Child Support and Remarriage

Ning Ma*

Johns Hopkins University

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Abstract

This paper studies the reasons for low levels of child support paid by non-custodial divorced fathers. When mothers remarry, some financial burden of raising their children shifts from fathers to step-fathers. This provides an incentive for the father to encourage mother's remarriage through the use of strategically picked payment level. Assuming father's income is to some degree unobservable by mother after divorce, I first formulate a theoretical model of the father's optimal transfer and the mother's remarriage decision in a two-period dynamic Stackelberg game. The equilibrium closed form solution shows that the father's optimal transfer is lower when his income is partly unobservable to the mother than when it is fully observable. I then investigate the issue empirically, using data from the Panel Study of Income Dynamics (PSID) in the U.S., examining whether the father's payment is related to the degree of unobservability of his income, using proxies for that unobservability. The results show that the payment is indeed lower, the greater the degree of unobservability. In terms of the magnitude, associated with 1% increase in the income variation/level ratio, the annual reduction in child support transfer is estimated to be $8-25 in amount or 0.9-2% in likelihood, depending on the measure of income volatility used.

JEL Classification Numbers:

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1 Introduction

Single-parent female-headed families are a large and growing proportion of all families and comprise a disproportionately large share of the poor population. According to U.S. Census, in 2005, 22 percent of children less than 21 years old lived with their mother only, among which 27.7 percent lived under poverty and only 23.5 percent received full child support from divorced fathers [1]. The failure of many divorced fathers to comply with court-mandated child support awards has been identified as a major reason why a growing number of children live in poverty in female-headed households (Beller and Graham 1985).

A variety of reasons have been identified for inadequate transfer by divorced father, but few of them considers the endogenous role of mother's remarriage and is unsatisfactory in some way. Single mothers have serveral options to counteract their decline in economic well-being upon divorced, including joining the labor force and living on social welfare benefits. Faced with constrained options in the labor market by low experience levels or high need for children care, and inadequate or short term welfare benefits, however, the surest one is remarrying someone to share the burden of supporting family (Folk, Graham, and Beller 1992). Therefore, one might expect child support and remarraige to be correlated. However, both theoretical and empirical research provides inconclusive answers to the relationship between father's transfer and mother's remarriage in both direction and magnitude, while treating remarriage decision as exogenous.

In this paper, I jointly analyze father's optimal transfer and the mother's remarriage decision in a dynamic model. When mothers remarry, some financial burden of raising their children shifts from fathers to step-fathers, which provides an incentive for the father to encourage mother's remarriage through the use of strategically picked payment level. Assuming father's income is to some degree unobservable by mother after divorce, I first formulate a theoretical model of the father's optimal transfer and the mother's remarriage decision in a two-period dynamic Stackelberg game. The equilibrium closed form solution shows that the father's optimal transfer is lower when his income is partly unobservable to the mother than when it is fully observable. I then investigate the issue empirically, using data from the Panel Study on Income Dynamics (PSID) in the U.S., examining whether the father's payment is

[1] See "Custodial Mother's and Fathers and Their Child Support: 2005" by Bureau of Census at http://www.census.gov/prod/2007pubs/p60-234.pdf.

related to the degree of unobservability of his income. Using various measures of father's income volatility as proxies for that unobservability, I fit both mother's child support received amount and received dummy on unobservability proxies using OLS and Probit model. As a result, significantly negative impact of income variation on transferred amount and frequency are obtained. These results are robust to alternative hypotheses, because alternative explanations of lower divorced income level, higher precautionary saving motive, and lower frequencies of father-child contact are ruled out.

The plan of the paper is as follows. After describing the legislative child support system in U.S. and proving the degree of freedom in father's payment in Section 2, I briefly review the literature background in Section 3. In Section 4, I provide an exposition of modeling assumptions and divorced parents' equilibrium behavior in a structural model. The analysis leads to two statements about optimal transfer, remarriage probability, and unobservability. Following a description of the PSID and supplemental datasets in Section 6, I present reduced form evidence on the statement of optimal transfer in Section 7.2. Results in this section are shown to be robust, as alternative hypotheses are ruled out. Finally, Section 8 offers some concluding remarks.

2 The Child Support System in the United States

2.1 Child Support Court Award

When married parents divorce or separate, or when only one of the unmarried parents of a child has custody, the court may order the "non-custodial" parent (the parent with whom the child does not live) to pay a certain portion of his or her income as child support. In cases involving unmarried mothers seeking child support, the first step may be to legally establish the father's "paternity" of the child. These orders are issued by the family court, depending on the non-custodial and custodial parent's income, and the needs of the children.

2.2 Child Support Enforcement

Whereas once the arrangement for and payment of child support was left to the parents, now state child support enforcement agencies are taking an aggressive role in seeking payments from non-custodial parents. In response to the explosion of welfare caseloads in the 1960s, state and federal legislators have taken a number of steps to prevent nonresident fathers from abandoning their children financially and to increase the responsibility of resident mothers (see Garfinkel, McLanahan, and Meyer (1998) for a brief history). In 1975, Congress created the Child Support Enforcement (CSE) Program, which established state offices of CSE and authorized federal matching funds for states to help locate absent parents, establish paternity, institute child support orders, and obtain child support payments. The 1984 Child Support Amendments required states to develop legislative guidelines for determining child support awards and to withhold child support obligations from the paychecks of delinquent fathers. In 1988, the Family Support Act further mandated states to adopt presumptive guidelines for child support awards and to initiate automatic withholding from fathers' paychecks, regardless of delinquency. The Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996 finally reinforced paternity establishment by streamlining the legal processes and adopted the Revised Uniform Reciprocal Enforcement of Support Act (RURESA) to ensure payment of child support, when the non-custodial parent moves to another state.

Obviously in order to be eligible for CSE program, the divorced parents need to have a formal legal agreement established on child support obligation. Otherwise, there is no rule in guiding offices of child support enforcement to collect the delinquent amount. Even among these eligible famlies, the emphasis on welfare and nonwelfare cases are different, though in principle federal and state offices of child support enforcement are supposed to serve both welfare and nonwelfare cases. Due to the limited resources [2], the focus of legislators and bureaucrats has been on welfare cases with court award order only. As mentioned by Garfinkel, Heintze, and Chien-Chung (2001), "a much larger improvement in child support enforcement for welfare cases over nonwelfare cases is to be expected".

Current child support collected on behalf of families receiving AFDC is returned to reimburse the state and Federal governments for AFDC payments made to the families, and the extra child support payments are forwarded to the families. By contrast, for non-AFDC cases, participation in the OCSE caseload is voluntary, and the collected child support payments are sent to the families (Legler 1996; Wolk and Schmahl 1999).

[2] Federal matching funds were not available on a permanent basis to serve non-AFDC families until 1980. Incentive funding, which was available for AFDC collections, was not extended to non-AFDC collections until 1984. See Sorensen and Halpern (1999).

2.3 Non-custodial Parents' Flexibility to Pay

It's worth nothing, however, that even with CSE program put into practice, non-custodial parents can always have some degree of freedom in choosing whether and how much to pay. For one thing, the eligibility condition of welfare cases with court award only rules out a large share of divorced parents. According Bureau of Census report, of the 13.6 million custodial parents in 2005, only 2 million (15 percent) both have court award order and participate in public assistance programs, and therefore are eligible to be covered by CSE program automatically. For another, even with RURESA, non-custodial parents can still move in a different state than their ex spouses to shirk payments, as interstate support order enforcement is very less likely due to the process complexity and the low priority assigned. Furthermore, a person may petition the court for a reduction, if he/she becomes unable to pay support for whatever reason. In the extreme case, he/she could get his/her employer to falsely claim that he/she'd been fired even though that is not the truth [3].

In terms of the statistics, an estimated 13.6 million parents had custody of 21.2 million children under 21 years of age while the other parent lived somewhere else, representing 26 percent of all 81.6 million children under 21 years old living in families in 2005 [4]. In all cases, mothers are more likely to get custody and suffer from poverty. Of the 13.6 million custodial parents, 5 of every 6 were mothers (83.8 percent) and 1 in 6 were fathers (16.2 percent). The poverty rate of custodial mothers is 27.7 percent, much higher than the poverty rate amoung custodial fathers, 11.1 percent. Of the same 13.6 million custodial parents, only 7.8 million (57.3 percent) had some type of agreement or court award to receive financial support from the non-custodial parent for their children [5], among which 46.9 percent received the full amount of child support due in 2005 [6]. The deliquency problem is even more serious for custodial mothers, since 9 of every 10 (90 percent) custodial parents due child support were mothers, and 1 in 10 (10 percent) were fathers.

The above reasoning and evidence provide ground for analysis of transfer pattern as a

[3] For instance, see a real case at http://www.nolo.com/legal-encyclopedia/question-28399.html;jsessionid=43341CFE47F1EDC60C184CAAF930055B.jvm1.

[4] See "Custodial Mother's and Fathers and Their Child Support: 2005" by Bureau of Census at http://www.census.gov/prod/2007pubs/p60-234.pdf.

[5] The most often cited reasons for no formal legal agreement established were that they did not feel the need to go to court or get legal agreements (33.7 percent), the other parent provided what he or she could for support (27.9 percent), and they felt the other parent could not afford to pay child support (24.1 percent).

[6] Another 30.3 percent received some but not all payments, and 22.8 percent received no child support at all.

rational behavior result.

2.4 Child Support and Remarriage

Normally the basis for stopping child support for a child is when the child reaches the age of majority (usually eighteen) or graduates high school, depending on the law of the state [7]. Parents' remarriages, however, don't necessarily stop the payment by law. Even if a custodial parent remarries, he or she is still entitled to receive child support unless his or her new spouse adopts the child.

Nonetheless, in the event that the custodial mother remarries, child support is expected to be depressed, as judges and former spouses would assume income from her current spouse to be available to the children of her former union, regardless of prescriptions to the contrary. Indeed, previous studies have found that remarried mothers are less likely to receive child support and receive significantly less than do other eligible mothers. Using March/April Match File of the 1979 Current Population Survey, Beller and Graham (1985) find 44% of divorced or separated mothers receive any child support, while only 39% of remarried mothers receive anything. Likewise, using PSID 1968-1975, Cassetty (1978) find if the female head remarried, not only was the amount of support likely to be reduced by $205 per year, but it was quite likely that it ceased altogether. In PSID 1968-2007, I also find received child support amount by divorced or separated mothers is averaged at $537 per year, compared to only $75 for married mothers. The likelihood of receiving any child support is much higher for divorced or separated mothers at 18%, than only 3% for remarried mothers.

3 Literature

3.1 Theoretical Explanations for Low Child Support Transfer

Focusing on the female-headed families, a variety of possible reasons have been proposed to explain why so many divorced fathers allow their children's welfare to suffer as a consequence of divorce (Weiss and Willis 1985).

Among the poor and near poor, the existence of AFDC/TANF welfare program obviously creates a disincentive for child-support transfer from father because it will be offset by re-

[7] Many states say payments stop at the later of those two events (assuming the child will graduate high school in a normal amount of time).

ductions in welfare transfer. The Child Support Amendments of 1984 entitled the custodial family on AFDC to receive only the first $50 collected in child support each month, referred to as the "$50 pass through" or the "$50 disregard," as this $50 was not to be included in the determination of AFDC eligibility or payment amounts (Barnow, Dall, Nowak, and Dannhausen 2000). When covered by the welfare program, each additional dollar transferred from father to mother would increase her well-being and therefore reduce welfare benefits entitled by the same amount.

However, the problem of inadequate transfer and noncompliance by divorced father is not confined to the poorest segments of society. Even fathers who have a considerable "ability to pay" often do not comply with court awards, and the amounts awarded are often of fairly modest magnitude (Cassetty 1978, Chambers 1979, Sorenson and MacDonald 1983). This evidence suggests another possibility that divorce itself results in a reduction of the joint real income of the couple, so that the living standards of the couple and their children achieved under marriage are no longer feasible. Such income losses may be due to the costs of divorce itself, to the loss of gains from the division of labor and scale economies associated with marriage, or to labor market reversals caused by or resulting in divorce.

While divorce doubtless inflicts economic costs, there is evidence that the living standards of (non-custodial) divorced father tend to suffer far less than do the living standards of the (custodial) mother and her children (Hoffman 1977, Weitzman 1981, Bane and Ellwood 1983b). To interpret such phenomenon, Weiss and Willis (1985) model children as collective consumption goods from the father's and mother's point of view. Within marriage, proximity and altruism serve to overcome the "free-rider" problem associated with the provision of public goods. Upon divorce, however, the non-custodial parent suffers a loss of control over the allocation decisions of the custodial parent, and therefore reveals a reduced interest in the welfare of their children.

