Marrying up: trading off spousal income and spousal height

VERY PRELIMINARY!

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Couple's heights tend to match. However, whether such matching is for the sake of height or the many desirable traits associated with stature (e.g., income) is unclear. We contribute to this literature by randomly assigning heights and incomes to 360 unique artificial profiles on a major online dating website in China. We then recorded nearly 800 "visits"—clicks on abbreviated profiles, which include height and income information, from search engine results. Supporting the preference basis for assortative matching on height, taller men preferred taller women. Men were indifferent to women's incomes, but women preferred higher income men. Surprisingly, instead of finding that women also have assertive preference for mate height, women's willingness to trade mate height for mate income (marginal rate of substitution--MRS for height) form a U-shaped frontier on their own heights. For short and medium men, a small increase in height makes them much more attractive to short women, a moderate difference for medium, and a negligible difference for tall women. However, for tall men, the reverse ranking of MRSs among women. We confirm these finding with CFPS survey data of married couples using Chiappori et al.'s (2012) method for multidimensional matching, which we extend to heterogeneity across women of different heights by combining new theory with Vella (1993) *instrumental variable approach. The MRS of short wives is significantly higher than medium, but not significantly higher than tall. Short early mothers drive the difference. Only the earliness of their marriages and childbirth increase on husband's height. Our evidence suggests that short women are matching non-assortatively, and that, to increase the height of their children.*

Key Words: matching, marriage, anthrometry, height, online dating, field experiment, gender differences

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Introduction

Couple's heights tend to match (Weitzman and Conley 2014). However, whether such matching is for the sake of height or the many desirable traits associated with stature is unclear. Stature is associated with many desirable traits (R. Steckel 1995), especially for males: cognitive ability (Case and Paxson 2008), non-cognitive ability, e.g., self-confidence (Persico, Postlewaite, and Silverman 2004), health (Lundborg, Nystedt, and Rooth 2009), education, occupation and industry (Case, Paxson, and Islam 2009), career prospects (Herpin 2005), happiness (Deaton and Arora 2009), and through these factors, or by itself, socioeconomic status (Cavelaars et al. 2000; Hatton and Bray 2010; Peck and Lundberg 1995; Singh-Manoux et al. 2010; Walker, Shaper, and Wannamethee 1988) and income (Case and Paxson 2008; Gao and Smyth 2010; Harper 2000; Heineck 2005; Persico, Postlewaite, and Silverman 2004). However, stature, unlike those other traits, is also readily observable and therefore, may function as an important basis for initial sorting among couples. Indeed, there is evidence that taller men are more attractive to women (Hitsch, Hortaçsu, and Ariely 2010b; Oreffice and Quintana-Domeque 2010; Pierce 1996; Tao and Yin 2015).

Given such associations between height and other desirable qualities, assortative matching on height alone could contribute to the increase in economic inequality across families (Schwartz 2013; Schwartz and Mare 2005). Moreover, height is highly heritable (McEvoy and Visscher 2009; Stulp and Barrett 2016), ranging from 0.80 in developed countries to 0.60 in developing countries, like China, which has a heritability quotient of 0.65 (Li et al. 2004), where nutrition and other environmental factors could play more of a role. Assortative mating on height alone could therefore also contribute significantly to intergenerational persistence of inequality and to the continued association between height and social class, even more so than for birth weight (Currie and Moretti 2007). However, despite the importance of a potential preference for height in assortative mating, there is very little work in the economics literature on how people might match on height, and whether such matching is the result of a preference for height or other associated factors (Black and Devereux 2011).

We contribute to the understanding of the preference for mate height by randomly assigning heights and incomes to 360 unique artificial profiles on a large online dating website in China.

The heights were one standard deviation below, at, or above the average heights of each gender: 160 cm for women and 172 cm for men in the cities of the experiment[2]. These we refer to respectively as “short”, “medium” and “tall” heights. We also randomly assigned these profiles “low”, “middle” and “high” incomes. We then counted “visits”—clicks on abbreviated profiles from search engine results, which include these height and income information,. Because we independently manipulated income and height with online dating data, we can identify the effect of height on visits separated from income and income separated from height, and thus, cleanly test for the *pre-match*ing (i.e., before the opposite sex’s preferences and intra-sexual competition is significant) willingness of men and women to tradeoff between mate income and mate height.

First, we show that both men and women prefer taller members of the opposite sex independently of income, education, and even beauty, and health--as revealed through profile pictures. Second, we confirm prior work that men are indifferent to women’s incomes, and that women also prefer higher income men (Ong and Wang 2015). Thus, our online dating data suggest that women may tradeoff mate income and mate height. Moreover, our design allows us to test for the possibility that women (men) of different heights may differ in their willingness to tradeoff mate income for mate height. To test for potential heterogeneity among women (men) in their preferences for mate height, we calculated how much women (men) of different heights are willing to trade mate income for mate height at each of the male profile’s (female’s) heights.

Surprisingly,women's preference for mate height, as reflected in how much mate income they are willing to trade for it (marginal rate of substitution of height for income--MRS for height) has a “U-shaped” frontier on their own heights, in the following sense. For short men, a small increase in height makes them much more attractive to short women in terms of the income the women are willing to give up for an incremental increase in height. The incremental increase in short men’s height makes less of a difference to medium women and a negligible difference for tall women. However, we see the reverse ranking of MRSs for height at the tall men’s height. A small increase in their height makes a moderate positive difference to tall women, less of a positive difference to medium, and a negligible difference to short women. In general, while the MRS for height among women of different heights form a U-shaped frontier on their heights, short women’s MRS is higher than tall women’s at the short and medium men’s height than tall

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[2] These are: Beijing, Shanghai, Chengdu and Shenzhen. Adult men are on average 5 cm shorter in China than in the US, where they are on average 177 cm in height. Adult women are 3 cm shorter in China than in the US, where they are on average 163 cm in height.

women's at tall men's height. Men's preference is assortative on height, while women's preference for height is non assortative for short women.

We follow up by analyzing the income and height characteristics among married couples using the Chinese Family Panel Studies (CFPS) survey data. As expected from the offsetting effects of men's assortative preference and short women's strongly non-assortative preference for height, the height of the husband of each height type with whom the women are matched, but less dispersed than the women's own. In particular, the husband of the tall wife is only slightly above the medium's wife, while husband of short wife is only slightly below. The medium wife's husband is slightly shorter than the medium man's height. This pattern is consistent with the two opposing effects of a stronger preference among short women for taller men and men's preference for taller women cancelling, so that most women are married to similar height men, who are near average height. Women's preference could, however, dominate when men are more plentiful and women have more men to select from. Indeed, the spousal height difference increases on sex ratio (number of men/number of women).

To find the actual MRSs of height across women of different heights for realized matches that resulted in marriage, we used the methodology developed by Chiappori et al. (2012) for multidimensional matching, which we extend to test for heterogeneity across subsets of wives of different heights by applying the methodology of Vella (1993). Consistent with the U-shaped frontier of MRSs found with online dating data, the MRS of height for short wives is significantly higher than medium, but not significantly higher than tall wives. We hypothesized that this demand for a taller husband, which at some level is inversely related to their own height, if the women are short enough, could be driven by short women's desire for taller children. Such a desire may reflect their desire for their children to escape their own hardships from widespread height discrimination in China (Kuhn and Shen 2013). Confirming this conjecture, only the incomes of husbands of short wives who are early mothers (first childbirth before the age of 24, the median age) decrease on the height of their husband. Only the earliness of their first birth increases on their husband's height. While all early mothers' MRS for height increases on the availability of men, short early others increase the most, followed by medium, and lastly, tall early mothers.

Our findings with online dating and marriage data reject a general preference basis for assortative mating by height. Rather, they suggest that women's preference for mate height is reference dependent. But unlike the case with a reference dependent preference for income, where high-income women exhibit the strongest preference for high-income men (Ong and Wang 2015; Ong, Yang, and Zhang 2015), women's preference for male height may be inversely related to their own height if they are short. We also find evidence consistent with the hypothesis that women's marginal utility for height may reflect concern for the height of their children, and moreover, that there may be a gender difference in intergenerational altruism. In particular, our findings are consistent with evolutionary theories that mothers are more zealous stewards of the welfare of their offspring than fathers, which this literature argues is due to the differential investments that men and women make in their offspring (Alger and Cox 2013).

Given that short women have the highest intensity preference for mate height, prior work on reference dependent preference (Ong, Yang, and Zhang 2015) suggests that they could lose out in the competition for taller men, when those men become more plentiful, because the increase in the numbers of those men may disproportionately increase the entry of other women (e.g., early mothers), who might have been satisfied with shorter richer men when taller poorer men were less available. Indeed, only short women's probability of marriage decreases on local sex ratios, both relative to medium women and absolutely. Sex ratio has no effect on older mothers, including wives who are not mothers up to the age of 45, in their tradeoff between husband income and husband height. This findings extends previous work on RDP (Ong, Yang, and Zhang 2015), which focused on only income by showing that women have RDP for height as well, and one that may be inversely related to their own height. Unlike a RDP for mate income, which can be explained by women wanting to cover their potential opportunity cost from decreased labor market participation, however, an RDP for height has, to our knowledge, no explanation consistent with the classical theory of marriage (Becker 1973).

Related literature

A vast literature on matching has grown out of Becker's (1973) seminal work on the reasons why people form families (Schwartz 2013; Schwartz and Mare 2005). More recently, Becker's theory has given rise to a nascent literature on matching by anthropometric characteristics like body mass (Chiappori, Oreffice, and Quintana-Domeque 2012; Oreffice and Quintana-Domeque 2010) and height. Prior empirical studies suggest that women prefer taller men in online dating and marriage data in the US (Hitsch, Hortaçsu, and Ariely 2010a), in speed dating data (Stulp et al. 2013; Stulp, Buunk, and Pollet 2013), and in marriage data from the UK (Belot and Fidrmuc 2010). Our study, which focuses on tradeoffs, is limited to moderate variation in height of the mass of men and women, instead of outliers.

Apart from the above mentioned correlation between height and other desirable qualities, especially in men, mere height in men is considered a part of what makes them attractive, and attractiveness increases earnings in Western countries (Hamermesh and Biddle 1994). Height has less of (Case and Paxson 2008) or insignificant (Heineck 2005) effect on women's wages. In Asia, height raises earnings for both genders through increased human capital in China (Gao and Smyth 2010) and Taiwan (Tao 2014). That correlation with human capital may contribute to or be the consequence of widespread labor market discrimination by height in China (Kuhn and Shen 2013). Due to the heritability of income, educational attainment (Schwartz and Mare 2005), and height (Cole 2003), all of these advantages may persist for many generations, so that height becomes the visible indicator of class (Cardoso and Caninas 2010; Harper 2000; Hatton and Bray 2010; Singh-Manoux et al. 2010), and therefore, one possible basis of assortative matching by class and a contributing factor to the continued stratification of societies by socioeconomic status. Despite the adoption of communism in China, class exerts a significant influence on life outcomes (Gregory Clark 2014), separate from educational attainment or occupation (Jia and Li 2016).

Not surprisingly, height increases mating success and fertility for men in Taiwan (Tao and Yin 2015). However, owing to the correlations between height and many other desirable and often unobservable traits, the effect of height alone in matches can be difficult to identify. Women (men) could be reacting to those other characteristics of men (women), e.g., income, when they appear to be matching on heights. More important for the social science of marriage matching is the inverse possibility that a preference for height could be exerting a significant but unobserved influence in speed dating or marriage data testing for other factors. Height could be the driving factor in women's apparent preference for more ambitious men, or conversely, height could be the basis for less ambitious men's dis-preference for more ambitious women (Fisman et al. 2006). As a consequence of either preference, tall women may invest relatively more in the job market, anticipating less satisfaction on the mating market, either because they desire even taller men, who are rare, or because they anticipate under-appreciation from most men, who are shorter than themselves.

The "chemistry" of spontaneous characteristics that arise when couples meet presents a further problem for disentangling the preference for height from other preferences in empirical data. For example, a woman's reaction to men who happen to be taller than her may make her more attractive to them. Her pupils may dilate (Tombs and Silverman 2004). Her voice may soften (Fraccaro et al. 2011). Hormonal changes may also occur upon meeting (Grillot et al. 2014; López, Hay, and Conklin 2009), which may increase the attractiveness of couples to each other at that moment in ways that are not captured by standard measures (Fraccaro et al. 2011). See Van Anders, Grey and Anders (2007) for an academic and Alexander (2012) for a popular survey of the academic literature. Women's preference for taller men, which could make them more attractive to those men, could then induce a preference in taller men for shorter women[3].

Surveys might seem like a natural remedy to these problems of separating height from non-height preferences. However, there is no reason to expect that people can separate their preferences over through introspection any better than social scientists can from their choices. Surveys can also suffer from subject's systematic misunderstanding of their own preferences, e.g., subjects always imagine tall men as also being more healthy/handsome/athletic/intelligent, because that is true of the tall men they know and misreport a preference for height when they actually cared about those other characteristics. For example, Hitsch et al. (2010a) find a within race preference revealed by women in their first contact emails to men, but the women did not reveal such a preference in their stated preferences. Surveys of preferences for ideal mate characteristics have not been predictive in actual interactions in speed dating experiments (Eastwick et al. 2014).

