Preference Evolution in Different Marriage Markets

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Abstract

We examine the evolution of preferences under different arrangements of the marriage market, when preferences are influenced by own choices and parents' preferences. The system exhibits pitchfork bifurcation as the degree of sorting varies: Multiple stable equilibria arise under sufficiently random matching, but a unique equilibrium exists under sufficiently assortative matching. Differences in evolutionary trajectories after transitory and permanent shocks by marriage market arrangement allow us to discuss in a unified way the evolution of (i) female labor force participation in developed countries, (ii) gender norms in developing countries, (iii) the capitalistic spirit in preindustrial England, and (iv) cultural norms in the long run.

Keywords: preference evolution, marriage market, intergenerational transmission, evolutionary games, pitchfork bifurcation

JEL: C73, C78, Z13

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1 Introduction

Standard economic analyses often treat preferences as fixed and exogenous. In contrast, recent contributions investigate how preferences evolve across generations over time. One approach subjects preferences to natural selection and provides an evolutionary foundation for preferences, such as those on risk, time, and altruism.[1] Another approach assumes that preferences are shaped by family and society in a cultural transmission process.[2]

However, in these studies, preference is usually assumed to only be affected by the preference or choice of one parent (or two parents treated as a unit). Intergenerational transmission of preferences is two-sided in reality, as both parents' preferences and choices influence their children genetically and culturally.[3] If both parents influence preferences, how parents pair in the marriage market determines the effectiveness of parental influences. Therefore, the organization of the marriage market must be taken into consideration to obtain a complete picture of the evolution of preferences in societies. To the best of our knowledge, the intergenerational transmission of preferences under two-sided matching has not been systematically studied.[4] The central goal of this paper is to investigate how different marriage market structures lead to different evolutions

[1]See Robson and Samuelson (2011); Alger and Weibull (2019); and Newton (2018) for surveys of the literature of preference evolution. The literature has studied preferences on risk (Robson, 1996a; Roberto and Szentes, 2017; Robson and Samuelson, 2019); time (Rogers, 1994; Robson and Samuelson, 2007, 2009); overconfidence (Zhang, 2013; Gannon and Zhang, 2020); social preferences, including altruism, reciprocity, and morality (Güth and Yaari, 1992; Güth, 1995; Sethi and Somanathan, 2001; Alger and Weibull, 2010, 2013); and the interaction between institutions and evolution (Wu, 2017; Besley and Persson, 2018).

[2]Initiated by Bisin and Verdier (2000, 2001), a body of research contributes to the explanation of a wide variety of cultural phenomena; see Bisin and Verdier (2011) for an extensive survey. Bisin and Verdier (2000) and Bisin et al. (2004) explain the persistence of ethnic differences and the coexistence of religious preferences in the United States, respectively. Fernández et al. (2004) attribute the increasing female labor force participation in the United States to the intergenerational transmission of gender norms after a temporary increase in female labor force participation triggered by World War II. Doepke and Zilibotti (2006) show that the rise of the middle class during the British Industrial Revolution was associated with the transmission of work ethic and patience. Tabellini (2008) demonstrates that historical institutional qualities may have a long-run impact on the current societal level of generalized trust through cultural transmission. Kuran and Sandholm (2008) account for psychological forces that drive the evolution of culture. Cheung and Wu (2018) provide a continuous-trait extension of the binary-trait Bisin-Verdier model.

[3]In the terminology of evolutionary economics, previous models assume that reproduction is asexual, but in reality it is not.

[4]Several papers consider preference formation in the presence of a two-sided marriage market, but they do not systematically investigate the importance of its structure. Robson (1996b) considers risk-taking in an assortative marriage market without frictions. Bisin and Verdier (2000) consider preference formation in a model with choices in random or assortative marriage markets. Fernández et al. (2004) consider female labor force participation in a random marriage market. Mailath and Postlewaite (2006) demonstrate the social value of unproductive heritable traits in a stable matching model with intergenerational transmission. Bisin and Tura (2020) study cultural integration in a model of assortative marriage market and collective household decisions on fertility and cultural socialization.

and distributions of preferences.

In the model, matching technologies differ in the degree of assortativity, ranging from the least assortative—i.e., completely random matching—to the most assortative—i.e., perfectly positive assortative matching.[5]

Each person can be one of two preference types. We start with a simple model in which a man's type is inherited and a woman's type is by choice.[6] We will generalize the model so that both men and women inherit from both parents and make choices to determine their types. A woman's choice depends on whom she can marry—which is determined by the matching technology—and the cost associated with the choice. A woman's choice shapes her son's preference through intergenerational transmission.[7] For an example, a man's type represents his preference for either a working wife (type a) or a nonworking wife (type b), and a woman's type reflects whether she participates in the formal labor force (action a) or not (action b).[8]

The evolution of preferences differs by the matching technology. On the one hand, under random matching, as the fraction of type-a men increases, more women will be attracted to choose action a, as there is a higher chance of marrying a type-a man. Hence, the interaction between men and women takes a form similar to a coordination game; since men inherit their types from their mothers, there is an intertemporal complementarity in women's actions. We find that generically, there exist two stable equilibria: one with type a being predominant and another one with type b being predominant.[9] On the other hand, under assortative matching, the marital prospect of a type-a woman is better when there are fewer type-a women. Therefore, the interaction between men and women takes a form similar to an anti-coordination game; there is intratemporal

[5]Such a comparative approach to understanding the impact of assortativity has been applied to study cooperation (Bergstrom, 2003; Bilancini et al., 2018); asexual preference evolution (Alger and Weibull, 2013); and income inequality (Kremer, 1997; Fernández and Rogerson, 2001).

[6]Obviously, the simple model can be applied to the mirror case in which men's types are by choice and women's types are by inheritance.

[7]See Fernández (2013) and Fernández et al. (2004) for evidence supporting the notion that men's preferences for working women are significantly affected by whether their mothers work. In the general analysis, we allow for a more general transmission mechanism.

[8]For another example, in the mirroring model in which women inherit their preferences and men choose actions, a woman's type is her preference for a blue or green beard, and a man's action is to dye his beard blue or green.

[9]There is an additional equilibrium with a more balanced distribution of types, but it is never stable. Many models that study cultural evolution feature multiple equilibria. See Hazan and Maoz (2002) and Fernández (2013) for models with multiple possible evolutionary paths of female labor force participation; Bénabou and Tirole (2006); Mailath and Postlewaite (2006); and Guiso et al. (2009) for models with multiple social norms; and Tabellini (2008), Bidner and Francois (2010, 2013), Belloc and Bowles (2013) and Besley and Persson (2018) for models with multiple institution-culture pairs.

competition between women. We find that there always exists a unique stable equilibrium. In general, equilibria resemble those under the perfectly random setting when a sufficiently high proportion of couples are matched randomly and otherwise resemble those in the perfectly assortative setting.

The results demonstrate that the number and properties of equilibria crucially depend on the underlying two-sided matching technology. The matching technology influences not only who matches with whom but also, more importantly, individual choices that shape future generations' preferences and choices. The number and properties of equilibria in turn determine how shocks may impact the evolution of preferences under different matching technologies. Differences in evolutionary trajectories after shocks enable us to comment on a wide range of phenomena.

First, we can explain how World War II contributed to the growth in female labor force participation through the channel of preference evolution in the United States, because it served as a tremendous transitory shock that boosted female labor force participation during the war. If couples sort randomly on the dimension of gender role attitudes, our model predicts that such a shock is able to overcome frictions in the marriage market and move social attitudes about working women, as well as the female labor force participation rate, to what they are today. This prediction is similar to the main prediction of Fernández et al. (2004) on the importance of World War II for female labor force participation through the mother-son transmission channel, but differs in that we highlight the importance of the underling matching technology being sufficiently random during the time when World War II serves as a transitory shock.

Second, we can partly attribute the persistence of traditional gender norms in developing countries to the prevalence of arranged marriages. We argue (and provide evidence) that arranged marriages are more assortative than freewill marriages on the dimensions of gender norms, such as men's preferences for female chastity, and the practices of child marriage and purdah.[10] Our model predicts that under assortative matching, the dynamic always moves toward the unique equilibrium regardless of the transitory shock, which explains why a social norm persists as well as why neither a government campaign to change the preferences of a generation nor a temporary social or political event may result in a permanent change.

Third, we can explain the spread of the "spirit of capitalism" in the middle class instead of the

[10] Purdah is the practice of female seclusion that is prevalent among certain Muslim and Hindu societies.

landed upper class in preindustrial England from a marriage-market perspective, which differs from the economic incentive-based explanation provided by Doepke and Zilibotti (2006). Historical evidence suggests that marriages were mostly arranged in the landed upper class, while freewill marriages were more prevalent in the lower classes, and the marriage markets in different classes were essentially segregated. This evidence allows us to separately apply the assortative matching model to the landed upper class and the random matching model to the middle class. If the Protestant Reformation served as a sufficiently large transitory shock on preferences, it would have successfully moved the middle-class population toward a preference distribution dominated by the Protestant ethic—which includes frugality, thrift, and diligence—but not the landed upper class.

Finally, our model helps to explain the empirical findings of Grosjean and Khattar (2019) that the historical male-biased sex ratio has a persistent effect on men having a more traditional gender attitude toward women in Australia. They deduce from evidence that the male-biased sex ratio altered the bargaining position within a household, which permanently changed men's marital preferences. Our model demonstrates that a permanent shock to marital preferences will result in a permanent shift in the distribution of preference types in the long run in the direction documented by them, regardless of the underlying matching technologies. In addition, our model predicts that a cultural shock that promotes gender equality may shift the population to an equilibrium with a more progressive gender view under random matching, but not under assortative matching. This explains Grosjean and Khattar's observation that a male-biased sex ratio leads to a more traditional gender view in areas with more homogamous marriages.

The rest of the paper is organized as follows. Section 2 presents the simple model that illustrates the main insights. Section 3 investigates equilibria under different matching technologies—random matching, assortative matching, and any matching that mixes random and assortative matching. Section 4 investigates the evolution of preferences after transitory and permanent shocks. Section 5 discusses the implications of our model. Section 6 presents the general model. Section 7 discusses related literature and concludes.

2 The Simple Model

We use the simplest possible model to illustrate the main insights in this section, and will generalize the simple model in Section 6. Each person can be one of two types. In the simple model, each man's type is inherited from his mother, and a woman's type is determined by her choice. A motivating example would be that men's types represent their preferences for either a two-income household or a single-income household in which only the man works, and women's types reflect whether they participate in the formal labor force or not. In Section 6, we generalize the model to one in which both men and women have types and choices and their types are determined jointly by inheritance from both parents and their own choices.

2.1 Basic Setup

There is a unit mass of men and a unit mass of women every period. All men and women pair up and each pair reproduces two children, one son and one daughter; equivalently, each child is a male or a female with equal probabilities. Each person is either type a or type b. Let p_t denote the mass of type-a men in period t. Assume that men's types are determined through intergenerational transmission, which is specified in Section 2.2. Before she enters the marriage market, each woman chooses to become type a or b by choosing action a or b, respectively. Whom they can marry is determined by the matching technology in the marriage market, which is specified in Section 3.

The cost difference in actions a and b is heterogeneous. We normalize the cost of action b to 0 and denote the cost of action a by c. Assume the cost is distributed according to a differentiable and strictly increasing distribution F with associated density f. Assume the density f is *single-peaked*: There exists a $\widehat{c}$ such that $f(c) \leq f(c') \leq f(\widehat{c})$ for any c and c' such that $c < c' < \widehat{c}$ or $c > c' > \widehat{c}$. For example, bell-shaped distributions, triangular distributions, and uniform distributions satisfy the condition.

Let $u_{t_w t_m}$ denote a type-t_w woman's utility from marrying a type-t_m man. We do not impose additional assumptions on the utility function other than *homophily*: $u_{aa} > u_{ab}$ and $u_{bb} > u_{ba}$.

The cost of choosing an action and the utility obtained through marriage, which depends on the matching technology, jointly determine a woman's optimal action choice. Let q_t denote the mass of women choosing action a in period t.

2.2 Intergenerational Transmission

Let $\alpha_m(t_m, t_w)$ denote the probability that a son is type a given his father's type t_m and his mother's type t_w. One can impose different assumptions on $\alpha_m(t_m, t_w)$. We give two examples used in the literature.

Example 1 (Superior transmission for homogamous marriages). *Mathematically,* $\alpha_m(a, a) = 1$*,* $\alpha_m(a, b) = \alpha_m(b, a) = \frac{1}{2}$*, and* $\alpha_m(b, b) = 0$*. When both parents are of the same type, a son would adopt that type for sure. Otherwise, a son would randomly become either type* a *or type* b*. In other words, a homogamous marriage has a superior transmission technology compared with a heterogamous marriage, which is assumed in the model of Bisin and Verdier (2000) and is empirically supported by Dohmen et al. (2012) on the transmission of risk preferences and trust attitudes. This is a special case of the vertical transmission mechanism in Cavalli-Sforza and Feldman (1981), and is also considered in Mailath and Postlewaite (2006).*

Example 2 (Mother-to-son transmission). *Mathematically,* $\alpha_m(t_m, t_w) = 1_{t_w=a}$*. Each son's preference is solely influenced by his mother's type. A mother's influence on her son is documented in Fernández et al. (2004) and Fernández (2013).*

These two examples are special cases of a more general specification. Assume that a son adopts his father's type with probability h and his mother's type with probability $1 - h$, for $h \in [0, 1]$. When $h = \frac{1}{2}$, we have the first example. When $h = 0$, we have the second example. The value of h does not change the main results of the model. Therefore, for illustrative purposes, we focus on the simplest case: $h = 0$. In this case, the evolutionary dynamic of preferences is simply $p_{t+1} = q_t$, that is, the mass of type-a men in a period is the mass of action a women in the previous period.

The intergenerational transmission model we consider differs from that of Bisin and Verdier (2000, 2001) in two crucial ways. First, we only model the vertical transmission from parents to children without considering the oblique transmission in which children adopt preferences from peers or role models. We argue that adding the oblique transmission would not significantly affect the main insights of the model. To see why, suppose that a son instead adopts his mother's type with probability $\phi \in (0, 1)$, and randomly adopts the type of a role model in the society otherwise. In this case, the dynamic is given by

$$p_{t+1} = \phi q_t + (1-\phi)\frac{p_t + q_t}{2} = \frac{1+\phi}{2} q_t + \frac{1-\phi}{2} p_t.$$

Compared with the dynamic generated in the case without oblique transmission, the new dynamic would result in the same stationary equilibria, which are defined in Section 2.3, and would behave similarly except for the speed of convergence to equilibria. Second, we do not explicitly model the decision process of parents to transmit their types to their children, which is a crucial factor for the phenomenon of cultural heterogeneity of Bisin and Verdier (2000, 2001). The main insights of our paper are instead driven by the incentives in the marriage market determined by its two-sided matching technology. Adding the parents-to-children decision process would not change either the number of equilibria or their properties. Therefore, we abstract away from the parents-to-children decision process to elucidate the marriage-market effect.

2.3 Equilibrium

The intergenerational transmission process gives rise to a dynamic that describes the evolution of preferences. Subsequently, we are interested in the stationary equilibria of the dynamic under different matching technologies. In a stationary equilibrium, each woman chooses her type to maximize her expected payoff, and the distribution of types is the same across periods. Any stationary equilibrium can be simply characterized by a cutoff cost c^*: Any woman with a cost below c^* chooses action a, and any woman with a cost above c^* chooses action b.

