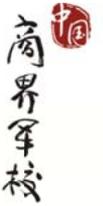


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Income attraction: An online dating field experiment

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Income attraction: An online dating field experiment^{*}

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We measured gender differences in preferences for mate income ex-ante to interaction (“income attraction”) in a field experiment on one of China’s largest online dating websites. To rule out unobserved factors correlated with income as the basis of attraction, we randomly assigned income levels to 360 artificial profiles and recorded the incomes of nearly 4,000 “visits” to full versions of these profiles from search engine results, which displayed abbreviated versions. We found that men of all income levels visited our female profiles of different income levels at roughly equal rates. In contrast, women of all income levels visited our male profiles with higher incomes at higher rates. Surprisingly, these higher rates increased with the women’s own incomes and even jumped discontinuously when the male profiles’ incomes went above that of the women’s own. Our male profiles with the highest level of income received 10 times more visits than the lowest. This gender difference in ex-ante preferences for mate income could help explain marriage and spousal income patterns found in prior empirical studies.

Keywords: online dating, field experiment, gender differences, matching, marriage

JEL Codes: C93, J01, J12

Introduction

Prior studies have found a robust negative correlation between rates of marriage and relative incomes between the genders in the US. Women made about 60 percent of men’s salaries in the 1960s. This increased to about 70 percent in 2003 (Blau and Kahn, 2007).

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At the same time, the rate of ever-married women aged 20-24 fell from 64 percent in 1970 to 34 percent in 1994 (Blau et al., 2000). A similar trend was found for women in their 30s and 40s. The pattern extends up to 2004 (Popenoe, 2005). In contrast, women's relative wages have been decreasing in China (Gustafsson and Li, 2000; Mu and Xie, 2011). Female pay as a percent of male fell from 85 percent in 1985 to 63 percent in 2005 (Mu and Xie, 2011). Little noted is the fact that at the same time, marriage rates increased 56 percent from 1978 (6.2 per thousand) to 2011 (9.7 per thousand, China's Civil Affairs Statistical Yearbook, 2012³), despite the increasing scarcity of women in China (Ebenstein, 2010).

Such correlated changes in marriage rates and relative incomes are consistent with Becker's (1973) theory of the family. He posits that the surplus from marriage is maximized by one partner (traditionally men) specializing in market production, while the other specialized in home production. In his theory, better labor market opportunities for women lower their gains from marriage and raise their opportunity costs--the opposite for men. However, due to institutional change and endogeneity issues, not to mention a myriad of unobserved factors which may influence a match, identification of the cause of the correlation between spousal incomes and marriage patterns has remained controversial. See for example, Schwartz (2010), for a review of the vast literature.

More recently, researchers have attempted to demonstrate an "identity preference" (Akerlof and Kranton, 2000) basis for the pattern of correlation between rates of marriage and spousal incomes. In this theory, people have an inherent cost for deviating from what social norms might dictate should be their roles, for example, that men provide the main financial support for their families. To test this, Fisman et al. (2006) conducted a speed dating study in which couples spoke for 4-min, then rated each other and indicated whether they wanted further contact. They found that the men's decisions to share contact information with the women were increasing on the women's intelligence (from theirs and the women's self-reports and SAT scores) and ambition (from theirs and the

³ <http://tongji.cnki.net/kns55/Dig/dig.aspx>. The marriage rate = number of marriages per thousand people = number of marriages/(population at the beginning of that year + population at the end of that year)/2*1000%.

women's self-reports), until they reached their own level. In contrast, women's ratings were always increasing on the men's intelligence and ambition.

Supporting the evidence for identity preferences contributing to marriage and spousal income patterns, Bertrand et al. (2013) found with US data that marriages were less likely to form between a man and a woman who has higher potential earnings than he does. Indeed, they found a discontinuous drop in marriage rates as the wife's income approaches that of the husband's, as if couples were trying to avoid the situation where the husband was not the breadwinner. They also found lower reported happiness, greater strife, and greater likelihood of divorce for couples where the wife earned more. They argue that a substantial portion of the decrease in the rate of marriage in the US since 1970 can be explained by this aversion in the context of rising female wages. Their analysis makes a strong case for couples' preferences driving results. However, they refrain from attempting to identify the source or the relative strength of the preference within the couples.

Prior studies with marriage and speed dating data are of outcomes, ex-post to interactions. Preferences would be very difficult to identify, even in the case of 4 min dates. Beyond the usual problem of ruling out other fixed characteristics like height, health, and beauty in the study of the effect of income on mate preferences, face-to-face interactions may also involve variable characteristics or "chemistry" that only show themselves with certain people in certain contexts. For example, if a woman always prefers men who are more intelligent and ambitious, one would expect that she would be more delighted (i.e., more "turned on") in the company of men with more of those qualities. Her pupils may dilate (Tombs and Silverman, 2004). Her voice may soften or increase in pitch (Fraccaro et al., 2011). That may increase her attractiveness (Feinberg et al., 2008). Her hormonal reactions (López et al., 2009) may build upon his (Roney et al., 2007; van der Meij et al., 2010) and vis versa, and the feedback may lead to other changes to the quality of their meeting, which are palpable to them, but not necessarily measurable yet to social scientists. (See van Anders and Gray (2007) for an academic and Young and Alexander (2012) for a popular survey of this nascent literature.) In other words, women's preferences could become the basis of men's choices, which would

create both a simultaneity and an omitted variable problem in the identification of men's preferences from men's choices.

Endogeneity is even more of a problem for the identification of preferences using marriage data. Less ambitious women or women who anticipate a drop in labor market participation may invest more in being “charming” to men than in earning higher incomes themselves. Contrariwise, women on higher income paths can afford to be more blasé while dating and less obliging when married, especially if they make more than their husbands. Their incomes could make their marriages less likely and less stable.

We extend this literature by identifying gender differences in preferences for mate income *ex-ante* to any interactions in a field experiment on one of China's largest online dating websites. We randomly assigned income and other attributes to artificial profiles and counted “visits⁴” to those profiles from search engine results to measure income based attraction.

Visits are a credible measure of mate preferences, since they are necessary for any interactions. Though visits without other active follow-up, e.g., an email, need not involve the threat of rejection, since *ex-ante* preferences do not imply *ex-post* preferences, and therefore, an offer to be rejected -- they are not free. They involve time and therefore opportunity costs. Thus, we expect people to make calculated tradeoffs between profiles to visit. Because visits are *ex-ante* to any interactions, they can only be based upon the information we reveal in the search engine results. Random assignment on these observables can then rule out unobserved factors confounded with income as causes. Simultaneity and omitted variable cease to be issues in our design.

We found that men of all income levels visited our female profiles of all income levels about equally. In contrast, we found that women of all income levels visited our higher income male profiles more. This is consistent with Becker's theory and many prior results. Surprisingly, however, the rate of women's visits to higher income male profiles were *increasing* on their own incomes, even jumping as the profiles' income approached their own. Thus, not only do women prefer higher income men, they specifically prefer

⁴ Hitsch, Hortaçsu and Ariely (2010b) use “browse” for what we call visits.

men who have higher incomes than themselves. The combined effect resulted in men with the highest levels of income getting 10 times more visits than men with the lowest.

This gender difference in the preference for mate income could provide a preference basis for a number of outcomes reported in the empirical literature on marriage. Since these possible implications are motivations rather than results, we reserve them for the end of the paper. Our field experiment is in the tradition of numerous labor market audit studies of racial and gender discrimination using artificial resumes beginning in the economics literature with Bertrand and Mullainathan (2004). To our knowledge, this is the first audit study of gender differences in preferences for mate income.