To my knowledge, the only study that interprets this phenomenon taking mother's remarriage as endogenous is by Chiappori and Weiss (2007). Because of potential conflict with the new husband who cares less about the child, a transfer that guarantees that the custodial wife, if single, would be restored to the same level of child expenditure as under marriage is insufficient to maintain that level of child expenditure if she remarries. There is thus room for additional payment by the father to boost her bargaining power on child expenditure with the new husband. A higher transfer level, however, also reduces his own utility; therefore the optimal transfer is solved by maximizing his expected utility upon separation. Furthermore, a symmetric equilibrium where all agents act in the same way is solved to match divorce probability with remarriage probability in the marriage market. Without empirical evidence, they conclude that the higher expectations for remarriage following from higher divorce rates can trigger an equilibrium in which divorced father makes more generous transfers than what guarantees the same level of child expenditures as under marriage to benefit both this child and the mother in the aftermath of divorce. Such a conclusion is apparently inconsistent with the fact that child always suffer from lower living standards than under marriage.

3.2 Empirical Relationship between Remarriage and Child Support

Using cross-sectional data from March/April match file of the Current Population Survey, Folk, Graham, and Beller (1992) indicate that child support receipt is not related to remarriage for those divorced women who remarry quickly (within the first five years). For those who are not married five years after their divorce child support does lower the probability of remarriage but the effect is very small. However, as the authors indicate, those who are unmarried five years or more after their divorce may differ from women who remarry more quickly on unobservable factors that also affect their probability of remarrying. Those who remain unmarried after five years may be negatively selected on, for example, income, which would raise their child support, ceteris paribus, and provide the observed result.

Using four longitudinal datasets [8], Yun (1992) undertakes event history analysis and finds that the relationship between child support transfer and remarriage is nonlinear. Receiving any child support makes remarriage more likely, but the strength of this influence wanes as the amount of child support paid grows. Additionally, continuity in transfer is important. Those mothers who do not receive regular amounts of transfer on a steady basis are more likely to remarry. Yun also examines the quality of the new partners as proxied by their income and education level. Theory would predict that those who do not receive child support marry men of lower quality, for they must marry more quickly for economic security reason and can only undertake a short search. This prediction is upheld when income is used to measure men's

[8] The Court Record Database (CRDB), tax records, welfare records, and the Parent Survey. The first three are administrative records collected by counties of the state of Wisconsin. The fourth dataset is conducted by the Institute for Research on Poverty, University of Wisconsin-Madison.

quality, but not when education is used.

In short, researchers tend to find a mild negative effect of child support on remarriage. But they do not provide conclusive answers to the issue of either direction or magnitude.

4 Theoretical Model

The model built in this paper describes the mechanism through which father's optimal transfer and mother' remarriage decision are made jointly on the household level. The analysis begins with divorce, but doesnt involve divorce decision itself. In the aftermath of divorce, when partners are loosely related to each other both physically and mentally, they may not be always on the same page, so I assume father has private information about his own income level. Because of such unobservability, child support is modeled as a signal of this income level and used to lever mother's remarriage decision. Suppose the mother is more likely to get remarried when the father pays insufficient amount, and her remarriage makes him better off by shifting the burden of childrearing to stepfather, then the father would have potential to intentionally underpay in order to encourage her remarriage. Thus the introduced father's unobserved income level enables him to strategically pick child support amount with an eye towards manipulating her remarriage decision.

In the rest of the paper, I assume:

Assumption 1. The mother is child's custodial parent.

Assumption 2. Both father and mother live for two periods after divorce. The father never remarries, and pays child support only when she remains single. The mother remains single in the first period, and considers remarriage in the second.

Assumption 3. The remarriage proposal arrives at beginning of second period, when the stepfather alone gets to decide on child expenditure exogenously. Without any bargaining, the mother responds by either accepting remarriage offer or rejecting it.

Assumption 4. Father's and stepfather's utility are linear in adult good and quadratic in child good: $U_{it}(c_{it}, a_{it}) = a_{it} + \beta(c_{it} - \frac{c_{it}^2}{2\alpha_i Y_i})$, where a, c are adult and child good, $i = \{f, s\}$ denotes father and stepfather, $t = \{1, 2\}$ denotes time, and α, β are parameters. Mother's utility depends on child good alone: $U_{mt}(c_t) = c_t, t = \{1, 2\}$.

Assumption 5. Father's income type $\dot{Y}_f$ is unobservable to the mother after divorce, and stepfather's type $\tilde{Y}_s \sim \mathsf{U}(0, \frac{1}{k})$, where k is parameter. Mother has no income. No saving is allowed.

The following sub-sections describe modeling assumptions and partners' equilibrium behaviors in detail.

4.1 Legal Framework, Timing and Matching

Without loss of generality, I assume the mother is child's custodial parent.

By assumption, both parents live for two periods after divorce, a minimum requirement of being a dynamic model. It's worth noting that a dynamic model is needed in order to address the concern here, because his payment and her remarriage decision have to be modeled sequentially in order for manipulation to be feasible. Otherwise if they were to act simultaneously, there would be no chance for his manipulation at all.

The father is assumed to never remarry after divorce, and pay child support only if the mother is single. The purpose of assuming zero payment upon remarriage is driven by the necessity to capture declined payment level in reality, while simplifying the derivation process. Allowing some reduced nonzero payment would not change the main results in general, but will complicate the process of solving an equilibrium closed form solution a lot.

The mother remains single in the first period, and considers remarriage only in the second, when she has already observed father's first period payment, formed expectation of his next payment, and met with an exogenously randomized new husband, whose income level is known with certainty at this time. To focus on the play between biological parents, bargaining between mother and new spouse is assumed away, so that stepfather alone gets to decide how much to spend on the child after remarriage, based on his exogenous income level. When he proposes such offer to the mother, she responds by either accepting or rejecting the offer, depending on whether her second period expected utility is improved. If she's better off with the new husband, remarriage occurs. Otherwise, remarriage proposal is rejected.

4.2 Preferences and Endowments

With a variant utility functional form of Chiappori and Weiss (2007)'s, I assume father and stepfather's utility are linear in adult good and quadratic in child good standardized by his income:

$$U_{it}(c_{it}, a_{it}) = a_{it} + \beta(c_{it} - \frac{c_{it}^2}{2\alpha Y_i}) \quad (1)$$

where a_{it}, c_{it} are adult and child good, $i = \{f, s\}$ denotes father and stepfather, $t = \{1, 2\}$ denotes periods, and parameters α, β govern their preference. β is a discount factor for proximity, and α is curvature of child's utility. I will not distinguish between father's and stepfather's α, β, because evidence has found little difference between natural child and stepchild[9]. But it can be shown that introducing α_i, β_i won't change the main results.

The main difference between father's and stepfather's behaviors is marked by their their different income proverty. Father's income $\dot{Y}_f$ is assumed to be his private information and not prefectly observable to the mother. Whether far from sight is far from heart or to what degree the father wants to compensate the child for loss of an intact family is a personal matter to himself, and may not be observable to the mother. Unobservability of $\dot{Y}_f$ also necessitates the child support payment as a signal tool for the true value of $\dot{Y}_f$. Being unable to forecast his next payment based on true $\dot{Y}_f$, she would have to formulate her expectation based on what he paid previously. From her perspective, an extremely low amount would indicate low value of $\dot{Y}_f$ and therefore father's genuine inability to pay in the future, so that she had better get remarried. Otherwise, if information were symmetric between father and mother, she would always accurately predict his future payment regardless of what he paid previously, and base her remarriage decision on that. This again rules out any possibility for father's manipulation. By contrast, stepfather's income level $\tilde{Y}_s$ is a random draw from a uniform distribution between 0 to $\frac{1}{k}$, where k is an exogenous parameter evaluating the inverse of mother's remarriage propensity. Such income level is unknown to both mother and father, until the beginning of the second period when remarriage proposal is realized.

Both father and stepfather allocate their exogenous income Y_i between a_{it} and c_{it} in each period, without savings allowed. The unit price of child's goods is assumed to be 1. All this information is common knowledge, so that the mother knows it as well as the father and the

[9]By analyzing questionnaire data from 2,247 respondents, Wilson, Zurcher, McAdams, and Curtis (1975) find little differences between natural children and stepchildren. Duberman (1973), using a random sample of stepparents who married during the years 1965-68 in Ohio, find 18, 18, and 64 percent rated their stepparent-stepchild relationships as "poor", "good", and "excellent". Such observations may not be surprising, as higher marital quality is found to be associated with more positive stepparent-stepchild relationship in Brand and Clingempeel (1987).

stepfather.

For simplicity again, I assume away the complexity involved in mother's resource allocation, and her utility is solely dependent on child's consumption. Allowing mother's utility to depend on both adult goods and child goods won't change the main results, as that will essentially boost her welfare status under different arrangements by the same amount. The last simplifying assumption is mother's zero income, by the same token. As a result, her second period utility is either father's child support transfer if she remains single or stepfather's child expenditure if she remarries.

4.3 Time Line

Figure 1 describes the procedure involved in this two-period dynamic model. In the first period, the father starts with a transfer level c_{f1}, and in the second period, a potential stepfather arrives with an exogenous income level $\tilde{Y}_s$. If the mother agrees to remarry with him, he promises to pay c_{f2} on child expenditure in the second period, which is a function in $\tilde{Y}_s$. The mother, being unable to forecast father's second period payment beforehand because of unobservability, forms some expectation of father's next payment based on what he paid previously, and compares it with the stepfather's potential transfer in making remarriage decision. Since her own utility is also child's utility, the decision is based on whoever promises better child welfare.

On one hand, if she remarries, father doesn't have to pay anything but enjoys the free-rider benefit of stepfather's investment through the child's welfare. Therefore his second period utility when she remarries is a function in stepfather's income $\tilde{Y}_s$. On the other hand, if she decides to reject the remarriage offer, the father would have to decide on his own second period payment optimally given his preference. The obtained optimal utility level can be shown to be a fixed amount. Knowing all these rules of mother's remarriage and stepfather's resource allocation, the father would have incentive to strategically pick his transfer level c_{f1} in the first period dynamically so as to maximize his lifetime utility.

4.4 Backward Induction Algorithm

This two-period model is solved using the backward induction algorithm. Specific formulas of father's second period utility and mother's remarriage decision will be first solved, given that

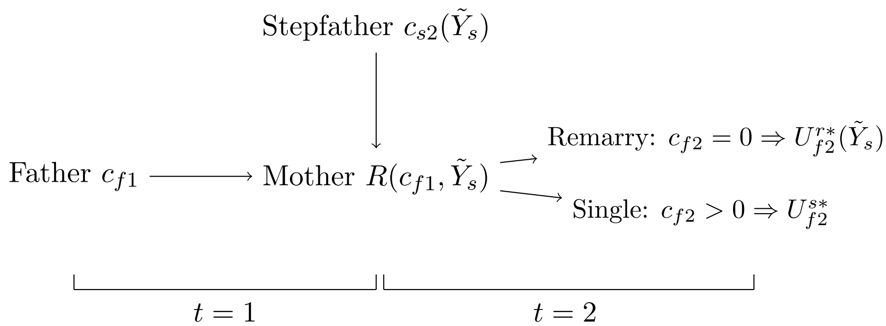

Figure 1: Time Line

agents have already been in the second period. Then these intermediate expressions will be plugged back into father's first period problem, to solve the optimal value of c_{f1}^* dynamically.

4.4.1 Stepfather's Second Period Problem

In the second period, if mother decides to accept the remarriage proposal, the stepfather's optimization problem is to allocate his income $\tilde{Y}_s$ between adult good a_{s2} and child good c_{s2}, in order to maximize his current utility under income constraint:

$$\begin{aligned} \text{Max} \quad & U_{s2}(c_{s2}, a_{s2}) = a_{s2} + \beta(c_{s2} - \frac{c_{s2}^2}{2\alpha\tilde{Y}_s}) \\ \text{s.t.} \quad & c_{s2} + a_{s2} = Y_s \end{aligned} \tag{2}$$

The quadratic nature of his preference leads to an optimal transfer linear in his income:

$$\begin{cases} c_{s2}^*(\tilde{Y}_s) &= \gamma\tilde{Y}_s \\ a_{s2}^*(\tilde{Y}_s) &= (1-\gamma)\tilde{Y}_s \end{cases} \tag{3}$$

where $\gamma \equiv \alpha(1 - \frac{1}{\beta})$. To make meaningful sense, I assume $\beta > 1$ so that $c_{s2}^*(\tilde{Y}_s) > 0$.

The same child expenditure indirectly affects father's second period utility through child's welfare. By spending all his income on adult goods and enjoying a free-rider benefit of stepfather's investment, the father ends up having an optimal second period utility as a function in stepfather's income $\tilde{Y}_s$:

$$U_{f2}^{r*}(\tilde{Y}_s) = \dot{Y}_f + \beta(\gamma\tilde{Y}_s - \frac{\gamma^2\tilde{Y}_s^2}{2\alpha\dot{Y}_f}) \tag{4}$$

4.4.2 Father's Second Period Problem

Contrarily, if she declines the remarriage proposal and remains single, the father would solve a similar problem to stepfather and allocate income $\dot{Y}_f$ optimally between adult good a_{f2} and child good c_{f2} in the second period:

$$\begin{aligned} \text{Max} \quad & U_{f2}(c_{f2}, a_{f2}) = a_{f2} + \beta(c_{f2} - \frac{c_{f2}^2}{2\alpha\dot{Y}_f}) \\ \text{s.t.} \quad & c_{f2} + a_{f2} = \dot{Y}_f \end{aligned} \tag{5}$$

The quadratic nature of his preference again leads to an optimal transfer linear in his type:

$$\begin{cases} c_{f2}^* &= \gamma\dot{Y}_f \\ a_{f2}^* &= (1-\gamma)\dot{Y}_f \end{cases} \tag{6}$$

Substituting the solutions back into father's utility function generates his optimal second period utility when she remains single:

$$U_{f2}^{s*} = (1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha}) \tag{7}$$

This fixed amount U_{f2}^{s*} is the best he can do under the circumstances, once she remains single in the second period.

