Household bargaining, the Marriage Market, and Assortative Matching Based on Preferences

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Abstract

This paper analyzes the role of preferences in assortative matching. In a marriage market with heterogeneous preferences, two types of preference-based assortative matching increase overall welfare: positive assortment on individuals' optima and negative assortment on their willingnesses to compromise. Preference-based assortative matching may reduce the sensitivity of collective decisions to "bargaining power," and it may become more important as incomes and wages rise. Data from the PSID (1972-1976) show a significant correlation between spouses' self-reported rates of time preference, and marriages appear more stable when partners agree.

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1. Introduction

The compatibility of individuals' preferences determines who is married to whom. Some partnerships are more successful than others because spouses have similar tastes and values, especially regarding major life decisions. However, when partners do disagree, the relationship can be salvaged by the willingness of one person to compromise. On the other hand, conflict between preferences, combined with unwillingness to compromise, can contribute to the failure of marriages.

This study analyzes the role of preferences in assortative matching. I combine the economic literature on marriage with the literature on collective decision-making. In a marriage market with heterogeneity in preferences, individuals should seek partners with whom they can make joint decisions that both enjoy. I hypothesize that market efficiency involves two forms of *preference-based assortative matching*: positive assortment on demands and negative assortment on abilities to substitute. In other words, the marriage market pairs together people who tend to agree, or else it matches someone who can compromise easily with someone who finds compromise difficult.

Matching based on preferences is new to the economics literature, although the consequences of dissimilar objectives (collective decision-making, or "bargaining") are not. Following Becker (1973, 1974), previous economic theories of matching can all be described as *production-based assortative matching.*[1] Depending on their skills and the productive complementarities between these skills, two people would "marry each other if their total output exceeded their combined aggregate incomes from marrying other persons or remaining single" (Becker 1991; p. 123). Maximizing output is necessary and sufficient for efficiency when each household has a single ("unitary") objective function.

An extensive literature on intrahousehold allocation (McElroy and Horney 1980, Lundberg, Pollak, and Wales 1998, Browning and Chiappori 1998, and others) argues that household income alone is not a sufficient statistic for individual well-being in a pluralistic household. "Bargaining power" may influence whether money is spent on goods enjoyed by the husband, by the wife, or by both. Lam (1988) then notes that resources go further when spent on goods that both people enjoy, instead of on goods

[1] Becker (1991), Bergstrom (1997), and Weiss (1997) discuss this literature.

that only one cares for: "gains from marriage result from joint consumption of household public goods."

This leads into my motivation for studying the role of preferences in assortative matching. Suppose there is heterogeneity in women's preferences toward their partners' consumption of some good, like clothing. Some people derive pleasure from viewing their partners' attire (making "his clothing" a somewhat public good); others are largely indifferent (and so "his clothing" is essentially a private good). In the other side of the market, some men receive greater pleasure from their appearance than others. Everything else the same, it seems intuitive that the marriage market should match together the two people with the strongest preferences for "his clothing," the two who care the least about "his clothing," and in between. Because couples have similar preferences regarding how to allocate resources between "his clothing" and other goods, this assortment ensures that each household's income is spent in a way that both enjoy. This scenario can be generalized to heterogeneity in preferences over any set of outcomes: whether to have children (and how many), which religious services to attend, where to live, what lifestyle to lead. If the marriage market matches individuals who agree, then each gets his or her maximal utility from the collective decision; if disagreers marry, then at least one does not get the preferred outcome.

This study pursues the intuition that there are gains from matching people based on preferences. In the following sections of this paper, I formulate a model of the marriage market in which peoples' preferences differ, and I integrate collective decision-making.[2] In general, a joint decision depends on two things: the optima of individual household members and their relative willingnesses to compromise. This makes each person's utility an indirect function of these aspects of the partner's preferences. Clearly, this gives incentive for individuals to assort on these dimensions. I show that the marriage market will generate positive assortment on optima and negative assortment on willingness to compromise, everything else equal.

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[2] While marriage markets have long been incorporated into models of household decision-making, the usual source of heterogeneity is in "bargaining power" (Manser and Brown 1980, Lundberg and Pollak 1993, Chiappori, Fortin, and Lacroix 2002). Peters and Siow (2002) and Iyigun and Walsh (2002) examine production-based matching as well (specifically, the heterogeneity caused by individuals investing in different levels of skills before the marriage market).

Both forms of matching tend to reduce the dependency of joint decisions on "bargaining power." Effectively, preference-based assortative matching in the marriage market is an alternative to subsequent intra-household bargaining. Furthermore, although the two forms of matching complement each other, preference-based matching is likely to become relatively more important than production-based matching as people's wages and incomes rise.

Data from the Panel Study of Income Dynamics (PSID) confirm a significant positive correlation between partners' intertemporal discount rates. This is consistent with preference-based assortative matching. The data also suggest that marriages are more stable when household members agree.

2. A marriage market with heterogeneous preferences

This model illustrates that the marriage market should match people with complementary preferences for household public good. I analyze assortment on the two most important ingredients into joint decision-making: individuals' optima and their willingnesses to compromise.

The marriage market consists of two sets of individuals, I and J, who match one-to-one to form households. The household $h(i,j)$ consists of some $i \in I$ and some $j \in J$. All potential households are endowed with the same skills, attributes, and resources. However, people have different preferences regarding public goods. Each individual has preferences of the form:

$$u_i(x_i, y_{h(i,j)}) = x_i + \phi_i(y_{h(i,j)}) \tag{2.1}$$

where x_i is his or her private consumption and $y_{h(i,j)}$ is some collective decision made by household $h(i,j)$, from the choice set Υ.[3] This decision could represent the share of household resources spent on some good, or it could be the location of the household, or it could be the share of resources allocated to some good. The function $\phi_i(y)$ is assumed to be strictly concave and maximized somewhere on the interior of

[3] In the following analysis, I treat Υ as some one-dimensional spectrum of choices. The results generalize to a multi-dimensional choice set, albeit with a *ceteris paribus* caveat.