These simultaneity and omitted variable problems in identifying non-height mate preferences from speed dating experiments would be exacerbated in marriage data. Spontaneous characteristics from the chemistry arising from well matched statures, or the lack thereof from mismatched statures, could in the long run, give rise to permanent relationship advantages or handicaps, respectively. Height alone or through its correlation with income, could be a contributing factor to the lower marital satisfaction in couples in which the husbands have lower reported incomes than their wives, but in which relative heights were not controlled for (Bertrand, Kamenica, and Pan 2015; Brown and Roberts 2014). Few studies have tried to

[3] Note that this problem is distinct from the well-recognized problem of men seeming to prefer women who are shorter than themselves because they expect higher rates of rejection from women who are taller than themselves.

separate the effect of income and height on matching behavior. Belot & Fidrmuc's (2010) empirical study of the effect of height in across-ethnicities marriages using real marriage data controlled for education. To our knowledge, only Hitsch et al. (2010a) controlled for income when they tested for effect of height on attraction in an empirical study of online dating behavior.

We overcome these endogeneity and omitted variable issues by identifying gender differences in preferences for mate height *ex-ante* to any interactions in a field experiment on one of China's largest online dating websites. Our field experiment is in the tradition of the large correspondence studies literature on discrimination. To our knowledge, this is the first field experimental study of the effect of height and income on mate preferences with random assignments of height. We, furthermore, confirmed the representativeness of the heterogeneity in preferences revealed before first dates with CFPS data from married couples for which we developed an innovative econometrics strategy to test for heterogeneity.

Online Dating Field Experiment

Experimental Design

We conducted our experiment on one of the largest online dating websites in China, with a reported membership of 60 million in 2011. Users can create a profile without a paid membership. These profiles must include demographic (e.g. age and gender), socioeconomic (e.g., income), and physical characteristics (e.g., height) information, at least one photo, and a free-text personal statement. Such requirements are common to most online dating websites. Users may also add information, particularly, verifiable information, which would increase the "credibility"[4] of their profile. Users can browse, search, and interact with other members after registration. Typically, users start by inputting their preferred age range and geographic location of partners into the search engine. The query returns a set of abbreviated profiles which include: ID, picture, nicknames, age, city, marital status, height, income, and the first two lines of a

[4] The credibility of the profile is indicated by a score. This score can be increased with phone verification of the registered phone number, a government issued ID, extra photos, email and phone verifications…etc. All our profiles have a low credibility score, because they have only phone verification and one photo. However, the low score does not appear in user search results, and hence, would not affect visits to our profiles. To affect visits, users would have to search specifically for low-credibility profiles. Even then, such searches would not affect visit rates across our profiles, which is the basis for our findings.

free-text statement. Users can then click a link and "visit"[5] the full profile. They can signal interest for free. However, emails require payment of a 10 CNY/month membership at the time of the experiment, when one USD was about six CNY. We only recorded visits.

We constructed our 360 (180 for each gender) profiles by collecting nicknames, pictures, statements from inactive real profiles from *another* website that would have automatically hidden them after a month of inactivity[6]. We posted our constructed profiles for 24 hours to a randomly assigned city, which is unlikely to be the same as that from which the depicted user originated. At the end of the 24 hours, we closed the account.

For the profile's fixed traits, we assigned male profiles the age of 27 and female profiles the age of 25, which are the average ages of marriage in China. Birthdays were within 8 days of each other and under the same zodiac sign. We assigned our profiles a college education[7], a marital status of "single with no children", and no house ownership.

The main treatment consisted of a block random assignment design with three heights and three incomes for each gender. "Short" male profiles are 166 cm in height, one standard deviation below the average of "medium" male profiles, which are 172 cm (Zhang and Wang 2011). "Tall" male profiles are 178 cm, one standard deviation above medium. These male profiles were also block randomly assigned one of three levels incomes of incomes: 3-5, 8-10, 10-20 (1,000 CNY)[8]. At the time of the experiment, one USD was about six CNY. These

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[5] Visits are necessary for any further interactions. They are costly in so far as they require time. Hence, we expect people to reveal their preferences through their observed tradeoffs between profiles to visit. On the other hand, we do not expect these visits to be made strategically to avoid rejections. A visit reveals only an *ex-ante* desire to see the full profile, and not necessarily an *ex-post* desire for more interactions. Thus, we also do not expect visits to be made strategically to avoid humiliating rejections, because visits do not imply an offer to be rejected.

[6] To our knowledge, there are no legal restrictions on the noncommercial use of user created content uploaded to social media websites in China. We assume that such restrictions, if they exist, are weaker in China than in the United States, where our research activities would also fall under the "fair use" exemption to the US copyright law. Major US social media websites explicitly announce terms of use that effectively make uploaded user created content public domain. See, for example, "publish content or information using the Public setting" in https://www.facebook.com/legal/terms.

We do not expect users to give more than a brief glance at our profiles, which contain little information beyond what was already revealed in the search engine results. Indeed, no one pursued further contact with any of our profiles. Moreover, our profiles are spread out among many other profiles on any given day. They are also spread out across many days. Users of this website are unlikely to encounter our profiles more than once (if at all).

Chinese universities, like European universities, do not have IRBs to approve the ethics of experiments. However, to the best of our understanding, our design falls under the "minimal risk" exemption from IRB approval. "Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests."

See here: http://www.virginia.edu/vpr/irb/sbs/resources_regulations_subparta.46.101.html#46.102(i)

[7] Men 30-40 years old who are college graduates in Beijing and Shanghai earn around 8k/month. The lowest income profile in our experiment is 3-5k/month, which is roughly between the 20th and the 50th percentiles, according to CFPS data for 2010. However, the sample is quite small (44 observations for male 30-40 years old college graduates in Beijing and Shanghai). The comparable Census data for income distribution in 2010 is not available.

[8] We chose these income levels, which are similar to those chosen in Ong and Wang (2015), to be high enough to receive a sufficient number of visits within a short period of time (24 hours) without being conspicuously high. In support of the reasonableness of our income assignment to

incomes are slightly higher than the median for this website in order to make our profiles more attractive to potential female visitors.

"Short" female profiles are 155 cm, also one standard deviation below "medium", which are 160 cm (Zhang and Wang 2011), and one standard deviation below tall, which are 165 cm. These female profiles are assigned incomes: 2-3, 3-5, 8-10 (1,000 CNY). 3-5 is the mean income level for women of this age group on this website. Hence, in summary, we had 20 profiles for each combination of incomes and heights in our 3×3 design for a total of 180 profiles for each gender. Thus, with these treatments, we constructed 360 profile "slots." Then, we randomly assigned according to gender 360 pictures[9], nicknames, and personal statements to these 360 slots.

User can rank the profiles of other users by registration time, login time, age, number of photos, credibility of the profile, and income in the website's search engine. The website also highlights randomly chosen (so far as we can tell) new profiles. Neither should affect our results, since all of our profiles had statistically identical characteristics.

Users could see our profiles' picture, nicknames, age, city, marital status, height, income, and the first few lines of a free-text statement in their default search results[10]. They could then click a link and visit our full profile, which did not contain any more information. We could see our visitors' full profiles by clicking their link in our profile's visitor history, which records visits from any individual visitor to an individual profile only once. Therefore, visits across our profiles are not necessarily from unique visitors. Nevertheless, the fact that we posted our profiles with lags so that many other profiles would be between our profiles in search engine results, and also that we randomly assigned characteristics to our profiles should rule out the individual idiosyncratic factors of specific visitors as the main driver of our findings[11].

We created 36 profiles (of the same gender) the day before to allow the website time to register them. Each day had four profiles from each of the nine income and height combinations.

low-income men, 3-5*k*/month is slightly lower than the 6*k*/month that female respondents said was satisfactory for a mate in a national survey three years later:
http://www.scmp.com/news/china/society/article/1913694/great-expectations-chinese-womens-ideal-man-should-earn-6701-yuan.

[9] The website software automatically detects and focuses the profile pictures on faces. Therefore, it is unlikely that users can impute income, height, or other characteristics, which would be revealed by clothing to the profiles that would conflict with what we assigned the profiles.

[10] We were ready to eliminate any potential inconsistencies between the text of the personal statement and the assigned photo. However, we found no such inconsistencies.

[11] Since we randomly assigned pictures, nicknames and the first two lines of the statements to profiles, we would find a uniform distribution of clicks across heights and incomes across cities, if visitor choices were based upon anything other than the height and income of our profiles.

We logged in these 36 profiles in a random order, with about five minutes between each, to leave at least one page between each of our profiles, for five days during the period of September 11-17, 2013 for the male profile treatments and September 24-29, 2013 for the female profiles. We alternated between logging in the next day's profiles and the collection of the previous day's visit data. The total login/collection time was 1-3 hours per day depending upon the computer speed and number of visits.

Based upon previous findings that men are indifferent to women's incomes (Ong 2015; Ong and Wang 2015), we predict

Hypothesis 1. Men will be indifferent to female profile incomes while women will prefer higher income male profiles.

Based on the prior literature's finding that women prefer taller men and the theory of assortative matching, we predict that

Hypothesis 2. All women will prefer taller male profiles, with taller women preferring the taller male profiles the most.

Based on previous work which showed a weak preference among men for taller women, as well as the association between health, and height we predict

Hypothesis 3. Men will prefer the taller female profiles (among those who are shorter than they).

Data Results

We received and recorded all 1516 women visitors[12] to our 180 male profiles. We recorded 2310 men visitors, which is a random sample of a fifth of the total number of visitors to our 180 female profiles[13]. We test for heterogeneity in the response to mate height as a function of own height at three levels: short, medium, tall. 529 of the 1516 female visitors were at the three levels we are interested in. 310 of the 2310 male visitors that we counted were at these three corresponding levels for men. Thus, the total number of visits we used for our analysis is 839.

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[12] Though users can view anyone else's profile, including those of the same gender, they cannot report a same sex preference on this website.

[13] More men visited our female profiles than women visited our male profiles. The men who visited our female profiles are from a larger range of age. Men can be more aggressive in their search because of the scarcity of women in China. Hitsch et al. (2010b) find that men visited female profiles at 2-3 times the rate of women to male profiles in the US where the sex ratio is close to 1.

We used the remaining data for robustness checks, which yielded similar results. These are available on request.

Before we present our results, we first confirm the strong association between height and other desirable characteristics like education and income for both men and women in China. Table 1 shows the strong correlation between visitor income and education on height for both men and women in our online dating data. On the website, a 1 cm increase in men’s height is associated with a 1.6 percent increase in men’s income and an 1.8 percent increase in female income. We control for the effect of education to better approximate the effect of height discrimination. When education is controlled for, the percentage increase for men is 0.5 percent and the percent increase for women 1.6 percent. Table 2 shows the comparably strong correlation in CFPS. A 1 cm increase in men’s height is associated with a 0.7 percent increase in men’s income a 0.5 percent increase in female income. These effects are roughly comparable to prior findings for China (with more controls for location etc...) which find a 1 cm increase is associated with a 1 percent increase in wages for men and a 0.9 percent increase for women (Gao and Smyth 2010). When education is controlled for, the increase for men is 0.3 percent, while that for women is 0.3 percent. The differences between the impact of height for men and women on the online dating website and in the CFPS could be due differences in the importance of heights and its correlates for the two major cities (Beijing, Shanghai, Chengdu, Shenzhen) of the online dating experiment and the more representative sample of cities in the CFPS data. Married men earn 36 percent more than single men. This increases to 44 percent when education is controlled for. Married women earn 29 percent less than single women, but marriage makes an insignificant difference to their earnings when education is controlled for.

The graphs of men’s visits to female profiles are summarized in Figure 1 below. The horizontal axis indicates the heights of our female profiles. The vertical axis indicates the average daily visits. The number in brackets in the legend is the total average number of visits per day for that height. For example, the average number of medium men who visited our 165 cm female profiles with reported incomes of 3-5 (in 1,000CNY) was about 6 per day. The total of the average visits per day from medium men was 36, the number in bracket in Figure 1. The actual total for all such men for the 15 days of the experiment was 181, the number in bracket in Figure 2.

[Insert Figure 1 here]

[Insert Figure 2 here]

We next normalize the graphs by dividing each average daily visit by all of the visits at each of the height levels of the visitors so that we might see the probability of visits from each height level of the visitors to each height and income levels of the visited profile. For example, Figure 1 shows that there was an average of 6 visits by medium men to tall women with the median income. This becomes 6/36 $\cong$ 17 percent in Figure 2. We see no discernable trend by income for these lines. However, except for short men, these graphs all increase on the height of the women. This pattern is confirmed in the regression results in Table 3.

