The legalization of abortion and women's bargaining power: a marriage market analysis[1]

Pierre-André Chiappori[2] Sonia Oreffice[3]

March 2005

Very preliminary - Please do not quote

[1]Paper presented at Boston University and Hunter College, New York. We thank the participants and Gary Becker, Kevin Lang and Derek Neal for many helpful discussions. Errors are ours, though.

[2]Department of Economics, University of Chicago, and Department of Economics, Columbia University. Email: pc2167@columbia.edu

[3]Department of Economics, Clemson University.

Abstract

Innovations in birth control technology have largely affected women and their available fertility choices. We analyze the consequences of these innovation on intrahousehold allocation of resources in a simple model of frictionless matching on the marriage market, in which women differ in their taste for children. The qualitative feature of the equilibrium depend on whether men or women are in excess supply on the marriage market. When women are in excess supply, while the specific feature of the equilibrium vary with the taste distribution, an improvement in the birth control technology generally increases the 'power', hence the welfare of all women, including those who are not interested in the new technology. However, this 'empowerment' effect crucially relies on the avilability of the new technology to single women. Should the innovation be reserved to married women, the conclusion may be reversed.

1 Introduction

The legalization of abortion, and more generally the various innovations in birth control that took place during the last four decades, had a strong impact on modern societies. The direct effect on demography, and especially on birth rates in specific social groups, has been abundantly studied.[1] An additional, indirect effect operates through the reduction in uncertainty faced by couples and single women due to the increased ability to plan demographic phenomena. This fact has dramatically altered the context in which decisions regarding human capital accumulation were made. For instance, many authors have argued that the spectacular increase in women's education and participation to the labor market since the 60s was largely due to these innovations.[2]

A third, and relatively less studied consequence goes through a different channel - namely, the impact of the changes on the respective bargaining powers within the couple. After all, the legalization of abortion has a potentially huge effect on men's and women's respective decision rights regarding such crucial issues as the number or timing of births within the household. It is hard to believe that a shift of such magnitude would leave the balance of powers unaltered. This claim has been put forth by a number of sociologists[3], but not much has been done in terms of an economic analysis of this phenomenon.

Recently, Oreficce (2004) has provided an econometric study based on the collective approach to household behavior. The basic idea is to check whether, everything equal, the legalization of abortion had an impact on labor supply of married females. If, as it is often argued, the legalization actually improved the wife's bargaining situation within married couples, she should be able to attract a larger share of household resources. By a standard income effect, the reform should thus decrease her labor supply and increase her husband's. As it turns out, the predictions of the model are remarkably well confirmed by the data. A significant effect is observed on both male and female labor supply for married couples, not for single males and females.

The claim that abortion legalization influenced intrahousehold bargaining process has thus received some empirical support. However, the mechanism

[1] See for instance Angrist and Evans (1996).

[2] See Michael (2000) and Goldin and Katz (2002).

[3] See for instance Williams (1994), Héritier (2002), or Coombs and Fernandez (1978).

by which this empowerment appears still deserves some scrutiny. While it is not hard to convince oneself that *some* women will gain, whether *all* will is another matter. Women have heterogeneous tastes with respect to children (or different attitudes toward abortion); some, in particular, do not consider abortion as an option, either for religious or ethical reasons or because they do want a child. Whether the legalization will benefit to these women as well is not clear. From a general perspective, the new context will affect the matching process on the market for marriage, and in particular the way the surplus generated by marriage is shared between members. In principle, these secondary effects could annihilate or even reverse the direct impact, particularly for these women who are unlikely to derive much direct benefit from the reform.

The goal of the present paper is precisely to construct an explicit model of matching on the marriage market in which these phenomena can be formally analyzed. We use a barebone setting in which, in the initial situation, any woman who wants a child is biologically able to have one, but unwanted pregnancies are possible. Children (whether wanted or not) generate utility for both parents, but decrease the mother's ability to earn income. We assume that men are identical, while women differ by their preferences towards children. Finally, marriage is the outcome of a frictionless matching process; utilities are assumed transferable, so that the impact of the matching process on individual utilities can readily be assessed.

This simple model has several interesting implications. First, as it is common in this type of settings, the property of the equilibrium crucially depends on the respective proportions of male and females on the marriage market. An additional property of our setting is the existence of three classes of women: those who like children enough to be willing to be a mother even when single, those who want to have a child only if married, and those who never want to have a child. In particular, when women are globally in excess supply, then the main patterns of the stable match on which class the 'marginal' married woman belongs to.

The framework generates appealing comparative statics results. A proportional increase in female income (both with and without children) decreases fertility. A decline in the supply of men on the marriage market decreases total fertility but increases out-of-wedlock births, and always harms women's well-being. The introduction of more generous benefits targeted to single mothers also increases out-of-wedlock fertility, but the impact on female welfare is more complex, since its consequences on the qualitative

patterns of the stable match must be taken into account. We believe that these features are broadly compatible with the evolutions observed in the US over the last decades.

We then consider the introduction of a new technology that allows women (or couple) to better control the birth of a child. Note that this broad setting can be applied not only to abortion, but to any birth control technology on the marriage market. A particularly interesting application is to the pill, which first became available to married women only, and later to singles as well. Our main finding is that, in this simplified setting, the legalization of abortion never makes women worse off and never makes men better off. If, in particular, the marriage market is characterized by an excess supply of women that is not too 'large' (in a sense precisely defined below), all women are strictly better off after the reform. Even women who do not actually use the new technology benefit from its introduction, because they are able to grab a larger share of household resources (correspondingly, men are strict losers from the reform).

Our model thus predicts that a better birth control technology leads to an empowerment of all women in the economy. However, this empowerment relies on a market adjustment mechanism in which single women play a key role. We show, indeed, that the reform benefits married women with children only insofar as the new technology is available to single women. Paradoxically, should the new technology be exclusively reserved to married women (as was initially the case for the pill), then the benefits for most women are either inexistent or even negative (at least when women are in excess supply).

Our work is related to two existing contributions. One is the influential work of Akerlof, Yellen and Katz (1996, from now on AYK) on out-of-wedlock child bearing in the United States. The relationship between their approach and ours is discussed in more details at the end of this paper. At this stage, we may just emphasize a crucial difference. In AYK, the level of welfare reached by *individuals* within each couple is taken as exogenously given, whereas it is fully endogenous in our context. Our goal is precisely to analyze how equilibrium conditions on the marriage market influence intrahousehold allocation of welfare. In that sense, our approach is closer to that proposed by Neal (2004); in particular, Neal also constructs a model in which intrahousehold allocation of resources is the outcome of a matching equilibrium. The major difference with our paper is the emphasis is put on income heterogeneity, whereas differences in taste for children are the driving force in our frame-

work. Hence our approach is largely complementary to those existing in the literature, although some conclusions differ.

The paper is organized as follows: Section 2 describes the model; Section 3 provides the equilibrium analysis and some comparative statics; Section 4 studies the effects of the technological innovation on the equilibrium outputs; Section 5 presents some extensions and discusses the links with the existing literature.

2 The model

Preferences and budget constraints In the economy we consider, there exists a continuum of men and women who derive utility from one private composite good a_i and from children. For the sake of expositional simplicity, we only consider the choice between having children or not, although the generalization to different numbers of children is straightforward. Let the dummy variable k denote the presence ($k = 1$) or the absence ($k = 0$) of children in the household; alternatively, k can be interpreted as the additional children that men and women may have at any given moment.

