ, to indicate the 'outcome effect' of U. Similarly, the odds ratio of U in the logit model of $Pr(F=1 \mid U, \mathbf{X})$ is estimated, defined as Λ, to indicate the 'treatment effect'.

After specifying the binary covariate U, the effect of social father on PPVT score is re-estimated using the propensity score matching method with U as an additional independent variable. Table 5 presents the results of the sensitivity analysis. For comparison purpose, the baseline estimate without the covariate U is -2.962. For small treatment effect $(s=0.1)$, the estimate is still significant for very large outcome effect $(d=-0.5)$. Similarly, for small outcome effect $(d=-0.1)$, the magnitude of the estimates only becomes insignificant for very large treatment effect $(s=0.5)$. Both cases seem not very plausible according to Ichino et al.(2008). Also, the estimate is still significant for a combination of moderate treatment effect $(s=0.2)$ and moderate

[28] I focused on the negative effect on the outcome of the control group because the results showed that the presence of social fathers have a negative effect on the PPVT score

[29] We followed the work of Ichino et al.(2008) and defined the following: $d = p_{01} - p_{00}$ is the measure of the effect of U on the outcome of the control group; $s = p_{1.} - p_{0.}$ is the measure of the effect of U on the selection into the treatment group.

outcome effect $(d = -0.2)$. Thus, the sensitivity analysis show that the estimates using the propensity score matching method are robust under reasonable deviations from the CIA.

6.3 Regression-Based Method

The choice of instrumental variables should be dictated by the fact that they should be sufficiently correlated to the endogenous variable (the existence of social father) but uncorrelated to the outcome (PPVT score). The first instrument is a dummy indicating whether the mother was in romantic relation with a partner before childbirth. Table 3 shows that it is a significant factor for remarriage; and this variable is not liable to be related to child's PPVT score. Other choices of instrumental variables include mother's education (some college, high school, and less than high school) and household poverty ratios. We believe that these factors would directly affect the earning ability of the mother and eventually the choice to remarry.

Table 6 reports the ATET of control-function and Probit-2SLS in Column 2 and 3, respectively. The results of Heckit are reported in column 4 of table 6. We present the ATET of social fathers only. The full results of all estimation methods are available upon request[30]. While the homogeneous control function -OLS estimate (-2.955) is the same as OLS in Table 2, the standard error is slightly smaller. Also, the standard errors tend to be larger when using Jacknife correction. Controlling for heterogenity, the impact becomes stronger (-3.171). The coefficients are signficant at 5% in both cases. Our results from tables 4-6 clearly show that the presence of social father reduces the PPVT score of children when self-selection is based on observables (PSM and control-function); but no impact when it is based on unobservables[31] since the estimates of Probit 2SLS and Heckit are insignificant. We tried other methods based on unobservables (Direct 2SLS and Probit-OLS), the results were the same.

7 Discussion

This paper aims to show how the presence of social fathers affects the well-being of out-of-wedlock children. Previous studies focused more on the effect of stepparents on older children or adolescents. Along the existing strand of literature, we examine the effect of social fathers on children born to unmarried parents by using a large representative sample of out-of-wedlock children. For these children, the occurrence of social fathers happens early in their life without going through the divorce or separate of the biological parents. This can identify the pure effect of social father presence independent of the change of family structure or the effect of divorce.

The presence of social fathers is the result of self-selection. To address the selection issue, We use the propensity score matching and control function methods for the analysis. We found that the presence of social father has a significant negative effect on child's cognitive abilities, measured by the child's PPVT score.

Several factors can explain the negative effect of social fathers on child's PPVT scores. Decreasing maternal time with the child has been found to have harmful effect on

[30] We calculate the robust standard error.

[31] To our knowledge, there is no test distinguishing self-selection on observable from unobservable like the Hausemen test in 2SLS.

child's cognitive abilities (Ruhm 2004). Maternal time with the child is controlled in the analysis by the number of days per week that the mother reads story to child. However, the presence of social father might affect the quality of maternal time with the child. Mothers with new partners may shift some of the focus on the romantic relationship instead of focusing on the only child. Thus, the quality of mother-child time may be worse than before. This can explain the drop in PPVT score for child with social father.

Another possible explanation is the parent's incentive to allocate resources toward the child. Hofferth and Anderson (2003) found that stepparents tend to be less involved with the child compared to biological parents. For single mothers, they focus on their own child and put all the resources on the child. For mothers with new partners, they may plan or already have new child with the new partners. The resources putting on the original child would decrease because of new competition.