It is clear from Figure 2 that both 178 and 172 cm men visited female profiles who were 165 cm the most. These were 13-7 cm shorter than themselves. We see no pattern for the few 166 cm men who visited our profiles. This skew in the distribution away from short men indicates that men on this website may tend to be taller than the rest of the population or they are misreporting their height when short. However, the average reported height of men on this online dating website was 175 cm in Beijing and 174 cm Shanghai, which was identical to that found in a representative survey (Zhang and Wang 2011). The average reported heights of women on this website were about 1.5 cm taller for women in Beijing and 1 cm taller in Shanghai. Even if there was misreporting, that should not affect our results because we condition on the height of the visiting men. We address the possibility of misreporting further below.

In stark contrast, Figure 3 illustrates how women's average daily visits increase for higher income men. This pattern is even more salient when we normalize by the height of the visitors in Figure 4.

[Insert Figure 3 here]

Figure 4 reveals further variation in the women's responses to our male profile's heights. Medium women always visited taller men more at all income levels. Most interestingly, short women visited short men the least among all of the men they visited. They visited short men the least among all women, while they visited medium men the most of all women. Short women visited medium men the most among themselves and among all women. Tall women generally visited tall more than both medium and short women, except for low-income men, where they visited even the tall men the least.

[Insert Figure 4 here]

Thus, Figure 4 thus already shows the rough outlines of our U-shaped MRS frontier finding, that short women have the highest MRS for height at the short and medium men's height, while tall women have the highest MRS for height at the tall men's height.

Regression analysis

We now test econometrically for the effect of income and height on visits. First, we explain our data in words, then mathematically. Each of our 180 profiles for each gender is at one of three income and height levels resulting in 3×3 = 9 treatment levels with 20 profiles in each. Each of our visitors also comes from three height levels. Thus, the N = 540 at the bottom of the our regression results in Table 3 and in Table 5 are perhaps better thought of as potential states which could be realized by our 529 visits from women and 310 visits from men. Thus, a data point among our 540 data points is quintuple (number of visits from each of three height levels; a profile at a height and income level). We normalized the number of visits to a female profile at each height level of the visitors by dividing by the total number of visits at a height level. We then assigned a dummy variable to each of the visitors' three height levels.

The percent of visits to profile i = 1, 2,…, 20

- at income level w = 4 (for 3-5), 9 (for 8-10), 15 (for 10-20) in 1,000 CNY and
- height level h = 166 (short), 172 (medium), and 178 cm (tall) for male profiles

and

- income level w = 2.5 (for 2-3), 4 (for 3-5), 9 (for 8-10) in 1,000 CNY and
- height h = 155 (short), 160 (medium), and 165 cm (tall) for female profiles

from visitors of height h' is

- $percent\ of\ visits_i^{h'} = \frac{N_{i,h,w}^{h'}}{\sum_{w\in\{4,9,15\}}\sum_{h\in\{166,172,178\}}\sum_{i=1}^{20} N_{i,h,w}^{h'}}$ to male profiles
- $percent\ of\ visits_i^{h'} = \frac{N_{i,h,w}^{h'}}{\sum_{w\in\{2.5,4,9\}}\sum_{h\in\{155,160,165\}}\sum_{i=1}^{20} N_{i,h,w}^{h'}}$ to female profiles

Thus, the equation that we estimate is:

$$percent\ of\ visits_i^{h'} = \alpha_1 + \alpha_2 \cdot (h' = medium\ dummy) + \alpha_3 \cdot (h' = tall\ dummy) + \beta_1 \cdot w_i + \beta_2 \cdot (h' = medium\ dummy) \cdot w_i + \beta_3 \cdot (h' = tall\ dummy) \cdot w_i + \beta_4 \cdot (h' = medium\ dummy) \cdot h_i + \beta_5 (h' = tall\ dummy) \cdot h_i + \varepsilon_{i,h}^{h'} \qquad \text{Eq.(1)}$$

To control for heteroskedasticity and within-city correlations, we use clustered standard errors (s.e.).

Table 3 has the regression of the percent of men's visits to female profiles. The coefficients for men's height dummy (e.g., -6.494 in column 1) are artifacts of normalization and should be ignored. Men generally do not respond to our female profile's incomes, with possible exception of short men, who seem to respond marginally in column (1). However, our sample size for short men was also small (37 visits in total or an average of 7 visits per day). This is quite consistent with Ong and Wang's (2015) who also find that men in general do not respond to women's income. Medium (0.042) and tall men (0.073) respond to women's height while short men (0.020) do not.

To see how this regression result relates to Figure 2, note that in Figure 2, men's visits increase about five percent for each 5 cm increase in the reported height of our female profiles, which scales down to a 1 percent increase for every 1 cm increase in height. Since there are 20 profiles for each of our $3 \cdot 3$ height and income combinations, that 1 percent increase translates into a 0.06 percent increase per profile increase in height of 1 cm, which is the coefficient 0.062 for *profile height* in column (2) in Table 3. The response of tall men to our female profile's increasing height is not significantly different from that of the medium. We also introduced quadratic heights into these regressions in A-Table 18 and find no significant coefficients. These results are available on request. Table 4 shows that the MRS between mate height and mate income represented by the ratio of the percentage change in men's visits for a 1 percent change in female height over the percentage change in visits for a 1 percent change in female income. None of the MRSs are significant. We tested for heterogeneity among the men in A-Table 19 and find no difference.

[Insert Table 3 here]

Observation 1. Men are indifferent to the incomes of female profiles, but prefer taller female profiles.

The regression of the percent of women's visits to male profiles is in Table 5. Column (1) in Table 5 has short women visitors as the benchmark, while column (2) has medium women visitors as the benchmark. Column (1) in Table 5 shows that the linear coefficient of short women on male profiles' height (4.684) is higher than the linear coefficient for medium women (-4.318) and higher than that of tall women's (-6.560).

[Insert Table 5 here]

However, due to significant quadratic term, we must find the peak visit rates in order to conclude whether women of each height prefer taller men. The levels of the probability of visits from different heights are as we would have expected. The height that maximizes the percent of visits from short women is -406.8 + 0.0543 · Male income + 4.684 · Male height − 0.0135 · Male height ^{2}. This has a peak at male profiles of 173.5 cm = -4.684/(-0.0135 · 2) height, which is 173.5-155 = 18.5 cm taller than the women themselves. Income here is in 1,000 CNY units. The peak for medium women is 11cm[14]. Tall women have no peak, but they have a trough at 13cm[15].

Observation 2. Women visit higher income male profiles and taller male profiles more than lower income and shorter male profiles.

Again, due to the quadratic term, the marginal rates of substitution (MRSs) between height and income would depend upon their coefficient at each male profile height. We evaluate the MRS at each of the short (166cm), medium (172cm), medium and tall (178 cm) male heights in Table 6.

[Insert Table 6 here]

Column (1) shows that the MRS of mate height and mate income for short women, represented by the ratio of the percentage change in visits of short women for a 1 percent change in male height over the percentage change in visits for a 1 percent change in male income. The MRS of short women (3.908) is higher than medium (0.887) women and even to tall women (-0.360) at the height of the short male profile height (166cm). Short women's (0.930) MRS is still higher than medium (0.699) and even tall (0.447) at the medium male profile height (172cm), but less responsive at the male profile (178cm). However, at the tall male profile height, tall women (1.254) have the highest MRS, followed by medium (0.512) and lastly by short (-2.047). The chi2 test shows that the MRS of short women is significantly higher than medium at the short man's height, but not at the medium or the tall man's height. Short women are different than tall at all men's heights, as are medium and tall. In other words, short women

[14] The height that maximizes the percent of visits from medium women is (-406.8 + 371.7) + (0.0543 + 0.00593) · Male income + (4.684-4.318) · Male height + (-0.0135 + 0.0125) · Male height^2 = -35.1 + 0.06023 · Male income + 0.366 · Male height − 0.001 · Male height^2. This has a peak at male profiles of 183 cm = (-0.366)/(-0.001 · 2) height, which is 183 − 160 = 23 cm taller than the women themselves.

[15] Tall women have no male profile height which maximizes their percent of visits. The height that minimizes the percent of visits from tall women is (-406.8 + 564.6) + (0.0543 + 0.0284) · Male income + (4.684-6.560) · Male height + (-0.0135 + 0.0190) · Male height^2 = 97.14 + 0.0827 · Male income − 1.876 · Male height + 0.0055 · Male height^2. This has a trough at male profiles of 170.5 cm = -(-1.876)/(0.0055 · 2). Since they exhibited no maximum within the variation in our profile heights, we infer that they preferred men who were at least the difference between the maximal male height and their own height 178 − 165 = 13 cm above themselves.

have the highest MRS of mate height for mate income at the short and medium man's height. Next is medium women. Last is tall women. But we have the opposite ordering at the tall man's height. The MRS of each height of woman depends on the height of the man at which her MRS is evaluated. However, the change in the MRS across women of different heights can be described by the following observations.

Observation 3. Women's MRSs for mate height forms a U shaped frontier on the women's own height.

Chinese Family Panel Studies Data

We now test whether these preferences revealed through visits before the first dates in the online dating environment are born out in the marriage data from the China Family Panel Studies (CFPS) 2010 baseline dataset[16]. The CFPS is a comprehensive survey of individual-, family-, and community-level data across China, covering various aspects of economic and non-economic issues. It includes 16,000 households in 25 provinces and is representative for the whole population of China. We restrict the sample to married couples living in urban areas, both aged 20-45, which contains 2191 couples. We drop the observations whose height and weight are beyond three standard deviations from the mean, which are either outliers or possibly recording mistakes during the survey. This leaves us a final sample of 2147 couples for analysis. Table 7 shows the summary statistics.

[Insert Table 7 here]

We make the following hypothesis based upon our finding in Observation 2 that all women prefer taller men. In that case, we would expect a truncation at the lower end of the husband's height distribution due to women's preference for taller men.

Hypothesis 4. The height gap for the husbands of short and tall wives is smaller than the height gap for those wives.

The top part of Table 8 shows the summary statistics of the spousal height difference and husband's height.

[Insert Table 8 here]

[16] Though the CFPS for 2012 data is available, it only collected household income without separating into husband income and wife income. Moreover, it did not collect the income of individuals who are self-employed, unlike the 2010 data set.

Short wives, who are one standard deviation shorter than the medium women, are nearly 3 standard deviations shorter than their husbands (15.4cm). Medium wives are nearly two standard deviations shorter than their husbands (11.2cm). Tall wives are one standard deviation shorter than their husbands (6.2cm). The compression of the spousal height gap from short to tall wives increases when the short (tall) wife is two standard deviations shorter (taller) than medium. The bottom part shows the effect of this compression. The husband (168.7cm) of the short wife (who is one standard deviation (5 cm) shorter than medium wife (160cm)) is only half a standard deviation (5.1cm) shorter than the husband (171.1cm) of the medium wife, while the husband (172.7cm) of the tall wife is only a quarter of a standard deviation taller than the husband of the medium wife. The husband (167.6cm) of the very short wife (two standard deviations below the medium wife) is only one sixth of a standard deviation shorter than the husband of the short wife, while the husband (174.1cm) of the very tall wife (two standard deviations taller than the medium wife) is only one sixth of a standard deviation taller than the husband of the tall wife. These statistics indicate that women of all heights are marrying men of roughly the same heights, who are generally near or above medium height, even among short women. Such medium and tall men would be relatively scarce, though women are in general scarce in China. Their overrepresentation among married men suggests that women are in competition with each other for taller men.

Observation 4. The height gap among the husbands of short and tall wives is smaller than the height gap for those wives.

Given a preference for husband height on the part of women, we would expect that

Hypothesis 5. The spousal height gap increases with the availability of men.

Columns (1) in Table 9 show that the spousal height gap indeed increases with the availability of men as measured by sex ratio, controlling for height differences across provinces. When sex ratio increases by 10 percent, the height gap increases by 0.4897cm. Column (2) shows husbands are taller in higher sex ratio cities when we control provincial differences in the average heights of husbands. This indicates that women are marrying taller men when men are more plentiful.

[Insert Table 9 here]

Observation 5. The spousal height gap increases with the availability of men.

Height and income are both good things. We would therefore expect that women are trading off between height and income. Based upon our online dating finding in Observation 3 and the above subsequent confirmations with marriage data, we predict,

Hypothesis 6. Short wives are most willing to trade husband income for husband height.

Heterogeneity in women's willingness to tradeoff husband income for husband height

We test Hypothesis 6 in Table 10, which applies the methodology of Chiappori et al. (2012) on the tradeoff between spousal weight and spousal income to husband height and husband income for different heights of women. They provide a theoretical framework of multi-dimensional matching in which the matching process operates via a single index of "attractiveness". Under this framework, the marginal rate of substitution between spousal characteristics can be empirically identified. Their theory assumes that all individuals have the same "tastes" regarding the opposite sex, i.e., that they tradeoff between different characteristics of potential spouses in the same way. (We have included an outline of their theoretical framework in the Appendix for the convenience of the reader.)