Υ for all individuals. The sum of private consumption within the household is assumed to be constant: $x_i + x_j = c$.[4]

With the possibility of side payments, an efficient and stable marriage market outcome is one that maximizes aggregate welfare in the marriage market. The welfare resulting from matching two arbitrary individuals is:

$$\Omega(i,j) = c + \max_{y\in\Upsilon}\{\phi_i(y) + \phi_j(y)\} \qquad (2.2)$$

The value of y that solves this maximization problem is the joint decision that i and j would make, if they choose something Pareto optimal.

2.1 Positive assortment on optima

Intuition suggests that people should desire like-minded partners. This model reveals that this result is true; it follows from the concavity of utility functions, which generates increasing marginal disutility from deviations. To show this, I rely on Becker's result that optimal assortment patterns can be determined from the cross-partial derivative of $\Omega(i,j)$ with respect to characteristics.

Let us assume that people have different optima, but that their preferences are otherwise identical. Allowing $y_i^* = \arg\max_{y\in\Upsilon} \phi_i(y)$ to denote *i*'s most preferred choice for the collective decision, we can write:

$$\psi_i(y - y_i^*) = \phi_i(y) \qquad (2.3)$$

The parameter y_j^* and the function $\psi_j(y - y_j^*)$ are defined analogously. All people of the same population are assumed to differ only in their optima; the functions ψ_i or ψ_j are otherwise the same (and from now on, will be denoted with ψ_I or ψ_J). In other words, all indifference maps are merely polar shifts of one another. Using (2.3), we can rewrite household welfare as a function of optima:

[4] Following Becker (1974), private consumption is introduced as a way of allowing transfers between household members. This avoids the complications of determining assortative matching patterns with non-transferable utility (see Bergstrom 1989 for a discussion of the general ambiguity; see Legros/Newman 2002 for a solution).

$$\Omega(y_i^*, y_j^*) = c + \max_{y \in \Upsilon}\{\psi_I(y - y_i^*) + \psi_J(y - y_j^*)\} \tag{2.4}$$

We want to know the sign of $\partial^2\Omega / \partial y_i^* \partial y_j^*$. The envelope theorem tells us the first derivative of (2.4):

$$\partial\Omega / \partial y_i^* = -\psi_I'(y_{h(i,j)}^* - y_i^*) \tag{2.5}$$

where $y_{h(i,j)}^*$ represents the collective decision. In order to evaluate the cross-partial derivative,

$$\partial^2\Omega / \partial y_i^* \partial y_j^* = -\psi_I''(y_{h(i,j)}^* - y_i^*) \cdot \partial y_{h(i,j)}^* / \partial y_j^* \tag{2.6}$$

we must determine how the collective decision depends on individual optima. At an interior solution, this $y_{h(i,j)}^*$ must satisfy:

$$\psi_I'(y_{h(i,j)}^* - y_i^*) + \psi_J'(y_{h(i,j)}^* - y_j^*) = 0 \tag{2.7}$$

By applying the implicit function theorem, we see that:

$$\partial y_{h(i,j)}^* / \partial y_j^* = \frac{\psi_J''(y_{h(i,j)}^* - y_j^*)}{\psi_I''(y_{h(i,j)}^* - y_i^*) + \psi_J''(y_{h(i,j)}^* - y_j^*)} \tag{2.8}$$

Unsurprisingly, the household's choice of y will rise as either demands more of it. (However, the exact magnitude of the response depends on the partners' relative willingness to substitute at the margin.) Inserting this into (2.6), we find that:

$$\partial^2\Omega / \partial y_i^* \partial y_j^* = \frac{-\phi_I''(y_{h(i,j)}^*) \cdot \phi_J''(y_{h(i,j)}^*)}{\phi_I''(y_{h(i,j)}^*) + \phi_J''(y_{h(i,j)}^*)} \tag{2.9}$$

Concavity of the utility functions ensures that this is positive: thus, efficiency dictates *positive assortment based on individual optima, everything else the same*. A natural example is the tradeoff between two household goods: the number of children and quality of children. People naturally have different desires regarding how to divide time and money between these goods. If all households had the same resources, then the marriage market would match people based on their intents: men who want fewer children of higher quality should marry women who want the same.

2.2 Negative assortment on willingness to compromise

In some cases, assortment on optima may be infeasible. Populations may have little heterogeneity (y may represent the share of housework performed by the husband, which is probably clustered around zero among the male population and around one in the female population), or else people may not know their optima at the time of marriage. Joint location decisions are a prime example of the latter.

The question arises: when the individuals cannot assort on their optima, on what do they assort? In this section, I show that being able to unambiguously rank the members of each population according to their marginal disutilities from deviations is a sufficient condition for an unambiguous assortment pattern; we should negative assortment, everything else the same. In general, a weaker condition does not exist. This marginal disutility of deviations can be interpreted as the "willingness to compromise."[5] It is also closely linked to the curvature of the utility function, and consequently to parameters like risk-aversion and elasticity.

Let us assume that all $i \in I$ in the marriage market have the same preferred outcome y_I^*, and similarly all $j \in \mathcal{J}$ share the same optimum $y_{\mathcal{J}}^*$. Without loss of generality, I assume that $y_I^* < y_{\mathcal{J}}^*$. I want to show that if there is an unambiguous ranking of people according to the steepness of their utility functions over the Pareto set, then efficiency dictates negative assortative matching on this characteristic. To support this, it is sufficient to show that whenever we have two men and two women, matching each "stubborn" person with a "compromising" partner generates greater welfare than matching stubborn people together and compromising people together.