There are two limitations of this study. The first one is related to methodology – Why the negative social father effect is present only when self-selection is based on observables? There are three plausible reasons. (1) The intention of FFCWS is providing a comprehensive dataset of mother and child characterisitics (we are using 38 independent variables); that these factors should be sufficient to explain the choice of having a social father rendering the use of instrumental variable redundant. (2) The standard error is imprecise. Some instrument (for example, P_F) is a generated series from the first step estimation, the error can be carried over to the second step. Moreover, heterogeneous Probit-2SLS is not an efficient method. (3) The instruments may be correlated to child's PPVT score. Having said all these, there is one clear message from this paper - by OLS, PSM of the control function analysis, the presence of social father, on average, reduces the PPVT score of a child by 3 points.

The second limitation is about scope of analysis. There is evidence that boys are more adversely affected by family transition (Cooper *et al. 2011*). Boys and girls may react to the presence of social fathers differently. There is evidence that boys are more negatively affected by family instability than girls are (Hetherington *et al.* 1985, Cavanagh *et al.* 2008). Two possible reasons have been proposed: (1) The boys have no male role model to follow. (2) Due to negative emotions after separating with the biological fathers, mothers may treat sons differently than daughters. To our knowledge, the literature on boys' cognitive ability and the presence of social fathers is rather limited. Cooper *et al.* (2011) is one of them. While the authors found more negative association between boys' cognitive ability and the presence of social fathers[32], they failed to adjust for self-selection.

A simple strategy to test the null hypothesis that a boy is more negatively affected by family transitions is testing the significance of an interaction term of indicator function of a boy and social father. That being said, there are two technical difficulties: (1) Only one treatment effect is allowed in the propensity score and control function-OLS methods. (2) To our knowledge, there is no method to handle nonlinear treatment effect, *i.e.* multiplicative term of boy and social father dummies. Splitting the sample into boys and girls, we conducted the same analyses as in section 6. However, the social father effect is not significant. One reason is loss of sample size when restricting to boys of girls only. Propensity score method requires large sample size to match the sample into treatment

[32] The authors also found a positive association with boys' behavioral problems.

and control groups. Another reason is the large standard error generated from the two-stage procedures.

Because of high percentage of non-marital births, cases of young children living with social fathers would still be prevalent in the future. The negative effect of social father found in this study may only reflect part of the problem facing the children. To improve their well-being, increasing financial support for single mothers and providing high-quality early childhood education for children living with single mothers may be more desirable. A test score of cognitive ability of the child is only a very narrow measure of child's well-being. Future research using a wider range of child's outcomes would provide a clearer picture about how social fathers affect the well-being of children.

References

Becker, G., and N. Tomes (1979). An eqilibrium theory of the distribution of income and intergenerational mobility. *Journal of Political Economy* 87(6): 1153–89.

Ben-Porath, Y. (1967). The production of human capital and the life-cycle of earnings. *Journal of Political Economy* 75(4): 352–65.

Brown, S.L. (2004). Family Structure and Child Well-Being: The Significance of Parental Cohabitation. *Journal of Marriage and Family*, 66(2): 351 - 367.

Brunelli, S. A., Wasserman, G. A., Rauh, V. A., Alvarado, L. E., & Caraballo, L. R. (1995). Mothers' report of paternal support: Associations with maternal child-rearing attitudes. *Merrill-Palmer Quarterly*, 41(2), 152-171.

Bumpass, L.L., R.K. Raley, and J.A. Sweet (1995). The Changing Character of Stepfamilies: Implications of Cohabitation and Nonmarital Childbearing. *Demography*, 32(3): 425-436.

Bzostek, S.H. (2008). Social Fathers and Child Well-Being. *Journal of Marriage and Family*, 70(4): 950-961.

Caliendo, M., and S. Kopeinig (2008). Some Practical Guidance for the Implementation of Propensity Score Matching. *Journal of Economic Surveys*, 22(1): 31-72.

Carlson, M.J., S.S. McLanahan, and P. England (2004). Union Formation in Fragile Families. *Demography*, 41(2): 237-261.

Carneiro, P., C. Crawford, and A. Goodman (2007). The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes. *Research paper of Centre for the Economics of Education,* London School of Economics.

Cavanagh, Shannon E.; Crissey, Sarah R.; Raley, Kelly R. Family Structure History and Adolescent Romance. Journal of Marriage and Family. 2008; 70:698–714.

Cawley, J., J. Heckman, and E. Vytlacil (2001). Three observations on wages and measured cognitive ability. Labor Economics, 8 (4): 419-442.