We say an equilibrium c^* is *stable under positive perturbations*, or *positive-stable*, if there exists an $\epsilon > 0$ such that women's optimal cutoff converges to c^* when there is initially mass $F(c^*)+\epsilon$ of type-a men. Similarly, we say an equilibrium c^* is *stable under negative perturbations*, or *negative-stable*, if there exists an $\epsilon > 0$ such that women's optimal cutoff converges to c^* when there is initially fraction $F(c^*)-\epsilon$ of type-a men. We say an equilibrium is *stable* if it is both positive-stable and negative-stable, is *unstable* if it is neither positive-stable nor negative-stable, and is *partially stable* if it is neither stable nor unstable (positive-stable but not negative-stable, or negative-stable but not positive-stable).

3 Equilibria under Different Marriage Markets

In this section, we characterize equilibria of the simple model under different matching technologies. We first consider a marriage market with completely random matching, which can be thought of as an environment with high frictions such that people are unable to sort according to types. Second, we consider assortative matching in which women are free to match with men they like, though they may need to compete with one another when there is a shortage of likable men. Given the assumption of homophily, homogamous marriages will be the most frequent in such an environment. Finally, we investigate intermediate cases by varying the level of friction.

3.1 Random Matching

Suppose men and women are randomly matched. That is, in period t, given mass p_t of type-a men, any woman marries a type-a man with probability p_t and a type-b man with probability $1 - p_t$. Under the random matching technology, compared with action b, action a for a woman yields a gain $u_{aa} - u_{ab}$ when she marries a type-a man, which happens with probability p_t, and a loss $u_{bb} - u_{ba}$ when she marries a type-b man, which happens with probability $1 - p_t$. Hence, a woman chooses action a if and only if the (net) cost of the action is lower than the expected benefit, or equivalently, the cost is lower than a cutoff cost that depends on the distribution of men's preferences:

$$c \leq p_t(u_{aa} - u_{ab}) - (1 - p_t)(u_{bb} - u_{ba}) \equiv c_R(p_t).$$

The cutoff cost function $c_R(p_t)$ has a positive slope $\Delta \equiv (u_{aa} - u_{ab}) + (u_{bb} - u_{ba})$, which is the sum of the gains from homogamous marriages. A positive slope of the function means that more women choose action a when more men are type a. A steeper slope, which results from higher gains from homogamous marriages, leads women to be more responsive to changes in the distribution of men's preference types. Since the distribution of men's preference types is determined by the choices made by women from the previous generation, the slope Δ serves as a measure of the intertemporal complementarity between the choices of women.

When the cutoff cost in period t is c_t, because the mass of type-a men is determined by the mass of women choosing action a in the previous period—$p_{t+1} = F(c_t)$—the cutoff cost in period $t + 1$ is $c_R(F(c_t))$. The change in men's and women's type distributions is $F(c_R(F(c_t))) - F(c_t)$, and the change in the cutoff cost is

$$c_R(F(c_t)) - c_t \equiv \psi_R(c_t).$$

When $\psi_R(c_t)$ is positive (negative), the cutoff increases (decreases), so more (fewer) women choose action a in the current period than in the previous period. Stationary equilibrium c^* satisfies $\psi_R(c^*) = 0$.

The slope of ψ_R is $\psi_R'(c) = f(c)\Delta - 1$. If $f(\widehat{c})\Delta > 1$, then the slope of $\psi_R(c)$ is negative unless c is sufficiently close to $\widehat{c}$. Namely, there are two solutions to $\psi_R'(c) = 0$, denoted by $\underline{c}$ and $\overline{c} > \underline{c}$. When $c < \underline{c}$ or $c > \overline{c}$, $\psi_R(c)$ is decreasing, and when $c \in (\underline{c}, \overline{c})$, $\psi_R(c)$ is increasing. The function $\psi_R(c)$ when $f(\widehat{c})\Delta > 1$ is depicted in Figure 1a. When $\psi_R(c)$ is decreasing, the dynamic is converging, and an equilibrium is stable if there is any. When $\psi_R(c)$ is increasing, the dynamic is diverging, and an equilibrium is unstable if there is any.[11] To summarize, we have the following characterization of equilibria under random matching.

Proposition 1 (Equilibria under Random Matching). *Suppose agents are randomly matched. If $f(\widehat{c})\Delta > 1$ and $\psi_R(\underline{c}) < 0 < \psi_R(\overline{c})$, where $\underline{c}$ and $\overline{c}$ are the two solutions to $\psi_R'(c) = 0$, there are two stable equilibria $c_1^R < \underline{c}$ and $c_2^R > \overline{c}$ and one unstable equilibrium $c_0^R \in (\underline{c}, \overline{c})$.*

The conditions $f(\widehat{c})\Delta > 1$ and $\psi_R(\underline{c}) < 0 < \psi_R(\overline{c})$ are necessary and sufficient for the existence of two stable equilibria. The case with two stable equilibria described in Proposition 1 is the generic case we will consider, and it is depicted in Figure 1a. We characterize, in the proof of Proposition 1, the cases in which these conditions do not hold. There is one stable equilibrium, and potentially, another partially stable equilibrium.

Another way to present the generic case is provided in Figure 2a. The graph depicts the relation between p_t and p_{t+1}. The existence of two stable equilibria relies on $F(C_R(p_t))$ being sufficiently "S-shaped". A reduction in the variance of F and/or an increase in Δ helps to make $F(C_R(p_t))$ more "S-shaped". In other words, it is more likely to have two stable equilibria when the environment is less volatile and/or the intertemporal complementarity is stronger.

The dynamic incentive structure of our model under random matching is similar to that of an

[11] The dynamic is converging and any equilibrium is stable when $\psi_R(c)$ is decreasing, because if $\psi_R(c^*) = 0$, $\psi_R(c)$ for any $c < c^*$ is positive, so $c_R(F(c)) > c$, and $\psi_R(c)$ for any $c > c^*$ is negative, so $c_R(F(c)) < c$. The dynamic is diverging and any equilibrium is unstable when $\psi_R(c)$ is increasing, because if $\psi_R(c^*) = 0$, $\psi_R(c)$ for any $c < c^*$ is negative, so $c_R(F(c)) < c < c^*$, and $\psi_R(c)$ for any $c > c^*$ is positve, so $c_R(F(c)) > c > c^*$.

Figure 1: Equilibria under Random Matching versus Assortative Matching.

(a) Random Matching: Two stable equilibria c_1^R and c_2^R and one unstable equilibrium c_0^R. **(b) Assortative Matching**: One stable equilibrium c^A and no other equilibrium.

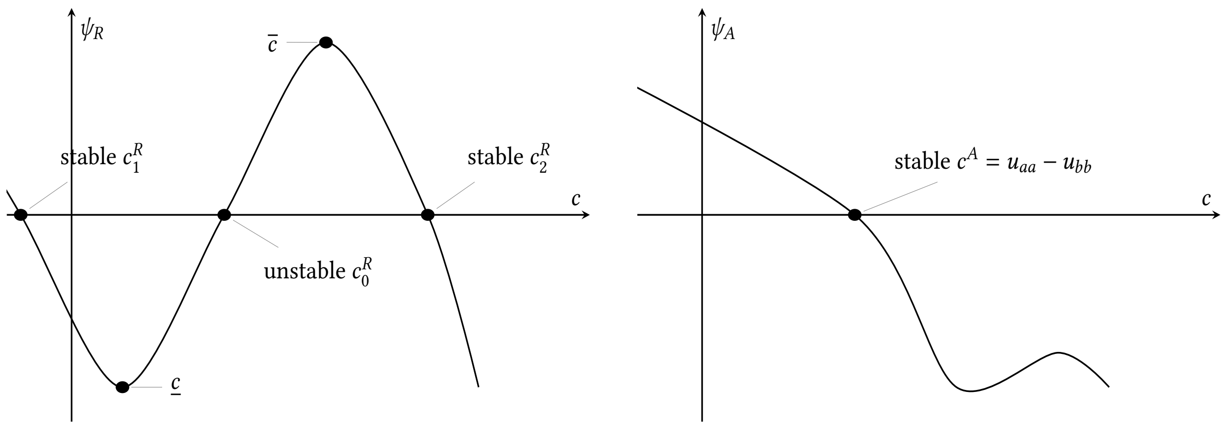
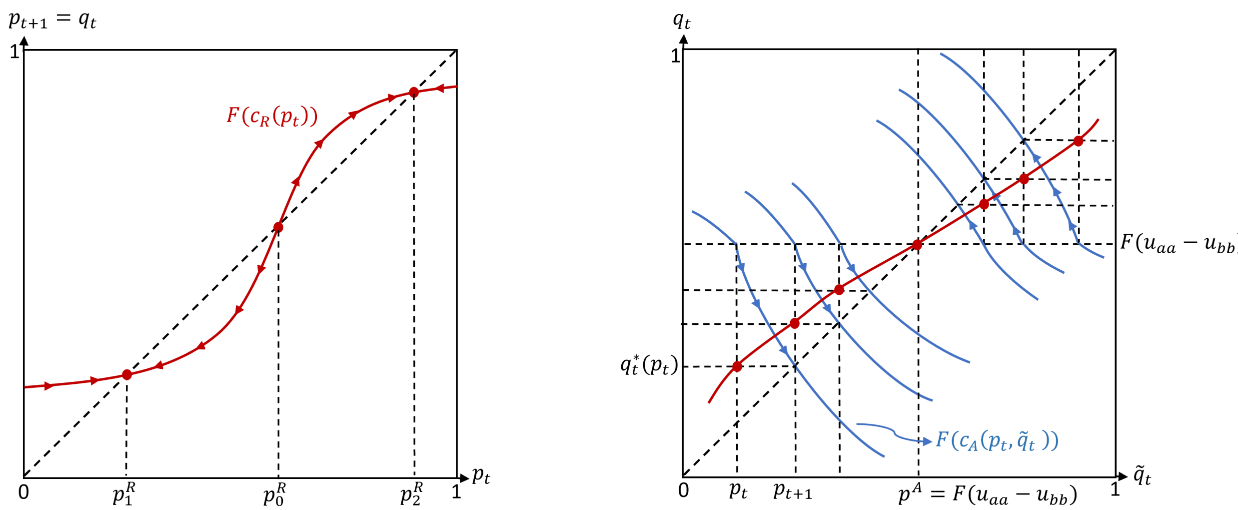


Figure 2: An Alternative Representation of the Equilibria.

(a) Random Matching: Two stable equilibria p_1^R and p_2^R and one unstable equilibrium p_0^R. **(b) Assortative Matching**: One stable equilibrium p^A and no other equilibrium.



evolutionary model of coordination games. Women are trying to "coordinate" on the action that matches the prevalent type of men, which is inherited from the actions of the previous generation of women, leading to two distinct social conventions: one with type-a men predominant and more women choosing action a, and another with type-b men predominant and more women choosing action b.

3.2 Assortative Matching

Suppose men and women are positive assortatively matched.[12] When the distributions of types are identical across sexes, the matching would exhibit perfect assortativity, as type-a men and women marry, and type-b men and women marry. When there is an imbalance of types, there are cross-type marriages. For example, if there are more type-a women than type-a men, then there are some cross-type marriages between type-a women and type-b men.

The payoff difference between the two actions depends on the relative distributions of preferences of men and women. Let q_t represent the mass of women choosing action a in period t. Suppose $q_t > p_t$. A type-a woman marries a type-a man with probability p_t/q_t and marries a type-b man with probability $1 - p_t/q_t$, so that a woman's expected payoff from action a is $\frac{p_t}{q_t}u_{aa} + (1 - \frac{p_t}{q_t})u_{ab} - c$. A type-$b$ woman marries a type-b man for sure, so that her payoff from action b is u_{bb}. We can follow a similar logic to derive a woman's expected payoff when $q_t = p_t$ and when $q_t < p_t$. In summary, a woman chooses action a if and only if $c \leq c_A(p_t, q_t)$, where

$$c_A(p_t, q_t) = \begin{cases} \frac{p_t}{q_t}u_{aa} + \left(1 - \frac{p_t}{q_t}\right)u_{ab} - u_{bb} & q_t > p_t \\ u_{aa} - u_{bb} & q_t = p_t \\ u_{aa} - \left(\frac{p_t - q_t}{1-q_t}u_{ba} + \frac{1-p_t}{1-q_t}u_{bb}\right) & q_t < p_t \end{cases}.$$

Note that the function $c_A(p_t, q_t)$ is continuous and strictly increasing in p_t, and is continuous and strictly decreasing in q_t. That is, when there are more type-a men, more women would choose action a, but when there are more type-a women, fewer women would choose a. Hence, two effects on the choices of women are present under assortative matching: intertemporal complementarity and intratemporal competition.

Under random matching, women's optimal decisions are purely driven by the distribution of men's preferences and do not depend on other women's actions. However, under assortative matching, *women are instead playing a game with one another because their decisions take into account what other women choose.* Given p_t, the mass of type-a men in the market, the mass of

[12]It is theoretically implausible to consider negative assortative matching under homophily preference. In addition, there are technical difficulties associated with considering negative assortative matching. We discuss this further in Appendix C.

women choosing action a in period t is given by $F(\widetilde{c})$, where $\widetilde{c}$ is the unique value that satisfies the following equation.[13]

$$c_A(p_t, F(\widetilde{c})) - \widetilde{c} = 0.$$

In a stationary equilibrium of the simple model, the distributions of preference types must be identical for the two sexes. Otherwise, the mass of type-a men will change in the next period.[14] Also, the equilibrium cutoff cost c^A must coincide with the unique cutoff cost simultaneously determined by all women's choices. Therefore, it satisfies

$$c_A(F(c^A), F(c^A)) - c^A = 0.$$

Since there is no imbalance in types across sexes in the stationary equilibrium, a type-a woman gets u_{aa} and a type-b woman gets u_{bb}. Hence, the equilibrium cutoff cost c^A is the difference between the two homophily payoffs, $u_{aa} - u_{bb}$, and the equilibrium mass of type-a men is $F(c^A)$.

To determine the stability of the unique equilibrium, we need to check that the dynamic is converging. Namely, define the change in the cutoff costs,

$$\psi_A(c) \equiv \widetilde{c}(c) - c,$$

where $\widetilde{c}(c)$ is the current period's cutoff cost when the previous period's cutoff cost is c. We need to check that $\psi_A(\cdot)$ is decreasing at the equilibrium.[15] In summary,

Proposition 2 (Equilibria under Assortative Matching). *Suppose agents are positively assortatively matched. There exists a unique equilibrium $c^A = u_{aa} - u_{bb}$, and it is stable and stationary.*

The case described in Proposition 2 is depicted in Figure 1b. The intuition for Proposition 2 is best described by Figure 2b. Let $\widetilde{q}_t$ denote the belief of a woman in period t about the proportion of women in period t choosing action a. Suppose the proportion of type-a men is smaller than the equilibrium one: $p_t < p^A = F(u_{aa} - u_{bb})$. If a woman believes that $\widetilde{q}_t$ equals p_t, then she should

[13]The uniqueness of the solution follows from the fact that c_A is continuous and strictly decreasing in q_t.

[14]We show in the proof of Proposition 2 the nonexistence of a nonstationary equilibrium.