Experimental Design

We constructed baseline profiles from 360 (180 per gender) nicknames, pictures, and free-text statements we collected from inactive real profiles from another website⁵. We assigned the men in these baseline profiles the age of 27 and a height of 175 cm (5 ft 9 in), 4 cm (1.5 in) higher than the national average⁶, to make them more attractive. We assigned the women in our profiles the age of 25 with a height of 163 cm (5 ft 4 in), again 4 cm above the national average. All birthdays were randomly assigned to within 8 days of each other and shared the same zodiac sign. To possibly enhance the attractiveness of our profiles to potential visitors of all education levels, we made both genders college educated since that was the most intermediate level of education among the six listed on the website, which ranged from high school to Ph.D. We also made them single with no children. They both would prefer to “buy a house after marriage”, i.e., did not currently

⁵ To minimize any possible imposition, we used only profiles which this other website was about to automatically hide due to user inactivity.

We are not aware of legal restrictions on the use of user created content uploaded to social media websites in China. We assumed that such restrictions, if they exist, were weaker than the US. Consistent with a lack of legal restriction, Facebook explicitly states that users relinquish their copyright of self-made content to Facebook for the time of their posting. We infer that this content becomes public domain since Facebook then distributes this content freely to other users.

The Chinese website in which we did the field experiment has a similar statement to Facebook, though the website from which we borrowed materials to construct the profiles has no such statement. We assumed that their policy is no more restrictive than Facebook's.

Chinese 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\(i\)](http://www.virginia.edu/vpr/irb/sbs/resources_regulations_subparta.46.101.html#46.102(i))

⁶ National Physique Monitoring Bulletin, http://www.gov.cn/test/2012-04/19/content_2117320.htm

own a home. We made block random assignments (where we fixed the proportions of the randomization) of nicknames, pictures, statements⁷, cities⁸ (Beijing, Shanghai, Chengdu, Harbin, and Shenzhen), and six incomes: 2001-3000, 3001-5000, 5001-8000, 8001-10000, 10001-20000, 20001-50000 CNY. At the time of the experiment, 1 USD was about 6 CNY.

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, and they could click a link and visit the full profile. We could see our visitors' full profiles by clicking their links in the history of visitors, which makes a permanent record of visits without distinguishing among the visits. The website offers a number of ways to rank the profiles of other users in its search engine, including: registration time, login time, age, number of photos, "credibility"⁹ of the profile, and income. The website also highlights randomly chosen (so far as we can tell) new profiles. Since all of our profiles had statistically identical characteristics, there should have been no systematic effects from the use of different ranking criteria, although being featured may increase the variance of visits among our profiles. We omit details about registration that are standard to social network websites or not relevant to our hypotheses.

We created 30 profiles (of the same gender) the day before to allow the website time to register them. Each day had 5 profiles from each of the 6 income levels. We logged in these 30 profiles in a random order, with 5 min between each, to leave at least one page between each of our profiles, for 6 days during the time period of March 16 to April 1, 2013 for men, and 6 days during the time period of May 6 to May 15, 2013 for women. Each account was open for only 24h.

⁷ We were prepared to carefully eliminate any possible inconsistencies between statements and other parts of the reconstructed profiles, though we did not find any.

⁸ We collected profiles from all across China and randomly assigned these to five different cities. This, combined with the fact that we posted our artificial profiles on an alternate dating website, and then, only for 24 hrs, should minimize the risk of that the pictures of the people we borrowed might be recognized with different birthdays, nicknames or other characteristics by their friends or colleagues.

⁹ The credibility of the profile is indicated by a positive score. There are many ways to increase this score: phone verification of the registered phone number earns 2 points, the use of the Chinese national ID to register earns 4 points, each uploaded photo earns 1 point, email verification earns 1 point up to 2 points, video verification earns 2 points, a paid membership earns 10 points, etc. Users without a paid membership can browse profiles, while users with a paid membership can, among other things, send first-contact emails to each other. All our profiles just have phone verification and one photo. Thus, our credibility score was 3. But, that would not affect visits, because the score does not appear in search results. To affect visits, users would have to search specifically for low credibility profiles.

Data Results

The graphs of visits by men to female profiles are summarized in Figure 1 below. The horizontal axis shows the incomes of our female profiles. The vertical axis shows average daily visits. We separated the visits by men to our female profiles by the men's incomes. The number in brackets in the legend is the average number of visits per day: total number of visits for an income level, e.g., ≤ 5 (1000 CNY) was 1296 divided by 6 days, which is equal to 216. We counted every fifth of the 9981 visits by men to our female profiles. We counted all 1820 visits by women to our male profiles¹⁰. The fivefold greater number of visits by men could have been due to each man possibly clicking more profiles. The men who visited our female profiles tend to also belong to a larger range of ages than the women who visited our male profiles. All of these possibilities could stem from the shortage of women in China.

The median income of 22 year old males and females and 25 year old females on this website was 2-3 (1000 CNY) per month. The median income of 25 year old males and 27 and 30 year old males and females was 3-5 (1000 CNY) per month. See Appendix B for the distributions of incomes by age groups and genders. As the graphs show, the visits of low income men dwarf that of other income levels. Although not every visit is necessarily from a unique visitor, random assignment of characteristics ensures that we would not get a significant effect from our income treatments due to the idiosyncratic characteristics of individual visitors. Figure 5 in Appendix A has a more detailed breakdown by income of the male visits in Figure 1.

¹⁰ This website does not allow users to report a same-sex preference, though users can view anyone else's profile. A number of visitors did include pictures with their profiles. We can infer the gender of visitors to our male profiles from a feature that was enabled at that time. We recorded no same-sex visits for them. However, this feature was turned off by the website later, when we did the female profile treatments. We presume but cannot rule out same-sex visits from women. Homosexual visitors to our profiles seem unlikely due to the combination of the stigma of homosexual relationships, the low awareness of them among the general population, plus the availability in China of smart phone apps like Jack'd which are exclusively dedicated to homosexual dating.

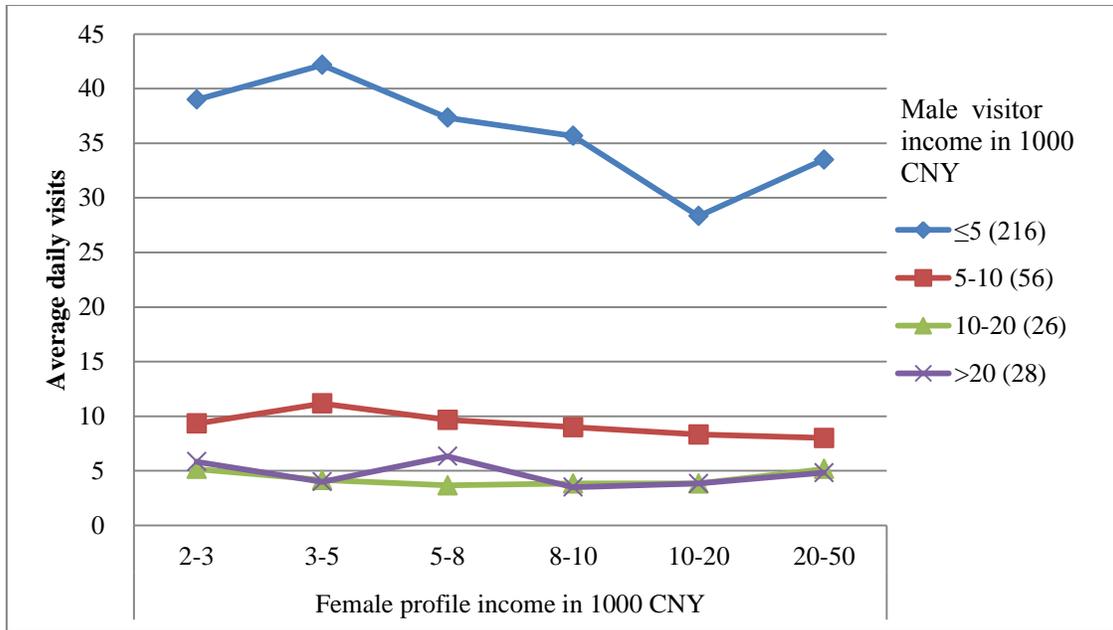


Figure 1: Average daily male visits per income (in 1000 CNY) level vs. income of female profiles

Notes: Numbers in brackets are the totals of the averages of daily visits per income level of visitor.