Chan, K.H., K.W.T. Fung, and E. Demir (2014). The Health and Behavioral Outcomes of Out-of-Wedlock Children from Families of Social Fathers. *Review of Economics of the Household,* forthcoming.

Checchi, D. (2008). The Economics of Education: Human Capital, Family Background and Inequality. *Cambridge University Press*, 1st edition (Chapter 2).

Childers, J.S., T.W. Durham (1994). Relation of Performance on the Kaufman Brief

Intelligence Test with the Peabody Picture Vocabulary Test-Revised among Preschool Children. *Perceptual and Motor Skills*, 79(3): 1195-1199.

Coleman, M., L. Ganong, and M. Fine (2000). Reinvestigating Remarriage: Another Decade of Progress. *Journal of Marriage and the Family*, 62(4): 1288 - 1307.

Cooper, C.E., C.A. Osborne, A.N. Beck, S.S. McLanahan (2011). Partnership Instability, School Readiness, and Gender Disparities. *Sociology of Education*, 84(3): 246-259.

Craigie T.A. (2008). Effects of Paternal Presence and Family Instability on Child Cognitive Performance (Working Paper No. 2008-03-FF). Princeton, NJ: Center for Research on Child Wellbeing.

Dunn, L. M., and L.M. Dunn (1997). *Peabody Picture Vocabulary Test (3rd ed.)*. Circle Pines, MN: American Guidance Service.

Galor, O., and J. Zeira (1993). Income distribution and macroeconomics.*Review of Economic Studies* 60: 35–52.

Guterman, N. B., Lee, Y., Lee, S. J., Waldfogel, J. & Rathouz, P. J. (2009) Fathers and Maternal Risk for Physical child Abuse. *Child Maltreatment*, 14(3), 277-290.

Hack, M., N.K. Klein, and H. Gerry Taylor (1995). Long-Term Development Outcomes of Low Birth Weight Infants. *The Future of Children*, 5(1): 176-196.

Hamilton, B.E., J.A. Martin, and S.J. Ventura (2011). Births: Preliminary Data for 2010. *National Vital Statistics Reports*, 60(2).

Heckman, J.J., R. Robb (1985). Alternative Models for Evaluating the Impact of Interventions. *Journal of Econometrics*, 30(1-2): 239-267.

Heckman, J.J., H. Ichimura, and P. Todd (1998). Matching as an Econometric Evaluation Estimator. *Review of Economic Studies*, 65(2): 261-294.

Heckman, J.J., R.J. Lalonde, and J.A. Smith (1999). The Economics and Econometrics of Active Labor Market Programs. In Ashenfelter, A. & Card, D. (Eds.), *Handbook of Labor Economics* (3). New York: Elsevier Science.

Hetherington, E Mavis; Cox, Martha; Cox, Roger. Long-term Effects of Divorce and Remarriage on the Adjustment of Children. Journal of the American Academy of Child and Adolescent Psychiatry. 1985; 24:518–30.

Ho, C.Y. 2014. More Friends with Better Health: The Role of Social Capital in Producing Health. MPRA working paper.

Hofferth, S.L. (2006). Residential Father Family Type and Child Well-Being: Investment

versus Selection. *Demography*, 43(1): 53 - 77.

Hofferth, S.L., and K. Anderson (2003). Are All Dads Equal? Biology versus Marriage as a Basis for Paternal Investment. *Journal of Marriage and the Family*, 65(1): 213-232.

Ichino, A., F. Mealli, and T. Nannicini (2008). From Temporary Help Jobs to Permanent Employment: What Can We Learn from Matching Estimators and Their Sensitivity? *Journal of Applied Econometrics*, 23(3): 305-327.

Imbens, G.W. (2004). Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review. *Review of Economics and Statistics*, 86(1): 4-29.

Lechner, M. (1999). Earnings and Employment Effects of Continuous Off-the-Job Training in East Germany after Unification. *Journal of Business and Economic Statistics*, 17(1): 74-90.

Lee, V., and D. Burkam (2002). Inequality at the Starting Gate: Social Background Differences in Achievement as Children Begin School. *Economic Policy Institute*.

Liu, S.H., and F. Heiland (2012). Should We Get Married? The Effect of Parents' Marriage on Out-of-Wedlock Children. *Economic Inquiry*, 50(1): 17-38.

Lundberg, S., S.S. McLanahan, and E. Rose (2007). Child Gender and Father Involvement in Fragile Families. *Demography*, 44(1): 79-92.