[15]The function $\psi_A(\cdot)$ may not be decreasing at all c, as illustrated by Figure 1b, but for the purpose of proving a unique equilibrium, it suffices to show that it satisfies a single-crossing property: $\psi_A(c^A) = 0$, $\psi_A(c) > 0$ for any $c < c^A$, and $\psi_A(c) < 0$ for any $c > c^A$.

expect that the fraction of women choosing action a equals $F(u_{aa} - u_{bb}) = p^A$, which is greater than $\widetilde{q}_t = p_t$. Hence, the woman's belief is not correct. Since an equilibrium of the game played by all women requires equilibrium knowledge, the woman should adjust her belief up until her belief is consistent with the actual fraction of women choosing action a, $\widetilde{q}_t = q_t^*(p_t)$, which results in an increase in the fraction of type-a men in the next period. The hypothetical belief adjustment process described above is depicted by the blue curves in the graph. The red curve depicts the dynamic relation between p_t and p_{t+1} (if we replace the x-axis label with p_t and the y-axis label with p_{t+1}), which leads to the unique equilibrium p^A.

Interestingly, even though more women tend to "coordinate" on an action when more men are of the corresponding type under assortative matching because of the intertemporal complementarity, the evolutionary trajectory in fact resembles that of an anti-coordination game because of the intratemporal competition. More specifically, the better prospect of marrying a type-a man induces more women to compete for type-a men when the fraction of type-a men, p_t, is smaller than p^A. Similarly, the opposite is true when $p_t > p^A$.

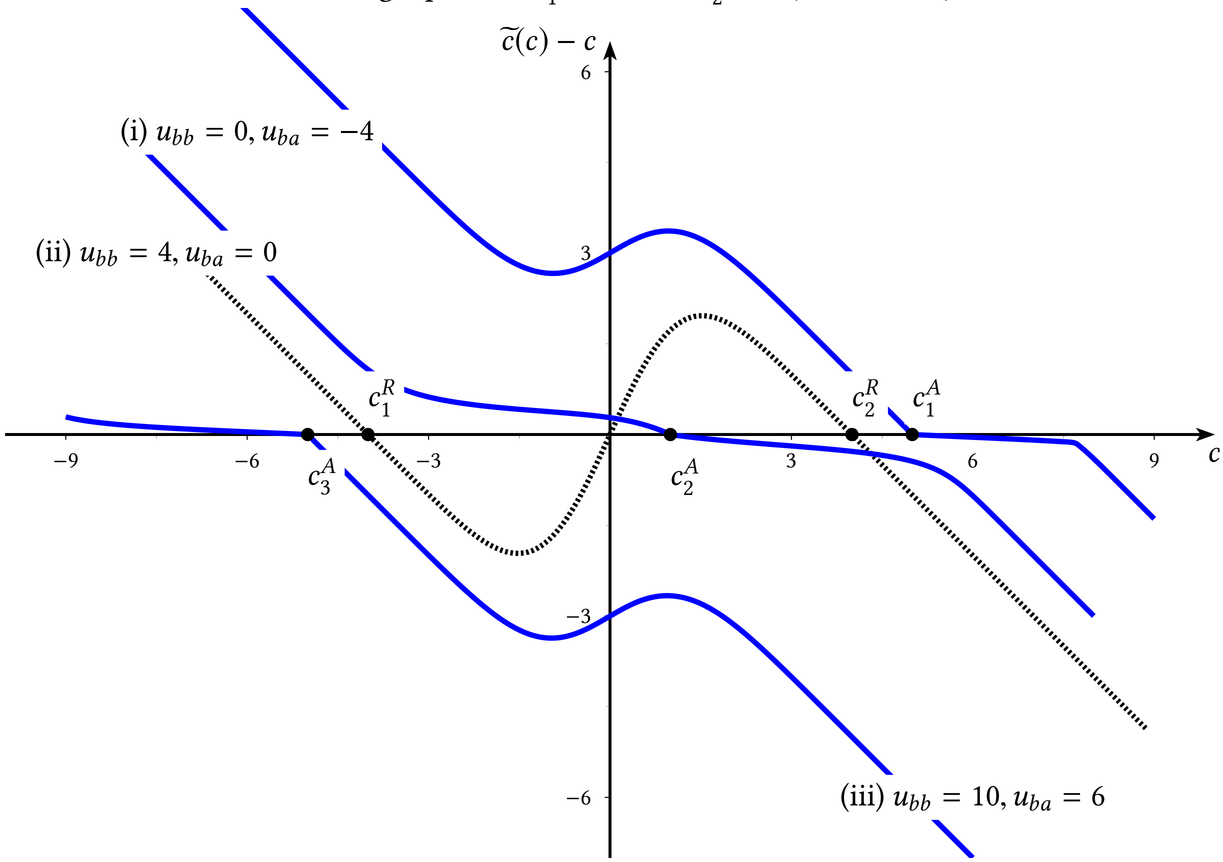
It is worth noting that the equilibrium distribution of types is *not necessarily* more balanced under assortative matching than under random matching, ceteris paribus. Figure 3 shows the possible relationships between the two stable equilibria under random matching and the unique stable equilibrium under assortative matching. The equilibrium mass of type-a women under assortative matching can be (i) bigger than, (ii) between, or (iii) smaller than the two possible equilibrium masses of type-a women under random matching.

3.3 Welfare Comparison between Random and Assortative Matching

In the simple model, only women's marriage utilities and costs are defined. Hence, we use the average payoff of women as the criterion for welfare analysis. To obtain sharp predictions, we assume that the range of c is $[u_{ba} - u_{bb}, u_{aa} - u_{ab}]$. In this case, the two stable equilibria under random matching are $c_1^R = 0$ and $c_2^R = 1$, and the average payoffs of women for these two equilibria are $W(c_1^R) = u_{bb}$, and $W(c_2^R) = u_{aa} - \int_{u_{ba}-u_{bb}}^{u_{aa}-u_{ab}} c dF(c)$.

The unique stable equilibria under assortative matching $c^A = u_{aa} - u_{bb}$ corresponds to an

Figure 3: Relationship between the Two Random-Matching Stable Equilibria and the Assortative-Matching Stable Equilibrium. Fix $c \sim N(0,1)$, $u_{aa} = 5$, and $u_{ab} = 1$. The one assortative-matching equilibrium can be (i) $c_1^A = 5$ when $u_{bb} = 0$ and $u_{ba} = -4$, bigger than, (ii) $c_2^A = 1$ when $u_{bb} = 4$ and $u_{ba} = 0$, between, or (iii) $c_3^A = -5$ when $u_{bb} = 10$ and $u_{ba} = 6$, smaller than the two random-matching equilibria $c_1^R = -4$ and $c_2^R = 4$ (dashed line).



average payoff of women that equals to

$$W(c^A) \quad = \quad F(c^A)u_{aa} + (1 - F(c^A))u_{bb} - \int_{u_{ba}-u_{bb}}^{c^A} c\,dF(c).$$

We have $W(c^A) > W(c_1^R), W(c_2^R)$. Hence, assortative matching gives a higher average payoff to women than random matching. Note that the welfare analysis is solely based on the model's fundamentals. Nevertheless, the different equilibria may have implications outside of the model's specifications. For example, if action a corresponds to female labor participation, then high female labor participation may be beneficial to the entire society. If type a represents the "spirit of capitalism", then the spread of type a would be critical for the emergence of industrial revolution.

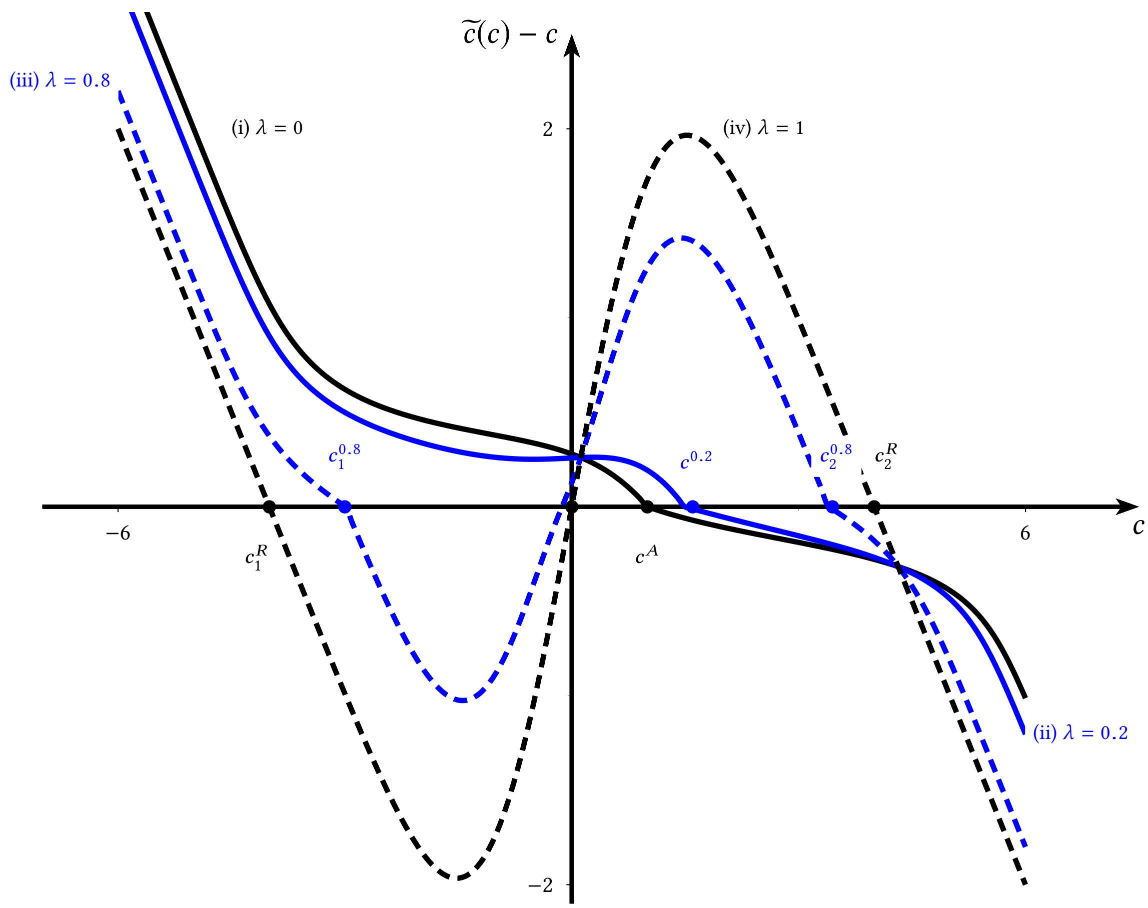
3.4 Mixed Matching

Finally, we combine the two extremes—the random matching market and the assortative matching market—and consider the intermediate cases in which both markets operate. Suppose that each person marries in the random matching pool with probability λ and in the assortative matching pool with probability $1 - \lambda$. Therefore, λ captures the degree of randomness—or, in other words, the level of friction—in the matching market.

Figure 4: Stable Equilibria under Mixed Matching.

Fix $c \sim N(0, 1)$, $u_{aa} = 5$, $u_{bb} = 4$, $u_{ab} = 1$, and $u_{ba} = 0$.

(i) A unique stable equilibrium c^A when $\lambda = 0$ (perfectly assortative matching)
(ii) A unique stable equilibrium $c^{0.2}$ when $\lambda = 0.2$ (predominantly assortative matching)
(iii) Two stable equilibria $c_1^{0.8}$ and $c_2^{0.8}$ when $\lambda = 0.8$ (predominantly random matching)
(iv) Two stable equilibria c_1^R and c_2^R when $\lambda = 1$ (perfectly random matching)



When random matching is prevalent, there may exist two stable equilibria, but when assortative matching is prevalent, there is only one stable equilibrium. Figure 4 demonstrates four cases, in which λ takes the value of 0, 0.2, 0.8, and 1, respectively. When $\lambda = 0.2$, there is one stable equilibrium, which resembles the equilibrium under assortative matching. When $\lambda = 0.8$, there are two stable equilibria, which resembles those under random matching. Moreover, equilibria in the intermediate mixed-matching environment are between the stable equilibria in the extreme cases of random and assortative matching environments. For example, let c_1^R and c_2^R denote the two random-matching stable equilibria and c^A the unique assortative-matching stable equilibrium. The two stable equilibria when $\lambda = 0.8$, $c_1^{0.8}$ and $c_2^{0.8}$, are between c_1^R and c^A and between c^A and c_2^R, respectively.

Furthermore, we can show that there is one stable equilibrium if the degree of friction is lower than some critical degree λ^*, and there are two stable equilibria otherwise. We call a marriage market with $\lambda \leq \lambda^*$ **predominantly assortative** and a marriage market with $\lambda > \lambda^*$ **predominantly random**. The existence of a unique critical degree of friction λ^* that separates the number of stable equilibria depends on the fact that the dynamic describing the change in the cutoff cost, ψ_λ, is a linear combination of ψ_R and ψ_A.[16] Figure 5 shows bifurcation diagrams, i.e., the set of equilibria as λ shifts from 0 to 1. In the language of bifurcation theory, we have a *pitchfork bifurcation* in which the system transitions from one fixed point to three fixed points.

Proposition 3 (Equilibria under Mixed Matching). *There exists a critical degree of friction λ^* such that there is one stable equilibrium when $\lambda \leq \lambda^*$, and there are two stable equilibria when $\lambda > \lambda^*$.*

4 Evolution of Preferences

In this section, we investigate how transitory and permanent changes in preferences and matching technology affect the equilibrium distribution of preferences.

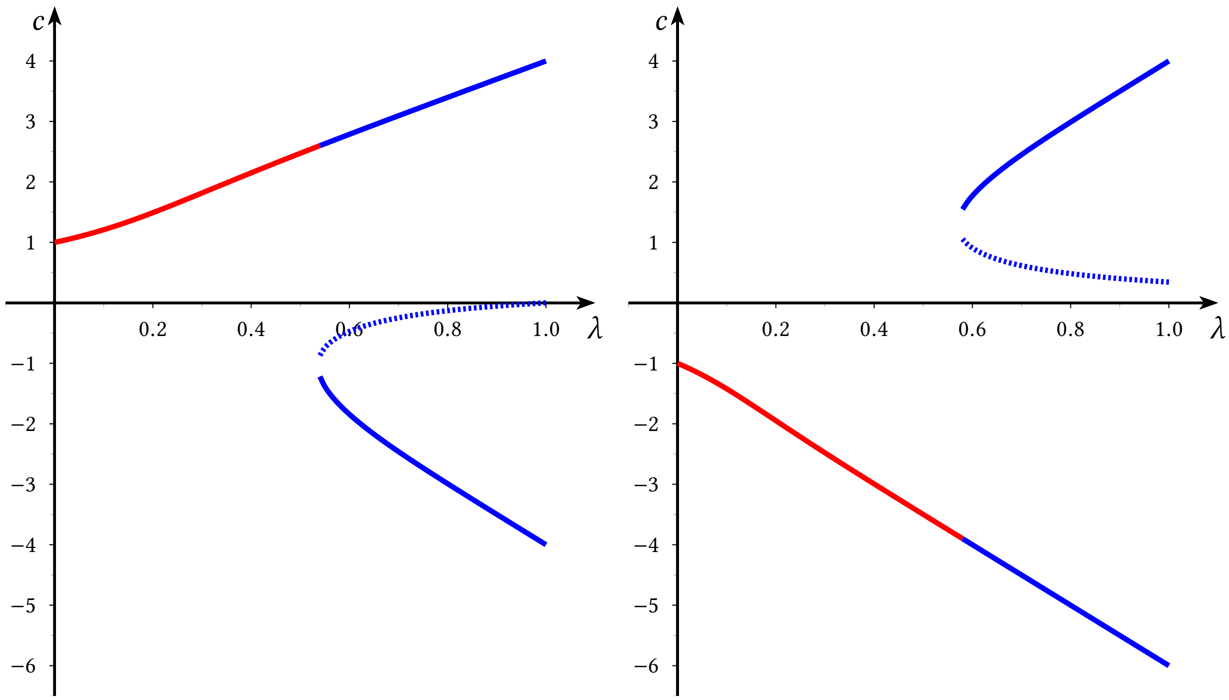
4.1 Transitory Change in Preferences or Costs

When random matching is sufficiently prevalent, there are two stable equilibria, c_1^* and $c_2^* > c_1^*$, and an unstable equilibrium, $c_0^* \in (c_1^*, c_2^*)$. A sufficiently large transitory shock can move the system from one stable equilibrium to the other. For example, suppose the system is initially at the equilibrium c_1^* with fewer type-a men. There is a shock that results in an increase in

[16] The detailed expression of ψ_λ is given in the proof of Proposition 3.