4.4.3 Mother's Second Period Problem

Given father's previous payment and stepfather's remarriage proposal, the mother's remarriage decision is made at the beginning of second period by maximizing her second period expected utility. Since mother's utility is simply child good, to make the remarriage decision is equivalent to pick whoever pays more:

$$R = \begin{cases} 1 & \text{if} \quad c_{s2}^* >= c_{f2}^* \\ 0 & \text{if} \quad c_{s2}^* < c_{f2}^* \end{cases} \tag{8}$$

By the intermediate solutions of optimal payment in Equation (3) and (6), the criterion reduces to a comparison between father and stepfather's income level, only that $\dot{Y}_f$ is father's private information and unobservable to the mother:

$$R = \begin{cases} 1 & \text{if} \quad \tilde{Y}_s >= \dot{Y}_f \\ 0 & \text{if} \quad \tilde{Y}_s < \dot{Y}_f \end{cases} \tag{9}$$

The innovation of this paper is to introduce a functional form $g(c_{f1})$ which links father's first period payment c_{f1} and his true income level $\dot{Y}_f$, from the mother's perspective. It represents a mechanism through which, she believes, his previous payment and income are related. Such belief has to coincide with father's true behavior at equilibrium, but ex ante it can be anything. Substitute $g(c_{f1})$ back into mother's remarriage decision, the threshold value of stepfather's income that makes her indifferent between remaining single and remarriage is a function in father's first period payment and stepfather's income:

$$R(c_{f,1}, \tilde{Y}_s) = \begin{cases} 1 & \text{if} \quad \tilde{Y}_s >= g(c_{f1}) \\ 0 & \text{if} \quad \tilde{Y}_s < g(c_{f1}) \end{cases} \tag{10}$$

This equation is exactly the reason for father's strategic behavior, as knowing that her remarriage is dependent on previous payment, he would be not only motivated but also capable of controlling her remarriage decision to his own interest by strategically picking c_{f1} in the first place.

4.4.4 Mother's Belief

Undoubtedly, father's optimal payment is going to depend on what the mother believes. In the following, I consider three cases for $g(c_{f1})$ specification, corresponding to various degrees of unobservability between mother and father. The purpose is to show lower optimal value of c_{f1} when the degree of unobservability is higher.

Perfect Observability In the extreme case of perfect observability, the mother would always know his type with certainty, so that

$$\forall c_{f1}, g(c_{f1}) \equiv \dot{Y}_f, g'(c_{f1}) = 0 \tag{11}$$

Such perfect observability on mother's part would rule out any possibility for father's manipulation by paying less, therefore a higher level of payment would be expected.

No Observability On the contrary, in the opposite extreme case of no observability, $g(c_{f1})$ could be of any functional form rather than a constant, and $g(c_{f1})$ is not 0 point by point. The only restriction is that at the particular value of optimal payment she would have to guess it right. This is because equilibrium requires every agent involved to behave optimally given their expectations, and those expectations are realized:

$$g(c^*_{f1}) = \dot{Y}_f, \forall c_{f1}, g'(c_{f1}) > 0 \tag{12}$$

To make meaningful sense, I assume father's payment is always a positive signal of his type, so that $g'(c_{f1}) > 0$. Under this scenario, he is able to entirely control her reaction via the equilibrium condition, implying a lower strategic payment level than with perfect observability.

Rational Expectation In between perfect and no observability cases, I also consider the intermediate case where mother's belief is father's true income tainted with some error term. To see that, consider father's type as a combination of unobserved permanent trend $\dot{Y}_f$ and a transitory shock ω. In predicting his next payment, the mother only cares about his permanent trend $\dot{Y}_f$, which matters in the long run. Knowing the existence of ω, her belief based on c_{f1} alone would have to involve some error term in addition to the true value of $\dot{Y}_f$. Therefore mother's belief now becomes a two dimensional function:

$$g(c_{f1}, \epsilon) = \dot{Y}_f + \epsilon \tag{13}$$

where ϵ is her independent guessing error that follows a symmetric distribution $\epsilon \sim (0, \sigma^2_\epsilon)$. This is again required by the rational expectation condition: expectedly her belief is realized at equilibrium. The variance σ^2_ϵ measures the degree of father's controllability over mother's behavior, due to the existence of transitory shock ω. The very existence of ω deprives the father of his full control over her belief as in the extreme case of no observability. The larger σ^2_ϵ is, the more uncertain her belief would be, and the more difficult it will be for his manipulation, and the higher payment would be needed. In other words, a payment level increasing in σ^2_ϵ

and in between perfect observability and no observability cases will be expected.

4.4.5 Father's First Period Problem–Equilibrium

With all these intermediate expressions underway and various specifications for $g(c_{f1})$ formula, father's first period problem corresponding to each scenario is listed below. Given mother's remarriage function, the optimal c_{f1} and a_{f1} are dynamically picked so as to maximize father's lifetime utility, subject to first period income constraint and equilibrium condition:

- Perfect Pbservability:

$$\begin{aligned} \max_{a_{f1},c_{f1}} \quad & a_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha\dot{Y}_f}) + \rho\{\int\limits_{\tilde{Y}_s > g(c_{f1})} U_{f2}^{r*}(\tilde{Y}_s) f(\tilde{Y}_s) d\tilde{Y}_s + U_{f2}^{s*} F_{\tilde{Y}_s}[g(c_{f1})]\} \\ \text{s.t.} \quad & c_{f1} + a_{f1} = \dot{Y}_f, \dot{Y}_f \equiv g(c_{f1}) \end{aligned} \tag{14}$$

- Rational Expectation:

$$\begin{aligned} \max_{a_{f1},c_{f1}} \quad & a_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha(\dot{Y}_f+\omega)}) + \rho E_\epsilon\{\int\limits_{\tilde{Y}_s > g(c_{f1},\epsilon)} U_{f2}^{r*}(\tilde{Y}_s) f(\tilde{Y}_s) d\tilde{Y}_s) + \\ & U_{f2}^{s*} F_{\tilde{Y}_s}[g(c_{f1},\epsilon)]\} \\ \text{s.t.} \quad & c_{f1} + a_{f1} = \dot{Y}_f + \omega, \dot{Y}_f + \epsilon = g(c_{f1},\epsilon), \epsilon \sim (0, \sigma_\epsilon^2) \end{aligned} \tag{15}$$

- No Observability:

$$\begin{aligned} \max_{a_{f1},c_{f1}} \quad & a_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha\dot{Y}_f}) + \rho\{\int\limits_{\tilde{Y}_s > g(c_{f1})} U_{f2}^{r*}(\tilde{Y}_s) f(\tilde{Y}_s) d\tilde{Y}_s + U_{f2}^{s*} F_{\tilde{Y}_s}[g(c_{f1})]\} \\ \text{s.t.} \quad & c_{f1} + a_{f1} = \dot{Y}_f, \dot{Y}_f = g(c_{f1}^*), g'(c_{f1}) > 0 \end{aligned} \tag{16}$$

Except for the different specifications of $g(c_{f1})$ across three cases, the objective function in rational expectation case also differs from the extremes with the expected value terms. In the objective function, c_{f1} affects value function not only through his instant utility but also his subsequent expected utility via the integration bound for remarriage and likelihood of remaining single. The U_{f2}^{s*} and $U_{f2}^{r*}(\tilde{Y}_s)$ expressions are obtained from backward induction algorithm in Equation (7) and (4). $f(\tilde{Y}_s)$ is density function for $\tilde{Y}_s$. Functional form of $g(\cdot)$ is unknown and needs to be solved.

4.4.6 Equilibrium Solution and Statements

From the constrained first order conditions[10], equilibrium closed form solutions of c_{f1} corresponding to the above cases are:

- Perfect Observability:

$$c^*_{f1} = \gamma \dot{Y}_f \tag{17}$$

- Rational Expectation:

$$c^*_{f1} = \gamma(Y_f + \omega)[1 - \sqrt{1 - \frac{\rho k(\sigma^2_\epsilon - 12(\beta - 4)Y^2_f)}{(\beta - 1)(Y_f + \omega)}}] \tag{18}$$

- No Observability:

$$c^*_{f1} = \gamma \dot{Y}_f (1 - \sqrt{1 - \frac{2\rho k \dot{Y}_f}{\beta - 1}}) \tag{19}$$

As expected, optimal payments under rational expectation and no observability scenarios are indeed lower than perfect observability. The decreased amount is used to signal and pretend he is a poor and impoverished father that he is really not. Even though the father can afford to pay more, he would not want the mother to think this way, as this would increase her remarriage likelihood and his chance of enjoying the free-rider benefit. Furthermore, in the intermediate case of rational expectation, c^*_{f1} also increases with σ^2_ϵ.

To see the underlying pattern more intuitively, Figure 2 plots the simulated c^*_{f1} as father's income $\dot{Y}_f$ changes under different scenarios The parameter values used are listed at the bottom. Indeed, more wealthy fathers typically transfer more; the more information advantage he has over the mother, the less payment he has to offer.

[10]See Appendix for mathematic derivation.

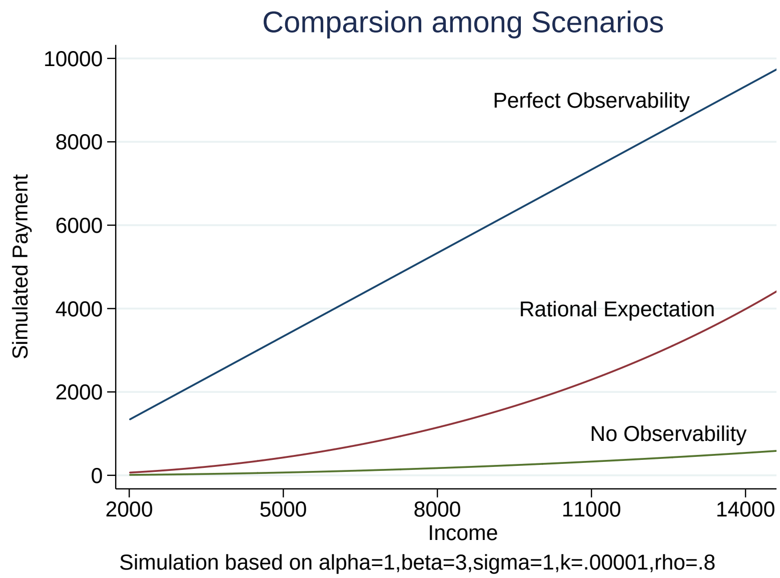

Figure 2: Optimal Payment Pattern

Here comes the main statement about child support.

Statement. ***The father's optimal transfer is lower when his income is partly unobservable to the mother than when it is fully observable.***

The resulted mother's remarriage likelihood is then the difference between upper bound of $\tilde{Y}_s$ uniform distribution and the threshold value of $g(c^*_{f1})$, by mother's remarriage reaction function in Equation (10):

$$\Pr(\text{remarry}) = \frac{1}{k} - g(c^*_{f1}) \tag{20}$$

Two corollaries about remarriage likelihood can be derived from this formula. First of all, as c^*_{f1} is lower than it would be under perfect observability, the remarriage likelihood is also higher than it would be. Secondly, ceteris Paribas, child support should be negatively correlated with remarriage, but as the unobserved k parameter in remarriage equation also enters c^*_{f1}, conventional estimates of its causal effect on remarriage must be biased. In particular, c^*_{f1} and k, and remarriage probability and k are both negatively correlated, so that failure to explicitly control k would bias the estimates upward. This perhaps explains the lack of consistent evidence in the empirical literature. Such a bias could be removed by using instrumental variables for father's transfer that are not related to mother's remarriage propensity. Seearch for a valid instrument variable holds its own interest and is beyond the scope of this paper.

Corollary 1. ***The mother is more likely to get remarried when his income is partly unobservable than when it is fully observable.***

Corollary 2. ***Conventional causal effect estimates of fathers transfer on mothers remarriage suffer from upward bias.***

5 Empirical Estimation

As far as the estimation method is concerned, the model could have been structurally estimated if the assumptions about mother's utility and income were not made so strict and unrealistic. But if the purpose is only to prove the existence of strategic behavior and to interpret inadequate payment through such existence, not about the utility function parameters, a reduced form OLS would be sufficient to do the job.

A practical problem with empirical test of child support statement lies in the lack of information on both spouses upon separation. In micro surveys, data on both divorced spouses upon separation seldom coexist, as the surveys are usually carried out on a household basis, and one of them always moved away. For instance, in the PSID dataset to be used here, only family unit of either spouse but not both are covered in a divorce or separation, depending on who was found first for the interview. Consequently, any information on the absent spouse after divorce is missing and needs to be simulated. In the following, I will take mother's subsample as basis and simulate divorced father's missing information from his within marriage historical records.

