Men's Rush to Marriage: Implications of the Child Support Enforcement Policy for Marriage, Fertility, and Long-Term Inequality

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Abstract

The child support enforcement (CSE) policies, aimed at protecting out-of-wedlock children from financial disadvantages, brought unexpected changes in individuals' marriage and fertility behaviors during the 1980s and the 1990s. Our estimates from state-year panel data show that in states with strict CSE there has been a significant decrease in non-marital births and a significant increase in marital births. Taking into account all these changes, what are the effects of CSE on children's welfare? To answer this question, we build a heterogeneous-agent model that features endogenous marriage and child-investment decisions. Exploiting the state-level variation in enforcement, we estimate it using the National Vital Statistics Report data. We find that men's increased willingness to marry is the driving force behind the shift from non-marital births to marital births. As evidence for the mechanism, we show that the number of marriages has risen in the states with strict CSE during the same period, consistent with the model's implication. Our model predicts that a large increase in child investment comes through a secondary effect of CSE: the shift from non-marital births to marital births increases child investment through its income effect.

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1 Introduction

Since the late 1970s, the U.S. federal government has taken a number of steps to strengthen the state-regulated, private child support systems. In the mid-1970s, it created the Office of Child Support Enforcement (OCSE), required all states to establish comparable state offices, and raised federal funding for three-quarters of the states' expenditures on child support enforcement. It also passed major federal regulations in the 1980s requiring states to strengthen paternity establishment, to create legislative guidelines for states' child support orders, and to withhold obligations from fathers' wages. As a consequence, many states increased their child support collections significantly (as shown in Figure 1) by establishing child support enforcement (CSE) policies through the 1980s and 1990s.[1]

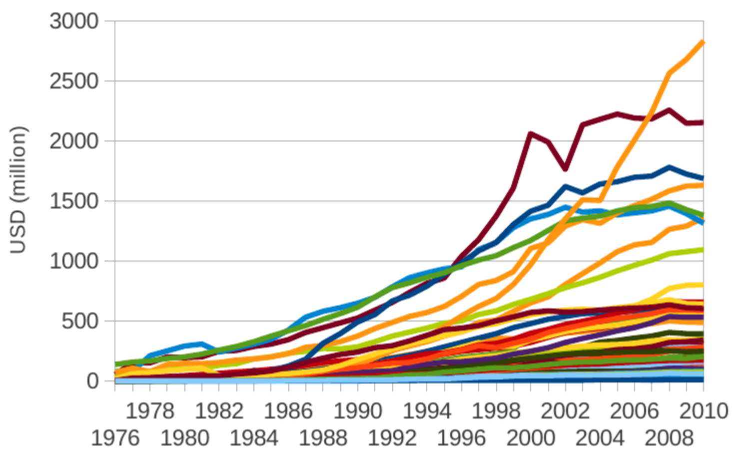

Figure 1: Child Support Collection Amount by States. Source: OCSE

However, these CSE policies have also brought unexpected changes in people's marriage and fertility behaviors in the United States. In addition to a reduction of non-marital births, which is well-known in the literature,[2] we find significant increases in the number of marital births and also

[1]CSE policies consist of child support legislation and plans of state's expenditures for CSE cases. The major CSE laws are on genetic testing, paternity establishment, wage withholding under delinquency, immediate wage withholding for new cases, universal wage withholding, and state income tax interception. The years when these legislations were approved, vary across states. See the work of Huang (2002) for more details.

[2]See the work of Case (1998), Huang (2002), Garfinkel, Huang, McLanahan, and Gaylin (2003), and Aizer and McLanahan (2006), for example.

in marriages in the states with strict CSE. (See Table 1 for a summary of our estimates.[3,4]) Why did these changes happen after the CSE policies were strengthened? Furthermore, what was the effect of CSE on children's welfare if we take into account all these changes?

Table 1: The Effects of a 10% Increase in the Child Support Collection Rate

Variable	**Level in 1980**	**Changes in Level**	**Changes in %**
Total Fertility Rate for Non-Marital Births	0.304	$-\Delta$ 0.0297	$-\Delta$ 9.8%
Total Fertility Rate for Marital Births	1.582	$+\Delta$ 0.0172	$+\Delta$ 1.1%
Marriage Rate	0.042	$+\Delta$ 0.0013	$+\Delta$ 3.1%

To address these issues, we build a heterogeneous-agent model which features marriage and child investment decisions. In our model, people form marital or non-marital relationships in a stable matching equilibrium and also choose the number and the quality of children within each relationship. As in the work of Weiss and Willis (1985), here marriage allows couples to achieve the efficient level of public good investment. If a couple chooses a non-marital relationship, however, only the mother can determine the level of child investment; the father transfers child support payments to the mother but often at inefficiently low levels because of the lack of coordination. We compute our model by extending the Gale and Shapley (1962) algorithm. And we estimate using the total fertility rate for marital and non-marital births (the National Vital Statistics Report: Natality data published by the Centers for Disease Control and Prevention), exploiting the exogenous variations in CSE across the states during the period 1980 - 1997.

We find that men's increased willingness to marry is the driving force behind the shift from non-marital births to marital births. After the strengthening of CSE policies, facing the larger cost per child due to the mandatory child support payment, men in non-marital relationships may

1. Reduce the number of children and, instead, increase investments in child quality.

[3] In Table 1, the *marriage rate* is defined as the number of marriages per population. To create the total fertility rate (total period fertility rate), first we calculate age-specific marital and non-marital birth rates for six age groups. Then we sum them up and multiply the sum by five.

[4] According to our estimate, a 10% increase in the child support collection rate has decreased the total fertility rate for non-marital births by 9.8%, increased the total fertility rate for marital births by 1.1%, and increased the marriage rate by 3.1% (as summarized in Table 1) relative to the trends.

2. Reduce the number of children and, instead, increase the private consumption.

3. Get married to avoid the child cost change.

We find that option (1) is not attractive to unmarried fathers, because to increase a child's quality investment they have to transfer money to the mothers. But these transfers involve two types of inefficiency: First, in non-marital relationships, since the mothers are not considering the fathers' utility, they don't invest all the money in children's quality. They use some of it for their private consumption. Second, if the mother in a non-marital relationship is on a welfare program, then the state government takes away a significant portion of child support payments made by the biological father.[5] Therefore, fathers' investments don't really increase a child's quality. And unmarried fathers are thus left with options (2) or (3). Through our estimation, we show that men split between reducing the number of children and increasing marriage when facing the increased degree of CSE. This result hinges upon finding parameters that govern the elasticity between the utility from consumption and from children.

After estimating the model's underlying parameters using marital and non-marital total fertility rates in the state-year panel data, we check the identification of the model by predicting the increase of marriages found in the data. This is crucial to distinguish our story from the other alternatives. From the reduced-form regression, a 10% increase in the child support collection rate induces a 3.1% increase in the marriage rate and a 1.93% increase of the number of ever-married people at age 45. The model predicts a rise of 1.39% in the number of ever-married people, accounting for 72% of the increase in marriages in the data.

Finally, using the estimated parameters, we find that there are secondary, positive effects of CSE on child investment. CSE was originally supposed to protect out-of-wedlock children and, thus, to improve child investment in non-marital relationships. However, we find that a large gain in the average child investment comes through a shift from non-marital births, when we allow for the income effects on child quality investment. Our model predicts that a 10% increase in the child support collection rate will increase average child investment by 1.1%. Assuming a general human

[5] In most states, child support payments to mothers on Aid to Families with Dependent Children (AFDC) are now taxed 100%. Some states allow a $50 pass-through per month.

capital transmission function, we find that stronger CSE will men's decrease 90-10% income ratio of the next generation by 2.2%. We find that the effects are especially strong for the bottom group of the income distribution.

Related Literature

Our work here is related to a sizable number of studies in the sociology and economics literature that examine the effect of CSE on non-marital births. Case (1998) and Garfinkel, Huang, McLanahan, and Gaylin (2003) analyze state level data similar to ours. Case (1998) finds significantly lower non-marital birth rates in the states where legislation allows genetic testing to establish paternity, permits paternity establishment up to age 18, and establishes presumptive guidelines for setting child support awards. Extending her framework, Garfinkel, Huang, McLanahan, and Gaylin (2003) use paternity the establishment rate[6] and child support collection amounts per cases,[7,8] and show significantly negative effects of their CSE measures on non-marital births. Huang (2002), Aizer and McLanahan (2006), and Plotnick, Garfinkel, McLanahan, and Ku (2007) look into microeconomic data. Huang (2002) and Aizer and McLanahan (2006) use the U.S. Labor Department's National Longitudinal Survey of Youth 1979 (NLSY79) to examine whether CSE is related to the likelihood that a women's first birth is premarital. And both studies show that CSE reduces the risk of out-of-wedlock births. So do Plotnick, Garfinkel, McLanahan, and Ku (2007), but they use the University of Michigan's Panel Study of Income Dynamics (PSID) for their analysis.

Compared to studies of non-marital births, not much research has been done on the effect of CSE on marital births and marriages. Huang (2002) is one of the exceptions; he uses the multinomial logit model for NLSY79 and finds a significant increase in the likelihood of marital births in the states with strict CSE. Our work is motivated by his work, but we use state-year panel data constructed from the CDC's National Vital Statistics Report (NVSR). We show that there is an increase in marital births also in our state panel data. For marriage, the work of Acs and Nelson (2004) is the

[6] The paternity establishment rate is defined as the number of paternity establishments for non-marital births over the total number of non-marital births.

[7] More precisely, they consider only cases with single mothers on Aid to Families with Dependent Children (AFDC).

[8] Those are calculated from the Office of Child Support Enforcement (OCSE) 1980 - 1997 Annual Reports to Congress.

only research, as far as we know, which reports the effect of strengthened CSE on marital statistics. They show that two-parent families have increased in the states where CSE has been strengthened, especially among low-income people. They use the University of Michigan's 1997 and 1999 National Surveys of America's Families and apply the difference-in-difference estimation method to derive their results. Unlike their approach, we don't analyze the 'stock' of married people. Instead, we look at the marriage rate in the state-year panels. Our data cover the longer period, and our result is more robust than theirs.

In terms of theory, our study is related to the growing literature on family economics. One of the most relevant works is Weiss and Willis (1985). They show that non-marital childbearing potentially involves inefficiencies in child investment. This is because single mothers don't take into account fathers' utility when investing, and if fathers know that, they don't transfer much money to mothers. Del Boca and Flinn (1995) apply Weiss and Willis (1985)'s framework to explain why child support payments are low in the U.S. data. Our study is also based on the work of Weiss and Willis (1985). And we extend their model to the stable matching problem. Other relevant studies which analyze child support and/or CSE are those of Chiappori and Weiss (2006), Chiappori and Weiss (2007), and Greenwood, Guner, and Knowles (2003). All these use two-period models, which enable them to analyze the divorce situations. Other relevant works are those which apply the two-sided matching problem to an analysis of the marriage market. Del Boca and Flinn (2005) compute a stable matching equilibrium applying Gale and Shapley (1962)'s algorithm. We further extend their framework, allowing for marital and non-marital relationships. Finally, our work is related to those which study the intergenerational transmission of human capital. These include the work of Aiyagari, Greenwood, and Guner (2000), Greenwood, Guner, and Knowles (2003), and Kocharkov (2010), who analyze the effects of the government's family policies on the next generation's income distribution. Also, in the growth context, De La Croix and Doepke (2003) and Moav (2005) show that economies with a less equitable income distribution have a lower rate of economic growth as the consequence of the quantity-quality trade-off of child investment.

