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Intra-household decisions making on intertemporal choices: An experimental study in rural China

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Abstract: In this paper, we conduct a high stake experiment in rural China to investigate the determinants of individual and joint decisions regarding intertemporal choices, and estimate the relative influence of spouses on the joint decisions. We use the Convex Time Budget experimental method to elicit individual and joint decisions on how much money to allocate to an early and a later date. We find that the rates of return have significant effects on the decisions, yet both individual and joint decisions exhibit present-biased time preferences. We also find that both spouses have a significant influence on joint decisions. However, husbands have a stronger influence than wives. Although there are few individual and household characteristics related to the relative influence, we do find a link between relative influence in the experiment and households' decisions on financial savings in real life. We also find that neither the order of the individual and joint decisions nor the initial control of the endowment in the joint decision affects the behavior in the experiment.

Keywords: household decision-making; intertemporal choices; Convex Time Budget; relative influence.

JEL classification: C91, C92, C93, D10

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1. Introduction

Intertemporal choices concerning, e.g., savings, investments, education, and insurance are important determinants of household development. Although household decisions on such choices are often made jointly, they depend on a number of factors including the preferences of the individual household members making the decision and the bargaining position of each individual. Previous research for example shows that who is in control of the resources could have important implications for decisions relating to children health and nutrition (Thomas, 1990, 1994), household expenditure patterns (Phipps and Burton, 1998), and children's education (Namoro and Roushdy, 2008). The approach of these studies is to compare households where the woman has relatively strong control over the assets with households where the woman has little control over the assets. Another approach is to study how the control of income or access to financial assets in the households is exogenously changed by external public programs (Hashemi et al., 1996; Lundberg et al., 1997; Duflo, 2003; Pitt et al., 2006; Bobonis, 2009) or field experiments (De Mel et al., 2009; Ashraf, 2009; Ashraf et al., 2010; Mani, 2010; Robinson, 2011). These studies consistently find the importance of financial control in improving women's decision power and the allocation decisions of the household. Finally, an alternative approach to measure the influence of individual decision on joint household decision is to use laboratory or artefactual experiments (de Palma et al., 2011; Carlsson et al., 2009, 2011). Apart from having control over the decision environment, the perhaps main advantage is that both individual and joint decisions can be observed and related to each other.

In this paper we investigate the determinants of both spouses' individual and joint decisions regarding intertemporal trade-offs, and to what extent the joint decisions are influenced by the individual preferences. We do this by conducting a high stake experiment where subjects decide how much money to allocate to an early and a later date. Relatively few studies have looked at households' intertemporal choices. Instead, factors such as risk taking (Bateman and Munro, 2005; Carlsson et al., 2009; de Palma et al., 2011; Abdellaoui et al., 2011), stated preferences (Quiggin, 1998; Dosman and Adamowicz, 2006; Strand, 2007; Beharry-Borg et al., 2009), public good provisions (Iversen et al., 2011; Peters et al., 2004) and social dilemmas (Cochard et al., 2009) have been studied. However, Abdellaoui et al. (2011) compare the difference between individuals' and couples' intertemporal and risk preferences,

and find that couples make more patient decisions than the corresponding individual decisions. Moreover, the study by Carlsson et al. (2011) is similar to ours, since it also investigates intertemporal choices within households in rural China. There are, however, some important differences that make the current paper a novel contribution as well. Both Abdellauoui et al. (2011) and Carlsson et al. (2011) use a multiple price list elicitation method (Coller and Williams, 1999) that has been used extensively in time preference experiments (see, e.g., Harrison et al., 2002; Harrison et al., 2005; Andersen et al., 2006, 2008; Reuben et al., 2010; Tanaka et al., 2010). A multiple price list method is designed to elicit subjects' time preferences by having them make multiple choices between smaller rewards in the sooner dates and larger rewards in the later dates. The time discounting rates can then be calculated based on the points at which subjects switch from sooner choices to later choices. While the method is fairly simple for subjects, it often results in high discount rates (upwards-biased) due to the assumption of linear utility (Frederick et al., 2002). In addition, the amount of information gained is rather limited, since what is observed is at what point subjects switch, or which of two options is chosen. An additional difference is that we investigate a number of potential order effects that could affect the decisions (as described further down).

In this paper, we employ the Convex Time Budget (CTB) experimental method suggested by Andreoni and Sprenger (2012) to elicit individual and couple's time preferences. This method allows us to collect substantial information about both individual and joint decisions. It also provides the possibility to test respondents' understanding of the experimental environment, and quantify how respondents change their intertemporal allocations from individual decisions to joint decisions. Although this method has been applied in the field in Malawi by Gine et al. (2012), we modify the experimental design with special emphasis on how individual decisions affect joint decisions. The experiment is high stake with the average household payments corresponding to four or five days of non-farm wages of one local full-time worker. In the experiment, each spouse had to make 10 independent choices—five for each of two timeframes. The first timeframe relates to the very near future, i.e., allocation of money between today and one month from today. The second timeframe concerns allocation of money between two months from today and three months from today. Each choice corresponds to one of five different rates of return for waiting; the rates of return for waiting increase from the first to the fifth choice. Hence, each respondent needed to trade off different time frames and different rates of return for waiting. The spouses also made the same choices jointly. Using the framework in Carlsson et al. (2011), we can relate the individual choices to

the choices made jointly and investigate to what extent the husband and wife influence joint decisions. Moreover, we can investigate whether the influence in the experiment is correlated with household and individual characteristics such as income and education, and with the households' actual decisions on savings.

