

A Marriage-Market Perspective of Career Choices

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Abstract

This paper incorporates career choices in an equilibrium marriage-market model to justify risky career choice due to marriage-market incentives, as well as to explain gender differences in career choices, income inequality, marriage timing, and effects of marital status on career choices. Namely, (1) marriage-market incentives, surprisingly, may encourage both men and women to choose risky careers with low mean income and high income variance, (2) men are more likely than women to choose risky careers because of gender differences in reproductive length, (3) income inequality among men is bigger than income inequality among women, (4) men choose risky careers and marry late whereas women tend to choose safe careers and marry early, and (5) unmarried men are more likely than married men to choose risky careers, whereas unmarried women are less likely than married women to choose risky careers.

Keywords: career choices, marriage market, gender differences in risk-taking

JEL: C78, D31, J41

Preliminary and incomplete. Please do not circulate.

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1 Introduction

The choices of a career and a marriage partner are two of the most important lifelong decisions. Many papers have studied these two decisions separately, but few have studied these two decisions jointly, especially in an equilibrium market setting. The main contribution of the paper is *to study risk-taking and career choices in an equilibrium matching framework*. The model we present is simple to state and analyze, and explains many observed patterns that have not been able to be explained jointly in a unified framework or to be explained at all. The model makes the following five predictions, stated as five propositions in the paper:

1. (Risky career choice due to marriage-market incentives). Because of the possibility to improve bargaining power and partner quality in the marriage market after successful career outcome, both men and women may choose a *risky career*, an career with an uncertain income path, than a *safe career*, an career with a certain income path, even if the risky career yields a lower expected income.
2. (Gender difference in career choices). Men are more likely than women to choose risky careers, because it takes time to realize the outcome from a risky career, and it is more costly for women to wait for the outcome due to their shorter reproductive lengths.
3. (Gender difference in income inequality). Because men are more likely than women to choose risky careers, the income inequality among men is larger than the income inequality among women.
4. (Gender difference in marriage timing). Men tend to choose risky careers and marry late, whereas women tend to choose safe careers and marry early.
5. (Gender difference in effects of marital status on career choices). Because of the possibility to improve martial prospects, unmarried men are more likely to choose risky careers than married men. In contrast, because of the constraint in reproductive length that interferes with their career choice, unmarried women are more likely to choose safe careers than married women.

1.1 Literature Review

The paper makes contributions to three strands of literature.

First and foremost, the paper incorporates career choices into a general-equilibrium marriage-market framework. Previously, many papers have studied how different biologically rooted preferences might affect individuals' career choices and social roles: Bergstrom and Bagnoli (1993,

JPE), Siow (1998, JPE), Low (2016), Zhang (2016), Zhang (2017), but these papers do not explicitly consider the possibility that agents actively choose the level of income uncertainty they are exposed to. The papers do not consider this possibility possibly because risk-averse people are reasonably assumed to choose safe careers. However, this paper shows surprising but plausible subtleties regarding the effects of the competitive marriage market on career choices.

Second, Proposition 1 provides a new explanation of risk-taking based on the marriage market. All of these papers have talked about why people may take risks: Smith (1776), Friedman and Savage (1948, JPE), Friedman (1953, JPE), Rubin and Paul (1979, EI), Robson (1992, Ecta), Robson (1996, GEB), Rosen (1997, JoLE), Becker et al. (2005, JPE).

Third, Propositions 2 to 5 provide a unifying explanation of gender differences in career choices, income inequalities, marriage timing, and effects of marital status on career choices, only assuming gender difference in cost in risky career choice and *without* assuming other inherent gender differences in risk preference, competitiveness, or overconfidence. Previously, people have looked at gender differences in competitiveness: Niederle and Vesterlund (2007, QJE), Kleijnans (2008), Gill and Prowse (2014, QE), Wozniak et al. (2014, JoLE).

Section 2 describes the basic model. Section 3 solves the model and characterizes the equilibrium. Section 4 states testable implications of the model. Section 6 concludes.

2 Model

Time is discrete and infinite, $t = 1, 2, \dots$. At the beginning of each period, mass one of **men** and mass one of **women** reach adulthood.¹ They make career and marriage decisions in two periods, described below and illustrated in Figure 1.

2.1 Abilities

Men and women are distinguished by their *abilities* x_m and x_w . Their abilities are distributed according to continuous and strictly increasing mass distributions F_m and F_w with supports $X_m \equiv [x_m, \bar{x}_m] \subset \mathbb{R}_+$ and $X_w \equiv [x_w, \bar{x}_w] \subset \mathbb{R}_+$.

2.2 Career Choices

Each agent chooses a career at the beginning of the first period of his/her life. One can choose either a *safe career* or a *risky career*. The safe career exactly compensates a person's human capital: an ability x_m man who chooses a safe career receives an income $y_m = x_m$ and an ability x_w woman who

¹The gender balance assumption is innocuous, as we can always turn a market with gender imbalance to a market with gender balance by adding dummy agents who produce zero marriage surplus to the long side of the market.

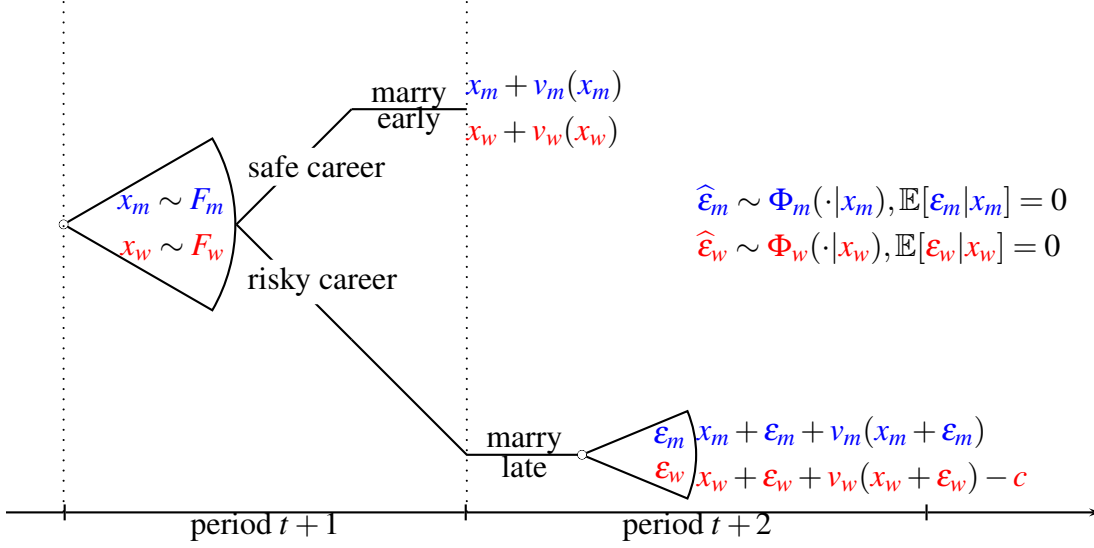


Figure 1: An Individual's Career and Marriage Decision Tree in the Benchmark Model.

chooses a safe career receives an income $y_w = x_w$. The risky career noisily compensates a person's human capital: an ability x_m man who chooses a risky career receives an income $y_m = x_m + \varepsilon_m$ where ε_m is distributed according to a cumulative distribution $\Phi_m(\cdot|x_m)$ and $\mathbb{E}[\varepsilon_m|x_m] = 0$, and an ability x_w woman who chooses a risky career receives an income $y_w = x_w + \varepsilon_w$ where ε_w is distributed according to a cumulative distribution $\Phi_w(\cdot|x_w)$ and $\mathbb{E}[\varepsilon_w|x_w] = 0$. In essence, the income distribution from the risky career is a mean-preserving spread of that from the safe career.