Men have identical, quasi-linear preferences over consumption and children. To sharpen our analysis, we assume that the utility of single men only depends on their consumption; i.e., men cannot derive utility from (and do not share the costs of) out-of-wedlock children, due to the fact that they do not live in the same household.[4] On the other hand, married men's utility is of the form $U_H(a_H, k) = a_H + u_H.k$, with $u_H > 0$. Note, in particular, that the utility of a married man does not depend on the identity of the person he married, but only on the fertility decision and on the share of composite good he receives.[5]

Women, on the other hand, differ by their preferences towards children.

[4] We can modify these assumptions to allow for single men sharing some costs of children (in terms of child support) and having some utility from children they don't live with. However, childrearing remains more (time) costly for women; also, men not living in the household do not fully share the costs of their out-of-wedlock children. Single men's utility from children is lower than married men's, because they do not live with their children, so that the woman's compensation will be lower too. Our main results of the effect of the legalization of abortion on the marriage market would not change.

[5] Following Chiappori and Weiss (2002), one could include an additional, non-monetary benefit θ_i received by both spouses from the companionship in marriage. Results would not change provided that the distribution of θ_i is the same for woemn of different types.

Specifically, female utility functions take the quasi linear form $U(a,k) = a + uk$. Here, each women is characterized by the individual-specific taste parameter u, which is distributed over some interval $[0, U]$ with some density f. Note, in particular, that utilities are transferable, a property that will facilitate the matching analysis that follows.

Throughout the paper, the price of the private composite good p_a is normalized to 1. Male income is denoted Y. Women initially receive an income y; however, if a woman has children, her income drops to z, with $z < y$, reflecting both the loss in her earning capacity due to childbearing and the cost of raising the child. We assume that $u_H < y - z$, i.e. that the gain received by the husband from having a child does not offset by itself the loss in income experienced by the wife. This assumption implies, in particular, that the couple's decision to have a child or not will also depend on the wife's preferences.

When getting married, a man and a woman agree on two issues. One is the fertility decision; i.e., they must decide whether to have kids or not. We assume that couples who want a kid face no difficulty in having one. However, should they decide no to have kids, unexpected pregnancies may still be possible, depending on the available technology. We shall precisely model abortion as a shift in this technology. The other decision relates to the distribution of resources within the household (i.e., the allocation of income between male and female consumption of the composite good).[6] Both decision will be ultimately determined by the situation of the market for marriage. Finally, a single woman may decide to have children, in which case her utility is $z + uk$. Should she plan not to have children, unwanted birth may still occur (depending on the technology available). Without children, she consumes her income y;with children, she also consumes her income (who has dropped to z) and receives moreover the utility u from their child.[7]

As indicated above, our main focus is the impact of innovations in the birth control technology. Specifically, we denote by p the probability of experiencing an unwanted pregnancy, and we model the legalization as a technological innovation exogenously decreasing p.[8]

[6]Note that the consumption may also depend on whether a child is born or not, should the couple decide not to have children. The expectation is taken on this random event.

[7]For simplicity, we assume that u does not depend on the mother's marital status.

[8]In particular, we disregard for the moment the other benefits derived from the improved birth control technology (e.g., easier access to sexual activity before marriage). This extension will be considered in the last section.

Marriage market We assume that the marriage market is frictionless; i.e., we model marriage as a matching process, for which we will characterize the 'stable' matches in the usual sense (i.e., no married person would rather be single, and there cannot be a man and a woman who would both prefer being married together to their current situation). Any individual gets married as long as the utility (s)he can get from marriage is larger than or equal to the utility (s)he gets from remaining unmarried. Note that our analysis is consistent with a collective model of household behavior in which spouses interact and take Pareto-efficient decisions, possibly transferring resources to each other. From this perspective, a contribution of this paper, following several others[9], is to endogenize the 'sharing rule' that characterizes intrahousehold allocation.

Because children are public goods, marriage generates a net surplus; hence it must be the case that either all men or all women are married. As it is often the case with matching models, the qualitative properties of the stable match will crucially depend on which side is in excess supply. Throughout the paper, we normalize the mass of women to be 1, and we denote by M the total mass of males on the market. Hence we shall distinguish two main cases, depending on whether the male population M is smaller or larger than 1, as well as several subcases.

3 Stable matching on the marriage market

We now characterize the main features of the equilibrium (or stable assignment) reached on the marriage market.

3.1 Fertility decisions

We first consider the fertility decisions of singles and couples, staring with single individuals. Single men do not make decisions: they consume their income, and reach a utility equal to Y. Single women, on the other hand, will decide to have children if and only if the benefit compensates the income loss, i.e. if $u \geq y - z$, leading to a utility equal to $z + u$. In the alternative case when $u < y - z$, single women of type u choose not to have a child; any pregnancy will be involuntary and occur with probability p. Their expected

[9] See for instance Browning, Chiappori and Weiss ($$$), Iyigun and $$$ ($$$), and Chiappori, Iyigun and Weiss ($$$).

utility will thus be equal to $y(1-p)+p\,(z+u)$. In what follows, the threshold $y-z$ is denoted $\bar{u}$.

Regarding couples, note, first, that in a transferable utility context the stable match must maximize total surplus. The total benefit, for a couple, of having a child is u_H+u, whereas the cost is $y-z$. It follows that a married couple will plan to have a child if $u \geq y-z-u_H$, and the total utility is $Y+z+u_H+u$. The threshold $y-z-u_H$ is denoted $\underline{u}$; note that $\underline{u}<\bar{u}$. If $u<y-z-u_H$, then only unwanted kids are born, leading to an expected total utility equal to $Y+(1-p)\,y+p\,(z+u_H+u)$.

The next step is to analyze the properties of the equilibrium. As we said above, a crucial distinction is related to the respective number of men and women on this market. We thus consider two cases.

3.2 Marriage market with excess supply of women

We first consider the case of an excess supply of women; i.e., we assume that $M<1$. Because women are in excess supply, they have to compete for marriage. An intuition of the driving force behind this competition is provided by Figure 1, which plots the maximum utility a man can achieve when marrying a woman of taste u (if he was to get all the surplus generated by marriage), as a function of u. The function is increasing; i.e., it is always better (for the husband) to marry a wife with a large taste coefficient u. More precisely, there exist three categories of women. Women whose parameter u is greater than $\bar{u}$ (the 'high' type) would plan to have a child even when single; these would be chosen in priority, and are equivalent from a husband's perspective (since they require the same compensation for getting married, namely the income with a child, z). Women between $\underline{u}$ and $\bar{u}$ (the 'intermediate' type) come next in males' preferences; they would plan to have a child only when married, and the compensation they require decreases with their taste parameter (so men prefer intermediate women with a higher parameter u). Finally, women with a u smaller than $\underline{u}$ (the 'low' type) never plan to have a child. Again, these women are equivalent from a husband's perspective, since they require the same compensation for getting married, namely their consumption as single, i.e. y. The intuition, here, is that women with a larger preference for children have a comparative advantage: the compensation they need from their husband to accept marriage is smaller, because they valuate highly the possibility of having a child.