5.1 Proxy Measures of Observability

The key explanatory variable of the child support statement involves degree of mother's observability on father's income level. This is proxied by various father's income volatility–a readily available measure reflecting mother's difficulty in predicting his allocable resources. In particular, four measures of father's scaled income variation over the married historical periods are constructed. These are the periods when she can observe his income and become aware of his income volatility. The constructed measures are:

1. Mean accumulated scaled standard deviation of labor income in logarithm:

$$\frac{1}{T}\sum_{t=1}^{T}\frac{[\sum_{s=1}^{t}(y_s-\overline{y}_s)^2]}{t*\overline{y}},$$

where y_s is logarithm of father's labor income at period s, $\overline{y}_s = \frac{\sum_{s=1}^{t} y_s}{t}$ is the accumulated mean up until period s, and $\overline{y} = \frac{\sum_{s=1}^{T} y_s}{T}$ is the averaged level over all T years when father was married with mother;

2. Mean accumulated scaled mean squared change of logarithm labor income:

$$\frac{1}{T}\sum_{t=1}^{T}\frac{[\sum_{s=2}^{t}(y_s-y_{s-1})^2]}{(t-1)*\overline{y}};$$

3. Mean accumulated scaled mean squared change of logarithm labor income over the last three available years:

$$\frac{1}{T}\sum_{t=1}^{T}\frac{[\sum_{s=t-2}^{t}(y_s-y_{s-1})^2]}{3*\overline{y}};$$

4. Simulated scaled squared residual of father's divorced labor income fitted on his characteristics within marriage, with coefficient estimates from father's sample:

$$ln(y_{ft}^{D}) = \boldsymbol{\alpha}_1 X_f^M + \epsilon_t \Rightarrow \hat{\epsilon}_t \Rightarrow \frac{\hat{\epsilon}_t^2}{\overline{y}} = \boldsymbol{\alpha}_2 X_f^M + \zeta_t \qquad (21)$$

where y_{ft}^{D} is father's (subscript f) labor income at period t in divorce (superscript D); X_f^M contains his averaged demographic attributes within the previous marriage and income, including labor income, age, education, race, number of kids, residence within a Primary Metropolitan Statistical Area (PMSA) and within the central city, state, region, and year dummies; ϵ_t is an idiosyncratic error term; $\boldsymbol{\alpha}_1$ is coefficient vector to be estimated. The obtained scaled residuals $\frac{\hat{\epsilon}_t^2}{\overline{y}}$ are in turn regressed on X_f^M to estimate parameter vector $\boldsymbol{\alpha}_2$, where ζ is another i.i.d error term. The obtained vector $\hat{\boldsymbol{\alpha}}_2$ is then multiplied with father's averaged within-marriage historical records to simulate the last control of observability in mother's sample.

5.2 Child Support Statement

With the constructed income volatility measures, the child support statement is tested by fitting the following equation:

$$C^D_{mt} \quad = \quad \boldsymbol{\beta}_1 V^M_f + \boldsymbol{\beta}_2 X^D_{mt} + \eta_t \tag{22}$$

where C^D_{mt} is child support received by mother (subscript m) at period t in divorce (superscript D), V^M_f is father's marriage-specific income volatility measure, and X^D_{mt} contains mother's characteristics in divorce at period t, including age, race, education, total income, welfare participation status, number of kids, marriage duration, the number of years since divorce, residence within a PMSA and within the central city, state, region, and year dummies. η_t is an i.i.d. error term, representing the remaining unexplained variation due to the varying magnitude of utility parameters α, β. $\boldsymbol{\beta}$'s are coefficient vectors to be estimated. Equation (22) will be fitted by both OLS and Probit, with dependent variable being received amount and dummy, respectively.

5.3 Alternative Hypotheses

Approximating observability with income volatility is not error proof, because income volatility may have some other negative impact on child payment, even without strategic consideration. The multiple channels that income volatility may have negatively impacted father's transfer include:

- Alternative 1 (A1): father with more unstable income may have lower income levels, and poorer father tends to transfer less;
- Alternative 2 (A2): father with more unstable income may have a higher precautionary saving motive, and more prudential father transfers less;
- Alternative 3 (A3): father with more unstable income may care less about the child, and less concerned father transfers less.

To sum up, a father earning risky income may transfer less because he might have in general lower income level, or higher precautionary saving motive, or simply care less about the child after divorce. Each of these leads to lower child support payment, regardless of strategic

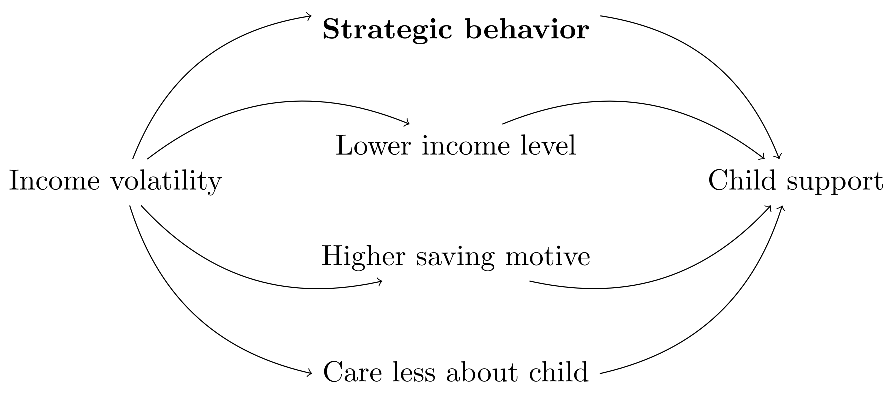

Figure 3: Alternative Hypotheses

behavior. Figure 3 presents the multiple channels through which high income volatility and low child support might be correlated.

Therefore one should be cautious in drawing conclusions on the transfer statement based solely on a negative $\hat{\boldsymbol{\beta}}_1$ estimate from Equation (22). The goal here is to prove the existence of a negative relationship between income volatility and child support, while guaranteeing that such linkage doesn't go through any other channel than strategic behavior. To rule out alternative possibilities, ideally I would wish to run a regression of child support on income volatility, with additional controls for all these alternatives to tease out their effects. But the missing data problem of divorced father in mother sample negates such attempt.

Instead, these alternatives are eliminated by cutting off the one side linkage between income volatility and some additional controls. The logic comes from the fact that establishment of alternative rationalities requires not only a positive correlation between these additional controls and child support, but also a negative correlation between them and income volatility. The lack of relationship in either side would be sufficient to rule out a certain hypothesis in favor of the strategic story, regardless of how they might be correlated on the other side. For instance, if there is no evidence of a serious relationship between income volatility and lower income level, apparently there would be no reason to believe the negative impact of income volatility on child support payment goes through the channel of lower income level.

This alternative strategy turns out to be feasible, although using some other sample spaces. To see that, consider the father sample consisted of all fathers whose family units are covered by PSID throughout marriage and divorce. With their attributes observed all over the time, it's feasible to first construct their within-marriage income volatility measures as before, and then test how they are correlated with a series of alternatives controls in divorce. In particular, five additional variables are constructed in divorce to control these alternatives:

- lower income level hypothesis (A1):
  - divorced labor income
- higher precautionary save motive hypothesis (A2):
  - divorced food expenditure/income ratio
- care less about child hypothesis (A3):
  - indoor activities with child
  - outdoor activities with child
  - whether mother relocated upon divorce

In lack of detailed information about saving or overall consumption, the food expenditure/income ratio roughly controls his overall consumption rate, the complement of which measures his saving motive. Frequencies of indoor and outdoor activities with child and mother's relocation reflect how close the father was to his child after divorce, both physically and mentally. All these controls are constructed in divorce, at the same time when child support is paid. Except for the last control of whether mother relocated upon divorce, all other controls are based on some other sample space than mother's.

6 Data

As income volatility measures require multiple observations of the same person over time, empirical test of the statement requires a panel data to begin with. In this paper, the 1968-2007 Panel Study of Income Dynamics (PSID) is used, in view of its both longitudinal design and supplemental datasets in providing marital specific information.

During the years of coverage, interviewees may have experienced multiple marriages and/or divorces, so that any marriage specific analysis, including the current one, needs to mark out the beginning and end of each marriage, and construct marriage-specific measures accordingly. In order to facilitate such access to individual specific retrospective marriages histories, PSID supplements its core data with Marriage History File 1985-2007 (MH) which contains marriage information about adults living in a PSID family at the time of the interview in any wave between 1985 and 2007. Each record contains all past-year detail about the timing, circumstances, and spouse identification number of a marriage up to and including 2007. With the help of MH, it is possible to assign marriage and divorce order for each individual's records over time, identify ever divorced population, and create father's income volatility measures within each marriage accordingly.

Another supplemental dataset involved is Geocode Match File 2000, which includes the 2000 Census geographical identifiers for the neighborhood in which household resides. These identifiers make it possible to link PSID core with Census and other data to investigate effects of nonfamily context variables on family and individual outcomes, including 2-digit state code, 3-digit county code, and 5-digit city/town code. For current research, residence in the central country/city/town of a Metropolitan Statistical Area and Primary Metropolitan Statistical Area are merged in from Census 2000 through geographical identifiers[11].

Furthermore, in an effort to study the dynamic process of early human capital formation, PSID supplemented its main data collection with additional information on 0-12 year-old children and their parents in Child Development Supplement 1997 & 2002. Among others, questions about the targeted child's contact with father in 1997 and 2002 were investigated:

- About how often does (CHILD) spend time with (his/her) (father/stepfather/adoptive father/father-figure) in indoor activities? [12]
- About how often does (CHILD) spend time with (his/her) (father/stepfather/adoptive father/father-figure) in outdoor activities?

Offered multiple choices include “Never”, “A few times a year or less”, “About once a month”, “A few times a month”,“ About once a week”, “Several times a week”, and “At least once a day”. Outcomes were obtained from the child's primary caregiver, a secondary caregiver, and others. As the most often primary and second caregivers are targeted child's biological parents, the personal identification number designed for each caregiver makes it possible to identify and merge in child's parents' information from the PSID core data. It's worth noting,

[11] For Census 1999 Metropolitan Areas and Components, see http://www.census.gov/population/estimates/metro-city/99mfips.txt.

[12] In CDS-I, this question focused on time in general.

Table 1: Individual Sample Size

	Basis	Ruled-out	
	Female	Male	Child
Head/Wife	18,604	16,893	
Ever married	10,531	10,108	
Ever divorced	3,464	3,057	
Followed up	1,899	1,574	
Ever remarried	392		
Total			3,563
Parents id			1,805
Merged			1,539
Final	1,077	519	937

however, that year 2002 is not covered in PSID core. In order to merge them together, I assume the same person's attribute didn't change much within one year, and merge PSID 2001 records with CDS 2002 records. Of course, parents' marital status in 2002 is still coded correctly according to MH.

6.1 Individual Sample Size

The general sample size limitation problem of a panel dataset gets worse in current research, as the key variable of child support concerns the ever divorced population only. Roughly speaking, only around 10% of original sample space can be used for current purpose [13]. Table 6.1 shows the evolution of sample sizes by source. Female sample is used primarily for child support statement test. For the alternative hypotheses, "lower income level" and "higher precautionary saving motive" are ruled out using male sample, and "care less about child" is ruled out using partly child sample and partly female sample.

From 1968 to 2007, the PSID core sample covers 14,818 households over a mean of 15 and maximum of 35 years. Since the key economic questions are available for household head and wife only, the relevant female and male adult samples consisting of either household head (male or female) or his wife (when male head was married) contain 18,604 and 16,893 individuals separately. Among these adults, about 60% individuals ever get married (10,108/16,893=0.598, 10,531/18,604=0.566), with the male's rate slightly higher than female's. Among the ever married, around 30% experienced divorce at least once. Only half of

[13] This is obtained by 60% marriage rate times 30% divorce rate times 50% survey follow up rate (60%*30%*50%=9%). See http://www.cdc.gov/nchs/fastats/divorce.htm.

the remaining male and female adult samples are successfully followed up, as only family unit of either spouse but not both are covered in a divorce or separation, leaving 1,899 females and 1,574 males respectively. At last, when controlled for demographic characteristics both under marriage and during divorce, the final sample sizes are reduced to 1,077 females and 519 males. Among these 1,077 mothers, 40% (392) of them ever remarried.

The last column shows sample size evolution of child sample. In 1997 and 2002, CDS surveyed 3,563 children in total, but only half of them had complete parents' identity information converted from primary and secondary caregiver's identities. When merged with parents' information in 1997 and 2001 from the PSID core, 1,539 children are successfully linked with both parents but only 937 with complete information. These observations are all from year 2002 of CDS, as region variable is not available in PSID core between 1994 and 1998, including CDS year 1997.

6.2 Basis Sample Summary

Table 2 displays the mean and standard deviation of relevant variables in basis female sample, for both child support statement test and ruling out the "care less about child" hypothesis. The relevant sample is those years when the mother was divorced or separated and reported non-missing child support amount. Except for father's income volatilities that are constructed from his historical records within marriage, all other mother's attributes are controlled while she was in divorce.