We next normalize the graphs by dividing each average daily visit by all of the visits at each of the income levels of the visitors so that we might see the probability of visits from each income level of the visitors for each income level of the visited. For example, Figure 1 shows that men whose income was below 5,000 CNY made on average 39 visits to women with incomes between 2001 and 3000 CNY. This becomes $(39 \times 6) / 1296 = 18$ percent in Figure 2. These lines appear flat except for males whose incomes are below 5000 CNY, which show an increasing trend from 2001-3000 CNY to 3001-5000 CNY, then a decreasing trend to 10001-20000 CNY and then slightly increasing. We checked with linear and linear with quadratic terms regressions for low (≤ 5000 CNY) and medium income (5001-10000 CNY) male's visits as benchmarks for Figure 1, and for low (≤ 1000 CNY) and medium income (5001-8000 CNY) as benchmarks for Figure 5, which has a more detailed breakdown by income. None of the slopes are significantly different from zero. Figure 5 also shows that what appears to be a nonlinear trend in the ≤ 5 (1000 CNY) income level in Figure 1 is actually the average of two opposing trends in visits for the 2-3 and the 3-5 (1000 CNY) income levels.

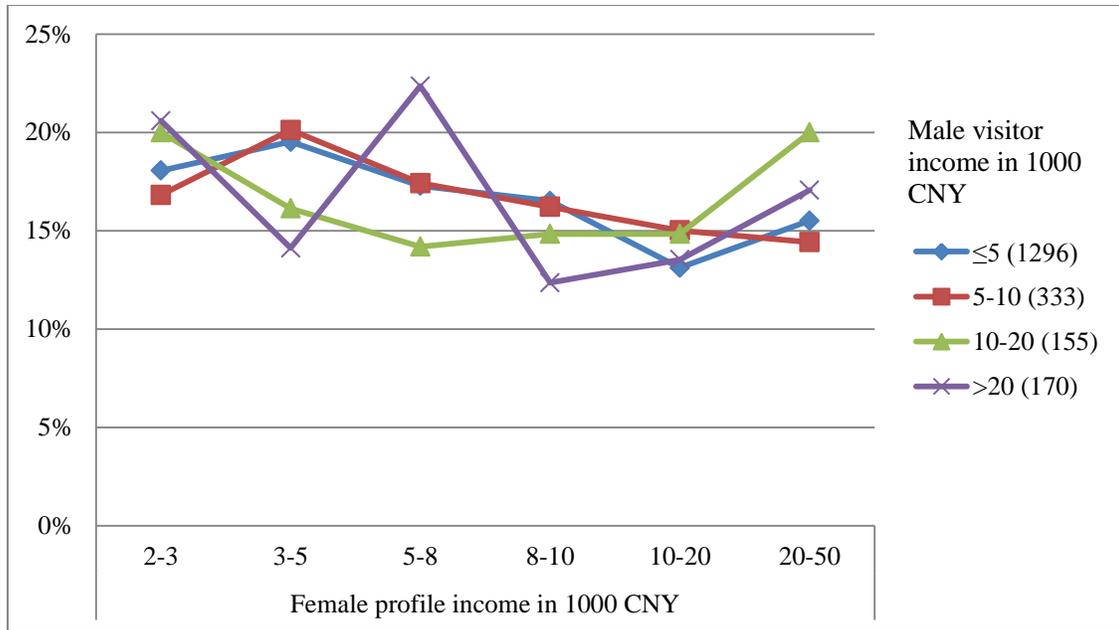


Figure 2: Percent of male visits per income level vs. income of female profiles.

Notes: Numbers in brackets are total visits per income level of visitor.

In contrast, Figure 3 shows a strong increasing trend for visits by women to male profiles with higher incomes. The average daily visits to male profiles with the highest income levels ($70+26+7=103$) was about 10 times higher than that of the lowest income male profiles (about 10). Figure 6 in Appendix A has a more detailed breakdown by income than Figure 3. The only discernable change in behavior these details reveal is among women with incomes of 2-3 (1000 CNY), the slope of whose visits fluctuated above trend at the male profiles' income level of 5-8 (1000 CNY).

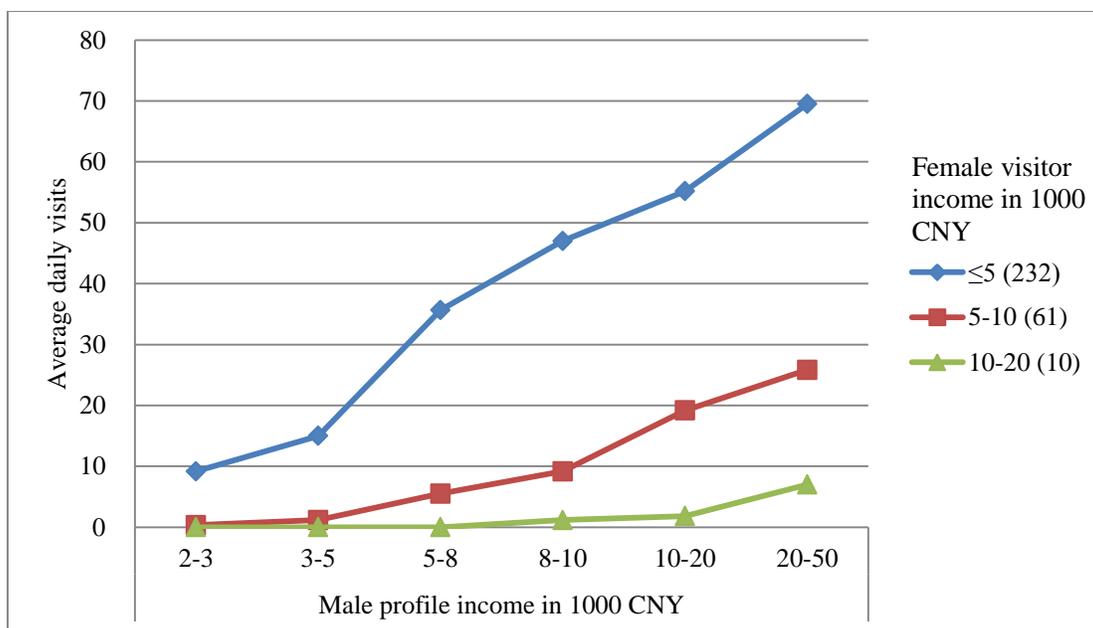


Figure 3: Average daily female visits per income level vs. income of male profiles.

Notes: Numbers in brackets are the totals of the averages of daily visits per income level of visitor.

The pattern in Figure 3 is even more striking in the normalized graph in Figure 4, where all of the lines share the same percent scale. It is then evident both from the decreasing intercepts and the rotation of the slopes that women of all income levels visited men with higher incomes at higher rates. The graph indicates that these higher rates increased with the women's own reported incomes. We found an almost identical pattern when we conditioned on the women's education. We fully control for education in the regression results in Table 1 below.

There is also some evidence that these visits increased as the men's incomes exceeded that of the women's own, indicating that women have reference dependent preferences for mate income. For the women who reported less than 5000 CNY, there is a slight kink at 3-5 (1000 CNY). For women who reported incomes of 5-10 (1000 CNY), the same kink is at 8-10 (1000 CNY). For women who reported incomes of 10-20 (1000 CNY), that kink is at 10-20 (1000 CNY). We formally test for discontinuous jumps in regressions (3) and (4) in the Table 1 below.