Manning, W.D., and K.A. Lamb (2003). Adolescent Well-Being in Cohabiting, Married and Single-Parent Families. *Journal of Marriage and Family*, 65(4): 876 - 893.

McLanahan, S. S., & Sandefur, G. (1994) *Growing Up with a Single Parent: What Hurts, What Helps*. Cambridge, MA: Harvard University Press.

Osborne, C., and S.S. McLanahan (2007). Partnership Instability and Child Well-Being. *Journal of Marriage and Family*, 69(4): 1065-1083.

Reichman, N.E., J.O. Teitler, I. Garfinkel, and S.S. McLanahan (2001). Fragile Families: Sample and Design. *Children and Youth Services Review*, 23(4-5): 303-326.

Rosenbaum, P.R., and D.B. Rubin (1983). The Central Role of the Propensity Score in Observational Studies for Casual Effects. *Biometrika*, 70(1): 41-55.

Ruhm, C.J. (2004). Parental Employment and Child Cognitive Development. *Journal of Human Resources*, 39(1): 155-192.

Schmidt, F L. J.E. Hunter, A.N. Outerbridge (1986). *Journal of Applied Psychology*, 71(3):432-439.

Sigle-Rushton, W., and S.S. McLanahan (2002). The Living Arrangements of New Unmarried Mothers. *Demography*, 39(3): 415-433.

Smith, J.A., and P.E. Todd (2005). Does Matching Overcome LaLonde's Critique of Nonexperimental Estimators? *Journal of Econometrics*, 125(1-2): 305-353.

Smith, T.C., B.L. Smith, and K. Dobbs (1991). Relationship between the Peabody Picture Vocabulary Test-Revised, Wide Range Achievement Test-Revised, and Weschler Intelligence Scale for Children-Revised. *Journal of School Psychology*, 29(1): 53-56.

Sweeney, M.M. (2010). Remarriage and Stepfamilies: Strategic Sites for Family Scholarship in the 21st Century. *Journal of Marriage and Family*, 72(3): 667-684.

Thomson, E., T. L. Hanson, and S.S. McLanahan (1994). Family Structure and Child Well-Being: Economic Resources vs. Parental Behaviors. *Social Forces*, 73(1): 221 - 242.

Wooldridge, J. (2002). Econometric Analysis of Cross Section and Panel Data, MIT Press.

Yoshikawa, H. (1995). Long-Term Effects of Early Childhood Programs on Social Outcomes and Delinquency. *The Future of Children Long-Term Outcomes of Early Childhood Programs*, 5(3): 51-75.