The income volatility measures of scaled standard deviation, mean squared change, and recent mean squared change are all averaged at 5-6% of logarithm labor income. The simulated scaled squared income residual is not something that could be directly observed in the data, but needs to be simulated in the first place, so it's not listed in sample summary statistics.

The dependent variable of received child support amount is measured in terms of monetary transfers only and doesn't include in-kind transfers of food, clothing, or child care that may have been provided by some absent fathers. The averaged received amount is $707 annually, which is well below the cost of raising children. The receipt proportion of 23% is also much lower than the report in Census 2005, perhaps because PSID put more emphasis on low-income families. Section 7.2 will report weighted estimation results.

Mother's average age, when divorced, are 42 years old. White and Black are equally likely to be covered. Education is a key factor in both income and child support determination, and is coded into categories rather than total number of years to allow a nonlinear effect. Highest education level obtained by mothers are mostly centered around high school diploma with 12 grades. 47% of people lived in PMSA and 94% in central areas where surveyed units are more convenient to locate and reach. Mother's divorced total income consists of both labor income and welfare transfer if any, and is averaged at $12,698 per year. Non-missing child support report is controlled in female sample, therefore every mother is eligible to participate in AFDC welfare program. However, only 11% of them are covered. Number of kids and length of previous marriage measure marital-specific capital from the marriage and would be expected to have a positive relation with child support. Number of children is averaged at 1.1, and marriage duration is averaged at 12 years. The same marriage capital accumulated may have a depreciation rate over time, so that the further away the marriage and divorce are the weaker the bond between ex-family members is. Therefore number of years since divorce is controlled to capture the time varying pattern of father's contribution. On average, 7 years had passed since divorce in female sample. Finally, the additional control to rule out "care less about child" hypothesis is appended at the bottom. Only 6% of divorced mothers changed region of living upon shattered marriage. In terms of the sample size, the 1,077 mothers in first column of Table 6.1 each has 4-5 observations in divorce, so that the final sample size is 4,617.

6.3 Male Sample Summary

An innocent negative correlation alone doesn't necessarily imply the existence of strategic behavior in child support payment, unless alternative channels of income volatility's impact have been ruled out. In order to rule out alternatives through lower divorced income level and lower divorced consumption rate, relationship between labor income and food expense/income ratio, and income volatility are examined in male sample. Except for the dependent variables, all regressors are controlled within marriage. Table 3 presents mean and standard deviation of relevant variables in male sample.

Similar to the basis female sample, in male sample various income volatility measures are averaged at 5%. Father's labor income increases upon divorce, as a result of age and experience growth over time. The average food expense/income ratio 28% does not necessarily

Table 2: Basis Female Sample Summary Statistics

	Pre-divorce Father		Post-divorce Mother	
	Mean	St.Dev	Mean	St.Dev
Information asymmetry				
Standard deviation	0.046	[0.045]		
Mean squared change	0.057	[0.171]		
Recent mean squared change	0.047	[0.123]		
Child support				
Child support amount			707.226	[1899.12]
Child support dummy			0.23	[0.421]
Demographics				
Age			41.872	[11.331]
Race–White			0.487	[0.5]
Race–Black			0.492	[0.5]
Race–Other			0.021	[0.143]
Education–0-5 grades			0.017	[0.129]
Education–6-8 grades			0.04	[0.197]
Education–9-11 grades			0.186	[0.389]
Education–12 grades			0.386	[0.487]
Education–College, no degree			0.258	[0.438]
Education–College, bachelors degree			0.077	[0.267]
Education–College, advanced degree			0.035	[0.185]
PMSA status			0.469	[0.499]
Central city status			0.943	[0.233]
Total income			12697.63	[15231.08]
Welfare participation status			0.109	[0.311]
Number of children			1.129	[1.272]
Marriage duration			11.75	[8.187]
Years since divorce			6.913	[6.241]
Whether relocated			0.063	[0.243]
Samplesize				
Obs.	4617			

Table 3: Male Simulation Sample Summary				
	Pre-divorce Father		Post-divorce Father	
	Mean	St.Dev	Mean	St.Dev
Information asymmetry				
Standard deviation	0.045	[0.041]		
Mean squared change	0.049	[0.138]		
Recent mean squared change	0.043	[0.109]		
Income and food expense/income ratio				
Labor income	11962.38	[8921.339]	20864.16	[18021.84]
Food expense/income ratio			0.281	[1.292]
Demographics				
Age	31.204	[8.293]		
Race–White	0.565	[0.496]		
Race–Black	0.403	[0.491]		
Race–Other	0.033	[0.178]		
Education–0-5 grades	0.017	[0.13]		
Education–6-8 grades	0.074	[0.261]		
Education–9-11 grades	0.233	[0.423]		
Education–12 grades	0.343	[0.475]		
Education–College, no degree	0.204	[0.403]		
Education–College, bachelors degree	0.095	[0.293]		
Education–College, advanced degree	0.034	[0.182]		
PMSA status	0.407	[0.491]		
Central city status	0.947	[0.224]		
Number of children	1.749	[1.268]		
Samplesize				
Obs.	2210			

suggest that the actual saving rate of divorced fathers in U.S. is anywhere close to 72%, since only food consumption is excluded not the overall consumption. But this ratio should be highly correlated with the real saving rate and could serve as a good mimic. Father's average age, when still married, is 31 years old. White fathers are slightly more likely to be covered than Black. Their highed education level are again mostly centered around high school diploma. 41% of people lived in PMSA and 95% in central areas, similar to the female sample. The average number of children when father is still married is 1.7, and the total number of observation is 2,210, meaning each father has 4-5 observations in divorce.

6.4 Child Sample Summary

The last alternative hypothesis of "care less about child" is ruled out using child sample. Summary statistics for relevant dependent and independent variables are shown in Table 4.

Except for the father's outcome variables of contact frequencies and explanatory variables of income volatility, all other attributes are merged in from mother's record in 2001.

Compared with female and male samples, income volatility measures are slightly lower at 4% in here. The frequency outcomes of father's indoor and outdoor activities with child are each recorded in seven categories, ranging from "Never" to "At least once a day". Half (0.386+0.175=0.561) of interviewed fathers engaged in indoor activities with the child for at least several times a week, while frequencies of outdoor activities are a little lower, with only 33% (0.302+0.025=0.327) for at least the same amount. The discrepancy does not necessarily imply that one control is superior over the other in measuring father-child intimacy, as outdoor activities often require more physical strength and adults may feel reluctant to do it.

Mothers are generally younger than in female sample, at 39 years old on average. White mothers are more likely to be covered in CDS than other race groups. Compared with female sample, mothers in child sample also tend to be better educated, with the majority of highest education level centered around college level without degree. Again, 43% of people lived in PMSA and 90% in central areas. Her total income consisting of labor income and welfare transfer if any is significantly higher than that in female sample, maybe because of better education and larger share of White people. The average number of children is also higher at 2.3.

In CDS, children are surveyed regardless of their parents' marital status, but mostly when they were still with each other. To control both biological parents' marital status and allow the degree of father's intimacy with his child to depend on such status, a divorced dummy is created by comparing the child' birth year with timing of parents' marriage at the time of survey. Technically, if the child was born within the duration of current marriage in 2002, divorced dummy is 0, otherwise it is 1. It turns out only 9% parents of covered children were separated when surveyed by CDS. Finally, boys and girls are equally likely to be covered. The total number of observation is 937, with unique entry in 2002 for each child in the sample.

Table 4: Child Simulation Sample Summary

	Father		Mother	
	Mean	St.Dev	Mean	St.Dev
Information asymmetry				
Standard deviation	0.041	[0.033]		
Mean squared change	0.038	[0.109]		
Recent mean squared change	0.034	[0.075]		
Frequency of father's activities with child				
Indoor activities–Never	0.031	[0.173]		
Indoor activities–A few times a year or less	0.048	[0.214]		
Indoor activities–About once a month	0.041	[0.197]		
Indoor activities–A few times a month	0.137	[0.344]		
Indoor activities–About once a week	0.182	[0.386]		
Indoor activities–Several times a week	0.386	[0.487]		
Indoor activities–At least once a day	0.175	[0.38]		
Outdoor activities–Never	0.045	[0.207]		
Outdoor activities–A few times a year or less	0.095	[0.293]		
Outdoor activities–About once a month	0.095	[0.293]		
Outdoor activities–A few times a month	0.203	[0.402]		
Outdoor activities–About once a week	0.236	[0.425]		
Outdoor activities–Several times a week	0.302	[0.459]		
Outdoor activities–At least once a day	0.025	[0.155]		
Demographics				
Age			39.209	[5.924]
Race–White			0.641	[0.48]
Race–Black			0.222	[0.416]
Race–Other			0.137	[0.344]
Education–0-5 grades			0.011	[0.103]
Education–6-8 grades			0.03	[0.17]
Education–9-11 grades			0.079	[0.27]
Education–12 grades			0.247	[0.431]
Education–College, no degree			0.315	[0.465]
Education–College, bachelors degree			0.234	[0.423]
Education–College, advanced degree			0.085	[0.28]
PMSA status			0.428	[0.495]
Central city status			0.9	[0.301]
Total income			20708.18	[33087.57]
Number of children			2.288	[0.952]
Divorced when CDS	0.085	[0.28]		
Boy			0.509	[0.5]
Samplesize				
Obs.	937			

7 Results

7.1 Simulation for Scaled Labor Income Residual

Simulation results from Equation (21) are reported in Appendix Table A-1 column (1) and (2). All regressors are controlled as mean value within marriage. In column (1), there exists a strong persistence between father's earning when married and divorced. The estimated elasticity of income in divorce with respect to income under marriage is 0.747, significant at 1% level. Black people tend to earn 16.7% less than White people do, although not significant enough. Higher education level increases income earning capacity, as the default group of fathers with 12 grades earn 99.8% higher than 0-5 grades.

When the scaled squared residuals are in turn regressed on the same set of covariates in column (2), a negative coefficent estimate of lagged income level under marriage is observed, meaning that richer people also tend to have more stable income. This set of coefficiient estimates in column (2) will be used to simulate absent father's last income volatility measure in female sample.

7.2 Child Support Statement

To provide empirical evidence for the child support statement that father's lower optimal transfer is associated with higher degree of unobservability, I related received child support to income volatility measures and other factors, in hope of seeing a significant negative impact. Two dependent variables–received amount and received dummy indicating whether any transfer was received–are fitted by Ordinal Least Square (OLS) and Probit models.

7.2.1 OLS Estimate for Child Support Amount

Coefficient estimates of the received amount outcome fitted by OLS are presented in Table 5. The explanatory variables are income volatility measures as defined in the column title and other mother's characteristics. These are variables that have been related to child support amount awarded and received empirically. Mother's income is coded in actual amount instead of logarithm, as logarithm neglects all zero income which is not scarce among mothers. Welfare participation status is coded in dummy, indicating whether the mother was covered or not. Age is coded in years. Race and education are coded in categories, with the default category being White and college with 12 grades. Number of children and length of previous marriage measure marital-specific capital from the marriage, and number of years since divorce captures a time varying pattern of divorced father's contribution. Additional control variables include residence within a PMSA, central city of a PMSA, state, and year of the survey.

For each of the four income volatility measures in columns (1)-(4), numbers in the first row present the estimated change in transfer amount associated with one unit increase in income volatility. For instance, examining the first row in the first column, a 1% increase in father's scaled income standard deviation reduces amount paid by $14 per year. Although not significant enough in column (1) and (3), the estimated effects of father's income volatility on transfer amount show strong consistency in negative direction. So there is evidence that fathers with more unstable income tend to systematically underpay support. In terms of the magnitude, I find each additional percent of income variation tend to reduce the received support amount by $8-25 per year, depending on the measure of income volatility adopted.

Effects of other socioeconomic characteristics are consistent with findings of previous studies. Mothers covered by the welfare program receive significantly lower transfer from the father, while her total income doesn't matter much. Because of the $50 pass-through legislation, joining the program reduces voluntary payment by $1,400-1,800 annually, and White people tend to pay $623-770 more than Black and other race. As expected, the measures of marital-specific capital both exert significantly positive impacts, with each additional child and marriage year raising total annual payment by $908-1,060 and $28-41. Finally, there does not seem to exist a time varying pattern in father's contribution, since the variable of years since divorce is always insignificant. Surprisingly, mother's age negatively impacts father's ability to pay, perhaps because the older the parents are when the child is still young, the shorter amount of time there is for them to enjoy the benefit from him/her. So they wouldn't invest too much on the child.

It's worth noting that although the reported size for female sample is 4,617 in Table 2, none of the five columns end up having those many observations. This is because calculation of income volatility consumes observations. For instance, calculation of standard deviation, mean squared change requires at least two rounds of labor income under marriage, recent mean squared change over the last three periods requires four, and squared residual requires not only father's labor income but also other demographic characteristics. Ideally, the analysis would be restricted to a uniform sample space with all five measures available, but according to column (3), that would cut the sample size further by half.

7.2.2 Probit Estimate for Child Support Amount

Turning from amount to dummy, Table 6 examines the results from fitting child support receipt dummy by Probit model. The outcome variable is child support receipt dummy, and the explanatory variables are income volatility measures as defined in column title and other characteristics. The reported coefficients are marginal effect evaluated at sample mean for continuous regressors and discrete change in the probability for dummy variables.