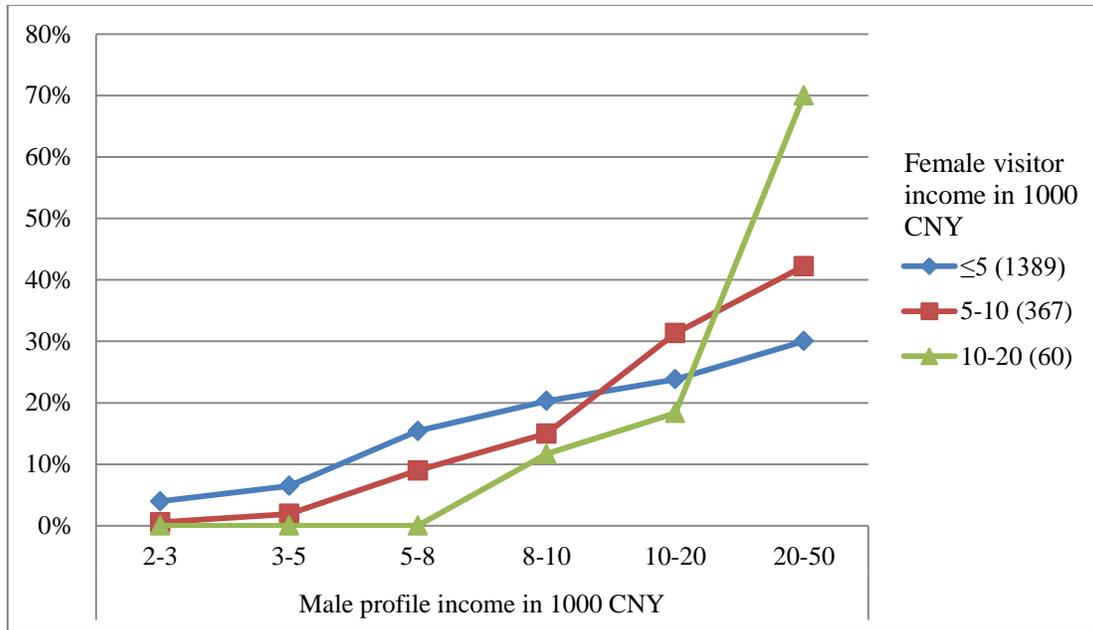


Figure 4: Percent of female visit per income level vs. income of male profiles

Notes: Numbers in brackets are total visits per income level of visitor.

We now test formally for a rotation. First, we explain our data. Each of our 180 male profiles is at one of the six income levels 2-3, 3-5, 5-8, 8-10, 20-50 (1000 CNY) and can have female visits from 3 aggregate income levels: ≤ 5 , 5-10, and 10-20 (1000 CNY). Thus, a data point among our $180 \cdot 3 = 540$ data points is quadruple (number of female visits at each of 3 income levels: ≤ 5 , 5-10, 10-20 (all in 1000 CNY); a male profile at an income level).

Note that 540 is not the same number as our count of visits for either gender. A visit is to a particular profile among our 180 male profiles, each of which has 1 of 6 income levels. The visitor herself is from 1 of 9 income levels, which we have aggregated into 3 levels for the main part of the analysis. 540 is perhaps better thought of as potential states which could be realized by a visit.

We then normalized the number of visits to a profile at each income level of the visitors by dividing by the total number of visits at that income level, for all of our male profiles that had women visitors at that income level. More formally, the percent of visits to profile $i = 1, 2, \dots, 30$ at income levels $w = 2.5$ (for incomes ≤ 5), 4 (for incomes 3-5), 6.5 (for incomes 5-8), 9 (for incomes 8-10), 15 (for incomes 10-20), 35 (for incomes 20-

50) from visitors of income levels $w' = 1$ (for incomes ≤ 5), 2 (for incomes 5-10), 3 (for incomes 10-20) all in 1000 CNY. Visitor income level numbers 1, 2, 3 are only for reference. These income levels will enter only as dummy variables in the regressions.

$$\text{percent of visits}_{i,w}^{w'} = \frac{N_{i,w}^{w'}}{\sum_{w \in \{2,5,\dots,35\}} \sum_{i=1}^{30} N_{i,w}^{w'}}$$

Table 1 shows the results of the regression of the percent of female visits at the three income levels in the graphs as a function of the incomes of male profiles.

$$\begin{aligned} \text{percent of visits}_{i,w}^{w'} &= \alpha_1 + \alpha_2 \cdot (w' = 1 \text{ dummy}) \\ &+ \alpha_3 \cdot (w' = 3 \text{ dummy}) + \beta_1 \cdot w_i \\ &+ \beta_2 \cdot (w' = 1 \text{ dummy}) \cdot w_i \\ &+ \beta_3 \cdot (w' = 3 \text{ dummy}) \cdot w_i + \varepsilon_{i,w}^{w'} \end{aligned}$$

The coefficients are small because an observation is the percent of visits at each female income level per each of the 180 male profiles. We used the middle income women visits (5-10 in 1000 CNY) as the baseline for the dummy variable regression (1) in Table 1. This allows us to test for the significance of the rotation in the slopes (a negative β_2 and a positive β_3) of the trend lines in Figure 4. The regression shows that the rotation is significant at less than the 5 percent level. We get a similar level of significance with the baseline income for women of less than 5,000 CNY. (This result is available on request.)

Relating the regression back to the graphs, Figure 4 shows the percent of visits from a female income level to a given level of income of male profiles summed over 30 male profiles. For example, 9 percent of visits by females who made between 5-10 (1000 CNY) per month were to males with incomes of 5-8 (1000 CNY) per month, which is 30 times the constant plus the coefficient of β_1 times the average income ($0.036\% + 0.043\% \times 6.5$, where $6.5 = \frac{(5+8)}{2}$) or about 9.5 percent.

In regression (2), we included the visitors' level of education (high school, vocational school, associate, college, masters, or Ph.D.) by representing it with a number from 1 (for the lowest) to 6 (for the highest). This is simpler than using years of education, which could be similar across different levels of education. Using actual years decreases the level of significance of most of the p-values by about 1 percent. Since there are 6 levels

of education, there are now $6 \times 540 = 3240$ data points/states. This number is greater than the visits we counted for either gender, so most of these data points will be zeros. That is why the coefficients in regressions (2) and (4) are so much smaller than regressions (1) and (3).

If women's preferences for men's incomes are increasing on the women's own incomes, then the slope of their rate of visits should also increase discontinuously as the men's incomes exceed their own incomes. We tested for the possibility of a discontinuous increase in the rate of visits. We assigned a dummy variable the value of 1 for each data point that was above the hypothesized jump and 0 otherwise. See the coefficients of "(Dummy for jump at female visitors' own income) \times (Male profiles' incomes)" in regression (3). The coefficient for the jump is significant at less than the 10 percent level, though the male profiles' incomes now become insignificant. This implies that women's visits to male profiles that are below their own incomes could be roughly constant while increasing only for those that are above their own.

Table 1: Regression of percent of female visits on male income

	Percent of visits per profile			
	(1)	(2)	(3)	(4)
Female visitors' incomes \leq 5 dummy	0.232* (0.134)	0.039* (0.021)	0.163 (0.138)	0.027 (0.022)
Female visitors' incomes = 10-20 dummy	-0.372*** (0.134)	-0.062*** (0.021)	-0.283** (0.141)	-0.047** (0.022)
Male profiles' incomes	0.043*** (0.006)	0.002 (0.001)	0.016 (0.015)	-0.002 (0.003)
(Male profiles' incomes) \times (Female visitors' incomes \leq 5 dummy)	-0.019** (0.008)	-0.003** (0.001)	-0.017** (0.008)	-0.003** (0.001)
(Male profiles' income) \times (Female visitors' incomes = 10-20 dummy)	0.031*** (0.008)	0.005*** (0.001)	0.032*** (0.008)	0.005*** (0.001)
Dummy for female visitors' education		-0.009* (0.005)		-0.009* (0.005)
(Dummy for female visitors' education) \times (Male profiles' incomes)		0.001*** (0.000)		0.001*** (0.000)
(Dummy for jump at female visitors' own income) \times (Male profiles' incomes)			0.024* (0.012)	0.004** (0.002)
Constant	0.036 (0.095)	0.037 (0.023)	0.124 (0.105)	0.052** (0.024)
Observations	540	3240	540	3240
R ²	0.3069	0.0848	0.3119	0.0860
F-test <i>p</i> -value	47.29***	42.77***	40.26***	38.02***

Notes: Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Model (1) shows the coefficients of the percent of female visits using the baseline income 5-10 (1000 CNY). Thus, the 0.036 constant term with 0.043 coefficient for male profiles' income denotes that $[0.036 + 0.043 \cdot (\frac{2+3}{2})]$ of our 367 visits from females with incomes between 5-10 (1000 CNY) incomes visited one of our 30 male profiles with 2-3 (1000 CNY) income, and that the percent of visits increased 0.043 percent for every 1000 CNY increase in income. Model (2) includes the female visitors' education and interaction

with the profile's income. Model (3) includes a test for a discontinuous change in percent of visits when the male profiles' incomes exceed that of the female visitors'. Model (4) includes both the test of the effect of education and for a possibly discontinuous change.