There are several potential order effects that could affect how subjects respond. Hence, we control for both the order between the individual and joint decisions, and the order of the different parts of the time preference experiment. Moreover, we control for the effect of who has initial control over the tokens in the joint decision.

We find that both wives' and joint decisions are generally more patient than husbands' decisions, and that both individual and joint decisions suffer from present time bias. The rates of return have significant and positive effects on later allocations, which confirms that the respondents can understand the trade-offs between choices well. However, only a few observable characteristics are correlated with the individual and joint decisions. We find that both husbands and wives have an influence on the joint decisions. However, the husband on average has a stronger influence than the wife. The level of influence of the spouses and the relative influence is only correlated with a few observable individual and household characteristics such as the wife's education, the length of marriage, the number of children, etc. However, we find that there is a link between relative influence in the experiment and the households' decisions on financial savings in real life. Husbands who are the main decision makers with respect to savings also have a stronger influence on joint decisions in the experiment. We also find that neither the order of the individual and joint decisions nor the initial control of the endowment in the joint decision affects the behavior in the experiment.

The rest of this paper is organized as follows. In Section 2, we introduce the experimental design and procedure in detail. Section 3 presents the econometric framework. We describe and discuss empirical results in Section 4. Finally, Section 5 concludes the paper.

2. Experimental design and procedure

2.1 Location of the experiment and description of the sample

The experiment was conducted in two poor counties of the Gansu province, which is located in the northwest of China. The province is one of the poorest provinces in China due to its severely dry climate. The two counties, Linxia and Jingning, were randomly selected. They are located in the southwestern and southeastern parts of the province, respectively. Linxia

County is home to diverse groups of minorities, which account for around 41% of the population. In each county, we randomly chose three townships, and in total 13 villages were randomly selected. [1]

The locations of our sample villages provide a favorable setting for the experimental study on intertemporal choices. Most importantly, the malfunctioning local credit institutions have largely limited farmers' financial opportunities in rural China. In our sample, around 50% of the households complain that they are unable to loan from the credit institutions because they are poor. Even if 20% of the sample households have had loans from the local credit cooperative, the loans have been very small.[2] Moreover, only 7% of the households report that they have savings in the local bank. The absence of alternative saving products in rural China has limited the possibilities of short-term savings. It is also very hard to borrow substantial amounts of money from relatives and friends to deal with big negative economic shocks. In addition to the thin external financial market, the areas are almost autarkic. Due to the small agricultural production, almost all sample households are self-sufficient in grain output.[3] It is thus difficult for the participating households to smooth their income and consumption in their daily life.

In eight of the 13 sampled villages, we randomly chose 10 to 25 households with official marital status from the village registration list provided by the village leaders. In the other five villages, we randomly selected around five households in each village, also with official marital status. With the assistance of one village cadre, two randomly matched enumerators (always one man and one woman) approached the selected households. If both the husband and wife voluntarily agreed to be interviewed after our welcome announcement, the village cadre left. If one of the spouses was not home when the enumerators arrived at their house, the enumerators waited for a while or made an appointment to come back later. We had to make sure to interview the selected households in each village within one day in order to keep information about the experiment from spreading. If an appointment could not be made or if

[1] We originally planned to randomly select two villages in each township. But one village was spread out, and it was hard to reach all households due to the bad road conditions after raining. We could therefore only interview 15 households in that village. Therefore an additional 10 households were randomly selected from the neighborhood village.

[2] On average, each household can loan only around 5,000 Chinese yuan.

[3] On average, the proportion of agricultural income and off-farm income in total income is 22% and 53%, respectively.

one spouse in a couple refused to be interviewed[4], the enumerators visited the neighbor instead. Finally, 164 couples agreed to voluntarily participate in the experiment.

Table 1 describes the summary statistics of the sampled households. The average ages of the husbands and wives are 49 and 46 years, respectively. On average, the husbands have five years of education and the wives 2.5 years. As regards individual questions, husbands and wives have surprisingly similar responses. For example, the average income contribution to the households of the wives is around 40%. Husbands are the main decision makers in everyday life, but wives have more decision power when it comes to daily expenses such as food and clothes. As for the common household characteristics, the average household has five members, and the average length of marriage is 26 years. In 2010, the average household's gross income per capita was 7,064 yuan.[5]

<Table 1 about here>

2.2 Experimental design

We apply the Convex Time Budget method suggested by Andreoni and Sprenger (2012) to investigate subjects' intertemporal choices. In Table 2, the 10 intertemporal choice sets for each respondent are described. There are only two timeframes with the same delay time:[6] the near period between today and one month from today and the far period between two months and three months from today. To investigate whether respondents have present-biased preferences, we use "today" not "tomorrow" in the experimental design. However, this could imply different transaction costs between payment today and future payments (Anderson et al., 2008). To investigate how the credibility of future payment affects respondents' decisions in the experiment, before respondents started to make decisions, we asked questions about how they trusted they would receive the money in the future. The five interest rates we used in the experiment were tested and decided upon based on the results of the pilot experiment.[7]

[4] Three households refused to be interviewed. Among them, two households could not participate in the survey mainly because the wife stated they were too busy. One household refused to continue the experiment when the enumerators told them they could obtain some payments from our experiment. They did not tell us the concrete reason—they just did not want to continue.