The findings are in general consistent with those of OLS model in Table 5, in that significantly negative effects of income variation are observed for all columns. In terms of the magnitude, 1% increase in father's scaled income standard deviation reduces payment likelihood by 2%. But still the estimates show little consistency in magnitude, ranging from 0.9% to 2%.

Mothers covered by welfare program are 20-25% less likely to receive any transfer from the father, and her total income may have increased the chance of receipt, although the magnitude is too small to detect. Older mothers are less likely to receive anything from the older fathers. White fathers are 14-19% more likely to pay than Black, and both measures of marital-specific capital–number of children and duration of previous marriage, increase the probability significantly.

7.3 Alternative Hypotheses Ruled Out

Short versioned estimation results from predicting additional controls with income volatility in female, male, and child samples are reported in Table 7. For brevity, only coefficient estimates for income volatility measures and its interaction term with biological parents' marital status, if any, are presented. Full simulation results can be found from Table A-2 to A-5 in Appendix.

The first two continuous outcomes of divorced father's logarithm labor income and food expense/income ratio are fitted by OLS model in male sample. Other than father's income volatilities, regressors also include father's income level, age, race, education, number of children, and geographical location dummies within marriage. The following two categorical outcomes of contact frequencies are fitted by Ordinal Probit model in child sample. Re-

Table 5: OLS Estimate for Child Support Equation

Child support dummy	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Recent Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	-1,399.250	-1,058.347**	-657.439	-2,857.414***
	[0.92]	[2.28]	[1.04]	[2.72]
Mother's income	-0.001	-0.001	-0.005	-0.001
	[0.13]	[0.22]	[0.80]	[0.16]
Mother's welfare participation status	-1,631.686***	-1,621.297***	-1,830.227***	-1,413.172***
	[6.49]	[6.47]	[5.19]	[6.35]
Mother's age	-24.961**	-24.378**	-18.402	-28.368***
	[2.36]	[2.33]	[1.33]	[2.61]
Mother's race–Black	-769.763***	-766.095***	-707.090***	-623.047***
	[4.77]	[4.82]	[3.29]	[4.63]
Mother's race–Other	-349.044	-345.132	-680.125**	-303.040
	[1.04]	[1.02]	[2.39]	[0.96]
Mother's education–0-5 grades	-1,339.265***	-1,342.991***	-942.438	-1,103.079***
	[3.89]	[3.97]	[1.00]	[3.61]
Mother's education–6-8 grades	49.954	51.472	382.278	165.547
	[0.15]	[0.16]	[1.07]	[0.46]
Mother's education–9-11 grades	69.796	95.084	-28.043	72.624
	[0.41]	[0.58]	[0.11]	[0.49]
Mother's education–College, no degree	556.597***	534.293***	547.650**	481.560***
	[3.09]	[3.00]	[2.56]	[2.99]
Mother's education–College, bachelors degree	1,074.459***	1,050.440***	1,218.976**	813.854**
	[2.82]	[2.76]	[2.55]	[2.11]
Mother's education–College, advanced degree	996.605**	982.819**	1,261.180***	1,012.161**
	[2.55]	[2.52]	[2.72]	[2.50]
Mother's PMSA status status	366.598**	381.008**	306.907	283.458*
	[2.27]	[2.40]	[1.44]	[1.93]
Mother's central city status	-359.132	-344.425	-508.556	-356.307
	[0.84]	[0.81]	[0.92]	[0.85]
Mother's number of children	925.151***	926.874***	1,060.453***	908.385***
	[9.08]	[9.13]	[8.50]	[9.15]
Duration of mother's previous marriage	37.814***	36.789***	28.269**	40.611***
	[3.83]	[3.75]	[2.10]	[4.00]
Number of years since mother divorced	-3.427	-4.338	-14.306	10.024
	[0.26]	[0.33]	[0.81]	[0.81]
Constant	980.607	960.407	849.307	797.068
	[1.49]	[1.48]	[1.06]	[1.14]
Observations	3507	3507	2458	3876
R-squared	0.32	0.32	0.36	0.32
F test: Income volatility=0	0.84	5.18	1.09	7.40
Prob > F	0.36	0.02	0.30	0.01

Note: State, region, and year effects are controlled. Robust t statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Probit Estimate for Child Support Equation

Child support dummy	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Recent Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	-1.935***	-0.864***	-1.059**	-0.863***
	[3.42]	[3.67]	[2.27]	[2.61]
Mother's income	0.000**	0.000*	0.000	0.000**
	[2.24]	[1.95]	[0.75]	[2.14]
Mother's welfare participation status	-0.213***	-0.209***	-0.246***	-0.199***
	[3.82]	[3.67]	[3.53]	[3.64]
Mother's age	-0.026***	-0.025***	-0.021***	-0.018***
	[5.00]	[5.02]	[3.71]	[4.02]
Mother's race–Black	-0.187***	-0.177***	-0.157***	-0.143***
	[4.95]	[4.68]	[3.12]	[3.83]
Mother's race–Other	-0.056	-0.041	-0.133	-0.037
	[0.63]	[0.47]	[1.57]	[0.45]
Mother's education–0-5 grades	-0.215**	-0.212**	-0.182	-0.204**
	[2.42]	[2.44]	[1.11]	[2.26]
Mother's education–6-8 grades	-0.223***	-0.218***	-0.198**	-0.201***
	[5.80]	[5.72]	[1.99]	[4.59]
Mother's education–9-11 grades	-0.018	-0.018	0.036	-0.026
	[0.31]	[0.31]	[0.48]	[0.51]
Mother's education–College, no degree	0.073	0.061	0.093*	0.078*
	[1.59]	[1.37]	[1.68]	[1.83]
Mother's education–College, bachelors degree	0.197***	0.178**	0.300***	0.049
	[2.64]	[2.28]	[3.33]	[0.67]
Mother's education–College, advanced degree	0.245***	0.231***	0.276**	0.218**
	[2.97]	[2.80]	[2.57]	[2.44]
Mother's PMSA status status	0.099*	0.100*	0.010	0.110**
	[1.88]	[1.91]	[0.15]	[2.04]
Mother's central city status	0.026	0.030	0.044	-0.030
	[0.34]	[0.41]	[0.47]	[0.37]
Mother's number of children	0.214***	0.209***	0.239***	0.208***
	[11.42]	[11.13]	[9.15]	[11.51]
Duration of mother's previous marriage	0.020***	0.019***	0.014**	0.015***
	[4.32]	[4.11]	[2.34]	[3.51]
Number of years since mother divorced	0.013**	0.012**	0.004	0.007
	[2.30]	[2.25]	[0.60]	[1.24]
Observations	3224	3224	2229	3558
F test: Income volatility=0	11.72	13.46	5.17	6.82
Prob > chi2	0.00	0.00	0.02	0.01

Note: State, region, and year effects are controlled. Rubst z statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

gressors include father's income volatilities, parents' divorce status, their interactions, and mother's characteristics. The discrete outcome for whether mother relocated at bottom is fitted by Probit model in female sample, with the coefficients representing the marginal effect estimates evaluated at sample mean.

Throughout the table, no significant relationship between income volatilities and additional controls exists. Focusing on the middle panel, for instance, none of these 8 regressions find significantly negative correlation between income volatilities and father's activities with child, regardless of when he was divorced or not. With that being said, I believe income volatilities and additional controls are not correlated, which negates the possibility for the obtained negative impact in child support regressions to be caused by any alternative hypothesis. In other words, even though these alternatives might indeed have some effect on father's child support payment, they are not likely to be messed up with income volatility. Therefore, any observed income volatility impact can't be attributed to alternative explanations.

This concludes alternative hypotheses rule-out analysis, and leaves strategic behavior as the only plausible explanation for inadequate payment. The observed significantly negative relationship between income volatilities and child support in Table 5 and 6 is indeed caused by father's strategic behavior.

8 Conclusions

This paper analyzes father's child support transfer and mother's remarriage decision jointly in a dynamic model. The way of their decision making and interaction is built into a Stackelberg game, assuming the father's income level is at least partly unobservable to the mother upon separation. The equilibrium closed form solutions conclude that the father's optimal transfer is lower when his income is partly unobservable to the mother than when it is fully observable, a result empirically supported using PSID. With degree of observability proxied by father's income volatilities, the annual reduction is estimated to be \$8-25 in amount or 0.9-2% in likelihood associated with 1% increase in income volatilities. These results are shown to be robust, as alternative hypotheses have been ruled out by additional controls.

As a byproduct, the model also points to the endogeneity involved in conventional estimate of child support-remarriage relationship. By the closed form solutions, mother's unobserved

Table 7: Simulation of Additional Controls

Variable	St.Dev of Ln(laborinc) (1)	Mean Squared Change of Ln(laborinc) (2)	Recent Mean Squared Change of Ln(laborinc) (3)	Squared Residal of Ln(laborinc) (4)
OLS Model				
Ln(Labor income)				
Income volatility	0.524	-0.220	-0.045	-0.012
	[0.39]	[0.51]	[0.11]	[0.01]
Food Expense/income ratio				
Income volatility	1.531	0.449	0.164	1.269*
	[1.43]	[1.13]	[0.49]	[1.67]
Ordinal Logit Model				
Indoor Activities with Child				
Income volatility	2.516	0.994*	0.576	0.517
	[1.64]	[1.95]	[0.75]	[0.68]
Father divorced	-0.353	-0.280	-0.372*	-0.302
	[1.23]	[1.35]	[1.74]	[1.25]
Income volatility X Father divorced	4.056	1.579	2.602*	1.943
	[0.62]	[0.77]	[1.66]	[0.67]
Outdoor Activities with Child				
Income volatility	-0.064	0.284	-0.071	0.070
	[0.05]	[0.89]	[0.19]	[0.11]
Father divorced	-0.328	-0.443**	-0.520**	-0.531**
	[1.14]	[2.20]	[2.24]	[2.33]
Income volatility X Father divorced	-3.377	-0.331	1.096	1.267
	[0.51]	[0.17]	[0.97]	[0.64]
Probit Model				
Whether Mother Relocated				
Income volatility	0.154	0.025	-0.010	0.113
	[0.78]	[0.66]	[0.26]	[0.79]

Notes: Absolute value of t statistics in brackets for Ln(labor income) and Food Income Ratio.
Robust z statistics in brackets for Indoor, Outdoor Activities with Child, and Whether Mother Relocated.
* significant at 10%; ** significant at 5%; *** significant at 1%.

remarriage propensity in her remarriage equation also enters father's optimal transfer amount formula, causing conventional estimates to be upward biased. With the positive bias eliminated, transfer is expected to have a negative impact on remarriage. The unbiased estimate of such impact awaits further study for finding instrument variables that are correlated with father's child support payment but not mother's remarriage.

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A APPENDIX

A.1 Perfect Observability

Substituting income constraint $a_{f1} = \dot{Y}_f - c_{f1}$, formulas for $U_{f2}^{s*}, U_{f2}^{r*}(\tilde{\alpha}_s), g(c_{f1})$ as in Equation (7), (4), (11), and $f(\tilde{\alpha}_s) = k$ into the objective function, father's first period problem is equivalent to:

$$\begin{aligned} \max_{c_{f1}} V &= \dot{Y}_f - c_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha\dot{Y}_f}) + \\ & \rho\int_0^{\dot{Y}_f} [(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]kd\tilde{Y}_s + \rho\int_{\dot{Y}_f}^{\frac{1}{k}} [\dot{Y}_f + \beta(\gamma\tilde{Y}_s - \frac{\gamma^2\tilde{Y}_s^2}{2\alpha\dot{Y}_f})]kd\tilde{Y}_s \end{aligned} \tag{A-1}$$

Because of assumed perfect observability, no matter what c_{f1} is, mother can always predict value of $\dot{Y}_f$ with certainty, so that father's discounted second period utility is independent of c_{f1}. Then the first order condition respect to c_{f1} drops out both integration terms:

$$\begin{aligned} 0 &= -1 + \beta(1 - \frac{c_{f1}}{\alpha\dot{Y}_f}) \\ c_{f1}^* &= \gamma\dot{Y}_f \end{aligned}$$