Insert Figure 1 here

As often in matching models, the properties of the stable match crucially depend on the identity of the marginal spouse (i.e., the 'last' married woman). We denote by $u(M)$ the taste parameter of the marginal women; then the category of the marginal woman depends on the location of $u(M)$ with respect to the two thresholds $\underline{u}$ and $\bar{u}$. Thus three cases should be distinguished:

- If $M \leq \underline{W} = \int_{\bar{u}}^{U} f(t)\, dt$, the excess supply of women is 'large', in the sense that there are less men than high type women. Then $u(M) \geq \bar{u}$, and the marginal married women belongs to the high type. Only (some of) these women are matched; they do not receive any surplus from marriage, hence their consumption is the same as if single. Women of the same type who remain single decide to have a kid; all other women remain single and decide not to have children (although they may have one involuntarily).

- If $\underline{W} < M \leq \bar{W} = \int_{\underline{u}}^{U} f(t)\, dt$ ('intermediate' excess supply of women), the marginal wife belongs to the intermediate type; specifically, her taste parameter $u(M)$ is defined by the equation

$$\int_{u(M)}^{U} f(t)\, dt = M.$$

  which states that the number of women with a taste parameter larger than $u(M)$ equals the number of men M. All married women have a child, and consume the same amount, which is such that the marginal wife is indifferent between getting married and remaining single. In particular, all married women (but the marginal one) get a positive surplus from marriage.

- Finally, when the excess supply of women is small enough (technically, $M > \bar{W}$), the marginal wife belongs to the low type (i.e. $u(M) \leq \underline{u}$). Her fertility is the same with and without marriage - namely, no planned child. Stability requires that her consumption be also the same, i.e. equal to $(1-p)\, y + pz$. The same conclusion applies to all married, low type women. Other married women belong to the high or

intermediate type, hence decide to have a child; their consumption is defined by the fact that men, who are in short supply, must be indifferent between the various potential spouses. Note that this condition generates a positive surplus for all of them.

These conclusions are formally expressed in the following Proposition:

Proposition 1 *In the presence of excess supply of women, there exists at least one stable match. For any stable match, all men marry; moreover:*

- *if* $M \leq \underline{W}$*, then all married women have a taste parameter* $u \geq \bar{u}$*; they all choose to have a child, and consume an amount* $c_0 = z$*, thus reaching a utility level of* $z + u$*. Some single women decide to have a child, others do not.*

- *if* $\underline{W} < M \leq \bar{W}$*, then all married women have a taste parameter* $u \geq u(M)$*, where* $u(M)$ *is defined by*

$$\int_{u(M)}^{U} f(t)\, dt = M, \text{ with } \underline{u} < u(M) \leq \bar{u}.$$

  All married women have a child, and consume an amount

$$c(M) = (y - u(M))(1 - p) + pz,$$

  thus reaching a utility level of

$$(y - u(M))(1 - p) + pz + u.$$

  No single woman plans to have a child.

- *if* $M > \bar{W}$*, then a married women decides to have a child if her taste parameter* u *is larger than* $\underline{u}$*; then she consumes* $\bar{c}_C = z + (1 - p)\, u_H$*. If, alternatively,* $u < \underline{u}$ *the woman does not plan to have a child, and consume an amount* $\bar{c}_N = (1 - p)\, y + pz$*. No single woman plans to have a child.*

Proof. *See Appendix 1* ■

The equilibrium is technically not unique, because in the first and third situations the identity of married women is indeterminate. In the first case, high type women are identical from the husband's perspective, hence any subset of size M may be married at equilibrium; and the same argument applies to low type women in the third case. Note, however, that the respective consumptions are uniquely determined in each case.

The variation in women's utility across the three types of equilibria exhibits interesting patterns. Not surprisingly, women are better off the smaller their excess supply on the market. However, when women's excess supply is either large or small, their welfare does not depend on the size of the imbalance. In the intermediate case, on the contrary, a marginal increase in the number of men continuously ameliorates married women's welfare.

3.3 Marriage market with excess supply of men

The alternative case in which men are in excess supply on the marriage market is much simpler. All women are married; and stability requires that each married man be indifferent with remaining single. We thus get the following result:

Proposition 2 *For any stable match, all women are married, men are indifferent between being married or single, and their utility is Y. Moreover:*

- *a woman with taste $u < \underline{u}$ plans not to have a child; she consumes $(1-p)\,y + p\,(z + u_H)$*
- *a woman with taste $u \geq \underline{u}$ will have a child and consume $z + u_H$*

In words: since men have to be indifferent, women leave them with whatever is needed for them to achieve their utility as single, namely Y. In particular, the utility men derive from having children is captured by women under the form of additional consumption.

The conclusions of the two Propositions are summarized in Table 1.

Insert Table 1 here

3.4 Comparative statics

Simple as it may be, our model still offers interesting insights on the role of several key parameters.

Incomes Consider, first, the impact of female income on fertility and allocations. Nor surprisingly, female utility always increases with both y (her income without a child) and z (her income with a child). However, the respective impact of the two incomes on a woman's welfare depends on the woman's type. For high type women, for instance, an increase in z is always favorable, since they always have a child; still y may also matter in the intermediate case, because the rent they receive is then positively related to the income of childless women. The opposite logic prevails for women of the low type: y always matter, because they will never have a child other than unwanted.

The situation is more complex when y and z do not increase by the same *amount*, because of the possible impact on the fertility decisions and the type of equilibrium finally reached. An interesting illustration obtains when both y and z are increased by the same *factor*. Then the difference $y - z$ increases proportionally, which reduces the number of high type women and inflates the low type population (the effect on the intermediate type depends on the distribution of tastes). A first consequence is a negative impact on fertility. More interestingly, the type of equilibrium reached may switch, at least when women are in excess supply; indeed, the thresholds $\underline{u}$ and $\bar{u}$ are positively related to the difference $y - z$. For instance, a 'large' excess supply of women (in the sense just define) may become 'intermediate'; and an intermediate case may switch to 'small'. Hence, in a sense, the growth in female income reduces the severity of the excess supply phenomenon, which further inflates their welfare gain but decreases male well being.

Smaller male population Let us now study the impact of the size M of the male population. Not surprisingly, a variation large enough to switch from an excess supply of men to an excess supply of women will favor men and cost to women. More interesting are changes taking place within the excess supply of women regime. Assume, for instance, that the initial situation is characterized by an intermediate excess of women. All married women (but the marginal one) receive a share of the surplus generated by marriage. A reduction the male population, assuming that the equilibrium remains an

'intermediate excess supply' one, moves the threshold $u(M)$. Some women who were previously married are now single; they decide not to have children, which reduces total fertility, and they lose entirely the share of the marital surplus they initially received. Even women who are married in both cases receive a smaller share of the surplus in the second situation.

Assume, now, that the number of men is reduced below the threshold $\underline{W}$, so that the equilibrium switches to a 'large excess' type. Various consequences can be expected:

- In the initial situation, some of the intermediate type women were married and had a child, while they are single and childless in the new equilibrium; hence *total fertility is smaller*.
- High type women were all married and had a child in the initial equilibrium. Some of them are now single, but they still choose to have a child. The result is *higher out-of-wedlock fertility*.
- The welfare of *all* married women is decreased down to their reservation utility. Indeed, in the initial, 'intermediate excess supply' equilibrium, married women receive a share of the surplus generated by marriage. In the new, 'large excess supply' equilibrium, however, men appropriate all the surplus, leaving married women at their reservation, single mother utility.
- The same analysis applies to those intermediate women who are married in the initial equilibrium but not in the new one. Again, all but the marginal one receive a fraction of the surplus when married, so that singlehood results in a welfare loss. In both cases, male utility is increased.