We begin with empirically checking the validity of Chiappori et al. framework to our data. The regressions of wife's education and beauty on husband's income and height are:

$$Edu_j = \alpha^1 + \beta_1^1 Income_i + \beta_2^1 Height_i + X_j^1 \gamma^1 + u_j^1 \qquad \text{Eq.(2)}$$

$$Beauty_j = \alpha^2 + \beta_1^2 Income_i + \beta_2^2 Height_i + X_j^2 \gamma^2 + u_j^2 \qquad \text{Eq.(3)}$$

They will be estimated using SUR regression. We then employ the Wald tests to check the following equality constraints:

$$\frac{\beta_1^1}{\beta_2^1} = \frac{\beta_1^2}{\beta_2^2} \qquad \text{Eq.(4)}$$

If the equality is not rejected, the MRS between husband's income and height is identified. Table 10 presents the regressions of wife's education and beauty on husband's characteristics. Table 10 shows that both wife's education and beauty are positively related to the husband's *log* income and height. We report the ratios and the products of the coefficients of interest within or across columns. The corresponding Wald test of the proportionality of these factors are not rejected (p-value = 0.538), indicating that the MRS is identified. The value of the MRS between husband's *log* income and height is between 11.753 and 15.173. This suggests that a 1 cm increase in height is equivalent to an 6.59-8.51 percent increase in income.

[Insert Table 10 here]

Intuitively, Chiappori et al. show that for the wife to have a well-formed MRS over men's height and income, that MRS has to be invariant on whether it is derived from coefficients of regressions where her quality is in terms education or in terms of her beauty. They assume that wives unobserved characteristics are not correlated with observables, fixing the index value. But facial features which may be attractive on a tall woman/man not be attractive on a short woman/man and vis versa. Even if no such "genetic complementarity" between observed and unobserved features, men's preferences may induce such a correlation in their wives. For example, cuteness may be independent of height in the population of women, but short married women tend to be cute. When we divide wives into short, medium, and tall, we may inadvertently introduce these correlations into the groups. Differences in MRSs of wives for husband's height and income across groups may then be due to husband's preferences, not wives, preferences.

Our online dating results suggest that women's taste for height may be heterogeneous according to their own height. Thus, we now weaken this assumption in our application by assuming that only subsets of *wives* share the same tastes. We now test for heterogeneity among short, medium, and tall wife's tradeoff between husband's height and income. We divide our data into three subsamples by the wife's height: short (one standard deviation below the mean height), medium, and tall (one standard deviation above the mean height) wife, and then re-run Eq. (2) and (3) separately on these three subsamples to get the corresponding MRS for each type of wife. We treat this new model as the unconstrained model and the previous, which used the whole sample as the constrained, since it restricts the coefficients to be constant across different types of wives. We test whether the constrained model is significantly different from the unconstrained one, using likelihood ratio (LR) tests. If so, we can conclude that short, medium, and tall wives are heterogeneous in their tradeoffs between husband's income and husband's height. By comparing the value of their MRSs between husband height and husband income, we can identify which type of wife value height in husband's the most.

To test for the heterogeneity in marginal rates of substitution of the wives of different heights, we divided the wives into three groups by their height, and then, run a SUR of wife's characteristics (edu and beauty) on husband's characteristics (income and height). However, the men themselves who choose a wife of each height could themselves differ systematically in their characteristics. Tall men could prefer tall wives as much as tall women prefer tall husbands. Such a preference on the part of men would also result in short wives being disproportionality matched with short richer husbands and tall wives with taller poor husband. To solve this problem, we apply the method of Vella (1993). First, we use the wife’s mother’s age of giving birth and the wife’s weight at birth as an instrument for the wife’s own height and run the first stage regression in Table 11.

Mother’s age of giving birth is positively correlated with children’s height. Height is a function of genes and resources. Potential height is determined by genes, but resources constrain the degree to which that genetic potential is realized (R. H. Steckel 2009; Stulp and Barrett 2016). Older mothers are also more knowledgeable. Such knowledgeability has been shown to contribute to the height of children (Rubalcava and Teruel 2004; Thomas et al. 1991) through better utilization of community and household resources, and possibly also through better child nutrition (Bhargava and Fox-Kean 2003). However, mother’s age should not be correlated with the traits related to marital matching of the daughter, including her beauty.

Both height and beauty (e.g., symmetry of features, body proportion) are influenced by genetic quality, prenatal hormonal levels, and exposure to diseases and parasites (Gangestad 1993; R. H. Steckel 2009). However, physical beauty in general is about averageness, symmetry, and sexual dimorphism of features (Rhodes 2006). In women, beauty is also signal of fertility, e.g., levels of oestrogen. For beauty, genes, mutation, a parasitic load play the dominant role, rather than resources (Gangestad 1993). Hence, father’s age could decrease child’s beauty because men produce new sperm throughout their lives. Sperm produced at later ages are more likely afflicted by mutation (Huber et al. 2014). In contrast, the quality of mother’s eggs are fixed even before their own birth and are not subject to mutation as the mother ages. Hence, the beauty of children is not affected by mother’s age. Weight at birth, which also affects height (Black, Devereux, and Salvanes 2007), should not influence beauty.

We calculated the generalized residual from Table 11 and put it into the second stage SUR regression as a control variable and bootstrap the standard errors. The result is Table 12. In Table 12, the equality constraints for short, medium, and tall wife are not rejected by the Wald test (p-value = 0.453, 0.483 and 0.892, respectively). The MRS of the short wife is between 3.382

and 5.585 and is the lowest among all wives, suggesting that short wives value men's height the most. For short wives, a 1cm increase in husband height is equivalent to between a 17.198- 32.39 percent increase his income, which is roughly twice the average value obtained in Table 10, and more than three times that of the medium wife. The LR test confirms that the difference in the value of MRS among short, medium, and tall wives is significant (p-value = 0.021). At least one pairing of these types of wives is heterogeneous in their tradeoffs between husband's height and income. The differences between short and medium, and between medium, and tall wife are both significant (p-value = 0.029 and 0.056). The MRS of the short wife is also lower than tall wife, though the difference is not significant (LR test p-value = 0.609), is consistent with our U-shaped MRS frontier finding with online dating data. We conclude,

Observation 6. Short wives are more significantly willing than medium wives to trade husband income for husband height, though only weakly more than tall wives.

In Table 13, we look at how husband tradeoff between wife's characteristics. We use education to replace wife's income following Chiappori et al. (2012). For males, the necessary equality condition for a well-defined MRS is violated (although the within-column p-value = 0.179, the across-columns p-value = 0.000).

[Insert Table 13 here]

Average men's MRS may not be well defined because of heterogeneity. To test for heterogeneity, we use men's income and instead of men's education, as in the case of the women, because income is generally regarded as more predictive of men's marital prospects. As with women, we use men's beauty instead of height, because we now divide men by their height. However, even the wife's height has generally no effect on husband income or beauty, which violates a primary condition of identification in Chiappori et al. We also attempted the instrumental variable approach for men that we used for women in A-Table 20 and A-Table 21. For the first stage in A-Table 20, unlike in other countries, mother's age of giving birth for husband height is marginally below the threshold of significance, but husband height does increase on their birthweight. This difference could be due to the preference for boys in China. More knowledgeable mothers make slightly more difference in the nutrition for girls than for boys. However, the second stage in A-Table 21 using residuals of first stage shows that generally, that while the wife's education increases husband income and beauty, height does not. The results are similar when we do not use the IV. When we change the independent variables to wife's income and height, neither coefficient is significant. These results are available on request.

We have now shown with both online dating and marriage data that short women value height more than medium and weakly more than tall women. Prior work has shown that high-income women could be worse off when men are more plentiful, because their plentifulness increases the expected value of low-income women entering the competition for these high-income men (Ong, Yang, and Zhang 2015). In this paper, we find that short women are more willing to trade mate income for mate height than tall women, i.e., women have a reference dependent preference for mate height. That implies that they are less willing to substitute to shorter men even when the competition for taller men increases. Therefore, the seemingly paradoxical outcome that was found with reference dependent preferences for mate income could also arise with mate height;

Hypothesis 7. Only short women's probability of marriage decreases on local sex ratios relative to medium, or even absolutely.

Table 14 shows the marriage probability of women as a function of their height, with the medium height women as the benchmark. Again, we define tall (short) women as one standard deviation above (below) the mean in column (1) and very tall (very short) two standard deviations above (below) in column (2). Column (1) indicates that tall women (-0.411) are significantly less likely to marry than medium women, while short women (-0.081) are insignificantly different in their probability. As might be expected, medium women are more likely to marry in high sex ratio cities (3.658). Tall women (1.697) and very tall women (0.617) are not significantly different from medium women in this respect. However, short (-8.292) and very short women (-10.382) are significantly less likely to marry in higher sex ratio cities.

[Insert Table 14 here]

This finding is summarized in the following observation.

Observation 7. Only short women's probability of marriage decreases on local sex ratios relative to medium, and absolutely.

We do not find similar results for men. A-Table 17 shows that late tall fathers tend to be poorer (-15.435). This would be consistent with the father's income being a constraint on fatherhood. Perhaps to compensate, tall wives of late fathers tend to have higher incomes (0.096). The gender difference between short women and short men may be attributable to a gender difference in intergenerational altruism, for which there is both empirical (Lundberg, Pollak, and Wales 1997) and theoretical (Alger and Cox 2013) support.

Gender differences in intergenerational altruism

One potential reason why short women may be more willing to trade mate income for mate height than tall women is out of concern for the height of their children. In that case, we would expect that short wives are more likely to have children earlier when the husband is taller, and that their fertility and probability of early marriage increases on local sex ratios. We test hypothesis related to fertility concerns next with CFPS data of married couples.

Figure 5 shows the raw data with trend lines for the correlation between husband height and income by the wife's height.

[Insert Figure 5 here]

The left panel shows the data for very short wives, the middle for medium height wives and the right panel for tall wives. In all three cases, the upper line is for late mothers (women who became mothers before the age of 24, the median age of all women giving birth.) and the lower line is for early mothers (women who became mothers after the age of 24). The positive trend increases slightly for late mothers from short to medium wives and more noticeably from medium to tall wives. This suggests that the willingness of late mothers to trade *log* husband income for husband height increases on her own height. In other words, these women value height less as they get taller. The trend also increases for early mothers, but is noticeably negative for short early mothers while is it noticeably less positive for tall early mothers as compared to tall late mothers. The slope of tall early mothers is roughly the same as medium early mothers, however. These impressions are confirmed for short women who are early mothers (-0.042) in Table 15, which has the medium wife as the benchmark, and which has the tall wife as the benchmark (available on request).

[Insert Table 15 here]

The negative coefficient for the interaction between *husband height*short wife* is unchanged (-0.040) when the husband's and wife's education, age, and income are controlled for.

Column (1) of Table 15 shows that short women who are early mothers are willing to give up 4.2 percent more income for every 1 cm increase in height than medium women (0.009), whose coefficient for the same tradeoff is not significant. These findings suggest that short early mothers are more willing to trade mate height for income than short late mothers, medium and tall early and late mothers. Column (3) shows that his height has a positive effect on his income when the wife is a medium (0.014) late mother. Husband height has no further effect on his income when the wife is tall compared with medium, regardless of the age of motherhood. One possible explanation for this latter finding is that women who are late mothers are waiting for richer husbands. We investigate this possibility in a follow up paper on the timing of marriage. Short wives who are early mothers tend to have husbands with higher incomes (6.665) (for reasons that are not apparent to us) than medium wives who are early mothers. Tall wives (0.031) show no such effect with respect to medium wives.

Observation 8. Short wives who are early mothers are most willing to give up husband income for husband height.

We next look at the effect of sex ratio on the willingness of wives to tradeoff between husband height and income in Table 16.

[Insert Table 16 here]

Column (1) shows that medium women are less willing to trade income for height when sex ratio increases (-0.129). Short women are even less willing than the medium income women (-0.011). Tall women are more willing to trade than medium income women (0.033).

Thus,

Observation 9. While all early mothers' willingness to trade husband income for husband height increases, short early mothers' increases most while tall early mothers' increases least on the availability of men.

We also use the earliness of marriage instead of early motherhood as a robustness check. All results are very similar in significance level, except the coefficient for sex ratio become insignificant. This, however, is to be expected since not all couples marry to have children and we hypothesized that short women's intensified preference for height was for the sake of their potential children. These results are available upon request.