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[5] If we compare two people with the same optimum, then the one whose $\phi_i(y)$ is everywhere flatter will always agree to a collective decision closer to his partner's optimum. Receiving lower marginal disutility from deviation (on the collective decision) makes it easier for him to substitute between y and x_i; this makes him more willing to allow his partner to compensate him for his concession on y.

Let us take two arbitrary members of each population, $i_1, i_2 \in I$ and $j_1, j_2 \in \mathcal{J}$, with the subscript denoting the relative ranking of the steepness of their utility functions:

$$\left|\phi'_{i_1}(y)\right| > \left|\phi'_{i_2}(y)\right| \quad \forall y \in (y^*_I, y^*_{\mathcal{J}}] \tag{2.10}$$

$$\left|\phi'_{j_1}(y)\right| > \left|\phi'_{j_2}(y)\right| \quad \forall y \in [y^*_I, y^*_{\mathcal{J}}) \tag{2.11}$$

There are two potential outcomes of the marriage market: $(h(1,1), h(2,2))$ or $(h(1,2), h(2,1))$. To compare the welfare of these permutations, we first need to characterize their collective decisions. From the first-order conditions (2.7), we can tell that an efficient household decision occurs where marginal disutilities are equal:

$$\phi'_i(y^*_{h(i,j)}) = -\phi'_j(y^*_{h(i,j)}) \tag{2.12}$$

Using (2.10) and (2.11) and concavity of the utility functions, we can infer where the optima of different potential households lie in relation to each other:

$$y_{h(1,2)} < y_{h(2,2)} < y_{h(2,1)} \tag{2.13}$$

$$y_{h(1,2)} < y_{h(1,1)} < y_{h(2,1)} \tag{2.14}$$

This can be seen in Figure 1, which graphs the marginal disutilities of these individuals. The four bundles picked by the potential households—labeled *A*, *B*, *C*, and *D*—are determined by intersections of the marginal disutility curves. The triangle bounded by y^*_I, $y^*_{\mathcal{J}}$, and one of these points has a specific interpretation: it is the total disutility inflicted on household members by a collective decision that differs from their own optima. The integrals on the right-hand side of

$$\Omega(i,j) = c + \phi_i(y^*_I) + \phi_j(y^*_{\mathcal{J}}) + \int_{y^*_I}^{y^*_{h(i,j)}} \phi'_i(y)dy - \int_{y^*_{h(i,j)}}^{y^*_{\mathcal{J}}} \phi'_j(y)dy \tag{2.15}$$

capture this disutility. Note that it is the only match-specific part of $\Omega(i,j)$.

In this subset of the marriage market, we could arrange people similarly or dissimilarly based on their rankings. Under the first scenario (creating households $h(1,1)$ and $h(2,2)$), aggregate disutility is the sum of triangles $(y^*_I B y^*_{\mathcal{J}})$ and $(y^*_I C y^*_{\mathcal{J}})$.

By switching to the second arrangement, (creating households $h(1,2)$ and $h(2,1)$), each person gains or loses a trapezoid bounded above by a particular line segment (and below by the horizontal axis). For i_2, the loss is the area beneath $\overline{CD}$; for j_2, it is the area below $\overline{AC}$. At the same time, i_1 gains the area below $\overline{AB}$ and j_1 the area beneath $\overline{BD}$. The overall improvement is the quadrilateral $(ABCD)$, or more precisely:

$$[\Omega(i_1,j_2)+\Omega(i_2,j_1)]-[\Omega(i_1,j_i)+\Omega(i_2,j_2)]=\int_{y^*_{h(1,2)}}^{y^*_{h(2,2)}}[-\phi'_{i_1}(y)-\phi'_{j_2}(y)]dy \\ +\int_{y^*_{h(2,2)}}^{y^*_{h(1,1)}}[\phi'_{i_2}(y)-\phi'_{i_1}(y)]dy+\int_{y^*_{h(1,1)}}^{y^*_{h(2,1)}}[\phi'_{j_1}(y)+\phi'_{i_2}(y)]dy \tag{2.16}$$

when $y^*_{h(2,2)}<y^*_{h(1,1)}$; the other case is similar. The first integral is necessarily positive, since concavity implies that $-\phi'_{i_1}(y)\geq-\phi'_{i_1}(y_{h(1,2)})=\phi'_{j_2}(y_{h(1,2)})\geq\phi'_{j_2}(y)$ within this range. For the same reason, the last integral is positive. The center integral is positive because $-\phi'_{i_1}(y)>-\phi'_{i_2}(y)$ everywhere. Therefore, the overall sum is positive: matching dissimilar people increases aggregate welfare for these two households. Since there must be negative assortment in all subsets of the marriage market, the outcome of the overall market must exhibit negative assortment as well.[6]

This result seems intuitive. While everyone would appreciate an accommodating partner, not everyone can have one. The outcome of the marriage market depends on values this scarce resource most, and flexible partners are most desirable to inflexible people. This generates matches where one person desires to be the "leader" on the

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[6] An unambiguous ranking of people's marginal disutility is almost necessary for unambiguous assortative matching: no weaker condition implied by (2.10) and (2.11) guarantees a particular assortment pattern. Suppose that we were to weaken (2.10) to allow the marginal disutility curves of i_1 and i_2 to cross somewhere within the Pareto set. (One plausible alternative is to rank population *I* based on cumulative disutility, instead of marginal disutility.) Merely knowing that $j_1,j_2\in\mathcal{J}$ satisfy (2.11) does not tell us the outcome of the market. The sign of (2.16) depends on relative marginal disutilities of i_1 and i_2 in the region where the ϕ'_j curves intersect the ϕ'_i curves. If all the $y^*_{h(i,j)}$ occur where ϕ'_{i_1} lies above ϕ'_{i_2}, we have one outcome; if they occur where the opposite is true, we have the opposite outcome. Consequently, if we relax condition (2.10), then we would need a condition stronger than (2.11) to generate an unambiguous result.

decision, while the other is willing to be a "follower." Although this assortment pattern generates joint decisions that the compromising people dislike, their partners are more than willing to compensate them in other regards.