Finally, a similar analysis applies if the equilibrium switches from 'small' to 'intermediate excess supply' types. On the contrary, if the initial equilibrium was characterized by a large excess supply of women, or if their excess supply is 'small' in both cases, welfare does not change in response to a reduction in M.

Single parent benefits So far, we have assumed that the income of a woman with a child is z whatever her marital status. We now allow for single parent benefits, say b. Hence the income of a woman with a child

is still z when she is married, but becomes $b + z$ when single. We assume, however, that $b \leq u_H$, i.e., that the surplus stemming from the public nature of children in case of marriage compensates the (monetary) loss of the single parent benefit. This condition is necessary for marriage to take place at equilibrium.

The consequences of the introduction of single parent benefits are summarized in Table 2 (where the changes with respect to the initial situation are in bold). Note that Table 2 does not include the last case (excess supply of men): single parent benefits do not matter in that case since all women are married and receive all the surplus created by marriage.

Insert Table 2 here

The main changes with respect to the initial situation can be summarized as follows. First, the upper threshold $\bar{u}$ declines by b: more women are now willing to have children even when single. It follows that when the excess supply of women is 'large', *out-of-wedlock fertility* increases. Note that, technically, an equilibrium initially classified as 'intermediate' may now become 'large', since the number of high type women has increased.

If we assume that the type of equilibrium does *not* switch, then women always gain from the introduction of the benefits. Specifically:

- In the case of a large excess supply of women, women of intermediate or low type are single and chose not to have a child. Still, they are entitled to the additional payment b in case of unwanted pregnancy; hence an increase in expected utility equal to pb. Women of the high type receive an additional gain equal to b when they are single, because they all have a child. But then equilibrium require that they receive the same gain when married (their reservation utility has increased by b). We thus have the counter-intuitive result that the introduction of the benefit profits all women, and that married women (who do not receive the benefit) gain on average more (per capita) than most singles. Not surprisingly, men lose the same amount.

- When the excess supply of women is either intermediate or small, all women (married or single) get an extra pb, and all men lose the same expected amount.

These conclusions should however be qualified for two reasons. First, when the initial excess supply of women is 'large', the number of potential spouses (i.e., women of the high type) increases. For a given supply of men, this decreases the probability that each one gets married; note, however, that since women are indifferent between getting married and remaining single, the welfare loss is nil (at least in our model). A more complex situation arises when the equilibrium switches from 'intermediate' to 'large'. While single parent benefits tend to improve married women's situation, the switch harms then, because tougher competition on the marriage market results in smaller rents. In our simple model, women receive a share of the surplus generated by marriage in the intermediate case, but not when the excess supply is large. The welfare comparison is complex, because this loss should be traded off with the higher expected utility when single (which boosts married women's reservation point). It can be showed that depending on the parameters, the introduction of the benefit may actually harm married women (then it profits to men).

Finally, if the distribution of these single parent benefits is 'too' generous, in the sense that $b > u_H$, then marriage becomes inefficient from the couple's viewpoint;[10] indeed, the surplus generated may be inferior to the opportunity cost in terms of lost income. Then welfare benefits would decrease (in our model, eliminate) marriage, fertility becoming exclusively an out-of-wedlock phenomenon.

In practice, our simple model generates predictions that seem to fit fairly well the main features of the marriage market in the US. Some predictions are fairly straightforward. The raise of female wages has had a negative impact on fertility, while more generous single parent benefits have resulted in a larger number of out-of-wedlock birth. More interesting (and perhaps less expected) is the fact that a decline in male labor supply, per se, reduces total fertility but increases out-of-wedlock birth rate - a mechanism that may have played an important role in specific submarkets. For instance, an overwhelming phenomenon that took place during the last decades is the dramatic decline in employment for black males with no college education.[11]

[10] Throughout the paper, we assume that the single parent condition can be enforced; i.e., we do not consider situations in which a man and a woman enjoy the benefits of parenthood through cohabitation while receiving the single parent benefit.

[11] Among black men aged 26-36 with education less than high school, the percentage of individuals who worked at least 26 weeks during the poll year dropped from 80% in 1960

According to our analysis, such a brutal change should induce a sharp rise in non marital fertility. Moreover, the augmentation should be further boosted by the increased generosity of single parent benefits over the beginning of the period; note, however, that this latter trend has been largely reverted since the 80s while the increase in birth outside marriage has persisted, suggesting that the marriage market factor may have been dominant. Note that, on this point, our results are in line with the earlier intuition of Neal (2004).

4 Changes in the birth control technology

We now come to the main implications of our model, namely the impact of a technological change in birth control.

Legalizing abortion We first consider the impact of innovations in birth control technology that reduce the probability of unwanted pregnancies, assuming that all women (including single) are given free access to the technology; a natural example could be the legalization of abortion that took place in the 70s.

We start with the case of an excess supply of men. Then the innovation has no impact on behavior, and a straightforward impact on welfare. Before and after the change, all women are married. The welfare of women of the high and intermediate type does not change: since all are married and planning to have kids, the technology has no consequence. Couples in which the wife is of the low type are better off, but only because they do not plan to have a child, and the new technology improves their ability to reach that goal. Clearly, all the gain goes to the wife.

The situation is drastically different in the alternative (and probably empirically more relevant) situation in which women are in excess supply. The conclusions, then, are the following:

- Not surprisingly, women who do not want to have a child (either because they belong to the low type or because they are single) benefit from the technology, precisely because unwanted pregnancies become less likely. In the extreme situation in which unwanted pregnancies are eliminated, the monetary gain is thus $p(y-z-u)$

to 44% in 1990. For high school graduates, the drop is from 86% to 67% (Neal, 2004, table 2). See also Wilson (1987) and Western and Pettit (2000).

- More interesting is the fact that when the excess supply of women is not 'large' (in the sense defined above), women who decide to have a child do also benefit from the technology, although to a lesser extent than singles. The intuition is that the intrahousehold distribution of resources is driven by the marginal women; for a small or intermediate excess supply of women, the marginal women is indifferent between getting married and remaining single *without kid*. Her reservation utility is thus boosted by the new technology. The nature of a matching game, however, implies that any improvement of the marginal agent's situation must be transmitted to all agents 'above' the marginal one.

  In practice, in the case of an intermediate excess supply, the benefit experienced by all married women, assuming the new technologies drives the risk of unwanted pregnancies to zero, is $p.(y-z-u(M))$ (where, again, $u(M)$ denotes the taste parameter of the marginal married woman). This benefit continuously increases with the number of men M. When the excess supply is small, the gain is $p.u_H$, still smaller than $p.(y-z)$, but nevertheless positive.

- Finally, men cannot gain from the introduction of the new technology. When the excess supply of women is large, their utility is not affected. When the excess supply of women is small, so that the marginal wife does not want a child, the total welfare of the household is increased, but so is the reservation utility of the wife; the husband is left with the same consumption, but loses the benefit he would have received from an unwanted birth. The intermediate case is even more spectacular. Here, all marriage result in a child being born, so the total surplus generated by marriage is not affected by the innovation. What changes, however, is the intrahousehold allocation of the surplus. The new technology improves the reservation utility of the marginal woman, hence her share of resources; stability requires this shift to be reproduced in all couples. All in all, the new technology results in a net transfer from the husband to the wife, equal to the expected gain of the marginal single woman, i.e. $p.(y-z-u(M))$.