Figure 5: Bifurcation Diagram. Fix $c \sim N(0, 1)$, $u_{aa} = 5$, $u_{ab} = 1$, and $u_{ba} = 0$.

(a) $u_{bb} = 4$. **(b)** $u_{bb} = 6$.



the mass of women—or equivalently, the mass of type-a men—choosing action a from $F(c_1^*)$ to $p_0 = F(c_0) > F(c_1^*)$. If the shock is so large—i.e., $c_0 > c_0^*$—that all women with costs lower than c_0^* choose action a, then this transitory change enables the population to escape from the basin of attraction of the c_1^* equilibrium to that of the c_2^* equilibrium, resulting in a change in the long-run outcome. Otherwise, if the shock is not large enough—i.e., $c_0 < c_0^*$—then the population initially has a higher mass of type-a agents due to the temporary shock, but later reverts to the equilibrium distribution.[17]

Figure 6a demonstrates the evolution of preferences after a small temporary deviation from the lower stable equilibrium as well as a large temporary deviation from the lower stable equilibrium. The economy moves toward the higher stable equilibrium after the large temporary deviation, but reverts back to the original equilibrium after the small temporary deviation.

When assortative matching is sufficiently prevalent, there is only one stable equilibrium. Hence, any transitory shock in the distribution of types does not lead to a persistent change in the equilibrium. Figure 6b demonstrates the evolution of preferences after a temporary deviation from the stable equilibrium. The distribution initially moves away from the equilibrium

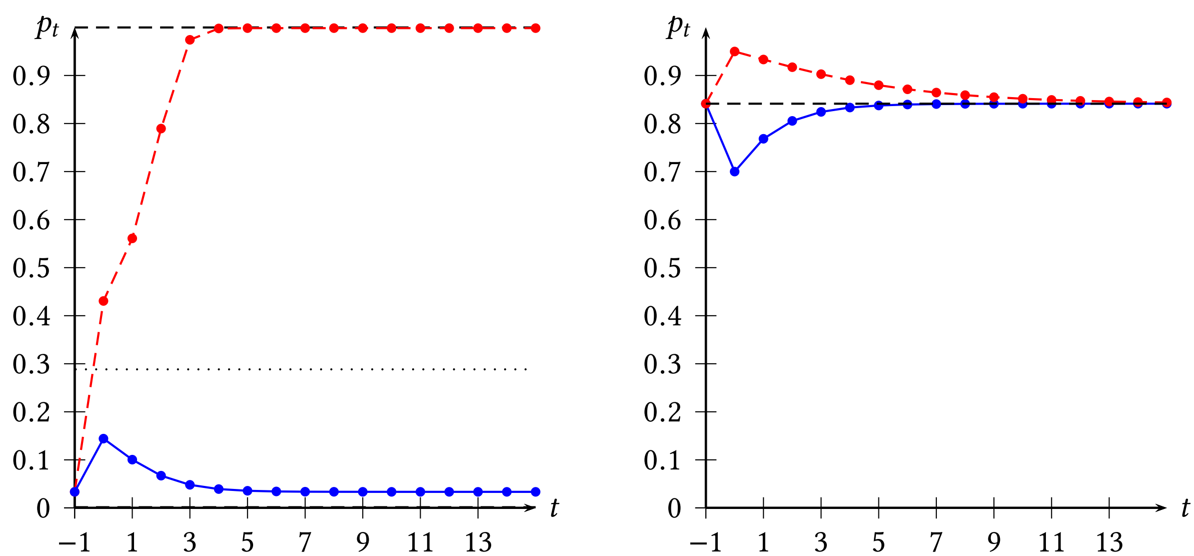
[17] If c_0 happens to be exactly c_0^*, then the shock shifts the system to the unstable equilibrium.

Figure 6: Evolution of Preferences After a Transitory Change.

Fix $c \sim N(0, 1)$, $u_{aa} = 3$, $u_{bb} = 2$, $u_{ab} = 0$, and $u_{ba} = 0$.

(a) Predominantly Random Matching. A sufficiently large transitory shock can have a long-run impact (dashed line). A small transitory shock cannot (solid line).

(b) Predominantly Assortative Matching. A large transitory shock cannot have a long-run impact (dashed line). A small transitory shock also cannot (solid line).



due to the shock, but the equilibrium immediately reverts to the unique stable equilibrium after either a positive temporary change or a negative temporary change.

To summarize, we have the following proposition.

Proposition 4 (Evolution After a Transitory Change in Preferences or Costs). *Consider a temporary change from a stable equilibrium cutoff cost to c_0.*

1. *Suppose there are two stable equilibria c_1^* and c_2^* and one unstable equilibrium $c_0^* \in (c_1^*, c_2^*)$. If (i) the original equilibrium is c_1^* and $c_0 > c_0^*$ or (ii) the original equilibrium is c_2^* and $c_0 < c_0^*$, the system moves to the other stable equilibrium. If $c_0 = c_0^*$, the system moves to the unstable equilibrium. Otherwise, the equilibrium is unchanged.*

2. *Suppose there is one stable equilibrium c^*. The system initially changes to c_0 but reverts to c^* afterward.*

4.2 Permanent Change in Preferences or Costs

The equilibrium changes in intuitive ways after a permanent shock to either preferences or women's cost of choosing action a, regardless of the structure of the marriage market.

Proposition 5 (Evolution After a Permanent Change in Preferences or Costs). *Type a becomes strictly more prevalent in equilibrium when (i) u_{aa} increases; (ii) u_{ba} decreases and $\lambda \neq 0$; (iii) u_{ab} increases and $\lambda \neq 0$; (iv) u_{bb} decreases; or (v) F decreases first-order stochastically.*

4.3 Permanent Change in Matching Technology

Consider a predominantly assortative environment so that there is always a unique stable equilibrium. If the marriage market becomes more random and less assortative, there might be more or fewer people choosing action a and becoming type a in equilibrium, as illustrated by the red lines in Figures 5a and 5b, respectively.

Proposition 6 (Evolution After a Permanent Change in Matching Technology). *Suppose $\lambda < \lambda^*$ so that there is a unique stable equilibrium. When λ increases, equilibrium c^λ decreases, i.e., there is a lower mass of type-a men and women when marriages become less assortative, if and only if $(1 - F(c^A))(u_{aa} - u_{ab}) > F(c^A)(u_{bb} - u_{ba})$.*

The variation in the number of stable equilibria discussed in Section 3.4 suggests that a significant change to the matching technology (from predominantly random to predominantly assortative or vice versa) can potentially serve as an effective policy instrument. For example, the matching is initially random and the population is situated at the stable equilibrium, with type-a people dominating. Suppose such an equilibrium is undesirable from a societal perspective. Policy makers can seek to reduce frictions such that the matching technology becomes more assortative, and consequently the population can possibly move to a more balanced state with both types coexisting.

5 Implications

We present four applications of our results to demonstrate that different marriage institutions can lead to different persistent patterns of preferences and different changes in preferences.

5.1 Female Labor Force Participation in Developed Countries

Many empirical studies have documented the profound impact of the attitude toward gender roles on female labor force participation.[18] Most notably, Fernández et al. (2004) show that men

[18] Fortin (2005) shows how cultural beliefs about the appropriate role for women influence women's labor market outcomes across OECD countries. Fernández and Fogli (2005) show that female labor participation rates in parents'

whose mothers worked were more likely to find wives who worked, by using regional variation in the influence of World War II as a shock to female labor force participation.[19] They suggest that an intergenerational transmission mechanism is at work: Compared with men who have nonworking mothers, those with working mothers develop a stronger preference for working wives.

Our model suggests that a tremendous transitory event like World War II could result in a permanent increase in female labor force participation through intergenerational transmission of gender role attitudes, but only if men and women were sufficiently randomly sorted on the dimension of attitudes toward women working. A transitory positive shock in mothers' work does not always increase labor force participation for women of future generations. When the marriage market is predominantly assortative, a transitory shock does not lead to a permanent change, because there is a unique stable equilibrium. When the marriage market is predominantly random, a transitory shock must be large enough to overcome frictions in the marriage market and shift from the equilibrium with fewer working women to one with more working women.

Fernández et al. (2004) also provide a theoretical model to support their empirical findings. In what follows, we briefly summarize the key mechanism of their model and point out the key difference between ours and theirs. In their model, men have two types: preferring a working wife and preferring a nonworking wife. A man's type is directly determined by whether his mother works. Before marriage, each woman chooses an education level that determines her wage distribution, which in turn affects her decision to work if she gets married. The marriage market consists of one round of random matching and the marriage decision is made after a pair is matched. Each woman can decide to get married or to stay single. They find that a woman's effort level is always increasing in the proportion of men who like a working wife. However, this does not necessarily result in an increase in the proportion of men who like a working wife across generations, because women can stay single. In general, depending on the functional forms, the model generates two possible dynamic paths: (i) an upward path leading to a steady state with men who like a working wife being the majority in the population, and (ii) a downward

countries of origin predict the labor participation rate of second-generation American women. Fernández (2007) shows that attitudes toward working women in parents' countries of origin can explain second-generation American women's work behavior.

[19] Goldin (1991), Acemoglu and Autor (2004), and Goldin and Olivetti (2013) also study the effect of World War II on female labor supply, which persisted for decades after the war.

path leading to a steady state with no man preferring a working wife. Therefore, there are two possibilities for the population to evolve to the state in which most men prefer a working wife (which is accompanied by a high female labor force participation rate). First, the evolutionary dynamic is already situated on the upward path, such that the composition of the population is moving to the desired steady state. Second, the evolutionary dynamic is on the downward path and factors such as war, the expansion of service sectors, labor-saving household technology, and decreasing importance of marriage bar may shift the curve to the upward path.

Compared with Fernández et al. (2004), our model incorporates a richer set of matching technologies. Furthermore, how the dynamic operates given different matching technologies depends solely on the incentives created by the matching technology, free of any particular functional forms used in the model. Our model also clearly demonstrates, in Section 4.1, that WWII as a transitory shock plays a key role in changing the female labor force participation and the result crucially depends on the matching technology being random. In their model, however, the dynamic is either on an upward path where transitory shocks play no role, or on a downward path, escaping from which instead requires permanent shocks to economic fundamentals. Finally, Section 4.3 suggests that reducing frictions in the marriage market, such that the entire society is transformed into a more assortative environment, serves as another way to escape from the equilibrium with low female labor force participation.[20]

5.2 Gender Norms in Developing Countries

While developed countries have experienced a tremendous transformation toward more equal gender norms and increasing female labor force participation and educational attainment, traditional gender role attitudes such as preferences for female chastity and practices such as child marriage, purdah, and female genital circumcision persist in Africa, the Middle East, and South Asia.

One feature that distinguishes these regions from the rest of the world is the prevalence of arranged marriages (Goode, 1970; Cherlin, 2012; Rubio, 2014),—and arranged marriages are deeply connected with the above described traditional gender norms. For example, 95 percent of all marriages are still arranged in South Asia (Rubio, 2014), and there is universal demand for female

[20]Pande (2018) suggests that raising a low rate of female labor force participation will “require behavioral interventions that address social norms.”

chastity.[21]

Traditional gender role attitudes and practices in regions where marriages are mostly arranged severely limit women's mobility and reduce their chances of education and work (Jayachandran, 2015, 2019). As Rubio (2014) demonstrates, there is a negative correlation between arranged marriage and female participation in the formal labor market and a negative correlation between arranged marriage and women's educational attainment.

Why did traditional gender norms persist under arranged marriage while transformation toward gender equality is observed in many parts of the rest of world, and especially the developed countries where freewill marriages prevail? We believe that how the assortativity of the marriage market affects the transmission of preferences, —as we have demonstrated in our model,—can at least partially answer the question.

We argue that arranged marriages result in more homogamous marriages in certain preferences than freewill marriages do, for the following reasons.

First, arranged marriages have fewer information and search frictions than freewill marriages. Arranged marriages are usually based on known qualities of families and children. Through their social networks, parents usually have wide access to potential candidates and they may be better at evaluating the candidates' characteristics. Under freewill marriages, in contrast, people must search for partners on their own with imperfect information about certain characteristics of their potential partners, and long courtships are often required. In addition, arranged marriages are usually organized locally, and naturally the relatively small size of the marriage market leads to a

[21] Even a slight possibility of losing her virginity will reduce a bride's desirability (Desai and Andrist, 2010). As a result, parents who benefit from delivering a virgin bride will try their best to prevent their daughter from contacting the opposite sex or searching for potential partners (Edlund and Lagerlöf, 2004). An effective way for parents to preserve a daughter's virginity is to marry her at a young age.

Wahhaj (2018) quotes the following paragraph from Rozario (1992) on the case of Bangladesh to support his argument that in societies with predominantly arranged marriages, child marriage results from the fact that age signals a woman's poor quality of women:

> Many ... parents prefer to have their daughters marry as young as possible. About 15-16 years old is seen as ideal, while 18 years is considered too old, particularly if a girl begins to visit friends and neighbours outside the household and thereby cast doubt on her purity. (Rozario, 1992)

Men's preference for female purity also result in the practice of purdah, which is adopted in certain Muslim and Hindu societies to segregate women from men, and it seems that the practice is transmitted across generations:

> [Women who practice purdah] look forward to being able to arrange their children's marriages and exert an element of power in that important decision. They certainly expect their sons to marry girls who have been carefully shielded by purdah from temptation. (White, 1977)

higher degree of assortativity, while freewill marriages occur in larger marriage markets. Studies have shown a positive correlation between freewill marriage and urbanization.[22] In an urban area, due to the sheer size of the market, the marriage market is inevitably more random.[23]

Second, as argued by Stone (1979), freewill marriages depend on

> personal affection, companionship and friendship, a well-balanced and calculated assessment of the chances of long-term compatibility, based on the fullest possible knowledge of the moral, intellectual and psychological qualities of the prospective spouse, tested by the lengthy period of courtship.

As a result, freewill marriages should exhibit relatively more randomness in the few dimensions that families usually care about in arranged marriages such as female chastity. In addition, Appendix D provides evidence that Indian couples in arranged marriages have more closely aligned preferences for family values such as women's work and desired number of children.

Third, freewill marriages often involve match-specific qualities that are idiosyncratic to the couple and not predictable according to observable traits. The match-specific quality can be interpreted as affection or attraction between a couple, and it adds randomness to the matching process (Fernández et al., 2005; Huang et al., 2017). Match-specific qualities, however, are usually not a factor in arranged marriages, since they are not important in the considerations for parents even if the parents are altruistic. In certain countries, the practice of blind marriage serves as a way to prevent love from standing in the way of achieving the goals of parents in arranged marriages.