The next section describes our economic model and defines an equilibrium. Sections 3 and 4 describe the data and the estimation methodology. Section 5 presents the results and the implications.

Section 6 concludes.

2 The Model Economy

We develop a structural economic model in order to identify the channels through which changes in the degree of CSE have effects on marriage decisions and fertility choices. In our model, equal population of women and men enter the marriage market only once in their life, form either marital or non-marital unions in a stable matching equilibrium, and choose about a quantity and quality of children. Our model is static in the sense that people make a decision about marriage and fertility only once in their lives.

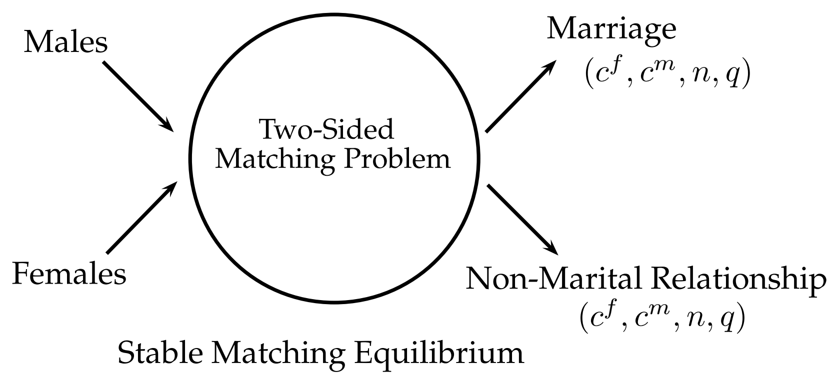

Figure 2: Structure of the Model Economy

2.1 Setup

The agents in the economy are unit masses of females (f) and males (m), who each live for one period. Among each of these types of agents, individuals differ in their human capital level, $h^f \in \mathcal{H}^f \subset \mathbf{R}_+$ and $h^m \in \mathcal{H}^m \subset \mathbf{R}_+$, and their charm level, $a^f \in \mathcal{A} \subset \mathbf{R}$ and $a^m \in \mathcal{A} \subset \mathbf{R}$. Assume that there is only a finite number of types of people in the economy and that the number of types is the same for women and men. The sets of all types of people are denoted as $\{(h_i^f, a_i^f)\}_{i\in\mathcal{I}^f}$ for women and $\{(h_j^m, a_j^m)\}_{j\in\mathcal{I}^m}$ for men, where $\mathcal{I}^f$ is the set of all indices for women's type and $\mathcal{I}^m$ is the set of all indices for men's type. We assume that $n(\mathcal{I}^f) = n(\mathcal{I}^m) = N_h \times N_a$, where $n(X)$

denotes the cardinality of a set X, N_h is the number of possible human capital levels, and N_a is the number of possible charm levels. Both N_h and N_a are common across sex. Let $\mathcal{I}^f \cap \mathcal{I}^m = \emptyset$ for the convenience of our analysis. Finally, assume that people are equally populated across each type (h_i, a_i).

After they are born, both men and women enter the frictionless marriage market, where each person chooses one partner and forms a relationship - either marriage or a non-marital relationship. As we will discuss later, people can form a relationship with whomever they want as long as the partner agrees. But, by assumption, they cannot have more than one relationship. Once people form a relationship, they determine allocations, (c^f, c^m, n, q), where $c^f \in \mathbf{R}_+$ is women's private consumption, $c^m \in \mathbf{R}_+$ is men's private consumption, $n \in \mathbf{R}_+$ is the number of children for the couple, and $q \in \mathbf{R}_+$ is the quality of each child for the couple. We assume that n and q are local public goods within couples.

Preferences Preferences are identical across sex, and are denoted as $u(c, a') + v(nq)$. People get utility from their private consumption c and from the number of children times the quality of children nq. Also, they get utility from their partner's charm a'. For men who choose non-marital relationship, probably, fathers are not always staying with their children.[9] And, thus, we take into account the possibility of a discount of their utility from children as $u(c, a') + \delta v(nq)$ where $\delta \in [0, 1]$.

Technology Couples in either marriage or a non-marital relationship invest in the number and the quality of children. Increasing one unit of the number, it requires fixed amounts of time ϕ and consumption good ψ. Increasing the quality requires an input of per-child educational investment s. Then children's quality is determined by a function, $q = f_1(s)$ for married couples, and $q = f_0(s)$ for non-married couples.

Child Support Men in non-marital relationships make child support payments to the mothers of their children. The payments consist of a mandatory portion and a voluntary portion. Let

[9] According to McLanahan, Garfinkel, Reichman, and Teitler (2001), more than half of new unwed parents are not cohabiting in the 1998-1999 data in the U.S..

$wh^m\gamma\tau^{cs}(n)$ be the amount of mandatory child support payments for men whose human capital level is h^m and who have n children out of wedlock, where $\tau^{cs}(n)$ is the child support order, which depends on the number of children and which determines the payment rate from their income. Assume that $\gamma \in [0, 1]$ is the strength of CSE, which state governments can control. And, w is the market price of human capital.

Aid to Families with Dependent Children (AFDC) Mothers in non-marital relationships who meet an income test are eligible for AFDC and receive monetary payments. AFDC is a welfare program provided by each state government. In the model, we assume that there are no differences across states. Mathematically, $g(e, n)$ is the amount of receipts from AFDC, which is decreasing in the mother's income e and increasing in the number of her children n.

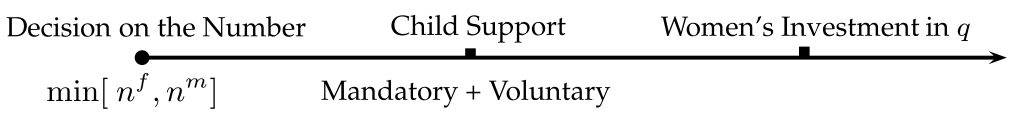

Figure 3: Timeline of Decisions in Non-Marital Relationships

2.2 Couples in Non-Marital Relationships

Allocations within the couples in non-marital relationships are determined through three stages, shown in Figure 3. In the first stage, women and men decide on the number of children they will have together. In the second stage, men pay mandatory child support, and choose the amounts of their private consumption and voluntary child support payments. In the third stage, women choose their private consumption and child investment.

Let us first focus on the last stage and go backward. Given the number of children n, the characteristics of the couple $\Phi \equiv (h^f, a,^f h^m, a^m)$, the strength of CSE γ, and a voluntary payment of child support from the biological father T^{cs}, a woman in a non-marital relationship (that is, still single, S) solves the following problem:

$$
\begin{aligned}
V_S^f(n, \Phi, \gamma, T^{cs}) \equiv & \max_{c^f, s \geq 0} \; u\left(c^f, a^m\right) + v\left(nq\right) \\
& \text{subject to} \\
& \qquad q = f_0(s) \\
c^f + (\psi + s)n = & \; wh^f(1 - \phi n) + \max\Bigg[\underbrace{g\left(wh^f(1 - \phi n), n\right)}_{\text{AFDC}}, \; \underbrace{wh^m\gamma\tau^{cs}(n) + T^{cs}}_{\text{Mandatory+Voluntary CS}}\Bigg],
\end{aligned}
$$

where V_S^f is the woman's utility value, c^f is her consumption, s is the amount of investment per child, q is the quality of each child, ψ is the consumption good cost per child, ϕ is the time cost per child, and $g(w^f, n)$ is the AFDC receipt. If there is a child support payment to a woman on AFDC from the biological father, it is taxed 100%. Denote the solution to the quality of the children in the above problem as $q_0^*(T^{cs}; n, \Phi, \gamma,)$.

The problem for a man in a non-marital relationship is defined in the following way. Given the number of children n, the characteristics of the couple Φ, the degree of CSE γ, and the woman's response function $q_0^*(T^{cs}; n, \Phi, \gamma)$, a man chooses his private consumption c^m and voluntary child support payments T^{cs}:

$$
\begin{aligned}
V_S^m(n, \Phi, \gamma; q_0^*) \equiv & \max_{c^m, T^{cs} \geq 0} \; u\left(c^m, a^f\right) + \delta v\left(nq_0^*(T^{cs}; n, \Phi, \gamma)\right) \\
& \text{subject to} \\
c^m + T^{cs} = & wh^m\left(1 - \gamma\tau^{cs}(n)\right),
\end{aligned}
$$

Denote the solution for the child support payments in the above problem as $T^{cs*}\left(n, \Phi, \gamma; q_0^*\right)$.

Finally, in the first stage, the number of children is determined as the minimum of the numbers which each partner wants:

$$
n_0^*(\Phi, \gamma) \equiv \min\left[\arg\max_n V_S^f(n, \Phi, \gamma, T^{cs*}), \arg\max_n V_S^m(n, \Phi, \gamma; q_0^*)\right].
$$

Once the number is determined, the utility values for each member of the couple in a non-marital relationship are well-defined. The set of utility values is denoted as $\left\{\hat{V}_S^f(\Phi,\gamma),\hat{V}_S^m(\Phi,\gamma)\right\}_{\Phi\in\mathcal{F}}$, where $\mathcal{F}$ is the set of all possible patterns of a couple's characteristics, which includes $N_h^2\times N_a^2$ patterns of coupling. Let $\hat{V}_s^f(\Phi,\gamma)$ be defined as $\hat{V}_S^f(\Phi,\gamma)\equiv V_S^f(n_0^*,\Phi,\gamma,T^{cs*})$ and $\hat{V}_s^m(\Phi,\gamma)$ be defined as $\hat{V}_S^m(\Phi,\gamma)\equiv V_S^m(n_0^*,\Phi,\gamma;q_0^*)$.

2.3 Married Couples

Unlike couples in non-marital relationships, married couples stay together with their children for a long time; thus, we assume that the allocation within marriage is determined through a Nash bargaining problem:

$$\max_{c^f,c^m,n,q,t^f,t^m\geq 0}\left[V_M^f(c^f,n,q;\Phi)-\hat{V}_S^f(\Phi,\gamma)\right]^{\frac{1}{2}}\times\left[V_M^m(c^m,n,q;\Phi)-\hat{V}_S^m(\Phi,\gamma)\right]^{\frac{1}{2}}$$

subject to

$$\begin{aligned}
&q=f_1(s)\\
&\phi n=t^f+t^m\\
&c^f+c^m+(\psi+s)n=wh^f(1-t^f)+wh^m(1-t^m)\\
&V_M^f(c^f,n,q;\Phi)\geq\hat{V}_S^f(\Phi,\gamma)\\
&V_M^m(c^m,n,q;\Phi)\geq\hat{V}_S^m(\Phi,\gamma)
\end{aligned}$$

and

$$\begin{aligned}
V_M^f(c^f,n,q;\Phi)&\equiv u\left(c^f,a^m\right)+v\left(nq\right)+\kappa\\
V_M^m(c^m,n,q;\Phi)&\equiv u\left(c^m,a^f\right)+v\left(nq\right)+\kappa
\end{aligned}$$

where t^f and t^m are the time spent for child nurture by each member of the couple, and which must sum to ϕn. Here $\kappa\in\mathbf{R}$ is the utility gain of marriage, which is common across couples.