Assorting on willingness to substitute may be particularly beneficial when individuals are uncertain what their optima will be. A prime example would be a joint location decision. At the time of marriage, individuals might not know where their best opportunities are located. Some people are geographically sensitive (good job offers may be sparse, and alternative jobs undesirable). Others people are fairly flexible. Ex-ante efficiency in the marriage market involves negative assortative matching: the men who are most mobile match with the women who are least mobile.

Second derivatives of utility functions are a particularly interesting special case of willingness to substitute. If two individuals are identical except that $\left|\phi''_{i_1}(y)\right| > \left|\phi''_{i_2}(y)\right|$ throughout the Pareto set, then clearly condition (2.10) is met. Consequently, we would expect to see negative assortment on this characteristic.[7] Second derivatives are closely linked to elasticities of substitution, as well as risk-aversion. This result seems intuitive as well: if I am highly risk-averse, then I am best suited to a risk-neutral partner who is willing to provide me insurance.

Two other aspects of preference-based assortative matching are noteworthy. If we generalize the model to allow the collective decision to depend on the distribution of "bargaining power" within the household, then we would find that assortative matching tends to reduce the sensitivity of decisions to shifts in bargaining power. Couples tend either to agree or to exhibit leader/follower behavior, so bargaining plays a smaller role in the decision. This seems to match with casual observation of family behavior: couples' fertility decisions are usually determined by their common

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[7] We can also confirm this result by modeling preferences as approximately quadratic within a neighborhood of the optimum; that is, $\phi_i(y) = \phi_i(y_i^*) + \frac{1}{2} s_i (y - y_i^*)^2$, where $s_i = \phi''_i(y_i^*)$. With these preferences, the efficient household decision is $y^*_{h(i,j)} = (s_i y_i^* + s_j y_j^*) / (s_i + s_j)$, and household welfare is $\Omega(i,j) = c + \phi_i(y_i^*) + \phi_j(y_j^*)$ + $\frac{1}{2}(s_i^{-1} + s_j^{-1})^{-1}(y_i^* - y_j^*)^2$. The cross-partial derivative of this function is $\partial^2\Omega / \partial s_i \partial s_j = s_i s_j (y_i^* - y_j^*)^2 / (s_i + s_j)^3$. Since this is negative, negative assortment on s_i must be efficient.

preferences more than through bargaining; joint location decisions are frequently determined by which partner is less flexible, more than through bargaining.

Finally, there may be substitution between preference-based and production-based assortative matching, although they are also complements in some ways. The benefits of matching based on skills in home production depend on how much the household uses those skills. As wages and incomes rise, households may shift away from home production toward market-purchased substitutes. This decreases the gains from production-based assortative matching. Furthermore, the choice set of the household expands as incomes rise. This increases the potential for disagreement between partners, and it makes preference-based assortative matching more important.[8] To the extent that there is substitution between production-based and preference-based assortative matching, the latter becomes relatively more attractive as incomes and wages rise.

At the same time, production and preferences can complement one another. Preference-based assortative matching increases the marginal welfare of wealth, since it ensures that resources are spent on goods that both household members enjoy. This amplifies the returns to maximizing the full income of the household. Moreover, among people who agree that a particular good (raising a family, for instance) is a priority, there are larger returns to matching in a way that maximizes production of that good (such as acquiring complementary child-rearing skills). Whenever there is greater agreement between household members' preferences, there are also larger benefits from production-based assortative matching.

3. PSID reports of savings preferences

To test whether the creation (and dissolution) of marriages depends on individual preferences, I use data from the Panel Study of Income Dynamics (PSID). This dataset is unique because it asks husbands and wives separately two questions that

[8] The idea that demands become more diverse with income is formalized as a theory of hierarchical demands by Jackson (1984): there are "a very limited set of items purchased at low incomes, [followed by] expansion of the set of items purchased as income increases [with] continuing growth in diversity at all income levels." Gronau and Hamermesh (2002) provide theoretical reasons why the "demand for variety" increases with income. Both studies also include empirical evidence that shows that variety is a normal good.

relate to an important preference parameter: their intertemporal discount rate.[9] Since the data are longitudinal, I can follow many of these couples and determine the stability of the relationship. However, the data are limited in several regards: self-reported preferences are imprecise at best; the dataset reveals only the outcome of the marriage market; and questions reveal only individuals' preferred outcomes, but not their willingness to compromise. Nonetheless, these PSID data provide better insight into individuals' preferences and marriage market outcomes than any alternative dataset.

The rate of time preference is relevant for three reasons. First, it clearly affects demands for future consumption; in the previous section of this paper, I hypothesize that we should see positive assortment on individuals' demands. Furthermore, agreement or disagreement over savings is plausibly a nontrivial determinant of the success and failure of marriages. Finally, within the population, there is a great deal of heterogeneity in individuals' discount rates (Harrison, Lau, and Williams 2002). Together, these suggest that we should find assortment on this preference parameter. Additionally, we should see that marriages will be more stable when couples agree, everything else the same. These are the two hypotheses that I test.

3.1 The data

From 1968 through 1972, the PSID asked each household head six questions about his desires; they later asked the wife the same questions in 1976. Among these are:

> Savings preferences: *"Would you rather spend money and enjoy life today, or save more for the future?"*
>
> Planning behavior: *"Are you the kind of person that plans his life ahead all the time, or do you live more from day to day?"*

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[9] Self-reported preferences and behavior are important for the study. Since observed household behavior is the result of a joint decision, we cannot recover *individual* preference parameters from behavior. It is also uncommon to observe both individuals in situations behaving autonomously (like before marriage) as well as jointly. A major concern is that self-reported behavior does not match actual behavior; in a separate study, I show that observed household consumption dynamics indeed correlate with responses to these particular questions (Lich-Tyler 2003).