Consider our model. For men, type b represents a preference for a modest and domestic wife or a preference for female chastity, and type a is the opposite. For women, action a is the decision to participate in the labor force or to receive formal education, and action b is the opposite. As we have argued, arranged marriages result in a relatively high degree of assortativity in the marriage market along the dimension of gender norms. Hence, our model predicts that

[22] Rubio (2014) finds that the transition from arranged marriage to freewill marriage is correlated with increases in urbanization across countries. Cherlin (2012) describes the rise of a "hybrid form" of arranged marriage with the daughter's consent in the urban middle class in India. Huang et al. (2017) document that in the early 1990s, 48 percent of rural couples and 14.5 percent of urban couples were married by parent-involved matchmaking in China.

[23] It is worth mentioning that the distinction between marriage markets in urban and rural areas allows us to explain why the same temporary shock to behavior may move the social norm in cities more than in villages.

there is a unique stable equilibrium. If the cost of choosing action b for women is sufficiently high, which is true in the regions we consider, then the unique equilibrium should feature strong traditional gender norms and a low female labor participation rate.[24] Moreover, the equilibrium is resilient to transitory events, which means that there is still a long way ahead for globalization and interventions by governments or international agencies to change the status quo.

5.3 The Capitalistic Spirit in Preindustrial England

Doepke and Zilibotti (2006) provide evidence that, in preindustrial England, the middle class,—which included craftsman, artisans, and merchants,—developed preference traits that feature a good work ethic and patience. In contrast, the landed upper class cultivated a refined taste for leisure. When the Industrial Revolution arrived, the patient and hardworking middle class seized opportunities for economic advancement through entrepreneurship and investment and rose in the social hierarchy, while the landed elites failed to do so.

Doepke and Zilibotti (2006) argue that this stratification in preferences and occupational choices across the two classes is deeply rooted in the economic incentives they faced. However, they do not consider the potential effects of the two classes' different marriage institutions. As we argue in this paper, different two-sided matching technologies can lead to distinct trajectories of preference evolution, and the mechanisms can further support the observed transmission of capitalistic preferences in early modern England.

To see this, we must describe a picture of the marriage arrangements that were common in England prior to the Industrial Revolution. Goody (1983) documents that the rise of the Catholic Church triggered the transformation from arranged marriages to freewill marriages across Europe,—except among the landed upper class, whose members continued to arrange marriages for their children until the arrival of the Industrial Revolution. For the specific case of England, we refer to Stone (1979)'s seminal sociological study on marriages in preindustrial England. He highlights several important properties of the class specific marriage arrangements of that era.

First, in the landed upper class, arranged marriages prevailed. People married at a young

[24] In rural and less developed areas, the high cost of choosing action a can be attributed to the lack of governmental support for the elderly and the absence of a market for household services. These factors raise the opportunity cost of working or receiving higher education for women and raise the value parents place on a submissive and home-oriented daughter-in-law.

age, and their families' considerations were heavily involved in determining the matches. Stone (1979) writes,

> Authoritarian control by parents over the marriages of their children inevitably lasted longest in the richest and most aristocratic circles, where the property, power and status stakes were highest.

Second, among the lower classes, freewill marriage instead was the most common form of marriage. There are several reasons for this phenomenon, which Stone (1979) summarizes as follows:

> In the first place, their parents had little economic leverage over them since they had little or nothing to give or bequeath them. In the second place, most of the children left home at the age of ten to fourteen in order to become apprentices, domestic servants, or living-on labourers in other people's houses. This very large floating population of adolescents living away from home were thus free from parental supervision and could, therefore, make their own choice of marriage partners as soon as they were out of apprenticeship. (Stone, 1979)

Members of these classes generally married late because of the need to accumulate sufficient capital to set up house and start a shop or trade. Given the high mortality rates in pre-modern society, parents were probably dead when their children reached their late twenties, which further freed them from parental control.

Third, marriages across classes were rare. As Stone (1979) explains, marriage markets in the upper class and the lower classes were essentially segregated: "Freedom of choice can most easily be conceded by parents in closely integrated groups with internalized norms, where there is little chance that the children will come into close contact with members of the lower social class."

Fourth, the marriage market for the upper class was organized relatively more locally, compared with the lower class: "[N]inety percent of the known marriages of Lancashire gentry in the early seventeenth century were with other gentry families" (Stone, 1979).

The local marriage market for the members of the landed class may have allowed families to arrange their children's marriages along some preference dimensions other than wealth, status, and power. For example, a wealthy man with a refined taste for leisure activities such as shooting, fox-hunting, and cricket may prefer to find a groom with the same tastes rather than one who is unusually enthusiastic about non-aristocratic business.

For members of the lower classes,—especially the craftsmen, artisans, and merchants who, Doepke and Zilibotti (2006) argue, were the main force that became the early industrialists during the Industrial Revolution,—the marriage market was much larger and exhibited a higher degree of randomness. Farr (2000) provides a comprehensive depiction of the people associated with these occupations in pre-modern Europe. He shows that craftsmen, artisans, and merchants constituted a substantial percentage of the stable urban population, and the number of trades was usually very large in major European cities. For example, Late medieval London had an estimated 180 trades and crafts. More importantly, he points out that guild endogamy was low: "The children of the great majority of guildsmen did not marry spouses who were, or whose fathers were, in the same guild as themselves or their fathers. That is, guild endogamy was far from the norm" (Farr, 2000).

Note that he also argues that artisanal endogamy was high: Artisans tended to find spouses in the broader social world beyond the guild, but within the artisanry. However, given that they represented a significant portion of the urban population and there were many trades within artisanry in each city, we can conclude that the marriage market for them must have been relatively random.

To summarize, the marriage markets in different social classes operated independently in pre-modern England. Arranged marriage persisted in the landed upper class, and the marriage market was usually organized locally and relatively assortative. Freewill marriage was popular among the lower classes. For the middle class, which mainly consisted of craftsmen, artisans, and merchants, the marriage market took place in large urban areas and was relatively random.

Now we attempt to apply our model to the context of preindustrial England. Consider the general model, which is specified in Section 6. Let type a represent a taste for diligence and type b a taste for leisure. Action a represents working in occupations that require diligence, such as craftsmanship, artisanry and commerce, whereas action b represents a choice to refrain from entering these occupations. Our model predicts the following. For members of the upper class, the (physical and opportunity) cost of working hard was universally larger, because people already had sufficient land income. Moreover, because the marriage market for them was relatively assortative, there will be a unique stable equilibrium in which type b dominates. For members of the middle class, the cost of choosing action a was much lower for type-a agents than type-b agents, because those occupations associated with action a favored hardworking people, and there was no land income at stake. Given that the marriage market for them was less assortative, there will be two stable equilibria, a type-a dominating equilibrium and a type-b dominating one.

A large transitory shock is needed to move the middle class population from the type-b dominating equilibrium to the type-a dominating one, while such a shock has no effect on the landed upper class. The Protestant Reformation represented such a shock. As Doepke and Zilibotti (2006) note, the Protestant ethic of Max Weber, and in particular Puritanism,—which featured frugality, thrift, and diligence,—spread through the urban middle class, while landed elites were still cultivating their taste for leisure. Therefore, our model presents a novel mechanism to explain the relation between the Protestant Reformation and the spirit of capitalism: The difference in the structure of their marriage markets between the landed upper class and the middle class determined that Protestant values were only able to spread in the middle class through intergenerational transmission, which enabled its members to rise up during the Industrial Revolution and changed the economic landscape of the entire society.[25]

5.4 Cultural Norms in the Long Run

A recent literature has documented the historical roots of today's gender role attitudes (Alesina et al., 2013; Hensen et al., 2015; Teso, 2018; Xue, 2018; Grosjean and Khattar, 2019). The idea is that the short-run outcome of a certain historical incident may imprint onto people's preferences and beliefs, which are transmitted through generations until today, even though the circumstances that caused the incident have long since changed.

Grosjean and Khattar (2019) show that the male-biased sex ratio caused by the British policy of sending convicts to Australia has a persistent effect of men having more traditional gender attitudes toward women even now, although the gender balance was quickly restored after the importation of convicts stopped. They argue that the male-biased sex ratio changed the bargaining position between men and women, leading to women enjoying more leisure in the short run. This in turn became part of the preferences, and persisted through cultural transmission. More-

[25] Bénabou and Tirole (2006) consider a model that produces multiple equilibria as in our random matching model, and they apply theirs to the context of religion. They show that there exists a Protestant dominant equilibrium, accompanied by high effort and low redistribution, and another one characterized by the predominance of agnosticism, with the reverse pattern of effort and redistribution.

over, they argue that homogamous marriages reinforce the persistence. They find that in areas with a higher percentage of homogamous marriages, a male-biased sex ratio leads to a more traditional gender view, while it is not the case in areas with a lower percentage of homogamous marriages. Our model can account for these empirical regularities.

Consider the simple model with type a referring to a man's preference for a two-income household and type b referring to the opposite. Action a represents a woman's participation in the work force and action b represents the opposite. Let the male-biased sex ratio be a shock that fundamentally changes people's utility in marriage. In particular, it leads to an increase in u_{bb}, the utility of a woman who chooses to stay home marrying a man who prefers a more traditional breadwinner-housewife family. According to Proposition 5(iv), an increase in u_{bb} will increase the prevalence of type b regardless of the matching technology. Hence, regardless of the underlying matching technology, an increase in u_{bb} has a persistent effect of lowering the proportion of type-a men in the population, which matches the main observation of Grosjean and Khattar (2019).

In addition, our model predicts that a sufficiently large cultural shock that promotes equal gender norms can shift men in regions with low prevalence of homogamous marriages (i.e., predominantly random matching) to have more progressive gender role attitudes, but not men in regions with high prevalence of homogamous marriages (i.e., predominantly assortative matching). This also explains observed variations of Grosjean and Khattar (2019) in gender role attitudes across regions with different marriage markets.

6 The General Model

In this section, we generalize the simple model by allowing both men and women to have types and actions and having each agent's final type determined by both parents and the choice he/she makes.

Consider a unit mass of men and a unit mass of women every period. There are two types available to all agents: a and b. Each agent's life has two periods: childhood and adulthood. During childhood, an agent adopts an initial type from his/her parents through intergenerational transmission. During adulthood, an agent chooses either action a or b. The initial type of an agent determines the cost of choosing different actions for him/her when he/she enters adulthood.

For example, suppose type a represents a preference for diligence, while type b represents a preference for leisure. Action a represents an occupation that requires diligence, and action b is the opposite. Then an agent who has a preference for diligence in his/her childhood is likely to have a lower cost for choosing an occupation that requires diligence when he/she enters the adulthood than one who has a taste for leisure in his/her childhood.

The action chosen in adulthood determines the final type for an agent. For example, consider an agent who has a taste for leisure in his/her childhood. Even though he/she is less likely to choose an occupation that requires hard work, as long as he/she chooses it, he/she will eventually develop a preference for diligence. Observe that although the choice made in adulthood determines the final type of an agent, intergenerational transmission indirectly influences the choice made by the agent through determining his/her initial type.

Let p_t^0 and q_t^0 denote the mass of men and women whose initial type is a in period t. Let α_t^m and α_t^w denote the mass of men and women whose initial type is a who choose action a in their adulthood in period t. Let β_t^m (β_t^w) denote the mass of men (women) whose initial type is b who choose action a in adulthood in period t. Let p_t (q_t) denote the mass of men (women) whose final type is a in period t, respectively. We have the following relationships:

$$\begin{aligned} p_t &= p_t^0\alpha_t^m + (1-p_t^0)\beta_t^m; \\ q_t &= q_t^0\alpha_t^w + (1-q_t^0)\beta_t^w. \end{aligned}$$

After choosing their actions and forming their final types in adulthood, all men and women enter the marriage market to find a partner. Assume that all men and women pair up, and each pair produces two children, one son and one daughter.

We normalize the cost of action b to 0 and denote the cost of action a by c_ρ^g for an individual whose gender is $g \in \{m, f\}$ and initial type is $\rho \in \{a, b\}$. Assume the cost is distributed according to a differentiable and strictly increasing distribution F_ρ^g with associated single-peaked density f_ρ^g, for $g \in \{m, f\}$ and $\rho \in \{a, b\}$.

Let $u_{t_i t_j}^i$ denote a type-t_i agent's utility from marrying a type-t_j agent of the opposite gender, for $i \neq j$ and $i, j \in \{m, f\}$. Assume homophily in types: $u_{aa}^m > u_{ab}^m$ and $u_{bb}^m > u_{ba}^m$; $u_{aa}^w > u_{ab}^w$ and $u_{bb}^w > u_{ba}^w$.

The intergenerational transmission process is characterized as follows. Suppose that a son has a probability h^m of inheriting his father's type and a probability $1 - h^m$ of inheriting his mother's type. A daughter has a probability $h^w \in [0, 1]$ of inheriting her father's type and a probability $1 - h^w$ of inheriting her mother's type. This intergenerational transmission process gives rise to a dynamic system that characterizes the evolution of preferences independent of the matching technology:

$$
\begin{aligned}
p_t &= (h^m p_{t-1} + (1 - h^m) q_{t-1}) \alpha_t^m + (1 - h^m p_{t-1} - (1 - h^m) q_{t-1}) \beta_t^m; \\
q_t &= (h^w p_{t-1} + (1 - h^w) q_{t-1}) \alpha_t^w + (1 - h^w p_{t-1} - (1 - h^w) q_{t-1}) \beta_t^w.
\end{aligned}
$$

Under random matching, a man chooses action a if and only if

$$
c \leq q_t(u_{aa}^m - u_{ba}^m) + (1 - q_t)(u_{ab}^m - u_{bb}^m) \equiv k_m^R(q_t),
$$

where $k_m^R(q_t)$ denotes the cutoff cost for men. We have $\alpha_t^m = F_a^m(k_m^R(q_t))$ and $\beta_t^m = F_b^m(k_m^R(q_t))$. Similarly, a woman chooses action a if and only if

$$
c \leq p_t(u_{aa}^w - u_{ba}^w) + (1 - p_t)(u_{ab}^w - u_{bb}^w) \equiv k_w^R(p_t),
$$

where $k_w^R(p_t)$ denotes the cutoff cost for women. We have $\alpha_t^w = F_a^w(k_w^R(p_t))$ and $\beta_t^w = F_b^w(k_w^R(p_t))$.

Under assortative matching, a man chooses action a if and only if

$$
c \leq k_m^A(p_t, q_t) = \begin{cases} \frac{q_t}{p_t} u_{aa}^m + \left(1 - \frac{q_t}{p_t}\right) u_{ab}^m - u_{bb}^m & p_t > q_t, \\ u_{aa}^m - u_{bb}^m & p_t = q_t, \\ u_{aa}^m - \left(\frac{q_t - p_t}{1 - p_t} u_{ba}^m + \frac{1 - q_t}{1 - p_t} u_{bb}^m\right) & p_t < q_t, \end{cases}
$$

where $k_m^A(p_t, q_t)$ denote the cutoff cost for men. We have $\alpha_t^m = F_a^m(k_m^A(p_t, q_t))$ and $\beta_t^m = F_b^m(k_m^A(p_t, q_t))$.