[5] At the time of the experiment, 1 USD=6.59 CNY.

[6] As we will discuss later, this design limits what information we can obtain from our parametric model, since we are not varying the delay time. The main reason for still choosing this design was that from the pilot studies it was clear that using more than 20 decisions would result in fatigue among a potentially large number of subjects. Moreover, since the main objective of the experimental design is to investigate the relationship between individual and joint decisions, we do not think the constant delay will matter much for our main results.

[7] During the pilot studies, we first used the interest rates used by Gine et al. (2012), i.e., 0.1, 0.25, 0.5, 0.75, and 1. However, especially at the high interest rates, there were almost no trade-offs; hence we reduced the rates to 0.05, 0.1, 0.25, 0.4, and 0.6.

Respondents needed to allocate the given 20 tokens[8] between a sooner and a later date with increasing interest rates.

<Table 2 about here>

As described in detail below, subjects were presented with two plates. The red plate represented the sooner date (today or two months from today) and the orange plate represented the later date (one month from today or three months from today). Their task was to decide how many tokens to put on each plate, where in all choices each token was worth 2 yuan if it was allocated to the red plate. One token was worth $2\times(1+r)$ yuan if it was allocated to the orange plate. r is the rate of return for waiting, and it increased from the first choice to the fifth choice.

The spouses made both individual and joint decisions. As described below the order was randomly determined. When they made the individual choices they were clearly told that the money was theirs, and when the made the joint choices they would receive the same amount each. The basic idea of the analysis is to relate the decisions made individually to the decisions made jointly. It is of course possible that the individual choices are made taking into consideration the preferences of the spouse, and we have no way to control for that. However, what we did was to stress that the choices were anonymous to the spouse and that the money was individual and not to be paid to the household.

2.3 Experimental procedure

We employed and trained 10 interviewers, from now on called experimenters, to conduct the experiment. Among them, five were from Beijing University and five were from the local university. The five local experimenters could understand and speak the local dialect. All experiments were conducted by pairs of experimenters where one experimenter was from the local university.

Once a couple had agreed to participate in the whole survey, one of the experimenters gave a brief introduction of the tasks. Then the couple together answered a set of questions about the household. The rest of the procedure depended on the order of the parts of the experiment (see Section 2.4). However, we will for simplicity only describe in detail one of the orders used.

[8] The main reason for why we use tokens instead of Chinese Yuan is that the total amount of money varies in each decision since it depends on the interest rate and amount of money allocated to the earlier date.

In the version where individual decisions were made before the joint decisions, the respondents were (following the first initial questions) physically separated into two rooms where they could not hear each other; one experimenter followed the wife and one followed the husband. The experimenter read out the experimental instructions to the respondent. The respondent needed to make 10 separate decisions, and one of these decisions would be randomly chosen to be paid out by rolling a 10-sided die. The number that came up on the die decided which choice would determine the respondent's earnings. Thus, each decision had an equal chance of being used in the end. Moreover, the respondent was told that s/he would get two vouchers, one for sooner payments and one for later payments, signed by the project coordinator. The voucher indicated the amount of cash and corresponding date the respondent could redeem the money. After the experiment, the respondent decided whether we should send the money to them by the postal savings bank or other commercial bank.

To help the respondents understand the experiment, they first made two trial decisions.[9] Once the experimenter was certain that the respondent had understood, s/he was asked to make the first five independent decisions about how to allocate 20 tokens between today and one month from today. Following the experimental design in Section 2.2, to help the respondent remember which dates the two plates represented, the experimenter put a sign in front of each plate with the corresponding date and the value of a token. The respondent then decided how to allocate the tokens between today and one month from today for each choice. After a decision was confirmed, the experimenter translated the total tokens in each plate into Chinese yuan and wrote the decision on the whiteboard. The experimenter then repeated the allocation by pointing to the whiteboard, and at this point the respondent had the possibility to revise the decision. If the respondent did not want to change the allocation, the experimenter moved on to introduce the next choice. When the respondent had finished all five decisions, the experimenter presented all notes on the whiteboard to her/him and asked whether s/he would like to change the allocation for any of the choices. If the respondent wanted to make changes, they were asked what they wanted to change. Once the respondent did not want to make any more changes, the experimenter continued to the next five independent choices, i.e., for allocation between two months and three months from today.

[9] As part of the trial decisions, the respondents allocated 10 tokens between one month from today and two months from today. Before the respondent did this, the experimenter asked some control questions about the meaning of the plates and the tokens. The respondent started to make the trial decisions only when s/he had understood the meaning of the plates and the tokens.

The elicitation procedure was similar for the second five independent choices. Yet the respondent was reminded that s/he needed to wait for both the sooner payment (two months from today) and the later payment (three months from today). After the respondent had finished all 10 choices, s/he was asked some questions about individual characteristics. We intentionally arranged such interruptions before having the husband and wife made the joint decisions.