In the benchmark model, suppose that a person who chooses the safe career enters the marriage market immediately in the current period and a person who chooses the risky career waits until the income is realized in the next period to enter the marriage market. We will allow separate career choice and marriage timing in the extended model, but we will see that it is not desirable for a person who chooses the safe career to prefer delaying marriage or a person who chooses a risky career to prefer an early marriage. The only gender difference in the model is that *women who enter the marriage market due to risky career choice late incur a cost $c > 0$* . We interpret this cost as the cost associated with delayed family and childbearing, but we can also interpret the cost as distaste for a risky career. (We can model the reproductive fitness as an additional dimension of women's characteristics, but incorporating an additional dimension into the model does not bring additional insights about the career choices with marital concerns.)

Assume that each agent of the same gender-ability type chooses the same strategy, so that the strategies are stationary and ability-symmetric. Let $\sigma_m(x_m)$ represent the probability that an ability x_m man chooses a risky career and $\sigma_w(x_w)$ the probability that an ability x_w woman chooses a risky career.

2.3 Income Distributions

Career choices σ_m and σ_w induce income distributions G_m and G_w . For any y_m , men with income below y_m include those men who have ability below y_m and choose the safe career and those men who choose the risky career and end up with an income below y_m ,

$$G_m(y_m) = \underbrace{\int_{x_m}^{y_m} (1 - \sigma_m(x_m)) dF_m(x_m)}_{\text{safe career}} + \underbrace{\int_{x_m}^{\bar{x}_m} \Phi_m(y_m - x_m | x_m) \sigma_m(x_m) dF_m(x_m)}_{\text{risky career}},$$

Similarly, for any y_w , women with income below y_w include those women who have ability below y_w and choose the safe career and those women who choose the risky career and end up with an income below y_w ,

$$G_w(y_w) = \underbrace{\int_{x_w}^{y_w} (1 - \sigma_w(x_w)) dF_w(x_w)}_{\text{safe career}} + \underbrace{\int_{x_w}^{\bar{x}_w} \Phi_w(y_w - x_w | x_w) \sigma_w(x_w) dF_w(x_w)}_{\text{risky career}}.$$

2.4 The Marriage Market

The marriage surplus an income y_m man and an income y_w woman produce is $s(y_m, y_w) = y_m y_w$ (see Appendix A.1 for a household public good provision problem that justifies the use of this specific surplus function as well as transferable utilities), and any single produces zero. Note the few properties of the surplus function we will use repeatedly:

1. The surplus function is twice differentiable.
2. The surplus function increases linearly in the man's income: $\partial s / \partial y_m = y_w > 0$.
3. The surplus function increases linearly in woman's income: $\partial s / \partial y_w = y_m > 0$.
4. The surplus function is strictly supermodular in the incomes: $\partial^2 s / \partial y_m \partial y_w = 1 > 0$.
5. The surplus function is symmetric in incomes: $s(y, y') = s(y', y)$.

Men and women match and negotiate the division of their marriage surplus to reach a stable outcome of the marriage market.

Definition 1. A stable outcome of the marriage market characterized by a pair of income distributions, (G_m, G_w) , consists of a matching G and marriage payoff functions v_m and v_w such that

1. Stable matching $G(y_m, y_w)$ describes the mass of couples with incomes lower than y_m and y_w such that

$$(a) G(y_m, \infty) = G_m(y_m).$$

$$(b) G(\infty, y_w) = G_w(y_w).$$

2. Stable marriage payoff functions $v_m(y_m)$ and $v_w(y_w)$ describe income y_m men and income y_w women's marriage payoffs such that

(a) Everyone is better than being single: $v_m(y_m) \geq 0$ and $v_w(y_w) \geq 0$ for any y_m and y_w .

(b) Every couple divides the marriage surplus: $v_m(y_m) + v_w(y_w) = s(y_m, y_w)$ for any (y_m, y_w) in the support of G .

(c) No other division of surplus would make any unmatched pair of man and woman strictly better off: $v_m(y_m) + v_w(y_w) \geq s(y_m, y_w)$ for any (y_m, y_w) .

By Theorem 2 of Gretsky et al. (1992), a stable outcome exists.

2.5 Payoffs

Each person is risk neutral and does not discount. A person's payoff consists of his/her income and marriage payoff: an income y_m man's utility is $y_m + v_m(y_m)$, and an income y_w woman's utility is $y_w + v_w(y_w)$ potentially net a cost c associated with a risky investment. An x_m man's expected payoff from strategy $\sigma_m(x_m)$ is

$$\begin{aligned} u_m(\sigma_m|x_m) &= \sigma_m(x_m)\mathbb{E}[x_m + \varepsilon_m + v_m(x_m + \varepsilon_m)|x_m] + (1 - \sigma_m(x_m))[x_m + v_m(x_m)] \\ &= x_m + \sigma_m(x_m)\mathbb{E}[v_m(x_m + \varepsilon_m)|x_m] + (1 - \sigma_m(x_m))v_m(x_m) \end{aligned}$$

where the second line follows from the fact that the expected income of the risky career is the same as that of the safe career. An x_w woman's expected payoff from strategy $\sigma_w(x_w)$ is

$$\begin{aligned} u_w(\sigma_w|x_w) &= \sigma_w(x_w)[\mathbb{E}[x_w + \varepsilon_w + v_w(x_w + \varepsilon_w)|x_w] - c] + (1 - \sigma_w(x_w))[x_w + v_w(x_w)] \\ &= x_w + \sigma_w(x_w)[\mathbb{E}[v_w(x_w + \varepsilon_w)|x_w] - c] + (1 - \sigma_w(x_w))v_w(x_w). \end{aligned}$$

2.6 Primitives of the Model

In summary, the model's primitives are: continuous and strictly increasing ability distributions $F_m(\cdot)$ and $F_w(\cdot)$, risky career's continuous and strictly increasing income distributions $\Phi_m(\cdot|x_m)$ and $\Phi_w(\cdot|x_w)$ for all $x_m \in X_m = \text{support}(F_m)$ and $x_w \in X_w = \text{support}(F_w)$, women's investment cost $c > 0$, and the marriage surplus function $s(y_m, y_w) = y_m y_w$. Hence, $(F_m, F_w, \Phi_m, \Phi_w, c, s)$ summarizes the model.

3 Equilibrium

In this section, we characterize the stationary equilibrium of the model.