Similarly, a woman chooses action a if and only if

$$c \leq k_w^A(p_t, q_t) = \begin{cases} \frac{p_t}{q_t} u_{aa}^w + \left(1 - \frac{p_t}{q_t}\right) u_{ab}^w - u_{bb}^w & q_t > p_t \\ u_{aa}^w - u_{bb}^w & q_t = p_t, \\ u_{aa}^w - \left(\frac{p_t - q_t}{1-q_t} u_{ba}^w + \frac{1-p_t}{1-q_t} u_{bb}^w\right) & q_t < p_t, \end{cases}$$

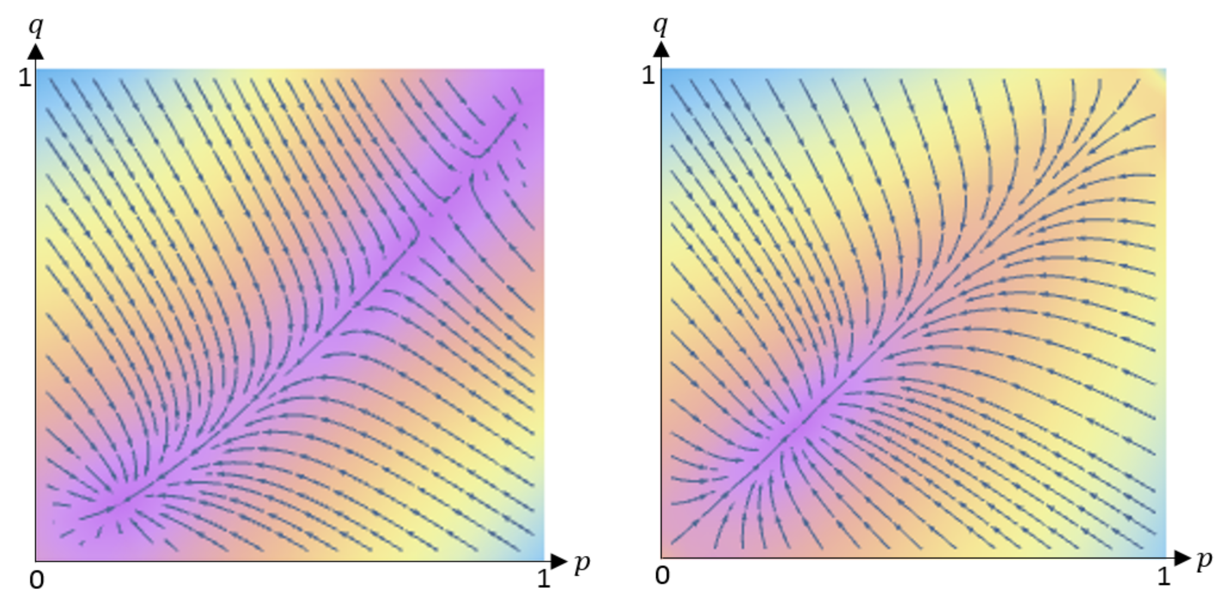
where $k_w^A(p_t, q_t)$ denotes the cutoff cost for women. We have $\alpha_t^w = F_a^w(k_w^A(p_t, q_t))$ and $\beta_t^w = F_b^w(k_w^A(p_t, q_t))$.

In Appendix B, we characterize the equilibria of the general model. Generically, as in the simple model, there are two stable equilibria and one unstable equilibrium under random matching and a unique stable equilibrium under assortative matching. Figure 7 provides numerical demonstrations. The horizontal axis represents the mass of type-a men, and the vertical axis represents the mass of type-a women.

Figure 7: Equilibria in the General Environments.
$h^m = 0.6$, $h^w = 0.4$, $u_{aa}^m = 4$, $u_{ab}^m = 3$, $u_{ba}^m = 1$, $u_{bb}^m = 4$, $u_{aa}^w = 4$, $u_{ab}^w = 2$, $u_{ba}^w = 2$, $u_{bb}^w = 4$, $F_a^m = F_a^w \sim N[0, 1]$ and $F_b^m = F_b^w \sim N[5, 5]$.

(a) Random Matching: Two stable equilibria ($p_1^* = 0.15, q_1^* = 0.10$) and ($p_2^* = 0.96, q_2^* = 0.92$) and one unstable ($p_0^* = 0.78, q_0^* = 0.68$).

(b) Assortative Matching: One stable equilibrium ($p^* = 0.24, q^* = 0.24$) and no other equilibrium.



7 Conclusion

This paper examines the intergenerational transmission of preferences under different organizations of the marriage market. We find that different organizations of the marriage market influence the evolution of preferences. Namely, there are multiple stable equilibria, like in coordination games, when the degree of frictions in matching is large, and there is one stable equilibrium, like in anti-coordination games, when the degree of frictions is small.

Market-differential effects of transitory and permanent shocks on preference evolution help us explain a set of phenomena. First, to be able to explain how the equilibrium permanently shifts due to a transitory shock to individual choices or preferences (for example, more women work today due to the transitory increase in World War II), we must be working under a sufficiently frictional matching market. Second, the prevalence of arranged marriages—which are a result of an assortative marriage market—may help explain the persistence of backward gender norms. Third, different marriage structures in different social classes may explain the rise of the middle class in England after the Industrial Revolution. Finally, a small initial difference may lead to a big difference in preferences in the long run, which explains the long-term impact of sex ratio on gender role attitudes in Australia.

To conclude, we discuss the differences between our model and the influential model of Bisin and Verdier (2000) that consider the role of marriage market in the evolution of preferences. Bisin and Verdier (2000) propose an overlapping generational cultural transmission model with a marriage market. In their model, agents in the population have two types and prefer their children to have their own types, an assumption called "imperfect empathy." Agents must enter a frictional marriage market to marry and produce offspring. The marriage market consists of two restricted matching pools exclusive to the two types, respectively, and a common matching pool. Entering a restricted matching pool is costly. The authors assume that same-type parents enjoy a more efficient socialization technology for their shared type than mixed-type parents. As a result, agents prefer to marry their own type (homogamous marriage). The authors also show that when the proportion of a type of agents decreases in the population, agents of that type have a stronger incentive to enter the restricted marriage pool and exert a higher effort to socialize their type to their children. The dynamic generated by this cultural transmission process will eventually lead to cultural heterogeneity: a stable equilibrium in which both types coexist.

Although Bisin and Verdier (2000)'s model considers marriage and sexual reproduction, agents in the population are not distinguished by sex and consequently the marriage market is not two-sided, as in our model.[26] In addition, as they show in their subsequent paper (Bisin and Verdier, 2001), imperfect empathy alone can generate the key prediction of cultural heterogeneity without marriage or sexual reproduction as long as the socialization technology is not perfect,—i.e., children have the possibility of being influenced by role models in the population at large. In our model, the socialization technology is perfect, as children are influenced by either their father or their mother. Interestingly, we are able to obtain an equilibrium in which both types coexist, with each constituting a significant proportion of the population. This demonstrates that cultural heterogeneity in preferences can be attributed to the incentives that arise in an assortative two-sided marriage market.

[26]Note that Bisin and Tura (2020) considers a two-sided marriage market, in which assortativity in culture arises due to the same incentives as in Bisin and Verdier (2000).

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A Omitted Proofs

Proof of Proposition 1 (Equilibria under Random Matching).

Stationary equilibrium c^* satisfies

$$\psi_R(c^*) = c_R(F(c^*)) - c^* = 0.$$

The slope of ψ_R is

$$\psi_R'(c) = c_R'(F(c))f(c) - 1 = \Delta f(c) - 1.$$

Since we assume $f(\widehat{c})\Delta > 1$, and f is single-peaked, there exist two solutions, $\underline{c}$ and $\overline{c}$, to the equation $\psi_R'(c) = \Delta f(c) - 1 = 0$. As a result, $\psi_R(c)$ is strictly decreasing for any $c < \underline{c}$ and for any $c > \overline{c}$. For $c \to -\infty$ or $c \to \infty$, $f(c) \to 0$, so $\psi_R'(c) \to -1$. Furthermore, we assume $\psi_R(\underline{c}) < 0 < \psi_R(\overline{c})$. Therefore, there is a $c_1^R < \underline{c}$ and a $c_2^R > \overline{c}$ such that $\psi_R(c_1^R) = \psi_R(c_2^R) = 0$. Because $\psi_R(c)$ is strictly decreasing around c_1^R and c_2^R, $c_R(F(c)) > c$ for any c smaller than but sufficiently close to c_i^R and $c_R(F(c)) < c$ for any c larger than but sufficiently close to c_i^R, $i = 1, 2$. Hence, the dynamic around the equilibrium costs c_1^R and c_2^R is converging, so these two equilibria are stable.

Furthermore, $\psi_R(c)$ is strictly increasing for any $c \in (\underline{c}, \overline{c})$. And by the assumption that $\psi_R(\underline{c}) < 0 < \psi_R(\overline{c})$ and continuity of $\psi_R(c)$, there exists a $c_0^R \in (\underline{c}, \overline{c})$ such that $\psi(c_0^R) = 0$. Since $\psi(c)$ is strictly increasing around c_0^R and $\psi(c_0^R) = 0$, $c_R(F(c)) < c$ for any c smaller than but sufficiently close to c_0^R, and $c_R(F(c)) > c$ for any c larger than but sufficiently close to c_0^R. The dynamic around equilibrium c_0^R is diverging, so the equilibrium c_0^R is unstable.

Figure A.1 illustrates the four possible scenarios when $f(\widehat{c})\Delta > 1$ but the assumption $\psi_R(\underline{c}) < 0 < \psi_R(\overline{c})$ does not hold. There is always one stable equilibrium. If $f(\widehat{c})\Delta \leq 1$, then $\psi_R(c)$ is always decreasing and there is one and only one equilibrium, and the equilibrium is stable.

There may exist nonstationary equilibria; for example, a nonstationary equilibrium in which the cutoff alternates between c_1 and c_2 such that $c_2 = c_R(F(c_1))$ and $c_1 = c_R(F(c_2))$. However, these nonstationary equilibria are unstable. □

Proof of Proposition 2 (Equilibria under Assortative Matching).

Let $\widetilde{c}(c)$ denote the cutoff cost in a period when c is the cutoff cost in the previous period. By

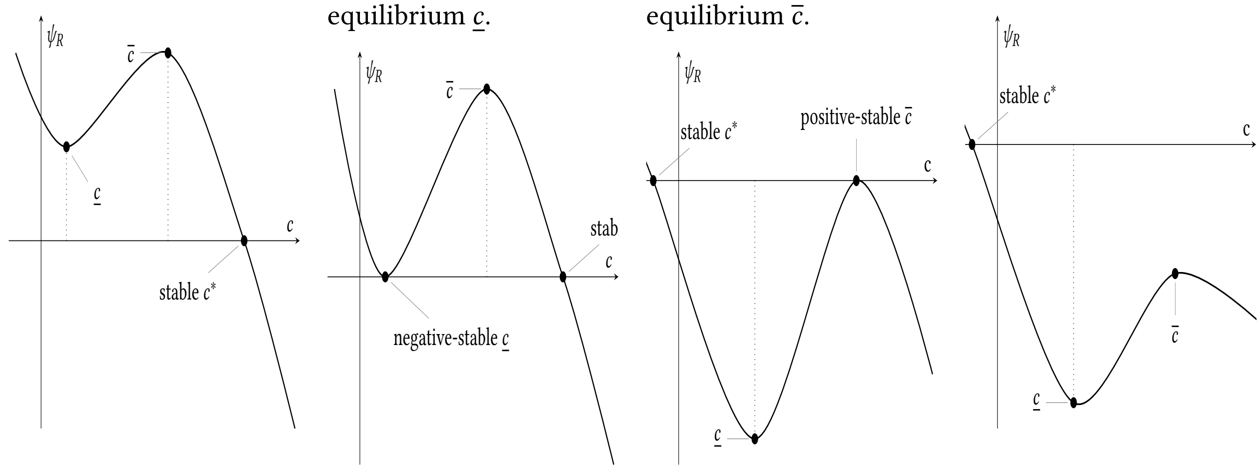
Figure A.1: Equilibria in Nongeneric Cases under Random Matching.

(a) $0 < \psi_R(\underline{c}) < \psi_R(\overline{c})$: A stable equilibrium $c^* > \overline{c}$ and no other equilibrium.

(b) $0 = \psi_R(\underline{c}) < \psi_R(\overline{c})$: A stable equilibrium $c^* > \overline{c}$ and a negative-stable positive-unstable equilibrium $\underline{c}$.

(c) $\psi_R(\underline{c}) < \psi_R(\overline{c}) = 0$: A stable equilibrium $c^* < \underline{c}$ and a positive-stable negative-unstable equilibrium $\overline{c}$.

(d) $\psi_R(\underline{c}) < \psi_R(\overline{c}) < 0$: A stable equilibrium c^* and no other equilibrium.



definition, $\widetilde{c}(c)$ solves

$$c_A(F(c), F(\widetilde{c})) - \widetilde{c} = 0.$$

Define $\psi_A(c)$ as

$$\psi_A(c) \equiv \widetilde{c}(c) - c.$$

The slope of $\psi_A(c)$ is

$$\psi_A'(c) = \widetilde{c}'(c) - 1,$$

where $\widetilde{c}'(c)$ satisfies

$$c_{A1} f(c) + c_{A2} f(\widetilde{c}(c))\widetilde{c}'(c) - \widetilde{c}'(c) = 0,$$

which simplifies to

$$\widetilde{c}'(c) = \frac{c_{A1} f(c)}{1 - c_{A2} f(\widetilde{c}(c))},$$

where

$$c_{A1} = \begin{cases} \frac{1}{F(\widetilde{c}(c))}(u_{aa} - u_{ab}) & \widetilde{c}(c) > c \\ \frac{1}{1-F(\widetilde{c}(c))}(u_{bb} - u_{ba}) & \widetilde{c}(c) < c \end{cases}, \text{ and } c_{A2} = \begin{cases} -\frac{1}{F(\widetilde{c}(c))} \frac{F(c)}{F(\widetilde{c}(c))}(u_{aa} - u_{ab}) & \widetilde{c}(c) > c \\ -\frac{1}{1-F(\widetilde{c}(c))} \frac{1-F(c)}{1-F(\widetilde{c}(c))}(u_{bb} - u_{ba}) & \widetilde{c}(c) < c \end{cases}.$$

The slope of $\psi_A(c)$ is

$$\psi_A'(c) = \frac{c_{A1} f(c) + c_{A2} f(\widetilde{c}(c)) - 1}{1 - c_{A2} f(\widetilde{c}(c))}.$$

More specifically,

$$\psi_A'(c)[1 - c_{A2} f(\widetilde{c}(c))] = \begin{cases} \frac{F(c)}{F(\widetilde{c}(c))}(u_{aa} - u_{ab}) \left[\frac{f(c)}{F(c)} - \frac{f(\widetilde{c}(c))}{F(\widetilde{c}(c))}\right] - 1 & \widetilde{c}(c) > c \\ \frac{1-F(c)}{1-F(\widetilde{c}(c))}(u_{bb} - u_{ba}) \left[\frac{f(c)}{1-F(c)} - \frac{f(\widetilde{c}(c))}{1-F(\widetilde{c}(c))}\right] - 1 & \widetilde{c}(c) < c \end{cases}.$$

To have a stationary equilibrium c^A, we must have $\widetilde{c}(c^A) = c^A$. Therefore, in equilibrium, $\widetilde{c}(c^A)$ must satisfy

$$c_A(F(c), F(c)) - c = 0.$$

This equation simplifies to

$$u_{aa} - u_{bb} - c = 0.$$

Therefore, there is a unique cost $c^A = u_{aa} - u_{bb}$ that satisfies the equation. Because $1 - c_{A2} f(\widetilde{c}) > 0$, $\lim_{c \uparrow c^A} \psi_A'(c) = -1/(1 - c_{A2} f(\widetilde{c})) < 0$ and $\lim_{c \downarrow c^A} \psi_A'(c) = -1/(1 - c_{A2} f(\widetilde{c})) < 0$, the unique equilibrium is stable.