When both the husband and the wife finished, they were brought together for the joint decisions. The couple was told that they would make 10 intertemporal choices similar to the individual decisions they had just made. The main difference was that both of them would obtain the same amount of experimental payments according to one of the decisions, which would be randomly selected by rolling a 10-sided die. Before each decision was made, they were encouraged to speak to each other and discuss the decision, as they needed to agree on how to allocate the money between the sooner and later dates. The couple followed the same elicitation method as the individual decisions, i.e., they first made joint decisions about how to allocate the 20 tokens between today and one month from today, and then made the other five joint decisions about how to allocate the 20 tokens between two months and three months from today.

On average, the whole survey lasted for one and a half hours for each household. The average experimental payment for each individual respondent was 52 yuan, and the average experimental payment for each household was 208 yuan, which equals three days of non-farm wages for one local full-time worker.

2.4 Order effects and initial control over the endowment

In the design, we control for two important order effects. The first one is about the order of making separate decisions and joint decisions. Half of the households made the individual decisions first and then the joint decisions. The other half of the households made the joint decisions first and then the individual decisions. While the natural order would be to first conduct the individual experiment and then the joint, we want to test if the ordering affects the behavior in the joint decision experiment. There could, for example, be learning effects, or the respondents may try to smooth out the earnings over time and the two parts of the experiment.

The second order effect concerns the order of the two parts of the time preference experiment. Half of the households answered the five questions regarding money allocated between today

and one month from today first, while the other half started with the five questions regarding money allocated between two months and three months from today.

In addition, we control for experimenter effects by interchanging their interviewing subjects in each household. For example, if the male experimenter interviewed the husband and the couple in one household, then the female experimenter needed to interview the husband and couple in the next household.

Finally, to control for the effects of who had the initial control over the tokens, we had four alternatives for how they were initially distributed. The first reference situation was that the experimenter just put the 20 tokens between the husband and the wife, but did not say anything else about who was responsible to put tokens on the plates. The second situation was that the experimenter gave the 20 tokens to the wife, making her in charge of putting the tokens on the plates. In the third situation, the experimenter gave the 20 tokens to the husband, who was initially responsible to put the tokens on the plates. The fourth situation was that the experimenter gave 10 tokens to the wife and 10 tokens to the husband, making both of them in charge of putting the tokens on the plates. For all cases, both spouses could adjust the amount of tokens on the plates until they had reached an agreement, i.e., they were not told that only one or both should put the tokens on the plates.

3. Econometric framework

3.1 Modeling individual decisions

In the experiment the subjects had to decide how much of a given amount of money to allocate to a sooner date, c_t, and a later date, $c_{t+\tau}$, given a certain interest rate, r, and where τ is the delay time. Since the experiment was fairly complex and we could not ask the subjects to make too many decisions, we chose to keep the delay time constant ($\tau = 1\,\text{month}$). This means that we will not obtain a full picture of their discounting preferences. In any case, we can describe the decision in the experiment as a utility maximization subject to a convex budget constraint of the following form (Andreoni and Sprenger, 2012):

$$\max \quad U = U(c_t\,, c_{t+\tau}) = u(c_t) + \beta\delta u(c_{t+\tau}) \qquad (1)$$

$$s.t. \quad (1+r)c_t + c_{t+\tau} = m$$

$u(\cdot)$ is instantaneous utility from consumption; it is assumed as an increasing and concave function ($u(\cdot)' > 0$ and $u(\cdot)'' < 0$). β is the present bias parameter, which is assumed

$0 < \beta \leq 1$. δ is the discount factor, and $\delta > 0$. m is the given experimental budget. c_t and $c_{t+\tau}$ represent the experimental payments on a sooner and later date, respectively. Based on the different rates of return for waiting, respondents' allocation decisions are continuous along the convex budget set. Given a certain value of the present bias parameter (β), a rational individual should not decrease the amount of money allocated to the later period as the return to waiting increases (Choi et al., 2007, 2011). However, additional assumptions about the utility function are necessary in order to obtain an estimable function. Given that we do not have information about daily consumption expenditures, we assume a constant absolute risk aversion (CARA) utility: $u(c_t) = -\exp(-\rho c_t)$, where ρ is a risk aversion parameter. By maximizing the utility in equation (1) subject to the convex budget constraint, we can easily derive the equation (2) as follows:

$$c_{t+\tau} - c_t = \frac{1}{\rho} ln(1+r) + \frac{ln\delta}{\rho}\tau + \frac{ln\beta}{\rho} D_{t=0} + \varepsilon \qquad (2)$$

$D_{t=0}$ is the present dummy that equals to one if the sooner allocations involve today payments. However, as explained above, in our experiment the delay time is constant and therefore the discount factor in the second element of the equation (2) is not estimable (it will be a constant).[10] But we can obtain the utility curvature parameter ($\hat{\rho}$) and present bias parameter ($\hat{\beta}$) by non-linear transformation of the estimated coefficients.