In our model, thus, an improvement in the birth control technology, such as the legalization of abortion, generally increases the welfare of all women, including those who do not abort but decide to have a child instead. Note,

however, that the mechanism generating this gain is largely indirect. The reason why even married women willing to have a child benefit from the birth control technology is that the latter, by raising the reservation utility of single women, raises the 'price' of all women on the matching market.

The power shift of the pill The previous argument shows clearly that an important channel through which the new technology benefits all women is the raise in reservation utility - what could be called 'empowerment'. In turn, the source of this empowerment lies in the fact that single women can access the new technology. Consider, now, a situation in which a new technology of this type is introduced but exclusively available to married women - as it was the case for the pill in the 60s.

Our conclusions are then drastically modified. Specifically, considering the case in which women are in excess supply, we have the following:

Proposition 3 *In the presence of excess supply of women, when the new technology is available to married women only, there exists at least one stable match. For any stable match, all men marry; moreover:*

- *If $M \leq \underline{W}$, then all married women have a taste parameter $u \geq \bar{u}$; they all choose to have a child, and consume an amount $c_0 = z$, thus reaching a utility level of $z + u$. Some single women decide to have a child, others do not. The new technology is not used and makes no difference.*

- *If $M > \underline{W}$, there exists two thresholds $u_1(M)$ and $u_2(M)$ defined by*

$$\begin{aligned} M &= \int_0^{u_1(M)} f(t)\,dt + \int_{u_2(M)}^{U} f(t)\,dt \\ &\text{and} \\ y - z &= u_H + p u_1(M) + (1-p)\,u_2(M) \end{aligned}$$

  These thresholds satisfy $u_1(M) \leq \underline{u} \leq u(M) \leq u_2(M) \leq \bar{u}$ and are such that

  - *Women with a taste parameter $u \geq u_2(M)$ are married and have a child; their welfare is smaller than without the new technology*

- *Women with a taste parameter* $u(M) \leq u < u_2(M)$ *are single (whereas they would have been married without the new technology); their welfare is smaller than without the new technology*
- *Women with a taste parameter* $u_1(M) \leq u < u(M)$ *are single with and without the new technology; their welfare is identical*
- *Women with a taste parameter* $u < u_2(M)$ *are married (whereas they would have been single without the new technology); their welfare is larger than without the new technology*

Finally, men gain from the introduction of the new technology.

Proof. *See Appendix 2* ■

The conclusions of Proposition 3 are summarized in Table 3.

Insert Table 3 here

In words, the introduction of the new technology has different consequences. First, the selection of women into marriage is qualitatively different from the initial case, at least when the excess supply of women is not 'large'. Figure 2 gives the plot of the maximum utility a man can achieve when marrying a woman of taste u (if he was to get all the surplus generated by marriage), as a function of u; it thus corresponds, in the new setting, to Figure 1 in the previous context. The key remark is that the graph is no longer monotonic. Indeed, marriage now also attracts women with a very low taste for children - precisely because they view marriage as the only way to access the birth control technology. The competition for marriage becomes tougher. Some intermediate women are single, whereas they would have been married otherwise. Even for women who are married in both situations, welfare is lower with the new technology, because increased competition on the marriage market reduces their share of total surplus. The gainers from the new technology are women with the lowest taste for children, and men.

Insert Figure 2 here

In other words, reserving the new technology to married women essentially *reverses* the empowerment effect. The arrival on the marriage market of women with a low taste for children toughens competition for husbands; women of the high or intermediate type are made worse off by the introduction of the new technology. Only women with a very low taste parameter (i.e., below the lower marginal value) gain from the innovation.

This comparison emphasizes the complex and partly paradoxical welfare impact of a new technology. On the one hand, its effects can go well beyond the individuals who actually use it, or even consider using it. Our model suggests that a major effect of legalizing abortion may have been a shift in the intrahousehold balance of powers, and in the resulting allocation of resources, even in couples who were not considering abortion as an option. On the other hand, the new technology benefits all married women only because it is available to singles. A technological improvement which is reserved to married women will have an impact on their fertility, partly because it changes the mechanisms governing selection into marriage. But its impact on women's welfare is largely negative, except for a small fraction of women who chose marriage as an access to the new technology.

Our analysis thus suggests that as far as the intrahousehold balance of power is concerned, the introduction of the pill in 1960 (when it was available to married women only) may have had a *disempowerment* effect on most women. The true empowerment revolution came later; it was caused by the generalization of its availability for single women during the late 60s, and strengthened by the legalization of abortion in the 70s.

5 Extensions

Costly access to the new technology A first extension of the model introduces the assumption that access to the new technology is 'costly'. The cost, here, should be understood in a general way; it includes financial costs, but also the moral or ethical discomfort some women may experience with the new technology. The crucial point, however, is that the distribution of this cost among women is not (too) correlated with marital status. If abortion is costly for single women only, we are back to the previous case of a technology exclusively available to married women. To keep things simpler, we consider

the opposite polar case. We thus assume that among women with identical preferences some are willing to adopt the new technology while the others do not, and that the respective proportion of the two classes (say, μ and $1-\mu$) is identical for all values of the taste parameter u. Also, we concentrate on the case in which women are in excess supply.

In this new context, women who do not accept the new technology are in a weaker position on the market, because their reservation utility as single is lower. A first consequence is that these women are, everything equal, more likely to marry. Regarding the equilibrium structure, there are now four possible cases. First, when the excess supply of women is 'large' in the previous sense, nothing is changed, since the marginal married woman belongs to the high type and wants children in all situations.

In all other situations, things are more complex (see Figure 3). Indeed, married women may either be women with a large taste parameter or women unwilling to adopt the new technology (both being ready to accept a lower compensation). Depending on the size of male supply, four cases may obtain.

- In the first case, there exist two marginal married women; both belong to the intermediate type, but one accepts the technology while the other does not, the taste parameter being larger for the former. In this situation, all low type women are single, as well as some intermediate type.

- In the second case, there are still two marginal women, but one (who rejects the technology) belongs to the low type, while the other is 'intermediate and accepts abortion.

- The third possible situation is such that all women who reject the technology (including the 'low type' ones) are married, whereas some intermediate women who accept the technology remain single; there is only one marginal woman, who belongs to the intermediate type and accepts abortion.

- Finally, if the supply of male is large enough, the only women remaining single (as well as the marginal married woman) are low type women who accept the technology.

Insert Figure 3 here

From a welfare point of view, it should be noted that no woman can possibly lose from the introduction of the new technology, even when some (possibly many) women reject its use. It is in general the case that all women gain from the introduction, including those who reject it, except when the excess supply of women is large. Conversely, if we take as a benchmark the situation in which all women can access the technology, the introduction of costs that preclude its use by some women harms all women in general.

This remarks sheds a new light on the reforms affecting the accessibility to abortion, for instance through Medicaid public funding. For example, in the first few years after the national legalization of abortion in 1973, abortion was eligible for Medicaid public funding; this provision was ruled out in 1976 by the Hyde Amendment that generated many similar provisions at the state level. According to out analysis, these fluctuations in public funding not only modify women's actual use of abortion, but affect the gains generated by the legalization *for all women* - including those who are willing to bear the costs and those who are not interested in abortion in any case.