Discussion

Our study explores the gender difference in preference for mate height in an online dating field experiment, where we randomly assigned heights and incomes, and in actual marriages, based on CFPS survey data. Since we independently manipulated income and height with online dating data, we can identify the effect of height separated from income and income separated from height for both men and women. With our online dating data, we confirm an earlier finding that men are indifferent to women's income, though they prefer taller women (Observation 1). Women prefer higher income and taller men income (Observation 2). Since we fixed education, and randomized on income and beauty and health as revealed through profile pictures these results imply that the preferences of height of each gender is independent of other correlated factors. Surprisingly, women's MRSs for mate height forms a U shaped frontier on the women's own height (Observation 3). Short women have the highest MRS at the short and the medium men's heights, followed by medium women, which are both higher than tall women's. However, tall women have the highest MRS for mate height at the tall men's height, followed by medium women, which are both higher than short women's. While the MRS for height among women of different heights form a U-shaped frontier on their heights, short women's MRS is higher than tall women's at the short and medium men's height than tall women's at tall men's height. Thus, our findings with online dating and marriage data reject a preference basis for assortative mating on height for women inferred in prior speed dating experimental studies and empirical studies of the data married couples. Rather, our finding suggests the intriguing possibility that mate height could be complementary for tall or medium men and women, but a substitute for short women.

We find a remarkable consistency between women's preferences as revealed through online dating data and their marital outcomes with CFPS data of married couples using the methodology developed by Chiappori et al. (2012) for multidimensional matching, which we extend to test for heterogeneity across women of different height by applying the instrumental methodology of Vella (1993). As predicted by the online dating findings, short men tend to be absent from the population of married men. Rather, all women seem to be marrying men of similar heights, which are around medium or higher. The height gap between the husbands of short, medium, and tall women is much smaller than among the women themselves (Observation 4). As expected, the height gap between the women and their husband increases on the availability of men (Observation 5). Short wives are significantly more willing than medium wives to trade husband income for husband height, though only weakly more than tall wives (Observation 6). Given this reference dependent preference for mate height, and consistent with prior work on reference dependent preferences, only short women's probability of marriage decreases on local sex ratios, both relative to medium women and absolutely (Observation 7).

We do not find heterogeneity in men's preferences in online dating data nor in CFPS data of married couples. In the case of online dating data, the MRS was not well defined because men did not prefer higher income women. In the case of CFPS data for, men did not meet the identification conditions of Chiappori et al. (2012), because neither men's income nor beauty increase on women's height. This did not change conditions for our new instrumental variable based on mother's age of giving birth and birth weight. In relation to our main finding that short women seem to have the highest demand for mate height, we know of no evidence in the large psychological and demographic literatures on height. Thus, while we cannot rule out endogeneity on the men's side, we know of no evidence in the large psychological and demographic literatures on height which suggests that men's preference for shorter women increases on their own height (Stulp and Barrett 2016), which is what would be required for men's preferences to be a confound for our findings for short women.

Based upon prior work, we conjecture that the gender difference in the heterogeneity in preference for mate height that we find could be due to gender differences in intergenerational altruism. In support of this, short wives who are early mothers are indeed more willing to trade husband income for husband height than medium or tall wives (Observation 8). Short mother's willingness to trade husband income for husband height increases on the availability of men (Observation 9). Only short wives are more likely to have children earlier when their husband is taller (**Error! Reference source not found.**).

Our findings of a higher intensity preference for height among short women complements Stulp, Buunk, and Pollet's (2013) and Stulp, Buunk, Kurzban's (2013) finding of a more pronounced preference for mate height among women than among men. However, they did not test for heterogeneity among women, nor do they test for the tradeoff between mate income and height. Thus, their results could have been driven by short women.

Our finding of a preference for height among women that is inversely related to their own height suggests a possible reason for the finding of a greater rate of out-race marriages for Chinese women compared to Chinese men in Britain (Belot and Fidrmuc 2010). Indeed, though British men (175 cm) and women (162 cm) are about 2 cm taller than men and women in our study, the average height of the Chinese women in their study is 158 cm, which is 2 cm shorter than the average height of the women in our study. The gender difference in out-ethnicity marriage among ethnically Chinese men and women could be due to the Chinese women (in particular, women who want children, which they do not control for) in their sample being shorter than the average woman and the Chinese men not being that much richer than White British men.

There is mixed evidence of heterogeneous rates of fertility for women of different heights in prior studies. Medium women have more children and their children are more likely to survive in the Netherlands (Stulp et al. 2015). Shorter women show greater fertility in the US (Stulp et al., 2012). However, others find no effect of women's height on fertility in the UK (Krzyżanowska, Mascie-Taylor, and Thalabard 2015). These studies do not use sex ratio as a treatment variable. Though they do control for income, they do not control for state welfare subsidies to unwed mothers (e.g., low rent housing, food stamps...), which could vary by time and country[17]. Our findings that short women are more fertile with taller mates and have a stronger preference for mate height may help explain why tall men are likely to have more children in Taiwan (Tao and Yin 2015).

Heterogeneity in preference for height among women could also be the reason why Weitzman and Conely (2014) find that men who are shorter than the average man do a smaller share of the housework and contribute a greater share of the household income. This result is consistent with our analysis in Table 5, which suggest that such wives may require a higher mate income premium to compensate for the men's shorter stature. This difference could be due to the possible handicap that short men may suffer in finding a mate. The fact that these short men are married at all, given their height handicap (Manfredini et al. 2013; Stulp et al. 2012, 2013, 2014; Stulp, Buunk, and Pollet 2013), may signal other factors that make these men distinct, e.g., like a higher value for traditional families, particularly for children, or ethnic differences (Belot and Fidrmuc 2010), which could be the cause of both differences in stature and differences in actual and potential incomes. Hence, the differences in the marriages of men who are shorter than their wives (but not necessarily short) could be the result of a confluence of unobserved or partially observed factors that make their marriages distinct, and possibly less stable.

[17] https://en.wikipedia.org/wiki/Aid_to_Families_with_Dependent_Children

One important limitation of our data is our tall women were shorter than our short men. We therefore cannot confirm Hitsch et al.'s (2010a) finding that men dis-prefer women who were taller than themselves, nor that women dis-prefer men who are shorter than themselves. We avoided using extreme heights among our profiles in order preserve the representativeness of preferences that might be revealed through our treatments, while maximizing the sample sizes for those treatments.

Our findings suggest the importance of the inclusion of height controls in matching studies that attempt to identify the effect of other match characteristics like income or education. They also suggest that people may match assortatively on bundles of characteristics across generations. Short women's preference could increase economic inequality within a generation because they are more willing to give up mate income for mate height, despite have lower earnings themselves. However, this counter assortative mating preference could decrease economic inequality across generations, especially in the context of greater social mobility, if their children are taller, and taller people have on average higher earnings (Power, Manor, and Li 2002).

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Tables and figures

Table 1: Correlation between income and profile height from online dating website

	Male visitors			Female visitors		
	Log income	Log income	Edu years	Log income	Log income	Edu years
	(1)	(2)	(3)	(4)	(5)	(6)
Height	**0.016*** **	**0.005** **	**0.058*** **	**0.018*** **	**0.016*** **	**0.024*** **
	(0.002)	**(0.002)**	**(0.005)**	**(0.003)**	**(0.003)**	**(0.008)**
Edu		0.178***			0.115***	
		(0.006)			(0.009)	
Age	0.119***	0.099***	0.115***	0.266***	0.218***	0.423***
	(0.018)	(0.017)	(0.038)	(0.028)	(0.027)	(0.076)
Age^2	-0.001***	-0.001***	-0.002***	-0.004***	-0.003***	-0.007***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
City dummies	Y	Y	Y	Y	Y	Y
Constant	3.518***	2.953***	3.173***	1.057*	0.421	5.552***
	(0.510)	(0.474)	(1.058)	(0.622)	(0.595)	(1.652)
Observations	5,284	5,284	5,284	1,760	1,760	1,760
R-squared	0.117	0.238	0.075	0.214	0.287	0.063

Table 2: Correlation between income and profile height from CFPS data

	Male			Female		
	Log income	Log income	Edu years	Log income	Log income	Edu years
	(1)	(2)	(3)	(4)	(5)	(6)
Height	**0.007*** **	**0.004** **	**0.040*** **	**0.005* **	**0.003**	**0.034*** **
	(0.002)	**(0.002)**	**(0.008)**	**(0.003)**	**(0.002)**	**(0.006)**
Edu		0.077***			0.106***	
		(0.004)			(0.006)	
Married dummy	0.367***	0.440***	-1.136***	-0.299***	-0.095	-2.321***
	(0.060)	(0.057)	(0.228)	(0.089)	(0.086)	(0.236)
Age	0.219***	0.168***	0.520***	0.256***	0.197***	0.482***
	(0.029)	(0.028)	(0.104)	(0.040)	(0.038)	(0.100)
Age^2	-0.003***	-0.002***	-0.009***	-0.004***	-0.003***	-0.009***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)
Province dummies	Y	Y	Y	Y	Y	Y
Constant	5.222***	5.413***	-0.314	5.255***	4.774***	3.771*
	(0.609)	(0.580)	(2.253)	(0.783)	(0.744)	(1.936)
Observations	3,035	3,035	3,279	2,857	2,857	3,721
R-squared	0.169	0.247	0.158	0.129	0.215	0.235

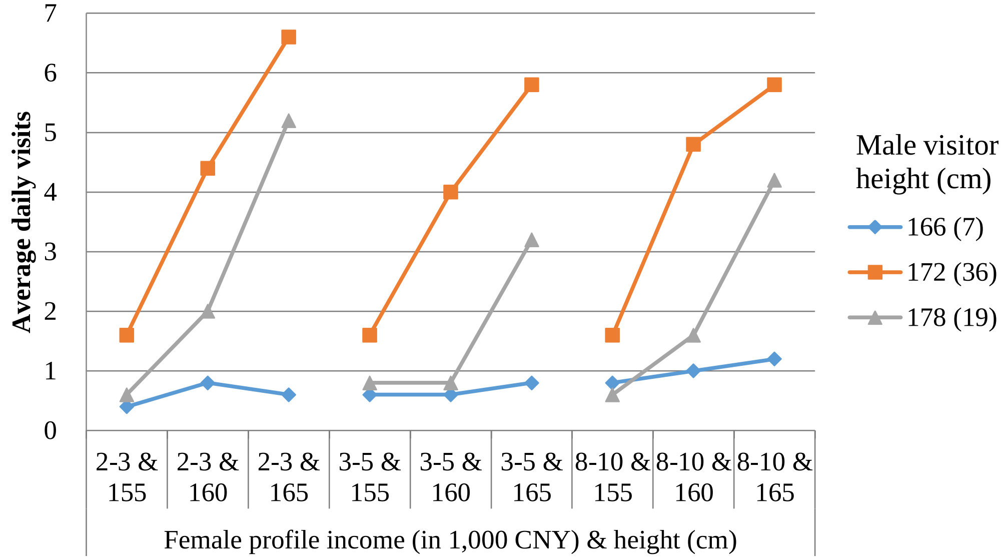

Figure 1: Male average daily visits to female profiles vs female profile incomes and heights

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Numbers in brackets are total average daily visits. 3-5 (in 1,000 CNY) is the median income for women on the website.

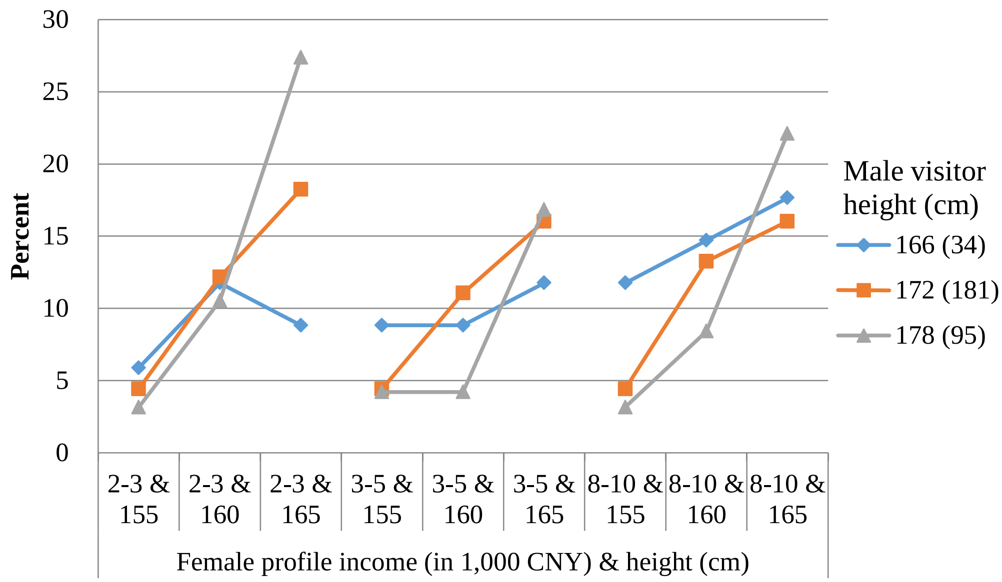

Figure 2: Percent of male visits to female profiles vs female profile incomes and heights

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Numbers in brackets are total daily visits. 3-5 (in 1,000 CNY) is the median income for women on the website.