Clearly, the responses to both questions should depend on the individual's underlying discount rate: people with lower discount rates will prefer delaying consumption, and people with lower discount rates will be more forward-looking in their planning behavior as well. However, the desire to save (and the response to the first question) may be affected by upcoming events like retirement, purchasing a home, or paying for an education. Inasmuch as these factors are common to all household members, they can generate a correlation in partners' responses to the savings question. This question may also be subject to different perceptions of savings—for instance, respondents may not purchasing durable goods as implicit savings, although it generates a stream of future consumption. The second question, about planning behavior, is probably more robust to these complications. The question is worded ("are you the *type* of person"; emphasis added) to elicit the respondent's inherent nature, not the outcome of other events. In testing my hypotheses, I extract a measure of the discount factor from each, and I perform parallel analysis using both. Results are essentially identical, although models typically fit better using the planning question.

The PSID has 2087 couples "married" continuously from 1972 through 1976.[10] These include common-law partners and cohabiters.[11] Table 1 contains a description of this sample in 1976. Tables 2 and 3 compare partners' answers on the savings and planning questions. In each question, I group responses into three categories: forward-looking, present-oriented, or a mixture. On each question, nearly half of couples answer identically. Partners' responses have a rank correlation of 0.19 and 0.18, and we can strongly reject that these variables are independent.

3.2 Estimation

[10] The other selection criteria are that both partners be at least 18 years old in 1972 and no more than 65 in 1976, and that they respond to both the savings and planning questions. This and estimation programs are available on the author's website.

[11] The PSID does not distinguish between cohabitors and legal spouses. This value is inferred from the "start of most recent marriage": couples that are not officially married are assigned missing values, as well as those for whom the start is marriage is "unknown." This imputation may create error in both directions: a person who forgets his anniversary is categorized as "cohabiting"; while a person who marries, divorces, and then cohabits is classified as "not cohabiting."

There are two potential complications that affect the interpretation of this raw correlation. First, couples could be assorted on another trait that is correlated with their discount rate (age or education, in particular). Second, the correlation is reduced by misclassification, akin to the attenuation bias of classical measurement error. I estimate an ordered probit in order to control for other characteristics; I then calculate the expected value of the unobservable term for each person, and I test whether these residuals are correlated for husbands and wives. This analysis is naturally conservative: both the misclassification error and the over-controlling for observables will cause the estimated correlation to understate the true correlation.

Formally, here is the econometric model:

$$R_i = \text{"Forward-looking" if } X_i\beta^I + f(\delta_i) + \varepsilon_i < \gamma_1^I \tag{3.1}$$
$$R_i = \text{"Mixture" if } \gamma_1^I < X_i\beta^I + f(\delta_i) + \varepsilon_i < \gamma_2^I \tag{3.2}$$
$$R_i = \text{"Present-oriented" if } \gamma_2^I < X_i\beta^I + f(\delta_i) + \varepsilon_i \tag{3.3}$$

for each of the two questions separately. The estimated parameters (γ and β) differ for the male and female populations. R_i denotes the individual's response; X_i is a vector of observable characteristics of the household. The unobservable term consists of some idiosyncratic noise or misclassification error ε_i and a fixed individual-specific component $f(\delta_i)$, which is some unknown monotonic function of the underlying preference parameter. This reflects merely that people with lower discount rates are more likely to respond that they are "forward-looking," but the exact nature of this relationship is unknown.

Estimates of these multinomial probits appear in Table 4. The model works substantially better for the planning question. The responses to this question are strongly correlated with education (the more highly educated one is, the more likely one is to plan for the future) and the religious identity (all with a religious identity are more future-oriented, and Jewish couples state a remarkably strong tendency to plan).

Since partners' education and religious identity tend to be similar, there will tend to be correlation between their responses. (Indeed, the rank correlations between the explained portions of partners' responses—that is, $X_i\hat{\beta}^I$—are 0.41 and 0.79.) I am interested in the portion of the response that cannot be explained by such variables.

The conditional expectation of the residual $f(\delta_i)+\varepsilon_i$, given the observables and estimated parameters, can be calculated:

$$\hat{f}(\delta_i)=\mathbb{E}[(f(\delta_i)+\varepsilon_i)\big|(f(\delta_i)+\varepsilon_i)>\hat{c}_2^I-X_i\hat{\beta}^I]\ \text{ if }\ R_i=\text{“Forward-looking”}\quad(3.4)$$

$$\hat{f}(\delta_i)=\mathbb{E}[(f(\delta_i)+\varepsilon_i)\big|\hat{c}_2^I-X_i\hat{\beta}>(f(\delta_i)+\varepsilon_i)>\hat{c}_1^I-X_i\hat{\beta}^I]\ \text{ if }\ R_i=\text{“Mixture”}\quad(3.5)$$

$$\hat{f}(\delta_i)=\mathbb{E}[(f(\delta_i)+\varepsilon_i)\big|\hat{c}_1^I-X_i\hat{\beta}^I>(f(\delta_i)+\varepsilon_i)]\ \text{ if }\ R_i=\text{“Present-oriented”}\quad(3.6)$$

If $f(\delta_i)+\varepsilon_i$ is distributed normally, then the formula for these calculations is an adaptation of the inverse Mills ratio. By construction, this variable is orthogonal to all the regressors X_i. Most importantly, $\hat{f}(\delta_i)$ is positively correlated with the latent discount factor δ_i. Since the exact relationship between $\hat{f}(\delta_i)$ and δ_i is unknown, there is little loss in taking another monotonic transformation. I create a rank ordering of each population based on $\hat{f}(\delta_i)$:

$$\rho_i=\#\left\{i'\in I:\hat{f}(\delta_i)\le\hat{f}(\delta_{i'})\right\}/\#I\qquad(3.7)$$

