Sex and Marital Prospects: An Equilibrium Analysis
PRELIMINARY!

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Abstract

We develop a simple competitive-search model of the tradeoffs between single and married fertility, based on the premise that fertility reduces future marital prospects. We then explore the role of trends in relative wages and other observed changes, such as women's wages and birth-control technology, in accounting for the changes in marriage and fertility rates observed since the 1970s in the US. We find that both the closing of the gender wage gap and improved birth control can independently account for much of the decline of marriage and the rise of unmarried fertility. Unlike the the birth control explanation however, the wage explanation fails to account for the relative stability of the marriage and fertility of single mothers.

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1 Introduction

According to the US census, about 50% of marriages now involve a spouse who has been previously married, and 30% of U.S. children are not living with both parents. These two facts represent a rapid shift of actual demographic behavior away from the standard represented in economic marriage models, where marriage occurs once and parenthood, if included at all, is restricted to married couples. While fertility decline and rising divorce rates among married couples are among the behavioural shifts driving these trends, these shifts are no longer as important as they were in the 1960s. Since 1970, the shifts in the behavior of singles, such as declining marriage rates and rising fertility rates, appear to be much more important (see [1]). As a short-hand, we will refer to these changes as 'The marital transition'.

The goal of this paper is to develop a model of marriage and fertility that can answer a number of questions that arise from contemplation of the marital transition. Ultimately, the big questions are 1)what are the causes of marital transition? 2) is the transition symptomatic of inefficiency?, and 3) who benefits from the marital transition, and who suffers? We develop a model that can allow for several explanations, including improvements in birth-control technology, the closing of the gender-wage gap and changes in social transfers policy. A useful feature of our approach is that we can assess the implications of different stories for women who differ in the number of children they have. We impose on the model the discipline of pareto-optimal outcomes, so that we can see to what extent the transition can be explained without resorting to inefficiency.

The premise of our analysis is that when men and women make their current decisions they take into account the likely effect on their marital prospects, ie the expected gain to lifetime utility from a marriage at some time in the future. For singles we take these decisions to include choosing whether to pursue marriage or casual sex; single women who opt for casual sex must also decide how much effort to spend preventing the arrival of a child. The fertiltiy and divorce decisions of married people are determined by the value of a return to the marriage market and hence the marital prospects also matter for the decisions of married people.

Relative to the existing marriage literature, the theoretical contribution of our paper is that our model can allow for arbitrarily high numbers of children and and of transitions in and out of marriage.The recursivity of our model permits us to deal with a major stumbling block in the literature on marriage-market equilibria, the problem of carrying children as a state variable. Economists have long argued that children are the primary reason for marriage (ch Becker), and yet fertility decisions are often absent in marriage-market models. For instance, fertility is exogenous in [28], , and [7]. The exceptions tend to impose severe restrictions in terms of lifecycle (a maximum lifespan of 2 or 3 periods as in [17]. Models with a lifecycle marriage structure on the other hand, such as [9]or Bruze and Weiss(2011) abstract entirely from fertility.

More generally, the search-and-matching literature, while conceding the importance of match-speciofic investments (cf [4], [18]), has avoided actually modelling thse investments. Our paper therefore contributes to the search and matching literature a framework that allows for repeated investments both inside and outside the match; mathematically, investment in human capital, for instance, is just a relabelling of the fertility decisions in our model.

The long life-times in our model means it is relatively straightforward to parameterize our model to match annual data and thus measure the importance of these interactions. We exploit this property to carry out a computational comparison of two potential causes of the marital transition: wage convergence and birth-control technology.

To compare the plausibility of the different explanations of the marital transition, we apply a methodology from macro-economics, that of calibration to household data. We parametrize a "benchmark" version of the model so that the steady-state model approximates two sets of statistics drawn from US data:

1. marriage, fertility and divorce rates by marital status, as compiled from the 1995 wave of the National Survey of Family Growth (NSFG).

2. average allocations of time between leisure, market work and unpaid work by marital status and number of children.

We then ask whether there exist values of the gains from sex and the penalty for single-motherhood, both essentially unobservable, such that marriage and fertility patterns respond to higher costs of birth control in a way that the marital-fertility patterns observed in the 1973 NSFG. Similarly, we also perturb the benchmark model by reducing the female wage from 0.75 of the male wage to 0.61, to replicate the 1990s and the 1970s, respectively.

The main result is that the marital transition appears to be more the result of changes in birth-control technology than the result of the closing of the gender gap in wages. Starting from the benchmark and increasing the cost of birth control up to the point that results in the 1970s level of marriage rates for women without children defines the relevant range of variation for birth control effectiveness. Over this range, the birth rates to unmarried women decline from 5% per year to 1%. The similarity to the historical changes is striking. While it is possible to generate a similar range of variation by shifting women's wages, the range of wage variation required is far greater than the observed wage changes over this period. Both stories turn out to be consistent with the relative stability of the marriage rate of single mothers.

Our paper is most closely related [22] , which develops a life-cycle model to analyze trends in marriage, divorce and fertility. They find that reducing the wage gender gap by 19% increases the fraction of women who are single by 59% and the fraction of single mothers by 47%. In contrast to our model, they focus on random search with heterogeneity in wages. Their model is significantly richer than that developed here, particularly in terms of human capital investment and wage dispersion, but abstracts from the male side of the marriage market and hence from the marriage-market dynamics explored in the current paper. [1] [15] argues that technological progress in home goods reduced

[1] An important abstraction in the current paper is that we abstract from wage dispersion

the economic gains from marriage, making potential matches more unstable, which both reduced marriage rates and increased divorce rates. [15] models the segregation of young singles into sexually promiscuous and abstinent groups in response to improvements in contraception technology. [19] models the impact of abortion, marital instability and contraception technology on fertility, wages and occupational choice, but takes marital status as exogenous.

While there is a large literature on the determinants of unmarried parenthood, very few published papers consider the impact on marriage-market equilibria posed by the choice between fertility inside and outside of marriage. Most papers that consider fertility in the context of marriage-market equilibria such as [10], assume fertility within marriage only. [2] for instance, women prefer not to have children at all (i.e. pregnancy is simply a side-effect of sexual activity). The main exceptions are [21], which examines the interaction between welfare payments and marriage-market equilibria that differ in unmarried fertility rates, [16] (GGK hereafter), which shows how marriage-market dynamics and human-capital investment perpetuate the effect of rising welfare payments on unmarried fertility, and [8], which shows how improved contraception technology raises the equilibrium price of wives by reducing the fertility risk of single women. An important feature of these papers is that they model, inter alia, the impact of pre-marital fertility on the household allocations of married couples through the mechanism of marriage-market equilibrium. All of these papers suffer however from an extreme compression of the lifecycle; of the three, only GGK allows for divorce and remarriage, but even there, marriage is only allowed in two periods and divorce only in one.

In the search-and-matching literature, models with repeated matching opportunities are entirely standard, however this is typically achieved by abstracting from choices, such as investment, that permanently change the state of an agent. In the marriage-market model of [6], for instance, based on the job-search framework of [5] agents experience an infinite succession of marriages and divorces in response to changes in match quality, which is represented by an iid random variable. The matching literature has also considered the analysis of marriage markets with ex-ante heterogeneous agents, as in [3] , where agents sort into marriages on the basis of quality differences which are assumed to be permanent.

2 Empirical Background

2.1 Marriage and Childbirth

About half of all marriages now involve a second or higher order spouse (Census 2000: statistical abstract).

within sexes; it is interesting therefore that one of the main conclusions of [22] is that changes in wage dispersion do little to account for the trends in marriage and fertility.

The fraction of U.S. births accounted for by unmarried women has risen steadily, from 5% in 1945 to 40% in 2009, according to [27] They show that there has been steady growth in the unamrried birth rate since 1940, and in the share of births since 1960.

Of course the population of unmarried women has changed over time, with the rise of divorce and cohabitation. To isolate the effect of fertility behavior, we compare the behavior of unmarried women in two waves of the NSFG, 1973 and 1995, which have complete fertility and marital histories for women aged 15-44 at the time of the survey. [2] We estimate probit regressions by month for the birth of a child, and for marriage, for 1970-73 and 1990-95 (these date ranges correspond to periods for which the surveys asked more detailed questions). Earlier surveys did not interview single women, and so are not useful for this purpose. The explanatory variables include indicators for whether the woman is cohabiting, whether she was previously married and whether she graduated from high school, attended college or attained a bachelor's degree.[3]

The resulting estimates are presented in detail in the appendix, in Table A1. In Figure 1 we show projected age profiles using the estimated coefficients. The figure compares predicted profiles for women with no children to those for women with one child already. In both cases the comparison is for women with a high-school diploma but no college attendance. It is apparent from panel (a) that marriage rates for women without children fell considerably; the marriage hazard rate at age 22 declined from 30% per year to about 12%, while panel (b) shows virtually no change for single mothers. With regards to birth rates, those of childless women aged 22 quadrupled, from 2% to 8% annually, while for single mothers, the birth rates fell significantly, from 18% for 22 years old, to 13%.

These results indicate that neither trends in education nor in cohabitation can explain away the dramatic rise in unmarried fertility since the 1970s. Indeed the trend in unmarried birth rates predate these candidate "explanations" considerably, as the fraction of couples engaged in cohabitation in the US was negligible in the 1970s. Even in 1995, as we see from figure 2, based on our NSFG samples, cohabitation is a minor concern. In panel (a) of the figure we show the mean birth rates for singles, both including and excluding cohabitants; it is clear that the two series are virtually identical, despite the fact that, as the third series shows, cohabitants are much more likely to give birth.

Panel (b) shows that cohabitants make little difference for mean marriage rates either. This of course is because cohabitants are such a small fraction of single women, about 7% in the 1995 NSFG; with regards to parents the situation

[2] While the 2005 wave is designed to be representative of the US population as a whole, the 1973 wave excluded never-married women with no co-habiting own children.We reweight this survey by using the 1970 Census to account for these excluded women by age and education level, so that the proportions of these women in each cell match the 1970 census. The details of this procedure are in the appendix.

[3] The 1973 wave does not record wether the responded is attending school, nor her eventual attainment. Instead we know her years of schooling completed. We assume she is not attending if her age exceeds years of schooling by 6 years or more, while we use thresholds of 12 and 16 years as proxies for high-school graduation and attained of a bachelors degree, respectively.

is even starker: according to [?] less than 2 percent of children lived with two cohabiting (ie non-married) biological parents.

2.2 Sexual activity and contraception

Regarding sexual behavior and contraception, it is much harder to make full-population comparisons in the NSFG, because the Census is not informative about the never-married singles who were excluded from the sample. It is quite clear from other work that there was a significant increase over time in the sexual activity of these women. For instance [1] show that the fraction of females aged 15–19 years who have ever had sexual intercourse increased from 30% to 50% from 1971 to 1995.

Comparing singles who are in the 1973 NSFG with the comparable population in the 1995 NSFG confirms that this increase in sexual experience is echoed by an increase in sexual activity of previously married women. In addition we can observe a sharp increase in the fraction of singles using highly effective ("safe") contraception methods, mainly the pill and the IUD. As in the previous section, we use regression analysis to estimate age profiles so that we can use compare observably similar women over time.

The regression specifications are identical to those used for marriage and fertility, except that the dependent variables are sexual activity and measures of contraception. In the 1973 survey we measure sexual activity from an interval-level variable that gives the number of months without sex in the interval. [4] To construct the sex activity measure, we compute the ratio of months without sex to the number of single, non-pregnant months in an interval; the sex variable equals 1 minus this ratio. Since this is a proportion, rather than an indicator, we then estimate our standard model by OLS.

For the 1995 survey, we have two sources of information; for each interval, we have the start/end dates for up to four periods of sexual inactivity per interval, and we also have a list of all male sexual partners over the last 5 years, along with the dates of the relationship. We measure inactivity as the sum of months in an inactive interval plus months not in recorded sexual relationship. This provides a lower bound on the number of single, non-pregnant months that a woman is having sex. We then estimate by probit regression the probability that a woman is having sex in a given month. The estimated coefficients, which are shown in the appendix in Table A2, are then used to construct predicted age profiles.

In the left-hand panel of figure 3(a) we show the predicted age profiles for sexual activity of non-college women with no previous children. It is abundantly clear that there has been a radical shift in sexual activity of these women; the age profiles are quite flat and shift up from about 20% in 1973 to 80% in 1995. This picture of radical change in sexual behavior is entirely absent in the right-hand panel, which shows the sex profiles for single mothers. These women had

[4] An interval can be of two types: "pregnancy" and "open"; the latter refers to the time elapsed since the last pregnancy if any. Pregnancy intervals are the time between the ending dates of each pregnancy.

high rates of sexual activity, around 80%, in both the 1970s and the 1990s.

Contraception plays an important role in our theoretical analysis because when single women prefer not to raise children the birth rate of single women indicates an important cost of non-marital sexual activity. The two most important features of birth-control in our model are: there is a fertility-effort frontier, and for single women at least, the location of this frontier changes over time. The evidence for the role of effort is rife in the empirical literature on contraception. In the 1995 NSFG, [11]find that, after correcting for under-reporting of abortion, the annual pregnancy rate of women on the pill averages 9% overall, compared to 15% for women who rely on the male condom. These numbers are well above the "perfect-use" failure rates of these methods, and the disparities are attributed to incomplete compliance with the regime. While economists (eg [23]) tend to attribute compliance issues to lack of education, the medical literature (see the summary in [12]) finds virtually no impact of information on compliance. The case for effort is consistent with one of the most important stylized facts in the contraception literature; the fact that women who are contracepting to delay childbearing ("delayers") have much higher failure rates than those who are try to avoid it altogether ("preventers"). For instance [26] find that, among married women in 1970-73, 7% of delayers and 4% of preventers became pregnant in the first year of contraception use.

It is well-known that access to highly effective contraception was more difficult for single than for married women in the US but that much of the strictures against use of birth control by unmarried dissappeared by the 1990s [13] use state-wise comparisons to show a dramatic response of highly-educated women to changes in availability of the birth-control pill in the early 1970s. The effect of the strictures on poorer, less educated women must have been even more prohibitive.

Figure 3(b) shows that the rate of use of highly effective contraception use has increased commensurately with non-marital sex; for women without children, the safe-method profiles shift up from 10% in 1973 to 40% in 1995 while the no-contraception profile, evaluated at age 25, shifts down from 60% to about 30%. For single mothers on the other hand, the changes are smaller, a rise from around 35% to 50%.[5]

It is perhaps worth stressing that the method of this section controls for shifts in both cohabitation and education, as well as for the shift in age differences between women with and without children, features of the data that are apparent from Table 1. Overall the marital transition appears to be reflecting changes in behavior of women without children; the relative stability of single-mother behavior is a challenge for models of fertility and marriage that has been

[5]The profiles for pill use and not contracepting (not shown) yield a similar story. For single mothers, the fraction using the pill did increase, but only by about a third, from 30% to 40%, at age 25, while the fraction not using contraception declined slightly from about 35% to about 30%. An interesting difference between the two types of single women is that the role of other safe methods is more important for single mothers; this is due to the rise of female sterilization as a contraception method. Presumably this method is more appealing to women who already have children because they are less likely to want children in the future.

ignored until now.

3 The Model

The population consists of infinitely-lived adults, with a continuum of each sex denoted by $\{M, F\}$ and mass N_M and N_F. Individuals have zero mass. Life is divided into discrete periods. Women are of sex f and may produce up to K children. Adults enjoy a consumption good c, production of which requires only inputs of adult time; a unit of women's time yields w_f units of the good, while a unit of men's time yields w_m.

There are three types of households; single males, single females, and married couples. Married adults live together as husband and wife with all the children ever born to the female spouse. Let k be the number of kids in a married-couple household, and $k_m \leq k$ be the number of the husband's biological (own) kids. These couples can split up each period, in which case the spouses remain unmatched singles until the following period, the ex-wife retaining all k children.

Households exit permanently from active status, ie "become sterile" with probability δ each period; we assume they then enjoy their current utility flow forever. They are replaced by an equal inflow of unmatched men and child-less women.

Children are born to women who are matched with men, at rates that are determined endogenously each period. Married women are matched with men by definition, while singles can have transitory matches.

3.1 Preferences

Each period, a household generates an exogenous utility flow. These are designated $\widetilde{u}_{SM}, \widetilde{u}_{SF}(k)$ and $\widetilde{u}_M(k, k_m)$, for, respectively, single males, single women and married-couples. Sex between unmarried couples generates additional utility u^x_{SM} for a male and u^x_{SF} for a female. Utility within matched couples is perfectly transferable. For a more explicit treatment of the household structure, the reader is referred to the calibration section below.

The critical assumption is that children generate more utility within a marriage than without:

$$\widetilde{u}_{SF}(k+1) - \widetilde{u}_{SF}(k) < \widetilde{u}_M(k+1, k_m - 1) - \widetilde{u}_M(k, k_m)$$

What we have in mind here is the idea that parents get less utility from step children than from their own children, so that an additional child within a marriage raises the father's utility more than a pre-existing child would. To avoid additional complexity, we assume that children outside the household do not enter the parent's utility function.

Each period, couples experience random shocks to the quality $\widetilde{q}$ of the marriage, which consist of additional utility flows to the couple. The stochastic process for match quality $\widetilde{q}$ is assumed to contain both a persistent component $q \in Q \subseteq \mathbb{R}$ and an iid component ε, with cdfs $\chi(\cdot|q)$ and $\Phi(\cdot)$, respectively. For a newly matched couple in the marriage market, the initial marriage-quality distribution is $\chi(\cdot|\hat{q})$, where $\hat{q} \in Q$.[6]

Fertility decisions are made after the match quality has been realized. The utility cost of choosing the fertility rate π^F is given by the function $\Theta(\pi^F)$. We will assume that $\Theta'(\pi^F) < 0$, so that we can think of this as representing birth-control effort.

We also assume that while entry into the marriage market is cost-less for women, there is a utility cost $\gamma > 0$ that single men must pay to enter the marriage market. Finally, we assume that there is a cost ζ_i of participating in the sex market follows an iid stochastic process with cdf $\Gamma(\cdot|i,k)$ indexed by the sex i of the participant and, in the case of female participants, the number of children, k.

3.2 Frictional assignment

The population of singles consists of new entrants and older agents who were single or became divorced last period. Each period, singles choose between participating in either the marriage market or the sex market. Each market consists of $k+1$ submarkets, one for each $k \in \{0, 1...K\}$. All unmarried women with k children who decide to participate in a given market are assigned to submarket k. Unmarried people can also choose not to participate in either market, in which case they receive the autarky utility, $\widetilde{u}_{SM}$ or $\widetilde{u}_{SF}(k)$, as the case may be. The number of single-female households with k children is denoted by $N_F(k)$. Of these women, a mass $N_F^x(k)$ choose to enter sub-market k of the sex market, while the mass $N_F^m(k)$ choose to enter sub-market k of the marriage market.