So the father's first period payment when no manipulation is allowed under perfect observability is the same as level solved from a static model. Local maximization of value function at $\gamma\dot{Y}_f$ is guaranteed by the negative second order condition with respect to c_{f1}:

$$\frac{\partial^2 V}{\partial c_{f1}^2} = -\frac{\beta}{\alpha\dot{Y}_f} < 0$$

□

A.2 No Observability

A.2.1 First order condition

Substituting income constraint $a_{f1} = \dot{Y}_f - c_{f1}$, formulas for $U_{f2}^{s*}, U_{f2}^{r*}(\tilde{\alpha}_s)$ as in Equation (7), (4), and $f(\tilde{\alpha}_s) = k$ into the objective function, father's first period problem is equivalent to:

$$\begin{aligned}\max_{c_{f1}} V &= \dot{Y}_f - c_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha\dot{Y}_f}) + \\ &\rho\int_0^{g(c_{f1})}[(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]kd\tilde{Y}_s + \rho\int_{g(c_{f1})}^{\frac{1}{k}}[\dot{Y}_f + \beta(\gamma\tilde{Y}_s - \frac{\gamma^2\tilde{Y}_s^2}{2\alpha\dot{Y}_f})]kd\tilde{Y}_s\end{aligned} \tag{A-2}$$

where $g()$ is an unknown functional form to be solved. Setting the first order derivative with respect to c_{f1} to 0, solution of c_{f1} has to satisfy:

$$\begin{aligned}0 &= -1 + \beta(1 - \frac{c_{f1}}{\alpha\dot{Y}_f}) + \\ &\rho[(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]kg'(c_{f1}) - \rho[\dot{Y}_f + \beta(\gamma g(c_{f1}) - \frac{\gamma^2 g(c_{f1})^2}{2\alpha\dot{Y}_f})]kg'(c_{f1})\end{aligned} \tag{A-3}$$

Imposing the equilibrium condition of Equation (13), the first order condtion reduces to:

$$-1 + \beta(1 - \frac{c_{f1}}{\alpha\dot{Y}_f}) - \rho k\gamma\dot{Y}_f g'(c_{f1}) = 0$$

which is a first order differential equation in c_{f1}. Taking integral of c_{f1}, functional form of $g(c_{f1})$ is obtained:

$$g(c_{f1}) = \frac{(\beta-1)c_{f1}}{\rho k\gamma\dot{Y}_f} - \frac{\beta c_{f1}^2}{2\alpha\rho k\gamma\dot{Y}_f^2} \tag{A-4}$$

By imposing equilibrium condition again, the equilibrium value of c_{f1} is solved from the quadratic equation:

$$\dot{Y}_f = \frac{(\beta-1)c_{f1}}{\rho k\gamma\dot{Y}_f} - \frac{\beta c_{f1}^2}{2\alpha\rho k\gamma\dot{Y}_f^2}$$

at

$$c_{f1}^* = \gamma\dot{Y}_f(1 \pm \sqrt{1 - \frac{2\rho k\dot{Y}_f}{\beta - 1}})$$

□

A.2.2 Second order condition

To guarantee the above c_{f1} solutions are indeed local maximizers, second order condition is also checked in the following. Taking the derivative of right hand side of Equation (A-3) with respect to c_{f1}, the second order derivative is:

$$\begin{aligned}\frac{\partial^2 V}{\partial c_{f1}^2} &= -\frac{\beta}{\alpha \dot{Y}_f} + \rho[(1-\gamma)\dot{Y}_f + \beta(\gamma \dot{Y}_f - \frac{\gamma^2 \dot{Y}_f}{2\alpha})]kg''(c_{f1}) - \\ &\quad \rho[\dot{Y}_f + \beta(\gamma g(c_{f1}) - \frac{\gamma^2 g(c_{f1})^2}{2\alpha \dot{Y}_f})]kg''(c_{f1}) - \rho\beta[\gamma g'(c_{f1}) - \frac{\gamma^2 g(c_{f1}) g'(c_{f1})}{\alpha \dot{Y}_f}]kg'(c_{f1})\end{aligned}$$

Imposing equilibrium condition, the expression reduces to:

$$\frac{\partial^2 V}{\partial c_{f1}^2} = -\frac{\beta}{\alpha \dot{Y}_f} - \rho k \gamma \dot{Y}_f g''(c_{f1}) - \rho k \gamma g'(c_{f1})^2$$

Substituting $g'(c_{f1}), g''(c_{f1})$ from Equation (A-4), finally the second order derivative is shown to be negative:

$$\frac{\partial^2 V}{\partial c_{f1}^2} = -\frac{\beta^2 (c_{f1} - \gamma \dot{Y}_f)^2}{\rho k \gamma \alpha^2 Y^4} < 0$$

Therefore neither root can be ruled out by second order condition. □

A.2.3 Common Sense

However, from Equation (A-4) again, the way mother updates her belief of $\dot{Y}_f$ from observed c_{f1} is different across the two roots:

$$g'(c_{f1}) = -\frac{\beta}{\alpha \rho k \gamma \dot{Y}_f^2}(c_{f1} - \gamma \dot{Y}_f) \begin{cases} > 0 & \text{if} \quad c_{f1} < \gamma \dot{Y}_f \\ \\ < 0 & \text{if} \quad c_{f1} > \gamma \dot{Y}_f \end{cases}$$

In particular, only the low amount indicates a positive comovement between what he paid and how much he cares about the child. With the high amount, however, things would be the other way around. The mother would form such an expectation of his type that the more he paid, the less he cares about the child. This is an obvious contradiction to the common sense, and does not survive economic judgmental criteria. Therefore, although both high and low amounts achieve a local maximum of the value function, only the low one is accepted as an economically meaningful solution.

□

A.2.4 Comparative Static Analysis and Interpretation

To further understand how lower transfer is preferable to father with private information, comparative static analysis of father's value function is also provided.

To begin with, it should be made clear that the father is always better off when she remarries, due to "free-rider" benefit. This can be seen from Equation (7), (4), and (9). With a stepfather who cares about the child expenditure at least as he does, the father can always enjoy a boosted utility level with more expenditure on his own adult consumption while not decreasing the child's. Therefore, the more likely she remarries, the better off he is.

An alternative way to see this is by taking the partial derivative of V with respect to $g(c_{f1})$, while keeping all other variables constant:

$$\frac{\partial V}{\partial g(c_{f1})} = \rho[(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]k - \rho[\dot{Y}_f + \beta(\gamma g(c_{f1}) - \frac{\gamma^2 g(c_{f1})^2}{2\alpha\dot{Y}_f})]k$$

Evaluation of the partial derivative at the equilibrium condition leads to:

$$\frac{\partial V}{\partial g(c_{f1})} = -\rho k\gamma\dot{Y}_f < 0$$

which is always negative when $\beta > 1$. In economic meaning, the higher threshold value a stepfather must have, the less likely father gets to enjoy the "free-rider" benefit, and the worse off he is.

Secondly, remember the father can always bring down the stepfather's threshold type and increase mother's remarriage probability by paying less, according to the positive derivative in Equation (A-4). Therefore, lower level of c_{f1} is always preferrable to the father, although extreme low amount is not sensible as father also cares about the child. All things considered, the observed father's under-transfer behavior is a result of his strategic intention to trigger more remarriage by decreasing her screening standard.

□

A.3 Rational Expectation

Substituting income constraint $a_{f1} = \dot{Y}_f - c_{f1}$, formulas for $U_{f2}^{s*}, U_{f2}^{r*}(\tilde{\alpha}_s), g(c_{f1}, \epsilon)$ as in Equation (7), (4), (13), and $f(\tilde{\alpha}_s) = k$ into the objective function, father's first period problem is equivalent to:

$$\begin{aligned}\max_{c_{f1}} V &= \dot{Y}_f - c_{f1} + \beta(c_{f1} - \frac{c_{f1}^2}{2\alpha(\dot{Y}_f + \omega)}) + \\ &\rho E\{\int_0^{g(c_{f1},\epsilon)} [(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]kd\tilde{Y}_s\} + \rho E\{\int_{g(c_{f1},\epsilon)}^{\frac{1}{k}} [\dot{Y}_f + \beta(\gamma\tilde{Y}_s - \frac{\gamma^2\tilde{Y}_s^2}{2\alpha\dot{Y}_f})]kd\tilde{Y}_s\}\end{aligned} \tag{A-5}$$

Setting the first order derivative with respect to c_{f1} to 0, solution of c_{f1} has to satisfy:

$$\begin{aligned}0 &= -1 + \beta(1 - \frac{c_{f1}}{\alpha(\dot{Y}_f + \omega)}) + \\ &\rho E\{[(1-\gamma)\dot{Y}_f + \beta(\gamma\dot{Y}_f - \frac{\gamma^2\dot{Y}_f}{2\alpha})]kg'\} - \rho E\{[\dot{Y}_f + \beta(\gamma g - \frac{\gamma^2 g^2}{2\alpha\dot{Y}_f})]kg'\}\end{aligned} \tag{A-6}$$

or

$$E[\frac{\beta\gamma^2}{2\alpha\dot{Y}_f}g^2 g' - \beta\gamma g g' + ((\beta-1)\gamma\dot{Y}_f - \frac{\beta\gamma^2\dot{Y}_f}{2\alpha})g'] = \frac{1-\beta}{\rho k} + \frac{\beta c_{f1}}{\alpha\rho k(\dot{Y}_f + \omega)} \tag{A-7}$$

where $g \equiv g(c_{f1}, \epsilon), g' \equiv \frac{\partial g(c_{f1},\epsilon)}{\partial c_{f1}}$. Taking integral of c_{f1} on both sides of the equation through Continuous Theorem, functional from of g follows the rule of:

$$E[\frac{\beta\gamma^2}{6\alpha\dot{Y}_f}g^3 - \frac{\beta\gamma}{2}g^2 + ((\beta-1)\gamma\dot{Y}_f - \frac{\beta\gamma^2\dot{Y}_f}{2\alpha})g] = \frac{1-\beta}{\rho k}c_{f1} + \frac{\beta c_{f1}^2}{2\alpha\rho k(\dot{Y}_f + \omega)} \tag{A-8}$$

Under rational expectation condition, expected values of g, g^2, g^3 are combinations of $\dot{Y}_f$ and σ_ϵ^2:

$$\begin{aligned}E(g) &= \dot{Y}_f \\ E(g^2) &= \dot{Y}_f^2 + \sigma_\epsilon^2 \\ E(g^3) &= \dot{Y}_f^3 + 3\dot{Y}_f\sigma_\epsilon^2\end{aligned} \tag{A-9}$$

Substituting them back in Equation (A-8), it turns into a quadratic equation in c_{f1}:

$$\frac{\beta c_{f1}^2}{2\alpha\rho k(\dot{Y}_f+\omega)}+\frac{1-\beta}{\rho k}c_{f1}=\frac{\beta\gamma^2(\dot{Y}_f^2+3\sigma_\epsilon^2)}{6\alpha}-\frac{\beta\gamma}{2}(\dot{Y}_f^2+\sigma_\epsilon^2)+((\beta-1)\gamma-\frac{\beta\gamma^2}{2\alpha})\dot{Y}_f^2 \quad \text{(A-10)}$$

Then the equilibrium values of c_{f1} are obtained from the dual roots of Equation (A-10):

$$c_{f1}^*=\gamma(\dot{Y}_f+\omega)[1\pm\sqrt{1-\frac{\rho k(\sigma_\epsilon^2-12(\beta-4)\dot{Y}_f^2)}{(\beta-1)(\dot{Y}_f+\omega)}}]$$

□

A.4 Second order condition

Taking the derivative of right hand side of Equation (A-6) with respect to c_{f1}, the second order derivative is:

$$\begin{aligned}\frac{\partial^2 V}{\partial c_{f1}^2} &= -\frac{\beta}{\alpha(\dot{Y}_f+\omega)}\\ &\quad +\rho k[(1-\gamma)\dot{Y}_f+\beta(\gamma\dot{Y}_f-\frac{\gamma^2\dot{Y}_f}{2\alpha})]E(g'')-\rho kE\{\beta(\gamma-\frac{\gamma^2 g}{\alpha\dot{Y}_f})g'^2+[\dot{Y}_f+\beta(\gamma g-\frac{\gamma^2 g^2}{2\alpha\dot{Y}_f})]g''\}\\ &= -\frac{\beta}{\alpha(\dot{Y}_f+\omega)}+\frac{\rho k\gamma(\beta-1)\dot{Y}_f}{2}Eg''-\rho k\beta\gamma E(g'^2+gg'')+\frac{\rho k\beta\gamma^2}{2\alpha\dot{Y}_f}E(2gg'^2+g^2g'')\\ &= -\frac{\beta}{\alpha(\dot{Y}_f+\omega)}+\frac{\rho k\gamma(\beta-1)\dot{Y}_f}{2}Eg''-\frac{\rho k\beta\gamma}{2}E(g^2)''+\frac{\rho k\beta\gamma^2}{6\alpha\dot{Y}_f}E(g^3)''\end{aligned}$$

where the last step is obtained by power rule and product rule of derivative. The value of second order derivative thus depends on the mean value of second order derivative function of g, g^2, g^3. By Continuous Theorem again, as ϵ and c_{f1} are independent, the order of taking derivative and integral could be switched, so that:

$$\begin{aligned}Eg'' &= (Eg)''\\ E(g^2)'' &= (E(g^2))''\\ E(g^3)'' &= (E(g^3))''\end{aligned}$$

According to Equation system (A-9), the expected terms simply drop out of the second order derivative, and therefore the second order condition for local maximization is always satisfied:

$$\frac{\partial^2 V}{\partial c_{f1}^2} = -\frac{\beta}{\alpha(\dot{Y}_f + \omega)} < 0$$

A.5 Common Sense

In order to rule out the higher root, an explicit formula for g' is necessary as in Section A.2.3. Unfortunately, this is not available under current circumstances, since g' in Equation (A-7) gives way to the rational expectation condition after taking integral in Equation (A-8). But if the same logic in Section A.2.3 could have been applied here, the higher root will be ruled out for intuitive reason again, leaving only the lower value as economically sensible solution.