This transformation was chosen because the theoretical model predicts (to be precise) similarity in partners' rankings within each population. I find that the rank correlation between the residual portion of partners' responses to be 0.18 and 0.15 for the two models; we can easily reject the hypothesis that this is random.[12]

The more that partners differ in their rankings, the less stable the marriage should be, so I test whether $(\rho_i-\rho_j)^2$ can explain divorce rates. Since the PSID tracks many of these families until 1993, I can observe the outcomes of these partnerships. However, attrition is a large and non-trivial problem. (Couples may drop out of the sample as they divorce, and they may change addresses at the same time, making them harder to recontact.) The simplest way to address this selection is to estimate a multinomial logit with three marital outcomes: divorce, survival, and unknown. The marriage

[12] As long as the noise ε_i is nontrivial, this understates the correlation between the true $f(\delta_i)$ and $f(\delta_j)$. The rank correlation between the head's response to the same question in adjacent years (1971 and 1972) are 0.40 for the savings question and 0.50 for the planning question. These statistics give some insight into the magnitude of the misclassification and transitory factors, if each represent the same underlying preference parameter plus different realizations of the error term.

"survives" if the couple remains together from 1972 until the death of one partner, until 1993, or if they leave the study when the head is over 60. (Divorce is assumed to be uncommon at that point.) A household "divorces" if either the husband or wife moves out of the household. The outcomes of the remaining marriages are "unknown." Roughly 46% of marriages survive; 17% end in divorce; and the outcomes of 37% are unknown.

In Table 5, I estimate the likeliness of each outcome conditional on observable characteristics of the household, the difference between partners' preferences, and these preferences themselves. Age, duration of marriage, and previous marriages are strong predictors of divorce.[13] At p-values of 0.08 and 0.04, we can reject the hypothesis that the *difference* between partners' preferences has no impact on divorce rates. (However, the preferences themselves—whether people are patient or impatient—appear to have no effect on divorce.) The size of this effect is modest. The estimates from the second model suggest that if everyone in the sample were married to their equivalent, 25.3% of marriages (among those whose outcome is known) would end in divorce. If the population were matched randomly, 27.8% of marriages would end in divorce.

Altogether, these data confirm a significant positive correlation between partners' discount factors. They also suggest greater stability in marriages between agreeing couples. Together, these findings are consistent with preferences being a determinant of quality-of-match. While the degree of assortment is not high (certainly not near the rank correlation of one, which this frictionless model predicts), many other variables factor into the decision to marry or to remain married. The correlation between unobservable and observable determinants of the quality-of-match is likely large and negative (the fact that two people choose to marry indicates that they see *something* between themselves, even if the econometrician does not.)

[13] The estimates in Table 5 suggest that the longer a couple has been together, the more likely the marriage is to end in divorce. This is somewhat deceptive, since duration of marriage is highly correlated with the ages of the head and wife—both associated with a decreased likeliness of divorce. For essentially all couples, a one-year increase in ages and duration of marriage diminishes the divorce likelihood. Moreover, the joint significance of the age variables is very high, although their t-stats are low due to the high correlation.

4. Conclusion

Understanding the role of preferences in the marriage market contributes to our knowledge of household behavior and of the formation of partnerships. This study argues that preference-based assortative matching must be part of an efficient marriage market outcome. An individual has strong incentives to find the marital partner with whom he will make decisions that both enjoy. Oppositely, an individual has incentives to leave a partnership when he dislikes the choices determined by his partner's preferences.

Two principles characterize efficient preference-based assortative matching: pairing people with similar demands, and pairing people with differing capacities to substitute between outcomes. These principles increase welfare within the household: for any decision a couple could make, a more assorted couple could make a decision that both partners prefer.

Preference-based assortative matching reduces subsequent household bargaining. People resolve some of their potential disagreements in the marriage market, or else they find partners who are willing to compromise on the most important decisions. Both types of preference-based assortative matching reduce the sensitivity of joint decisions to changes in bargaining power. As a population becomes more highly assorted—in either regard—we might see that households behave more like a single entity with a single set of preferences. This does not necessarily mean that its preferences are identical to those of either household member, however. The household may follow the desires of one person on one decision and the other person on another decision.

Both preferences and production are determinants of who marries whom. To some extent, they complement each other. Preference-based matching raises the marginal welfare of household wealth, since money is spent on goods that both partners enjoy. This magnifies the returns from production-based matching. However, preferences-based matching is likely to become relatively more important as market wages and incomes rise. The value of skills in production is limited by how much the household utilizes those skills. As wages and income rise, the household relies more on market-purchased substitutes for home production; the benefits of production-based matching decline. At the same time, as income rises and the household can afford a variety of new choices, the potential for disagreement increases and the benefits of assortment rise. This parallels the perceived changes in marriage patterns in developed countries during the 20th century: finding a partner with the right breadwinning or homemaking skills became less important than finding a partner that one "gets along with." At the same time, grounds for divorce have shifted from "neglect of household duties" to "irreconcilable differences."

This raises questions about marriage and divorce trends. If individuals' preferences are more likely to change than their skills are, then marriages may become less stable as preference-based matching prevails. Furthermore, divorce may be less common for people with unusual preferences—ones unlikely to find another like-minded mate. On the other hand, preference-based matching may make marriage less risky: finding a like-minded partner is one way of ensuring that changes in "bargaining power" are unlikely to alter household decisions substantially.