Men choose which market and which submarket to enter. $N_M^m(k)$ denotes the number of men who enter sub-market k of the marriage market, while $N_M^x(k)$ denotes the mass of those who enter sub-market k of the sex market. The critical difference is that while for the women k is pre-determined, men can choose k each time they enter the market.

Apart from the possibility of immediate divorce, the structure of the sub-markets is a standard competitive search environment.[7] Each period there is random assignment of men to women within each of the sub-markets. Let $\phi_k^j = N_M^j(k)/N_F^j(k)$ denote the queue-length for sub-market (j,k). Each single woman is assigned a random integer number of suitors $z \in \mathbb{N}$ with probability $\omega_z^k = \omega_z(\phi_k)$. This probability equals $\omega_0(\phi_k) = e^{-\phi_k}$ for $z = 0$,and $\phi_k e^{-\phi_k}$ for $z = 1$.A man will match with probability $1/z$, which on average is equal to the number of matches $1 - \omega_0(k)$ divided by the number of men per woman ϕ^k.

Women auction the match to the highest bidder. In each market, abstracting

[6]Computational considerations restrict the persistent component to a discrete support, so the iid component of the process is a computational convenience that allows for a continuous support for match quality, which is critical for comparative statics.. We are grateful to Victor Rios-Rull for suggesting this stochastic structure for match quality.

[7]The mechanics of the sub-market can also be expressed in terms of wage posting, as in Shimer 2005.

from divorce, the probability that the husband receives the surplus is therefore $\omega_0(k)$, the probability that he was the only bidder. Similarly, the probability that a woman marries is given by $[1-\omega_0(k)]$, the probability that she has at least one suitor, and the probability that she gets the surplus, again abstracting from divorce, is $[1-\omega_0(k)-\omega_1(k)]$.

The probability that a newly matched couple in the marriage market ends up marrying is $\left(1-\pi^D(\hat{q})\right)$ where $\pi^D(\hat{q})$ indicates the probability that the couple would want to divorce on learning the first realization of their marriage quality (q,ε). If they do not marry, the members of the couple spend the remainder of the period as single agents. All of the probabilities in the previous paragraph are therefore multiplied (in the marriage market only) by $\left(1-\pi^D_{k,0}(\hat{q})\right)$, the probability that the match quality was sufficiently high.

A newly matched couple in the sex market chooses the fertility probability π^F_{kx} that is optimal for the woman. As in the marriage market, the woman auctions the match, collecting the entire surplus if she has more than one bidder, and getting her reservation utility otherwise.

3.3 Expected payoffs

It is convenient to divide the period into the stage before and the stage after marriage and divorce decisions. We use the superscript E to refer to the expectations as of the start of the period ("ex ante") and R to refer to the expectations as of the close of the matching markets, but before fertility is realized. Let the effective discount rate be denoted $\beta \equiv \tilde{\beta}(1-\delta)$.

For any function $g(k)$, let $\Delta g(k) = g(k+1) - g(k)$ represent the effect of having one more child.

3.3.1 Marriages

Let $Y^E(k, k_m|q_{-1})$, denote the expected value, on entering the period, of a marriage consisting of a woman with k kids of her own, of which k_m are fathered with her current husband. q_{-1} denotes the previous-period's realization of q.

Recall that the initial distribution of q be indexed by $\hat{q}$, so we can write the value of a new marriage as $Y^E(k,0|\hat{q})$.Finally, let $EU\left(\pi^F,k,k_M\right)$ represent the expected utility flow to the married couple in each period, net of the quality flow and conditional on fertility choice π^F:

$$EU\left(\pi^F,k,k_M\right) \equiv \pi^F u_M(k+1,k_M+1) + \left(1-\pi^F\right) u_M(k,k_M)$$

Let $Y^R(k,k_m|q,\varepsilon)$ be the expected value of the marriage, given optimal fertility decisions, after the match quality shocks (q,ε) are realized but before the fertility realizations. Letting π^F be the optimal fertility choice,we can write this in terms of the flows we have just defined as:

$$\begin{aligned} Y^R(k,k_m|q,\varepsilon) = {} & EU\left(\pi^F,k,k_M\right) + q + \varepsilon - \Theta\left(\pi^F\right) + \beta Y^E(k,k_m|q) \\ & + \beta\pi^F \Delta Y^E(k,k_m|q) \end{aligned} \tag{1}$$

.

3.3.2 Singles

Singles can enter the marriage or sex markets, or stay out of the markets ("remain on the couch"). The payoff for staying on the couch is V_{Sj}^{R}, $j \in \{F, M\}$, and the fertility risk is zero.

Let the values on entering sub-market (k, j), for men and women respectively, be denoted $V_{SM}^{E}(k, j)$ and $V_{SF}^{E}(k, j)$.Now we can define the values of single people on entering the period, conditional on sex cost realization ζ_i:

$$W_{SM}^{E} = E \max_{k} \left\{ \max \left(V_{SM}^{E}(k, x) - \zeta_i, V_{SM}^{E}(k, j) - \gamma \right) \right\}$$
$$W_{SF}^{E}(k) \equiv E \max \left(V_{SF}^{E}(k, x) - \zeta_i, V_{SM}^{E}(k, j) \right)$$

The alternative to any given match is to remain unmatched for the period. Let $V_{SM}^{R}(\phi)$ and $V_{SF}^{R}(k)$ denote the continuation values as unmatched singles for men and women, respectively, at the close of the matching markets.

We can write the continuation value for single men as:

$$V_{SM}^{R} = u_{SM} + \beta W_{SM}^{E} \tag{2}$$

, while for a woman with k children, it is

$$V_{SF}^{R}(k) = u_{SF}(k) + \beta W_{SF}^{E}(k) \tag{3}$$

. These values are also what an agent gets when choosing to enter neither market.

Value of Entering the Sex Market Having sex produces an immediate utility gain equal to $u_{SF}^{x} + u_{SM}^{x}$. However because having sex implies the possibility of an increase in k, the net surplus must account for both the cost $\Theta\left(\pi_k^{SF}\right)$ of implementing the optimal fertility probability π_k^{SF} and the impact of fertility on the woman's welfare. The net utility produced from sex is therefore $y^{x}\left(\pi_k^{SF}\right) \equiv u_{SF}^{x} + u_{SM}^{x} - \Theta\left(\pi_k^{SF}\right)$.

The welfare effect of fertility is comprised of a dynamic effect on the mother's continuation values, $\Delta W_{SF}^{E}(k) \equiv W_{SF}^{E}(k+1) - W_{SF}^{E}(k)$ and an immediate effect, $\Delta u_{SF}(k) \equiv u_{SF}(k+1) - u_{SF}(k)$.

The surplus of a match in the sex market is therefore:

$$S_x(k) \equiv y^{x}\left(\pi_k^{SF}\right) - \Theta\left(\pi_k^{SF}\right) + \pi_k^{SF}\left[\Delta u_{SF}(k) + \beta \Delta W_{SF}^{E}(k)\right] \tag{4}$$

. The probability that a woman entering the sex market actually ends up with the surplus is

$$p_k^{x} \equiv 1 - \omega_0\left(\phi_k^{x}\right) - \omega_1\left(\phi_k^{x}\right) = 1 - \left(1 + \phi_k^{x}\right) e^{-\phi_k^{x}}$$

, so the (ex ante) expected value is:

$$V_{SF}^{E}(k, x) \equiv V_{SF}^{R}(k) + p_k^{x} S_x(k)$$

. A man only gets the surplus if no other men compete for his match, which happens with probability $q_k^x \equiv \omega_0 \left(\phi_k^x\right) = e^{-\phi_k^x}$. The (ex ante) expected value is:

$$V_{SM}^E (k, x) \equiv V_{SM}^R (k) + q_k^x S_x (k)$$

.

Value of Entering the Marriage Market Using the notation defined above, we can define the surplus from a marriage where the bride has k children as:

$$S_m (k, 0) = Y^E (k, 0|q_{-1}) - V_{SF}^R (k) - V_{SM}^R \tag{5}$$

. Given a man has probability $\omega_0 \left(\phi_k^m\right)$ of getting the marital surplus, the *ex ante* net value of a man's prospects in marriage market k is given by

$$V_{SM}^E (k, m) = V_{SM}^R + \omega_0 \left(\phi_k^m\right) \left(1 - \pi_{k,0}^D (\hat{q})\right) S^m (k, 0) \tag{6}$$

. Similarly for single women with k children, the *ex ante* net value of entering the marriage market is:

$$V_{SF}^E (k) = V_{SF}^R (k) + \left[1 - \omega_0 \left(\phi_k^m\right) - \omega_1 \left(\phi_k^m\right)\right] \left(1 - \pi_{k,0}^D (\hat{q})\right) S (k, 0) \tag{7}$$

.

3.4 Divorce Policy

We assume that the divorce rule $\varepsilon^* (k, k_m, q)$ maximizes the present discounted value of the spouses:

$$\begin{aligned} & Y^E (k, k_m, q_{-1}) \\ & = \max_{\varepsilon^*} \left\{ \int_q \left[\int_{-\infty}^{\varepsilon^* (k, k_M, q)} \left[V_{SM}^R + V_{SF}^R (k) - \tau\right] d\Phi (\varepsilon) \right] d\chi (q|q_{-1}) \right. \\ & \left. + \int_q \left[\int_{\varepsilon^* (k, k_M, q)}^{\infty} Y^R (k, k_m|q, \varepsilon) \, d\Phi (\varepsilon) \right] d\chi (q|q_{-1}) \right\} \end{aligned} \tag{8}$$

, where the equal weighting of the spouses follows from the FTU assumption. As a convenience, we can write the divorce probability arising from the optimal divorce decision rule as:

$$\pi_{k,k_m}^D (q_{-1}) = \int_q \Phi \left(\varepsilon^* (k, k_M, q)\right) d\chi (q|q_{-1}) \tag{9}$$

.

3.5 Fertility Policy

The main issue here is that having a child changes the state of the marriage and of single females. The net benefit of having a child therefore depends on the forecast of the probability of marital transitions, which for married couples depends on the current value of q.

For a single woman with fewer than K kids who is matched in the sex market, optimal fertility π_k^{SF} solves:

$$\max_{\pi} \left\{ u_{SF}(k) + u_{SF}^{x} + \beta W_{SF}^{E}(k) - \Theta(\pi) + \pi\left[\Delta u_{SF}(k) + \beta \Delta W_{SF}^{E}(k)\right]\right\}$$

The optimal fertility therefore solves:

$$\Theta'\left(\pi_k^{SF}\right) = \Delta u_{SF}(k) + \beta \Delta W_{SF}^{E}(k) \tag{10}$$

. Similarly for a married woman with fewer than K kids, optimal fertility π_{k,k_m}^{MF} solves:

$$\Theta'\left(\pi_{k,k_m}^{MF}\right) = \Delta u_M(k, k_m) + \beta \Delta Y^{E}(k, k_m, q) \tag{11}$$

.

3.6 Market-Clearing

Given our assumption that the match surplus is declining in k, there is some $k^* \in \{0, 1, ...K\}$ such that in equilibrium $\phi_k > 0$ if $k \leq k^*$ and $\phi_k = 0$ otherwise. Let $\mathcal{M} \subseteq \{0, ...K\}$ be the set of active marriage markets of type k. For sex

markets on the other hand, the assumption that the cost support extends to -∞ implies that there will always be some people on each side who strictly prefer the sex market to the marriage market and so the sex market operates for all k.

Consider an unmarried woman i with k children; if $k \in \mathcal{M}$, then if she is indifferent between the two markets, it must be that

$$V_{SF}^{E}(k, x) - \xi_i = V_{SF}^{E}(k, m)$$

This defines the threshold value ξ_F^*; women will optimally enter the sex market if $\xi_i < \xi_F^*(k)$; the marriage market otherwise. If $k \notin \mathcal{M}$, then the threshold value for women $\xi_F^*(k)$ is defined by

$$V_{SF}^{E}(k, x) - \xi_F^*(k) = V_{SF}^{R}(k)$$

. In all cases, the mass of women entering the marriage sub-market k is $N_F^m(k) = \left[1 - \Gamma\left(\xi_F^*(k)\right)\right] N_F(k)$ .Similarly for the sex sub-market k the mass is $N_F(k, x) = \Gamma\left(\xi_F^*(k)\right) N_F(k)$.

For men the quantity entering each market can also be expressed in terms of the threshold, but since men within a submarket are all identical and can freely choose k it must be that their values are equated across all active submarkets.

For any k where both sub-markets operate, the values of being a man in those markets must solve:

$$V_{SM}^{E}(k,x)-\xi_{M}^{*}=V_{SM}^{E}(k,m)-\gamma=V_{SM}^{R} \tag{12}$$

.

Using this condition , we can easily solve for the queue length in the marriage market as a function of the surplus:

$$V_{SM}^{E}(k,m)=V_{SM}^{R}+e^{-\phi_{k}^{m}}\left(1-\pi^{D}(\hat{q})\right)S_{k}^{m}=V_{SM}^{R}+\gamma$$

$$\phi_{k}^{m}=\log\left[\frac{\left(1-\pi^{D}(\hat{q})\right)S_{k}^{m}}{\gamma}\right] \tag{13}$$

, where the ex ante divorce probability $\pi^{D}(\hat{q})$ enters because a match only becomes a marriage if it would not result in an immediate divorce.

For the sex market, similar considerations apply, but only to the marginal man

$$V_{SM}^{E}(k,x)=V_{SM}^{R}+e^{-\phi_{k}^{x}}S_{k}^{x}=V_{SM}^{R}+\zeta_{M}^{*}$$

$$\phi_{k}^{x}=\log\left[\frac{S_{k}^{x}}{\zeta_{M}^{*}}\right] \tag{14}$$

Since men also have the option of sitting out of all markets, the participation constraint must be satisfied:

$$V_{SM}^{R}\geq V_{SM}^{A} \tag{15}$$

.

There is also a resource constraint for each market, which we can express in terms of demand and supply of single men. This constraint is

$$\sum_{k\leq K}\left[N_{M}^{x}(k)+N_{M}^{m}(k)\right]\leq N_{M} \tag{16}$$

using the definition of queue length, we can write this as:

$$\sum_{k\in\{0,..K\}}\phi_{k}^{x}N_{F}^{x}(k)+\sum_{0\leq k\leq k^{*}}\phi_{k}^{m}N_{F}^{m}(k)\leq N_{M} \tag{17}$$

If in equilibrium, condition (15) binds when V_{SM}^{R} equals the autarky value $V_{SM}^{A}=u_{SM}/\beta$, then since all marriage markets yield men the same ex ante value, men will be indifferent between the marriage market and sitting on the couch, and so condition (17) will not bind.

Now suppose instead that single men strictly prefer entry into active marriage markets: $V_{SM}^{R}>V_{SM}^{A}$. Another way to think of this is that there is excess demand for husbands; the supply constraint (17) binds. In that case there is some reservation value $V_{SM}^{R}>V_{SM}^{A}$ that will generate a queue lengths $\{\phi_{k}^{x},\phi_{k}^{m}\}$ such that (17) holds with equality.

3.7 Equilibrium

Let $N_F(k)$ and $M(k, k_m, q)$ denote the masses of single and married women, respectively, in each state and let the next-period values be $N'_F(k)$ and $M'(k, k_m, q)$. Later in the paper we work out the law of motion for these distributions. For now we limit ourselves to consideration of the stationary distributions $N^*_F(k)$ and $M^*(k, k_m, q)$.

A stationary equilibrium consists of the following objects: a list of decision rules for fertility $\left\{\pi^{SF}_k, \left\{\pi^{MF}_{k,k_m}\right\}^k_{k_m=0}\right\}^{K-1}_{k=0}$, and divorce $\left\{\{\{\varepsilon^*(k, k_M, q)\}\}^k_{k_m=0}\right\}^K_{k=0}$, rules $\{N^m_M(k), N^x_M(k)\}^K_{k=0}$ and $\{N^m_F(k), N^x_F(k)\}^K_{k=0}$ for assigning singles to markets , and laws of motion $\left\{T_S(k), \{T_M(k, k_m, q)\}^k_{k_m=0}\right\}^K_{k=0}$ for the distributions. These objects must satisfy the following conditions:

1. Optimality:
   (a) For every $k < K$, the decision rules for unmarried fertility solve condition (10)
   (b) For every $k < K$, and $k_m \leq k$, the decision rules for married fertility solve condition (11)
   (c) For every $k < K$, and $k_m \leq k$, the decision rules for divorce solve problem (9)
2. Market-clearing: the assignment rules imply queue lengths that satisfy conditions (12), (15) and (17):
3. Aggregation:
   (a) The laws of motion of the distributions of agents over states aggregate the individual decisions
   (b) Stationarity: The distributions are the fixed points of their laws of motion.

4 Solving the Model

Due to the directed-search nature of the model, the decision rules in market k depend on the other markets only through the values of ϕ^k and V^R_{SM}. Therefore we can solve the asset equations for each level of k separately, conditional on conjectured values of $\left\{\phi^k, V^R_{SM}\right\}$ in the equilibrium vector , by backwards induction from $k = K$. Given the complete system of decision rules, we then solve for steady-state distributions, starting from $k = 0$. This yields new values of $\left\{\phi^0...\phi^K, V^R_{SM}\right\}$ implied by the market-clearing conditions. We then repeat the procedure using the new values until they converge.

This sequential procedure works because the only transition we allow in k is to increase by one.To ensure that this procedure converges quickly, we hold fixed the markets that are active. Letting $k^* \leq K$ indicate the highest market that is open, we start from $k^* = 0$ and apply the solution procedure for successively higher values of k^* until we get either $k^* = K$ or $\phi^{k^*+1} = 0$.

4.1 Asset Equations

To solve the asset equations for a given level of k, we solve for the policy rules $\left\{\pi^D(k, k_m, q), \pi^F(k, k_m, q)\right\}_{q=1}^{n_q}$, and the surplus vector $\{S(k, 0, q)\}_{q=1}^{n_q}$. Suppose the shock q has a discrete n_q-point support and that marriage market k is active.Lets assume that we know the value functions for $k+1$, the fertility and divorce probabilitiies for $\{(k, q_i)\}_{i=1}^{n_q}$ and the *ex post* value V_{SM}^R of being a single male.[8] A very convenient feature of the model is that these assumptions allow us to write the asset equations relevant to the marriage market for women with k children as the following linear system:

$$\begin{bmatrix} W_{SF}^E(k) \\ Y^E(k, 0, q_1) \\ \dots \\ Y^E\left(k, 0, q_{n_q}\right) \end{bmatrix} = A_{1k} \begin{bmatrix} W_{SF}^E(k) \\ Y^E(k, 0, q_1) \\ \dots \\ Y^E\left(k, 0, q_{n_q}\right) \end{bmatrix} + A_{0k} \tag{18}$$

. The elements of A_{1k} and A_{0k} are derived in the appendix. Note that this system is independent of the value of being a family with k children and $k_m > 0$, because those outcomes have zero probability for these women. However, the value of a $(k, k_m > 0)$ family depends on the value of being single with k children, so with the solution to (18) in hand we then solve a second, smaller linear system for the values of these families:

$$\begin{bmatrix} Y^E(k, k_m, q_1) \\ \dots \\ Y^E\left(k, k_m, q_{n_q}\right) \end{bmatrix} = B_{1k} \begin{bmatrix} Y^E(k, k_m, q_1) \\ \dots \\ Y^E\left(k, k_m, q_{n_q}\right) \end{bmatrix} + B_{0k} \tag{19}$$

The elements of B_{1k} and B_{0k} are derived in the appendix.