Table 1 Summary statistics of the FFCWS sample

	Sample Mean	With Social Father	Without Social Father
Presence of social father	0.1957 (0.397)	Nil	Nil
PPVT score of the child***	83.91 (15.44)	82.01 (16.63)	84.38 (15.12)
Child is of low birth weight	0.1092 (0.3121)	0.0982 (0.2984)	0.1119 (0.3155)
Child is a boy	0.533 (0.4992)	0.5521 (0.4988)	0.5284 (0.4996)
Child is mother's first birth	0.4034 (0.4909)	0.3865 (0.4884)	0.4075 (0.4917)
Mother's age***	23 (5.03)	21.93 (4.38)	23.26 (5.15)
Mother is white	0.1056 (0.3076)	0.1411 (0.3492)	0.097 (0.2962)
Mother is Hispanic	0.1657 (0.372)	0.1411 (0.3492)	0.1716 (0.3774)
Mother is black	0.7095 (0.4543)	0.6871 (0.4651)	0.7149 (0.4518)
Mother is of other race	0.0192 (0.1373)	0.0307 (0.173)	0.0164 (0.1272)
Mother's education: less than HS	0.4406 (0.4968)	0.4847 (0.5013)	0.4299 (0.4954)
Mother's education: HS	0.3169 (0.4656)	0.3252 (0.4699)	0.3149 (0.4648)
Mother's education: some college**	0.2185 (0.4135)	0.1534 (0.3615)	0.2343 (0.4239)
Mother's education: college	0.024 (0.1532)	0.0368 (0.1889)	0.0209 (0.1431)
Mother is foreign born	0.036 (0.1864)	0.0368 (0.1889)	0.0358 (0.186)
Mother is Catholic	0.1753 (0.3804)	0.1595 (0.3673)	0.1791 (0.3837)
Mother is Protestant	0.4358 (0.4962)	0.4049 (0.4924)	0.4433 (0.4971)
Mother is of other religion	0.1801 (0.3845)	0.2025 (0.4031)	0.1746 (0.3799)
Mother has no religion	0.2089 (0.4068)	0.2331 (0.4241)	0.203 (0.4025)
Mother attends religious activity	0.5558 (0.4972)	0.5583 (0.4981)	0.5552 (0.4973)
PPVT score of the mother	87.16 (11.19)	87.5 (10.85)	87.07 (11.27)
Mother meets depression criteria	0.2533 (0.4352)	0.2209 (0.4161)	0.2612 (0.4396)
Prenatal smoking by mother	0.2485 (0.4324)	0.2883 (0.4544)	0.2388 (0.4267)
Prenatal drinking by mother	0.1044 (0.306)	0.1043 (0.3066)	0.1045 (0.3061)
Mother is working	0.5522 (0.4976)	0.5215 (0.5011)	0.5597 (0.4968)
Household income (<=$10,000)	0.3914 (0.4883)	0.362 (0.482)	0.3985 (0.49)
HH's inc. ($10,000 - $25,000)	0.3601 (0.4803)	0.3374 (0.4743)	0.3657 (0.482)
HH's inc. (>$25,000)*	0.2485 (0.4324)	0.3006 (0.4599)	0.2358 (0.4248)
HH's Poverty ratio (0-49%)	0.3565 (0.4793)	0.362 (0.482)	0.3552 (0.4789)
HH's Poverty ratio (50-99%)	0.2437 (0.4296)	0.2209 (0.4161)	0.2493 (0.4329)
HH's Poverty ratio (100-199%)	0.2425 (0.4289)	0.2393 (0.4279)	0.2433 (0.4294)
HH's Poverty ratio (>=200%)	0.1573 (0.3643)	0.1779 (0.3836)	0.1522 (0.3595)
No. of adults in household	1.7899 (0.9696)	2.0859 (0.6885)	1.7179 (1.0139)
No. of kids in household	2.4202 (1.4087)	2.4049 (1.3592)	2.4239 (1.4214)
Parents in romantic relationship at childbirth***	0.7587 (0.4281)	0.6564 (0.4764)	0.7836 (0.4121)
Days in a week mother tells story	5.2005 (2.1263)	5.3129 (2.1301)	5.1731 (2.126)
Child uses father's last name	0.7503 (0.4331)	0.7239 (0.4484)	0.7567 (0.4294)
Father's name on birth cert.*	0.8451 (0.362)	0.7975 (0.4031)	0.8567 (0.3506)
Paternity established**	0.605 (0.4891)	0.5276 (0.5008)	0.6239 (0.4848)
Number of Observations	833	163	670

Note:

(a) Standard deviations are reported in parentheses.

(b) Statistical tests on the equality of proportions/mean between sample with social father and sample without social father: ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level, and *denotes statistical significance at the 10% level.

Table 2 Ordinary Least Squares Estimates of Social Father Impact on Child's PPVT Score

Social Father is present	-2.9552 (1.406)**
Child is of low birth weight	-4.9895 (1.8008)***
Child is a boy	-1.3836 (1.0442)
Child is mother's first birth	0.1192 (1.3329)
Mother's age	0.9364 (0.9976)
Mother's age square	-0.0178 (0.0189)
Mother's race (Ref: Other race)	
White	2.7553 (4.1588)
Hispanic	-1.5228 (4.0066)
Black	-1.9058 (3.8356)
Mother's education (Ref: College)	
Less than High School	-4.8764 (3.492)
High School	-4.1371 (3.4011)
Some College	-2.1751 (3.3597)
PPVT score of the mother	0.2712 (0.0591)***
Mother is working	0.263 (1.1785)
Prenatal smoking by mother	-0.2494 (1.3546)
Prenatal drinking by mother	4.073 (1.7195)**
Mother is foreign born	-2.0534 (2.9588)
Mother's religion (Ref: No Religion)	
Catholic	-0.6139 (1.7717)
Protestant	-1.4468 (1.3829)
Other religion	0.5418 (1.7054)
Mother attends religious activity	-0.5531 (1.0921)
Child's Household Income (Ref: >$25,000)	
<=$10,000	6.1661 (3.3044)*
$10,000 - $25,000	4.0105 (2.2599)*
Child's Household Poverty Ratio (Ref: >=200%)	
0-49%	-6.4024 (3.865)*
50-99%	-6.3143 (3.2176)**
100-199%	-1.0021 (2.4602)
Days in a week mother tells story	0.6642 (0.255)***
No. of adults in household	1.1317 (0.5698)**
No. of kids in household	-0.2171 (0.4485)
Mother meets depression criteria	-1.498 (1.246)
Parents in romantic relationship at childbirth	0.0429 (1.2824)
Child uses father's last name	0.517 (1.4784)
Father's name on birth cert.	0.7306 (1.665)
Paternity established	-0.3435 (1.1755)

Notes:

(a) ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level. *Denotes statistical significance at the 10% level.