Definition 2. $(\sigma_m^*, \sigma_w^*, G_m^*, G_w^*, G^*, v_m^*, v_w^*)$ is an equilibrium of $(F_m, F_w, \Phi_m, \Phi_w, c, s)$ if

1. $\sigma_m^*(x_m)$ maximizes an x_m man's expected utility when men's marriage payoff is v_m^* :

$$\sigma_m^*(x_m) \in \arg \max_{\sigma_m \in [0,1]} \sigma_m \mathbb{E}[v_m^*(x_m + \varepsilon_m)|x_m] + (1 - \sigma_m)v_m^*(x_m) \quad \forall x_m \in \text{support}(F_m),$$

and $\sigma_w^*(x_w)$ maximizes an x_w woman's expected utility when women's marriage payoff is v_w^* :

$$\sigma_w^*(x_w) \in \arg \max_{\sigma_w \in [0,1]} \sigma_w \mathbb{E}[v_w^*(x_w + \varepsilon_w)|x_w] + (1 - \sigma_w)v_w^*(x_w) \quad \forall x_w \in \text{support}(F_w).$$

2. Men's career choices σ_m^* induce men's income distribution G_m^* :

$$G_m^*(y_m) = \int_{\underline{x}_m}^{\bar{x}_m} [1_{x_m \leq y_m} (1 - \sigma_m^*(x_m)) + \Phi_m(y_m - x_m|x_m) \sigma_m^*(x_m)] dF_m(x_m) \quad \forall y_m,$$

and women's career choices σ_w^* induce women's income distribution G_w^* :

$$G_w^*(y_w) = \int_{\underline{x}_w}^{\bar{x}_w} [1_{x_w \leq y_w} (1 - \sigma_w^*(x_w)) + \Phi_w(y_w - x_w|x_w) \sigma_w^*(x_w)] dF_w(x_w) \quad \forall y_w.$$

3. (G^*, v_m^*, v_w^*) is a stable outcome of the marriage market (G_m^*, G_w^*) .

3.1 Equilibrium Matching

Because the surplus function s is strictly supermodular in incomes, by Becker (1973), men and women are positive-assortatively matched in incomes in any stable matching. For continuous and strictly increasing cumulative distributions G_m and G_w , under any stable matching, a man and a woman of the same income rank marry each other: $G_w(y_w) = G_m(y_m)$. Let $y_w(y_m)$ represent y_m man's wife's income and $y_m(y_w)$ an income y_w woman's husband's income: $y_w(y_m) \equiv G_w^{-1}(G_m(y_m))$ and $y_m(y_w) \equiv G_m^{-1}(G_w(y_w))$. The conditions the stable marriage payoffs satisfy can be rewritten as follows: for any y_m ,

$$v_m(y_m) + v_w(y_w(y_m)) = s(y_m, y_w(y_m)),$$

and for y_w ,

$$v_m(y_m(y_w)) + v_w(y_w) = s(y_m(y_w), y_w).$$

We will further characterize the equilibrium marriage payoff functions in the next section.

3.2 Equilibrium Marriage Payoffs

Stable marriage payoff functions are derived as follows. By the stability conditions that for any y_m : $v_m(y_m) + v_w(y_w(y_m)) = s(y_m, y_w(y_m))$ and $v_m(y_m) + v_w(y_w) \geq s(y_m, y_w)$ for any $y_w \neq y_w(y_m)$, we have

$$v_m(y_m) = s(y_m, y_w(y_m)) - v_w(y_w) \geq s(y_m, y_w) - v_w(y_w) \forall y_w \neq y_w(y_m).$$

Thus,

$$v_m(y_m) = \max_{y_w \in \text{support}(G_w)} [s(y_m, y_w(y_m)) - v_w(y_w)].$$

Hence we have the envelope condition

$$\frac{\partial s(y_m, y_w(y_m))}{\partial y_w} - v_w'(y_w(y_m)) = 0.$$

Taking the derivative with respect to y_m ,

$$v_m'(y_m) = \frac{\partial s(y_m, y_w(y_m))}{\partial y_m} + \underbrace{\frac{\partial s(y_m, y_w(y_m))}{\partial y_w} y_w'(y_m) - v_w'(y_w)}_{=0 \text{ by the envelope condition}} = \frac{\partial s(y_m, y_w(y_m))}{\partial y_m}.$$

By the fundamental theorem of calculus, for any \tilde{y}_m ,

$$v_m(\tilde{y}_m) = v_m(\underline{y}_m) + \int_{\underline{y}_m}^{\tilde{y}_m} \frac{\partial s(y_m, y_w(y_m))}{\partial y_m} dy_m = v_m(\underline{y}_m) + \int_{\underline{y}_m}^{\tilde{y}_m} y_w(y_m) dy_m.$$

Similarly, for any \tilde{y}_w ,

$$v_w(\tilde{y}_w) = v_w(\underline{y}_w) + \int_{\underline{y}_w}^{\tilde{y}_w} \frac{\partial s(y_m(y_w), y_w)}{\partial y_w} dy_w = v_w(\underline{y}_w) + \int_{\underline{y}_w}^{\tilde{y}_w} y_m(y_w) dy_w.$$

The stable marriage payoff functions are continuously differentiable and strictly increasing because the surplus function is continuously differentiable and strictly increasing. Most importantly,

Lemma 1. *Men's and women's marriage payoff functions are convex in their respective income.*

Proof of Lemma 1. For $v_m(\tilde{y}_m) = v_m(\underline{y}_m) + \int_{\underline{y}_m}^{\tilde{y}_m} y_w(y_m) dy_m$,

$$v_m'(\tilde{y}_m) = y_w(\tilde{y}_m)$$

$$v_m''(\tilde{y}_m) = y_w'(\tilde{y}_m) > 0$$

since there is positive assortative matching in equilibrium. Similarly, for $v_w(\tilde{y}_w) = v_w(\underline{y}_w) + \int_{\underline{y}_w}^{\tilde{y}_w} y_m(y_w) dy_w$,

$$v_w'(\tilde{y}_w) = y_m(\tilde{y}_w),$$

$$v_w''(\tilde{y}_w) = y_m'(\tilde{y}_w) > 0$$

since there is positive assortative matching in equilibrium. □

3.3 Equilibrium Career Choices

The first main result of the paper is that men always choose risky careers, due to the incentives provided by the marriage market.

Lemma 2. *It is a strictly dominant strategy for each man to choose the risky career.*

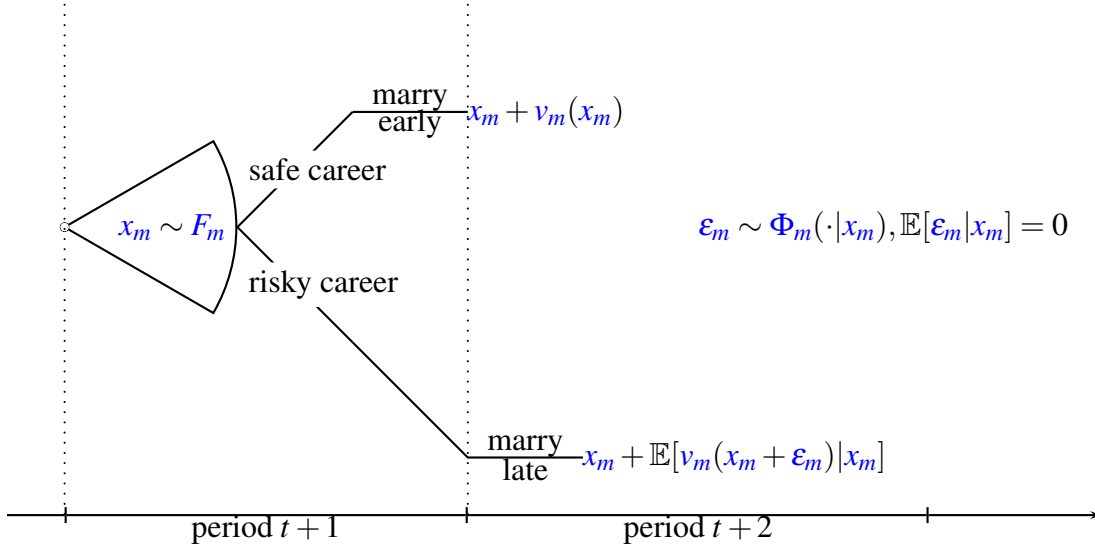


Figure 2: An Man's Risky Career versus Safe Career Choice.