We denote the solution of the utility values for the above problem for married (M) couples as $\left\{\hat{V}_M^f(\Phi,\gamma), \hat{V}_M^m(\Phi,\gamma)\right\}_{\Phi\in\mathcal{F}}$. It is often true that there doesn't exist a solution to the above problem. In that case, we simply assume that $\hat{V}_M^f(\Phi,\gamma) = \hat{V}_M^m(\Phi,\gamma) = -\infty$, so that couples choose non-marital relationships in the stable matching equilibrium.

As in the work of Weiss and Willis (1985), here marriage allows couples to attain the efficient level of public good investment through Nash bargaining. However, in non-marital relationships, mothers choose their private consumption and child investment without taking into account fathers' utility; thus, mothers under-invest in children. Furthermore, if fathers know their payments will not fully used for their children by mothers, they will not transfer enough child support payments to the mothers. Through these steps, inefficiency in public good investment arises in non-marital relationships.

2.4 Stable Matching Equilibrium

In this economy, women and men look for a partner in the frictionless marriage market. Again, they can form a marital or a non-marital relationship with whomever they want as long as the partner agrees, but we assume that they cannot form more than one relationship at the same time. Also, in equilibrium, all the agents must form some relationship with a partner.

Formally, we consider a set of matchings (μ_S, μ_M), where μ_S is a matching for non-marital relationships (single S) and μ_M is a matching for marital (M) relationships. Mathematically, μ_S and μ_M are mappings from $\mathcal{I}^f \cup \mathcal{I}^m$ onto itself.[10] In particular here we only consider the sets of mappings which satisfy the following properties.

Definition 1. *A pair (μ_S, μ_M) is defined as an **acceptable pair of matchings** if it satisfies the following properties:*

1. *$\forall R \in \{S, M\}$, if $\mu_R(x) \neq \emptyset$, then $\mu_R(\mu_R(x)) = x$.*
2. *$\forall R \in \{S, M\}$, if $x \in \mathcal{I}^g$ and $\mu_R(x) \neq \emptyset$, then $\mu_R(x) \in \mathcal{I}^{g'}$, where $g, g' \in \{f, m\}$ and $g \neq g'$.*

[10] Remember that we assumed $\mathcal{I}^f \cap \mathcal{I}^m = \emptyset$ at the beginning of this section. Thus, women and men are indexed by different numbers. And, $\mathcal{I}^f \cup \mathcal{I}^m$ denotes the entire set of types in the population.

3. $\forall R, R' \in \{S, M\}$ *with* $R \neq R'$, *if* $\mu_R(x) \neq \emptyset$, *then* $\mu_{R'}(x) = \emptyset$ *for all* $x \in \mathcal{I}^f \cup \mathcal{I}^m$.

In short, an acceptable pair of μ_S and μ_M is a set of mappings which specify the couples in each relationship and in which no one in the pairs has more than one relationship. Next, we define an equilibrium of the economy using these matchings μ_S and μ_M.

Definition 2. *Given* $\gamma \in [0, 1]$, *a* ***stable matching equilibrium*** *is an acceptable pair of matchings,* (μ_S, μ_M), *which satisfies these two conditions:*

1. $\forall R \in \{S, M\}$, *a woman* $i \in \mathcal{I}^f$ *with* $\mu_R(i) \neq \emptyset$ *receives utility,* $\hat{V}_R^f\left(h_i^f, a_i^f, h_{\mu_R(i)}^m, a_{\mu_R(i)}^m, \gamma\right)$, *and a man* $j \in \mathcal{I}^m$ *with* $\mu_R(j) \neq \emptyset$ *receives utility,* $\hat{V}_R^m\left(h_{\mu_R(j)}^f, a_{\mu_R(j)}^f, h_j^m, a_j^m, \gamma\right)$.

2. *(No Blocking) There doesn't exist a pair of couples* $(i, \mu_R(i))$,$(\mu_{R'}(j), j)$, *and relationships* $R, R', R'' \in \{S, M\}$ *such that*

$$\hat{V}_{R''}^f\left(h_i^f, a_i^f, h_j^m, a_j^m, \gamma\right) > \hat{V}_R^f\left(h_i^f, a_i^f, h_{\mu_R(i)}^m, a_{\mu_R(i)}^m, \gamma\right),$$
$$\hat{V}_{R''}^m\left(h_i^f, a_i^f, h_j^m, a_j^m, \gamma\right) > \hat{V}_{R'}^m\left(h_{\mu_{R'}(j)}^f, a_{\mu_{R'}(j)}^f, h_j^m, a_j^m, \gamma\right).$$

The second condition in the equilibrium definition requires that there are no pairs of a woman and a man who jointly deviate from their current relationships and obtain higher utility by starting a new relationship with the partner. In other words, the equilibrium is a *core of matching game.*

As in the last part of this section, we now pose a theorem for the existence of a stable matching equilibrium. The proof is an extension of Gale and Shapley (1962)'s.

Theorem 3. *A stable matching equilibrium exists in the economy.*

Proof. In Appendix 1.

□

2.5 Computing an Equilibrium

Definition 4. *A stable matching equilibrium (μ_S, μ_M) is **M-optimal** if every man likes it at least as well as any other stable matching equilibria. Similarly, a stable matching equilibrium (ν_S, ν_M) is **W-optimal** if every woman likes it at least as well as any other stable matching equilibria.*

Based on the approach of Del Boca and Flinn (2005), we focus on two extreme stable matching equilibria, the one that is most beneficial to men (the M-optimal stable matching equilibrium) and the one most beneficial to women (the W-optimal stable matching equilibrium). A straight-forward extension of the Gale and Shapley algorithm enables us to compute at least these two equilibria. In addition, because assuming that each individual has strict preference over mates, each of these equilibria turns out to be unique.

Assumption 5. *All the agents have strict preference over partners' types.*

To satisfy the above assumption, differences in human capital level have to create strictly different utility values for potential partners.[11] When couples choose non-marital relationships, it is not obvious because some low-income men might not make any child support payments. Then if those men's charm levels are the same, women become indifferent among the different types of men. To exclude this situation, we assume that $\gamma > 0$ always holds. If γ is strictly positive, then women get better off by having a non-marital relationship with a man with higher income because the state government transfers child support payments proportionally to men's income. Thus, Assumption 5 is always satisfied.[12]

Theorem 6. *Under Assumption 5, both the M-optimal stable matching equilibrium and the W-optimal stable matching equilibrium are unique.*

Proof. See Appendix 1.

□

[11] For charm, the utility function specified in Section 4.6 automatically creates strict differences.

[12] Here, we implicitly assuming that there don't exist (h_j^m, a_j^m) and $(h_{j'}^m, a_{j'}^m)$ such that $h_j^m > h_{j'}^m$, $a_j^m < a_{j'}^m$, and $\hat{V}_R^f(h_i^f, a_i^f, h_j^m, a_j^m) = \hat{V}_R^f(h_i^f, a_i^f, h_{j'}^m, a_{j'}^m)$ for some i and R. When we actually compute an equilibrium and discretizing the state spaces $\mathcal{H}^g$ and $\mathcal{A}$, it is the case only as a measure zero event. Thus, we exclude the possibility of the case from our analysis.

In Appendix 1, we also show that these two equilibria can be computed by extending Gale and Shapley (1962)'s algorithm. In Section 4, we actually compute and estimate an unique M-optimal stable matching equilibrium. Hereafter, we refer to a stable matching equilibrium as an M-optimal stable matching equilibrium.[13]

3 The Data

To estimate the equilibrium which we defined in the previous section, we construct state-year panel data from the birth and the marriage records of the CDC's National Vital Statistics Report (NVSR). In this section, we discuss the details of the construction of our variables: the total fertility rate for marital and non-marital births and the marriage rate. We also describe how we create the CSE measures and discuss some other control variables like state characteristics.

3.1 Dependent Variables

We use three dependent variables for our main analysis: the total fertility rate (more precisely, the total period fertility rate) for marital births, the total fertility rate for non-marital births, and the marriage rate. For the marital and non-marital total fertility rates, first we calculate age-specific (the mother's age) marital and non-marital birth rates for six age groups for each state and year from the NVSR 1980 - 1997, restricting the mother's age to 15 - 44. And we sum them up and multiply the sum by five. For the marriage rate, we define it as the number of marriages per 15 - 44 year-old female population.[14] And, we calculate it also from the NVSR (1980 - 1995). The summary statistics for the NVSR: Natality data are in Table 2.

[13]In this paper, we only analyze the M-optimal stable matching equilibrium. But, there may well exist other stable matching equilibria including the W-optimal stable matching equilibrium. Del Boca and Flinn (2005) explore how much other equilibria could be different from the M-optimal stable matching equilibrium by counting the pairs which exist both in the M-optimal stable and W-optimal matching equilibria. In their case, the same pairs are matched in over 96% of the cases in the male-preferred and female-preferred equilibria. And, they conclude that even though other equilibria exist, they are not so different from the M-optimal stable matching equilibrium. We will leave the application of this stability exercise for our future work.

[14]Although the best measure of the marriage rate would be the number of marriages per non-married population, the stock of (non)-married people is only available for the years in which the decimal U.S. Census has been conducted.

Table 2: Summary Statistics for National Vital Statistics Report Natality Data, 1980 - 1997

Name		
		Num. of Observations
State-Year Panels		908
Total Number of Births in the Data		69,315,940
Average Number of Births within a Panel		76,339
	Mean	**Std. Deviation**
Age of Mother at Child's Birth	26.19	5.68
Age of Father at Child's Birth	26.78	5.50
Mother's Education	**Num. of Observations**	**% in the Sample**
HS <	13,360,589	19.27
HS =	23,428,527	33.80
HS >	23,463,224	33.85
Mother's Race		
White	55,610,558	79.79
Black	10,940,109	15.78
Ohters	2,765,173	4.43

3.2 Child Support Enforcement Measures

Our main concern is to analyze how people adjust their marriage and fertility decisions to a change in the cost of non-marital births. Therefore, we think that the aggregate collection rate of child support defined for each state and year is the most suitable measure for our main analysis.[15] The aggregate collection rate is the total amount of child support collected over the total eligible amount of child support. For the numerator, we pick the numbers from the Office of Child Support Enforcement (OCSE) 1980 - 1997 Annual Reports to Congress (U.S. Department of Health and Human Services, 1980 - 1997). For the denominator, we calculate a number from the Current Population Survey (CPS) (U.S. Bureau of Labor Statistics) in the following way.

[15] One of the difficulties with CSE measures is the possibility of their endogeneity. Case (1998) applies the instrumental variable method by using the percentage of the state's House and Senate members that are women as an instrumental variable and still finds a significant negative impact of CSE on the non-marital birth rate. Miller and Garfinkel (1999) employ the same strategy to control the endogeneity. Without exception, our CSE measures might potentially involve endogeneity. We leave the problem for future work.

1. Consider the sample of the married couples. Regress the husband's real annual income on the wife's demographic characteristics and the characteristics of the residential state, age, age-squared, education, ethnicity, whether or not living in a central city, the unemployment rate of the state, and the average income of the state.

2. Predict the income of the single mother's partner from the above regression.

3. Based on the number of children the single mother has, apply the Wisconsin guideline to determine the eligible amount of child support.[16]

4. Calculate the total eligible amount for each state and year by summing up the amount obtained in step 3, and then adjust the population of single mothers in each state to match the numerator by using the Surveillance, Epidemiology, and End Results (SEER) data published by the National Center Institute.