4.2 Distributions

Using the marriage and fertility decision rules derived above, we then compute the steady-state distributions of the household types. Within each level of k we solve separately for the households with $k_m = 0$ and those with $k_m > 0$.

Let the next-period mass of the singles and married at each state be given by $N_F'(k)$ and $M'(k, k_m, q)$, respectively. We show in the appendix that we can write the law of motion of the distribution of singles and marriages with $k_m = 0$ as the linear system:

$$\begin{bmatrix} N_F'(k) \\ M'(k, 0, q_1) \\ \dots \\ M'\left(k, 0, q_{n_q}\right) \end{bmatrix} = C_{1k} \begin{bmatrix} N_F(k) \\ M(k, 0, q_1) \\ \dots \\ M\left(k, 0, q_{n_q}\right) \end{bmatrix} + C_{0k} \tag{20}$$

[8] Note that the transitory shock ε is not part of the state vector.

, where the elements of B and b_1^k are derived in the appendix. This linear system is easily solved for the stationary values $N_F^*(k)$ and $M^*(k, 0, q)$. However for any $k > 0$, we first have to solve for the stationary distributions of married couples with $k_m > 0$. This is the fixed point of the linear system:

$$M'(k, k_m, Q) = D_{1k,k_m} M(k, k_m, Q) + D_{0k,k_m} \tag{21}$$

Because any increase in k_m entails an increase in k, the law of motion for each different value of k_m forms a separate linear system of equations that depends on behavior at $k - 1$; unless $k_m > 0$, the behavior of women with k children is not required to solve these equations.

5 Calibration

In this section, we explain how we choose parameters and functional forms for the model so as to generate a "benchmark" version of the model. This takes place in two stages. In order to discipline the choice of utility flows associated with each state, we first model each household as solving a standard labor-supply problem, subject to a home-production constraint, as in [20]. The utility flows are determined by calibrating the child-cost and labor-supply parameters so as to match the allocations over leisure and home production as measured in the 2003 wave of the American Time-Use Survey. In this way we arrive at child cost parameters that are pinned down by the moments we match in the time-allocation data. This will prove important for disciplining the effects of changes in income variables, such as wages and social transfers.

For the dynamic components of the model, we try to incorporate empirical information directly where possible. For instance roughly a third of non-contracepting sexually-active married women give birth each year, according to the 1995 National Survey of Family Growth (NSFG); we therefore set the maximum fertility rate equal to $1/3$.

We then search over the parameters governing marriage and divorce so that that the revelvant statistics from the stationary equilibrium resemble the patterns of average fertility, marriage rates and the distribution of family types, as observed in the 1995 wave of the NSFG.

5.1 Parameters set *a priori*

Some parameters can be set independently of the marriage-market equilibrium. This part of the calibration relies mainly on statistics from government publications and other papers. The probability δ of exiting the reproductive state, as in [22], is set so as to replicate the average number of years a woman spends in the reproductive state. We compute this by summing the fraction of women who are fecund at each age between 16 and 44, as estimated by [25].[9] This results in a total of 20.45 fecund years per woman, so we set $\delta = 0.0489$. This

[9] The numbers we use are based on the interpolated series reported in [24].

means we need to keep track of the fraction of women who are inactive in the population, as our model includes only the active ones.

Wages are set to the medians for each sex from the 1995 CPS for the age group 25-45. For men the median hourly wage is $10; so we set $w_m = 10$. For women, the median hourly wage is $8.17, so we set $w_f = 8.31$. Wages at younger ages would not be informative about the cost of time, as younger people are likely to be in school or provisional jobs. We set $\beta = 0.96$, the standard value in the macroeconomics literature.

5.2 Within-household structure

The idea is to choose child costs to match the observed mean labor and home-production times by marital status and kid numbers. We assume two types of kids costs, pecuniary and time; another way to put it is that there is a home production function with two inputs, time and money, with some substitutability between the two. Time inputs in turn are a composite of the inputs of husbands and wives. In order to keep the calibration simple, we assume as in Knowles(2005) that there is no utility for home output, that it just imposes a constraint which is increasing in the number of children. Below we first describe the optimal time allocations and then how we set the parameters that govern these allocations, conditional on the wage values above.

In order to allow both singles and married to be modeled as operating the same technology, we assume the effective labor input of married couples is CES in the individual inputs:

$$h\left(h_W, h_H\right) = \left[\eta_0 h_W^{1-\eta_1} + \left(1-\eta_0\right) h_H^{1-\eta_1}\right]^{1/(1-\eta_1)}$$

Let the effective time input be h and the goods input be m. The production function for kids is

$$G\left(h, m\right) = \left[\rho_0 h^{1-\rho_1} + \left(1-\rho_0\right) m^{1-\rho_1}\right]^{1/(1-\rho_1)}.$$

. Allowing $g_i\left(k\right)$ to be the home-production required for household type i with k children, the inputs must satisfy the constraint:

$$G\left(h, m\right) \geq g_i\left(k\right) = \gamma_{0i} + \gamma_{1i} k^{\gamma_{2i}}$$

. For a single household, the home-production problem defines the full-income $I_i\left(k\right)$ of the household:

$$I_i\left(k\right) = \max_{h_i, m_i} \left\{w_i\left(1-h_i\right) - m_i + \mu_i\left[G\left(h_i, m_i\right) - g_i\left(k\right)\right]\right\}$$

, where μ_i is the multplier on the home-production constraint.

We assume that assume the utility from kids is separable from the utility from consumption and leisure:

$$u\left(c_i, l_i, k, k_m\right) = u\left(c_i, l_i\right) + v\left(k, k_m\right)$$

The choice of labor supply can then be seen as maximizing household utility subject to the spending on leisure and consumption not exceeding the full income

$$\max_{l_i} \{u(I_i(k) - w_i l_i, l_i)\}$$

Similarly, the home production problem of a married household with k children can be written as:

$$I_{Mar}(k) = \max_{h_{MF}, h_{MM}, m} \{w_M(1 - h_{MM}) + w_F(1 - h_{FF}) - m + \mu_{Mar}[G(h_{MM,}, h_{MF}, m) - g_{Mar}(k)]\}$$

Given home inputs, h_{MF}, h_{MM}, m, optimal labor supply of married couples solves:

$$U(k) = \max_{\{l_{MM}, c_{MM}, l_{MF}, c_{MF}\}} \{\mu u(c_{MM}, l_{MM}) + (1 - \mu) u(c_{MF}, l_{MF})\}$$

subject to

$$I_{Mar}(k) - w_M l_{MM} - w_F l_{MF} \geq c_{MM} + c_{MF}$$

where $\mu = 1/2$ is the weight on the husband in the household utility function implied by the assumption of fully transferable utility.

With the solution to the married problems in hand, we can write the flow utility of married households as

$$V(k, k_M) = U(k) + v(k, k_m)$$

, where the function $v(k)$ governing utility from children will be defined later.

We assume the functional form for the utility flows from consumption and leisure is given by:

$$u(c_i, l_i) = \left[\sigma_0 c_i^{1-\sigma_1} + (1 - \sigma_0) l_i^{1-\sigma_1}\right]^{1/(1-\sigma_1)}$$

This implies that the optimal home production time for single women is given by:

$$h_{SF}(k) = \frac{g_{SF}(k)}{\left[\rho_0 \eta_0^{1-\rho_1} + (1 - \rho_0) x_F^{1-\rho_1}\right]^{1/(1-\rho_1)}}$$

and pecuniary inputs $m_{SF} = x_W h_{SF}$ where

$$x_{SF} \equiv \left(\frac{w_F}{\eta_0} \frac{1 - \rho_0}{\rho_0}\right)^{1/\rho_1}$$

For married couples, we can write the wife's optimal home production time h_W in terms of the husband's, h_H :

$$h_{MF} = \left(\frac{w_H}{w_F} \frac{1 - \eta_0}{\eta_0}\right)^{1/\eta_1} h_{MM} \equiv A_M h_{MM}$$

This in turn implies we can write $h = \kappa_M h_{MM}$, where

$$\kappa_M \equiv \left[\eta_0 A_M^{1-\eta_1} + (1-\eta_0)\right]^{1/(1-\eta_1)}$$

the effective cost of labor input h is therefore

$$\widehat{\omega} = \frac{w_W A_M h_H + w_H h_H}{\kappa_M h_H} = \frac{w_W A_M + w_H}{\kappa_M}$$

. Finally, we get that effective home production time is given by:

$$h = \frac{g_M(k)}{\left[\rho_0 + (1-\rho_0)\left(\widehat{\omega}\frac{1-\rho_0}{\rho_0}\right)^{(1-\rho_1)/\rho_1}\right]^{1/(1-\rho_1)}}$$

this then implies the optimal inputs are:

$$h_{MM} = h/\kappa_M$$

$$h_{MF} = h_{MM} A_M$$

For labor supply predictions we need to solve for leisure; we assume consumption and leisure are allocated to maximize the weighted sum of the spouse's utility, conditional on meeting the home production and budget constraints, very much as in [20]. If we let μ equal the husband's weight in the household-planner's objective and λ be the wealth multiplier of the household, then the husband's leisure time is given by:

$$l_H = \left(\frac{\mu}{\lambda w_H}(1-\sigma_0)\right)^{1/\sigma_1}$$

and the wife's by

$$l_W = \left(\frac{(1-\mu)}{\lambda w_W}(1-\sigma_0)\right)^{1/\sigma_1}$$

. Market labor is then obtained from the time constraints. In the appendix we show that the multiplier is given by

$$\lambda = \left(\frac{A(w_H, w_W)}{Y_M^F(k)}\right)^{\sigma_1}$$

where $Y_M^F(k)$ is the full income of the household and $A(w_H, w_W)$ the effective price of consumption in the household.

5.2.1 The Home production constraint

We need a function $g(k)$ that gives the amount of home production required for k children. We assume that for each household type i there is a baseline amount γ_0^i of home production required even in the absence of children. Each child then requires addtitional inputs:

$$g^i(k) = \gamma_0^i + \gamma_1^i k$$

.

5.2.2 Empirical targets

Theoretically an increase in the number of kids has two effects on labor supply. The pecuniary cost increases, which tends to increase labor supply, but also the time cost increases, which tends to reduce labor supply. Substitution between husbands and wives explains why in the data husbands work more than single men and wives less than single women.

We compute averages of home production and paid labor weekly hours from the first wave of the American Time Use Survey (ATUS 2003). There are of course conceptual issues associated with both concepts; we use the definitions developed in [20], based on the assumption of 118 discretionary hours per week. We then choose the parameter values that give the closest match to the ATUS statistics; the resulting parameters are shown in Table 7(a); the match between model and data in table 6(a). The data also shows that, for husbands, home labor increases more slowly with the number of kids than is the case for other groups. To match this we add a fixed time cost h_H^0 of parenthood for men, as otherwise the ratio of husband to wife's time is constant wrt k.

An important feature of the calibration results is that marriage turns out not to save on home production; in contrast to the hypothesis of [14] for instance, singles spend less apart than they would married. Thus the fixed cost of establishing a household does not provide a motive for marriage in our model. This is because to match the higher leisure-expenditure share of singles, the calibration needs to reduce their home production cost; an alternative that we will consider in the robustness section would be to allow singles to have a lower marginal utility schedule for consumption. Thus the time allocation of singles, which is ignored in other marriage papers, turns out to be very informative about the gains from marriage.

5.3 Fertility Probability and Effort

We assume that for non-sterile women, the probability that a child will arrive next period is assumed to be a declining function of contraceptive effort, which is modeled as a utility cost or effort $\Theta\left(\pi_i^F\right)$ to the household. Therefore those who prefer to have a child will exert zero effort. Let the fertility probability at zero effort, for a woman of marital status i be $\hat{\pi}_i$. For fertility-cost parameter

$\alpha_i > 0$, the effort-probability frontier is given by:

$$\theta = \alpha_i$$

$$\pi_i^F = \min\left(\hat{\pi}_i, \frac{\alpha_i}{\sqrt{\Theta}} - 1\right)$$

. This gives a smooth convex frontier; the marginal cost approaches infinity as fertility approaches zero, so perfect fertility control is never optimal. We fix $\alpha_m = 1$ for the 1990s benchmark calibration, though we will allow it to vary in the comparative statics exercises below.

5.4 Free Parameters

Of the remaining parameters, ten are treated as free parameters that are set so that the model's stationary distribution matches as closely as possible a number of statistical targets. These targets are drawn from the marital and fertility patterns of the 1990s, by marital status and number of children, as described in the empirical analysis above; we take the predicted marriage, divorce and fertility rates for women aged 25 in three different marital states: unmarried, married with no step children, and married with one step child.

To map the model's outputs to these targets requires that we account explictly for the people in the model who have become inactive but are still present in the population. Therefore for each candidate parameterization, we simulate a cohort of 10,000 women from age 18 to age 25 using the decision rules and stochastic processes implied by the benchmark model and compute the relevant moments from the simulated population of 25 year olds. We then compute the average deviation between the moments of the model and the targets, and update the cohoice of parameters, repeating the process until the numerical solver finds a minimum.

6 Results

The current benchmark model is provisional in the sense that it assumes iid match quality and limits the maximum number of children to$K = 3$. In future work we will explore the impact of relaxing these and other assumptions to asses whether the becnhmark model should be more flexible. The results and parameters are shown in Tables 6 and 7. Table 6(b) shows that the benchmark model generates fairly close matches for marriage, divorce and fertility rates for childless women. The main problem in matching the targets is that the empirical fertility rate is 20% in 1995 for married women aged 25 with step children, while in the model it is 10%. There is no reason to believe the model cannot get a better match, but rather than fuss more with calibration for now, we forge ahead with the computational exercises.

6.1 Properties of the benchmark model

In Tables 8 and 9 we show some of the properties of the benchmark model. First the stationary distribution has roughly 33% singles and 77% married, compared to 40%/60% in the 1990s; about 7% of women are in step-families, compared to X% in the data. It may be that the discrepancies are due to the lack in the model of age as a state variable; this could lead to mis-match at younger and older age groups even though the model does a good job of matching statistics at age 25. This will be examined in future versions of the paper. The age to match was chosen arbitarily, and it may be that we have found a good reason to match an earlier age in the lifecycle profiles. There are also appears to be some bunching in the distribution at 3 children, both for singles and married, indicating fertility rates of married mothers in the model may be too high relative to data.

The table also shows in panel (d) the marriage rates and associated queues and payoffs. Women with more than 1 child are not getting married at all in the model, suggesting that single life in the model is too attractive for these women, perhaps because access to the sex market is too easy. About 30% of these women are in the sex market, and the queues are such that they get the surplus about 50% of the time. Raising the effect of kids on the entry cost would deal with this problem.

6.2 Comparative statics

In order to compare stories of the marital transition, here are the results of two experiments we carry out with the Benchmark model. In the first, we increase the cost of birth control for singles by raising the contraception-effort parameter α_S from 1 to 2. Note that $\alpha_S = 1$ means that singles have the same effort-fertility as married. This corresponds to making birth control more expensive for singles relative to married, which we take as one of the potential explanations of the difference between the 1960s and the 1990s, at least in the United States.

Note that in the calibration the expected value of entering the sex market is identified by the participation rates in the sex market; however this leaves the level of benefits and costs unidentified. We choose a level high enough to ensure that contraception has a strong effect on the attractiveness of sex in the model. This allows us to see whether the over impact on fertility and marriage is consistent with observed changes over time.

The results of this experiment are dramatic and unequivocal; a rise in contraception effectiveness for singles over time can indeed generate much of the observed changes in both marriage and fertility. The impact of these changes on the mapping from sex to fertility, shown in panel (a) of Figure 6 is as expected; more effective technology leads to lower fertility rates. In panel (b), we see that moving from right to left, in the direction of increasing effectiveness, we move from a world where marriage rates of non-mothers are on the order of 25-30% to one where marriage rates are on the order of 10%. At the same time birth rates for non-mothers increase from under 2% to nearly 5%, as in the data. For mothers, the scenario is much less dramatic; fertility rates decline slightly as contraception becomes more effective, as in the data. However this explanation implies a fairly dramatic rise in marriage rates for mothers, compared to a slight decline in the data.

The second experiment consists of increasing the wage for women from 0.6 to 0.8 of the men's wage, which is held constant. This is somewhat larger than the change in the FTFY wage gender gap observed for workers in their 30s between 1970 and 1995 and therefore contains the relevant range of variation, which would be from 0.63 to 0.71. This experiment turn out to be also consistent with a 50% increase in fertility among unmarried women without children, from about 2.5% annually in the 1970s.

However the implication also carries over to single mother fertility, which did not increase. Regarding marriage rates, the wage explanation also works for non-mothers, matching the historical decline from 25% to 12% per year, but again counterfactually predicts a similar effect (actually 50% larger) for mothers, whose marriage rates were in fact more stable. The overall changes are shown in Figure 7. It is evident that the wage change is capable of explaining a good deal of change in both the marriage rates and fertility rates of non-mothers.

These results suggest that both explanations have an important role to play. In Table 11 we show a summary of all the results of the paper. In the first column we show the empirical moments for the 1990s, followed by the corresponding benchmark results, as in Table 6(b). The CC column which follows then shows the impact of raising the contraception cost 50%. The Wage column shows the impact of increasing the wage gender gap from the 1990s to the 1970s levels. Finally, we show the impact of both experiments together; we see unmarried fertility drops to zero, and the marriage rate rise to 33%, well above the 29% observed in the 1970s. The impact on marriage rates of single mothers, as suggested above, is now much closer to the historical record, staying stable around 11%. Meanwhile, the fertility rate of single mothers has also remained stable, but this means it fails to match the fact that in the data single-mother fertility was 17%, higher than in 1995.