Proof of Lemma 2. An x_m man's expected utility from choosing the safe career is $x_m + v_m(x_m)$ and his expected utility from the risky career is $x_m + \mathbb{E}[v_m(x_m + \epsilon_m) | x_m]$. The utility gain from a risky career over a safe career is $\mathbb{E}[v_m(x_m + \epsilon_m) | x_m] - v_m(x_m)$. For each realization of ϵ_m ,

$$v_m(x_m + \epsilon_m) = s(x_m + \epsilon_m, y_w(x_m + \epsilon_m)) - v_w(y_w(x_m + \epsilon_m)).$$

By the stability condition, for any y_w ,

$$v_m(x_m + \epsilon_m) \geq s(x_m + \epsilon_m, y_w) - v_w(y_w).$$

In particular,

$$v_m(x_m + \varepsilon_m) = s(x_m + \varepsilon_m, y_w(x_m + \varepsilon_m)) - v_w(y_w(x_m + \varepsilon_m)) \geq s(x_m + \varepsilon_m, y_w(x_m)) - v_w(y_w(x_m)).$$

Economically, the inequality states that an income $x_m + \varepsilon_m$ man's marriage payoff when he marries an income $y_w(x_m + \varepsilon_m)$ woman and pays her her competitive marriage payoff $v_w(y_w(x_m + \varepsilon_m))$ is better than the marriage payoff he would get if he marries an income $y_w(x_m)$ woman, his hypothetical wife if he chooses the safe career, and gives her her competitive payoff $v_w(y_w(x_m))$. Since the matching is unique, the inequality holds strictly,

$$v_m(x_m + \varepsilon_m) > s(x_m + \varepsilon_m, y_w(x_m)) - v_w(y_w(x_m)),$$

and the inequality holds for any ε_m . Taking the expectation over all ε_m ,

$$\mathbb{E}[v_m(x_m + \varepsilon_m)|x_m] > \mathbb{E}[s(x_m + \varepsilon_m, y_w(x_m)) - v_w(y_w(x_m))|x_m].$$

Since $s(y_m, y_w) = y_m y_w$, the inequality becomes

$$\begin{aligned} \mathbb{E}[v_m(x_m + \varepsilon_m)|x_m] &> \mathbb{E}[(x_m + \varepsilon_m)y_w(x_m) - v_w(y_w(x_m))|x_m] \\ &= \mathbb{E}[(x_m + \varepsilon_m)|x_m]y_w(x_m) - v_w(y_w(x_m)) \\ &= x_m y_w(x_m) - v_w(y_w(x_m)) \\ &= s(x_m, y_w(x_m)) - v_w(y_w(x_m)) \\ &= v_m(x_m) \end{aligned}$$

where the first equality follows from the fact that $y_w(x_m)$ is not a random variable, the second equality follows from the fact that $\mathbb{E}[x_m + \varepsilon_m|x_m] = x_m$ by assumption, the third equality follows from the fact that $s(x_m, y_w(x_m)) = x_m y_w(x_m)$, and the fourth and final equality follows from the stability condition that a couple, x_m and $y_w(x_m)$ divide up the marriage surplus, $v_m(x_m) + v_w(y_w(x_m)) = s(x_m, y_w(x_m))$. \square

Note that the proof of Lemma 2 does not at all rely on the fact that the surplus is strictly supermodular. The surplus could have been strictly submodular, e.g. $s(y_m, y_w) = y_m + y_w - y_m y_w$ and the result would still hold perfectly. The proof partially relies on the linearity of surplus in incomes to guarantee that *all* men strictly prefer the risky career; the linearity of surplus in men's income is sufficient but not necessary. As long as the surplus function is weakly convex in men's income, the result continues to hold. The specific functional form of the surplus function does aide in the proof and the clean statement of the result, but the key ingredients that drives the strict

dominance of the risky career are the re-interpreted stability conditions.

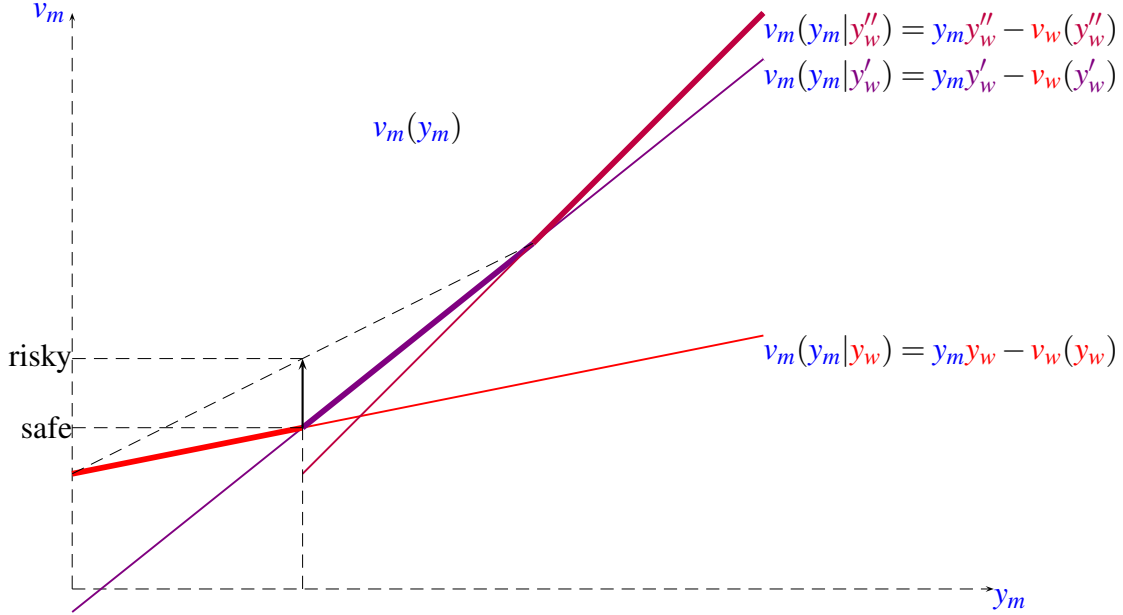


Figure 3: Linear Surplus Leads to Weakly Convex Payoff

In contrast, since women face an additional cost associated with choosing the risky career, when the cost is sufficiently large, not all women choose the risky career and some will opt to choose the safe career; and if the cost is too large, all women choose the safe career.