3.2 Modeling the influence of individual decisions on joint decisions

Household decisions depend on the preferences of the household members, the bargaining process, and the relative strengths of the household members. Since the introduction of a bargaining mechanism into the household decision making process by Manser and Brown (1980) and McElroy and Horney (1981), there has been a development of so-called collective household models, which assume that households can achieve efficient decisions (Chiappori, 1992; Browning and Chiappori, 1998). According to Browning and Chiappori (1998), a household's jointly discounted utility can be expressed as

$$V_j = \mu_h \cdot U_h + \mu_w \cdot U_w \qquad (3)$$

where V_j is joint utility, U_h and U_w represent the husband's and wife's utility respectively, and μ_h and μ_w denote the husband's and wife's decision or bargaining power respectively, which measures how individual preferences are aggregated into household joint decisions. One

[10] We also cannot estimate the hyperbolic discounting parameter.

approach to measure the influence of spouses on household decisions is to look at who is in control of the income and correlate this with household decisions (see, e.g., Browning et al., 1994; Lundberg et al., 1997; Phipps and Burton, 1998; Duflo, 2003). The major drawback of this approach is that it is, by definition, difficult to observe both individual and household decisions. However, using an experimental approach, it is possible to observe both individual and joint decisions. This in turn means that we can measure to what extent each spouse influences the joint decisions. We follow the approach outlined in Carlsson et al. (2011) and estimate the influence of each spouse by explaining the joint decisions by the individual decisions. The joint allocation decision for household *i* in choice situation *j* is specified as

$$(c_{t+\tau} - c_t)_{ij}^{J} = \alpha + \mu^{H}(c_{t+\tau} - c_t)_{ij}^{H} + \mu^{W}(c_{t+\tau} - c_t)_{ij}^{W} + \varepsilon_{ij} \quad (4)$$

where *J*, *H*, and *W* denote decisions made jointly, by the husband, and by the wife respectively. Thus, the parameters μ^H and μ^W are measures of the husband's and wife's influence on the joint decision. The ratio between these two parameters, $\lambda = \frac{\widehat{\mu^W}}{\widehat{\mu^H}}$, is then a measure of the relative influence of the wife and the husband. If the ratio is above one, then the wife has a stronger influence on the joint decision. However, the above specification only allows us to estimate the average relative influence. We will therefore also estimate a model where the estimated influence parameters depend on a set of observable individual characteristics, by interacting the husbands' and wives' individual decisions with these variables. From this model, we can estimate the relative influence of the wife and husband for household *i*: $\lambda_i = \frac{\widehat{\mu_i^W}}{\widehat{\mu_i^H}}$. This will give us a distribution of the sampled spouses' relative influence. Moreover, we can investigate whether this relative influence is correlated with household-specific characteristics. We therefore estimate a regression model where the relative influence is explained by a number of household characteristics.

4. Results

4.1 Descriptive results

In Table 3, we summarize the allocations, in Chinese yuan, made to the sooner period by the husbands, wives, and couples for all the decisions.

<Table 3 about here>

As can be seen, the allocation to the sooner period decreases when the rate of return increases, which is an indication of that the subjects are aware of the basic trade-offs they face in the choice tasks. On average, subjects allocate more money to later dates, except when the rate of return is 0.05. For example, when the rate of return is 0.25 and the sooner date is today, husbands' median allocation to the sooner period is 8 Chinese yuan, and to the later period it is 40 Chinese yuan. The wives' median allocation to the sooner period is 4 Chinese yuan, and to the later period it is 45 Chinese yuan. The median allocation in the joint decisions is 6 Chinese yuan to the sooner period and 42.5 Chinese yuan to the later period. The table also reports the share of allocations that are corner allocations, i.e., when the respondent allocates zero yuan to the sooner period and thus allocates everything to the later period. As expected, the share of corner allocations increases when the rate of return increases. Finally, we can also look at how subjects change their allocations when the rate of return increases. If they are consistent, they should not decrease their allocation to the later date. We can make in total 1,312 such comparisons.[11] Among these pairs, there are only seven inconsistent pairs among the husbands' decisions, nine inconsistent pairs among the wives' decisions, and eight inconsistent pairs among the joint decisions. Thus, around 99% of the pairs are in line with a basic test of consistency. Compared with the similar study by Gine et al. (2012), where only 81% of the pairs were consistent, this is a very high share of consistent pairs.

To summarize, we can thus say that subjects are making trade-offs between periods that are consistent with economic theory, and that they are making few inconsistent choices. There is a relatively high share of corner allocations, but far from all decisions are corner allocations. As argued by Gine et al. (2012), interior allocations imply that respondents have not realized that they have the opportunity to smooth income over time. However, if the local credit market functions well, respondents should allocate all the money to the sooner period when the market interest is higher than the experimental return for waiting and vice versa.

Table 3 also shows that the wives are on average more patient than the husbands, except for the first choice situation. Table 4 presents Wilcoxon rank sum tests of the differences between

[11] We evaluate respondents' basic consistency by partitioning their 10 decisions into pairs, where each element within each pair represents the tokens allocated to the same later dates but with the different rates of return. The first element within each pair is the allocation of tokens in the face of the rate of return r, which is the lowest rate of return. The other element is the allocation of tokens in the face of the next higher rate of return r'. Hence, for each timeframe, there are four such pairs, and each respondent has eight decision pairs in total. We have in total 164 sample households, and there are thus 1,312 decision pairs for husbands, wives, and couples, respectively. A consistent pair implies a pair within which the later allocation of tokens is not decreasing with the rate of return r. It thus also includes the cases when allocations do not change within one pair.

husbands' and wives' choices, and Wilcoxon signed rank tests of the differences between the joint decisions and the husbands' and wives' decisions.