One interesting quantitative result to take away from Table 1 is the change in coefficients as a function of income. For example, in regression (1), the coefficient of male profiles' income is 0.043 for female visitors with incomes 5-10 (1000 CNY); for female visitors with income 10-20 (1000 CNY), the coefficient of male profiles' income is $0.043+0.031$. The effect is even larger in regressions (2), (3) and (4)¹¹. This implies that for higher income male profiles, the rate of increase in the percent of female visits almost doubles as female visitors' income doubles.

The rotation result is robust to disaggregation from three into more detailed levels of incomes shown in Figure 8 in Appendix A. The negative coefficients of incomes below our baselines become insignificant. This could be due to a decrease in power from a decrease in data for each level of female visitors' incomes or from the more continuous changes in slopes between finer gradations of female visitors' incomes. However, the positive change in coefficients for female visitors with incomes higher than the baseline remains significant at less than the 5 percent level for incomes above 3-5 (1000 CNY). We get a weakening of significance when we use 5-8 (1000 CNY) as the baseline, but an increase in significance when the visitors' incomes are far enough below. We also tried including quadratic terms in these regressions to control for possible nonlinearities. However, none of their coefficients were significant. Since these findings are not essential to our results, we do not include them here, but will make them available on request.

Inferring the income preferences of women

We have shown that for women of all income levels, (i) their levels of visits were increasing on the incomes of male profiles (ii) their rates of increase were increasing on the women's own income levels (iii) their visits jumped upward within each of the women's income levels, as the male profiles' incomes increased above that of their own.

¹¹ Regressions (2) and (4) must be multiplied by $\frac{3240}{540} = 6$ to adjust for the larger number of possible data points/states in these regressions.

We can now show under plausible conditions that points (i)-(iii) imply that women preferred higher income men and this preference was increasing on their own incomes with the following simple model¹².

Suppose that for men of each type $i \in \{L, M, H\}$ ¹³, where L , M and H stand, respectively, for low, medium and high incomes, there is a vector of probabilities (p_{iL}, p_{iM}, p_{iH}) such that a man of type i accepts a match with a woman of type $j \in \{L, M, H\}$ with probability p_{ij} . Let v_{ij} be the value of a type j woman in matching with a type i man. We assume that the cost of visiting c is constant. A woman of type j would only visit a male profile of type i' more than i if her expected value $U_{ij} = v_{ij} \cdot p_{ij} - c$ of visiting i' profile was higher than visiting i

$$v_{i'j} \cdot p_{i'j} - c \geq v_{ij} \cdot p_{ij} - c$$

If as in point (i), all types of women visit higher income men more than lower income men, then we can infer that women derive greater utility from dating higher income men, if the probability of getting a date with a higher income man is lower (or what is the same, require a higher cost to maintain the same probability)

$$p_{i'j} \leq p_{ij}$$

This seems likely, if for no other reason than that higher income men are rarer. See Appendix B for the distribution of incomes for this website. Point (iii) further supports the surmise that women of all income levels prefer higher income men. Admittedly, our finding that the rates of women's visits are increasing on the women's own incomes noted in point (ii) can be explained by higher income women believing that it will be easier for them to get a date with higher income men than lower income women. However, indifference to women's incomes seems the most likely explanation for men's behavior given that their rates are insignificantly different from constant across all income levels of women for all of their own income levels.

¹² This model is a simplified version of a standard search model applied to dating and marriage markets. See Hitsch et al. (2010b) for a discussion.

¹³ Profiles in fact have six levels of incomes in our experiment.

Discussion

Others have found that women's interest in men is increasing on the men's incomes. We note a few recent studies in the developing world. Banerjee et al. (2013) is an empirical study which found that responders to personal advertisements for mates in Indian newspapers preferred candidates with higher incomes. Dugar et al. (2012) randomly assigned incomes and castes to advertisements for potential grooms. They found that female responders to these advertisements (or their families) were willing to trade off between caste and income. Lee (2009) found with data from a Korean online dating website which actually tracks dates and marriages that both men and women preferred potential mates with higher incomes, based upon a sequence of dates and eventual marriages, when these occurred. Our contribution with respect to these studies is to identify gender differences in ex-ante preferences for mate income in China.

Hitsch et al.'s (2010b) empirical study of mate preferences is probably closest to our study. They looked at empirical data on first contact emails, which required payments of membership fees. These were about 1/10 of all browses ("visits" here). They controlled for the confounding effect of physical attractiveness of the online profiles on the measured effect of user reported income by surveying 100 Chicago Business School students for the attractiveness of the profile pictures. They found that men as well as women preferred higher income mates. However, women's preferences for higher income men were stronger. Although Hitsch et al. (2010b) found that income preferences largely depend on the absolute and not the relative level of a mate's income among American women, they noted a small but statistically significant relative income effect. Women were less likely to send first contact emails to men whose incomes were more than \$25,000 lower than their own incomes. They also found that although women stated no same-race preference in their online dating profiles, they exhibited such a preference in their choices.

Due to the fact that they could not randomly assign incomes, their results depend crucially upon the representativeness of Chicago Business School (CBS) students' ratings of the attractiveness for the population of online daters. But, it is possible and perhaps even likely that CBS students are more international, less white, and more intelligent than the population of the daters. To see how this might change their results, suppose that

everyone's appearance is weakly increasing on their income, e.g., everyone looks better with better quality clothes. However, this effect could be weaker for those more accustomed to higher income peers. We observed that many women post professional photos of themselves in non-casual wear on these dating websites. While that may improve their appearance to everyone, it may not do so equally. Someone who looks well-groomed to a lower-middle class person may look "pretentious" or "gussied-up" to someone of a more elite background, especially if the elite counter-signal (Feltovich et al., 2002) by dressing-down when in a non-professional setting. That would create a *relatively* negative effect (say, increasing with the square root of income) with respect to the online dating subjects (as opposed to linearly with income) for the positive effect of income. This relatively negative effect of a biased rating of physical attractiveness could lead to a significant positive coefficient for an income regressor.

Our contribution with respect to their result is to confirm the gender differences in preferences for absolute and relative mate income in China by ruling out these and other possible confounds from unobserved heterogeneity through randomization. We furthermore showed that this preference exhibits a deep consistency in the form of a discontinuous increase in women's visits for male profiles with higher incomes than themselves.

Our evidence that women prefer higher income men provides a preference basis for the finding that married men have higher income than unmarried men, and not because of the greater specialization that marriage might afford (Hersch and Stratton, 2000). In fact, these men were on a higher income path than single men even before marriage (Mincy et al., 2009).

One way of explaining this income attraction on the part of women is if they anticipate lower labor market participation after marriage, for example, because of pregnancy (Angrist and Evans, 1998; Lundberg and Rose, 2000; Waldfogel, 1997), and seek men whose incomes are sufficient to make up for the shortfall. Motherhood reduced women's hours worked by 45 percent, but there is no significant change in hours worked by fathers (Lundberg and Rose, 2000). A self-insurance motivation on the part of women may help explain why women in the US gain roughly 55 percent in needs adjusted, total family income, regardless of whether they cohabit or marry, whereas men's remain unchanged

(Light, 2004). Marrying even higher income men may be a means for women to “opt out” of the labor market altogether (Hersch, 2013).