Lemma 3. *There exist \underline{c} and \bar{c} such that (1) if $c \leq \underline{c}$, (there exists an equilibrium in which) each woman chooses the safe career; (2) if $\underline{c} < c < \bar{c}$, (there exists an equilibrium in which) a positive mass of women choose the safe career and a positive mass of women choose the risky career; and (3) if $c \geq \bar{c}$, (there exists an equilibrium in which) each woman chooses the risky career.*

Proof of Lemma 3. Let G_m^R denote men's induced income distribution when all men choose the risky career, i.e., $G_m^R(y_m) \equiv \int_{\underline{x}_m}^{\bar{x}_m} \Phi_m(y_m - x_m | x_m) dF_m(x_m)$, and similarly, let G_w^R denote women's induced income distribution when all women choose the risky career, i.e., $G_w^R(y_w) \equiv \int_{\underline{x}_w}^{\bar{x}_w} \Phi_w(y_w - x_w | x_w) dF_w(x_w)$. Let $y_m^{RR}(y_w) \equiv G_m^{R-1}(G_w^R(y_w))$ denote an income y_w woman's husband's income in the stable matching of the marriage market (G_m^R, G_w^R) . Then the stable marriage payoff in (G_m^R, G_w^R) is $v_w^{RR}(\tilde{y}_w) = \int_{\underline{y}_w}^{\tilde{y}_w} \frac{\partial s(y_w, y_m^{RR}(y_w))}{\partial y_w} dy_w$. Let

$$\underline{c} \equiv \min_{x_w \in [\underline{x}_w, \bar{x}_w]} [\mathbb{E}[v_w^{RR}(x_w + \varepsilon_w) | x_w] - v_w^{RR}(x_w)].$$

When $c \leq \underline{c}$, it is strictly better off for each woman to choose the risky career when all other men and women choose the risky career, since even the woman who benefits the least from the risky

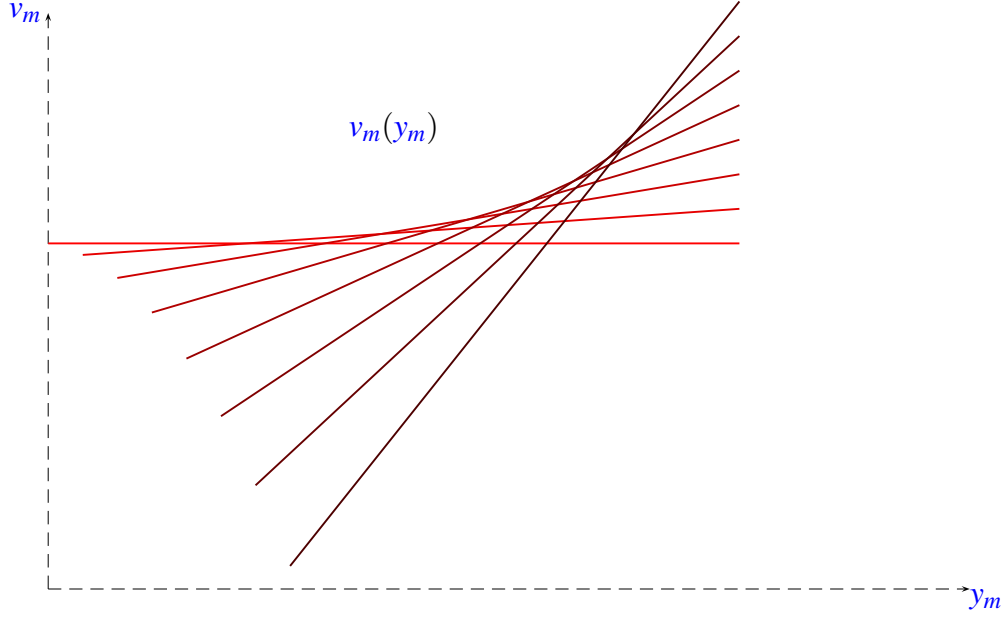


Figure 4: Linear Surplus and Income Heterogeneity Lead to Strictly Convex Payoff

career has a positive net benefit. Thus, if $c \leq \underline{c}$, the equilibrium in which everyone chooses the risky career is sustainable.

Let $G_w^S = F_w$ denote women's induced income distribution when all women choose the safe career. Let $y_m^{RS}(y_w)$ an income y_w woman's husband's income in the stable matching of the marriage market (G_m^R, G_w^S) , i.e. $y_m^{RS}(y_w) \equiv G_m^{R^{-1}}(G_w^S(y_w)) = G_m^{R^{-1}}(F_w(y_w))$. The stable marriage payoff is $v_w^{RS}(\tilde{y}_w) = \int_{\underline{y}_w}^{\tilde{y}_w} \frac{\partial s(y_w, y_m^{RS}(y_w))}{\partial y_w} dG_w^S(y_w)$. Let

$$\bar{c} \equiv \max_{x_w \in [\underline{x}_w, \bar{x}_w]} \left[\mathbb{E} \left[v_w^{RS}(x_w + \varepsilon_w) | x_w \right] - v_w^{RS}(x_w) \right].$$

When $c \geq \bar{c}$, it is strictly better off for each woman to choose the safe career when all other men choose the risky career and all women choose the safe career, since even the woman who could benefit the most from choosing the risky career receives a negative net benefit. Thus, if $c \geq \bar{c}$, the equilibrium in which all men choose the risky career and all women choose the safe career is sustainable.

Finally, if $\underline{c} < c < \bar{c}$, then neither the equilibrium in which all women choose the risky career nor the equilibrium in which all women choose the safe career is sustainable. In any equilibrium (if an equilibrium exists), there must exist a positive measure of women choosing the risky career and another positive measure of women choosing the safe career. \square

3.4 Equilibrium Income Distributions

Since all men choose the risky career, men's equilibrium income distribution is simply represented by

$$G_m^*(y_m) = \int_{x_m}^{\bar{x}_m} \Phi_m(y_m - x_m | x_m) dF_m(x_m).$$

Note that G_m^* is a mean-preserving spread of F_m . Since not all women choose the risky career and we cannot determine who choose which career without more information on the distributions, we cannot characterize women's income distributions more precisely than the characterization of the induced income distribution,

$$G_w^*(y_w) = \int_{x_w}^{y_w} (1 - \sigma_w^*(x_w)) dF_w(x_w) + \int_{x_w}^{\bar{x}_w} \Phi_w(y_w - x_w | x_w) \sigma_w^*(x_w) dF_w(x_w).$$

Note that, just like G_m^* is a mean-preserving of F_m , G_w^* is a mean-preserving spread of F_w .

3.5 Equilibrium Existence

Theorem 1. *An equilibrium exists.*

We apply Glicksberg's fixed-point theorem to prove equilibrium existence. However, there is no systematic way to guarantee the uniqueness of the equilibrium without parametric assumptions.