It remains to show that there does not exist a nonstationary equilibrium. Suppose there exists a nonstationary equilibrium with alternating cutoff costs c_1 and c_2. Then $c_2 = \widetilde{c}(c_1)$ and $c_1 = \widetilde{c}(c_2)$. Without loss of generality, suppose $c_2 > c_1$. Then, because $\widetilde{c}$ is strictly increasing, $\widetilde{c}(c_2) > \widetilde{c}(c_1)$, which means $c_1 > c_2$, a contradiction with the premise. Following the same logic, there cannot exist a sequence $\{c_1, c_2, \cdots, c_T\}$ such that $c_{t+1} = \widetilde{c}(c_t)$ for any $t = 1, \cdots, T-1$, and $c_1 = \widetilde{c}(c_T)$. □

Proof of Proposition 3 (Equilibria under Mixed Matching).
Next period's cutoff $\widetilde{c}(c)$ given current period's cutoff c satisfies $\widetilde{\psi}_\lambda(c) = 0$, where

$$\widetilde{\psi}_\lambda(c) = \lambda c_R(F(c)) + (1-\lambda) c_A(F(c), F(\widetilde{c}(c))) - \widetilde{c}(c).$$

A stationary equilibrium c^* satisfies $\psi_\lambda(c^*) = 0$, where

$$\psi_\lambda(c) = \lambda c_R(F(c)) + (1-\lambda) c_A(F(c), F(c)) - c,$$

which is simplified to

$$\psi_\lambda(c) = \lambda c_R(F(c)) + (1-\lambda)(u_{aa} - u_{bb}) - c,$$

because $c_A(p,q) = u_{aa} - u_{bb}$ when $p = q$. The slope of $\psi_\lambda(c)$ is

$$\psi'_\lambda(c) = \lambda f(c)\Delta - 1.$$

If $\lambda \leq 1/(\Delta f(\widehat{c}))$, then the slope $\psi'_\lambda(c)$ is negative for almost any c, and there is a unique stable equilibrium.

If $\lambda > 1/(\Delta f(\widehat{c}))$, then there is a range of c such that the slope $\psi'(c)$ is positive in the range and negative otherwise. Let $\underline{c}_\lambda$ and $\overline{c}_\lambda$ denote the smallest and the largest c such that the slope $\psi'_\lambda(c)$ is nonnegative when the degree of marriage frictions is λ. In other words, $\underline{c}_\lambda$ and $\overline{c}_\lambda$ are the two solutions of $\lambda\Delta f(c) = 1$. If $\psi_\lambda(\underline{c}_\lambda) < 0 < \psi_\lambda(\overline{c}_\lambda)$, then there are two stable equilibria. Otherwise, there is one stable equilibrium. When there is one stable equilibrium, either $\psi_\lambda(\underline{c}_\lambda) \geq 0$ or $\psi_\lambda(\overline{c}_\lambda) \leq 0$.

To show that there is a unique λ^* such that there are two stable equilibria for $\lambda > \lambda^*$ and there is one stable equilibrium for $\lambda \leq \lambda^*$, it suffices to show that if there is a unique stable equilibrium under λ then there is a unique stable equilibrium under λ' for any $\lambda' < \lambda$.

Let $\lambda > \lambda' > 1/(\Delta f(\widehat{c}))$. Otherwise, the unique stable equilibrium is satisfied because $\psi'_\lambda(c) < 0$ for any c. Since $\lambda\Delta f(c) > \lambda'\Delta f(c)$ for any c, we must have

$$\underline{c}_\lambda < \underline{c}_{\lambda'} < \widehat{c} < \overline{c}_\lambda < \overline{c}_{\lambda'},$$

which by extension,

$$\underline{c} = \underline{c}_1 < \underline{c}_\lambda < \underline{c}_{\lambda'} < \widehat{c} < \overline{c}_\lambda < \overline{c}_{\lambda'} < \overline{c} = \overline{c}_1.$$

In words, the range of c in which $\psi_\lambda(c)$ is increasing is shrinking as λ decreases to $1/(\Delta f(\widehat{c}))$.

Suppose there is one stable equilibrium c_λ under λ. We discuss two possible cases: (1) $c^A > c^R_0$ and (2) $c^A < c^R_0$. First, suppose $c^A > c^R_0$. There must exist a stable equilibrium c_λ larger than c^A, because $\psi_\lambda(c)$ is continuous, and $\psi_\lambda(c^A) > 0$ and $\lim_{c\to\infty}\psi_\lambda(c) < 0$ together imply that $\psi_\lambda(c_\lambda) = 0$ for some $c_\lambda > c^A$. As a result, there is no other stable equilibrium. Then $\psi_\lambda(\underline{c}_\lambda) > 0$. We can show that $\psi_{\lambda'}(\underline{c}_{\lambda'}) > 0$ for any $\lambda' < \lambda$. Suppose $\underline{c}_\lambda < c^R_0$. Because $\psi'_\lambda(c) > 0$ for any c between $\underline{c}_\lambda$ and $\underline{c}'_\lambda$,

$\psi_\lambda(\underline{c}_\lambda) > \psi_\lambda(c_\lambda)$. Because $\psi_A(c_{\lambda'}) > \psi_R(c_{\lambda'})$, $\psi_{\lambda'}(\underline{c}_\lambda) > \psi_\lambda(\underline{c}_{\lambda'})$. The case with $c^A < c_0^R$ is the mirror image of the case with $c^A > c_0^R$. There must exist a stable equilibrium c_λ smaller than c_0^R. There is no other equilibrium, and $\psi_\lambda(\bar{c}_\lambda) > 0$. We can then show that $\psi_{\lambda'}(\bar{c}_{\lambda'}) < 0$.

□

Proof of Proposition 4 (Evolution After a Transitory Change in Preferences or Costs). For the first part of the proposition, suppose c_1^* and c_2^* are the two stable equilibria and c_0^* is the unstable equilibrium in between. Let $\widetilde{\psi}_\lambda(c) = \widetilde{c}(c) - c$ be the difference between the current period cutoff c and the next period cutoff $\widetilde{c}(c)$. We must have $\widetilde{\psi}(c) > 0$ for all $c \in (c_0^*, c_2^*)$ and $\widetilde{\psi}(c) < 0$ for all $c \in (c_2^*, \infty)$, though $\widetilde{\psi}(c)$ may not be monotonic in those ranges. Otherwise, there may exist other stable equilibria: If $\widetilde{\psi}(c') = 0$ for some c', then $\psi(c') = 0$, and c' is an equilibrium, contradicting the claim that only c_0^*, c_1^*, and c_2^* are equilibria. Similarly, we must also have $\widetilde{\psi}(c) < 0$ for all $c \in (c_1^*, c_0^*)$ and $\widetilde{\psi}(c) > 0$ for all $c \in (-\infty, c_1^*)$. Therefore, only a shock $c_0 > c_0^*$ when the original equilibrium is c_1^* or a shock $c_0 < c_0^*$ when the original equilibrium is c_2^* results in a dynamic that converges to a different equilibrium in the long run.

For the second part of the proposition, suppose c^* is the unique stable equilibrium. Since $\widetilde{\psi}_\lambda(c) < 0$ as $c \to \infty$ and $\widetilde{\psi}_\lambda(c) > 0$ as $c \to -\infty$, we must have $\widetilde{\psi}_\lambda(c) \geq 0$ for all $c < c^*$ and $\widetilde{\psi}_\lambda(c) \leq 0$ for all $c > c^*$. Again, note that the proof does not need $\psi_\lambda(c)$ to be monotonic in c.

□

Proof of Proposition 5 (Evolution After a Permanent Change in Preferences or Costs).

Stable equilibrium c^* satisfies $\psi_\lambda(c^*) = 0$, where $\psi_\lambda(c^*)$ can be expanded and simplified to

$$\psi_\lambda(c^*) = \lambda F(c)(u_{aa} + u_{bb} - u_{ab} - u_{ba}) - \lambda(u_{aa} - u_{bb}) + (u_{aa} - u_{bb}) - c.$$

Since $\psi'(c^*) < 0$ at any stable equilibrium c^*, c^* would increase as a variable v increases if

$$\frac{\partial \psi_\lambda(c^*)}{\partial v} > 0.$$

Similarly, c^* would decrease as a variable v increases if $\partial\psi_\lambda(c^*)/\partial v < 0$, and c^* would not change as a variable v increases if the derivative is zero. Hence, locally, it is sufficient to derive the sign of

$\partial\psi_\lambda(c^*)/\partial v$ for any v. The derivative of $\psi_\lambda(c^*)$ with respect to each of the five variables of interest is as follows.

(i). $\dfrac{\partial\psi_\lambda(c^*)}{\partial u_{aa}} = 1 - \lambda(1 - F(c^*)) > 0.$

(ii). $\dfrac{\partial\psi_\lambda(c^*)}{\partial u_{ab}} = -\lambda F(c^*) < 0$ if $\lambda \neq 0$.

(iii). $\dfrac{\partial\psi_\lambda(c^*)}{\partial u_{ba}} = \lambda[1 - F(c^*)] > 0$ if $\lambda \neq 0$.

(iv). $\dfrac{\partial\psi_\lambda(c^*)}{\partial u_{bb}} = \lambda F(c^*) - 1 < 0.$

(v). $\dfrac{\partial\psi_\lambda(c^*)}{\partial F(c^*)} = \lambda\Delta > 0$ if $\lambda \neq 0$. If $\lambda = 0$, the decrease in $F(c)$ itself still results in a strict decrease in the prevalence of type a.

□

Proof of Proposition 6 (Evolution After a Permanent Change in Matching Technology).

The equilibrium cutoff is simply characterized by

$$\lambda c_R(F(c)) + (1-\lambda)c_A(F(c), F(c)) - c = 0.$$

Explicitly, the LHS is

$$\lambda F(c)(u_{aa} - u_{ab} + u_{bb} - u_{ba}) + \lambda(u_{ab} - u_{bb}) + (1-\lambda)(u_{aa} - u_{bb}) - c \equiv \psi_\lambda(c).$$

It has a slope of $\lambda f(c)\Delta - 1$. If $\lambda > 1/(f(\widehat{c})\Delta)$ and $\psi(\underline{c}) < 0 < \psi(\overline{c})$, where $\underline{c}$ and $\overline{c} > \underline{c}$ are the two solutions of $f(c)\Delta = 1/\lambda$, then there are two stable equilibria characterized by $c_1^* < \underline{c}$ and $c_2^* > \overline{c}$. Consider the equation characterizing the equilibrium cutoff,

$$\lambda F(c^*)(u_{aa} - u_{ab} + u_{bb} - u_{ba}) + \lambda(u_{ab} - u_{bb}) + (1-\lambda)(u_{aa} - u_{bb}) - c^* = 0.$$

Applying the implicit function theorem and taking the derivative of the equation, we get

$$F(c^*)(u_{bb} - u_{ba}) + (F(c^*) - 1)(u_{aa} - u_{ab}) - c'(\lambda) + \lambda f(c^*)\Delta c'(\lambda) = 0.$$

Rearranging, we have

$$c'(\lambda) = \frac{F(c^*)(u_{bb} - u_{ba}) - (1 - F(c^*))(u_{aa} - u_{ab})}{1 - \lambda f(c^*)\Delta}.$$

Since $\lambda f(c^*)\Delta - 1$ is the slope of the LHS of the equation, it is negative, and the denominator is positive. Therefore, $c'(\lambda)$ has the same sign as $F(c^*)(u_{bb} - u_{ba}) - (1 - F(c^*))(u_{aa} - u_{ab})$. $\square$

B Equilibria in the General Model

B.1 Equilibria under Random Matching

Let (p, q) denote an equilibrium, it should satisfy

$$(h^m p + (1 - h^m)q)F_a^m(k_m^R(q)) + (1 - h^m p - (1 - h^m)q)F_b^m(k_m^R(q)) - p = 0, \tag{R1}$$

$$(h^w p + (1 - h^w)q)F_a^w(k_w^R(p)) + (1 - h^w p - (1 - h^w)q)F_b^w(k_w^R(p)) - q = 0, \tag{R2}$$

where

$$k_m^R(q) = q(u_{aa}^m - u_{ba}^m) + (1 - q)(u_{ab}^m - u_{bb}^m),$$

$$k_w^R(p) = p(u_{aa}^w - u_{ba}^w) + (1 - p)(u_{ab}^w - u_{bb}^w).$$

Since for any p, there is a q that satisfies (R2), we have that

$$(h^w p + (1 - h^w)q(p))F_a^w(k_w^R(p)) + (1 - h^w p - (1 - h^w)q(p))F_b^w(k_w^R(p)) - q(p) = 0.$$

By the implicit function theorem,

$$\begin{aligned} (h^w + (1 - h^w)q')F_a^w + (-h^w - (1 - h^w)q')F_b^w - q' & \\ +(h^w p + (1 - h^w)q)f_a^w\Delta^w + (1 - h^w p - (1 - h^w)q)f_b^w\Delta^w &= 0, \end{aligned}$$

where

$$\Delta^w = u_{aa}^w - u_{ab}^w + u_{bb}^w - u_{ba}^w > 0.$$

Simplify and rearrange the above expression:

$$q' = \frac{h^w(F_a^w - F_b^w) + f^w\Delta^w}{1 - (1 - h^w)(F_a^w - F_b^w)} > 0,$$

where

$$f^w = (h^w p + (1 - h^w)q)f_a^w + (1 - h^w p - (1 - h^w)q)f_b^w \in (\min\{f_a^w, f_b^w\}, \max\{f_a^w, f_b^w\}).$$

Next, let's investigate the slope of the LHS of equation (R1), given $q(p)$. It is

$$(h^m + (1 - h^m)q')(F_a^m - F_b^m) + f^m\Delta_m q' - 1,$$

where

$$f^m = (h^m p + (1 - h^m)q)f_a^m + (1 - h^m p - (1 - h^m)q)f_b^m \in (\min\{f_a^m, f_b^m\}, \max\{f_a^m, f_b^m\}),$$

and

$$\Delta^m = u_{aa}^m - u_{ab}^m + u_{bb}^m - u_{ba}^m > 0.$$

Plugging in q', we can show that the LHS of (R1) has the same sign as the following expression:

$$\left[\frac{(1 - h^m)(F_a^m - F_b^m) + f^m\Delta^m}{1 - h^m(F_a^m - F_b^m)}\right] \cdot \left[\frac{h^w(F_a^w - F_b^w) + f^w\Delta^w}{1 - (1 - h^w)(F_a^w - F_b^w)}\right] - 1 \equiv K(p).$$

Suppose $K(p) = 0$ has two solutions, denoted by $\underline{p}$ and $\overline{p}$. We must have $K(p) < 0$ for $p \in (0, \underline{p}) \cup (\overline{p}, 1)$ and $K(p) > 0$ for $p \in (\underline{p}, \overline{p})$. Furthermore, if the LHS of (R1) is negative when $p = \underline{p}$ and is positive when $p = \overline{p}$, then there must exist two stable equilibria lying in $(0, \underline{p})$ and $(\overline{p}, 1)$, respectively (because the LHS of (R1) is nonnegative when $p = 0$ and is nonpositive when $p = 1$), and one unstable equilibrium lying in $(\underline{p}, \overline{p})$.