7 Conclusions

Our quantitative results are not meant to be definitive but rather should be taken as illustrations of the usefulness of our approach. The contribution of the current paper is to allow the theory of family structure to account for marriage-market dynamics associated with repeated opportunities to remarry and to have children; to get there we abstracted from important features explored in related papers, such as aging, human-capital investment in children or the impact of means-tested government transfers. There are also important features of marriage, such as the margin between cohabitation and marriage, that are ignored by both the current paper and the bulk of the related literature[10]. However it

[10] As a first pass, this neglect is not entirely unjustified, as cohabitation for many appears to be a form of extended courtship rather than a substitute for marriage. Spain and Bianchi

is easy to see that the approach used here can be extended to deal with these and other features of marriage and fertility.

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A Appendix

A.1 Age-Profile Regressions

[To be completed; see Tables A1-A4 for estimated specifications].

A.2 Solving the Asset Equations

In this section we derive the coefficients of the linear asset-equation systems that define the value functions. Recall that $q \in Q = \left\{q_1, ...q_{n_q}\right\}$ and that the probability of the first shock in a marriage being q_i is $\chi\left(q_i; \hat{q}\right)$, where $\hat{q} \in Q$ is the same for all new marriages.

A.2.1 Preliminaries

We write the divorce probability, before the current realizations (q', ε') of marriage quality are known, as|:

$$\pi^D_{k,k_m}\left(q\right) = \sum_{q' \in Q} \chi\left(q'; q\right) \Phi\left(\varepsilon^*\left(k, k_m, q'\right)\right)$$

, where $\varepsilon^*\left(k, k_m, q'\right)$ refers to the optimal divorce rule defined in the model section of the paper.

The probability that a single woman with k children marries is

$$\mu_k \equiv \left[1 - \omega_0\left(\phi^m_k\right)\right]\left[1 - \pi^D_{k,0}\left(\hat{q}\right)\right] p_z$$

, where p_z is the probability that marriages are permitted, an ad hoc parameter included so that we can experiment with the role of frictions.

When we solve the level-k system for $k < K$, we assume that we already know the solution for the $k+1$ system of asset equations. The system at $k = K$ is relatively easy to solve because with fertility assumed to be zero, there are no transitions to higher k.

A.2.2 Single Female

Let $p_S\left(\phi_k^j\right)$ denote the probability that a single female with $k \leq k^*$ obtains the surplus on entering market $j \in \{x, m\}$.

$$p_S\left(\phi_k^j\right) \equiv \begin{cases} \left[1-\omega_0\left(\phi_k^j\right)-\omega_1\left(\phi_k^j\right)\right]\left[1-\pi_{k,0}^D\left(\hat{q}\right)\right]p_z & j=m \\ \left[1-\omega_0\left(\phi_k^j\right)-\omega_1\left(\phi_k^j\right)\right] & j=x \end{cases}$$

Let the sex-cost threshold for a single female with k kids be ζ_{Fk}^*.The *ex ante* value of entering the period for woman i is:

$$\begin{aligned} W_{SF}^E(k) &= V_{SF}^R(k) + \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)S_m(k) \\ &+ \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right)S_x(k)-\xi\right] \end{aligned}$$

, where $\xi \equiv E\left(\zeta_i; \zeta_i < \zeta_F^*(k)\right)$.

Using the definitions (5) and (4) of $S_m(k)$ and $S_x(k)$, this can be written as:

$$\begin{aligned} W_{SF}^E(k) &= V_{SF}^R(k) + \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)\left[Y^E(k,0)-V_{SM}^R-V_{SF}^R(k)\right] \\ &+ \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right)\left[y^x+\pi_k^{SF}\left[\Delta u_{SF}(k)+\beta\Delta W_{SF}^E(k)\right]\right]-\xi\right] \end{aligned}$$

, where $y^x \equiv u_{SF}^x + u_{SM}^x - \Theta\left(\pi_k^{SF}\right)$ denotes the net gain from sexual activity *per se*. We can expand this further using the definition (3) of V_{SF}^R :

$$\begin{aligned} W_{SF}^E(k) &= \left[u_{SF}(k)+\beta W_{SF}^E(k)\right] + \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)\left[Y^E(k,0)-V_{SM}^R-\left[u_{SF}(k)+\beta W_{SF}^E(k)\right]\right] \\ &+ \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right)\left[y^x+\pi_k^{SF}\left[\Delta u_{SF}(k)+\beta\left[W_{SF}^E(k+1)-W_{SF}^E(k)\right]\right]\right]-\xi\right] \end{aligned}$$

Collecting all the terms in $W_{SF}^E(k)$

$$\begin{aligned} W_{SF}^E(k) &= \beta W_{SF}^E(k) - \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)\beta W_{SF}^E(k) - \Gamma\left(\zeta_F^*(k)\right)p_S\left(\phi_k^x\right)\pi_k^{SF}\beta W_{SF}^E(k) \\ &+ u_{SF}(k) + \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)\left[Y^E(k,0)-V_{SM}^R-\left[u_{SF}(k)\right]\right] \\ &+ \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right)\left[y^x+\pi_k^{SF}\left[\Delta u_{SF}(k)+\beta\left[W_{SF}^E(k+1)\right]\right]\right]-\xi\right] \\ &= a_{11}W_{SF}^E(k) + a_{1,\hat{q}}Y^E(k,0) + d_1 \end{aligned}$$

where

$$\begin{aligned} a_{11} &= \beta\left(1-\left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right)-\Gamma\left(\zeta_F^*(k)\right)p_S\left(\phi_k^x\right)\pi_k^{SF}\right) \\ a_{1,\hat{q}} &= \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]p_S\left(\phi_k^m\right) \\ d_1 &= u_{SF}(k) + \left[1-\Gamma\left(\zeta_F^*(k)\right)\right]d_m + \Gamma\left(\zeta_F^*(k)\right)d_x \end{aligned}$$

$$\begin{aligned} d_m &= p_S\left(\phi_k^m\right)\left[-V_{SM}^R-u_{SF}(k)\right] \\ d_x &= p_S\left(\phi_k^x\right)\left[y^x+\pi_k^{SF}\left[\Delta u_{SF}(k)+\beta\left[W_{SF}^E(k+1)\right]\right]\right]-\xi \end{aligned}$$

, which we can write as an expression of the form:

$$W_{SF}^{E}(k) = d_1 + a_{11} W_{SF}^{E}(k) + a_{1,\hat{q}} Y^{E}(k, 0, \hat{q}) \tag{22}$$

. Note that the terms in these coefficients are assumed to be already known[11].

Unmarriageable Women Let the utility cost of becoming a single mom be χ. Suppose $k > k^*$, then the *ex ante* value of entering the period for woman i is:

$$W_{SF}^{E}(k) = V_{SF}^{R}(k) + \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right) S_x(k) - \xi\right]$$

which simplifies to:

$$W_{SF}^{E}(k) = \frac{u_{SF}(k) + \Gamma\left(\zeta_F^*(k)\right)\left[p_S\left(\phi_k^x\right) C_x - \xi\right]}{1 - \beta + \beta \Gamma\left(\zeta_F^*(k)\right) p_S\left(\phi_k^x\right) \pi_k^{SF}}$$

, where $C_x \equiv \left[y^x + \pi_k^{SF}\left[\Delta u_{SF}(k) + \beta W_{SF}^{E}(k+1) - \chi\right]\right]$ and $\xi \equiv E\left(\zeta_i; \zeta_i < \zeta_F^*(k)\right)$.

A.2.3 Child-Less Marriages

Consider a married couple with no children. The value of a new marriage where the bride already has k children equals the sum of two components: the value if the marriage stays intact, and the value if the marriage ends:

$$Y^{E}(k, k_m, q) = \sum_{q' \in Q} \tilde{a}(q'; q) Y^{R}(k, 0 | \phi, q') \chi(q'; q) \tag{23}$$

$$+ \pi_{k,k_m}^{D}(q)\left[V_{SF}^{R}(k, \phi) + V_{SM}^{R} - \tau\right] \tag{24}$$

, where τ represent the divorce cost , and

$$\tilde{a}(q'; q) \equiv \left[1 - \Phi\left(\varepsilon^*(k, 0, q')\right)\right] \chi(q'; q)$$

is the probability of the marriage surviving with match quality transiting to q'.

.

Assuming the marriage survives the divorce stage, the value of the marriage, before the fertility realization is known, is

$$Y^{R}(k, 0 | \phi, q') = EU^{M}(k, q') + \beta(1 - \delta) EY^{E} \tag{25}$$

, where

$$EU^{M}(k, q) \equiv q + \left(1 - \pi_{k,0}^{MF}(q)\right) u_M(k, 0) + \pi_{k,0}^{MF}(q) u_M(k+1, 1) - \Theta^{MF}\left(\pi_{k,0}^{MF}(q)\right)$$

[11] Θ and u_{SF} are parameterised functions, π_k^{SF}, ζ_{SF}^* and p_S are conjectured, and $V_{SF}^{E}(k+1)$ was solved for in the previous step.

represents the expected flow utility this period, and

$$EY^E = \left[\left(1-\pi_{k,0}^{MF}\left(q'\right)\right)Y^E\left(k,0,q'\right)\right]+\pi_{k,0}^{MF}\left(q_i\right)Y^E\left(k+1,1,q'\right)$$

is the expected continuation value.

Using (3), we can write (23) as the sum of the continuation values without births, both as married and as single, plus a pre-determined component d_{j+1} that consists of period utility flows and the continuation values with births, :

$$Y^E\left(k,0,q\right) \tag{26}$$
$$= \sum_{q'\in Q}\tilde{a}\left(q';q\right)\beta\left(1-\delta\right)\left(1-\pi_{k,0}^{MF}\left(q'\right)\right)Y^E\left(k,0,q'\right) \tag{27}$$
$$+ \sum_{q'\in Q}\tilde{a}\left(q';q\right)\left[EU^M\left(k,q'\right)+\beta\left(1-\delta\right)\pi_{k,0}^{MF}\left(q_i\right)Y^E\left(k+1,1,q'\right)\right] \tag{28}$$
$$+ \pi_{k,0}^{D}\left(q\right)\left[u_{SF}\left(k\right)+\beta W_{SF}^{E}\left(k\right)+V_{SM}^{R}-\tau\right] \tag{29}$$

.

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$$Y^E\left(k,0,q_j\right) = a_{j+1,1}^{k,k_m}W_{SF}^{E}\left(k\right)+\sum_{q'\in Q}a_{j+1,i+1}^{k}Y^E\left(k,0,q_j\right)+d_{j+1}$$

where

$$\begin{aligned} a_{j+1,1}^{k,k_m} &= \pi_{k,0}^{D}\left(q_j\right)\beta \\ a_{j+1,i+1}^{k} &= \tilde{a}\left(q_j;q_i\right)\beta\left(1-\delta\right)\left(1-\pi_{k,0}^{MF}\left(q_j\right)\right) \\ d_{j+1} &= \pi_{k,0}^{D}\left(q_{j+1}\right)\left[u_{SF}\left(k\right)+V_{SM}^{R}-\tau\right]+d_{u,j+1}^{k}+d_{y,j+1}^{k} \end{aligned}$$

and

$$\begin{aligned} d_{u,j+1}^{k,k_m} &\equiv \sum_{q'\in Q}\tilde{a}\left(q';q_j\right)EU^M\left(k,q'\right) \\ d_{y,j+1}^{k,k_m} &\equiv \sum_{q'\in Q}\tilde{a}\left(q';q_j\right)\beta\left(1-\delta\right)\pi_{k,0}^{MF}\left(q'\right)Y^E\left(k+1,1,q'\right) \end{aligned}$$

.

A.2.4 Families with Husband's Children

Now that we have computed the value system for single women and newly-weds, it remains to compute the values of marriages with husband's children present, ($k_m > 0$).

Consider an ongoing marriage where the bride already has k children of which $k_m \leq k$ are the husband's.

By assumption, we know the solutions for $k+1$, so the only unknowns are $\left\{Y^E\left(k,k_m,q_i\right)\right\}_{q_i\in Q}$, where $k_m > 0$. [***remove:

If the realization last period was q then the *ex-ante* value is:

$$Y^E(k,k_m,q) = \pi^D_{k,k_m}(q)\left[V^R_{SF}(k,\phi)+V^R_{SM}-\tau\right] + \sum_{q'\in Q}\left[1-\Phi\left(\varepsilon^*(k,k_m,q')\right)\right]\chi(q';q)\,Y^R(k,k_m|q')$$

, where the ex post value Y^R is:

$$Y^R(k,k_m|q_i) = EU^M(k,q_i) + \beta(1-\delta)\left[\left(1-\pi^{MF}_{k,k_m}(q_i)\right)Y^E(k,k_m,q_i)+\pi^{MF}_{k,k_m}(q_i)\,Y^E(k+1,k_m+1,q_i)\right]$$

.

***]

The system to solve is (19), with coefficients $B_{1k}=[b_{ij}]$, where

$$b_{ij} = \chi(q_j;q_i)\left[1-\Phi\left(\varepsilon^*(k,k_m,q_j)\right)\right]\beta(1-\delta)\left(1-\pi^{MF}_{k,k_m}(q_j)\right)$$

and $B_{0k}=[d_i]$, where

$$d_i = \pi^D_{k,k_m}(q_i)\left[V^R_{SF}(k,\phi)+V^R_{SM}-\tau\right] + EU^M(k,q_i)+\widetilde{\beta}\pi^{MF}_{k,k_m}(q_i)\,Y^E(k+1,k_m+1,q_i)$$

. Note that the term $V^R_{SF}(k,\phi)$ is known from the solution to the previous equation (18) with $k_m=0$.

A.3 Distributions

A.3.1 case 1: $k=0$

We now derive the coefficients of equation (20) representing the law of motion for the masses of women at $k=0$.

Single Women The population of single women without kids next period includes those from this period who:

1. Entered the sex market:
   (a) but did not have sex, mass: $\alpha_0 N_F(0)$ where $\alpha_0=(1-\delta)\Gamma(\zeta^*_F(0))\,\omega_0(\phi^x_0)$
   (b) and did have sex but did not get pregnant, mass is $\alpha_1 N_F(0)$, where $\alpha_1=(1-\delta)\Gamma(\zeta^*_F(0))(1-\omega_0(\phi^x_0))\left(1-\pi^{SF}_0\right)N_F(0)$.
2. Entered the marriage market but did not get married mass is : $\alpha_2 N_F(0)$,where $\alpha_2=(1-\delta)(1-\Gamma(\zeta^*_F(0)))(1-\mu_0)$
3. Arrive at the begining of the next period: δ

It also includes childless wives who divorced, mass is $(1-\delta)\sum_{q\in Q}\pi^{D}_{0,0}(q)\,M(0,0,q)$

We can therefore write the law of motion for the mass of single women with $k=0$ as:

$$N'_F(0)=\delta+a_{11}N_F(0)+\sum_{q\in Q}a_{1,q+1}M(0,0,q)$$

, where $N'_F(0)$ is the fraction of the population next period consisting of childless single women. The coefficients are:

$$a_{11}=\alpha_0+\alpha_1+\alpha_2$$
$$a_{1,q+1}=(1-\delta)\,\pi^{D}_{0,0}(q)$$

Married Couples The flow out of the married childless state includes both fertility and divorce, while the only flow is from marriage of childless singles:

$$M'(0,0,q_j)=\kappa_0(q_j)\left[(1-\Gamma(\zeta^*_F(0)))\,\chi(q_j,\hat{q})\,(1-\omega_0)\,N_F(0)+\sum_{q\in Q}\chi(q_j;q)\,M(0,0,q)\right]$$

where $M'(0,0,q')$ is the fraction of women next period who are both childless and married, and

$$\kappa_0(q)\equiv(1-\delta)\left[1-\Phi(\varepsilon^*(0,0,q))\right]\left(1-\pi^{MF}_{0,0}(q)\right)$$

. We can therefore write the law of motion of the mass of child-less marriages as

$$M'(0,0,q_j)=a_{j+1,1}N_F(0)+\sum_{i=1}^{n_q}a_{j+1,i+1}M(0,0,q_j)$$

where

$$a_{j+1,1}=\kappa_0(q_j)\,(1-\Gamma(\zeta^*_F(0)))$$
$$a_{j+1,i+1}=\kappa_0(q_j)\,\chi(q_j,q_i)$$

. Let $C_{1k}=[a_{i,j}]$. The vector of constants (20) is $C_{0k}=[\delta,0,...0]$.

A.3.2 case 2: $k>0,k_m>0$

Once the system at $k-1$ is known, it is easy to compute the steady-state distribution for $M(k,k_m,q)$ with $k_m>0$ as the fixed point of equation (21). This is particularly easy for $k_m>1$ because the only inflow is from $M(k-1,k_m-1,q)$, whereas for $k_m=1$, we must also allow for inflows from $N_F(k-1)$. To represent this inflow, we define a pre-determined term $g^0_{k,k_m}(q_j)$:

$$g^0_{k,k_m}(q_j)=\begin{cases}\kappa^0_{k,k_m}(q_j)\,\chi(q_j,\hat{q})\left(1-\omega^k_0\right)(1-\Gamma(\zeta^*_F(k-1)))\,N_F(k-1) & k_m=1\\ 0 & k_m>1\end{cases}$$

, where

$$\kappa^0_{k,k_m}(q_j) = (1-\delta)\left[1-\Phi\left(\varepsilon^*\left(k-1,k_m-1,q_j\right)\right)\right]\pi^{MF}_{k-1,k_m-1}(q_j)$$

represents the probability that a married woman with realized state $(k-1, k_m-1, q_j)$ will remain married and have an additional child. Now we can write the predetermined part of the flow into the system as

$$g_{j+1}(k,k_m) = g^0_{k,k_m}(q_j) + \kappa^0_{k,k_m}(q_j)\sum_{q\in Q}\chi(q_j;q)\,M(k-1,k_m-1,q)$$

for any $k_m \in \{0,1,...k\}$, the law of motion is:

$$M(k,k_m,q_j) = \kappa^1_{k,k_m}(q_j)\sum_{q\in Q}\chi(q_j;q)\,M(k,k_m,q) + g_j(k,k_m)$$

, where

$$\kappa^1_{k,k_m}(q_j) \equiv (1-\delta)\left[1-\Phi\left(\varepsilon^*\left(k,k_m,q_j\right)\right)\right]\left(1-\pi^{MF}_{k,k_m}(q_j)\right)$$

.

In terms of equation (21), the coefficients $D_{1k,k_m} = \left[\kappa^1_{k,k_m}(q_j)\,\chi(q_j;q_i)\right]$, and the vector of constants is $D_{0k,k_m} = \left[g_1(k,k_m), ...g_{n_q}(k,k_m)\right]'$.

A.3.3 case 3: $k > 0, k_m = 0$

For each $k > 0$ with $k_m = 0$, we can also construct a linear system similar to that for $k = 0$, except with flows in from the population with $k-1$ kids and no flows from new arrivals δ.