Our result is displayed in Table 3. Also in Table 3, two other child support enforcement measures are calculated to test the robustness of our estimation result, . The first one is the state's expenditure for the child support enforcement policies per single mother.[17] The state's expenditure data are from the OCSE's Annual Reports, and the population of single mothers is calculated from CPS and SEER. The second alternative measure is paternity establishment rate, defined as the number of paternities established for non-marital births over the total number of non-marital births in a given year. The data for the number of paternities established are from the OCSE's Annual Reports. And the data for the total number of non-marital births are from the NVSR.

[16]The Wisconsin guideline is a "percentage-of-income guideline" in which fathers' child support obligation is 17% of fathers' gross income for one child and 25%, 29%, 31%, and 34% for two, three, four, and five or more children, respectively. This percentage-of-income guideline have been adopted by 15 states, whereas other 31 have adopted variants of an income-shares guideline which takes into account the incomes of both parents when determining the award amount. Garfinkel, Miller, McLanahan, and Hanson (1998) examine the two types of guideline and find that state rankings on the collection rate are not sensitive to the guideline used.

[17]The numbers in Table 3 are based on 2000 dollars.

Table 3: Summary Statistics for CSE Measures, 1980 - 1997.

CSE Measures	**1980 Mean**	**1997 Mean**	**1980-1997 Mean**
Collection Rate	4.1 %	18.5 %	10.0 %
Expenditure per Single Mother	2.38	4.14	3.04
Paternity Establishment Rate	20.4 %	55.0 %	36.2 %

(The mean values are calculated across states.)

3.3 Other Independent Variables

State average wages of full-time workers and state unemployment rates are included as independent variables in our regression analysis because they potentially affect people's marriage and fertility decisions. The former is from CPS, and the latter is from the Local Area Unemployment Statistics (LAUS) (U.S. Bureau of Labor Statistics). The gender wage gap as a fraction of the average wage of female full-time workers over the average wage of male full-time workers is also included since it might affect, especially, female's marriage and fertility decisions.[18] Three demographic statistics - the fraction of blacks, the fraction of Hispanics, and the fraction of high-school dropouts - are the other controls considered in the analysis. Finally, previous studies show that generous welfare benefits make single motherhood more affordable and increase the number of non-marital child births (Rosenzweig (1999); Neal (2004)). Thus, we include the generosity measure of state welfare policy. The sum of the maximum amount of the Aid to Families with Dependent Children (AFDC) grant and food stamp benefit is used as this measure.[19] All the monetary values are converted to the 2000 dollar values.

4 Structural Estimation

In this section, we describe our econometric methodology to estimate the equilibrium values.

[18] See the work of Regalia, Ríos-Rull, and Short (2010), for example.

[19] These data come from the *Overview of Entitlement Program: Green Book* edited by the U.S. House of Representatives, Committee on Ways and Means.

4.1 Two-Step Estimation Procedure

We apply simulated method of moment (SMM) to estimate the parameters of the structural model laid out in Section 2. In particular, we apply a two-step procedure similar to that used by Voena (2010). The method is closely related to (but not the same as) the indirect inference method, which is a simulation-based method for estimating the parameters of economic models, first introduced by Smith (1990, 1993) and extended by Gourieroux, Monfort, and Renault (1993) and Gallant and Tauchen (1996).[20]

Our method consists of two stages of minimization. In the first stage, we employ the standard fixed effects regression model to obtain the coefficients of the variables of interest to the changes in the CSE measure. In the second-stage regression, we estimate the structural model's parameters by SMM targeting on the coefficients which we obtained in the first stage. More precisely, using reduced-form regressions, first, we estimate the effect of CSE on non-marital and marital total fertility rates and obtain the regression coefficients, $(\hat{\beta}_{\gamma}^{S,Data}, \hat{\beta}_{\gamma}^{M,Data})$. Then, in the second stage, we calculate structural counterparts for $\left(\hat{\beta}_{\gamma}^{S}(\boldsymbol{\theta}), \hat{\beta}_{\gamma}^{M}(\boldsymbol{\theta})\right)$ and estimate a set of structural parameters $\boldsymbol{\theta}$ with other targets $Z(\boldsymbol{\theta})$ by

$$\hat{\boldsymbol{\theta}} = \arg\min_{\boldsymbol{\theta}} \left[\, m(\boldsymbol{\theta})^T \times \mathbf{W} \times m(\boldsymbol{\theta}) \right],$$

where $m(\boldsymbol{\theta})$ is a column vector that equals to $\left(\hat{\beta}_{\gamma}^{S}(\boldsymbol{\theta}) - \hat{\beta}_{\gamma}^{S,Data}, \hat{\beta}_{\gamma}^{M}(\boldsymbol{\theta}) - \hat{\beta}_{\gamma}^{M,Data}, Z(\boldsymbol{\theta}) - Z^{Data}\right)^T$. Here $\mathbf{W}$ is an arbitrary weighting matrix. The other targets $Z(\boldsymbol{\theta})$ are chosen so that the model captures the important characteristics of the real data, like the total fertility rate or the total educational expenditure in the economy.

As the last step of our estimation, we test our model's performance by predicting the marriage rate. As we have said, the marriage rate has also sharply risen in the states with strict CSE. This

[20]The difference between our method and indirect inference is as follows. In indirect inference, the regressions in the first stage (called an 'auxiliary model') and those in the second stage must be the same. But, in our case, the first-stage regression includes the state fixed effects, the state characteristics, and the state-specific trends, which are not included in the regressions in the second stage. In the indirect inference method, even if the independent variables are endogenous in the first-stage regression, one can obtain the consistent estimator in the structural estimation. But, in our case, if the independent variables are endogenous, then the estimated structural parameters are no longer consistent.

increase in marriages is crucial to identify our story from other alternatives. Therefore, we use it as an over-identification device for the estimates obtained from the structural estimation.

4.2 First Stage: The Fixed Effects Regression Model

In the first-stage estimation, we use the fixed effects regression model. Moreover, we include state-specific time trends[21] in our benchmark model. Focusing on the period 1980 - 1997, we run the following regressions on the state-year panel data:

$$Y^S_{s,t} = \beta^S_0 + \beta^{S\prime}_1 X_{s,t} + \sum_s \beta^S_{2,s} D_s + \sum_s \beta^S_{3,s} \left(D_s \times t\right) + \beta^S_\gamma \gamma_{s,t}$$

$$Y^M_{s,t} = \beta^M_0 + \beta^{M\prime}_1 X_{s,t} + \sum_s \beta^M_{2,s} D_s + \sum_s \beta^M_{3,s} \left(D_s \times t\right) + \beta^M_\gamma \gamma_{s,t},$$

In the above regressions, $Y^S_{s,t}$ and $Y^M_{s,t}$ are the total fertility rate for non-marital and marital births in state s in year t. Here $X_{s,t}$ includes the characteristics of state s in year t: the average wage of full-time workers, the state unemployment rate, the gender wage gap, the fraction of black people, the fraction of Hispanic people, the fraction of people without a high-school diploma, and also the measure of the generosity of welfare for single mothers. Here D_s is a state dummy and $(D_s \times t)$ is a state-specific time trend. Finally, $\gamma_{s,t}$ is the three-year moving average of the CSE measure.[22]

4.3 First Stage: Results

The results of the first-stage regressions are summarized in Table 4. For the non-marital fertility rate, all three CSE measures have negative effects which are significant at the 1% level. Looking at the coefficient for the fraction of black people, you may wonder why it is significantly negative. But this is true when we include the state fixed effects, and other studies are also getting the same result.[23] For marital births, the effects of CSE seem to be a bit weak, but they are still positive at

[21] The literature includes several discussions on the inclusion of state-specific time trends. Friedberg (1998) talks about the importance of them to measure the impacts of the divorce law reform on the divorce rate. In our case, it also turns out to be important, especially for the estimations of the total fertility rate for marital births and the marriage rate. The results without the state-specific time trends are discussed in Section 4.4.

[22] We also consider the five-year moving average of the measures in Section 4.5, in order to check the robustness of the result.

[23] See the work of Garfinkel, Huang, McLanahan, and Gaylin (2003), for example.

the 10% level for the collection rate measure and positive at the 5% level for the expenditure and paternity establishment rate measures.

4.4 Marriage Rate Regression

We also run the same regression for the marriage rate. The increase in the marriage rate is crucial to identify our story from other alternatives. So we will use this estimate later to check the model's performance. As for the regression result, we find significantly positive effects of CSE (at the 1% level) on the marriage rate for all three CSE measures as summarized in Table 5.

Table 4: First Stage Regressions: The Total Fertility Rate for Non-Marital and Marital Births

Dependent Variable	Non-Marital Total Fertility Rate			Marital Total Fertility Rate		
CSE Measures (3-Year Moving Average)						
1) Collection	-0.29737**			0.17234†		
	(0.07936)			(0.09502)		
2) Expenditure		-0.01548**			0.00738*	
		(0.00258)			(0.00313)	
3) Paternity			-0.04132**			0.03481*
			(0.01451)			(0.01550)
Average Wage	-0.00014**	-0.00013**	-0.00012**	-0.00008	-0.00008	-0.00009†
	(0.00004)	(0.00004)	(0.00004)	(0.00005)	(0.00005)	(0.00005)
Unemp. Rate	0.00425**	0.00421**	0.00592**	-0.00577**	-0.00570**	-0.00116
	(0.00128)	(0.00126)	(0.00139)	(0.00153)	(0.00153)	(0.00149)
Gender Gap	-0.00723	-0.00548	-0.00674	0.00507	0.00398	0.00467
	(0.01463)	(0.01442)	(0.01440)	(0.01751)	(0.01747)	(0.01538)
Frac. Black	-0.57926**	-0.59053**	-0.50151**	-0.05292	-0.05067	-0.03460
	(0.11592)	(0.11432)	(0.12300)	(0.13878)	(0.13850)	(0.13138)
Frac. Hisp.	-0.25437	-0.23141	0.29846	-1.18736**	-1.19020**	-0.31875
	(0.16167)	(0.15908)	(0.18415)	(0.19355)	(0.19273)	(0.19670)
Frac. HS DP	0.20511*	0.16742†	0.12462	0.17183	0.19072	0.18766†
	(0.09920)	(0.09798)	(0.10492)	(0.11877)	(0.11871)	(0.11207)
Max AFDC	0.04237**	0.04171**	0.07972**	0.02951**	0.03013**	0.07517**
	(0.00370)	(0.00359)	(0.00555)	(0.00443)	(0.00434)	(0.00593)
Intercept	-58.19391**	-56.04314**	-56.52598**	18.04203**	16.54161**	9.01692
	(4.96011)	(4.75847)	(5.45825)	(5.93830)	(5.76504)	(5.83009)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State-Specific Trends	Yes	Yes	Yes	Yes	Yes	Yes
N	908	908	806	908	908	806
R^2	0.95963	0.96069	0.96057	0.97126	0.97135	0.97615
F	174.02847	178.92167	155.563	247.45659	248.18175	261.29123

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

(Standard errors are in parentheses.)