(b) Robust standard errors are reported in parentheses.

Table 3 Probit Estimates of Propensity Score Method

Variable	Estimate (Standard Error)
Child is of low birth weight	-0.0202 (0.0424)
Child is a boy	-0.0034 (0.0275)
Child is mother's first birth	-0.1013 (0.0345)***
Mother's age	-0.0147 (0.0245)
Mother's age square	0.0001 (0.0005)
Mother's race (Ref: Other race)	
White	-0.0449 (0.0886)
Hispanic	-0.1232 (0.0658)
Black	-0.1216 (0.1114)
Mother's education (Ref: College)	
Less than High School	-0.1019 (0.0883)
High School	-0.0918 (0.0781)
Some College	-0.1294 (0.0619)*
PPVT score of the mother	0.0004 (0.0014)
Mother is working	-0.0126 (0.0308)
Prenatal smoking by mother	0.0383 (0.036)
Prenatal drinking by mother	-0.0015 (0.0477)
Mother is foreign born	-0.0449 (0.0646)
Mother's religion (Ref: No Religion)	
Catholic	-0.066 (0.0433)
Protestant	-0.0344 (0.0375)
Other religion	0.0115 (0.0452)
Mother attends religious activity	0.009 (0.0291)
Child's Household Income (Ref: >$25,000)	
<=$10,000	0.0851 (0.068)
$10,000 - $25,000	0.1168 (0.1034)
Child's Household Poverty Ratio (Ref: >=200%)	
0-49%	0.0988 (0.0657)
50-99%	0.0076 (0.0499)
100-199%	0.036 (0.0795)
Days in a week mother tells story	0.0061 (0.0066)
No. of adults in household	0.0624 (0.0156)***
No. of kids in household	-0.0111 (0.0122)
Mother meets depression criteria	-0.0473 (0.0301)
Parents in romantic relationship at childbirth	-0.1243 (0.0403)***
Child uses father's last name	0.0306 (0.0376)
Father's name on birth cert.	-0.0242 (0.049)
Paternity established	-0.0444 (0.0316)

Notes:

(a) ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level. *Denotes statistical significance at the 10% level.

(b) Marginal effects instead of the coefficients are reported.

(c) Standard errors are reported in parentheses.

Table 4 Estimated Effect of Social Father on Child PPVT Score

	OLS	*Gaussian*		*Epanechnikov*		*Uniform*	
		0.1	0.01	0.1	0.01	0.1	0.01
Estimate	-2.955**	-2.755*	-3.299*	-3.043*	-3.398*	-3.008**	-3.782**
Standard Error	1.406	1.461	1.699	1.579	1.794	1.492	1.744
No. of Obs. treated	163	163	163	163	162	163	162
No. of Obs. control	670	670	670	670	666	670	666
% Matched treated		100	100	100	99	100	99

Notes:

(a) ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level. *Denotes statistical significance at the 10% level.

(b) Source: Author's calculation from Fragile Families and Child Wellbeing Study (FFCWS).

(c) Robust standard error is reported for the OLS estimates.

(d) Bootstrap standard errors are reported for estimates.

Table 5 Sensitivity Analysis on Estimated Effect of Social Father on Child PPVT Score

	S=0.1 $\Lambda \in [1.4,2]$	S=0.2 $\Lambda \in [2.3,2.9]$	S=0.3 $\Lambda \in [3.9,4.7]$	S=0.4 $\Lambda \in [7.2,9.6]$	S=0.5 $\Lambda \in [18.4,25.3]$
d= -0.1; $\Gamma \in$ [0.58; 0.7]	-2.865** (1.608)	-2.582** (1.426)	-2.303* (1.647)	-2.085* (1.404)	-1.911* (1.343)
d= -0.2; $\Gamma \in$ [0.37; 0.43]	-2.633** (1.264)	-2.212** (1.246)	-1.707 (1.511)	-1.357 (1.418)	-0.827 (1.594)
d= -0.3; $\Gamma \in$ [0.24; 0.28]	-2.377* (1.596)	-1.847 (1.444)	-1.038 (1.457)	-0.665 (1.536)	-0.148 (1.526)
d= -0.4; $\Gamma \in$ [0.14; 0.17]	-2.379* (1.266)	-1.505 (1.364)	-0.591 (1.365)	0.214 (1.335)	1.635 (1.52)
d= -0.5; $\Gamma \in$ [0.08; 0.09]	-1.71 (1.615)	-0.971 (1.382)	0.114 (1.653)	1.565 (1.397)	2.346 (1.575)

Notes:

(a) ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level. *Denotes statistical significance at the 10% level.