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Figure 1: Negative Assortment on Willingness to Substitute

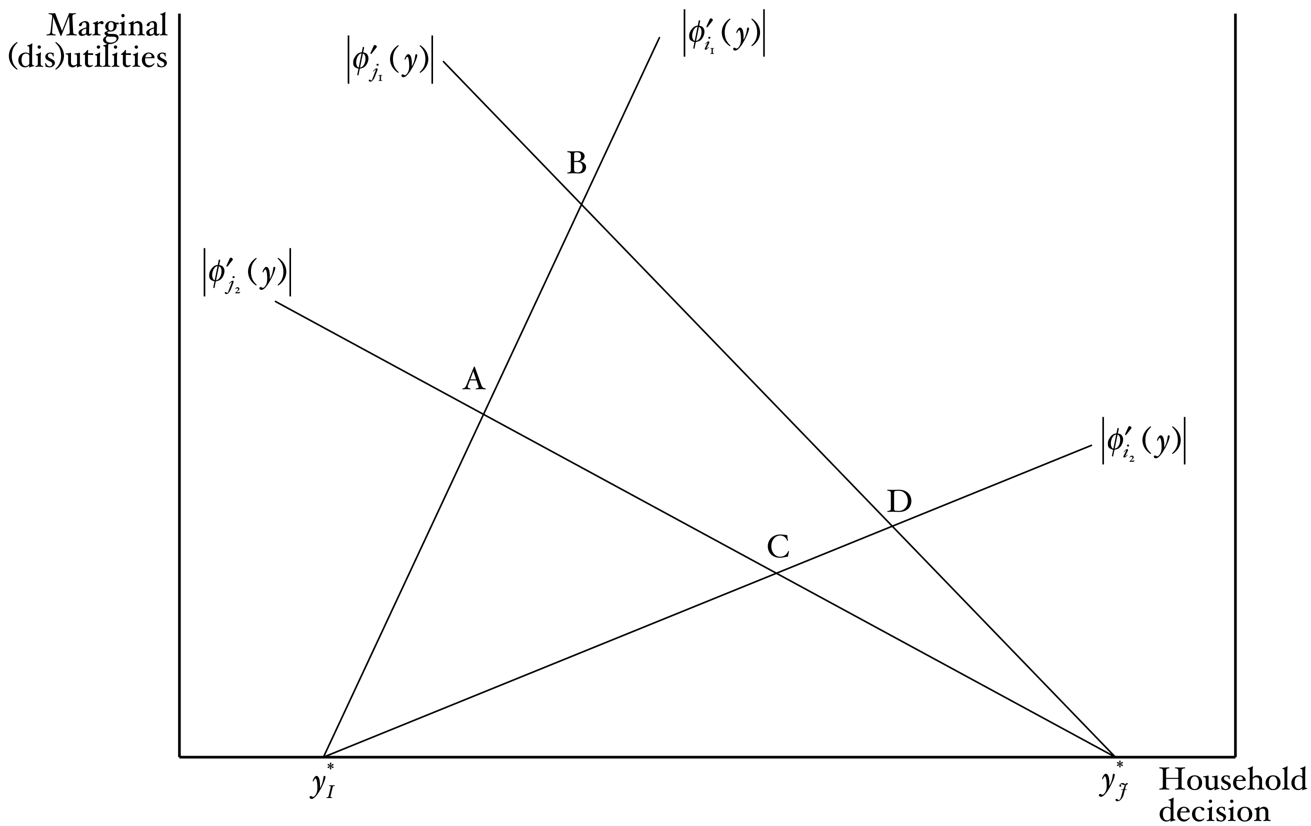

Table 1: PSID Couples, Married 1972-1976 (N=2087)

	HEAD	**WIFE**
Age (years)	42.27 (11.54)	39.42 (11.14)
Duration of marriage (zero if cohabiting)	14.56 (10.64)	
Whether couple is cohabiting	21.95%	
Outcome of marriage: divorce	17.20%	
Outcome of marriage: unknown	37.33%	
Whether have children	74.41%	
Number of children	1.77 (1.57)	
Whether previously married	8.69%	n/a
Education: some high school	17.49%	19.74%
Education: high school	18.06%	31.34%
Education: technical degree, some college	26.50%	25.68%
Education: college	10.64%	7.62%
Education: professional degree	5.85%	2.49%
Religious identity: Catholic	20.36%	20.32%
Religious identity: Jewish	2.68%	2.44%
Religious identity: Protestant, conservative	37.52%	38.19%
Religious identity: Protestant, moderate	17.92%	18.30%
Religious identity: Protestant, liberal	13.08%	16.58%
Region when young: North-east	17.11%	17.39%
Region when young: North-central	24.48%	25.01%
Region when young: South	45.52%	44.18%
Region when young: West	8.48%	9.00%
Size of town when young: small town or rural	33.73%	32.06%
Size of town when young: large city	27.31%	30.28%
Father's education: high school or beyond	9.97%	10.40%
Mother's education: high school or beyond	8.67%	10.50%

Notes: *Standard deviations in parentheses. Omitted educational category is "less than high school." Omitted religious identity is "none or not Jewish/Christian." Liberal Protestants are Episcopalians, Presbyterians, and non-denominational Christians; moderate are Lutherans and Methodists; conservative include Baptists and other denominations. Omitted birth region is "outside (contiguous) U.S."*

Table 2: Comparison of Savings Preferences

	Wife: Future	**Wife: Mixture**	**Wife Current**
Head's response: future	N=507 24.29%	N=159 7.62%	N=222 10.64%
Head's response: mixture	N=86 4.12%	N=87 4.17%	N=88 4.22%
Head's response: current	N=363 17.39%	N=173 8.29%	N=402 19.26%
Rank correlation [P-value, test of ind.]	0.190 [0.000]		

Notes: *Reponses to the question "Would you rather spend your money and enjoy life today, or save more for the future?"*

Table 3: Comparison of Planning Behavior

	Wife: Always	**Wife: Sometimes**	**Wife Never**
Head's response: always	N=596 28.56%	N=35 1.68%	N=295 14.14%
Head's response: sometimes	N=21 1.01%	N=5 0.24%	N=23 1.10%
Head's response: never	N=512 24.53%	N=64 3.07%	N=536 25.68%
Rank correlation [P-value: test of indep.]	0.177 [0.000]		