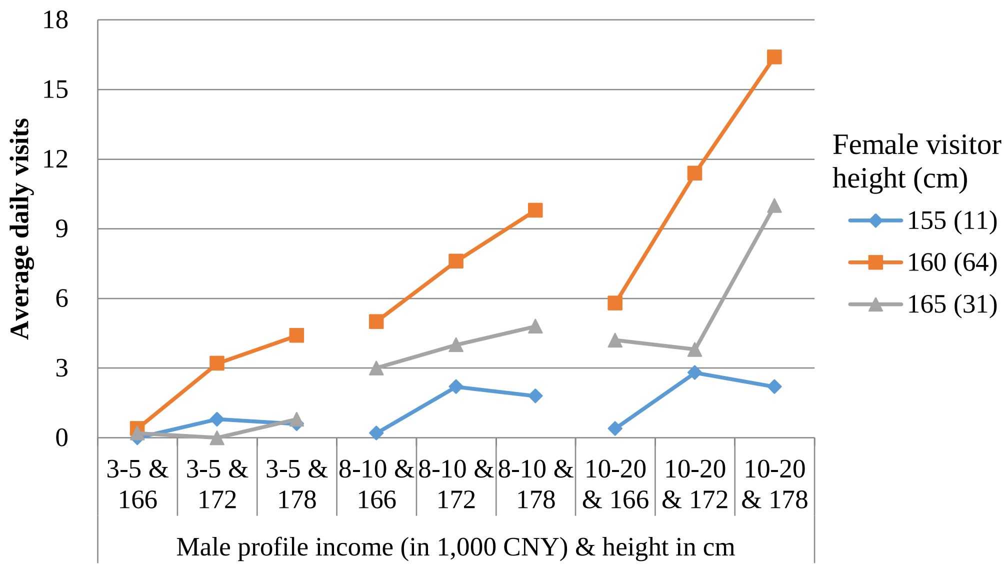

Figure 3: Female average daily visits to male profiles vs male profile incomes and heights

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Numbers in brackets are total average daily visits. 8-10 (in 1,000 CNY) is the median income for women on the website.

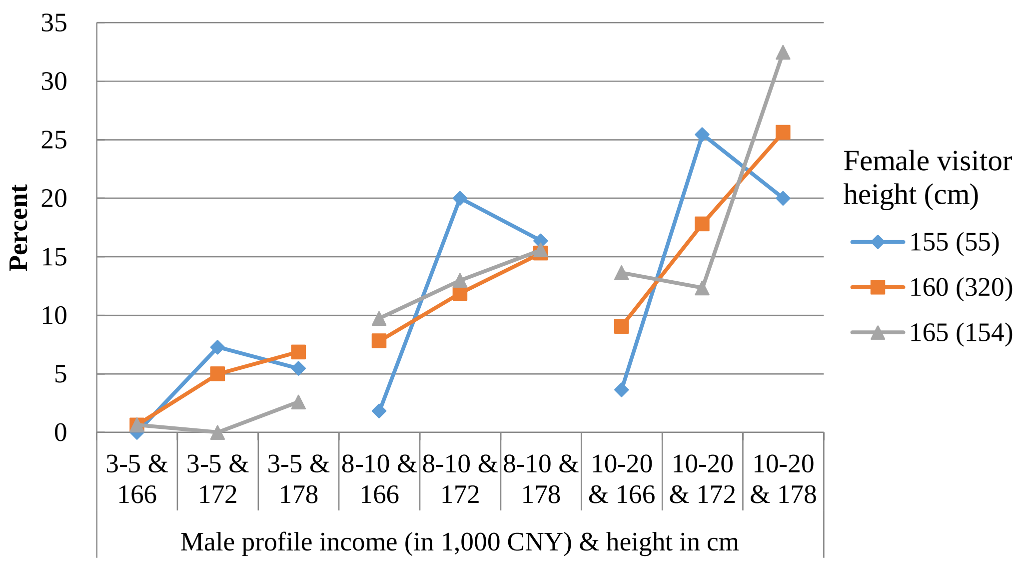

Figure 4: Percent of female visits to male profiles vs male profile incomes and heights

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Numbers in brackets are total daily visits. 8-10 (in 1,000 CNY) is the median income for women on the website.

Table 3: Regression of percent of men's visits to female profiles (online dating data)

Female profile	visit percent	
	(1)	(2)
Short man dummy		6.494*
		(2.568)
Med man dummy	-6.494*	
	(2.568)	
Tall man dummy	-11.465**	-4.971
	(2.732)	(3.019)
Profile income	0.046	-0.000
	(0.021)	(0.007)
Profile height	0.020	0.062**
	(0.016)	(0.019)
Profile income*short man dummy		0.046*
		(0.020)
Profile height*short man dummy		-0.042*
		(0.017)
Profile income*med man dummy	-0.046*	
	(0.020)	
Profile height*med man dummy	0.042*	
	(0.017)	
Profile income*tall man dummy	-0.053	-0.007
	(0.030)	(0.022)
Profile height*tall man dummy	0.073**	0.031
	(0.018)	(0.019)
City dummies	Y	Y
Constant	-2.855	-9.349**
	(2.528)	(2.936)
Observations	540	540
R-squared	0.086	0.086

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Robust standard errors clustered at the city level are in parenthesis: * $p<0.1$, ** $p<0.05$; *** $p<0.01$.

Table 4: Men's tradeoff between women's height and income (online dating data)

MRS	(1)	(2)
Short man	0.424	
	(0.517)	
Med man	-232.825	
	(6196.241)	
Tall man	-13.155	
	(48.701)	
Chi2 test of differences of MRSs		
short = med	chi2(1)=0.00	p=0.970
short = tall	chi2(1)=0.08	p=0.781
med = tall	chi2(1)=0.00	p=0.972

Notes: 160 cm is the average heights for females in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Robust standard errors clustered at city level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 5: Regression of percent of women's visits to male profiles (online dating data)

Male profile	visit percent	
	(1)	(2)
Short woman dummy		-371.707**
		(68.041)
Med woman dummy	371.707**	
	(68.041)	
Tall woman dummy	564.576***	192.869**
	(77.731)	(52.108)
Profile income	0.054*	0.060**
	(0.022)	(0.027)
Profile height	4.684***	0.366**
	(0.736)	(0.174)
Profile height sq	-0.013***	-0.001
	(0.002)	(0.000)
Profile income*short woman dummy		-0.006
		(0.018)
Profile height*short woman dummy		4.318**
		(0.799)
Profile height sq*short woman dummy		-0.013**
		(0.002)
Profile income*med woman dummy	0.006	
	(0.018)	
Profile height*med woman dummy	-4.318**	
	(0.799)	
Profile height sq*med woman dummy	0.013**	
	(0.002)	
Profile income*tall woman dummy	0.028	0.023
	(0.030)	(0.021)
Profile height*tall woman dummy	-6.560***	-2.242**
	(0.917)	(0.600)
Profile height sq*tall woman dummy	0.019***	0.007**
	(0.003)	(0.002)
City dummies	Y	Y
Constant	-406.577***	-34.870
	(61.316)	(15.682)
Observations	540	540
R-squared	0.276	0.276

Notes: 160 cm is the average heights for females in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Robust standard errors clustered at city level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 6: Men's tradeoff between women's height and income (online dating data)

MRS at 166cm men	(1)	(2)
Short woman	3.908**	
	(1.704)	
Med woman	0.887**	
	(0.433)	
Tall woman	-0.360	
	(0.302)	
Chi2 test of differences of MRSs		
short = med	chi2(1)=3.19	p=0.074*
short = tall	chi2(1)=6.67	p=0.010***
med = tall	chi2(1)=5.36	p=0.021**
MRS at 172cm men		
Short woman	0.930***	
	(0.224)	
Med woman	0.699**	
	(0.297)	
Tall woman	0.447**	
	(0.204)	
Chi2 test of differences of MRSs		
short = med	chi2(1)=0.52	p=0.472
short = tall	chi2(1)=3.30	p=0.069*
med = tall	chi2(1)=5.71	p=0.017**
MRSat 178cm men		
Short woman	-2.047	
	(1.673)	
Med woman	0.512***	
	(0.185)	
Tall woman	1.254**	
	(0.558)	
Chi2 test of differences of MRSs		
short = med	chi2(1)=2.49	p=0.114
short = tall	chi2(1)=3.98	p=0.046**
med = tall	chi2(1)=3.73	p=0.053*

Notes: 160 cm is the average heights for females in the four cities of experiment. Other heights are either one standard deviation above or below for their respective sexes. MRS of mate height and mate income for specific height type of woman is the ratio of the percentage change in visits of that height type for a 1 percent change in male height over the percentage change in visits for a 1 percent change in male income for that height type. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 7: Summary statistics of CFPS

Variable	Obs.	Mean	Std. Dev.	Min	Max
Husband					
Age	2147	36.05	5.90	20	45
Height (cm)	2147	170.95	5.27	155	187
Weight (kg)	2147	69.17	10.56	37	100
Annual income (RMB)	2147	26416.26	33054.93	0	600000
Wife					
Age	2147	34.35	6.22	20	45
Height (cm)	2147	159.91	4.61	145	174
Weight (kg)	2147	56.64	8.10	32.5	82.5
Annual income (RMB)	2147	12981.53	19488.41	0	360000

Notes: Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income.

Table 8: Summary statistics of height difference and husband height in CFPS

Height difference (husband-wife)	Obs.	Mean (cm)	Std. Dev.	Min	Max
1 s.d. above/below mean					
Short wife	397	15.4	5.6	0	30
Med wife	1340	11.2	5.3	-5	29
Tall wife	407	6.2	5.0	-8	20
2 s.d. above/below mean					
Very short wife	94	18.0	5.9	5	30
Med wife	2002	10.9	5.7	-8	29
Very tall wife	48	3.6	5.1	-8	13

Husband height	Obs.	Mean (cm)	Std. Dev.	Min	Max
1 s.d. above/below mean					
Short wife	397	168.7	5.3	155	182
Med wife	1340	171.1	5.1	155	187
Tall wife	407	172.7	4.9	160	187
2 s.d. above/below mean					
Very short wife	94	167.6	5.8	155	180
Med wife	2002	171.0	5.2	155	187
Very tall wife	48	174.1	5.3	162	183

Notes: Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income. Short/med/tall wife is a dummy variable which equals to 1 if the height is one standard deviation below/within/above the mean in the upper panel of each table (two standard deviations in the lower panel of each table).

Table 9: Regressions of height difference and husband height on sex ratio

	Height difference (husband-wife)	Husband height
	(1)	(2)
Sex ratio	6.346**	3.763*
	(2.634)	(1.898)
Wife income, age and edu dummies	Y	Y
Husband income, age and edu dummies	Y	Y
Province dummies	Y	Y
Constant	-4.080	155.325***
	(2.848)	(2.021)
Observations	2,051	2,051
R-squared	0.072	0.233

Notes: Data are from CFPS. Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income. Sex ratio is in *log* form, calculated according to woman's age, with a spousal age gap of two years and a five-year age window, based on 2010 Census at province level. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 10: SUR regressions of husband's characteristics on wife's characteristics

	Whole sample	
	Wife's education	Wife's beauty
Husband's log income	1.394***	0.218***
	(0.111)	(0.030)
Husband's height	0.119***	0.014***
	(0.018)	(0.005)
Standard controls	Y	Y
Observations	2,050	
Corr(residuals)	0.185***	
Breusch-Pagan test	chi2(1) = 70.058, Pr = 0.000	
Wald tests:		
Within columns:		
Husband's log income / Husband's height	**11.753*** **	**15.173*** **
	(2.067)	(5.546)
	chi2(1) = 0.38, Pr = 0.538	
Across columns:		
Husband's log income * Husband's height	0.020***	0.026***
	(0.007)	(0.005)
	chi2(1) = 0.51, Pr = 0.473	
Log likelihood	-8529.711	

Notes: Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01. Standard controls: husband's age and province fixed effects.