<Table 4 about here>

The difference in choices between wives and husbands is statistically significant for almost all choice situations, i.e., wives are on average more patient than husbands. Most joint allocations are in between the husbands' and wives' allocations, with the exception of the first two choices. In addition, the joint decisions are significantly more patient than the husbands' allocations. There are no significant differences between wives' average allocations and joint allocations. However, this is looking at the aggregate level. The next step is to use the information at the household level.

4.2 Husbands' and wives' allocation decisions

Following the framework in Section 3.1, we regress the difference between allocations to the later period and the sooner period ($c_{t+\tau} - c_t$) on the rate of return, and a present time dummy variable that is equal to one if the sooner allocation involved the today payment. In addition, we estimate a model where we also include a set of observable characteristics of the subjects. We estimate separate models for the husbands', wives', and joint decisions. The estimated results are reported in Table 5.[12]

<Table 5 about here>

As expected, the coefficient of the rate of return is positive and highly significant. The significant and negative sign of the present time dummy variable indicates that respondents on average have present biased time preferences. This is different from Andreoni and Sprenger (2012), who find little evidence of present bias preferences using the CTB approach. The utility curvature parameters are comparable with Andreoni and Sprenger (2012).

There are actually very few observable individual characteristics that have a statistically significant effect on the allocation decisions. For husbands, the only significant effect is that in minority households, husbands allocate more money to the sooner period, i.e., are more impatient. For wives, we find that older women allocate more to the later period, i.e., are more patient. Furthermore, in households with many children under 16 years of age, wives allocate

[12] We have also estimated a model with the log of the difference in allocations, and the results are similar to the ones for the level model. The results are available upon request.

more to the sooner period. Finally, we find that subjects who had more confidence in that they would actually get paid were more likely to allocate money to the later period. While this may be an indication that some subjects did not trust us, and hence preferred to receive the money today, it is also possible that it is just an indication of a rationalization of the behavior in the experiment. Moreover, the fraction of husbands and wives who did not trust that they would get paid in the future was rather low, 5% and 4% respectively[13]. For the joint decisions, we find that in households where the husband is a communist party member, the joint decisions are more patient, while if the husband has a higher education than primary school, the joint decisions are more impatient. There are no significant effects of wives' characteristics on joint decisions. In households with a large number of children under 16 years of age, joint decisions are also more impatient.

4.3 Order effects

We controlled for order and experimenter effects in all models. There were two order effects: (i) the order of making separate and joint decisions and (ii) the order of the two parts of the time preference experiment. The first ordering does not have any significant effect on the behavior in the individual or joint decisions. The second ordering significantly affects only husbands' decisions. When husbands make the five choices between today and one month from today first, they tend to allocate more to sooner periods compared with if they make these five choices in the second part of the individual experiment. The first finding is of particular interest, since it suggests that the decisions in the joint part of the experiment do not depend on whether they have answered individually first. It means that we can rule out factors such as learning and smoothing of the earnings over the course of the experiment. Finally, we also find some evidence that female experimenters have a negative effect on wives' later allocations; i.e., with female experimenters wives become more impatient, yet this is significant only at the 10 % level.

4.4 The effects of individual decisions on joint decisions in the experiment

We now move to the main interest of this paper: the relationship between the individual decisions and the joint decisions. We first estimate models where we explain the joint decisions with the husbands' and wives' decisions, as specified in equation 4. Again we only

[13] If we exclude the households who have any doubts about future payments, we obtain similar results as those reported in Table 5. The results are available upon request.

report results for the level form specification, although the results are similar for the log form specification. The results are reported in Table 6.[14]

<Table 6 about here>

In the first model, we only control for the husbands' and wives' individual decisions. As can be seen, both spouses have a significant impact on the joint decision in the sense that there is a positive and significant correlation between the individual decisions and the joint decision. However, both coefficients are well below one, suggesting that on average neither spouse has complete control over the joint decision. As discussed above, the relative influence of the two spouses can be estimated as the ratio between the wife's individual decision coefficient and the husband's individual decision coefficient. This parameter is 0.73, which means that the husband on average has a stronger influence on the joint decision than the wife. The value of the relative influence parameter has a clear and simple explanation. It is the ratio of marginal effects of the two spouses' influence on the joint decisions. The husbands' influence parameter is around 0.49. This means that if the husband allocates, say, 10 yuan more to the later period in the individual experiment, then the later period allocation in the joint experiment increases by 4.9 yuan. For the wife, the increase in the joint experiment for the same change is 73% of this, i.e. 3.6 yuan. Moreover, we can reject the hypothesis that the relative influence parameter is equal to one (p-value=0.07).

In the second model, we interact the spouses' individual decisions with the treatment dummy variables concerning who had initial control over the tokens. As can be seen, none of the interaction terms are significant. This is different from the study by de Palma et al. (2011), where, in an experiment on risky choices, women who ultimately implement the joint decisions show more decision power.