Table 5: Marriage Rate Regressions

Dependent Variable	Marriage Rate		
CSE Measures (3-Year Moving Average)			
1) Collection	0.01315**		
	(0.00419)		
2) Expenditure		0.00061**	
		(0.00015)	
3) Paternity			0.00302**
			(0.00076)
Average Wage	0.00018	-0.00025	0.00041†
	(0.00024)	(0.00023)	(0.00023)
Unemp. Rate	-0.00047**	-0.00046**	-0.00028**
	(0.00006)	(0.00006)	(0.00006)
Gender Gap	-0.00211	-0.00186	-0.00014
	(0.00226)	(0.00224)	(0.00228)
Frac. Black	0.00873	0.00853	0.00536
	(0.00581)	(0.00577)	(0.00605)
Frac. Hisp.	-0.01984	-0.01995	-0.01791
	(0.01275)	(0.01266)	(0.01317)
Frac. HS DP	0.00148	0.00292	0.00300
	(0.00481)	(0.00480)	(0.00500)
Max AFDC	-0.00077**	-0.00074**	0.00027
	(0.00018)	(0.00017)	(0.00029)
Intercept	2.27407**	2.16429**	1.97683**
	(0.24523)	(0.23862)	(0.26663)
State Fixed Effects	Yes	Yes	Yes
State-Specific Trends	Yes	Yes	Yes
N	681	681	591
R^2	0.96773	0.96814	0.97179
F	180.25471	182.62504	184.0761

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

(Standard errors are in parentheses.)

4.5 First Stage: Checking the Robustness

In this subsection, we briefly talk about the robustness of our first-stage estimation results. Details are available in Appendix 2.

Five-Year Moving Average of the CSE Measures

Since we have been taking only three-year moving averages of the CSE measures, it might be true that the dependent variables react too much to the change in the degree of CSE in the short term. In the long run, stronger CSE might affect the dependent variables more modestly. To check if that is true or not, we also consider the five-year moving averages of the CSE measures and run the same regressions. The results are summarized in Appendix 2. As shown there, the five-year moving averages of the measures increase the effects of stronger CSE on the dependent variables. Therefore, we conclude that the CSE effects don't disappear even if we consider the longer time period. (They last for at least 5 years.)

The Regressions without State-Specific Time Trends

Through our first-stage estimation, it turns out that the state-specific time trends, which we include in our bench-mark regressions, are important to capture the correct effects of stronger CSE on the dependent variables (In particular, for the marital total fertility rate and the marriage rate). To emphasize this point, we show the regression results without the state-specific time trends in Appendix 2. In those regressions, instead, we include an aggregate time trend with standard state dummies. As you see in the tables, the results of the non-marital total fertility don't change signs or significance. However, the results of the marital total fertility do change signs. And for the marriage rate, the results become no longer significant. Friedberg (1998) talks about the importance of state-specific time trends in her divorce rate regression. She reports that the effects of the divorce law reform on the divorce rate couldn't be observed without including state-specific time trends in the regression. That applies to our analysis as well.

4.6 Second Stage: Structural Estimation

Now we turn to the second-stage regression, where we estimate the structural model's parameters. In this subsection, we talk about the parameters, the moments to match, and the estimation procedure in our second-stage estimation.

Parametrization

First, let us assume the following functional forms for utility and child investment functions.

$$u(c, a') + v(nq) = \ln(c) + a' + \alpha \ln(nq)$$

$$f_0(s) = (\iota + s)^{\eta_0}, f_1(s) = (\iota + s)^{\eta_1} \quad 0 < \eta_0, \eta_1 < 1.$$

These functional forms give us five parameters to be estimated, $(\alpha, \iota, \eta_0, \eta_1, \psi)$. Also, we assume that people's charm is normally distributed, with mean 0 and variance σ_a^2 for both women and men; $a \sim N(0, \sigma_a^2)$, Then σ_a is another parameter to be estimated. Other parameters determined through estimation are δ: utility discount for fathers out of wedlock, κ: utility value of marriage, and ψ: good cost per child. Then we end up with eight parameters to be estimated. We list them in Table 6. Other parameters in the model can be exactly identified from the data. Those are summarized in Table 7 and discussed below.

Table 6: Parameters to be Estimated in the Second Stage

Name	**in Model**
Uitlity Discount for Fathers out of Wedlock	δ
Utility Value of Marriage	κ
Variance of People's Charm	σ_a
Parameter for Utilility Weight	α
Parameter for Child Investment Function	ι
Parameter for Child Investment Function (Non-Marital)	η_0
Parameter for Child Investment Function (Marital)	η_1
Goods Cost per Child	ψ

Table 7: Exactly Identified Parameters

Name	**Symbol**	**Value**	**Source**
AFDC Benefit (1980)	$g(e,n)$	0.81×(Poverty Threshold)	Congressional Green Book
Child Support Order	$\tau^{cs}(n)$	$0.17 \sim 0.31$	Wisconsin Guideline
Time Cost for Children	ϕ	0.075	De La Crox et al. (2003)
Women's Mean Wage	μ_h^f	2.20	Greenwood et al. (2003)
Men's Mean Wage	μ_h^m	2.58	Greenwood et al. (2003)
Log Var. of Wages	σ_h	0.57	Greenwood et al. (2003)

Aid to Families with Dependent Children (AFDC) Eligibility and benefit levels of AFDC vary across states and time periods. In order to simplify this criteria, we assume that the maximum AFDC benefit is 81% of of the Federal poverty threshold, where the number (81%) comes from the average eligibility criteria across states in 1980.[24] We also assume that if a single mother's income is below the poverty threshold, the portion is compensated by the AFDC benefit, so that her income is equal to the one at the poverty threshold. This poverty threshold is set as 0.27×(Men's mean income) calculated from the 1980 data.[25] The poverty line increases by 25% every time a household gets an additional member.

Child Support Order We follow the Wisconsin guideline to determine the eligible amount of child support. The guideline says 17% of a payer's income if there is only one child, 25% for two children, 29% for three children, 31% for four children, and 34% for five or more.

Time Cost for Children We follow De La Croix and Doepke (2003) to determine the time cost for children. Based on their calculation, parent spends 7.5% of time per child in parent's entire life.

[24]This data come from the *Overview of Entitlement Program: Green Book* edited by the U.S. House of Representatives, Committee on Ways and Means.

[25]See the website; http://www.census.gov/hhes/www/poverty/data/threshld/.

Human Capital Distribution We follow Greenwood, Guner, and Knowles (2003) to determine the human capital distributions for women and men. They assume log-normal distributions for human capital and match their mean and standard deviation to the wage data. More precisely, they assume that women's human h^f follows a log-normal distribution with its parameters $\mu_h^f = 2.20$ and $\sigma_h = 0.57$. For men, they assume the parameters $\mu_h^m = 2.58$ and $\sigma_h = 0.57$. When computing the model, we discretize those distributions so that each type has the same number of people as we assumed in Section 2.1.

Table 8: Targeted Values in the Second-Stage Estimation

Name	Value	Data Source
(1) Regression Coefficient for Non-Marital Births: β^S	-0.297	First Stage Regression
(2) Regression Coefficient for Marital Births: β^M	0.172	First Stage Regression
(3) 1980: Fraction of Non-Marital Births in Total Births	0.162	NVSR (1980)
(4) 1980: Total Fertility Rate	1.887	NVSR (1980)
(5) 1980: Total Educational Expenditure in Cons. Exp.	0.104	U.S. Dept. of Education
(6) 1980: Fertility Ratios Between Non-Married and Married	0.727	NSFG (1979)
(7) 1980: Educational Investment Ratio Between Non-Married and Married	2.764	U.S. Bureau of Labor Stat.
(8) 1980: Income Correlation among Married	0.440	CPS (1980)
(9) Fraction of Child's Consumption in Married Household with One Child (OECD)	0.147	

Moments

Listed in Table 8 the eight moments in the second-stage estimation. The seven parameters are thus over-identified. The regression coefficients for (1) the non-marital and (2) marital total fertility rates, (β^S, β^M), and (3) the fraction of non-marital births are the most crucial targets, which identify (δ, κ). (4) The total fertility rate, (5) the total educational expenditure,[26] (6) the fertility

[26] *Digest of Education Statistics*, edited by the Office of Educational Research and Improvement, U.S. Department of Education.

ratio between the non-married and the married, and (7) the educational investment ratio between the non-married and the married jointly determine the four parameters, $(\alpha, \iota, \eta_0, \eta_1)$.[27] (8) The fraction of child's consumption in married household with one child identifies ψ: good cost per child. (9) The income correlation among married couples determine σ_a. In the model, all the statistics (3) - (9) are calculated in the equilibrium in which CSE $\gamma \approx 0$. That is, assuming that CSE is very small in 1980, we calculate the model's counterparts for the pre-CSE targets.

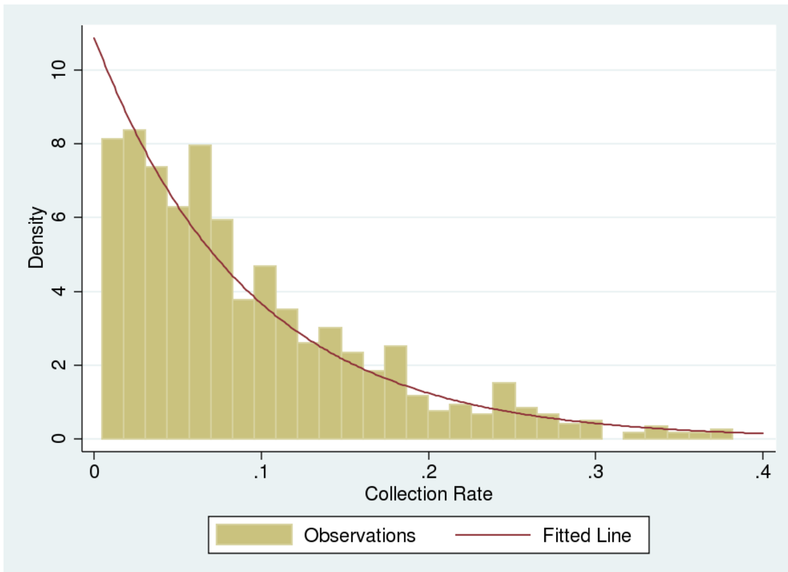

Figure 4: Distribution of Child Support Collection Rate, 1980-1997

Second-Stage Estimation Procedure

In the second-stage estimation, we simulate the model, run regressions, and obtain the model's counterpart for the regression coefficients $(\hat{\beta}^S_\gamma, \hat{\beta}^M_\gamma)$. In order to run this simulation, we first need to approximate the distribution of the child support collection rate in order to draw random policy values $\{\gamma_t\}$. Figure 4 shows such an approximation. The distribution of the collection rate is replicated by an exponential distribution with the same mean as in the data. Then we run the second-stage estimation by taking the following steps.

[27]The fertility ratio between the non-married and the married is calculated from the CDC's National Survey of Family Growth (NSFG) 1976. The educational investment ratio between the non-married and the married is calculated from *Household Expenditure on Children 2007-2008* in *the Monthly Labor Review*, U.S. Bureau of Labor Statistics.

1. In every loop in the estimation, simulate the policy from the exponential distribution 908 times, $\{\gamma_t\}_{t=1}^{908}$. This is the actual number of the state-year observations in the first-stage regression.

2. Then, given a set of parameters θ, compute the equilibrium for each given γ_t. In particular, when computing the equilibrium, we follow the steps below.

    (a) Discretize the spaces for human capital and charm.