Notes: *Reponses to the question "Are you the kind of person that plans his life ahead all the time, or do you live more from day to day?"*

Table 4: Ordered Probit Estimates of Responses

	Savings		Planning	
	Head	**Wife**	**Head**	**Wife**
Head's age	-0.0638 [0.068]	-0.0441 [0.197]	-0.0041 [0.911]	-0.0170 [0.645]
Head's age, squared	0.0006 [0.083]	0.0004 [0.274]	0.0001 [0.742]	0.0002 [0.654]
Wife's age	0.0162 [0.643]	0.0443 [0.199]	0.0498 [0.180]	0.0338 [0.364]
Wife's age, squared	-0.0002 [0.546]	-0.0005 [0.223]	-0.0006 [0.140]	-0.0004 [0.321]
Whether children	0.0226 [0.802]	0.0500 [0.570]	-0.0625 [0.516]	-0.2862 [0.003]
Number of children	0.0050 [0.834]	-0.0010 [0.964]	-0.0187 [0.457]	0.0164 [0.510]
Head's education	Included [0.553]	Included [0.580]	Included [0.000]	Included [0.015]
Wife's education	Included [0.479]	Included [0.440]	Included [0.004]	Included [0.000]
Head's religious identity	Included [0.211]	Included [0.401]	Included [0.000]	Included [0.229]
Wife's religious identity	Included [0.898]	Included [0.404]	Included [0.026]	Included [0.125]
Head's region when young	Included [0.016]	Included [0.599]	Included [0.297]	Included [0.234]
Wife's region when young	Included [0.123]	Included [0.134]	Included [0.681]	Included [0.444]
Head's size of town when young	Included [0.385]	Included [0.699]	Included [0.940]	Included [0.919]
Wife's size of town when young	Included [0.826]	Included [0.654]	Included [0.743]	Included [0.319]
Head's parents' education	Included [0.158]	Included [0.547]	Included [0.865]	Included [0.027]
Wife's parents' education	Included [0.826	Included [0.087]	Included [0.540]	Included [0.986]
Cut Point 1	-1.4800 [0.002]	-0.6347 [0.164]	1.1681 [0.018]	0.2356 [0.630]
Cut Point 2	-1.1574 [0.013]	-0.1108 [0.808]	1.2317 [0.013]	0.3723 [0.447]
Likelihood ratio, $\chi^2(42)$	71.25 [0.003]	54.75 [0.090]	190.21 [0.000]	203.01 [0.000]
Rank correlation based on observable characteristics	0.412 [0.000]		0.790 [0.000]	
Rank correlation based on unobservable characteristics	0.179 [0.000]		0.151 [0.000]	

Notes: *Bracketed value is the P-value of a (two-sided, unless inappropriate) test that the variable or variables are equal to zero.*

Table 5: Multinomial Logit Estimates of Disagreement and Outcome of Marriage

	Savings		Planning	
	$\frac{\mathbb{P}[\text{Divorce}]}{\mathbb{P}[\text{Survive}]}$	$\frac{\mathbb{P}[\text{Unknown}]}{\mathbb{P}[\text{Survive}]}$	$\frac{\mathbb{P}[\text{Divorce}]}{\mathbb{P}[\text{Survive}]}$	$\frac{\mathbb{P}[\text{Unknown}]}{\mathbb{P}[\text{Survive}]}$
Difference between preference rankings, $(\rho_i - \rho_j)^2$	0.6736 [0.079]	0.4521 [0.156]	0.8290 [0.038]	-0.3002 [0.371]
Head's preference ranking, ρ_i	-0.1249 [0.614]	-0.2140 [0.282]	-0.0931 [0.706]	0.1578 [0.428]
Wife's preference ranking, ρ_j	0.1033 [0.672]	0.0669 [0.738]	-0.1054 [0.666]	-0.1623 [0.413]
Duration of marriage	0.1978 [0.000]	0.1859 [0.000]	0.1955 [0.000]	0.1869 [0.000]
Duration of marriage, squared	-0.0035 [0.002]	-0.0035 [0.000]	-0.0038 [0.003]	-0.0034 [0.000]
Whether cohabiting	3.152 [0.000]	2.757 [0.000]	3.1398 [0.000]	2.7683 [0.000]
Head's age	-0.1792 [0.054]	0.2783 [0.001]	-0.1772 [0.057]	0.2727 [0.001]
Head's age, squared	0.0009 [0.395]	-0.0045 [0.000]	0.0009 [0.400]	-0.0044 [0.000]
Wife's age	-0.0074 [0.942]	0.0955 [0.266]	-0.0084 [0.934]	0.0987 [0.249]
Wife's age, squared	-0.0004 [0.756]	-0.0009 [0.366]	-0.0004 [0.743]	-0.0009 [0.338]
Whether children	0.1072 [0.667]	0.4858 [0.012]	0.1316 [0.598]	0.4879 [0.011]
Number of children	0.0825 [0.222]	0.1575 [0.002]	0.0761 [0.259]	0.1555 [0.002]
Head was previously married	0.7594 [0.009]	0.4543 [0.056]	0.7521 [0.010]	0.4881 [0.040]
Head's education	Included [0.868]	Included [0.135]	Included [0.790]	Included [0.136]
Wife's education	Included [0.069]	Included [0.324]	Included [0.051]	Included [0.300]
Head's religious identity	Included [0.668]	Included [0.487]	Included [0.647]	Included [0.524]
Wife's religious identity	Included [0.555]	Included [0.567]	Included [0.571]	Included [0.606]
Constant	4.3077 [0.003]	-7.6474 [0.000]	4.4202 [0.003]	-7.5590 [0.000]
Likelihood ratio, $\chi^2(66)$	819.43 [0.000]		824.42 [0.000]	

Notes: *Bracketed value is the P-value of a (two-sided, unless inappropriate) test that the variable or variables are equal to zero.*