B.2 Equilibria under Assortative Matching

Let (p, q) denote an equilibrium. It should satisfy

$$(h^m p + (1 - h^m)q)F_a^m(k_m^A(p, q)) + (1 - h^m p - (1 - h^m)q)F_b^m(k_m^A(p, q)) - p = 0, \qquad \text{(A1)}$$

$$(h^w p + (1-h^w)q)F_a^w(k_w^A(p,q)) + (1-h^w p - (1-h^w)q)F_b^w(k_w^A(p,q)) - q = 0, \tag{A2}$$

where

$$k_m^A(p,q) = \begin{cases} \frac{q}{p}u_{aa}^m + (1-\frac{q}{p})u_{ab}^m - u_{bb}^m & p \geq q \\ u_{aa}^m - \left(\frac{q-p}{1-p}u_{ba}^m + \frac{1-q}{1-p}u_{bb}^m\right) & p < q \end{cases},$$

and

$$k_w^A(q,p) = \begin{cases} \frac{p}{q}u_{aa}^w + (1-\frac{p}{q})u_{ab}^w - u_{bb}^w & p < q \\ u_{aa}^w - (\frac{p-q}{1-q}u_{ba}^w + \frac{1-p}{1-q}u_{bb}^w) & p \geq q \end{cases}.$$

Since for any p, there is a q that satisfies (A2), we have that

$$(h^w p + (1-h^w)q(p))F_a^w(k_w^A(p,q(p))) + (1-h^w p - (1-h^w)q(p))F_b^w(k_w^A(p,q)) - q(p) = 0.$$

By the implicit function theorem,

$$\begin{aligned} & (h^w + (1-h^w)q')F_a^w + (-h^w - (1-h^w)q')F_b^w - q' \\ +(h^w p + (1-h^w)q)f_a^w \cdot (k_{wp}^A + k_{wq}^A q') + (1-h^w p - (1-h^w)q)f_b^w \cdot (k_{wp}^A + k_{wq}^A q') &= 0, \end{aligned}$$

where $k_{wp}^A > 0$ and $k_{wq}^A < 0$ represent

$$k_{wp}^A = \begin{cases} \frac{1}{q}\left(u_{aa}^w - u_{ab}^w\right) & p < q \\ \frac{1}{1-q}\left(u_{bb}^w - u_{ba}^w\right) & p \geq q \end{cases}, \quad k_{wq}^A = \begin{cases} -\frac{p}{q}\frac{1}{q}\left(u_{aa}^w - u_{ab}^w\right) & p < q \\ -\frac{1-p}{1-q}\frac{1}{1-q}\left(u_{bb}^w - u_{ba}^w\right) & p \geq q \end{cases}.$$

Rearranging the above expression, we get

$$q' = \frac{h^w(F_a^w - F_b^w) + f^w k_{wp}^A}{1 - (1-h^w)(F_a^w - F_b^w) - f^w k_{wq}^A} > 0,$$

where

$$f^w = (h^w p + (1-h^w)q)f_a^w + (1-h^w p - (1-h^w)q)f_b^w \in (\min\{f_a^w, f_b^w\}, \max\{f_a^w, f_b^w\}).$$

The denominator minus the numerator of q' is

$$1-(F_a^w-F_b^w)-f^w(k_{wq}^A+k_{wp}^A)=1-(F_a^w-F_b^w)-f^w\times\begin{cases}(1-\frac{p}{q})\frac{1}{q}(u_{aa}^w-u_{ab}^w) & p<q\\ (1-\frac{1-p}{1-q})\frac{1}{1-q}(u_{bb}^w-u_{ba}^w) & p\geq q\end{cases}. \quad \text{(A3)}$$

As long as (A3) is nonnegative, q' is weakly smaller than 1.

Next, let's investigate the slope of the LHS of equation (A1), given $q(p)$. It is

$$(h^m+(1-h^m)q')(F_a^m-F_b^m)+f^m\cdot(k_{mp}^A+k_{mq}^Aq')-1,$$

where

$$f^m=(h^mp+(1-h^m)q)f_a^m+(1-h^mp-(1-h^m)q)f_b^m\in(\min\{f_a^m,f_b^m\},\max\{f_a^m,f_b^m\}),$$

and $k_{mp}<0$ and $k_{mq}>0$ represent

$$k_{mp}^A=\begin{cases}-\frac{q}{p}\frac{1}{p}(u_{aa}^m-u_{ab}^m) & p\geq q\\ -\frac{1-q}{1-p}\frac{1}{1-p}(u_{bb}^m-u_{ba}^m) & p<q\end{cases},\quad k_{mq}^A=\begin{cases}\frac{1}{p}(u_{aa}^m-u_{ab}^m) & p\geq q\\ \frac{1}{1-p}(u_{bb}^m-u_{ba}^m) & p<q\end{cases}.$$

Plugging in q', we can show that the slope of the LHS of (A1) has the same sign as the following expression:

$$\left[\frac{(1-h^m)(F_a^m-F_b^m)+f^mk_{mq}^A}{1-h^m(F_a^m-F_b^m)-f^mk_{mp}^A}\right]\cdot\left[\frac{h^w(F_a^w-F_b^w)+f^wk_{wp}^A}{1-(1-h^w)(F_a^w-F_b^w)-f^wk_{wq}^A}\right]-1.$$

The numerator minus the denominator of the first term is simplified as

$$1-(F_a^m-F_b^m)-f^m(k_{mq}^A+k_{mp}^A)=1-(F_a^m-F_b^m)-f^m\times\begin{cases}(1-\frac{q}{p})\frac{1}{p}(u_{aa}^m-u_{ab}^m) & p\geq q\\ (1-\frac{1-q}{1-p})\frac{1}{1-p}(u_{bb}^m-u_{ba}^m) & p<q\end{cases}. \quad \text{(A4)}$$

As long as (A4) is nonnegative, the first term is weakly smaller than 1. Coupled with q' smaller than 1, the LHS of (A1) must be decreasing and we have a unique equilibrium. Furthermore, since the LHS of (A1) is nonnegative when $p=0$ and is nonpositive when $p=1$, even if the LHS of

(A1) is upward-sloping for small p (or for big p), there is still a unique equilibrium.

Let us look at the special case in which men and women are completely symmetric. In this case, (A1) and (A2) imply that $p = q$, which in turn implies that (A3) and (A4) are

$$1 - (F_a^w - F_b^w) > 0,$$
$$1 - (F_a^m - F_b^m) > 0,$$

respectively. Hence, the slope of the LHS of (A1) is always negative and there must exist a unique stable equilibrium in this case.

C Negative Assortative Matching

Negative assortative matching is less theoretically plausible when people have homophily preferences. The arrangement should not be sustainable over time, as it is socially inefficient. In addition, from a modeling perspective, it involves a technical complication: There may exist multiple cutoff costs, even within a static period. We demonstrate this possibility below. Suppose p is the current period's mass of type-a men and q is the current period's mass of type-a women. Then the cutoff cost is

$$c_N(p,q) = \begin{cases} \frac{1-p}{q}u_{ba} + \left(1 - \frac{1-p}{q}\right)u_{aa} - u_{ab} & q > 1-p \\ u_{ba} - u_{ab} & q = 1-p \\ u_{ba} - \frac{p}{1-q}u_{ab} - \left(1 - \frac{p}{1-q}\right)u_{bb} & q < 1-p \end{cases}.$$

A cutoff cost $\widetilde{c}$ satisfies

$$\widetilde{\psi}_N(\widetilde{c}) \equiv c_N(p, F(\widetilde{c})) - \widetilde{c} = 0.$$

Explicitly, $\widetilde{c}$ satisfies

$$u_{aa} - u_{ab} - \frac{1-p}{F(\widetilde{c})}(u_{aa} - u_{ba}) - \widetilde{c} = 0,$$

if $F(\widetilde{c}) \geq 1-p$, and satisfies

$$u_{ba} - u_{bb} + \frac{p}{1-F(\widetilde{c})}(u_{bb} - u_{ab}) - \widetilde{c} = 0,$$

if $F(\widetilde{c}) < 1 - p$. In general, there may exist multiple $\widetilde{c}$ satisfying the condition. Hence, to describe the dynamics under negative assortative matching may require additional assumptions and refinements of the equilibrium.

D Evidence from Arranged Marriages in India

We use India Human Development Survey-II (IHDS-II), 2011-2012, to verify our assumption that arranged marriages are more assortative in marital preferences and characteristics, as well as our predictions that (the more assortative) arranged marriages are associated with more backward (male-dominated) norms in marriage and work, and in fertility preferences and actualization.

Arranged marriages are defined as those marriages in which parents/relatives alone choose the husband (MH4A=3) and the woman does not have a say in the choice (MH4B=0). Non-arranged marriages are those marriages in which (i) a woman chooses on her own (MH4A=1); (ii) the woman and parents/relatives jointly choose together (MH4A=2); or (iii) parents/relatives choose alone (MH4A=3), but a woman has a say in the choice (MH4B=1).[27]

Table D.1 shows summary statistics of arranged marriages: 5 percent of women choose their husband alone, 21.9 percent of women choose jointly with their parents, 30.6 percent of women have a say in their parents' choice, and 42.5 percent of women do not have a say in their parents' choices.

Table D.1: Marriage Type

Item	Number	Percent
Woman chooses	1,968.0	5.0
Woman and parents/relatives jointly choose	8,605.0	21.9
Parents/relatives choose, woman has a say	11,991.0	30.6
Parents/relatives choose, woman has no say	16,672.0	42.5
Total	39,236.0	100.0

Subsequently, we show how arranged marriages are associated with more homophily in preferences, more homophily in social and economic status, more backward norms in work and marriages, preferences for more children and sons, and actually having more children (but not ending up with more sons).

[27] Jacob (2016) defines arranged marriages in the same way. In contrast to our paper, which focuses on the associations of arranged marriages with marital preferences and with the alignment of husband's and wife's preferences, Jacob investigates the effects of arranged marriages on marital life and child development.

Table D.2: Preference Homophily in Arranged Marriages

	workpref	morekidspref	whennextkidpref	nmorekidspref
	b/t	b/t	b/t	b/t
arranged=1	0.011***	0.105***	0.003	0.001
	(4.07)	(13.43)	(0.65)	(0.08)
Constant	0.945***	0.533***	0.969***	0.956***
	(512.02)	(105.92)	(367.87)	(196.44)
Observations	26,677	16,179	6,505	2,769

First, arranged marriages are associated with more assortative matching in preferences. Table D.2 shows that arranged marriages are associated with 1.1 percent more chance of having the same preference for whether women want to work and 10.5 percent more chance of having the same preference for having more children as well as more homophily in preferences for when to have the next child and how many more children to have.

Table D.3: Social and Economic Status Homophily in Arranged Marriages

	samecaste	sameeconstatus	samecollege	sameEnglish
	b/t	b/t	b/t	b/t
arranged=1	0.014***	0.014***	0.034***	0.031***
	(6.58)	(3.75)	(8.41)	(7.15)
Constant	0.944***	0.159***	0.785***	0.781***
	(613.35)	(65.13)	(287.29)	(267.60)
Observations	39,077	39,143	39,236	34,401

Second, arranged marriages are associated with more assortative matching in social and economic status. Table D.3 shows that arranged marriages are associated with 1.4 percent more chance of marrying within the same caste, 1.4 percent more chance of marrying someone of the same or better economic status, 3.4 percent more chance of marrying someone of the same educational level, and 3.1 percent more chance of speaking English.

Table D.4: Backward Norms in Arranged Marriages

	purdah	illiterate	husbdecideswork	husbdecideskidmarr
	b/t	b/t	b/t	b/t
arranged=1	0.297***	0.262***	0.011*	0.035***
	(62.84)	(53.76)	(2.15)	(7.52)
Constant	0.452***	0.279***	0.422***	0.672***
	(136.48)	(93.42)	(128.42)	(214.87)
Observations	39236	39233	39236	39236

Finally, arranged marriages are associated with more male-dominated norms in marital preferences and behavior. Table D.4 shows that arranged marriages are associated with 29.7 percent more chance of practicing purdah, 26.2 percent more chance of being illiterate, 1.1 percent more chance that the husband decides whether the wife can work, and 3.5 percent more chance that the husband decides whom children marry.

Figure D.2: Correlation Between Percent of Backward Norms and Percent of Arranged Marriages in Different Indian States.

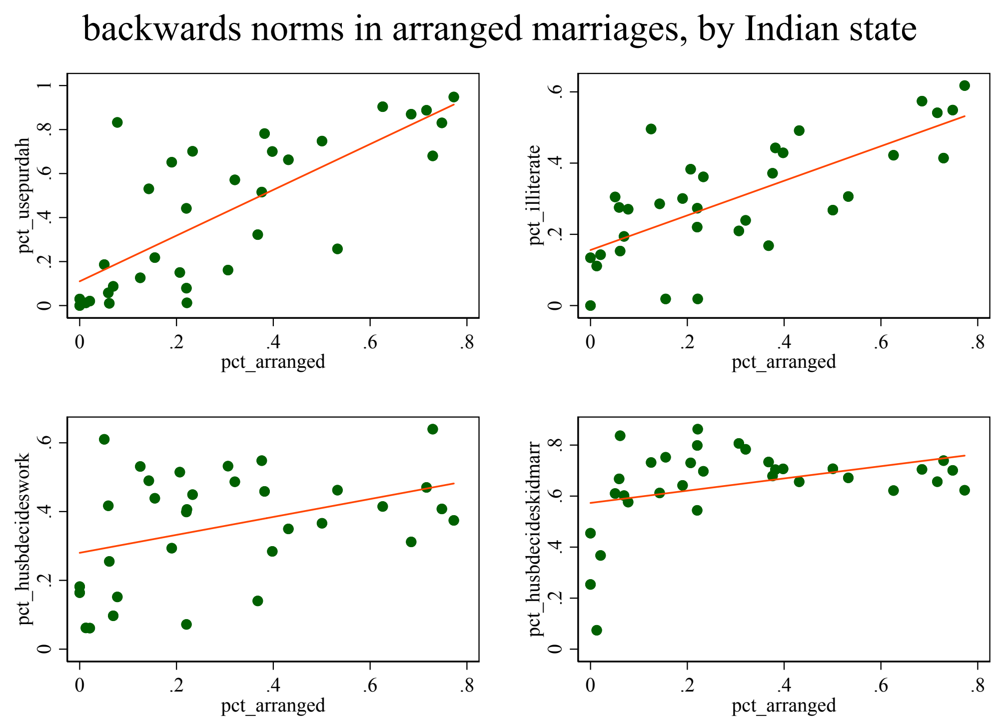


Figure D.2 confirms the positive correlation between percent of male-dominated norms and percent of arranged marriage in different Indian states.

Table D.5: Children Desired in Arranged Marriages

	nkidswanted b/t	nsonswanted b/t	ndaughterswanted b/t	psonswanted b/t
arranged=1	0.345***	0.263***	0.083***	0.023***
	(35.07)	(40.65)	(16.32)	(14.35)
Constant	2.261***	1.238***	1.097***	0.541***
	(376.60)	(330.05)	(338.58)	(524.53)
Observations	37,430	34,567	34,246	34,505

Arranged marriages are associated with more children and a higher percentage of sons desired. Table D.5 shows that compared to women in non-arranged marriages, women in arranged marriages want 0.345 more children, 0.263 more sons, 0.083 more daughters, and 2.3 percent more sons.

Table D.6: Children Realized in Arranged Marriages

	nkids	nsons	ndaughters	psons
	b/t	b/t	b/t	b/t
arranged=1	1.207***	0.609***	0.598***	-0.003
	(47.23)	(38.24)	(33.49)	(-0.66)
Constant	2.422***	1.259***	1.163***	0.540***
	(169.35)	(136.33)	(115.37)	(175.92)
Observations	24,452	24,452	24,452	22,695

Arranged marriages are associated with more actual children but not more actual sons. Table D.6 shows that women in arranged marriages have 1.207 more children, 0.598 more sons, and 0.598 more daughters, but virtually the same percent of sons as those in non-arranged marriages despite their preference for a higher composition of sons.