Singles The result of the previous section means that the inflows to single

status from married can be decomposed into a part with $k_m = 0$ and a predetermined part with $k_m > 0$.

For $k > 0$, the flows into $N'_F(k)$ are from:

1. singles with $k-1$ children who had sex and then had a baby:

$$d_{11} \equiv (1-\delta)\,\pi^{SF}_{k-1}\zeta^*_F(k-1)\left(1-\omega_0\left(\phi^x_k\right)\right)N_F(k-1)$$

2. singles with k children who didn't marry and didn't have a baby:

$$(1-\delta)\left[\zeta^*_F(k)\left[\left(1-\omega_0\left(\phi^x_k\right)\right)\left(1-\pi^{SF}_k\right)+\omega_0\left(\phi^x_k\right)\right]+1-\zeta^*_F(k)\right]N_F(k)$$

3. married with k children who divorced:

$$(1-\delta)\sum_{i=1}^{n_q}\left[\pi^D_{k,0}(q_i)\,M(k,0,q_i)+d_{13}(q_i)\right]$$

, where

$$d_{13}\left(q_i\right) \equiv \sum_{k_m=1}^{k} \pi_{k,k_m}^{D}\left(q_i\right) M\left(k, k_m, q_i\right)$$

. The law of motion for single women is:

$$N_F'\left(k\right) = a_{11} N_F\left(k\right) + \sum_{i=1}^{n_q} a_{1i+1} M\left(k, 0, q_i\right) + d_1$$

where

$$\begin{aligned} a_{11} &= \left(1-\delta\right)\left[\zeta_F^*\left(k\right)\left[\left(1-\omega_0\left(\phi_k^x\right)\right)\left(1-\pi_k^{SF}\right)+\omega_0\left(\phi_k^x\right)\right]+1-\zeta_F^*\left(k\right)\right] \\ a_{1i+1} &= \left(1-\delta\right)\pi_{k,0}^{D}\left(q_i\right) \end{aligned}$$

and

$$d_1 = d_{11} + d_{12}$$

Married, $k_m = 0$ Let

$$\kappa_k\left(q_i\right) = \left(1-\delta\right)\left(1-\pi_{k,0}^{MF}\left(q_i\right)\right)\left(1-\Phi\left(\varepsilon^*\left(k,0,q_i\right)\right)\right)$$

For married women in households with no kids from the husband, the flows into $M'\left(k,0,q_i\right)$ are:

1. From married with same number of wife's kids:

$$\kappa_k\left(q_i\right)\sum_{j=1}^{n_q} M\left(k,0,q_j\right)\chi\left(q_i,q_j\right)$$

2. From single women with the same number of kids:

$$\kappa_k\left(q_i\right)\chi\left(q_i,\hat{q}\right)p_z\left(1-\omega_0\left(k\right)\right)\left(1-\zeta_F^*\left(k\right)\right)N_F\left(k\right)$$

, where

. The full equations, written in terms of the linear system (20) are:

$$M'\left(k,0,q_i\right) = c_{i+1,1}N_F\left(k\right) + c_{i+1,j+1}M\left(k,0,q_j\right)$$

, where

$$\begin{aligned} c_{i+1,1} &= \kappa_k\left(q_i\right)\chi\left(q_i,\hat{q}\right)p_z\left(1-\omega_0\left(k\right)\right)\left(1-\zeta_F^*\left(k\right)\right) \\ c_{i+1,j+1} &= \kappa_k\left(q_i\right)\chi\left(q_i,q_j\right) \end{aligned}$$

. Therefore the coefficients $C_{1k} = \left[c_{i,j}\right]$ and the constant terms are $C_{0k} = \left[d_i\right]$.

B Time Allocation

B.1 Singles

The home production problem for single women is

$$\min \{w_W h + m\}$$

, subject to the constraint

$$G(h\eta_0, m) = g_i(k)$$

.

The FOC imply:

$$\begin{aligned} w_W &= \lambda \eta_0 G_h \\ \lambda &= 1/G_m \end{aligned}$$

so combining, we get

$$w_W = \frac{\eta_0 G_h}{G_m} = \frac{\eta_0 \rho_0}{1-\rho_0} \left(\frac{m}{h}\right)^{\rho_1}$$

so we can solve for the pecuniary expenditure as a a function of the time input:

$$m = \left(\frac{w_W}{\eta_0} \frac{1-\rho_0}{\rho_0}\right)^{1/\rho_1} h = x_W h$$

with the constraint this implies

$$\begin{aligned} g_{SW}(k) &= \left[\rho_0 (h\eta_0)^{1-\rho_1} + (1-\rho_0)[x_W h]^{1-\rho_1}\right]^{1/(1-\rho_1)} \\ &= h\left[\rho_0 \eta_0^{1-\rho_1} + (1-\rho_0) x_W^{1-\rho_1}\right]^{1/(1-\rho_1)} \end{aligned}$$

zxzccc–

$$h = \frac{g_{SW}(k)}{\left[\rho_0 \eta_0^{1-\rho_1} + (1-\rho_0) x_W^{1-\rho_1}\right]^{1/(1-\rho_1)}}$$

. So this unambiguously says that home time is increasing in number of kids, but the slope is declining in the wage . Hence decline over time in the impact of kids on labor-market time, particularly for single women. For men the expression is similar, with the obvious difference that

$$x_M = \left(\frac{w_M}{1-\eta_0} \frac{1-\rho_0}{\rho_0}\right)^{1/\rho_1}$$

B.1.1 Paid Labor

Optimal labor supply of singles of sex i solves:

$$\max_{n_i} \left\{ u\left(c_i, T - h_i\left(k\right) - n_i\right) + \lambda\left[w_i n_i + y_i - c_i - m\left(k\right)\right] \right\}$$

$$\begin{aligned} u_c &= \lambda \\ u_l &= \lambda w_i \end{aligned}$$

$$\begin{aligned} w_i &= \frac{u_l}{uc} = \frac{1-\sigma_0}{\sigma_0}\left(\frac{c}{l}\right)^{\sigma_1} \\ c_i &= \left[\frac{\sigma_0}{1-\sigma_0} w_i\right]^{1/\sigma_1} l \end{aligned}$$

Plug into budget constraint:

$$\begin{aligned} w_i\left(T - h_i\left(k\right)\right) + y_i &= \left(\left[\frac{\sigma_0}{1-\sigma_0} w_i\right]^{1/\sigma_1} + w_i\right) l_i + m\left(k\right) \\ l_i &= \frac{w_i\left(T - h_i\left(k\right)\right) + y_i - m\left(k\right)}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i} \\ n_i &= T - h_i\left(k\right) - l_i \\ &= T - h_i\left(k\right) - \frac{w_i\left(T - h_i\left(k\right)\right) + y_i - m\left(k\right)}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i} \\ &= \left(T - h_i\left(k\right)\right)\left(1 - \frac{w_i}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i}\right) - \frac{y_i - m\left(k\right)}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i} \\ &= \left(T - h_i\left(k\right)\right)\left(\frac{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1}}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i}\right) - \frac{y_i - m\left(k\right)}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i} \\ &= \left(T - h_i\left(k\right)\right)\left(\frac{1}{1 + \left(\frac{1-\sigma_0}{\sigma_0}\right)^{1/\sigma_1} w_i^{1-1/\sigma_1}}\right) - \frac{y_i - m\left(k\right)}{\left[\frac{\sigma_0}{1-\sigma_0} w\right]^{1/\sigma_1} + w_i} \end{aligned}$$

$$n_i = T - h_i\left(k\right) - l_i = \frac{T - h_i\left(k\right)}{1 + \left(\frac{1-\sigma_0}{\sigma_0}\right)^{1/\sigma_1} w_i^{1-1/\sigma_1}} - \frac{\left(y_i - m\left(k\right)\right)/w_i}{1 + \left[\frac{\sigma_0}{1-\sigma_0}\right]^{1/\sigma_1} w_i^{1/\sigma_1 - 1}}$$

This clearly shows the two effects of children on labor supply: in the left-hand term k reduces and in the right-hand term increases labor supply.

B.2 Married

For married, a similar result will apply in terms of effective home time, given the cost index of home time relative to goods. We begin with the construction of effective labor supply. The problem for married is

$$\min \{w_H + w_W h_W + m\}$$

subject to the constraint.

$$g_M(k) = \left[\rho_0 h^{1-\rho_1} + (1-\rho_0) m^{1-\rho_1}\right]^{1/(1-\rho_1)}.$$

and

$$h(h_W, h_H) = \left[\eta_0 h_W^{1-\eta_1} + (1-\eta_0) h_H^{1-\eta_1}\right]^{1/(1-\eta_1)}$$

For child-care time the FOC are

$$\begin{aligned} w_H &= h_H(h_W, h_H) G_h \\ w_W &= h_W(h_W, h_H) G_h \end{aligned}$$

so the ratio is

$$\frac{w_H}{w_W} = \frac{h_H(h_W, h_H)}{h_W(h_W, h_H)} = \frac{\eta_0}{1-\eta_0}\left(\frac{h_W}{h_H}\right)^{\eta_1}$$

so we can write the wife's time as

$$h_W = \left(\frac{w_H}{w_W}\frac{1-\eta_0}{\eta_0}\right)^{1/\eta_1} h_H = A_M(w) h_H$$

$$\begin{aligned} h(h_W, h_H) &= \left[\eta_0 [A_M(w) h_H]^{1-\eta_1} + (1-\eta_0) h_H^{1-\eta_1}\right]^{1/(1-\eta_1)} \\ &= h_H\left[\eta_0 [A_M(w)]^{1-\eta_1} + (1-\eta_0)\right]^{1/(1-\eta_1)} \end{aligned}$$

This in turn implies we can write $h = \kappa_M h_H$, where

$$\kappa_M = \left[\eta_0 [A_M(w)]^{1-\eta_1} + (1-\eta_0)\right]^{1/(1-\eta_1)}$$

the unit cost of h is therefore

$$\widehat{\omega} = \frac{w_W A_M h_H + w_H h_H}{\kappa_M h_H} = \frac{w_W A_M + w_H}{\kappa_M}$$

Now we can apply the results from the singles:

$$h = \frac{g_M(k)}{\left[\rho_0 + (1-\rho_0)\left(\widehat{\omega}\frac{1-\rho_0}{\rho_0}\right)^{(1-\rho_1)/\rho_1}\right]^{1/(1-\rho_1)}}$$

Since none of the results have relied on the total time endowment, we can easily add to this model the fixed husband's time cost h_H^0, so that the total husband's home time is $\tilde{h}_H = h_H^0 + h_H$.This will be useful for matching the relative flatness of husband time with respect to children.

Part of the calibration will try to match the wage-elasticity of the ratio of husband and wife home hours. This is given by $1/\eta_1$

$$\frac{d}{d\ln\left(\frac{w_H}{w_W}\right)} \ln\left(h_W/h_H\right) = 1/\eta_1$$

$$\begin{aligned}
\ln\left(h_W/h_H\right) &= 1/\eta_1 \ln\left(\frac{w_H}{w_W}\frac{1-\eta_0}{\eta_0}\right) \\
&= 1/\eta_1 \ln\frac{w_H}{w_W} + 1/\eta_1 \ln\frac{1-\eta_0}{\eta_0}
\end{aligned}$$

$$\left[\ln\left(h_W/h_H\right)\right]_{1975} - \left[\ln\left(h_W/h_H\right)\right]_{2003} = 1/\eta_1\left(\left[\ln\frac{w_H}{w_W}\right]_{1975} - \left[\ln\frac{w_H}{w_W}\right]_{2003}\right)$$

$$\eta_1 = \frac{\left[\ln\frac{w_H}{w_W}\right]_{1975} - \left[\ln\frac{w_H}{w_W}\right]_{2003}}{\left[\ln\left(h_W/h_H\right)\right]_{1975} - \left[\ln\left(h_W/h_H\right)\right]_{2003}}$$

B.2.1 Paid-Labor Supply

Given home time h, optimal labor supply of married couples solves:

$$\max_{\{n_i,c_i\}}\left\{\mu u\left(c_H, T - h_H(k) - n_H\right) + (1-\mu)\, u\left(c_W, T - h_W(k) - n_W\right) + \lambda\left[w_H n_H + w_W n_W + y_i - m(k) - c_i\right]\right\}$$

where $\mu = 1/2$ is the weight on the husband in the household utility function implied by the assumption of fully transferable utility.

Now the FOC:

$$\begin{aligned}
\mu u_{c_H} &= (1-\mu)\, u_{c_W} = \lambda \\
\frac{\mu}{w_H} u_{l_H} &= \frac{(1-\mu)}{w_W} u_{l_W} = \lambda
\end{aligned}$$

The implied leisure ratio solves

$$\begin{aligned}
\frac{\frac{\mu}{w_H} u_{l_H}}{\frac{(1-\mu)}{w_W} u_{l_W}} &= 1 \\
\frac{u_{l_W}}{u_{l_H}} &= \frac{\mu}{1-\mu}\frac{w_W}{w_H}
\end{aligned}$$

Substituting in the functional forms for the marginal utilities:

$$\frac{u_{l_W}}{u_{l_H}} = \left(\frac{l_H}{l_W}\right)^{\sigma_1} = \frac{\mu}{1-\mu}\frac{w_W}{w_H}$$

Note that this is independent of the home goods allocation. Concave utility implies that as relative wages converge, the ratio of wife's to husband's leisure will fall. To make the stationary ratio observed in the data consistent wtih the model, need something to raise the wife's marginal utility as wages fall. One way might be to assume substitutability with children-time ; as fertiltiy falls the muc of leisure for the wife increases. Alternatively, leisure is complementary with working time

For now, we just let this go. Choose parameters so that model gets closest possible match, even though we know we;'re going to miss. Using the FOC we get

$$
\begin{aligned}
c_W &= \left(\frac{(1-\mu)}{\lambda}\sigma_0\right)^{1/\sigma_1} \\
c_H &= \left(\frac{\mu}{\lambda}\sigma_0\right)^{1/\sigma_1} \\
l_H &= \left(\frac{\mu}{\lambda w_H}(1-\sigma_0)\right)^{1/\sigma_1} \\
l_W &= \left(\frac{(1-\mu)}{\lambda w_W}(1-\sigma_0)\right)^{1/\sigma_1}
\end{aligned}
$$

.

. to solve for λ, begin by defining full income Y_M^F from the budget constraint:

$$
\begin{aligned}
c_H + c_W &= w_W(T - h_W(k) - l_W) + w_H(T - h_H(k) - l_H) + y_M - m(k) \\
c_H + w_H l_H + c_W + w_W l_W &= w_W(T - h_W(k)) + w_H(T - h_H(k)) + y_M - m(k) = Y_M^F(k)
\end{aligned}
$$

This implies we can write the budget constraint in terms of λ and full income:

$$
\left(\frac{(1-\mu)}{\lambda}\sigma_0\right)^{1/\sigma_1} + \left(\frac{\mu}{\lambda}\sigma_0\right)^{1/\sigma_1} + w_H\left(\frac{\mu(1-\sigma_0)}{\lambda w_H}\right)^{1/\sigma_1} + w_W\left(\frac{(1-\mu)(1-\sigma_0)}{\lambda w_W}\right)^{1/\sigma_1} = Y_M^F(k)
$$

$$
\begin{aligned}
\left(\frac{1}{\lambda}\right)^{1/\sigma_1} &= \frac{Y_M^F(k)}{\left[((1-\mu))^{1/\sigma_1} + (\mu)^{1/\sigma_1}\right]\sigma_0^{1/\sigma_1} + \left[w_H\left(\frac{\mu}{w_H}\right)^{1/\sigma_1} + w_W\left(\frac{(1-\mu)}{w_W}\right)^{1/\sigma_1}\right](1-\sigma_0)^{1/\sigma_1}} \\
\lambda &= \left(\frac{A(w_H, w_W)}{Y_M^F(k)}\right)^{\sigma_1}
\end{aligned}
$$

where

$$
A(w_H, w_W) = \left[((1-\mu))^{1/\sigma_1} + (\mu)^{1/\sigma_1}\right]\sigma_0^{1/\sigma_1} + \left[w_H\left(\frac{\mu}{w_H}\right)^{1/\sigma_1} + w_W\left(\frac{(1-\mu)}{w_W}\right)^{1/\sigma_1}\right](1-\sigma_0)^{1/\sigma_1}
$$

This gives us the decision rules as functions of μ and of taxable income.

Variable	1973		1995	
	NoKids	SinMom	NoKids	SinMom
Age	20.49	30.847	23.187	31.03
	(2.210)	(3.151)	(5.411)	(4.462)
College Degree	0.11	0.054	0.312	0.138
	(0.675)	(0.102)	(0.366)	(0.227)
Birth Rate	0.00039	0.006	0.002	0.005
	(0.043)	(0.034)	(0.038)	(0.047)
Cohabiting	0.00011	0.00035	0.032	0.087
	(0.023)	(0.008)	(0.139)	(0.185)
Attended College	0.474	0.12	0.533	0.244
	(1.076)	(0.146)	(0.394)	(0.283)
High-School Diploma	0.938	0.563	0.843	0.739
	(0.520)	(0.223)	(0.287)	(0.290)
Prevously Married	0.006	0.216	0.067	0.557
	(0.172)	(0.185)	(0.198)	(0.327)
Marriage Rate	0.00247	0.006	0.006	0.007
	(0.107)	(0.036)	(0.061)	(0.055)

Table 1: Descriptive Statistics, NSFG 1973 and 1995 samples of single women aged 18-44. Sample for 1973 is reweighted to compensate absence of unmarried women without children.

Age	Non-Moms				Single Moms			
	1973		1995		1973		1995	
	Marr-73	Birth-73	Marr-95	Birth-95	Marr-73	Birth-73	Marr-95	Birth-95
21	0.301	0.021	0.117	0.072	0.122	0.169	0.103	0.134
22	0.304	0.022	0.122	0.069	0.124	0.175	0.108	0.128
23	0.305	0.022	0.126	0.065	0.125	0.178	0.111	0.122
24	0.304	0.022	0.128	0.061	0.124	0.177	0.113	0.114
25	0.301	0.021	0.130	0.056	0.122	0.173	0.114	0.106
26	0.296	0.020	0.130	0.051	0.120	0.166	0.115	0.098
27	0.289	0.019	0.129	0.046	0.116	0.156	0.114	0.090
28	0.280	0.017	0.127	0.041	0.111	0.143	0.112	0.081
29	0.269	0.014	0.123	0.037	0.106	0.129	0.109	0.073
30	0.257	0.012	0.119	0.032	0.100	0.113	0.105	0.064
31	0.243	0.010	0.114	0.028	0.093	0.097	0.100	0.056
32	0.229	0.008	0.108	0.024	0.086	0.081	0.095	0.049
33	0.213	0.006	0.101	0.020	0.079	0.066	0.088	0.042
34	0.196	0.004	0.093	0.017	0.071	0.052	0.082	0.035
35	0.179	0.003	0.086	0.014	0.064	0.040	0.075	0.029
36	0.162	0.002	0.078	0.011	0.056	0.029	0.068	0.024
37	0.145	0.001	0.070	0.009	0.049	0.021	0.061	0.020
38	0.128	0.001	0.062	0.007	0.042	0.014	0.053	0.016
39	0.111	0.001	0.054	0.005	0.036	0.009	0.047	0.012
40	0.096	0.000	0.046	0.004	0.030	0.006	0.040	0.009
41	0.082	0.000	0.039	0.003	0.025	0.003	0.034	0.007
42	0.068	0.000	0.033	0.002	0.020	0.002	0.028	0.005
43	0.056	0.000	0.027	0.002	0.016	0.001	0.023	0.004
44	0.046	0.000	0.022	0.001	0.013	0.001	0.019	0.000

Table 2: Predicted Age Profiles for Marriage and Divorce. Based on probit regression estimates on single-woman samples from NSFG 1973 and 1995. To compensate lack of never-married non-mothers in sample design, 1973 sample re-weighted using 1970 census.