In order to say more about what factors are correlated with the extent of the influence on the joint decision, we next estimate three additional models. In the first model the individual decisions are interacted with a set of individual characteristics. In the second model we add two sets of variables. The first set is a dummy variable equal to one if the husband/wife claimed to have experienced conflicts over financial decisions in the past. The second set is a dummy variable equal to one if the husband/wife stated that he/she is the primary decision maker when it comes to savings in the household. In the third model, we add two interaction

[14] We control for experimenter gender and the two order effects in all models. There are no significant gender or order effects.

terms between wife's and husband's decisions and a dummy variable equals to one if the husband is more patient than the wife. We do this since we find that husbands in general are more impatient and at the same time have stronger bargaining power. In order to investigate if this holds at the household level as well we include these two interaction terms. The results are presented in Table 7.

<Table 7 about here>

Again, there are relatively few significant effects. For husbands we find no significant effects in the first model. For wives we find that if a wife has more than primary schooling she has a stronger influence. Our findings are to some extent comparable to previous findings. For example Carlsson et al. (2009) also find that more educated wives have more influence on joint decisions in risk choices. Dosman and Adamowicz (2006) find that the relatively higher education can increase males' decision power in camping choice. This indicates that education has played an important role in improving spouses' decision making power in household decision making.

The second model reveals that there is some correlation between influence on the joint decision and real life decisions on savings, although not a strong one. In households where the husband states that he primarily makes the decisions on savings, he also has a stronger influence on joint decisions. However, a history of financial conflicts in the households does not correlate with the influence of the spouses.

In the third model, we do not find that more patient husbands have significantly stronger influence on the joint decisions. Thus it is not the relative patience or impatience of the spouses that affect the bargaining power. This is interesting and to some extent inconsistent with the theoretical prediction that demonstrates the important role of patience for the bargaining power (Rubinstein, 1982; Binmore et al., 1986).

Finally, based on the first model in Table 7, we estimate spouses' influence and the relative influence on the joint decisions. The descriptive statistics are reported in Table 8, and the distribution of the relative influence is plotted in Figure 1.

<Table 8 about here>

<Figure 1 about here>

There is some variation in the influence of the spouses and hence the relative influence. The average relative influence is 0.97, which is higher than what we found in the model without socio-economic characteristics. This is explained by a few observations with a high relative influence for wives. The median is also higher: 0.96. The ratio of relative influence is lower than one in 59% of the households. Consequently, although husbands have stronger influence in a majority of the households, there is a fair share of households where the wife actually has a stronger influence than the husband. In comparison, Carlsson et al. (2011) found in a similar study in China that there were very few households where the wife had a stronger influence than the husband. It is of course difficult to make a direct comparison, since the experimental method, context, and location of the experiment were different. This points to the difficulties with generalizing findings from a single experiment.

The relatively low variation in relative influence is explained by the fact that few of the individual observable characteristics are significant in the model in Table 7. However, in the last step we will estimate a model with the relative influence as the dependent variable and a set of household characteristics as independent variables. The results are reported in Table 9.

<Table 9 about here>

Again, only a few of the observable household characteristics are significant. If the household is a minority household, then the wife has less influence on the joint decision. Interestingly, the longer the couple has been married, the stronger the influence of the wife. But for households with many children younger than 16, the wife has less influence on joint decisions. Finally, if the spouses agree that it is mainly the husband who makes decisions on savings, then the wife has less influence on the joint decisions in the experiment as well. In contrast to the present study, Carlsson et al. (2011) do not find any other significant household characteristics that could affect the wife's relative influence than the dummy for whether the couple is living with husband's parents.

5. Conclusions

In this paper, we have investigated the influence of spouses' preferences on joint decisions regarding intertemporal allocations. We have also examined how the influence in the experiment is related to household and individual characteristics, and households' actual decisions on savings. We did this by conducting a high stake field experiment with 164

married couples in rural China, and used the Convex Time Budget experimental method to elicit individual and joint time preferences.

In general, we find that both wives and joint decisions show more patience than husbands, which provides complementary evidence of misaligned time preferences between spouses (Schaner, 2012). Furthermore, both individual and joint decisions exhibit present-biased time preferences. We find that both husbands and wives have an influence on the joint decisions, but on average husbands have a stronger influence than wives. In particular, husbands have a stronger influence on the joint decisions in 59% of the households. Thus, in 41% of households, wives have a stronger influence. However, few observable individual and household characteristics are significantly correlated with the spouses' relative influence on joint decisions, which is in line with the moderate variation in relative influence at the household level. Interestingly, we find a link between relative influence in the experiment and the households' decisions on financial savings in real life. Husbands who mainly make decisions on savings also have a stronger influence on the joint decisions in the experiment.

We present some interesting results regarding the design of this type of experiment. In particular, we show that the order in which the individual and joint decisions are presented does not affect the decisions. This is important since one critique against these experiments is that the behavior in the joint decision is affected by the fact that the respondents have just made choices individually. Moreover, in an attempt to affect the influence of the spouses on the joint decisions, we had a set of treatments where the initial control over the endowment was given to one of the spouses. This did not affect the influence of the spouses, however. One explanation for this could be that the treatment was not strong enough (it was not intended to be stronger). Future research should, among other things, look into what exogenous factors could affect the relative influence of the spouses, and whether the effects are similar between husbands and wives. For example, it would be interesting if the spouses had to earn the endowments in a real effort experiment, and then investigate to what extent they have influence over the resources.