    (b) After calculating the utility values for all possible pairs, $\left\{\hat{V}_S^f(\Phi,\gamma_t), \hat{V}_S^m(\Phi,\gamma_t)\right\}_{\Phi\in\mathcal{F}}$ and $\left\{\hat{V}_M^f(\Phi,\gamma_t), \hat{V}_M^m(\Phi,\gamma_t)\right\}_{\Phi\in\mathcal{F}}$, apply the extended version of Gale and Shapley's algorithm as described in Appendix 1. Compute the distribution of the pairs in non-marital relationships and marital relationships. Then calculate the total fertility rate in each relationship.

3. Run the following regressions for the obtained marital and non-marital total fertility rates for each of $\{\gamma_t\}_{t=1}^{908}$.

$$Y_t^S = \beta_0 + \beta^S(\boldsymbol{\theta})\gamma_t$$
$$Y_t^M = \beta_0 + \beta^M(\boldsymbol{\theta})\gamma_t.$$

4. Construct other targets, $Z(\boldsymbol{\theta})$, and evaluate the model's performance by calculating

$$m(\boldsymbol{\theta})^T \times \mathbf{W} \times m(\boldsymbol{\theta})$$

   where $m(\boldsymbol{\theta}) \equiv \left(\hat{\beta}_\gamma^S(\boldsymbol{\theta}) - \hat{\beta}_\gamma^{S,Data}, \hat{\beta}_\gamma^M(\boldsymbol{\theta}) - \hat{\beta}_\gamma^{M,Data}, Z(\boldsymbol{\theta}) - Z^{Data}\right)$.

5. Repeat steps 1 - 4 until the set of parameters attains the minimum of the above objective.

In the computation of the model, we discretize the state space for human capital and charm using 20 and 5 grids, respectively. Thus, there are 100 types of women and men in the economy.

5 Results

In this section, we talk about our estimation results. We also derive the CSE's implications for the next generation's income distribution.

5.1 Estimation Result

The model's performance and the estimation result for the parameters are summarized in Table 9 and Table 10. In Table 9, as you see in the data and model columns, our model is performing well; it closely matches most of the targets in the data including the coefficients, β_γ^S and β_γ^M. One exception is the fraction that educational expenditures are of the total consumer expenditures. In the data, education is about 10% of total consumer expenditures, but the model suggests about 20%. One possible explanation for this difference is the lack of public education in the model. If we include this amount, the model might perform better.

In the model, men's increased willingness to marry is the driving force behind the decrease in non-marital births ($\beta_\gamma^S < 0$) and the increase in marital births ($\beta_\gamma^M > 0$). After the strengthening of CSE policies, facing the larger cost per child due to the mandatory child support payment, men in non-marital relationships may

1. Reduce the number of children and, instead, increase investments in child quality.

2. Reduce the number of children and, instead, increase the private consumption.

3. Get married to avoid the child cost change.

Option (1) is not attractive to unmarried fathers, because to increase a child's quality investment they have to transfer money to the mothers. But these transfers involve two types of inefficiency in our model: First, in non-marital relationships, since the mothers are not considering the fathers' utility, they don't invest all the money in children's quality. They use some of it for their private consumption. Second, if the mother in a non-marital relationship is on a welfare program, then the state government takes away a significant portion of child support payments made by the biological father. Therefore, fathers' investments don't really increase a child's quality. And unmarried fathers are thus left with options (2) or (3). As a result, men split between reducing the number of children and increasing marriage when facing the increased degree of CSE. This result hinges upon the parameter, δ.

Table 9: The Match Between the Model and the Data

Name	**Data**	**Model**
(1) Regression Coefficients for M Births: β_{γ}^{S}	-0.297	-0.272
(2) Regression Coefficients for NM Births: β_{γ}^{M}	0.172	0.169
(3) 1980: Fraction of Non-Marital Births in Total Births	0.162	0.170
(4) 1980: Total Fertility Rate	1.887	1.899
(5) 1980: Total Educational Expenditure in Cons. Exp.	0.104	0.182
(6) 1980: Fertility Ratios Between Non-Married and Married	0.727	0.699
(7) 1980: Educational Investment Ratio Between Non-Married and Married	2.764	2.566
(8) 1980: Income Correlations among Married	0.440	0.434
(9) Fraction of Child's Consumption (OECD)	0.147	0.140

Table 10: Estimated Parameters

Name	**Parameter**	**Estimates**
Uitlity Discount for Fathers out of Wedlock	δ	0.491
Utility Cost of Marriage	κ	-0.185
Parameter for Utilility Weight	α	3.900
Parameter for Child Investment	ι	0.814
Parameter for Child Investment (Non-Marital)	η_0	0.251
Parameter for Child Investment (Marital)	η_1	0.610
Variance of People's Charm	σ_a	0.128
Goods Cost per Child	ψ	1.125

5.2 Over-Identification: Model's Performance for Marriage

We check the model's performance through its prediction for the increase of marriages after CSE strengthens. We calculate the changes in the number of the ever-married at age 45 after 10%

increase in the collection rate by using the estimated coefficient for the marriage rate from the previous regression. According to our estimate in Table 5, a 10% gain in the collection rate will increase the marriage rate by 0.0013 points. (Using the 1980's average marriage rate, 0.042, this turns out to be a 3.1% increase of the marriage rate) If we calculate the number of the ever-married using the marriage rate in 1980 and the one after the 10% increase of the collection rate, the change from the former to the latter is about 1.93%. And, the change in the model is 1.39%. Thus, the model accounts for 72% of the increase in the ever-married in the data, which implies a good performance of our model to account for the changes. (See Table 11)

	Num of Ever-Married (Data)	**Num of Ever-Married** (Model)
1980	0.940	0.860
CSE Δ10%	0.958	0.871
Change	Δ1.93%	Δ1.39%

Table 11: Model's Performance for the Increase of Marriage

5.3 The Effects of CSE on Child Investment and Individual's Welfare

Next, we use the model to quantify the effects of CSE on child investment and individual's welfare. In 12, we calculate the changes in the amount of child investment, the quality of child, and the number of child after 10% increase in the collection rate. As found in the table, CSE increases the amount of child investment significantly among the bottom-income group. This change is driven by the change in people's marital status. As more couples start getting married, they pool their income together, and access to the better child investment technology, which results in the increase in child investment.

Table 12: The Changes in Child Investment After a 10% Increase in the Collection Rate

Mother's Income Group	**Child Investment** Δs	**Child Quality** Δq	**Number of Child** Δn
Top 0-20 %	-Δ0.1%	-Δ0.1%	+Δ0.0%
20-40 %	-Δ0.1%	-Δ0.1%	+Δ0.0%
40-60 %	+Δ0.0%	+Δ0.0%	+Δ0.0%
60-80 %	+Δ1.1%	+Δ0.9%	-Δ0.5%
80-100 %	+Δ5.0%	+Δ4.8%	-Δ2.0%
Average	+Δ1.2%	+Δ1.1%	-Δ0.5%

Table 13 shows the associated changes in the number of the married, and women and men's welfare after 10% increase in the collection rate. As shown in the table, more people start getting married, especially, in the bottom-income group of people. This is caused by the men's increased willingness to marry; the mechanism we talk in the previous sections. And, that change of the increase in marriage is the driving force behind the increase in child investment.

Table 13 shows the changes in individual's welfare by income level. You will notice that there are significant transfers of utility from men to women even in the high-income groups of people. This is because women obtain more consumption within household after men's outside option values (the values of being single) decrease. This effect is not quite strong for women in the bottom-income group since not all the women in that group get married after 10% increase in the collection rate. Most of those unmarried women are on the welfare program (AFDC), and thus, they cannot enjoy the child support transfers from men because the government takes them away.

Table 13: The Changes in Marriage and Individual's Welfare After a 10% Increase in the Collection Rate

Income Group	**Marriage** Women	Men	**Welfare** Women	Men
Top 0-20 %	-Δ0.0%	-Δ0.0%	+Δ2.6%	-Δ2.2%
20-40 %	-Δ0.0%	-Δ0.0%	+Δ2.6%	-Δ2.2%
40-60 %	+Δ0.0%	+Δ0.0%	+Δ2.7%	-Δ2.3%
60-80 %	+Δ2.5%	+Δ0.0%	+Δ3.0%	-Δ2.5%
80-100 %	+Δ5.0%	+Δ7.5%	+Δ1.5%	-Δ5.1%
Average	+Δ1.5%	+Δ1.5%	+Δ2.5%	-Δ2.9%

5.4 Inter Generational Human Capital Transmission

Finally, we look into the changes in the next generation's income distribution. Assume human capital in the next generation is log-normally distributed around child quality. The conditional mean is $\mu^f_{h|q}$ and $\mu^m_{h|q}$, and conditional variance, $\sigma_{h|q} = \sigma_g$:

$$\mu^f_{h|q} = \log\left(\epsilon_1 \times q^{\epsilon_2}\right)$$
$$\mu^m_{h|q} = \log\left(\epsilon_1 \times q^{\epsilon_2} + \mu_g\right).$$

To predict the next generation's income distribution, we first calibrate the parameters $(\epsilon_1, \epsilon_2, \sigma_g, \mu_g)$ so that (1) human capital distribution in the next generation is the same as in the previous generation in 1980, and (2) the correlation between son and father's income is $\rho_g = 0.73$ (Knowles (1999)). Then we use those human capital transmission functions to generate the next generation's income distribution. The calibration result of $(\epsilon_1, \epsilon_2, \sigma_g, \mu_g)$ is summarized in Appendix 3.

Table 14 and Table 15 summarize the result of a 10% increase in the child support collection rate. Our model predicts that assuming a general human capital transmission function, the model predicts that the increased collection rate will increase people's income, especially, in the bottom group, and decrease the 90-10% income ratio of the next generation by 3.1%.

Table 14: The Changes in Income After a 10% Increase in the Collection Rate

Income Group	**Men's Income in the Next Generation** Δwh^m
Top 0-20 %	$+\Delta 0.0\%$
20-40 %	$+\Delta 0.1\%$
40-60 %	$+\Delta 1.3\%$
60-80 %	$+\Delta 1.7\%$
80-100 %	$+\Delta 3.0\%$
Average	$+\Delta 1.22\%$

Table 15: The Changes in Income Distribution After a 10% Increase in the Collection Rate

Name	**Before**	**After**	**Changes**
Men's 90-10 Income Ratio	1.963	1.904	$-\Delta 3.1\%$
Men's Gini Coefficient	0.348	0.345	$-\Delta 0.8\%$

6 Conclusion

In this paper, we have analyzed the effects of the strengthened U.S. Child Support Enforcement policies on people's marriage and fertility decisions and long-term inequality. Despite their original purposes, the CSE policies have brought unexpected changes in people's marriage and fertility behaviors. Based on our new empirical findings, we propose a mechanism which accounts for the changes of non-marital births, marital births, and the marriage rate. We develop a novel stable matching model which features the choices of marital or non-marital relationships, and structurally estimate the model using the CDC's National Vital Statistics Report Natality data. Our results show that strengthened CSE increases child investment through secondary effect; the shift from non-marital births to marital births. And our model predicts that there will be a significant reduction in the poverty in the next generation through this change.

References

Acs, G., and S. Nelson (2004): "Changes in Living Arrangements During the Late 1990s: Do Welfare Policies Matter?," *Journal of Policy Analysis and Management*, 23(2), 273–290.

Adda, J., and R. Cooper (2003): *Dynamic Economics: Quantitative Methods and Applications.* The MIT Press.

Aiyagari, S., J. Greenwood, and N. Guner (2000): "On the State of the Union," *Journal of Political Economy*, 108(2), 213–244.