Age	Sexual Activity				Safe CC			
	No Kids		Single Moms		No Kids		Single Moms	
	1973	1995	1973	1995	1973	1995	1973	1995
21	0.193	0.823	0.759	0.826	0.144	0.388	0.381	0.450
22	0.207	0.816	0.773	0.820	0.144	0.401	0.380	0.463
23	0.218	0.809	0.785	0.813	0.141	0.409	0.375	0.472
24	0.227	0.801	0.793	0.805	0.136	0.413	0.366	0.476
25	0.233	0.793	0.799	0.797	0.129	0.413	0.354	0.476
26	0.235	0.784	0.802	0.788	0.120	0.408	0.339	0.471
27	0.235	0.774	0.802	0.778	0.110	0.399	0.320	0.461
28	0.233	0.764	0.799	0.768	0.099	0.385	0.298	0.447
29	0.227	0.752	0.793	0.757	0.087	0.367	0.273	0.429
30	0.218	0.741	0.784	0.745	0.075	0.346	0.247	0.406
31	0.207	0.728	0.773	0.732	0.063	0.320	0.219	0.379
32	0.192	0.714	0.759	0.719	0.051	0.292	0.190	0.349
33	0.175	0.700	0.741	0.705	0.041	0.261	0.162	0.315
34	0.155	0.685	0.721	0.690	0.031	0.228	0.134	0.279
35	0.132	0.669	0.698	0.674	0.023	0.195	0.107	0.242
36	0.106	0.652	0.673	0.657	0.016	0.162	0.084	0.204
37	0.078	0.635	0.644	0.640	0.011	0.130	0.063	0.167
38	0.046	0.616	0.612	0.622	0.007	0.101	0.045	0.132
39	0.012	0.597	0.578	0.602	0.004	0.075	0.031	0.101
40	-0.025	0.577	0.541	0.582	0.003	0.054	0.021	0.074
41	-0.066	0.556	0.501	0.561	0.001	0.036	0.013	0.051
42	-0.109	0.534	0.458	0.540	0.001	0.023	0.008	0.034
43	-0.154	0.512	0.412	0.517	0.000	0.014	0.004	0.021
44	-0.203	0.489	0.363	0.494	0.000	0.008	0.002	0.012

Table 3: Predicted Age Profiles for Sex and Birth-Control. Based on probit regression estimates on single-woman samples from NSFG 1973 and 1995, except sex in 1973, which is based on linear OLS. To maintain cross-year comparability, sample of women without children restricted to previously married.

Pill	Birth-Control Pill				No Contraception Method			
	No Kids		Single Moms		No Kids		Single Moms	
	1973	1995	1973	1995	1973	1995	1973	1995
21	0.124	0.371	0.336	0.357	0.526	0.228	0.329	0.254
22	0.125	0.386	0.337	0.372	0.538	0.242	0.340	0.268
23	0.123	0.397	0.334	0.382	0.549	0.255	0.350	0.282
24	0.119	0.402	0.326	0.388	0.559	0.268	0.359	0.296
25	0.112	0.403	0.315	0.389	0.567	0.280	0.367	0.308
26	0.104	0.400	0.299	0.385	0.575	0.292	0.374	0.320
27	0.095	0.391	0.280	0.377	0.582	0.302	0.381	0.331
28	0.084	0.378	0.258	0.364	0.587	0.312	0.386	0.342
29	0.072	0.361	0.233	0.347	0.592	0.321	0.391	0.351
30	0.061	0.339	0.207	0.325	0.595	0.329	0.395	0.359
31	0.049	0.314	0.179	0.300	0.598	0.337	0.397	0.367
32	0.039	0.285	0.151	0.272	0.600	0.343	0.399	0.373
33	0.029	0.254	0.123	0.242	0.600	0.348	0.399	0.379
34	0.021	0.221	0.098	0.209	0.600	0.352	0.399	0.383
35	0.015	0.187	0.075	0.177	0.599	0.356	0.398	0.387
36	0.010	0.154	0.054	0.145	0.597	0.358	0.396	0.389
37	0.006	0.122	0.038	0.114	0.593	0.359	0.392	0.390
38	0.004	0.093	0.025	0.087	0.589	0.359	0.388	0.390
39	0.002	0.068	0.016	0.063	0.584	0.358	0.383	0.389
40	0.001	0.047	0.009	0.044	0.577	0.357	0.377	0.388
41	0.000	0.031	0.005	0.029	0.570	0.354	0.370	0.385
42	0.000	0.019	0.003	0.018	0.562	0.350	0.362	0.381
43	0.000	0.011	0.001	0.010	0.553	0.345	0.353	0.375
44	0.000	0.006	0.000	0.005	0.542	0.339	0.343	0.369

Table 4: Predicted Age Profiles for birth control pill and no contraception method. Based on probit regression estimates on single-woman samples from NSFG 1973 and 1995. To maintain cross-year comparability, sample of women without children restricted to previously married.

Value	Name	Role
0.96	bet	ANNUAL DISCOUNT FACTOR
0.05	delta	exit rate from fecundity
0.3	PIf_m_hi	high rate of married fertiltiy
0.35	PIf_s_hi	high rate of single fertiltiy
0.2	pi_die	death rate of sterile people
10	wage_m	male wage
7.5	wage_w	female wage
0.16	wf_tax	tax on wifes earnings
0.57	hub_wght	husband weight
1	FertCoef2	exponent on effort

Table 5: Values for parameters fixed outside the calibration loops.

	Single Women		Married Women		Married Men	
Kids	Model	Data	Model	Data	Model	Data
			Home Production Time			
0	19.11	19.60	29.52	26.61	23.33	20.15
1	23.34	23.73	32.21	32.99	24.40	22.50
2	27.56	30.53	34.89	37.32	25.46	24.42
3	31.78	31.02	37.57	41.11	26.52	25.86
			Single Men		17.91	17.88
			Paid Work Time			
0	26.40	26.51	19.86	22.43	31.13	33.01
1	25.28	24.77	18.44	19.13	31.24	31.94
2	24.15	20.88	17.01	16.60	31.34	31.52
3	23.03	22.88	15.58	14.61	31.44	30.84
			Single Men		27.47	27.14

Table 6(a): Calibration of Time-Allocation in Benchmark Model. Data consists of means from ATUS 2003 wave.

Targets	Results	Score	Stat
0.129	0.121	0.06	Marr. Rate No Kids
0.114	0.119	0.046	Marr. Rate 1 Kid
0.224	0.244	0.093	Mar Birth Rate No Kids
0.215	0.167	0.221	Mar Birth Rate 1 Kids
0.1	0.134	0.331	Mar Birth Rate 2 Kids
0.046	0.044	0.049	Sin Birth Rate No Kids
0.09	0.083	0.074	Sin Birth Rate 1 Kids
0.044	0.04	0.083	Divorce Rate No Kids
0.204	0.103	0.493	Fertility Rate StepKids
0.8	0.719	0.102	Sex Rate no kids
0.8	0.728	0.09	Sex Rate 1 Kid

Table 6(b): Calibration of Marriage and Fertility in Benchmark Model. Targets consist of Age-25 predictions from estimated age

Model: Targets consist of Age-25 predictions from estimated age
profiles based on 1995 NSFG

Value	Name	Role
	Free parameters	
-0.25	alpha2_m	husband,s dislike of other kids
1.06	alpha0_w	womens utility for no kids
-2.49	alpha0_m	mens utility for no kids
-0.18	alpha1_w	womens utility for kids curvature para
1.45	alpha1_m	mens utility for kids curvature parame
-0.50	SinUtil	Preference for being single
7.00	sig_epsD	Std. dev. of match quality
-35.00	alpha1_s	disutlity of single motherhood
23.75	usf_x	Joy of sex
0.30	KidSxCos	Effect of kids on cost of sex
	Normalized Parameters	
1	DivCost	Cost of divorce
1	EntryCost	Mens cost of entering marriage marke
1	eta	utility cost of fertility choice

Table 7(a): Benchmark parameter values

Time-Allocation Parameters

Parameter	Value	Parameter	Value
hub_0_time	0.099	util_param_2	2.342
hp_param_1	0.953	g_param_0_sm	0.084
hp_param_2	0.077	g_param_0_sw	0.084
time_param_1	0.546	g_param_0_mar	0.583
time_param_2	0.298	g_param_1_mar	0.015
util_param_1	0.910	g_param_1_sw	0.019

Table 7(b): Time allocation parameters

Kids	Marital Status			Total
	Single	Married with km=k	Married with step children	
0	0.209	0.06	-	0.269
1	0.037	0.11	0.01	0.157
2	0.026	0.11	0	0.136
3	0.054	0.31	0.05	0.414
Totals	0.326	0.59	0.06	0.976

Table 8(a): Stationary Distribution of Benchmark model: remainder equals mass of married with step children.

Kids	Fertility Rate per year		Mean	Divorce Rate
	Single	Married with km=k		
0	0.21	0.195		0.05
1	0.13	0.12		0
2	0.3	0.18		0
3	0	0		0
Means	0.17	0.08	0.10	

Table 8(b):Divorce and Fertility Rates.

Kids	Matching Rate	Queue Length	Value of Entering Market		Value of Marriage	Surplus
			Female	Male		
0	0.567	0.905	92.205	16.449	111.294	9.601
1	0.584	0.942	65.568	16.449	84.593	9.961
2	0	0	67.234	12.567	N/A	0
3	0	0	72.68	12.567	N/A	0

Table 9(a): Marriage-Market Clearing in Benchmark Model.

Fraction of Single Men in Sex market: 0.63984

Kids	Matching Rate	Queue Length	SinWom Entry Rate	Birth-Control Cost	Surplus	Prob Woman Gets Surplus
0	0.765	1.446	0.481	1.211	9.104	0.424
1	0.747	1.373	0.482	1.637	8.464	0.399
2	0.797	1.594	0.278	0.246	10.551	0.473
3	0.879	2.11	0.293	0	17.679	0.623

Table 9(b): Sex-Market Clearing in Benchmark Model.

Birth-Control Cost Parameter	Fertility		Marriage	
	No Kids	One Kid	No Kids	One Kid
1.00	0.0437	0.0256	0.1299	0.1195
1.06	0.0441	0.0261	0.1381	0.1266
1.11	0.0437	0.0277	0.1510	0.1227
1.17	0.0433	0.0291	0.1633	0.1210
1.22	0.0425	0.0306	0.1769	0.1182
1.28	0.0403	0.0328	0.1976	0.1092
1.33	0.0374	0.0347	0.2188	0.1037
1.39	0.0288	0.0371	0.2604	0.0919
1.44	0.0203	0.0397	0.3031	0.0786
1.50	0.0000	0.0426	0.3832	0.0591

Table 10(a) : Computational Experiment 1. Effort cost of fertility control is increased from equality with married to 50% higher.

Female Wage	Fertility		Marriage	
	No Kids	One Kid	No Kids	One Kid
6	0.014	0.038	0.334	0.068
6.2222	0.019	0.037	0.312	0.072
6.4444	0.023	0.037	0.292	0.075
6.6667	0.028	0.036	0.272	0.079
6.8889	0.031	0.035	0.251	0.086
7.1111	0.037	0.034	0.221	0.098
7.3333	0.041	0.033	0.199	0.106
7.5556	0.043	0.032	0.182	0.114
7.7778	0.046	0.031	0.167	0.121
8	0.047	0.031	0.161	0.123

Table 10(b): Computational Experiment 2. Female wage is increased from 1970s to 1990s, in terms of FTFY ratios.

1990s	Bench	CC	Wage	Wage+CC	1970s
0.13	0.12	0.26	0.26	0.34	0.29
0.11	0.12	0.02	0.31	0.10	0.12
0.22	0.24	0.23	0.23	0.22	0.23
0.22	0.17	0.16	0.16	0.16	0.19
0.10	0.13	0.12	0.12	0.12	0.10
0.05	0.04	0.03	0.03	0.00	0.02
0.09	0.08	0.09	0.05	0.11	0.06
0.04	0.04	0.02	0.01	0.01	0.01
0.20	0.10	0.27	0.08	0.00	0.24
0.80	0.72	0.28	0.36	0.01	0.23
0.80	0.73	0.91	0.20	0.79	0.79

Table 11: Summary of Computational Results. CC corresponds to increasing contraception-effort parameter by 50%, Wage to reducing female wage from 0.75 to 0.61 of the male ftfy wage.

Variable	1970-73		1990-95	
	birth	mar	birth	mar
Intercept	-5.603	-4.183	-4.012	-4.666
	(0.006)	(0.004)	(0.003)	(0.002)
kids1	0.758	-0.407	0.226	0.048
	(0.001)	(0.001)	(0.001)	(0.001)
kids2	-0.031	-0.094	-0.060	-0.018
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	0.061	0.151	-0.037	-0.051
	(0.001)	(0.001)	(0.001)	(0.001)
kids4	-0.016	-0.225	0.024	-0.123
	(0.002)	(0.002)	(0.001)	(0.001)
kids5	0.377	0.201	0.115	0.139
	(0.002)	(0.002)	(0.002)	(0.002)
cohabnow	1.073	-2.957	-0.058	0.054
	(0.005)	(0.586)	(0.001)	(0.000)
prevmar	0.051	0.671	0.194	-1.588
	(0.001)	(0.001)	(0.000)	(0.004)
age	0.194	0.081	0.026	-0.088
	(0.000)	(0.000)	(0.001)	(0.000)
age_sqr	-0.004	-0.002	0.142	0.169
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	0.014	-0.010	-0.003	-0.003
	(0.000)	(0.000)	(0.000)	(0.000)
attend	-0.107	-0.112	-0.325	-0.282
	(0.003)	(0.001)	(0.001)	(0.000)
hs_dip	0.442	1.371	-0.177	0.042
	(0.001)	(0.000)	(0.000)	(0.000)
coll	-0.184	0.030	-0.200	-0.040
	(0.001)	(0.001)	(0.001)	(0.000)
ba_coll	-0.394	0.273	-0.268	0.008
	(0.009)	(0.003)	(0.001)	(0.000)

Table A1: Probit Estimates of unmarried women's monthly marriage and divorce rates in the NSFG, 1973 and 1995 waves.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-0.8040	-0.6903	1.1594	0.9649
	(0.065)	(0.071)	(0.001)	(0.001)
kids1	0.5847	0.5663	0.0140	0.0924
	(0.008)	(0.008)	(0.000)	(0.000)
kids2	0.0399	0.0275	0.1868	0.2070
	(0.011)	(0.011)	(0.000)	(0.000)
kids3	0.0202	-0.0023	0.0832	0.1037
	(0.013)	(0.013)	(0.000)	(0.000)
kids4	-0.2085	-0.1645	0.1573	0.1790
	(0.020)	(0.020)	(0.000)	(0.000)
kids5	0.2166	0.1790	-0.1383	-0.1287
	(0.024)	(0.024)	(0.001)	(0.001)
cohabnow	0.6314	0.7146	0.7646	0.7922
	(0.077)	(0.077)	(0.000)	(0.000)
prevmar	-0.0453	-0.0431	-0.0756	-0.0716
	(0.008)	(0.008)	(0.000)	(0.000)
age	0.0780	0.0758	0.0060	0.0099
	(0.005)	(0.006)	(0.000)	(0.000)
age_sqr	-0.0014	-0.0014	-0.0007	-0.0008
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	.	0.0166	-0.0089	.
	.	(0.003)	(0.000)	.
attend	.	-0.0080	-0.2008	.
	.	(0.014)	(0.000)	.
hs_dip	.	-0.0779	-0.0366	.
	.	(0.007)	(0.000)	.
coll	.	-0.0707	-0.0639	.
	.	(0.011)	(0.000)	.
ba_coll	.	-0.3106	0.1330	.
	.	(0.069)	(0.000)	
	0.424	0.434	.	

Table A2: Regression Estimates for Sexual Activity in NSFG 1973/1995. Dependent variable in 1973 is fraction of total months in an interval that single non-pregnant woman had sex; estimation by OLS. In 1995 dependent variable is whether single non-pregnant woman had sex in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-3.9597	-5.306	-4.2798	-5.16
	(0.008)	(0.007)	(0.001)	(0.001)
kids1	0.7313	0.6595	-0.0386	-0.1494
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	-0.1391	-0.2256	-0.3929	-0.4549
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	0.3756	0.3523	-0.2053	-0.2256
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	-0.5979	-0.535	-0.2072	-0.2979
	(0.002)	(0.002)	(0.000)	(0.000)
kids5	0.4631	0.3792	-0.5327	-0.4957
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-3.9033	-3.5922	0.0219	-0.0175
	(0.721)	(0.722)	(0.000)	(0.000)
prevmar	0.2162	0.2004	0.1345	0.1228
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.2527	0.3652	0.3021	0.3892
	(0.001)	(0.001)	(0.000)	(0.000)
age_sqr	-0.00584	-0.00782	-0.00611	-0.00751
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	-0.04	.	-0.00722	.
	(0.000)	.	(0.000)	.
attend	-0.4886	.	-0.1364	.
	(0.001)	.	(0.000)	.
hs_dip	0.07	.	0.3016	.
	(0.001)	.	(0.000)	.
coll	0.4727	.	0.12	.
	(0.001)	.	(0.000)	.
ba_coll	0.9688	.	0.3326	.
	(0.008)	.	(0.000)	.