Table 11: First stage regression: Wife’s height group vs. mother’s age of giving birth

Ordered Probit:	Wife's height group (short, med, tall)
	(1)
Mother's age of giving birth	**0.009***
	(0.005)
Weight at birth	0.145***
(=0 if don’t remember)	(0.045)
Dummy for missing weight at birth	0.788***
	(0.275)
Age	-0.019***
	(0.005)
Province FE	Y
Observations	1,789
Pseudo R2	0.062

Notes: Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 12: Second stage regression for wife: SUR with robust standard errors clustered at province level

	Short wife (<1 s.d.)		**Med wife**		**Tall wife (>1 s.d.)**	
	Wife's edu	Wife's beauty	Wife's edu	Wife's beauty	Wife's edu	Wife's beauty
	(1)	(2)	(3)	(4)	(5)	(6)
Husband's log income	0.932**	0.104**	1.571***	0.133***	1.048***	0.120*
	(0.426)	(0.049)	(0.184)	(0.026)	(0.296)	(0.064)
Husband's height	0.167***	**0.031*** **	0.091***	**0.004**	0.108**	0.014**
	(0.036)	(0.011)	(0.021)	(0.004)	(0.045)	(0.006)
Generalized residual	-2.115	-1.058**	-4.866***	0.374*	-0.613	0.353
	(2.368)	(0.470)	(1.139)	(0.213)	(2.296)	(0.626)
Observations	319		1,071		326	
Corr(residuals)	0.184***		0.199***		0.073	
Breusch-Pagan test	chi2(1) = 10.282, Pr = 0.001		chi2(1) = 41.571, Pr = 0.000		chi2(1) = 1.707, Pr = 0.191	
Wald tests:						
Within columns:						
Husband's income /	**5.585***	**3.382***	**17.198*** **	**32.387**	**9.734** **	**8.575**
Husband's height	(2.928)	(2.053)	(4.464)	(36.823)	(4.500)	(6.114)
	chi2(1) = 0.53, Pr = 0.468		chi2(1) = 0.17, Pr = 0.678		chi2(1) = 0.02, Pr = 0.893	
Across columns:						
Husband's income /	0.029**	0.017	0.006	0.012***	0.015*	0.013
Husband's height	(0.014)	(0.011)	(0.007)	(0.003)	(0.008)	(0.011)
	chi2(1) = 0.56, Pr = 0.453		chi2(1) = 0.49, Pr = 0.483		chi2(1) = 0.02, Pr = 0.892	
Log likelihood	-1234.776		-4063.158		-1224.636	
LR test:						
H0: restricted model is	overall					
nested in unrestricted	**chi2(120) = 153.696****, Pr = 0.021					
	short vs. med		med vs. tall		short vs. tall	
	chi2(60) = 82.435**, Pr =0.029		**chi2(60) =78.343***, Pr =0.056		chi2(60) = 56.383, Pr = 0.609	

Notes: Wife's beauty ratings are corrected with interviewer fixed effects. Controls: husband's and wife's age, province fixed effects. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 13: SUR regressions of husband's characteristics on wife's characteristics

	Whole sample	
	Husband's log income	Husband's height
Wife’s education	0.052***	0.192***
	(0.004)	(0.026)
Wife's height	0.006	0.178***
	(0.004)	(0.024)
Standard controls	Y	Y
Observations	2,051	
Corr(residuals)	0.061***	
Breusch-Pagan test	chi2(1) = 7.521, Pr = 0.006	
Wald tests:		
Within columns:		
Wife's education / Wife's height	**8.917**	**1.078*****
	(5.841)	(0.218)
	chi2(1) = 1.80, Pr = 0.179	
Across columns:		
Wife’s education * Wife's height	0.009***	0.001
	(0.001)	(0.001)
	chi2(1) = 25.00***, Pr = 0.000	
Log likelihood	-8325.392	

Notes: Standard controls: wife's age and province fixed effects. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 14: Logit regressions of woman's marriage probability

	married=1; single=0	
(Medium woman as benchmark)	1 s.d.	2 s.d.
	(1)	(2)
Short woman	-0.081	-0.607
	(0.311)	(0.584)
Tall woman	-0.411**	-0.947***
	(0.173)	(0.269)
Sex ratio	**3.658****	**3.503***
	(1.748)	(1.795)
Sex ratio*short woman	**-8.292****	**-10.382***
	(3.260)	(6.241)
Sex ratio*tall woman	**1.697**	**0.617**
	(1.433)	(2.476)
Log income	-0.091***	-0.091***
	(0.024)	(0.024)
Age, education, and province	Y	Y
Constant	4.201***	4.108***
	(1.236)	(1.269)
Observations	1,686	1,686
Pseudo R2	0.386	0.387

Notes: Data are from CFPS. Sample is restricted to women living in urban areas, aged 22-35. Short/med/tall woman is a dummy variable which equals to 1 if the height is one standard deviations below/within/above the mean in Column (1), and two standard deviations in Column (2). Med women is the omitted benchmark. Sex ratio is in *log* form, calculated according to woman's age, with a spousal age gap of two years and a five-year age window, based on 2010 Census at province level. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

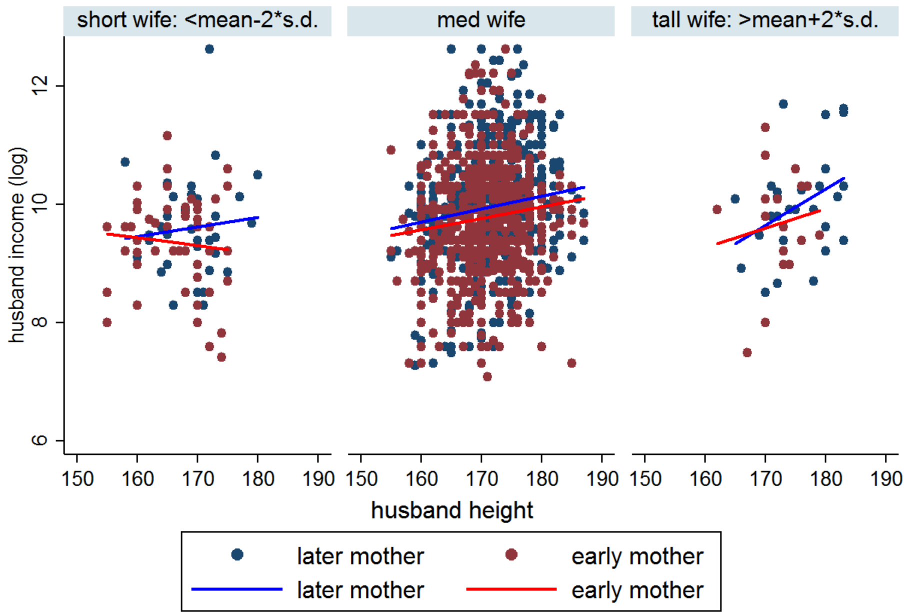

Figure 5: Husband's income and height by wife's height

Notes: Data are from CFPS. Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income. Early mother is defined as those who give birth to their children at or earlier than 24 years old, the mean age of birth.. Late mother is defined as those who give birth to their children later than 24 years old. Short/med/tall wife is a dummy variable which equals to 1 if the height is two standard deviations below/within/above the mean.

Table 15: Regression of husband's income on height by wife's height and age of having children

(Medium wife as benchmark)	Husband income(log)			
	Early mother (<=24 yrs old)		Late mother (>24 yrs old)	
	(1)	(2)	(3)	(4)
Husband height	0.009	0.009	0.014***	0.015***
	(0.007)	(0.007)	(0.005)	(0.005)
Short wife	6.665**	6.379**	0.770	1.266
	(2.675)	(2.496)	(3.368)	(3.688)
Tall wife	-5.527	-6.545	-4.553	-4.942
	(4.736)	(5.343)	(3.374)	(2.963)
Husband height*short wife	**-0.042****	**-0.040****	**-0.006**	**-0.009**
	(0.016)	(0.015)	(0.020)	(0.022)
Husband height*tall wife	**0.031**	**0.037**	**0.026**	**0.028**
	(0.027)	(0.031)	(0.019)	(0.017)
Husband age, edu dummies	Y	Y	Y	Y
Wife age, edu dummies	N	Y	N	Y
Wife income	N	Y	N	Y
Province dummies	Y	Y	Y	Y
Constant	8.475***	8.422***	8.387***	8.289***
	(1.156)	(1.188)	(0.890)	(0.825)
Observations	959	959	1,052	1,052
R-squared	0.308	0.336	0.377	0.395

Notes: Data are from CFPS. Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income. Early mother is defined as those who give birth to their children at or earlier than 24 years old, the mean age of birth.. Late mother is defined as those who give birth to their children later than 24 years old. Short/med/tall wife is a dummy variable which equals to 1 if the height is two standard deviations below/within/above the mean. Med wife is the omitted benchmark. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Table 16: Regression of husband's income on height by wife's height, age of having children, and sex ratio

	Husband income(log)			
	Early mother (<=24 yrs old)		Late mother (>24 yrs old)	
	(1)	(2)	(3)	(4)
Husband height	0.012**	0.012**	0.016***	0.017***
	(0.006)	(0.006)	(0.004)	(0.004)
Short wife	1.608*	1.800**	0.612	0.787
	(0.863)	(0.872)	(1.478)	(1.573)
Tall wife	-5.975**	-5.423*	0.911	0.993
	(2.147)	(2.764)	(1.403)	(1.389)
Sex ratio	22.536***	20.115**	7.592	8.560
	(6.836)	(7.533)	(8.126)	(8.655)
Husband height*sex ratio	**-0.129*** **	**-0.117** **	-0.045	-0.052
	(0.040)	(0.043)	(0.048)	(0.050)
Husband height*sex ratio*short wife	**-0.011** **	**-0.012** **	**-0.005**	**-0.006**
	(0.005)	(0.005)	(0.008)	(0.009)
Husband height*sex ratio*tall wife	**0.033** **	**0.030* **	**-0.005**	**-0.006**
	(0.012)	(0.016)	(0.008)	(0.008)
Husband age, edu dummies	Y	Y	Y	Y
Wife age, edu dummies	N	Y	N	Y
Wife income (log)	N	Y	N	Y
Province dummies	Y	Y	Y	Y
Constant	8.058***	8.091***	7.979***	7.812***
	(0.960)	(1.001)	(0.828)	(0.749)
Observations	959	959	1,052	1,052
R-squared	0.313	0.340	0.377	0.395

Notes: Data are from CFPS. Sample is restricted to married couples living in urban areas, both aged 20-45, and in which the husband has a positive income. Early mother is defined as those who give birth to their children at or earlier than 24 years old, the mean age of birth.. Late mother is defined as those who give birth to their children later than 24 years old. Short/med/tall wife is a dummy variable which equals to 1 if the height is two standard deviations below/within/above the mean. Med wife is the omitted benchmark. Sex ratio is in *log* form, calculated according to wife's age, with a spousal age gap of two years and a five-year age window, based on 2010 Census at province level. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

Appendix

Model setup

We follow the theoretical framework in Chiappori et al. (2012). Starting with a finite population of men and women of size N_m and N_w. Each potential wife can be characterized by a vector $X_j = (X_j^1, X_j^2, \dots, X_j^L)$ of observable characteristics, and some unobservable characteristic ϵ_j, where ϵ is randomly drawn from a continuous and atomless distribution. Let χ denotes the space of female characteristics, where χ_C denotes the space of observable female characteristics, i.e., $(X, \epsilon) \in \chi$ and $X \in \chi_C$. To include single women, define the augmented space $\chi^A = \chi \cup \{\emptyset_X\}$. Similarly, for men we have observable characteristics $Y_i = (Y_i^1, Y_i^2, \dots, Y_i^K)$ and unobservable characteristic η_i. $(Y, \eta) \in \Gamma$ and $Y \in \Gamma_C$; $\Gamma^A = \Gamma \cup \{\emptyset_Y\}$.

The framework does not need to specify any particular matching process. Chiappori et al. (2012) show that their approach can apply to frictionless non-transferable utility (*TU*) and transferable utility (*TU*), as well as search models. Here we simply consider frictionless matching w/t transferable utility (*NTU*).

If Ms. j married to Mr. i, her utility is $W_{ij} = \Psi(Y_i, \eta_i, X_j, \epsilon_j)$, his utility is $M_{ij} = \Phi(Y_i, \eta_i, X_j, \epsilon_j)$. For those who remain single, $W_{0j} = \Psi_0\,(X_j, \epsilon_j)$, $M_{i0} = \Phi_0(Y_i, \eta_i)$. With finite population, there exists at least one stable match (Chiappori and Reny 2016).

Assumption S (Separability): The observable characteristics $Y = (Y^1, Y^2, \dots, Y^K)$ (respectively $X = (X^1, X^2, \dots, X^L)$) matter only through a one-dimensional index $I = I(Y^1, Y^2, \dots, Y^K)$ ($J = J(X^1, X^2, \dots, X^L)$)

In *NTU* setting, it implies the functions Ψ, Φ are weakly separable in $Y = (Y^1, Y^2, \dots, Y^K)$ and $X = (X^1, X^2, \dots, X^L)$, i.e., there exist two indices $I = I(Y^1, Y^2, \dots, Y^K)$ and $J = J(X^1, X^2, \dots, X^L)$ such that

$$\Psi(Y, \eta, X, \epsilon) = \widetilde{\Psi}(I(Y^1, Y^2, \dots, Y^K), \eta, J(X^1, X^2, \dots, X^L), \epsilon)$$

$$\Phi(Y, \eta, X, \epsilon) = \widetilde{\Phi}(I(Y^1, Y^2, \dots, Y^K), \eta, J(X^1, X^2, \dots, X^L), \epsilon)$$

This assumption implies the impact of a spouse's observable characteristics on the couple's welfare is fully summarized by the corresponding index. Such an index requires that everyone has the same “tastes” for spouses. Technically, it means they tradeoff observable characteristics at the same rate. Since we are interested in heterogeneity of preferences, we will test a weaker form of this assumption, we will test whether their MRS for height is constant for each height of women.

Assumption CI (Conditional Independence): Conditional on the index $J = J(X^1, X^2, \dots, X^L)$, the distribution of ϵ is atomless and independent of $(X^1, X^2, \dots, X^L)$. Same for Y and η.