□

Table A-1: Simulation for father's Scaled Income Squared Residuals

Variable	Ln(labor income) in divorce (1)	Scaled Squared Residuals (2)
Ln(labor income)	0.747***	-0.077***
	[10.44]	[3.98]
age	-0.010*	0.001
	[1.85]	[0.85]
Race–Black	-0.167	0.011
	[1.62]	[0.48]
Race–Other	-0.367	0.064
	[1.35]	[0.68]
Education–0-5 grades	-0.998***	0.038
	[3.00]	[0.51]
Education–6-8 grades	-0.002	-0.059*
	[0.01]	[1.88]
Education–9-11 grades	-0.061	-0.033
	[0.59]	[1.47]
Education–College, no degree	0.057	-0.005
	[0.74]	[0.35]
Education–College, bachelors degree	0.011	0.012
	[0.10]	[0.62]
Education–College, advanced degree	0.357**	-0.022
	[2.50]	[0.57]
PMSA status	0.143	-0.007
	[1.59]	[0.42]
Central city status	-0.189	-0.001
	[1.52]	[0.07]
Number of kids	0.067*	0.008
	[1.77]	[1.02]
Constant	2.454***	0.617***
	[3.05]	[3.20]
Observations	2150	2150
R-squared	0.47	0.16

Note: State, region, and year effects are controlled. Absolute value of t statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table A-2: Simulation of father's Ln(laborinc) after Divorce

	St.Dev of Ln(laborinc) (1)	Mean Squared Change of Ln(laborinc) (2)	Current Mean Squared Change of Ln(laborinc) (3)	Squared Residal of Ln(laborinc) (4)
Income volatility	0.524	-0.220	-0.045	-0.012
	[0.39]	[0.51]	[0.11]	[0.01]
Ln(labor income)	1.211***	1.185***	1.286***	1.215***
	[4.14]	[4.03]	[4.25]	[4.23]
age	0.064	0.063	0.088	0.070
	[1.06]	[1.07]	[1.17]	[1.21]
Race–Black	-0.083	-0.090	-0.112	-0.147
	[0.86]	[0.93]	[1.04]	[1.55]
Race–Other	-0.325	-0.346	-0.687	-0.363
	[1.13]	[1.22]	[1.34]	[1.34]
Education–0-5 grades	2.838	2.698	12.794**	2.834
	[0.37]	[0.36]	[2.18]	[0.39]
Education–6-8 grades	2.102	2.320	2.903	2.848*
	[1.21]	[1.35]	[1.56]	[1.71]
Education–9-11 grades	0.852	0.835	0.613	1.380
	[0.57]	[0.58]	[0.33]	[0.96]
Education–College, no degree	2.246*	2.182*	2.555*	2.510**
	[1.78]	[1.75]	[1.71]	[2.05]
Education–College, bachelors degree	2.231	2.171	0.414	3.416*
	[1.17]	[1.18]	[0.18]	[1.92]
Education–College, advanced degree	-0.222	-0.325	0.188	-0.176
	[0.12]	[0.17]	[0.09]	[0.09]
PMSA status	0.097	0.106	0.116	0.128
	[1.08]	[1.19]	[1.15]	[1.39]
Central city status	-0.161	-0.150	-0.079	-0.125
	[1.30]	[1.21]	[0.54]	[0.99]
Number of kids	0.066*	0.067*	0.077*	0.062*
	[1.78]	[1.82]	[1.94]	[1.68]
Constant	-1.427	-1.094	-2.513	-1.626
	[0.59]	[0.47]	[0.81]	[0.71]
Observations	2011	2011	1540	2150
R-squared	0.49	0.49	0.49	0.48

Note: Income and age, education level interaction effects, and state, region, and year effects are controlled. Absolute value of t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A-3: Simulation of father's Food Expenditure Income Ratio after Divorce

	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Current Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	1.531	0.449	0.164	1.269*
	[1.43]	[1.13]	[0.49]	[1.67]
Ln(labor income)	-0.214	-0.195	-0.227	-0.127
	[1.36]	[1.27]	[1.30]	[0.82]
age	-0.051	-0.044	-0.058	-0.031
	[1.34]	[1.24]	[1.21]	[0.96]
Race–Black	0.073	0.070	0.085	0.101
	[1.03]	[0.98]	[1.04]	[1.57]
Race–Other	-0.079	-0.108	-0.259	-0.042
	[0.47]	[0.60]	[0.72]	[0.26]
Education–0-5 grades	26.710	26.536	38.086	26.098
	[0.85]	[0.85]	[0.66]	[0.86]
Education–6-8 grades	1.701	1.835*	1.619	1.703*
	[1.50]	[1.66]	[1.21]	[1.73]
Education–9-11 grades	0.751	0.828	1.115	0.542
	[0.64]	[0.72]	[0.75]	[0.49]
Education–College, no degree	-0.250	-0.276	-0.512	-0.238
	[0.31]	[0.35]	[0.51]	[0.32]
Education–College, bachelors degree	0.401	0.496	1.026	0.183
	[0.22]	[0.27]	[0.45]	[0.12]
Education–College, advanced degree	-1.120	-1.202	-1.912	-1.082
	[0.95]	[1.02]	[1.32]	[0.99]
PMSA status	-0.096	-0.100	-0.116	-0.111*
	[1.50]	[1.57]	[1.64]	[1.76]
Central city status	0.118	0.130*	0.200**	0.141*
	[1.52]	[1.69]	[2.06]	[1.79]
Number of kids	-0.002	-0.002	-0.001	0.001
	[0.09]	[0.09]	[0.03]	[0.05]
Constant	2.425	2.322	3.407	1.666
	[1.45]	[1.44]	[1.49]	[1.08]
Observations	2011	2011	1540	2150
R-squared	0.11	0.11	0.13	0.11

Note: Income and age, education level interaction effects, and state, region, and year effects are controlled. Absolute value of t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A-4: Simulation of Father's Indoor Activities with Child

	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Current Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	2.516	0.994*	0.576	0.517
	[1.64]	[1.95]	[0.75]	[0.68]
Father divorced	-0.353	-0.280	-0.372*	-0.302
	[1.23]	[1.35]	[1.74]	[1.25]
Income volatility X Father divorced	4.056	1.579	2.602*	1.943
	[0.62]	[0.77]	[1.66]	[0.67]
Boy	0.131	0.140*	0.147*	0.129
	[1.59]	[1.71]	[1.75]	[1.58]
Mother's income	0.000	0.000	0.000	0.000
	[0.64]	[0.59]	[0.67]	[0.76]
Mother's age	-0.056***	-0.055***	-0.051***	-0.055***
	[6.59]	[6.50]	[5.83]	[6.34]
Mother's race–Black	-0.629***	-0.638***	-0.691***	-0.609***
	[3.62]	[3.65]	[3.80]	[3.47]
Mother's race–Other	-0.355*	-0.368*	-0.418**	-0.397**
	[1.84]	[1.88]	[2.01]	[2.05]
Mother's education–0-5 grades	-0.086	-0.186	-0.085	-0.077
	[0.18]	[0.39]	[0.17]	[0.17]
Mother's education–6-8 grades	0.186	0.186	0.190	0.200
	[0.56]	[0.56]	[0.53]	[0.60]
Mother's education–9-11 grades	-0.302	-0.302	-0.271	-0.286
	[1.43]	[1.43]	[1.19]	[1.35]
Mother's education–College, no degree	0.580***	0.584***	0.626***	0.600***
	[4.95]	[4.95]	[5.14]	[5.10]
Mother's education–College, bachelors degree	0.437***	0.454***	0.522***	0.463***
	[3.62]	[3.76]	[4.10]	[3.78]
Mother's education–College, advanced degree	0.710***	0.722***	0.769***	0.761***
	[4.00]	[4.07]	[4.23]	[4.33]
Mother's number of kids	-0.045	-0.046	-0.035	-0.037
	[0.94]	[0.96]	[0.71]	[0.77]
Mother's PMSA status	-0.033	-0.037	-0.015	-0.044
	[0.27]	[0.30]	[0.12]	[0.36]
Mother's central city status	0.024	0.013	0.015	0.025
	[0.15]	[0.08]	[0.09]	[0.15]
Observations	926	926	883	920

Note: State, region, and year effects are controlled. Robust z statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table A-5: Simulation of Father's Outdoor Activities with Child

	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Current Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	-0.064	0.284	-0.071	0.070
	[0.05]	[0.89]	[0.19]	[0.11]
Father divorced	-0.328	-0.443**	-0.520**	-0.531**
	[1.14]	[2.20]	[2.24]	[2.33]
Income volatility X Father divorced	-3.377	-0.331	1.096	1.267
	[0.51]	[0.17]	[0.97]	[0.64]
Boy	0.308***	0.309***	0.339***	0.307***
	[3.74]	[3.77]	[4.01]	[3.77]
Mother's income	0.000	0.000	0.000	0.000
	[0.98]	[0.93]	[0.84]	[1.00]
Mother's age	-0.059***	-0.060***	-0.057***	-0.061***
	[7.25]	[7.37]	[6.72]	[7.40]
Mother's race–Black	-0.150	-0.147	-0.193	-0.132
	[1.09]	[1.08]	[1.33]	[0.96]
Mother's race–Other	-0.142	-0.134	-0.101	-0.132
	[0.66]	[0.62]	[0.44]	[0.62]
Mother's education–0-5 grades	-0.428	-0.483	-0.441	-0.545
	[0.58]	[0.64]	[0.59]	[0.80]
Mother's education–6-8 grades	-0.106	-0.111	-0.007	-0.115
	[0.33]	[0.35]	[0.02]	[0.36]
Mother's education–9-11 grades	-0.414**	-0.413**	-0.409*	-0.408**
	[2.07]	[2.05]	[1.82]	[1.99]
Mother's education–College, no degree	0.021	0.012	0.010	0.012
	[0.17]	[0.10]	[0.08]	[0.10]
Mother's education–College, bachelors degree	-0.031	-0.038	-0.008	-0.037
	[0.26]	[0.32]	[0.06]	[0.31]
Mother's education–College, advanced degree	0.133	0.127	0.172	0.139
	[0.76]	[0.73]	[0.98]	[0.82]
Mother's number of kids	0.090*	0.088*	0.098*	0.087*
	[1.79]	[1.76]	[1.92]	[1.71]
Mother's PMSA status	-0.058	-0.058	-0.044	-0.062
	[0.52]	[0.52]	[0.38]	[0.56]
Mother's central city status	0.291**	0.285**	0.361**	0.284**
	[2.08]	[2.03]	[2.50]	[2.01]
Observations	926	926	883	920

Note: State, region, and year effects are controlled. Robust z statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table A-6: Simulation of Whether Mother Relocated

	St.Dev of Ln(laborinc)	Mean Squared Change of Ln(laborinc)	Current Mean Squared Change of Ln(laborinc)	Squared Residal of Ln(laborinc)
	(1)	(2)	(3)	(4)
Income volatility	0.154	0.025	-0.010	0.113
	[0.78]	[0.66]	[0.26]	[0.79]
Mother's income	0.000	0.000	0.000	-0.000
	[0.48]	[0.45]	[0.43]	[0.09]
Mother's welfare participation status	-0.009	-0.010	-0.011	0.008
	[0.44]	[0.48]	[1.09]	[0.41]
Mother's age	0.001	0.000	0.001	0.001
	[0.47]	[0.36]	[0.80]	[0.68]
Mother's race–Black	0.022	0.019	0.012	0.025
	[0.78]	[0.65]	[0.57]	[0.94]
Mother's race–Other	-0.038***	-0.038***		-0.037***
	[4.04]	[4.08]		[4.36]
Mother's education–6-8 grades	-0.028	-0.028		-0.032*
	[1.15]	[1.12]		[1.66]
Mother's education–9-11 grades	0.033	0.037	0.039*	0.015
	[1.14]	[1.29]	[1.68]	[0.56]
Mother's education–College, no degree	0.026	0.026	0.016	0.008
	[1.13]	[1.12]	[0.98]	[0.42]
Mother's education–College, bachelors degree	0.105**	0.107**	0.030	0.066*
	[2.21]	[2.24]	[1.03]	[1.71]
Mother's education–College, advanced degree	0.028	0.028	0.019	-0.007
	[0.81]	[0.83]	[0.84]	[0.25]
Mother's PMSA status status	-0.044*	-0.043*	-0.024*	-0.042*
	[1.95]	[1.90]	[1.75]	[1.88]
Mother's central city status	0.036**	0.036***	0.016*	0.035***
	[2.54]	[2.58]	[1.76]	[2.86]
Mother's number of kids	-0.006	-0.005	-0.000	-0.001
	[0.67]	[0.55]	[0.04]	[0.13]
Duration of mother's previous marriage	-0.000	-0.000	-0.000	-0.001
	[0.19]	[0.10]	[0.33]	[0.54]
Number of years since mother divorced	0.001	0.001	0.001	0.001
	[0.72]	[0.79]	[0.69]	[0.67]
Observations	3122	3122	1942	3450

Note: State, region, and year effects are controlled. Robust z statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.