Table A3: Regression Estimates for Contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman relied on Pill for contraception in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-3.3895	-3.5551	-3.898	-4.6696
	(0.007)	(0.006)	(0.001)	(0.001)
kids1	0.7567	0.7005	0.1601	0.0593
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	-0.0321	-0.1521	-0.4503	-0.5063
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	0.4969	0.5246	-0.1289	-0.1481
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	-0.391	-0.4092	-0.3069	-0.3878
	(0.002)	(0.002)	(0.000)	(0.000)
kids5	0.0345	-0.094	-0.412	-0.3879
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-3.8253	-3.6126	0.047	0.0133
	(0.678)	(0.678)	(0.000)	(0.000)
prevmar	0.1666	0.1167	0.0554	0.0479
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.2088	0.219	0.2798	0.3543
	(0.001)	(0.000)	(0.000)	(0.000)
age_sqr	-0.00492	-0.00469	-0.00573	-0.00688
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	0.0755	.	-0.00241	.
	(0.000)	.	(0.000)	.
attend	-0.3514	.	-0.1318	.
	(0.001)	.	(0.000)	.
hs_dip	0.1143	.	0.2637	.
	(0.001)	.	(0.000)	.
coll	0.3306	.	0.0984	.
	(0.001)	.	(0.000)	.
ba_coll	-1.7726	.	0.2041	.
	(0.006)	.	(0.000)	.

Table A4: Regression Estimates for Effective Contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman relied on Pill, IUD or Sterilization for contraception in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-0.7602	-0.0439	-2.1423	-1.5591
	(0.005)	(0.005)	(0.001)	(0.001)
kids1	-0.5091	-0.3792	0.0819	0.1492
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	0.2221	0.3732	-0.3138	-0.2933
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	-0.5635	-0.5106	-0.1918	-0.1981
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	0.2539	0.1393	-0.0326	-0.00999
	(0.001)	(0.001)	(0.000)	(0.000)
kids5	-0.0488	0.1653	-0.1116	-0.1297
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-0.0843	-0.3358	-0.1189	-0.086
	(0.006)	(0.006)	(0.000)	(0.000)
prevmar	-0.016	0.0184	-0.1185	-0.1222
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.0843	0.00582	0.104	0.041
	(0.000)	(0.000)	(0.000)	(0.000)
age_sqr	-0.00127	-0.00003	-0.00138	-0.00023
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	0.00738	.	0.038	.
	(0.000)	.	(0.000)	.
attend	0.3583	.	0.0594	.
	(0.001)	.	(0.000)	.
hs_dip	-0.3843	.	-0.1774	.
	(0.001)	.	(0.000)	.
coll	-0.3382	.	-0.1317	.
	(0.001)	.	(0.000)	.
ba_coll	-0.3647	.	-1.0956	.
	(0.006)	.	(0.000)	.

Table A5: Regression Estimates for absence of contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman used no contraception in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-0.8040	-0.6903	1.1594	0.9649
	(0.065)	(0.071)	(0.001)	(0.001)
kids1	0.5847	0.5663	0.0140	0.0924
	(0.008)	(0.008)	(0.000)	(0.000)
kids2	0.0399	0.0275	0.1868	0.2070
	(0.011)	(0.011)	(0.000)	(0.000)
kids3	0.0202	-0.0023	0.0832	0.1037
	(0.013)	(0.013)	(0.000)	(0.000)
kids4	-0.2085	-0.1645	0.1573	0.1790
	(0.020)	(0.020)	(0.000)	(0.000)
kids5	0.2166	0.1790	-0.1383	-0.1287
	(0.024)	(0.024)	(0.001)	(0.001)
cohabnow	0.6314	0.7146	0.7646	0.7922
	(0.077)	(0.077)	(0.000)	(0.000)
prevmar	-0.0453	-0.0431	-0.0756	-0.0716
	(0.008)	(0.008)	(0.000)	(0.000)
age	0.0780	0.0758	0.0060	0.0099
	(0.005)	(0.006)	(0.000)	(0.000)
age_sqr	-0.0014	-0.0014	-0.0007	-0.0008
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	.	0.0166	-0.0089	.
	.	(0.003)	(0.000)	.
attend	.	-0.0080	-0.2008	.
	.	(0.014)	(0.000)	.
hs_dip	.	-0.0779	-0.0366	.
	.	(0.007)	(0.000)	.
coll	.	-0.0707	-0.0639	.
	.	(0.011)	(0.000)	.
ba_coll	.	-0.3106	0.1330	.
	.	(0.069)	(0.000)	
	0.424	0.434	.	

Table A2: Regression Estimates for Sexual Activity in NSFG 1973/1995. Dependent variable in 1973 is fraction of total months in an interval that single non-pregnant woman had sex; estimation by OLS. In 1995 dependent variable is whether single non-pregnant woman had sex in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-3.9597	-5.306	-4.2798	-5.16
	(0.008)	(0.007)	(0.001)	(0.001)
kids1	0.7313	0.6595	-0.0386	-0.1494
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	-0.1391	-0.2256	-0.3929	-0.4549
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	0.3756	0.3523	-0.2053	-0.2256
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	-0.5979	-0.535	-0.2072	-0.2979
	(0.002)	(0.002)	(0.000)	(0.000)
kids5	0.4631	0.3792	-0.5327	-0.4957
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-3.9033	-3.5922	0.0219	-0.0175
	(0.721)	(0.722)	(0.000)	(0.000)
prevmar	0.2162	0.2004	0.1345	0.1228
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.2527	0.3652	0.3021	0.3892
	(0.001)	(0.001)	(0.000)	(0.000)
age_sqr	-0.00584	-0.00782	-0.00611	-0.00751
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	-0.04	.	-0.00722	.
	(0.000)	.	(0.000)	.
attend	-0.4886	.	-0.1364	.
	(0.001)	.	(0.000)	.
hs_dip	0.07	.	0.3016	.
	(0.001)	.	(0.000)	.
coll	0.4727	.	0.12	.
	(0.001)	.	(0.000)	.
ba_coll	0.9688	.	0.3326	.
	(0.008)	.	(0.000)	.

Table A3: Regression Estimates for Contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman relied on Pill for contraception in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-3.3895	-3.5551	-3.898	-4.6696
	(0.007)	(0.006)	(0.001)	(0.001)
kids1	0.7567	0.7005	0.1601	0.0593
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	-0.0321	-0.1521	-0.4503	-0.5063
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	0.4969	0.5246	-0.1289	-0.1481
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	-0.391	-0.4092	-0.3069	-0.3878
	(0.002)	(0.002)	(0.000)	(0.000)
kids5	0.0345	-0.094	-0.412	-0.3879
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-3.8253	-3.6126	0.047	0.0133
	(0.678)	(0.678)	(0.000)	(0.000)
prevmar	0.1666	0.1167	0.0554	0.0479
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.2088	0.219	0.2798	0.3543
	(0.001)	(0.000)	(0.000)	(0.000)
age_sqr	-0.00492	-0.00469	-0.00573	-0.00688
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	0.0755	.	-0.00241	.
	(0.000)	.	(0.000)	.
attend	-0.3514	.	-0.1318	.
	(0.001)	.	(0.000)	.
hs_dip	0.1143	.	0.2637	.
	(0.001)	.	(0.000)	.
coll	0.3306	.	0.0984	.
	(0.001)	.	(0.000)	.
ba_coll	-1.7726	.	0.2041	.
	(0.006)	.	(0.000)	.

Table A4: Regression Estimates for Effective Contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman relied on Pill, IUD or Sterilization for contraception in a given month; estimation is by Probit.

Variable	1973		1995	
	Model 1	Model 2	Model 1	Model 2
Intercept	-0.7602	-0.0439	-2.1423	-1.5591
	(0.005)	(0.005)	(0.001)	(0.001)
kids1	-0.5091	-0.3792	0.0819	0.1492
	(0.001)	(0.001)	(0.000)	(0.000)
kids2	0.2221	0.3732	-0.3138	-0.2933
	(0.001)	(0.001)	(0.000)	(0.000)
kids3	-0.5635	-0.5106	-0.1918	-0.1981
	(0.001)	(0.001)	(0.000)	(0.000)
kids4	0.2539	0.1393	-0.0326	-0.00999
	(0.001)	(0.001)	(0.000)	(0.000)
kids5	-0.0488	0.1653	-0.1116	-0.1297
	(0.002)	(0.002)	(0.001)	(0.001)
cohabnow	-0.0843	-0.3358	-0.1189	-0.086
	(0.006)	(0.006)	(0.000)	(0.000)
prevmar	-0.016	0.0184	-0.1185	-0.1222
	(0.001)	(0.001)	(0.000)	(0.000)
age	0.0843	0.00582	0.104	0.041
	(0.000)	(0.000)	(0.000)	(0.000)
age_sqr	-0.00127	-0.00003	-0.00138	-0.00023
	(0.000)	(0.000)	(0.000)	(0.000)
age_ba	0.00738	.	0.038	.
	(0.000)	.	(0.000)	.
attend	0.3583	.	0.0594	.
	(0.001)	.	(0.000)	.
hs_dip	-0.3843	.	-0.1774	.
	(0.001)	.	(0.000)	.
coll	-0.3382	.	-0.1317	.
	(0.001)	.	(0.000)	.
ba_coll	-0.3647	.	-1.0956	.
	(0.006)	.	(0.000)	.

Table A5: Regression Estimates for absence of contraception in NSFG 1973/1995. Dependent variable is whether single non-pregnant woman used no contraception in a given month; estimation is by Probit.

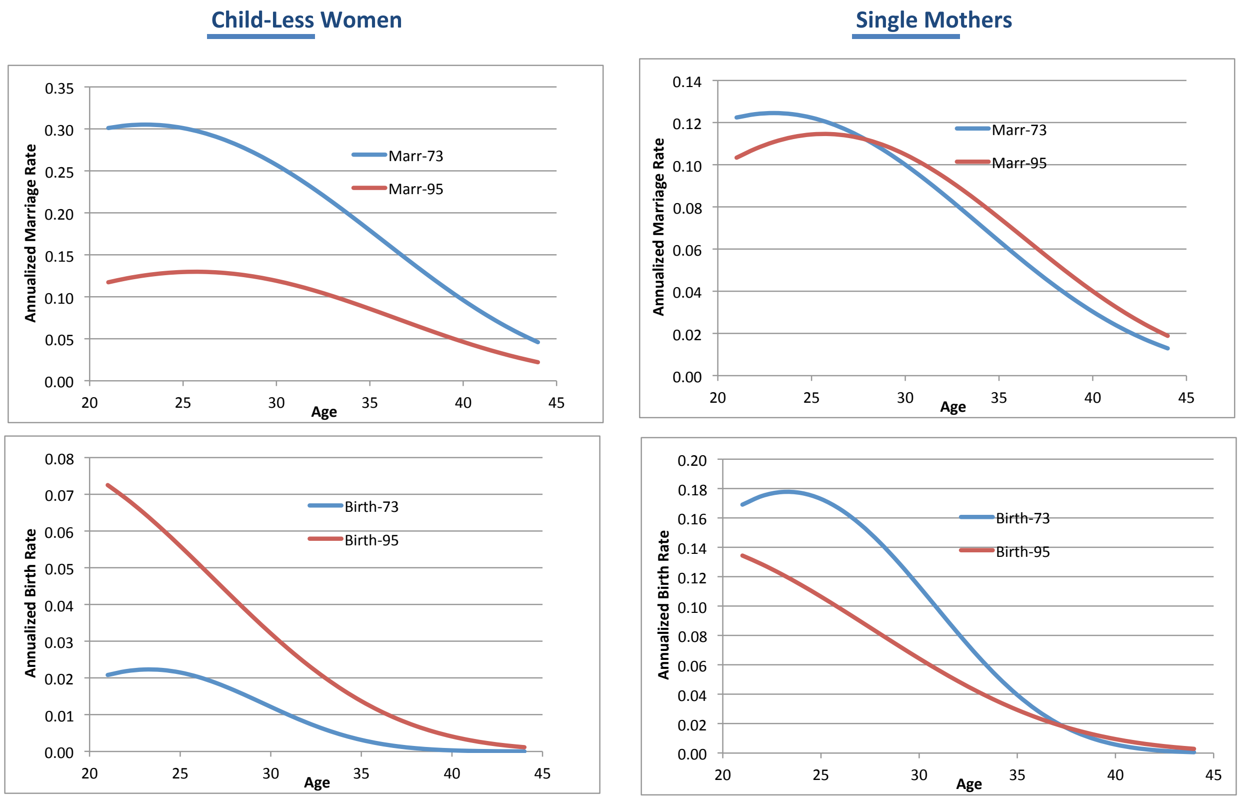

Figure 1: Estimated Age Profiles for Marriage and Birth Rates for Single Women in the NSFG waves for 1973 and 1995.Re-weighting of 1973 sample as described in text to correct for omission of never-married singles with no live births. Controls in estimation include co-habitation and previous marriages.

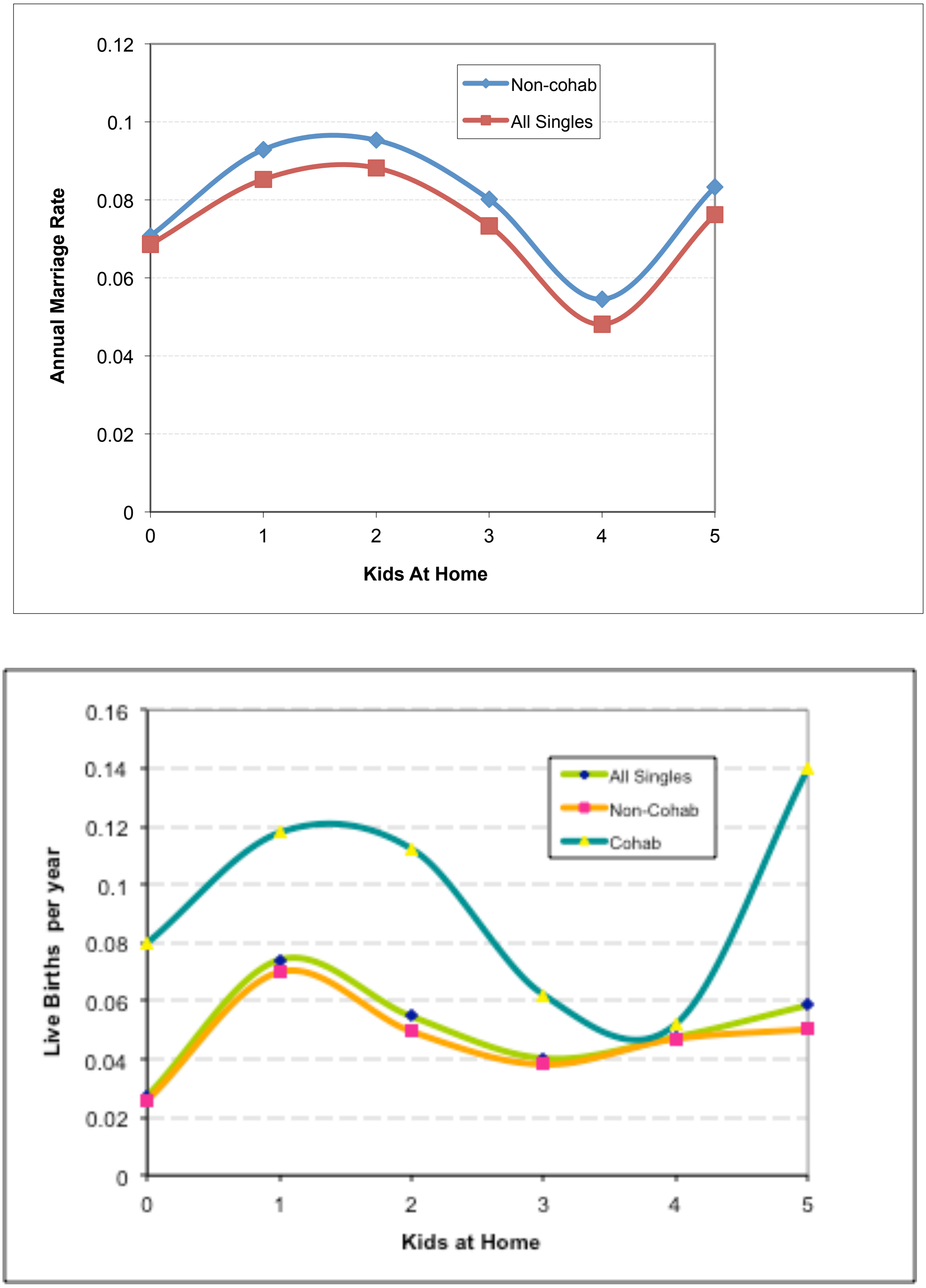

Figure 2: Single and Cohabitants in the 1995 NSFG. Annualised marriage and birth rates per single woman.