Aizer, A., and S. McLanahan (2006): "The Impact of Child Support Enforcement on Fertility, Parental Investments, and Child Well-Being," *Journal of Human Resources*, 41(1), 28–45.

Akerlof, G., J. Yellen, and M. Katz (1996): "An Analysis of Out-of-Wedlock Childbearing in the United States," *The Quarterly Journal of Economics*, pp. 277–317.

Altonji, J., and L. Segal (1996): "Small-Sample Bias in GMM Estimation of Covariance Structures," *Journal of Business & Economic Statistics*, pp. 353–366.

Becker, G. (1973): "A Theory of Marriage: Part I," *Journal of Political Economy*, 81(4), 813–46.

Becker, G., and N. Tomes (1976): "Child Endowments and the Quantity and Quality of Children," *The Journal of Political Economy*, 84(4), 143–162.

Blundell, R., P. Chiappori, and C. Meghir (2005): "Collective Labor Supply with Children," *Journal of Political Economy*, 113(6), 1277–1306.

Brown, M., and C. Flinn (2011): "Family Law Effects on Divorce, Fertility and Child Investment," *mimeo.*

Burdett, K., and M. Coles (1997): "Marriage and Class," *Quarterly Journal of Economics*, 112(1), 141–168.

——— (1999): "Long-Term Partnership Formation: Marriage and Employment," *Economic Journal*, pp. 307–334.

Burdett, K., and J. Ermisch (2003): "Single Mothers," *mimeo*.

Burdett, K., and R. Wright (1998): "Two-Sided Search with Nontransferable Utility," *Review of Economic Dynamics*, 1(1), 220–245.

Carlson, M., I. Garfinkel, S. McLanahan, R. Mincy, and W. Primus (2005): "The Effects of Welfare and Child Support Policies on Union Formation," *Population Research and Policy Review*, 23(5), 513–542.

Case, A. (1998): "The Effects of Stronger Child Support Enforcement on Nonmarital Fertility," p. 191, in *Fathers Under Fire: The Revolution in Child Support Enforcement*.

Chiappori, P., and Y. Weiss (2006): "Divorce, Remarriage, and Welfare: A General Equilibrium Approach," *Journal of the European Economic Association*, pp. 415–426.

——— (2007): "Divorce, Remarriage, and Child Support," *Journal of Labor Economics*, 25(1), 37–74.

Choi, S. (2011): "Fertility Risk in the Life-Cycle," *mimeo*.

De La Croix, D., and M. Doepke (2003): "Inequality and Growth: Why Differential Fertility Matters," *The American Economic Review*, 93(4), 1091–1113.

Del Boca, D., and C. Flinn (1995): "Rationalizing Child-Support Decisions," *American Economic Review*, 85(5), 1241–62.

——— (2005): "Household Time Allocation and Modes of Behavior: A Theory of Sorts," *mimeo*.

Edlund, L. (2005): "The Role of Paternity Presumption and Custodial Rights for Understanding Marriage Patterns," *mimeo*.

Fernandez, R., N. Guner, and J. Knowles (2005): "Love and Money: A Theoretical and Empirical Analysis of Household Sorting and Inequality," *Quarterly Journal of Economics*, 120(1), 273–344.

Fernpndez-Villaverde, J., J. Greenwood, and N. Guner (2009): "From Shame to Game in One Hundred Years: An Economic Model of the Rise in Premarital Sex and its De-Stigmatization," *mimeo.*

Friedberg, L. (1998): "Did Unilateral Divorce Raise Divorce Rates? Evidence from Panel Data," *The American Economic Review*, 88(3), 608–627.

Gale, D., and L. Shapley (1962): "College Admissions and the Stability of Marriage," *American Mathematical Monthly*, 69(1), 9–15.

Gallant, A., and G. Tauchen (1996): "Which Moments to Match?," *Econometric Theory*, 12(04), 657–681.

Garfinkel, I., C. Huang, S. McLanahan, and D. Gaylin (2003): "The Roles of Child Support Enforcement and Welfare in Non-Marital Childbearing," *Journal of Population Economics*, pp. 55–70.

Garfinkel, I., S. Mclanahan, and D. Meyer (1998): "A Brief History of Child Support Policies in the United States," p. 14, in *Fathers Under Fire: The Revolution in Child Support Enforcement.*

Garfinkel, I., C. Miller, S. McLanahan, and T. Hanson (1998): "Deadbeat Dads or Inept States?," *Evaluation Review*, 22(6), 717.

Gourieroux, C., A. Monfort, and E. Renault (1993): "Indirect Inference," *Journal of Applied Econometrics*, 8(S), S85–118.

Greenwood, J., N. Guner, and J. Knowles (2003): "More on Marriage, Fertility, and the Distribution of Income," *International Economic Review*, 44(3), 827–862.

Guvenen, F., and A. Smith Jr. (2010): “Inferring Labor Income Risk from Economic Choices: An Indirect Inference Approach,” *NBER Working Paper*.

Guyer, J., C. Miller, and I. Garfinkel (1996): “Ranking States Using Child Support Data: A Cautionary Note,” *Social Service Review*, 70(4), 635–652.

Huang, C. (2002): “The Impact of Child Support Enforcement on Nonmarital and Marital Births: Does It Differ by Racial and Age Groups?,” *The Social Service Review*, 76(2), 275–301.

Jones, L., A. Schoonbroodt, and M. Tertilt (2008): “Fertility Theories: Can They Explain the Negative Fertility-Income Relationship?,” *NBER Working Paper*.

Jones, L., and M. Tertilt (2006): “An Economic History of Fertility in the US: 1826-1960,” *NBER Working Papers*.

Kennes, J., and J. Knowles (2010): “Marriage, Fertility and Step Families: An Equilibrium Analysis,” *mimeo*.

Knowles, J. (1999): “Can Parental Decisions Explain US Income Inequality?,” PhD dissertation, University of Pennsylvania.

Kocharkov, G. (2010): “Abortions, Inequality and Family Formation,” *mimeo*.

Lam, D. (1988): “Marriage Markets and Assortative Mating with Household Public Goods: Theoretical Results and Empirical Implications,” *Journal of Human Resources*, 23(4), 462–487.

McLanahan, S., I. Garfinkel, N. Reichman, and J. Teitler (2001): “Unwed Parents or Fragile Families? Implications for Welfare and Child Support Policy,” p. 202, In *Out of wedlock: Causes and Consequences of Nonmarital Fertility*.

Miller, C., and I. Garfinkel (1999): “The Determinants of Paternity Establishment and Child Support Award Rates among Unmarried Women,” *Population Research and Policy Review*, 18(3), 237–260.

Moav, O. (2005): "Cheap Children and the Persistence of Poverty," *The Economic Journal*, 115(500), 88–110.

Neal, D. (2004): "The Relationship between Marriage Market Prospects and Never-Married Motherhood," *Journal of Human Resources*, pp. 938–957.

Plotnick, R., I. Garfinkel, S. McLanahan, and I. Ku (2007): "The Impact of Child Support Enforcement Policy on Nonmarital Childbearing," *Journal of Policy Analysis and Management*, 26(1), 79–98.

Rasul, I. (2006): "The Economics of Child Custody," *Economica*, 73(289), 1–25.

Regalia, F., J. Ríos-Rull, and J. Short (2010): "What Accounts for the Increase in the Number of Single Households?," *mimeo.*

Rosenzweig, M. (1999): "Welfare, Marital Prospects, and Nonmarital Childbearing," *Journal of Political Economy*, 107(S6), 3–32.

Roth, A., and M. Sotomayor (1990): *Two-Sided Matching. A Study in Game-Theoretic Modeling and Analysis.* Econometric Society Monographs, 18.

Smith, A. (1990): "Three Essays on the Solution and Estimation of Dynamic Macroeconomic Models," PhD dissertation, Duke University.

——— (1993): "Estimating Nonlinear Time-Series Models Using Simulated Vector Autoregressions," *Journal of Applied Econometrics*, 8(S), S63–84.

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

Voena, A. (2010): "Yours, Mine, and Ours: Do Divorce Laws Affect the Intertemporal Behavior of Married Couples?," *mimeo.*

Weiss, Y., and R. Willis (1985): "Children as Collective Goods and Divorce Settlements," *Journal of Labor Economics*, 3(3), 268–92.

Willis, R. (1999): "A Theory of Out-of-Wedlock Childbearing," *Journal of Political Economy*, 107(S6), 33–64.

Appendix 1

A.1.1. Gale and Shapley Algorithm

After women and men enter the marriage market, their marital status is determined in a stable pair of matchings (μ_S, μ_M). Here, we describe how to compute such a pair of matchings by applying the Gale and Shapley (1962) algorithm. As we have said, we are going to focus on a M-optimal stable matching equilibrium. But, with a small change, the method can be also applied for a W-optimal equilibrium. To begin with, we have the following lemma, which is easily derived from the participation constraints of marriage problem.

Lemma 7. *$\forall i \in \mathcal{I}^f, \forall j \in \mathcal{I}^m$,*

$$\hat{V}^f_M(h^f_i, a^f_i, h^m_j, a^m_j, \gamma) \geq \hat{V}^f_S(h^f_i, a^f_i, h^m_j, a^m_j, \gamma),$$

$$\Longleftrightarrow$$

$$\hat{V}^m_M(h^f_i, a^f_i, h^m_j, a^m_j, \gamma) \geq \hat{V}^m_S(h^f_i, a^f_i, h^m_j, a^m_j, \gamma).$$

Now we consider the situation in which each male proposes to a female in a given round, say the n-th round. Let $\lambda(j) = 1$ if a type-j male is tentatively matched with a partner from the previous round, and $\lambda(j) = 0$ if he is not matched at the beginning of the n-th round.

1. In the n-th round, if $\lambda(j) = 0$, then a type-j male proposes to a type-i female with a relationship $R \in \{S, M\}$, who gives him the highest utility value $\hat{V}^m_R(h^f_i, a^f_i, h^m_j, a^m_j, \gamma)$ among the females who have never received his proposal ($\rho(i, j) = 0$).

2. Each woman accepts the proposal which gives her the highest utility value $\hat{V}^f_R(h^f_i, a^f_i, h^m_j, a^m_j, \gamma)$ among the proposals which she received in the n-th round plus the one she carried over from the previous round. The selected male changes his status to $\lambda(j) = 1$. All other rejected males (these might include her partner from the previous round) change their status to $\lambda(j) = 1$. All the males $j' \in \mathcal{I}^m$ who newly proposed to her change their status to $\rho(i, j) = 1$.

3. Go back to step 1 until $\forall j \in \mathcal{I}^m, \lambda(j) = 1$.

Here unlike in the original Gale and Shapley algorithm, men choose a type of relationship (marriage or a non-marital relationship) every time they make an offer. Also, Lemma 7 assures that a woman doesn't have incentives to reject the highest offer she receives.[28]

A.1.2. Proof of Theorem 3

Proof. We will show that a pair of matchings (μ_S, μ_M) obtained through the above algorithm always satisfies the two conditions in Definition 2. Since condition 1 holds obviously, we will only check whether the condition 2 holds or not. Suppose, to the contrary, that within the matchings (μ_S, μ_M), there exist a pair of couples $(i, \mu_R(i))$,$(\mu_{R'}(j), j)$, and relationships $R, R', R'' \in \{S, M\}$ such that

$$\hat{V}^f_{R''}\left(h^f_i, a^f_i, h^m_j, a^m_j, \gamma\right) > \hat{V}^f_R\left(h^f_i, a^f_i, h^m_{\mu_R(i)}, a^m_{\mu_R(i)}, \gamma\right),$$
$$\hat{V}^m_{R''}\left(h^f_i, a^f_i, h^m_j, a^m_j, \gamma\right) > \hat{V}^m_{R'}\left(h^f_{\mu_{R'}(j)}, a^f_{\mu_{R'}(j)}, h^m_j, a^m_j, \gamma\right).$$

Then one of the following two must be true: (1) type-j male didn't propose to a type-i female when she gave the highest utility value among available mates, or (2) a type-i female didn't accept a type-j male's offer when he gave her the highest utility value among the offers she received. Both of these contradict the algorithm described above.