This motivation to maintain a constant standard of living after marriage and motherhood would explain our otherwise odd finding that women’s marginal utility of mate income is increasing on their own incomes. This interpretation would also be consistent with Becker’s (1973) theory of the family. Higher income women who anticipate a traditional homemaker role have more to give up in marriage and, thus, would demand more to compensate them for their loss. In contrast to the rest of the literature, which uses marriage data, we show that women’s preference for men may anticipate their opportunity costs of family ex-ante to any interaction with their intended spouses.

Men’s seeming indifference to women’s incomes suggests that they might be “just looking”, i.e., they derive utility from merely seeing photographs of women without any intention to date them. However, follow-up work (Ong, 2013) found on the same website that men of all heights prefer taller women (who, due to the large gender difference in height in China, are still shorter than the shortest men in our treatments), with taller men preferring taller women the most. The website’s software focuses the profile pictures on faces. Hence, men have to look at the numerical height information beside the picture to get a good sense of the height of the women. We know from those results that men were looking for dates, and by comparison with the results reported here that women’s incomes are not of primary concern.

It is important to emphasize that while we identify incentives that may influence dates, relationships and marriages, we cannot rule out other preferences or strategic interaction effects dominating these ex-ante preferences in ex-post outcomes. Hitsch et al. (2010a) do however also compare the match characteristics from the online dating data in Hitsch et al. (2010b) to actual marriage data. They found that preferences revealed in marriages were more intense than preferences revealed using first contact emails.

Our study suggests that women regard income as important when assessing the attractiveness of men. Our finding of women’s attraction for higher income men is analogous to the findings of several other studies that have demonstrated attraction based on superficial physical features. For example, women revealed a preference for men who

are taller than themselves in first contact emails in online dating data (Hitsch et al., 2010b) and for physically attractive men in speed dating experiments (Kurzban and Weeden, 2007). Womens' hypothesized preference for a thinner spouse could explain the longer hours of work (Oreffice and Quintana-Domeque, 2012) and higher wages of a more overweight spouse (Chiappori et al., 2012).

Asking people may seem like the obvious way to test for an income attraction. In fact, many studies beginning with Buss (1989) found that women reported a preference for higher income men, and that this preference seems to be increasing on their own economic prospects, in contrast to men, who reported no such a preference. However, the evidence supporting the accuracy of self-reported mate preferences in predicting dating choices is mixed at best (Eastwick and Finkel, 2008; Eastwick et al., 2014; Kurzban and Weeden, 2007). Recall for example that Hitsch et al. (2010b) found that although women stated no same-race preference in their online dating profiles, they exhibited such a preference in their choices. The influence of an income attraction could be pervasive, subconscious, and possibly embarrassing to acknowledge because of its implications of unromantic and possibly mercenary motives. However, the fact that the highest income male profiles received about 10 times more visits than the lowest, combined with the nearly proportional increase in visits for an increase in income, suggests that this income attraction on the part of women could play a nontrivial role in long term relationships.

Admittedly, it would be difficult to make quantitative claims about long term relationships based upon the gender differences in preferences for mate income that we have identified. However, our qualitative results would nonetheless be useful where a preference for income has already been identified as a factor for behavior in such relationships. For example, our results would suggest that women's preference could be relatively more important in explaining the decreased marriage rates, lower reported happiness, higher divorce rates for wives with higher incomes than their husbands found in Bertrand et al. (2013). Their data allowed for either or both spouses' preferences to be a contributing factor to those marital outcomes. The relevance of women's income preferences in our experiments to spousal income patterns is further bolstered by the discontinuous increase in women's visits to male profiles, as the male profiles' incomes exceeded the women's own. Our finding that women's preference for a potential mate's

income is relative to their own incomes suggests a reference dependent basis for Bertrand et al.'s (2013) finding that marriage rates decrease discontinuously when the wife's income exceeds 50 percent of the household's income.

Returning to the observed robust negative correlation between marital rates and gender differences in wages, there is a further though admittedly more speculative implication to our findings. The key factor in China's marriage market, which is hard to overestimate in its impact on matching behavior, is the increasing shortage of women as a consequence of decades of the "one-child" policy beginning in 1979. There is circumstantial evidence of greater competition for income among men in China due to the shortage of women. Provincial variations in skewed gender ratios predict higher savings in households with sons (Wei and Zhang, 2011a), savings presumably to help the son buy a house and increase his chances in the marriage market. Those ratios also predict men's work hours in dangerous and risky jobs (Wei and Zhang, 2011a); level of entrepreneurship (Wei and Zhang, 2011b; Yuan et al., 2012); criminal activities (Edlund et al., 2009); time spent on housework within households, as well as, women's participation in decision making (Edlund et al., 2009); and decreases in women's educational attainment, employment, professional employment, wage, and income (Edlund et al., 2013).

The income attraction of women that we have found, combined with the shortage of women, could be one way of explaining these stylized facts. An asymmetric income attraction on the part of women should provide an extra incentive for men to acquire greater income. This extra incentive would be all the more acute in the context of the increasing shortage of women, which is precipitating a "marriage squeeze", the dramatic rise in the number of men who cannot find spouses in China (Jiang et al., 2011). The combined effect of an income attraction on the part of women and an increasing marriage squeeze could increase the vigor with which men compete for income on the job market, crowding out women when competing for the same jobs or promotions, and exacerbating the gender gap in wages. Lower wages for themselves in the context of higher wage potential husbands could increase the value of the marriage option for women in China. More marriages could then result because the effect of increased competition among males on the gender gap in wages is stronger than the numerical effect of fewer women to marry. Such an effect could contribute to an explanation of the curious, and apparently,

unique simultaneous decrease in women's wages and increase in marriage rates observed in China.

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Appendix A

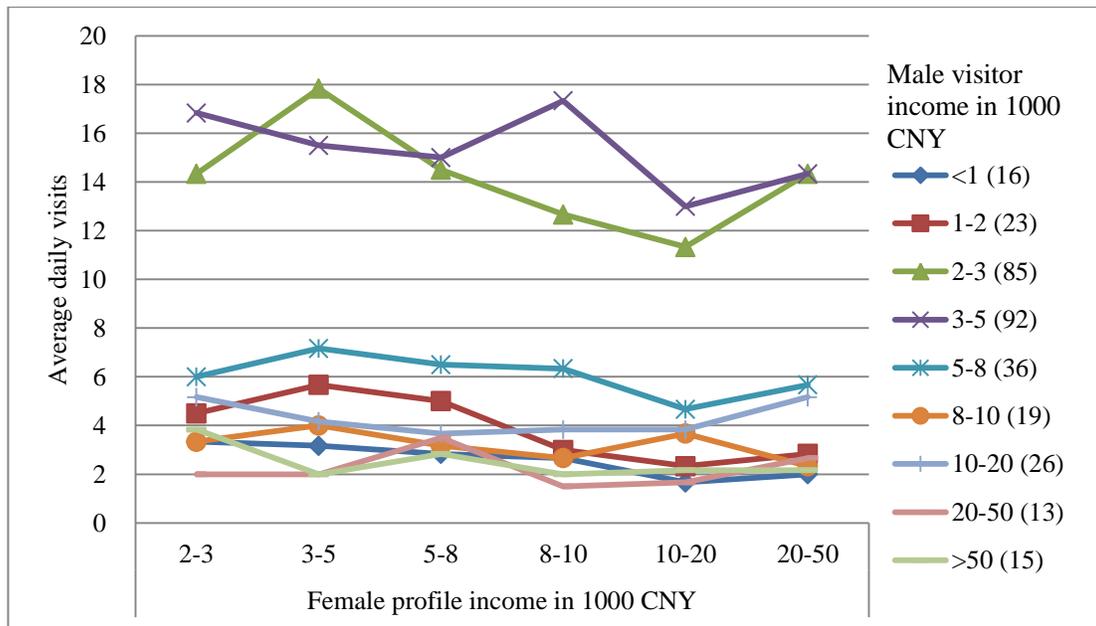


Figure 5: Detailed average daily male visits per income vs. income of female profiles.