(b) Source: Author's calculation from Fragile Families and Child Wellbeing Study (FFCWS).

(c) Bootstrap standard error is reported for the OLS estimates.

Table 6 Estimated Average Treatment Effect on the Treated of Social Father on Child PPVT Score

ATET	cf-ols	probit-2sls	heckit
Homogeneous Estimate- Bootstrap standard error	-2.955** 1.37	-6.135 12.21	-4.395 10.06
Heterogeneous Estimate - Bootstrap standard error	-3.171** 1.25	-10.24 583.0	-1.76 11.84
Homogeneous Estimate- Jackknife standard error	-2.955** 1.44	-6.135 13.75	-4.395 10.33
Heterogeneous Estimate - Jackknife standard error	-3.171** 1.42	-10.24 78.02	-1.76 14.55

Notes:

(a) ***Denotes statistical significance at the 1% level. **Denotes statistical significance at the 5% level. *Denotes statistical significance at the 10% level.

(b) Source: Author's calculation from Fragile Families and Child Wellbeing Study (FFCWS).

Appendix

A. Continuous Human Capital Accumulation Model

We hereby outline the continuous verstion of the human capital accumulation model depicted in section 3, in the spirit of Ben-Porath(1967) and Checchi (2008). We are making similar assumptions that leisure does not generate disutility; a perfect capital market exists; the human capital return is constand and the preference is linear. Instead of going through two stages of life, the identical individuals (the index i is omitted for this reason) are living in a continuous time span from t to T, where the terminal lifespan is known. The disposable income at each period is given by:

$$W_t = (1-E_t)\xi H_t - \theta B_t$$

where E_t is the fraction of time devoted to human capital production, ξ is the constant return, H_t dentoes the current stock of human capital, B_t is the gross amount of resources for schooling, θ is the unit cost of direct schooling. The human capital production function is given by

$$I_\tau^H = e^{b_1 SF}(AE_tH_t)^{\alpha_1}(B_t)^{\alpha_2} \qquad \alpha_1+\alpha_2 < 1 \tag{A.1}$$

A is a measure of childrens' unobservable ability, SF is an indicator function of the presence of social father. b_1 captures the impact of social father on the human capital production. The change of human capital stock is characterized by

$$\dot{H}_t = I_t^H - \delta H_t \tag{A.2}$$

where δ is the constant depreciation rate. At each time, the individuals minimize the total human capital production cost by choices of E_t and B_t

$$\min_{E_t,B_t}(\xi E_tH_t + \theta B_t)$$

subject to equation (A.2). The first order conditions give

$$\frac{\xi E_tH_t}{\theta B_t} = \frac{\alpha_1}{\alpha_2}$$

By simple algebra, we can derive the total cost function

$$C_t = \frac{\alpha_1+\alpha_2}{\alpha_1}\xi E_tH_t = \frac{\alpha_1+\alpha_2}{\alpha_1}\xi\left(\frac{I_t^H}{e^{b_1SF}A}\right)^{\frac{1}{\alpha_1+\alpha_2}}\left(\frac{\alpha_1\xi}{\alpha_2\theta}\right)^{\frac{\alpha_2}{\alpha_1+\alpha_2}} = C(I_t^H) \tag{A.3}$$

Each individual chooses an optimal path of E_t to maxmize his/her lifetime utility

$$\max_{E_t}\int_t^T e^{-\rho v}(\xi H_v - C_v)dv = \max_{E_t}\int_t^T e^{-\rho v}(\xi(1-E_v)H_v - \theta B_v)dv$$

subject to equation (A.2). By equation (A.3), we can rewrite the lifetime utility as

$$\max_{E_t}\int_t^T e^{-\rho v}\left(\xi\left(1-E_v\frac{\alpha_1+\alpha_2}{\alpha_1}\right)\right)dv$$

subject to

$$\dot{H}_t = Ae^{b_1SF}\left(\frac{\alpha_1\xi}{\alpha_2\theta}\right)^{\alpha_2}(E_tH_t)^{\alpha_1+\alpha_2} - \delta H_t \tag{A.4}$$