Proof of Theorem 1. Consider the following composite map

$$\Gamma : \mathcal{V} \rightrightarrows \Sigma_m \times \Sigma_w \rightarrow \mathcal{G}_m \times \mathcal{G}_w \rightrightarrows \mathcal{V},$$

where \mathcal{V} is the set of stable marriage payoff functions $v_m : X_m \rightarrow \mathbb{R}_+$ and $v_w : X_w \rightarrow \mathbb{R}_+$, $\Sigma_m \times \Sigma_w$ is the set of career choice strategies $\sigma_m : X_m \rightarrow [0, 1]$ and $\sigma_w : X_w \rightarrow [0, 1]$, and $\mathcal{G}_m \times \mathcal{G}_w$ is the set of income distributions. By Glicksberg's fixed-point theorem, an equilibrium exists if \mathcal{V} , the set of stable marriage payoff functions, is non-empty, convex, and compact, and Γ is non-empty-valued, upper-hemicontinuous, convex-valued, and compact-valued. \square

Uniqueness. Equilibrium uniqueness is much harder to prove. Ideally, we use the contraction mapping theorem (Banach fixed point theorem) and choose an appropriate metric to show that Γ is a contraction. In the parametric examples we work out in the subsequent sections, uniqueness can be shown by construction.

4 Justification of Risky Career Choice

4.1 Risky Career Choice due to Marriage Market Incentives

Proposition 1 (Risky Career Choice due to Marriage-Market Incentives). *Unmarried people might choose a career with a lower expected income and higher income uncertainty even if they are risk-averse, because of the potential marriage-market gain.*

Proof of Proposition 1. The result is a direct corollary of Lemma 1. Since the marriage payoff function is strictly convex in income, a risk-neutral man strictly prefers a risky career over a safe career that yields the same expected income. As a result, a risk-averse man could strictly prefer a risky career over a safe career that yields higher expected income, as long as the risk aversion is not too high and the expected income difference is not too big. \square

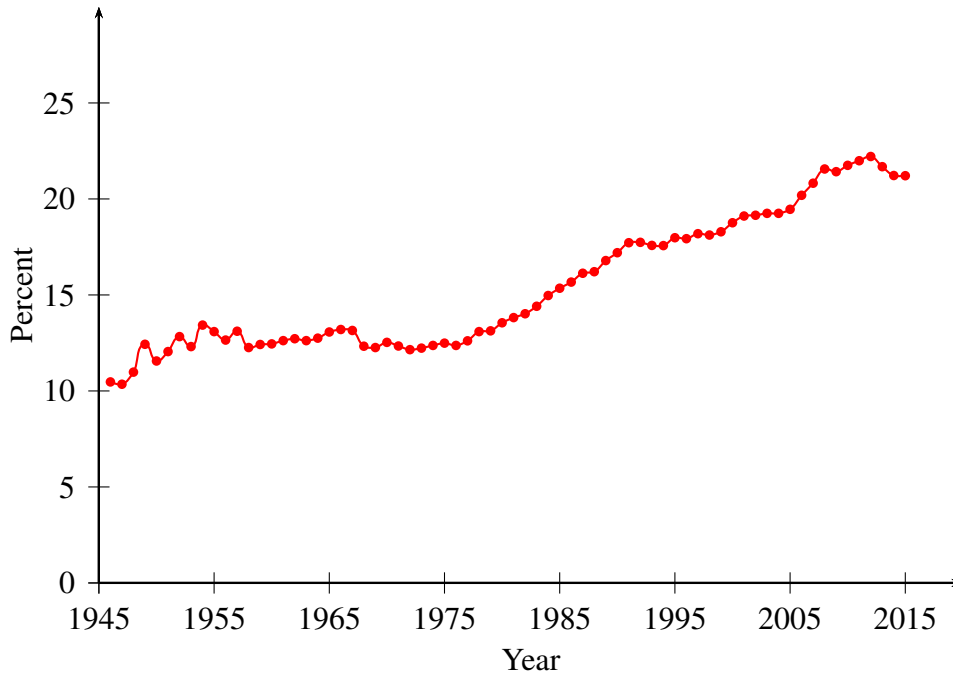


Figure 5: Percent of Female Entrepreneurs in the United States, 1945-2015

5 Gender Differences

5.1 Gender Differences in Career Choices

Proposition 2 (Gender Difference in Career Choice). *More men than women choose risky careers:*

$$\int \sigma_m^*(x_m) dF_m(x_m) > \int \sigma_w^*(x_w) dF_w(x_w).$$

Proof of Proposition 2. It is a direct corollary of Lemmas 2 and 3. All men choose the risky career, whereas for sufficiently large cost, not all women choose the risky career. \square

5.2 Gender Differences in Income Inequality

As a consequence of people choosing their careers to maximize expected utilities, inequality in realized incomes after career choices is larger than inequality in people's ex-ante naturally born abilities, for both genders.

Remark 1. *Inequality in incomes after career choices is larger than inequality in abilities before career choices, for both men and women: G_m^* is a mean-preserving spread of F_m and G_w^* is a mean-preserving spread of F_w .*

Furthermore, because more men than women choose the risky career, the income inequality among men is larger than that among women.

Proposition 3 (Gender Difference in Income Inequality). *If men's and women's ability distributions are identical and they have the same career opportunities, then in equilibrium after they choose their careers and their incomes are realized, income inequality among men is higher than income inequality among women: if $F_m(x) = F_w(x)$ and $\Phi_m(\cdot|x) = \Phi_w(\cdot|x)$ for all x , then G_m^* is a mean-preserving spread of G_w^* .*

This proposition potentially explains the observation that the top of the profession consists of men instead of women: <https://fourthwave.quora.com/Women-Running-Money?srid=C3RB>

5.3 Pre-Marital versus Post-Marital Career Choices

In the basic model, career and marital choices are connected: one who chooses the risky career marries late, and one who chooses the safe career marries early. We separate career and marital choices in this section. There are four possible choices as a result: (1) choosing the safe career and marrying early, (2) choosing the safe career and marrying late, (3) choosing the risky career and marrying early with unresolved uncertainty in incomes, and (4) choosing the risky career and marrying late with resolved uncertainty in incomes.

For an ability x_m man, the four choices respectively yield: (1) $x_m + v_m(x_m)$, (2) $x_m + v_m(x_m)$, (3) $x_m + v_m(x_m + \hat{\epsilon}_m|x_m)$, (4) $x_m + \mathbb{E}[v_m(x_m + \epsilon_m)|x_m]$, where $v_m(x_m + \hat{\epsilon}_m|x_m)$ represents the marriage payoff of an ability x_m man who chooses the risky career. First of all, there is no advantage in choosing the safe career and marrying late over choosing the safe career and marrying early - since