Notes: Numbers in brackets are the totals of the averages of daily visits per income level of visitor.

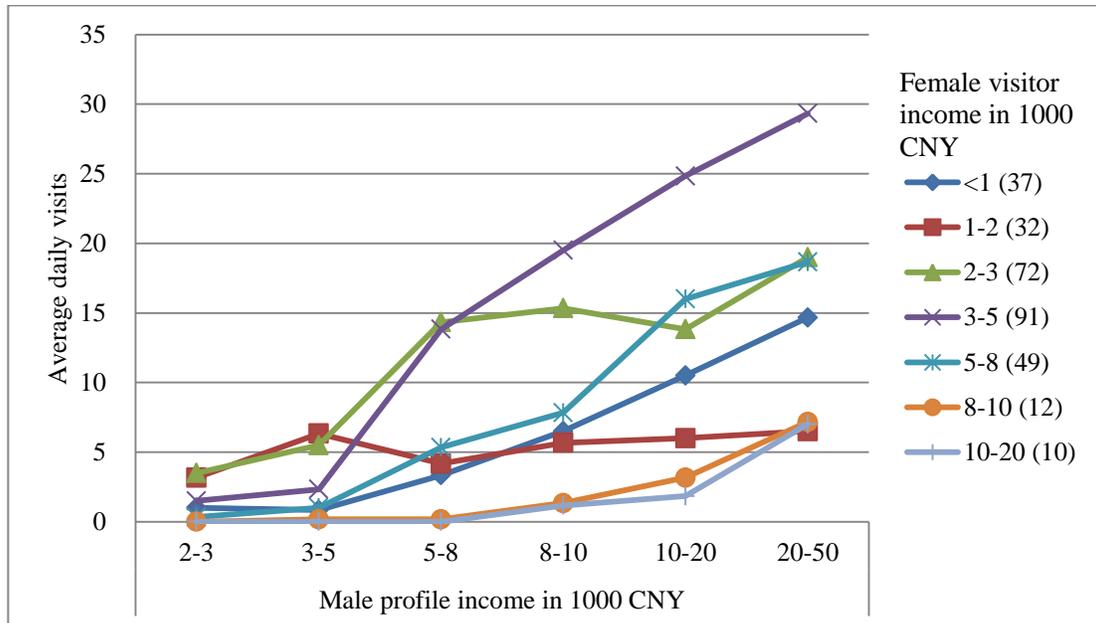


Figure 6: Detailed average daily female visits per income vs. income of male profiles.

Notes: Numbers in brackets are the totals of the averages of daily visits per income level of visitor.

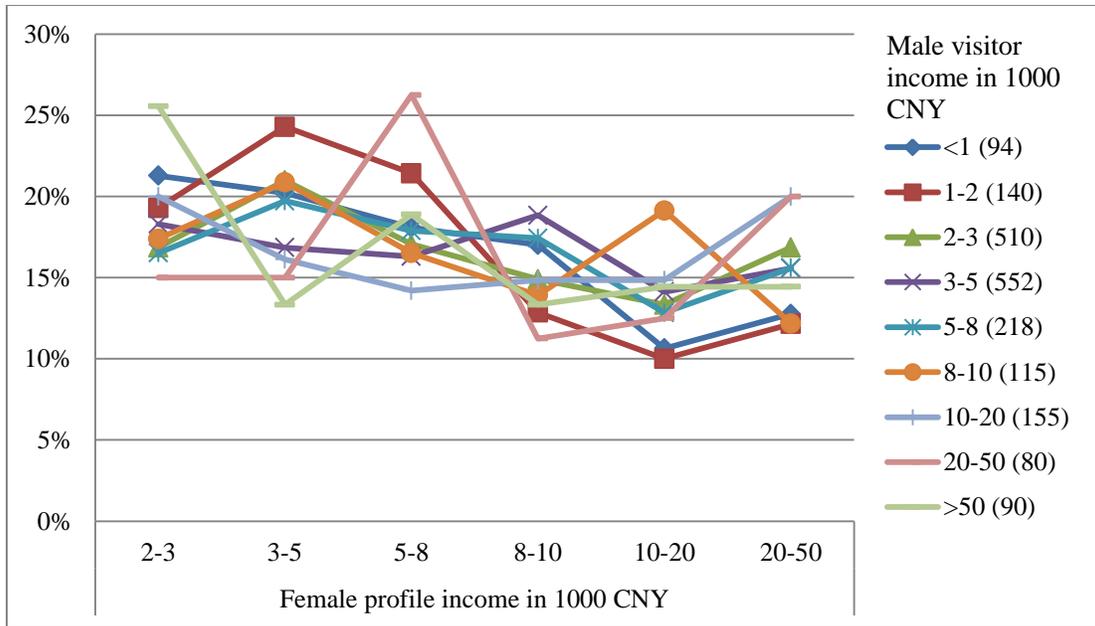


Figure 7: Detailed percents of average daily male visits per income level vs. income of female profiles.

Notes: Numbers in brackets are total visits per income level of visitor.

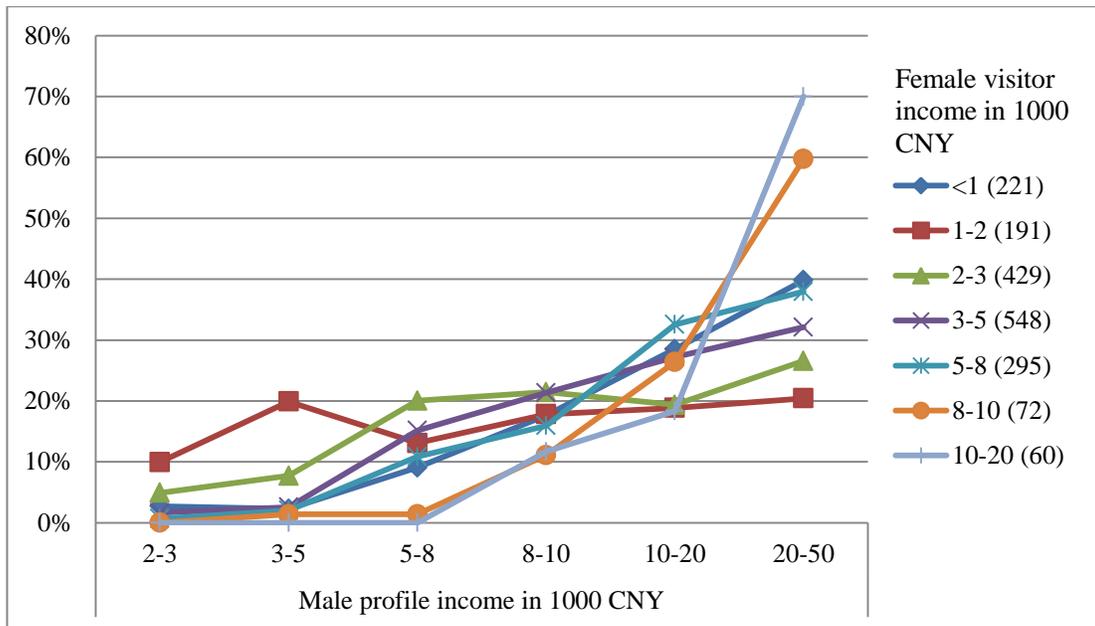


Figure 8: Detailed percents of average daily female visits per income level vs. income of male profiles.

Notes: Numbers in brackets are total visits per income level of visitor.