Shotgun marriages In the discussion of the consequences of legalized abortions, the issue of 'shotgun marriages' has attracted considerable attention. In an influential paper, Akerlof, Yellen and Katz (1996) has argued that abortion led to the disappearance of shotgun marriages, since women could avoid unwanted pregnancies, a fact that was known to (and potentially used by) men. They conclude that legalizing abortion may actually have harmed some women.

A first difference between AYK's model and ours reflects the emphasis we put on the intrahousehold allocation of resources as the endogenous outcome of equilibrium formation on the marriage market. In our model, a women being 'shotgun married' is not necessarily better off than a woman remaining single. The intuition is simply that in a context of excess supply of women, the surplus generated by marriage will be fully appropriated by the husband; the woman will thus 'pay' the marriage by a low share of household consumption.

While this extreme conclusion is clearly linked with our simple setting (e.g., the absence of frictions, hence of post-marital bargaining), we still believe that it stresses an important issue - namely, that shotgun marriage may not come for free. Whether forced marriages closely following an unwanted

pregnancy really benefited women is not clear; after all, the resulting allocation of household resources may not have been very favorable to women, and it is at least conceivable that the new wife's situation within such 'shotgun couples' was no better (or possibly worse) than what it would have been had she been single. We believe, in particular, that a crucial and possibly disputable component of the AYK model is the assumption that the benefit of marriage are exogenously given, and such that women are always better off married than single.

However, a second effect, which is explicitly discussed by AYK and can readily be incorporated into our model, may reverse this optimistic conclusion. Assume that a fraction of the male population is not interested in marriage, but only in sexual activity. Assume, furthermore, that in the absence of the birth control technology, social norms impose an implicit commitment from the male part, whereby sexual activity leading to pregnancy must end up in marriage, even against the male's initial intention. Assume, finally, that the availability of abortion results in the disappearance of the social norm, in the sense that the father of an unwanted child no longer feels committed by the mother's decision to keep the child. Under such circumstances, the new technology may result in a reduction in male labor supply. According to the previous analysis, such a reduction may be harmful for women in two cases: when the initial equilibrium was characterized by an intermediate excess supply of women, and when the type of equilibrium changes because of the cut in male supply.

The issue is difficult to assess empirically, if only because modifications of social norms are hard to document (let alone measure). Note, however, that a complete investigation must involve estimates of intrahousehold inequality. If our perspective is correct, neglecting changes in intrahousehold allocations resulting from the new technology may lead to erroneous conclusions. To take but one example, the idea of a 'feminization of poverty' taking place in the 70s should probably be considered with some caution. Insofar as available empirical evidence mostly relies on comparison between individuals and couples while failing to address the crucial issue of the allocation of individual well-being within couples, it may be largely misleading. Standard answers to this problem, based on equivalence scales, are inadequate. Relating the income of a single mother to half the income of a couple amounts to assuming that income is split equally within the couple. Our paper points precisely in the opposite direction: economic theory in general, and equilibrium considerations in particular, tells us that the split is endogenous, driven

by the environment, and responsive to the technological changes as well as to market conditions in general. Should these effects be taken into account, the conclusions may be reversed.

In order to establish that some female pauperization resulted from the legalization of abortion, one has to compare the *individual* welfare of women before and after the change. The mere claim, central in AYK's argument, that the reform reduced the number of marriages directly implies that the comparison has to be between the well being of married and single women. From a theoretical perspective, standard, 'unitary' models of household are unable to help, since they do not allow to recover individual utilities within the couple. The alternative, 'collective' approach seems particularly well adapted to tackle the problem. Although available evidence is scarce, Orrefice's (2004) findings, already mentioned, suggest that the effects described in our model are well supported by the data. Clearly, additional work on the topic would be welcome. We strongly believe, however, that future progresses on this issue will necessarily adopt some variant of the collective model.

Finally, AYK's 'shotgun' explanation raises difficult questions. Two of them were formulated by Neal (2004): If one believes that the decline in shotgun marriages is the primary explanation for the rise in never-married motherhood, why should the impact be concentrated among the economically disadvantaged, and especially among less educated black women? And how come the number of adoptions per non marital birth did not increase over this period? Note that our model provides simple answers for both phenomena. We relate the raise in out-of-wedlock fertility to the sharp decline in men's supply, a characteristic of the population of black male with lower education, and the higher generosity (*relative* to income) of single parent benefits for the poorer fraction of the population. Moroever, in our model the babies born out-of-wedlock were *wanted*, which explains the feable rate of adoptions.

Another empirical implication of AYK's 'shotgun' mechanism can readily be tested. In our framework, the 'impoverishment of women' effect described by AYK must operate through a particular channel, namely a reduction in the supply of men on the marriage market. If we think of the marriage market as mainly composed of women who do not get married by trying to get pregnant and of men who are actually willing to marry, then our initial approach applies, leading to the conclusion that abortion empowered women. On the contrary, if the legalization of abortion results in a significant fraction of the population deciding to remain single instead of getting married, then its impact on female welfare is unclear. To empirically analyze this issue, we

try to see whether legalization had a significant impact on the probability that a male will remain single. Casual observation does not seem to support this prediction. While the fraction of single men among all employed men increased over the period, the trend started much before legalization, and does not seem significantly affected by the new context (see Figure 4).

Insert Figure 4 here

To formally confirm these observations, we regress the probability of being single on age, education, race and fixed effect by year and state, as well as an abortion dummy[12] on the population of men in the PSID.[13] We find that the coefficient of the abortion dummy is significantly *negative* (see Table 4), which again contradicts the prediction. Similar results obtain using the CPS.

Insert Table 4 here

These results suggest that the central mechanism in AYK, namely that a significant proportion of males decided to withdraw from the marriage market (hence remain single) following legalization, may not be supported by the data. Clearly, though, this conclusion is at best preliminary; additional empirical work on this topic will be welcome.

6 Conclusion

Obviously, the model proposed in this paper provides (at best) a simplified view of the phenomena at stake. Many issues remain open. Marriage markets are characterized by multidimensional heterogeneity (tastes, but also incomes, ...). Frictions are paramount, which implies that intrahousehold bargaining could profitably be taken into account. Dynamic issues are crucial, not only because divorce and remarriage are important features of the

[12] The corresponding variable is equal to one if abortion was legal in the particular year and state under consideration, zero otherwise.

[13] Unemployed male are left aside, since it is usually assumed that they cannot fully enter the marriage market.

market, but also because such factors as the average age at marriage or the age difference between the spouses are known to matter for equilibrium.

On the other hand, our conclusions are likely to be robust to several extensions. For instance, a single, unified market for marriage does not exist; the relevant concept is more a multiplicity of markets by age, localization, and to a large extent race and religion. Our model applies to each of these submarkets, with possibly different conclusions in the various contexts. For instance, the decrease in the supply of men may be a more stringent phenomenon in some contexts (say, younger population in impoverished urban neighborhoods) than in others - and this fact may explain considerable differences in marriage or out-of-wedlock fertility across the population. Clearly, the empirical definition of these submarkets and the measure of their interconnections will raise delicate problems for future research.