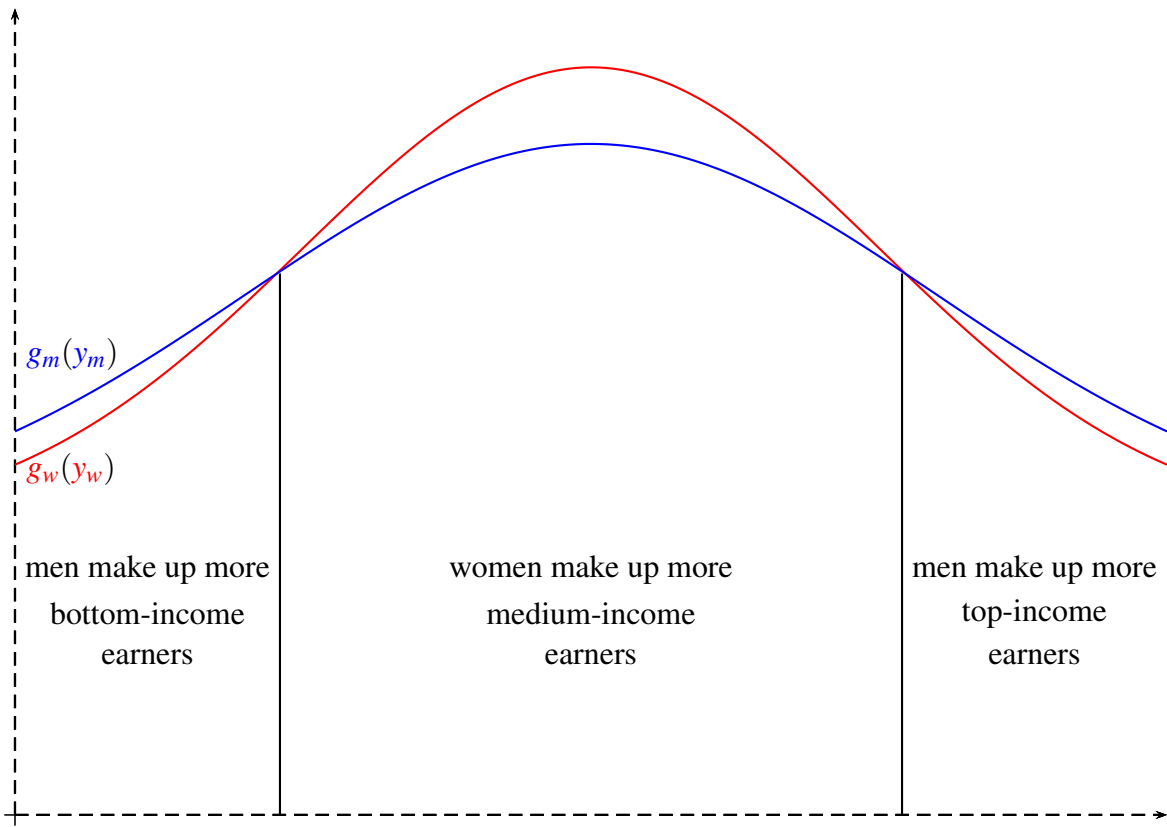


Figure 6: Men's income distribution is more spread out than women.

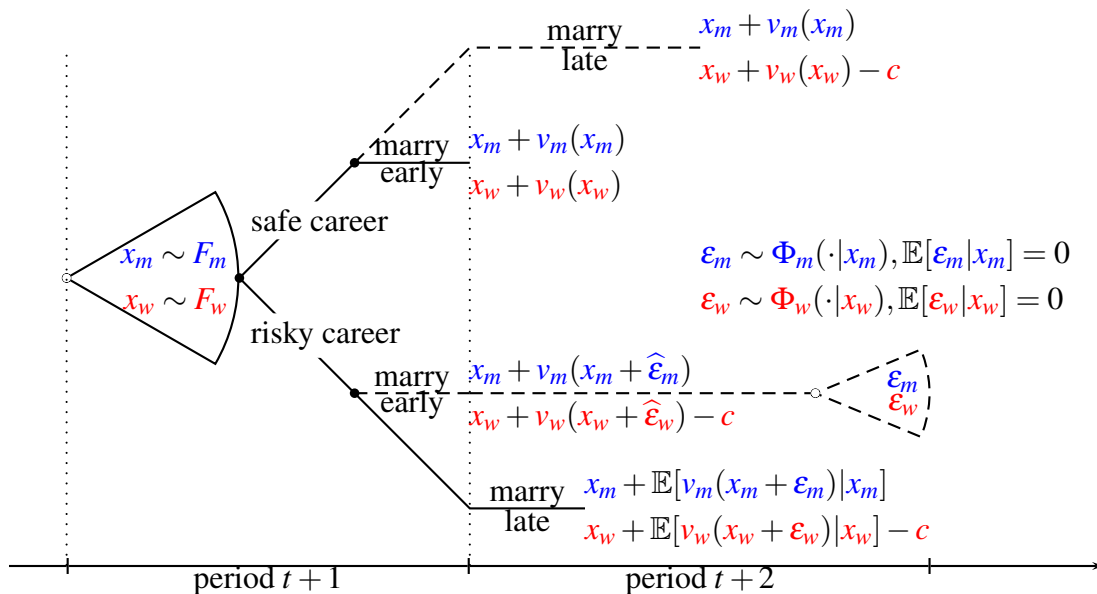


Figure 7: An Individual's Career and Marriage Decision Tree in the Extended Model

delaying is always associated with some costs and/or discounting, when a man chooses the safe career, he might as well choose to marry early.

Second of all, let's compare the payoffs from not resolving and resolving the risky career's income uncertainty. If a man marries in the first period after choosing the risky career, the expected surplus he gets from marrying an income y_w woman is $\mathbb{E}[s(x_m + \epsilon_m, y_w)|x_m] = \mathbb{E}[(x_m + \epsilon_m)y_w|x_m] = x_m y_w$. Hence, a man who chooses the risky career and marries early is treated as if he chooses the safe career and marries early. As a result, a male risk-taker is better off waiting to marry in the second period. This result again highlights that the marital benefits from the risky career come from the possibility to switch partners. The wife a man marries to is the wife that maximizes his personal marriage payoff, so choosing the risky career while unmarried is better than choosing the risky career while married.

Proposition 4 (Gender Difference in Marriage Timing). *Men choose risky careers and marry late whereas women tend to choose safe careers and marry early.*

Figure 8 shows that men always have always married later than women in the United States; the same pattern holds around the world: men marry later on average than women in every country in the world (Bergstrom and Bagnoli, 1993). This is true even controlling for education levels.

Finally, consider the possibility that a man is given the opportunity to gamble with an income change modeled by the random variable $\hat{\epsilon}_m$ after his realized income but he is married to a woman and cannot divorce (or must pay some cost to divorce). For a man who takes a gamble, his utility

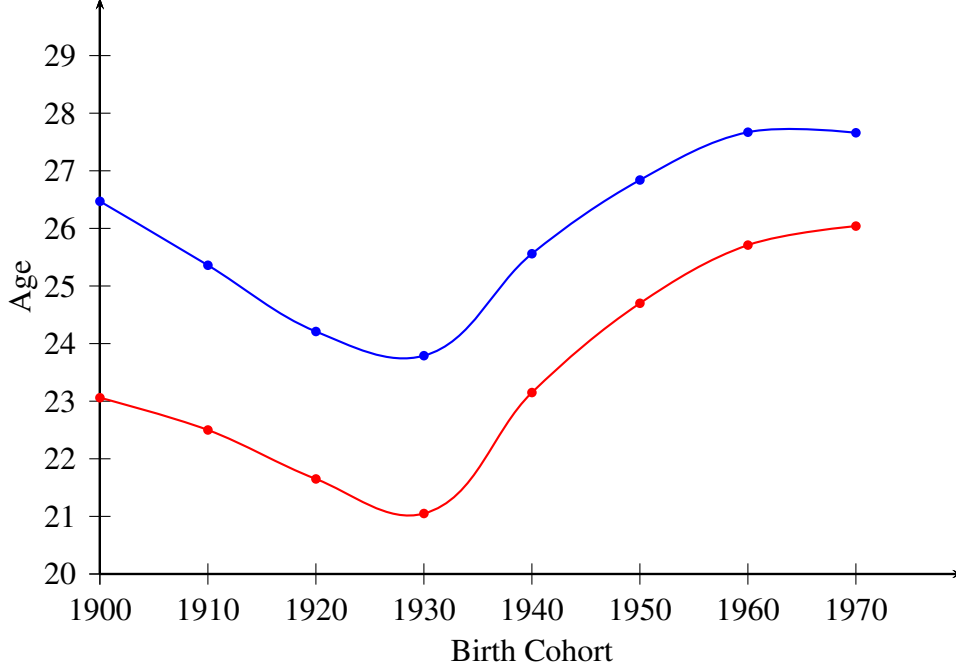


Figure 8: Average Marriage Age in the United States, Birth Cohorts 1900s-1970s.