Appendix B

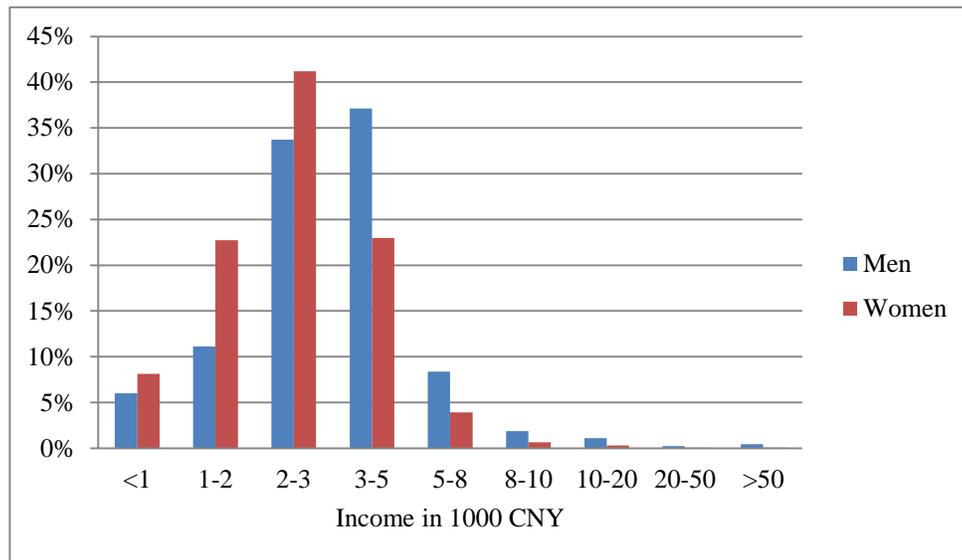


Figure 9: Income distribution (in 1000CNY) for 22 year old male and female members.

Notes: Number of men=20452. Mean income for men = 4,185-4,799 CNY. Median income for men = 2,001-3,000 CNY. Number of women = 16275. Mean income for women = 2522-3454 CNY. Median income for women = 2,001-3,000 CNY.

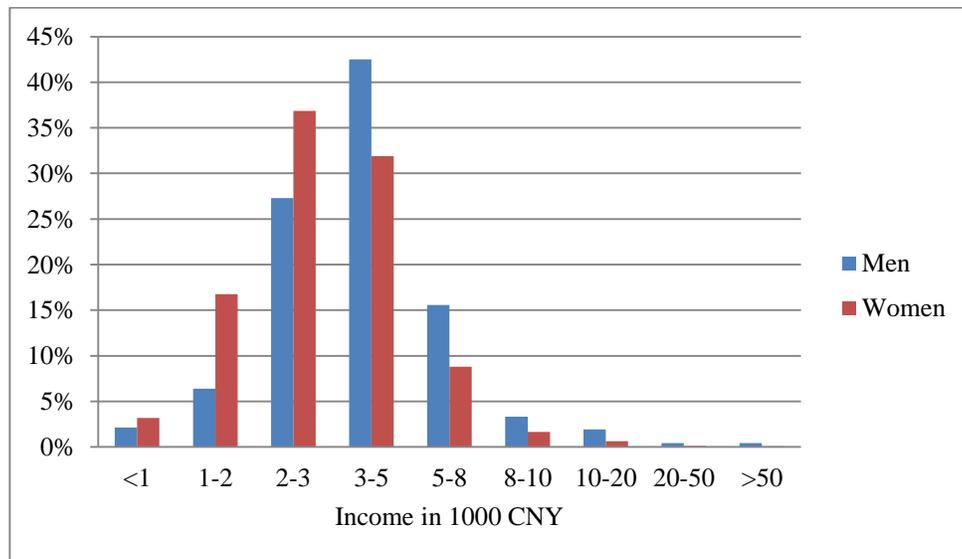


Figure 10: Income distribution (in 1000CNY) for 25 year old male and female members.

Notes: Number of men = 27337. Mean income for men = 3,423-5,701 CNY. Median income for men = 3,001-5,000 CNY. Number of women = 18156. Mean income for women = 2,562-4,204 CNY. Median income for women = 2,001-3,000 CNY.

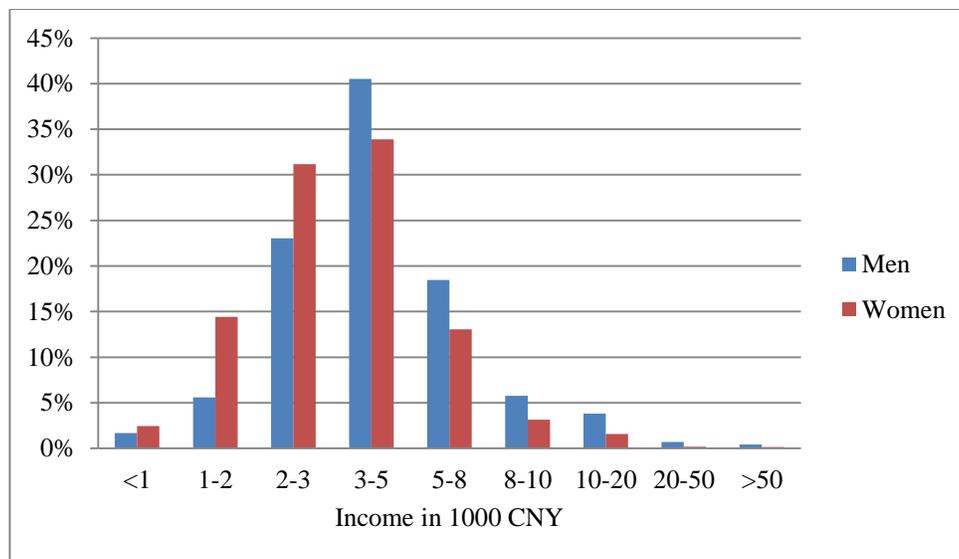


Figure 11: Income distribution (in 1000CNY) for 27 year old male and female members.

Notes: Number of men=19,449. Mean income for men = 3,849-6,436 CNY. Median income for men = 3,001-5,000 CNY. Number of women = 11,509. Mean income for women = 2,957-4,857 CNY. Median income for women = 3,001-5,000CNY.

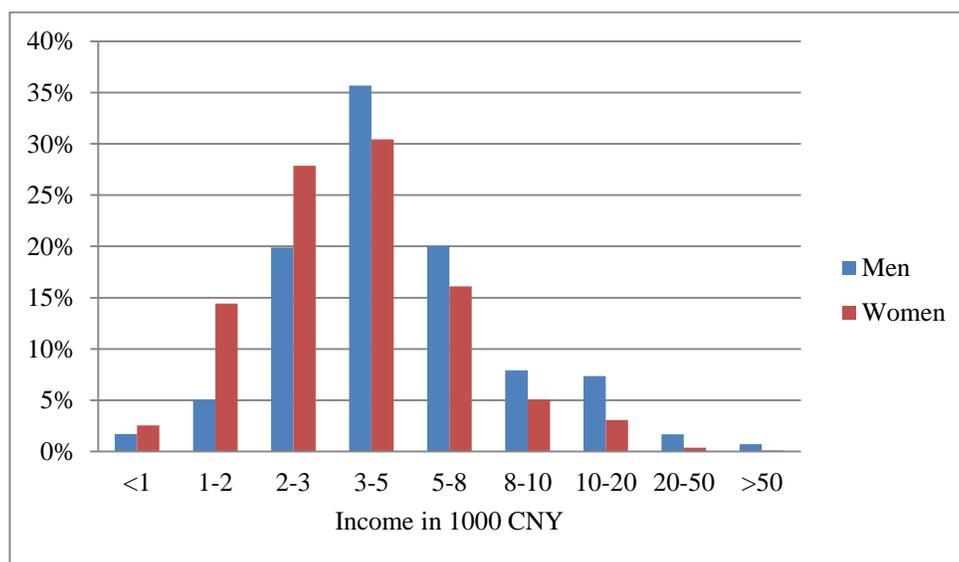


Figure 12: Income distribution for 30 year old male and female members.

Notes: Number of men=15,941. Mean income for men = 4,583-7,922CNY. Median income for men = 3,001-5,000 CNY. Number of women = 10,017. Mean income for women = 3,257-5,368 CNY. Median income for women = 3,001-5,000 CNY.