Let's define

$$\psi = Ae^{b_1 SF}(\frac{\alpha_1 \xi}{\alpha_2 \theta})^{\alpha_2}$$

The Hamiltonian function can be written as:

$$\Omega = e^{-\rho t}(\xi H((1-E\frac{\alpha_1+\alpha_2}{\alpha_1})) + \lambda(\psi(EH)^{\alpha_1+\alpha_2}\delta H) \quad \text{(A.5)}$$

The necessary conditions of the Hamiltonian will give

$$E^* = \frac{1}{H}(\frac{Ae^{b_1 SF}\alpha_1\alpha_2^{\alpha_2}\mu}{(\alpha_1\theta)^{\alpha_2}\xi^{1-\alpha_2}})^{\frac{1}{1-\alpha_1-\alpha_2}} \quad \text{(A.6)}$$

where $\mu = \lambda e^{\rho t}$ is the shadow price of investment which satisfies the transverality condition, $\lim_{t\to T}\mu(t)H(t) = 0$. It can be shown that

$$\mu(t) = \frac{\xi}{\rho+\delta}(1-e^{-(\rho+\delta)(T-t)}) \quad \text{(A.7)}$$

From equation (A.6), we derive the same conclusions from the discrete case that the input to human capital production is a positive function of A and μ; a negative functon of stock of human captial, ξ and θ.The impact of social father depends on the sign of b_1. The temporal evolution of E_t depends on the path of $\mu(t)$. It can be shown that E_t^* will be strictly less than 1 at the initial life cycle and gradually converges to zeor as t approaches T.

B. Detailed Description of Independent Variables For Estimation

Presence of social father	Mother was married to a new partner or was cohabiting with a new partner when the child was three year old
Child is of low birth weight	Dummy variables indicating the child weighted less than 5lbs 8 ounces at birth
Child is a boy	Dummy variables indicating the child is a boy
Child is mother's first birth	Dummy variable indicating the child is his/her mother's first birth
Mother's age	Mother's age at child's birth
Mother is white	Dummy variable indicating mother is white
Mother is Hispanic	Dummy variable indicating mother is Hispanic
Mother is black	Dummy variable indicating mother is black
Mother is of other race	Dummy variable indicating mother is of other race
Mother's education: less than HS	Dummy variable indicating mother completed less than high school study
Mother's education: HS	Dummy variable indicating mother completed high school study
Mother's education: some college	Dummy variable indicating mother completed some college
Mother's education: college	Dummy variable indicating mother completed college degree or above
PPVT score of the mother	Mother's PPVT score when the child was three years old
Mother is working	Dummy variable indicating mother was working when the child was three year old
Prenatal smoking by mother	Dummy variable indicating mother smoked cigarettes during pregnancy
Prenatal drinking by mother	Dummy variable indicating mother drank alcoholic beverages during pregnancy
Mother is foreign born	Dummy variable indicating mother was not born in the US
Mother is Catholic	Dummy variable indicating mother is Catholic
Mother is Protestant	Dummy variable indicating mother is Protestant
Mother is of other religion	Dummy variable indicating mother is of other religion
Mother has no religion	Dummy variable indicating mother has no religion
Mother attends religious activity	Dummy variable indicating mother attended religious activity
Household income (<=$10,000)	Dummy variable indicating mother's household income was less than $10,000
HH's inc. ($10,000 - $25,000)	Dummy variable indicating mother's household income was between $10,000 and $25,000
HH's inc. (>$25,000)	Dummy variable indicating mother's household income was higher than $25,000
HH's Poverty ratio (0-49%)	Dummy variable indicating mother's household income was below 49% of the poverty threshold (poverty line)
HH's Poverty ratio (50-99%)	Dummy variable indicating mother's household income was between 50% to 99% of the poverty threshold (poverty line)

HH's Poverty ratio (100-199%)	Dummy variable indicating mother's household income was between 100% to 199% of the poverty threshold (poverty line)
HH's Poverty ratio (>=200%)	Dummy variable indicating mother's household income was above 200% of the poverty threshold (poverty line)
Days in a week mother tells story	Number of days in a week the mother read story to the child
No. of adults in household	Number of adults in mother's household
No. of kids in household	Number of children in mother's household
Mother meets depression criteria	Mother meets liberal depression criteria when the child was three year old
Parents in romantic relationship at childbirth	The biological mother and biological father of the child was in romantic relationship when the child was born
Child uses father's last name	Dummy variable indicating the child uses the last name of the biological father
Father's name on birth cert.	Dummy variable indicating the name of the biological father was on the birth certificate of the child
Paternity established	Dummy variable indicating the paternity of the child was established