is

$$\mathbb{E}[y_m + \varepsilon_m | y_m] + [s(y_m + \varepsilon_m, y_w) | y_m] - v_w(y_w).$$

Proposition 5 (Gender Difference in Effects of Marital Status on Career Choices). *Unmarried men are more likely than married men to choose risky careers, whereas unmarried women are less likely than married women to choose risky careers.*

6 Conclusion

In this paper, we embed the discussion of career choices and their gender differences in an equilibrium marriage market framework. In the model, a set of variables is simultaneously and endogenously determined: career choices, marriage timing, income distributions, matching between couples, and the division of marriage payoffs. The model then makes the following five main predictions consistent with evidence:

1. (Risky career choice due to marriage-market incentives). Because of the possibility to improve bargaining power and partner quality in the marriage market after successful career outcome, both men and women may choose a *risky career*, an career with an uncertain income path, than a *safe career*, an career with a certain income path, even if the risky career yields a lower expected income.

2. (Gender difference in career choices). Men are more likely than women to choose risky careers, because it takes time to realize the outcome from a risky career, and it is more costly for women to wait for the outcome due to their shorter reproductive lengths.
3. (Gender difference in income inequality). Because men are more likely than women to choose risky careers, the income inequality among men is larger than the income inequality among women.
4. (Gender difference in marriage timing). Men tend to choose risky careers and marry late, whereas women tend to choose safe careers and marry early.
5. (Gender difference in effects of marital status on career choices). Because of the possibility to improve marital prospects, unmarried men are more likely to choose risky careers than married men. In contrast, because of the constraint in reproductive length that interferes with their career choice, unmarried women are more likely to choose safe careers than married women.

References

- Becker, Gary S.**, “A Theory of Marriage: Part I,” *Journal of Political Economy*, July-August 1973, 81 (4), 813–846.
- , **Kevin M. Murphy, and Ivan Werning**, “The Equilibrium Distribution of Income and the Market for Status,” *Journal of Political Economy*, April 2005, 113 (2), 282–310.
- Bergstrom, Theodore C. and Mark Bagnoli**, “Courtship as a Waiting Game,” *Journal of Political Economy*, February 1993, 101 (1), 185–202.
- Friedman, Milton**, “Choice, Chance, and the Personal Distribution of Income,” *Journal of Political Economy*, August 1953, 61 (4), 277 – 290.
- **and Leonard J. Savage**, “Utility Analysis of Choices Involving Risk,” *Journal of Political Economy*, August 1948, 56 (4), 279–304.
- Gill, David and Victoria Prowse**, “Gender differences and dynamics in competition: The role of luck,” *Quantitative Economics*, 2014, 5, 351–376.
- Gretsky, Neil E., Joseph M. Ostroy, and William R. Zame**, “The Nonatomic Assignment Model,” *Economic Theory*, 1992, 2, 103–127.
- Kleinjans, Kristin**, “Do Gender Differences in Preferences for Competition Matter for Occupational Expectations?,” 2008. Mimeo.
- Low, Corinne**, “Pricing the Biological Clock: Reproductive Capital on the US Marriage Market,” March 2016. Mimeo.
- Niederle, Muriel and Lise Vesterlund**, “Do Women Shy Away From Competition? Do Men Compete Too Much?,” *The Quarterly Journal of Economics*, 2007, 122 (3), 1067–1101.
- Robson, Arthur J.**, “Status, the Distribution of Wealth, Private and Social Attitudes to Risk,” *Econometrica*, July 1992, 60 (4), 837–857.
- , “The Evolution of Attitudes to Risk: Lottery Tickets and Relative Wealth,” *Games and Economic Behavior*, 1996, 14, 190–207.
- Rosen, Sherwin**, “Manufactured Inequality,” *Journal of Labor Economics*, April 1997, 15 (2), 189–196.
- Rubin, Paul H. and Chris W. Paul**, “An Evolutionary Model of Taste for Risk,” *Economic Inquiry*, October 1979, 17 (4), 585–596.

Siow, Aloysius, “Differential Fecundity, Markets, and Gender Roles,” *Journal of Political Economy*, April 1998, 106 (2), 334–354.

Smith, Adam, *An Inquiry into the Nature and Causes of the Wealth of Nations*, London: W. Strahan and T. Cadell, 1776.

Wozniak, David, William T. Harbaugh, and Ulrich Mayr, “The Menstrual Cycle and Performance Feedback Alter Gender Differences in Competitive Choices,” *Journal of Labor Economics*, 2014, 32 (1), 161–198.

Zhang, Hanzhe, “Labor-Market and Marriage-Market Outcomes by Age at Marriage: Theory and Evidence,” August 2016. Mimeo.

—, “A Marriage-Market Perspective of the College Gender Gap and the Gender Pay Gap,” April 2017. Mimeo.

A Omitted Proofs and Details

A.1 Public good provision justifies the surplus function

Consider a man with realized income y_m and a woman with realized income y_w . A single person's utility depends on the consumption of a public good and a private good: $u_m(Q, q_m) = q_m Q$ and $u_w(Q, q_w) = q_w Q$. They divide their incomes between the two goods to maximize their respective utilities. The utilities when they live alone are their reservation utilities $z_m(y_m) = \max_Q (y_m - Q)Q = (y_m/2)^2 = y_m^2/4$ and $z_w(y_w) = \max_Q (y_w - Q)Q = y_w^2/4$, respectively. The maximal total utility when the two marry (or live together) subject to the constraint $Q + q_m + q_w = y_m + y_w$ is

$$z(y_m, y_w) = \max_{Q, q_m, q_w} q_m Q + q_w Q = \max_Q (y_m + y_w - Q)Q = (y_m + y_w)^2/4.$$

The sum of private goods is determinate to be $q_m + q_w = (y_m + y_w)/2$, but the allocation of the private goods q_m and q_w is indeterminate. The surplus from the marriage of a couple (y_m, y_w) is hence

$$s(y_m, y_w) = z(y_m, y_w) - z(y_m) - z(y_w) = y_m y_w / 2.$$

The marital surplus is perfectly transferable between the two parties: to achieve a marital gain of v_m in combination with the reservation utility, the man consumes a private good of $q_m = [v_m + z(y_m)]/Q = 2[v_m + y_m^2/4]/(y_m + y_w)$. Similarly, the woman consumes a private good of $q_w = [v_w + z(y_w)]/Q = 2[v_w + y_w^2/4]/(y_m + y_w)$ to achieve a marital gain of v_w .