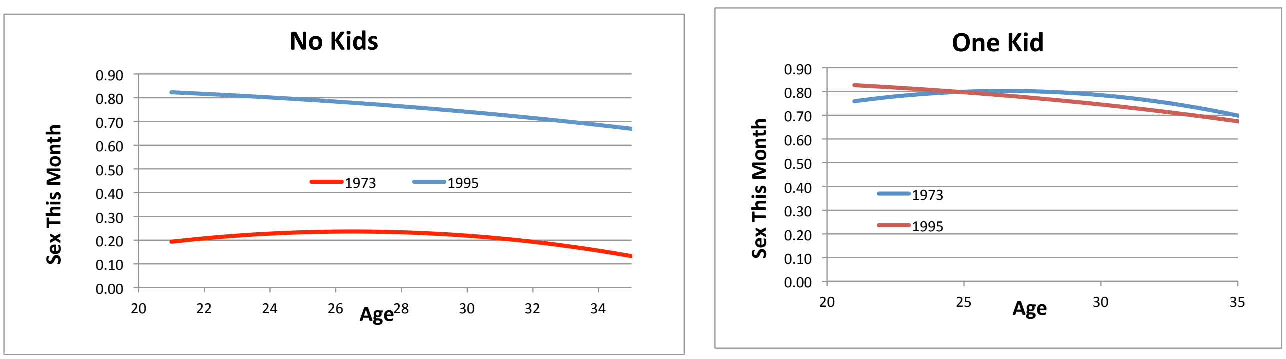

Figure 3(a): Probability that a single non-pregnant woman has sex in a given month. Predicted age profiles computed from regression equations estimated on NSFG 1973 and 1995

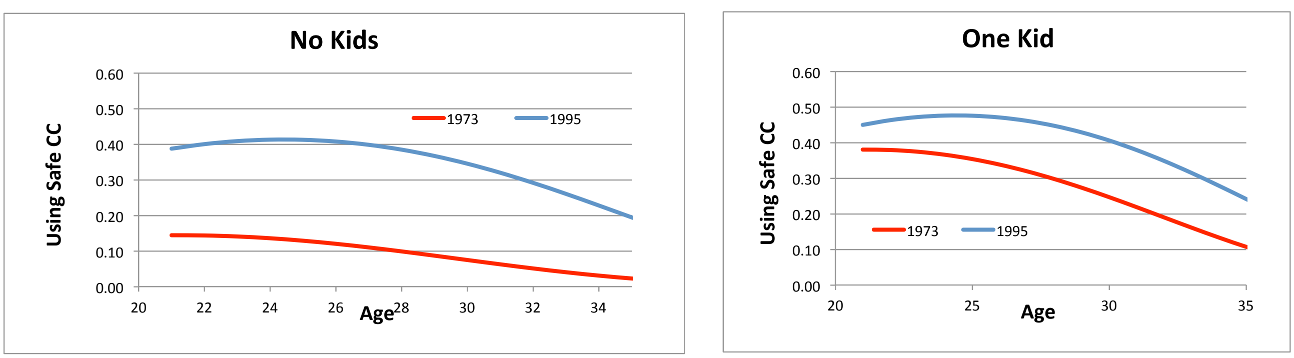

Figure 3(b): Probability that a single non-pregnant woman is using a highly-effective contraceptive technology: the pill, IUD or sterilization. Predicted age profiles computed from regression equations estimated on NSFG 1973 and 1995

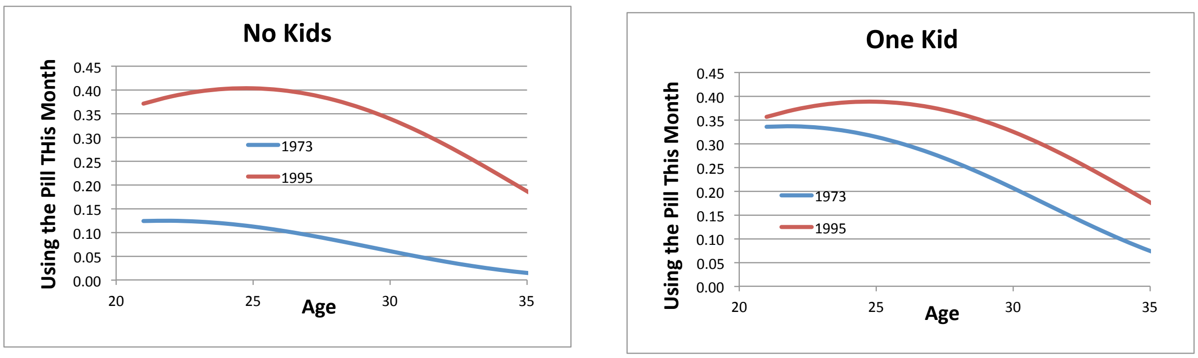

Figure 4(a) Probability that a single nonpregnant woman is using oral contraception; predicted age profile based on regression estimates from NSFG 1973 nd 1995 samples.

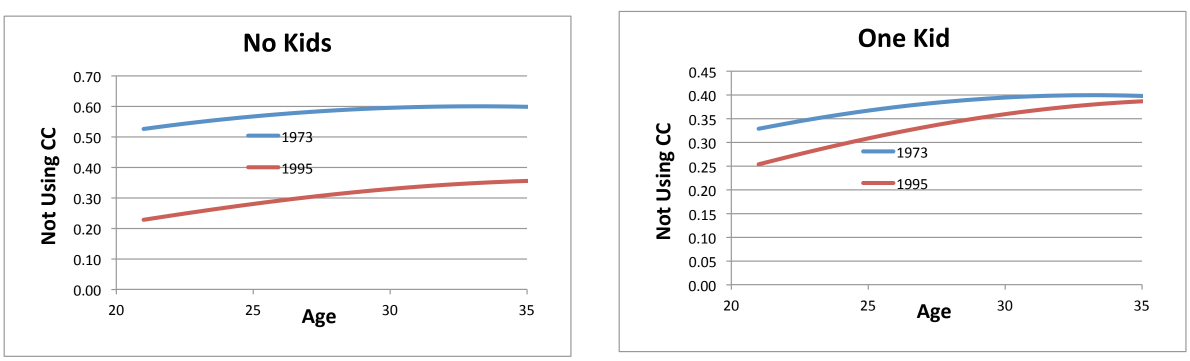

Figure 4(b) Probability that a single nonpregnant woman is not using contraception; predicted age profile based on regression estimates from NSFG 1973 and 1995 samples.

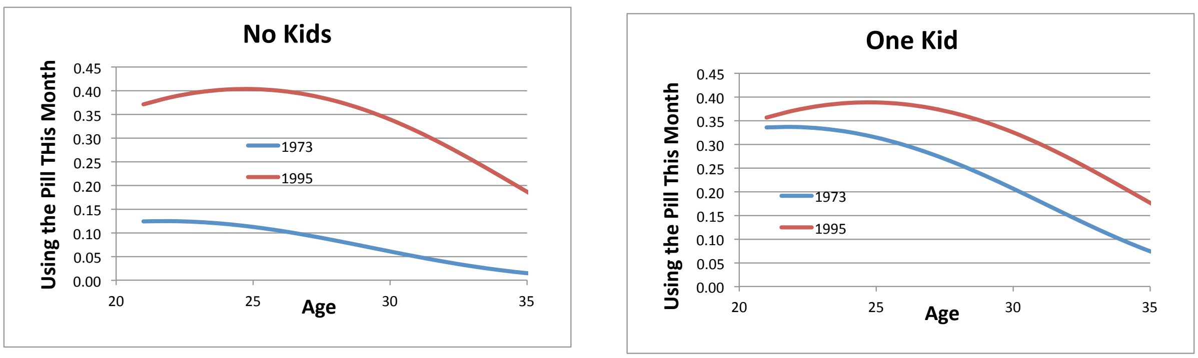

Figure 4(a) Probability that a single nonpregnant woman is using oral contraception; predicted age profile based on regression estimates from NSFG 1973 nd 1995 samples.

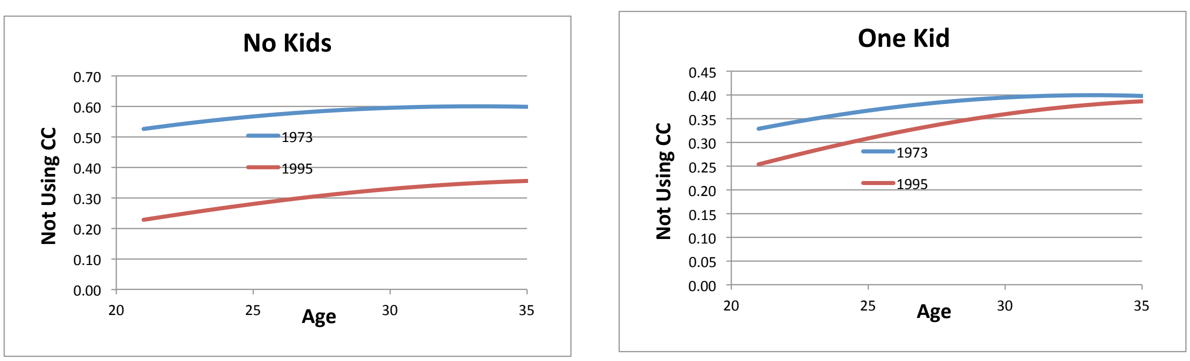

Figure 4(b) Probability that a single nonpregnant woman is not using contraception; predicted age profile based on regression estimates from NSFG 1973 and 1995 samples.

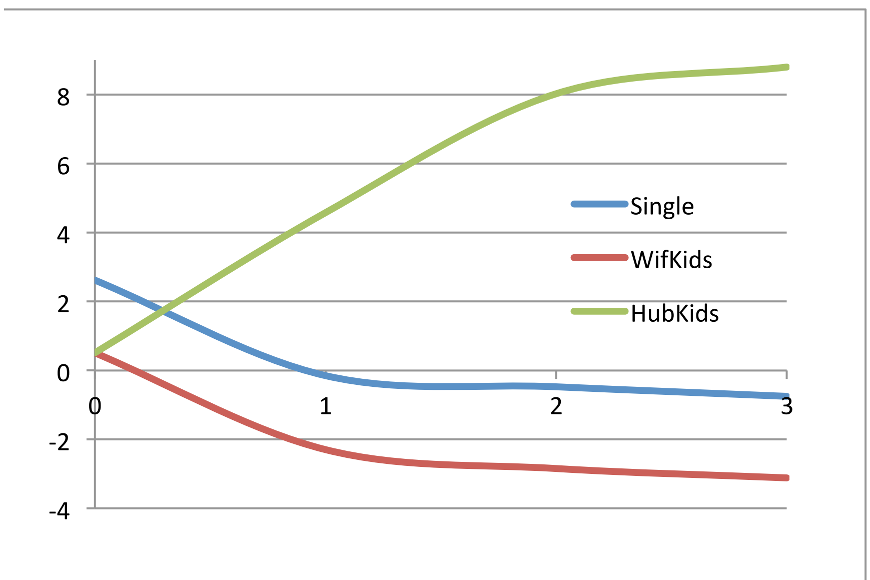

Figure 5: Utility flows from children in the benchmark model.

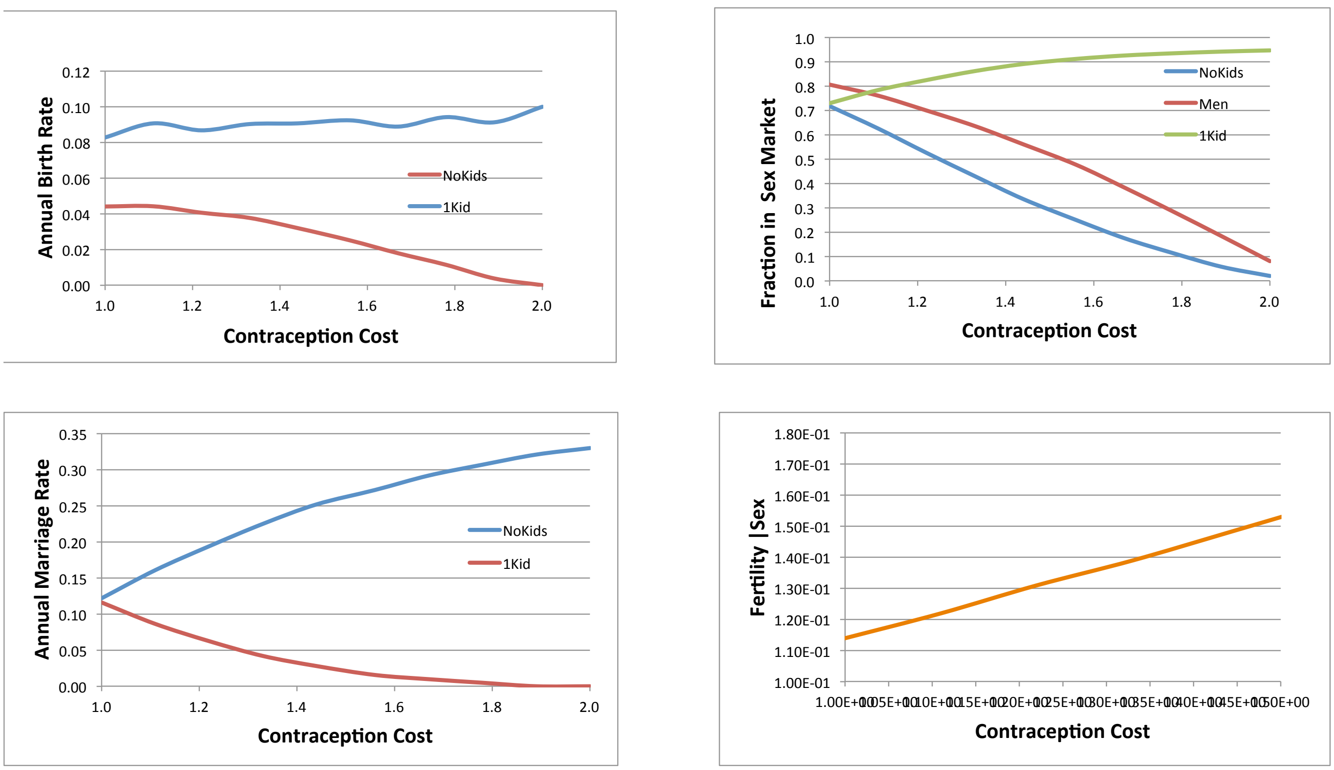

Figure 6: Contraception Experiment: Increasing Fertility-Effort Cost For Singles, Benchmark Model

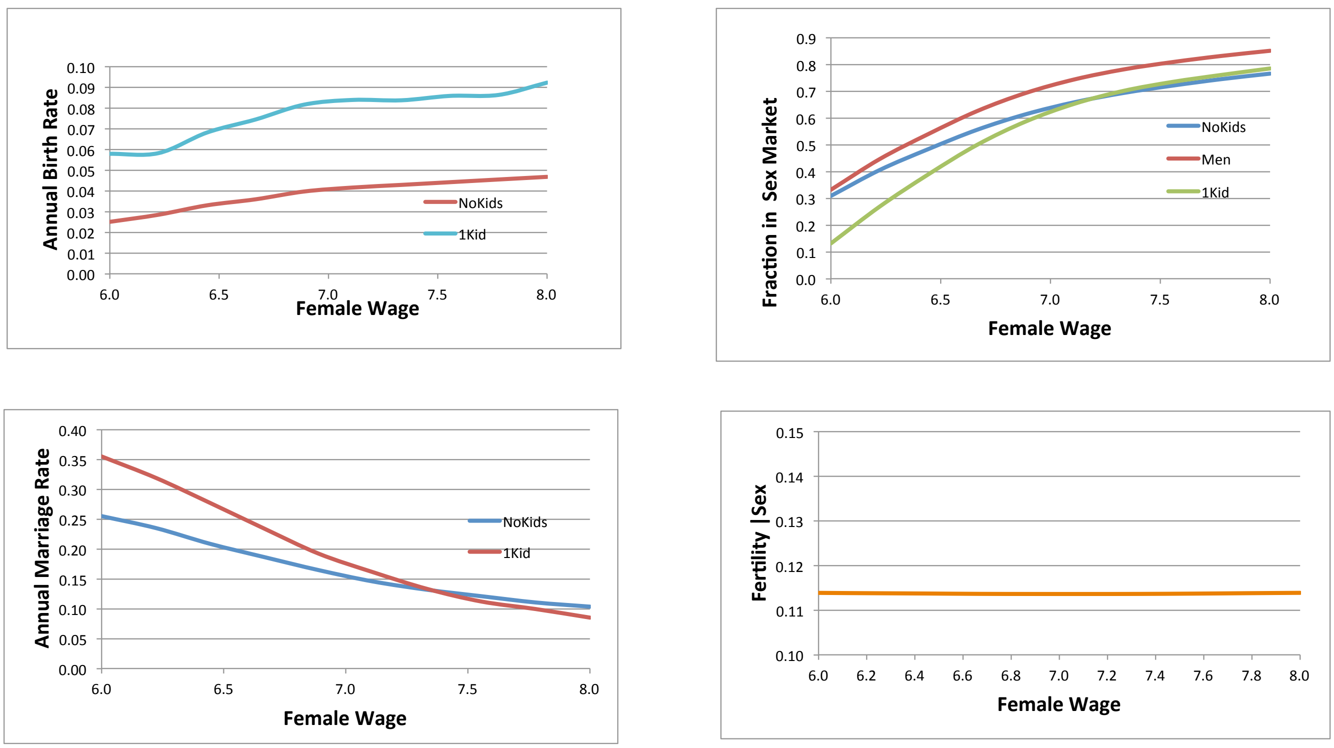

Figure 7: Wage Experiment: Unmarried Fertility, marriage and sex-participation rates as female wages are increased from 60% of male wage to 80%.

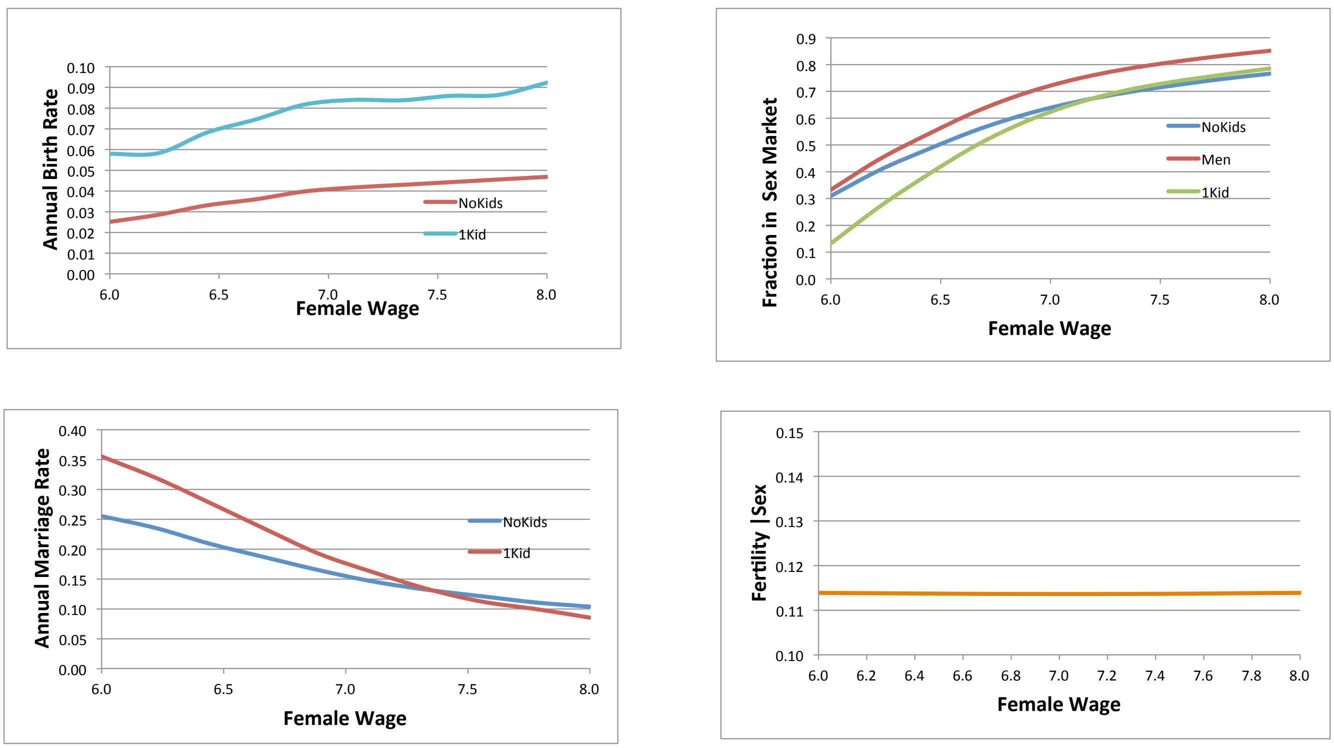

Figure 7: Wage Experiment: Unmarried Fertility, marriage and sex-participation rates as female wages are increased from 60% of male wage to 80%.