□

A.1.3. Proof of Theorem 6

Proof. We will show that a pair of matchings (μ_S, μ_M) obtained through the above algorithm is the unique M-optimal pair. In particular, we will prove that in the above algorithm, no man is ever rejected by an achievable woman. Consequently, the stable pair of matchings (μ_S, μ_M) that is produced in the above algorithm matches each man to his most preferred achievable woman, and

[28] If Lemma 7 doesn't hold, then, women might have strategic motives to reject the offer which gives her the highest utility value among those she receives in the current round.

is, therefore, the unique M-optimal stable pair of matchings. This proof is based on the work of Roth and Sotomayor (1990).

The proof is by induction. Assume that up to a given step in the procedure no man has yet been rejected by a woman who is achievable for him. At this step, suppose woman i rejects man j. If she rejects j in favor of man j', whom she keeps engaged, then she prefers j' to j. Then we must show that i is not achievable for j.

We know j' prefers i to any women except for those who have previously rejected him and hence (by inductive assumption) are unachievable for him. Consider a hypothetical pair of matchings (μ'_S, μ'_M) that matches j to i and everyone else to an achievable partner. Then j' prefers i to his partner at (μ'_S, μ'_M). So, the pair (μ'_S, μ'_M) is unstable, since it is blocked by j' and i, who each prefer the other to their partner at (μ'_S, μ'_M). Therefore, there is no stable matching that matches i and j, and so they are unachievable for each other, which completes the proof.

$\square$

Appendix 2

Table 16: First Stage Regressions: Total Fertility Rate for Non-Marital and Marital Births with the 5-Years Moving Average of the CSE Measures

Dependent Variable		Non-Marital Total Fertility Rate			Marital Total Fertility Rate	
CSE Measures (5-Year Moving Average)						
1) Collection	-0.46814**			0.39790**		
	(0.09619)			(0.10756)		
2) Expenditure		-0.01813**			0.01962**	
		(0.00345)			(0.00383)	
3) Paternity			-0.08773**			0.03272
			(0.02273)			(0.02242)
Average Wage	-0.01403**	-0.01301**	-0.01501**	-0.00663	-0.00713	-0.00724
	(0.00419)	(0.00415)	(0.00466)	(0.00468)	(0.00462)	(0.00460)
Unemp. Rate	0.00633**	0.00578**	0.00863**	-0.00391**	-0.00354*	-0.00165
	(0.00132)	(0.00130)	(0.00184)	(0.00147)	(0.00145)	(0.00181)
Gender Gap	-0.01025	-0.00844	-0.01077	0.00521	0.00387	0.00657
	(0.01423)	(0.01418)	(0.01483)	(0.01591)	(0.01577)	(0.01463)
Frac. Black	-0.54892**	-0.56211**	-0.44155**	0.01986	0.03852	-0.01728
	(0.11791)	(0.11771)	(0.13617)	(0.13185)	(0.13088)	(0.13433)
Frac. Hisp.	0.27465	0.23108	0.33257†	-0.55493**	-0.53392**	-0.23748
	(0.17962)	(0.17815)	(0.19925)	(0.20085)	(0.19809)	(0.19655)
Frac. HS DP	0.13233	0.12098	0.09186**	0.14240	0.15326	0.18223
	(0.10080)	(0.10054)	(0.11732)	(0.11271)	(0.11179)	(0.11574)
Max AFDC	0.06693**	0.06504**	0.09186**	0.06043**	0.06288**	0.07658**
	(0.00496)	(0.00499)	(0.00623)	(0.00555)	(0.00554)	(0.00615)
Intercept	-62.26066**	-58.74095**	-54.16074**	17.10579**	14.79859**	11.26589†
	(5.22574)	(5.07200)	(6.52845)	(5.84324)	(5.63974)	(6.44007)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes	Yes	Yes
N	857	857	705	857	857	705
R^2	0.96154	0.96174	0.95876	0.97529	0.97135	0.97720
F	171.33623	172.25725	126.92143	270.51605	248.18175	233.96588

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

(Standard errors are in parenthesis.)

Table 17: Marriage Rate Regression without State-Specific Time Trends.

Dependent Variable	Marriage Rate		
CSE Measures (5-Year Moving Average)			
1) Collection	0.02396**		
	(0.00525)		
2) Expenditure		0.00112**	
		(0.00020)	
3) Paternity			0.00190†
			(0.00101)
Average Wage	-0.00017	-0.00027	-0.00034
	(0.00024)	(0.00024)	(0.00021)
Unemp. Rate	-0.00046**	-0.00043**	-0.00049**
	(0.00006)	(0.00006)	(0.00007)
Gender Gap	-0.00168	-0.00117	0.00142
	(0.00229)	(0.00226)	(0.00200)
Frac. Black	0.00816	0.00813	-0.00372
	(0.00609)	(0.00603)	(0.00552)
Frac. Hisp.	-0.02013	-0.01856	-0.00783
	(0.01341)	(0.01327)	(0.01181)
Frac. HS DP	0.00443	0.00425	0.00519
	(0.00502)	(0.00496)	(0.00458)
Max AFDC	-0.00047†	-0.00036	0.00018
	(0.00025)	(0.00025)	(0.00027)
Intercept	2.34269**	2.20281**	1.96177**
	(0.26385)	(0.25569)	(0.26319)
State Fixed Effects	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes
N	634	634	506
R^2	0.96874	0.96933	0.98172
F	179.96616	183.53104	237.96394

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

(Standard errors are in parenthesis.)

Table 18: First Stage Regressions: Total Fertility Rate for Non-Marital and Marital Births without State-Specific Time Trends.

Dependent Variable	Non-Marital Total Fertility Rate			Marital Total Fertility Rate		
CSE Measures (3-Year Moving Average)						
1) Collection	-0.27859**			-0.21389*		
	(0.05941)			(0.09147)		
2) Expenditure		-0.01735**			-0.01440**	
		(0.00218)			(0.00341)	
3) Paternity			-0.03714**			-0.07411**
			(0.01239)			(0.01682)
Average Wage	-0.00714†	-0.00756*	-0.00795*	0.02292**	0.02241**	0.02541**
	(0.00367)	(0.00356)	(0.00391)	(0.00565)	(0.00558)	(0.00531)
Unemp. Rate	0.00132	0.00216†	0.00013	-0.00399*	-0.00330†	-0.00207
	(0.00128)	(0.00125)	(0.00135)	(0.00197)	(0.00196)	(0.00183)
Gender Gap	0.01130	0.01111	-0.00189	-0.03819	-0.03859	-0.05314*
	(0.01651)	(0.01612)	(0.01635)	(0.02542)	(0.02522)	(0.02221)
Frac. Black	-0.53101**	-0.56611**	-0.46910**	0.17598	0.14454	0.25145
	(0.11912)	(0.11648)	(0.12910)	(0.18341)	(0.18224)	(0.17534)
Frac. Hisp.	0.45978**	0.46487**	0.90602**	0.96065**	0.95865**	0.84388**
	(0.13544)	(0.13121)	(0.15132)	(0.20853)	(0.20530)	(0.20552)
Frac. HS DP	0.25737**	0.25041**	0.07038	-0.49354**	-0.49574**	-0.52108**
	(0.09159)	(0.08890)	(0.09845)	(0.14101)	(0.13909)	(0.13371)
Max AFDC	0.03307**	0.03569**	0.05378**	0.02653**	0.02868**	0.04181**
	(0.00357)	(0.00350)	(0.00501)	(0.00549)	(0.00547)	(0.00680)
Intercept	-62.40616**	-62.74655**	-55.96561**	39.13232**	38.45340**	38.05713**
	(2.55343)	(2.27437)	(2.37166)	(3.93135)	(3.55851)	(3.22118)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Specific Trends	No	No	No	No	No	No
Aggregate Time Trends	Yes	Yes	Yes	Yes	Yes	Yes
N	908	908	806	908	908	806
R^2	0.93801	0.94084	0.93834	0.92703	0.92807	0.93968
F	174.02847	228.5594	192.40494	182.59391	185.45679	196.96413

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

(Standard errors are in parenthesis.)

Table 19: Marriage Rate Regression without State-Specific Time Trends.

Dependent Variable	Marriage Rate		
CSE Measures (3-Year Moving Average)			
1) Collection	-0.00957*		
	(0.00411)		
2) Expenditure		0.00014	
		(0.00017)	
3) Paternity			-0.00087
			(0.00077)
Average Wage	-0.00042†	-0.00027	-0.00038†
	(0.00024)	(0.00024)	(0.00023)
Unemp. Rate	-0.00035**	-0.00036**	-0.00028**
	(0.00008)	(0.00008)	(0.00007)
Gender Gap	0.00036	0.00049	0.00043
	(0.00324)	(0.00327)	(0.00307)
Frac. Black	-0.01253†	-0.01222	-0.01592*
	(0.00581)	(0.00762)	(0.00754)
Frac. Hisp.	-0.01693	-0.01203	-0.01354
	(0.01112)	(0.01112)	(0.01116)
Frac. HS DP	-0.01542*	-0.01594**	-0.00984†
	(0.00599)	(0.00601)	(0.00581)
Max AFDC	0.00002	-0.00004	0.00072*
	(0.00022)	(0.00023)	(0.00030)
Intercept	1.09778**	1.34034**	1.05778**
	(0.17297)	(0.15891)	(0.15130)
State Fixed Effects	Yes	Yes	Yes
State Specific Trends	No	No	No
Aggregate Time Trend	Yes	Yes	Yes
N	681	681	591
R^2	0.91392	0.91327	0.93437
F	120.64919	119.65849	150.47517

Significance levels : † : 10% $*$: 5% $**$: 1%

(Standard errors are in parenthesis.)

Appendix 3

This appendix lists the result of the calibration for intergenerational analysis. The followings are the estimated value of the parameters, and the values for the targets.

Table 20: Estimated Parameters for Intergenerational Exercise

Name	**Parameter**	**Estimates**
Parameter for Conditional Mean	ϵ_1	3.385
Parameter for Conditional Mean	ϵ_2	0.856
Parameter for Gender Gap	μ_g	2.896
Parameter for Conditional Variance	σ_g	0.125

Table 21: The Match Between the Model and the Data for Intergenerational Exercise

Name		**Data**	**Model**
Log Mean of Human Capital for Women	μ_h^f	2.200	2.217
Log Mean of Human Capital for Men	μ_h^m	2.580	2.555
Log Variance of Human Capital for Women	σ_h^f	0.755	0.801
Log Variance of Human Capital for Men	σ_h^m	0.755	0.721
Intergenerational Correlation of Income	ρ_g	0.730	0.711