This implies that for two women (same for men) with the same index, they draw the vector of unobservables from the same distribution.

Property of Equilibrium

Assume that Assumptions S and CI are satisfied. Take any two male vectors $Y_i = (Y_i^1, Y_i^2, \dots, Y_i^K)$ and $Y_{i'} = (Y_{i'}^1, Y_{i'}^2, \dots, Y_{i'}^K)$, such that $I(Y_i) = I(Y_{i'})$. For any vector X_j, female j is indifferent about marrying Y_i or $Y_{i'}$.

$$\Psi\left(Y_i, \eta_i, X_j, \epsilon_j\right) = \widetilde{\Psi}(I(Y_i), \eta_i, X_j, \epsilon_j) = \widetilde{\Psi}(I(Y_{i'}), \eta_j', X_j, \epsilon_j)$$

The probability that Y_i is matched with X_j at a stable matching is equal to the probability that $Y_{i'}$ is matched with X_j at a stable matching. This implies the distributions of wives for two men with the same index (Y_i and $Y_{i'}$) are identical. That is, the distribution of male i’s wife only depends on his index $I(Y_i^1, Y_i^2, \dots, Y_i^K)$, thus any of its moments of this distribution also only depend on the index I. Then the expected value of the sth characteristic of the wife, conditional on the vector of characteristics of the husband is

$$E\left[X_j^s \middle| Y_i^1, Y_i^2, \dots, Y_i^K\right] = \phi_s[I(Y_i^1, Y_i^2, \dots, Y_i^K)] \tag{1}$$

Assuming I to be differentiable, the MRS between characteristics r and t for male i can be defined as

$$MRS_i^{r,t} = \frac{\partial I/\partial Y_i^t}{\partial I/\partial Y_i^r}$$

$$\frac{\partial I/\partial Y_i^t}{\partial I/\partial Y_i^r} = \frac{\partial E[X_j^s|Y_i^1,\dots,Y_i^K]/\partial Y_i^t}{\partial E[X_j^s|Y_i^1,\dots,Y_i^K]/\partial Y_i^r} \tag{2}$$

RHS of Eq. (2) can be recovered from data, therefore the MRSs are exactly identified. Eq. (2) also generates a host of overidentifying restrictions, since neither side of Eq. (2) depend on s, the MRS should be constant across s.

Empirical Strategy

Assume I and J are linear, similar to Hitsch et al. (2010a):

$$I(Y_i^1, Y_i^2, \ldots, Y_i^K) = \sum_k f_k Y_i^k$$

$$J(X_j^1, X_j^2, \ldots, X_j^L) = \sum_l g_l X_j^l$$

Since the distribution of any female characteristic conditional on the husband's vector $(Y_i^1, Y_i^2, \ldots, Y_i^K)$ depends only on $I(Y_i^1, Y_i^2, \ldots, Y_i^K)$, for any female characteristic s, from Eq. (2):

$$\frac{\partial E[X_j^s | Y_i^1, \ldots, Y_i^K] / \partial Y_i^t}{\partial E[X_j^s | Y_i^1, \ldots, Y_i^K] / \partial Y_i^r} = \frac{f_t}{f_r}$$

and by the same token,

$$\frac{\partial E[Y_i^s | X_j^1, \ldots, X_j^L] / \partial X_j^t}{\partial E[Y_i^s | X_j^1, \ldots, X_j^L] / \partial X_j^r} = \frac{g_t}{g_r}$$

Moreover, assume that the conditional expectations (ϕ_s and φ_s in (1)) are also linear in the index:

$$\begin{aligned} E\left[X_j^s \middle| Y_i^1, Y_i^2, \ldots, Y_i^K\right] &= \phi_s[I(Y_i^1, Y_i^2, \ldots, Y_i^K)] \\ &= b^s I(Y_i^1, Y_i^2, \ldots, Y_i^K) \\ &= b^s \sum_k f_k Y_i^k \end{aligned}$$

and

$$\begin{aligned} E\left[Y_i^s \middle| X_j^1, X_j^2, \ldots, X_j^L\right] &= \varphi_s\left[J(X_j^1, X_j^2, \ldots, X_j^L)\right] \\ &= a^s J(X_j^1, X_j^2, \ldots, X_j^L) \\ &= a^s \sum_l g_l X_j^l \end{aligned}$$

Then simply regress various characteristics of female j over the characteristics of j's husband i, on the married couple sample. The regression of the lth female attribute on the husband's characteristics is:

$$X_j^l = \sum_k \beta_k^l Y_i^k + \alpha_j^l \qquad (3)$$

where the random term $\alpha_j^l = X_j^l - E\left[X_j^l \middle| Y_i^1, \ldots, Y_i^K\right]$ captures the impact of the unobserved heterogeneity and other shocks. And α_j^l can be correlated across l. The theory predicts that for all values of l, s, r, t:

$$\frac{\beta_r^l}{\beta_t^l} = \frac{\beta_r^s}{\beta_t^s} = \frac{f_t}{f_r} \tag{4}$$

We estimate Eq. (3) simultaneously for all of the wife's characteristics l using seemingly unrelated regressions (SUR) and test for Eq. (4). If we cannot reject the equality of the ratios of coefficients in Eq. (4), we obtain the MRS between husband i's characteristics t and r:

$$MRS_i^{r,t} = \frac{f_t}{f_r}$$

The same strategy can be used for the MRS between the characteristics of the wife.

A-Table 17: Regression of wife income on height by husband's height and age of having children

	Wife income(log)			
	Early father (<=26 yrs old)		Late father (>26 yrs old)	
	(1)	(2)	(3)	(4)
Wife height	0.027***	0.028***	-0.014	-0.014
	(0.007)	(0.008)	(0.010)	(0.009)
Short husband	10.743	9.855	-2.887	0.510
	(8.332)	(7.638)	(6.624)	(5.726)
Tall husband	-6.747	-5.893	-15.435***	-15.287***
	(9.127)	(8.252)	(5.141)	(5.045)
Wife height*short husband	**-0.071**	**-0.065**	**0.014**	**-0.008**
	(0.052)	(0.048)	(0.043)	(0.037)
Wife height*tall husband	**0.040**	**0.035**	**0.096*** **	**0.095*** **
	(0.056)	(0.050)	(0.032)	(0.031)
Wife age, edu dummies	Y	Y	Y	Y
Husband age, edu dummies	N	Y	N	Y
Husband income	N	Y	N	Y
Province dummies	Y	Y	Y	Y
Constant	7.983***	7.175***	13.155***	12.479***
	(0.915)	(1.195)	(1.731)	(1.648)
Observations	883	883	741	741
R-squared	0.362	0.395	0.342	0.394

Notes: Data are from CFPS. Sample is restricted to married couples living in urban areas, both aged 20-45, and in which wife has a positive income. Early father is defined as those who have children at or earlier than 26 years old, the mean age of birth.. Late father is defined as those who have children later than 26 years old. Short/med/tall husband is a dummy variable which equals to 1 if the height is two standard deviations below/within/above the mean. Med husband is the omitted benchmark. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

A-Table 18: Regression of percent of men's visits to female profiles (online dating data)

Female profile	visit percent	
	(1)	(2)
Short man dummy		8.471
		(11.446)
Med man dummy	-7.630	
	(4.652)	
Tall man dummy	-12.539	-6.045
	(6.166)	(4.070)
Profile income	0.046	-0.000
	(0.021)	(0.007)
Profile height	-0.527	-0.479
	(1.061)	(1.033)
Profile height sq	0.002	0.002
	(0.003)	(0.003)
Profile income*short man dummy		-0.145
		(1.061)
Profile height*short man dummy		-0.054
		(0.072)
Profile height sq*short man dummy		0.000
		(0.000)
Profile income*med man dummy	0.064	
	(0.338)	
Profile height*med man dummy	0.049	
	(0.030)	
Profile height sq* med man dummy	-0.000	
	(0.000)	
Profile income*tall man dummy	-0.053	-0.007
	(0.030)	(0.022)
Profile height*tall man dummy	0.073**	0.031
	(0.018)	(0.019)
Profile height sq* tall man dummy	-0.000	-0.000
	(0.000)	(0.000)
City dummies	Y	Y
Constant	40.868	33.855
	(84.537)	(81.285)
Observations	540	540
R-squared	0.086	0.086

Notes: 160 and 172 cm are average heights for females and males on the website and in the four cities of experiment, respectively. Other heights are either one standard deviation above or below for their respective sexes. Robust standard errors clustered at the city level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

A-Table 19: Men's tradeoff between women's height and income (online dating data)

MRS at 165cm women	(1)	(2)
Short men's	0.054	
	(0.708)	
Med men's	0.459	
	(1.302)	
Tall men's	0.839	
	(3.623)	
Chi2 test of differences of MRSs		
short = med	Chi2(1)=0.09	p=0.7617
short = tall	Chi2(1)=0.07	p=0.7880
med = tall	Chi2(1)=0.01	p=0.9123
MRS at 165cm women		
Short men's	0.424	
	(0.519)	
Med men's	0.614	
	(1.820)	
Tall men's	1.015	
	(4.096)	
Chi2 test of differences of MRSs		
short = med	Chi2(1)=0.01	p=0.9076
short = tall	Chi2(1)=0.02	p=0.8842
med = tall	Chi2(1)=0.01	p=0.9240
MRS at 165cm women		
Short men's	0.794	
	(1.235)	
Med men's	0.769	
	(2.377)	
Tall men's	1.191	
	(4.579)	
Chi2 test of differences of MRSs		
short = med	Chi2(1)=0.00	p=0.9906
short = tall	Chi2(1)=0.01	p=0.9393
med = tall	Chi2(1)=0.01	p=0.9322

Notes: 172 cm is the average heights for males in the four cities of experiment. Other heights are either one standard deviation above or below for their respective sexes. MRS of mate height and mate income for specific height type of man is the ratio of the percentage change in visits of that height type for a 1 percent change in female height over the percentage change in visits for a 1 percent change in female income for that height type. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

A-Table 20: First stage regression: Husband's height group vs. mother's age of giving birth

A- Ordered Probit:	Husband's height group (short, med, tall)
	(1)
Mother's age of giving birth	**-0.006**
	(0.005)
Weight at birth	0.172***
(=0 if don't remember)	(0.042)
Dummy for missing weight at birth	1.010***
	(0.274)
Age	-0.027***
	(0.005)
Province FE	Y
Observations	1,988
Pseudo R2	0.089

Notes: Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.

A-Table 21: Second stage regression for husband: SUR with robust standard errors clustered at province level

	Short husband (<1 s.d.)		Med husband		Tall husband (>1 s.d.)	
	husband's log income	husband 's beauty	husband 's log income	husband 's beauty	husband 's log income	husband 's beauty
	(1)	(2)	(3)	(4)	(5)	(6)
Wife's edu	0.119***	0.168***	0173***	0.075***	0.165***	0.149***
	(0.038)	(0.036)	(0.015)	(0.015)	(0.031)	(0.034)
Wife's height	-0.128	0.271	0.815*	-0.062	0.974	-0.956
	(1.019)	(0.961)	(0.453)	(0.448)	(0.927)	(1.015)
Generalized residual	-1.081***	-0.619	-0.483**	-0.358*	-0.210	-0.218
	(0.435)	(0.410)	(0.0.193)	(0.191)	(0.302)	(0.330)
Observations	302		1333		265	
Corr(residuals)	0.294***		0.122***		0.058	
Breusch-Pagan test	chi2(1) = 26.125, Pr = 0.000		chi2(1) = 19.889, Pr = 0.000		chi2(1) = 0.905, Pr = 0.3415	
Wald tests:						
Within columns:						
Wife's income /	-0.930	0.622	0.212*	-1.215	0.169	-0.156
Wife's height	(7.377)	(2.239)	(0.121)	(8.805)	(0.167)	(0.166)
	chi2(1) = 0.05, Pr = 0.826		chi2(1) = 0.03, Pr = 0.871		chi2(1) = 2.02, Pr = 0.156	
Across columns:						
Wife's income /	0.032	-0.022	-0.011	-0.061*	-0.157	0.145
Wife's height	(0.114)	(0.172)	(0.077)	(0.036)	(0.170)	(0.142)
	chi2(1) = 0.09, Pr = 0.763		chi2(1) = 0.76, Pr = 0.3831		chi2(1) = 1.96, Pr = 0.161	
Log likelihood	-636.585		-2814.2629		-517.301	
LR test:						
H0: restricted model is	overall					
nested in unrestricted	chi2(120) = 1005.880***, Pr = 0.000					
	short vs. med		med vs. tall		short vs. tall	
	chi2(60) = 92.765***, Pr =0.004		chi2(60) =58.544, Pr =0.529		chi2(60) = 88.836***, Pr = 0.009	

Notes: Husband’s beauty ratings are corrected with interviewer fixed effects. Controls: husband's and wife’s age, province fixed effects. Robust standard errors clustered at province level are in parenthesis: * p<0.1, ** p<0.05; *** p<0.01.