Finally, we believe that our approach puts forth important insights regarding the impact of birth control technologies. One is that issues related to intrahousehold allocation are of crucial importance. The distribution of resources and welfare within couples must be understood as an endogenous phenomenon, which responds to changes in the economic and technological environment. In particular, the introduction of new technologies (or new benefits, for that matter) may have a major impact on individual welfare within couples who are no direct users. This intuition has been frequently mentioned by sociologists (the idea of 'female empowerment' resulting from the legalization is an old theme of feminist studies), but it may have been somehow disregarded by economists, at least as far as explicit modeling is concerned.[14]

A second contribution of our model is precisely to show how the 'collective' analysis, which has been largely developed at the household level, can easily be incorporated into a market-wide analysis to provide a model of the type required. In a sense, this is a very natural extension: the 'sharing rule', a crucial ingredient of the collective approach, has a very natural interpretation in the context of a matching model. Our model thus belongs to the line of research initiated by Chiappori and Weiss ($$$) and recently illustrated by Browning, Chiappori and Weiss ($$), Iyigun and $$ ($$) and Chiappori, Iyigun and Weiss ($$$). We hope that these approaches will be extended in the future.

[14] An interesting and early exception is the analysis of guaranteed employment programs in India proposed by Haddad and Kanbur ($$$).

References

[1] Akerlof, G., Yellen J., Katz M. (1996), "An analysis of out-of-wedlock childbearing in the United States", *Quarterly Journal of Economics*, 111- 2, 277-317

[2] Angrist, J. (2002), "How do sex ratios affect marriage and labor markets? Evidence from America's second generation", *Quarterly Journal of Economics*, 117-3, 997-1038

[3] Angrist, J., Evans, W. (1996), "Schooling and labor market consequences of the 1970 state abortion reforms", NBER working paper # 5406

[4] Becker G. (1973), "A Theory of Marriage: part I", *Journal of Political Economy*, 81-4, 813-846

[5] Browning M. and P.-A. Chiappori (1998), " Efficient Intra-Household Allocations: a General Characterization and Empirical Tests", *Econometrica*, 66, 1241-1278.

[6] Choo E., Siow, A. (2003), "Who marries whom and why", mimeo, University of Toronto

[7] Coombs, L., Fernandez, D. (1978), "Husband-wife agreement about reproductive goals", *Demography*, 15-1, 57-73

[8] Edlund L. (2004), "Sex and the city", mimeo, Columbia University

[9] Goldin, C., Katz, L. (2000), "Career and marriage in the age of the pill", *American Economic Review*, 90-2, 461-465

[10] Goldin, C., Katz, L. (2002), "The power of the pill: oral contraceptives and women's career and marriage decisions", *Journal of Political Economy*, 110-4, 730-770

[11] Héritier, F. (2002), "*Masculin/Féminin II*", Odile Jacob

[12] Neal, 2004

[13] Siow A. (1998),"Differential Fecundity, Markets, and Gender Roles", *Journal of Political Economy*, 106-2, 334-354

[14] Siow A. (2002), "Do innovations in birth control technology increase the welfare of women?", mimeo, University of Toronto

[15] Western and Pettit (2000).

[16] Williams, L. (1994), "Determinants of couple agreement in US fertility decisions", *Family planning perspectives*, 26-4, 169-173

[17] Wilson (1987)

Table 1
Agents' utilities in the various equilibria.

	ESW		
	Large	**Intermediate**	**Small**
Marriage	$\geq \bar{u} = y - z$	$u(M)$	$\leq \underline{u} = y - z -$
H women	$z + u$	$(y - u(M))(1-p) + pz + u$	$z + (1-p)u_H$
I women	$(1-p)y + p(z+u)$	married: $(y - u(M))(1-p) + pz + u$ single: $(1-p)y + p(z+u)$	$z + (1-p)u_H$
L women	$(1-p)y + p(z+u)$	$(1-p)y + p(z+u)$	$(1-p)y + p(z$
Men	$Y + u_H$	$Y - (y - z - u(M))(1-p) + u_H$	$Y + pu_H$

Notations: 'Marriage' denotes the threshold on the parameter taste u for which marriage takes place.

ESW: excess supply of women; ESM: excess supply of men.

Table 2
Same, single parent benefit **b**.

	ESW		
	Large	**Intermediate**	
Marriage	$\geq \bar{u} = y - z - \mathbf{b}$	$u(M)$	$\leq \underline{u} =$
H women	$z + u + \mathbf{b}$	$(1-p)(y - u(M)) + p(z + \mathbf{b}) + u$	$z + (1 -$
I women	$(1-p)y + p(z + \mathbf{b} + u)$	married: $(1-p)(y - u(M)) + p(z + \mathbf{b}) + u$ single: $(1-p)y + p(z + \mathbf{b} + u)$	$z + (1 -$
L women	$(1-p)y + p(z + \mathbf{b} + u)$	$(1-p)y + p(z + \mathbf{b} + u)$	$(1-p)y$
Men	$Y + u_H - \mathbf{b}$	$Y - (y - z - u(M))(1-p) + u_H - \mathbf{pb}$	$Y +$

Table 3

Same, new technology for married women only.

		ESW	**ESM**
	Large	**Intermediate**	
Marriage	$\geq \bar{u} = y - z$	$\leq u_1(M)$ or $\geq u_2(M)$	All women mar
H women	$z + u$	$(y - u_2(M))(1-p) + pz + u$	$z + u_H + u$
I women	$(1-p)y + p(z+u)$	married: $(y - u_2(M))(1-p) + pz + u$ single: $(1-p)y + p(z+u)$	$z + u_H + u$
L women	$(1-p)y + p(z+u)$	married: $(1-p)y + p(z + u_1(M))$ single: $(1-p)y + p(z+u)$	y
Men	$Y + u_H$	$Y - (1-p)(y - z - u_2(M)) + u_H$ $= Y + p(y - z - u_1(M))$	Y

Table 4
Probit estimates (dependant variable: 1 if single); PSID

Number of obs = 33345
Log likelihood = -7266.8866
Pseudo R2 = 0.1772
(standard errors adjusted for clustering on state)

Variable	Coefficient	Robust SE	z	P(>z)
Dummy legalization	-.0148	.006	-2.57	.01
Age	-.0038	.00019	-6.81	.00
Schooling	.0009	.0002	3.38	.00
Dummy black	.0523	.0134	4.97	.00

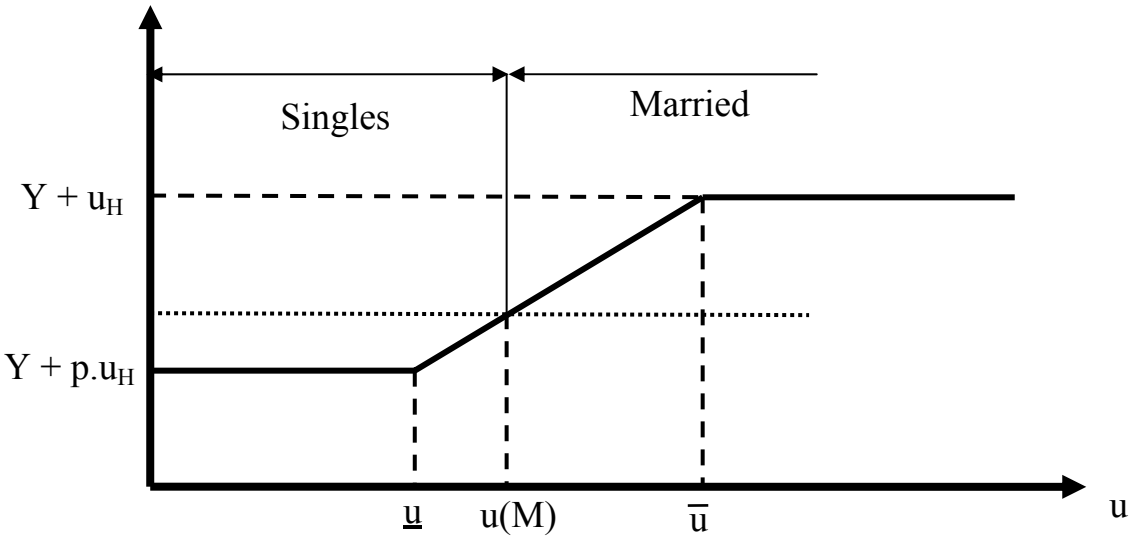

Figure 1
Maximum husband's utility as a function of the wife's taste
Initial model

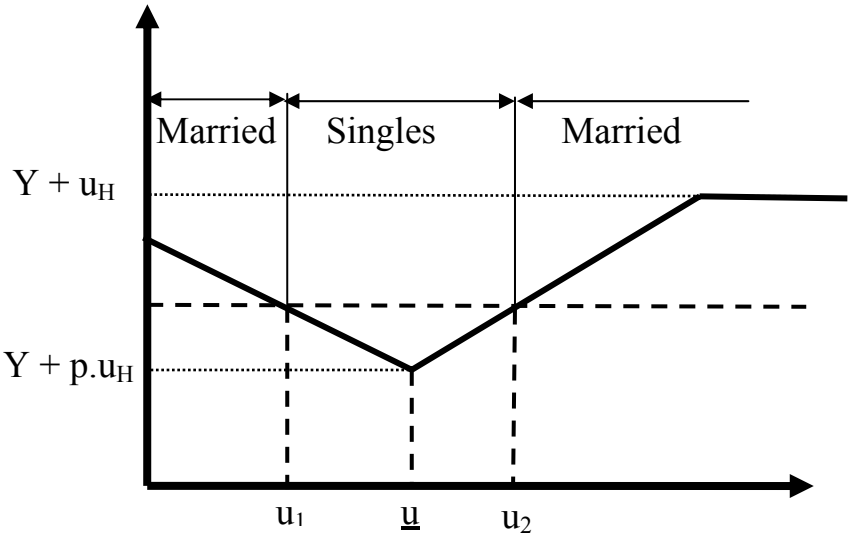

Figure 2
Maximum husband's utility as a function of the wife's taste
Innovation available to married women only

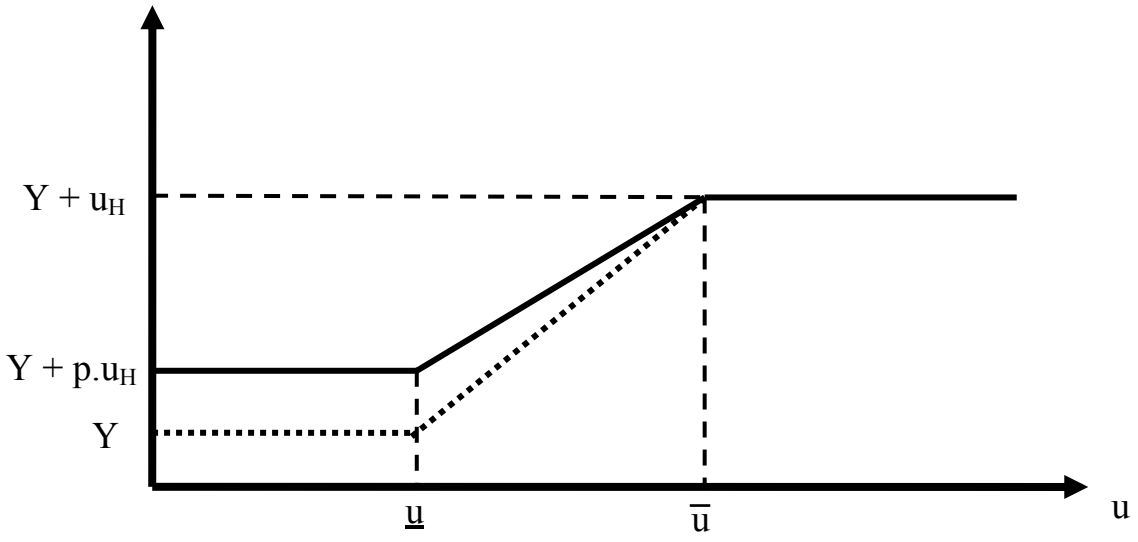

Figure 3
Costly access to the new technology
(women who accept the technology are represented by the dotted line)

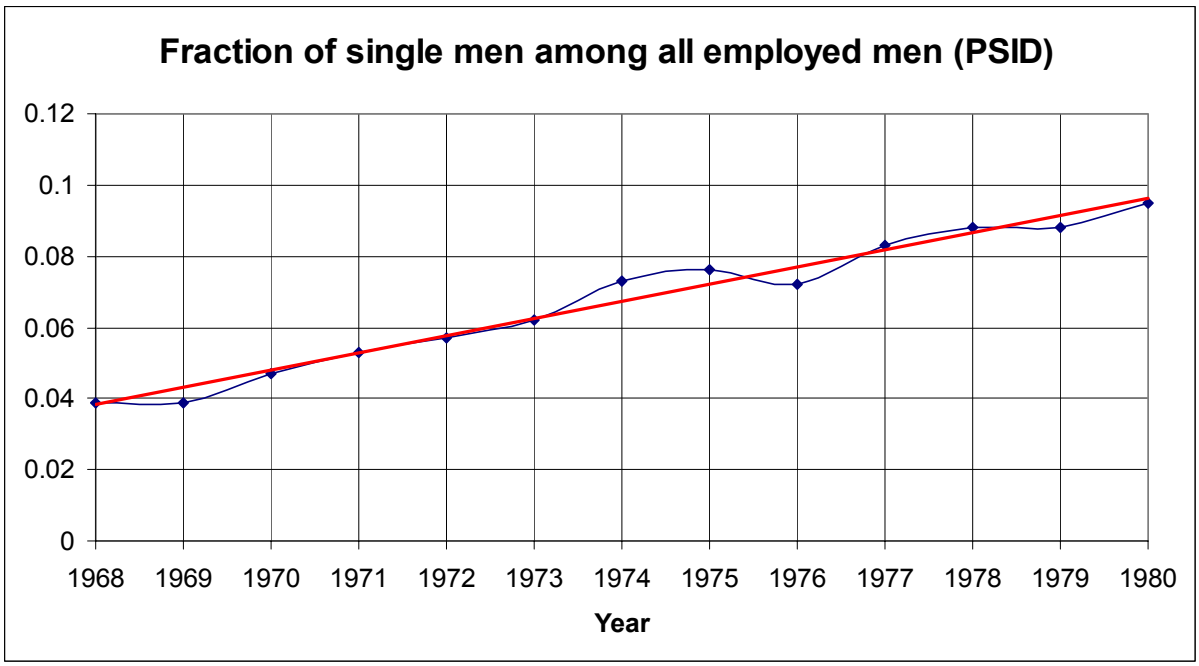
Fraction of single men among all employed men (PSID)
0.12
0.1
0.08
0.06
0.04
0.02
0
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
Year

Figure 4