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Tables

Table 1. Descriptive statistics of individual and household characteristics (N = 164 households)

Variables	Husband		Wife	
	Mean	Std. Dev.	Mean	Std. Dev.
Individual characteristics				
Age (years)	48.78	9.34	46.26	9.11
Higher than primary school (1=yes)	0.50		0.19	
Communist party (1=yes)	0.12		0.01	
Individual attitudes				
General decision maker (1=husband; 2=joint; 3=wife)	1.24	0.46	1.38	0.59
Wife income contribution	0.40	0.17	0.39	0.17
Husband income contribution	0.60	0.17	0.61	0.17
Decision maker on savings (1=husband; 2=joint; 3=wife)	1.31	0.49	1.34	0.51
Decision maker on daily expense (1=husband; 2=joint; 3=wife)	2.36	0.78	2.18	0.81
Decision maker for durable goods (1=husband; 2=joint; 3=wife)	1.55	0.53	1.55	0.61
Decision maker for expensive fixed asset (1=husband; 2=joint; 3=wife)	1.55	0.52	1.50	0.54
If conflict with spouse in the past (1=yes)	0.09		0.17	0.38
Trust payments will be received (1= do not trust at all; 2=do not quite trust; 3=neither trust nor not trust; 4= trust somewhat; 5=trust completely)	4.56	0.82	4.49	0.77
Household characteristics				
Household is minority (1=yes)	0.15			
Household size (persons)	4.98	1.50		
The length of marriage (years)	26.06	9.80		
The number of children less than 16 years old	0.85	0.85		
The number of adults older than 60 years old	0.56	0.82		
If the couple is living with the husband's parents (1=yes)	0.24			
If household experienced serious illness or death in the last two years (1=yes)	0.34			
Log of equivalence scaled total gross income (yuan)	9.03	0.68		
Log of equivalence scaled total assets (yuan)	9.34	0.89		

Table 2. Description of the 10 decisions in the time preference experiment

Sooner date	Later date	Token budget	Interest rate	Sooner value of one token	Later value of one token
0	30	20	0.05	2	2.1
0	30	20	0.1	2	2.2
0	30	20	0.25	2	2.5
0	30	20	0.4	2	2.8
0	30	20	0.6	2	3.2
60	90	20	0.05	2	2.1
60	90	20	0.1	2	2.2
60	90	20	0.25	2	2.5
60	90	20	0.4	2	2.8
60	90	20	0.6	2	3.2

Table 3. Husband's, wife's and joint allocations to the sooner period in Chinese yuan

		Husband			Wife			Joint		
Sooner date	R	Mean	Median	Share corner	Mean	Median	Share corner	Mean	Median	Share corner
0	0.05	22.5 (16.2)	24	23%	24.1 (15.9)	28	17%	20.8 (15.8)	20	24%
0	0.1	18.4 (15.9)	16	28%	17.9 (15.1)	19	26%	16.5 (15.2)	16	30%
0	0.25	12.7 (14.3)	8	39%	10.0 (12.9)	4	48%	10.3 (12.6)	6	44%
0	0.4	9.7 (13.2)	2	49%	7.0 (11.3)	0	59%	7.8 (11.7)	0	52%
0	0.6	7.1 (12.2)	0	62%	4.3 (9.5)	0	76%	4.9 (9.9)	0	70%
60	0.05	16.8 (14.9)	17	30%	12.7 (13.5)	10	38%	14.7 (15.0)	12	37%
60	0.1	11.9 (13.1)	8	40%	8.9 (11.9)	4	47%	9.6 (12.0)	4	47%
60	0.25	8.2 (11.5)	0	51%	4.8 (8.4)	0	64%	6.2 (9.6)	0	58%
60	0.4	5.8 (10.0)	0	60%	2.9 (6.7)	0	77%	4.1 (8.1)	0	68%
60	0.6	3.8 (8.7)	0	73%	2.0 (5.6)	0	84%	2.5 (7.1)	0	83%

Notes: 1. Figures the parentheses are standard deviation.
2. Share corner is the percentage of zero allocation to the sooner period

Table 4. Non-parametric difference tests between husband's, wife's and joint decisions on sooner allocations in Chinese yuan

		Husband-Wife		Joint-Husband		Joint-Wife	
Sooner date	**r**	Difference	Z-value[1]	Difference	Z-value[2]	Difference	Z-value[2]
0	0.05	-1.6	-0.93	-1.7	-1.16	-3.3***	-3.09
0	0.1	0.5	0.14	-1.9	-0.60	-1.4	-1.42
0	0.25	2.7*	1.85	-2.4**	-2.35	0.3	0.11
0	0.4	2.7**	1.96	-1.9**	-2.12	0.8	0.04
0	0.6	2.8***	2.70	-2.2**	-2.45	0.6	0.40
60	0.05	4.1***	2.44	-2.1*	-1.68	2.0*	1.85
60	0.1	3.0**	2.05	-2.3**	-2.40	0.7	1.38
60	0.25	3.4***	2.80	-2.0***	-3.05	1.4	1.58
60	0.4	2.9***	3.41	-1.7***	-3.21	1.2**	2.05
60	0.6	1.8**	2.34	-1.3***	-3.76	0.5	0.91

Notes: 1. Z-value[1]is Wilcoxon rank sum test; Z-value[2]is Wilcoxon signed rank test.
2. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.

Table 5. Estimated results for regression models for husband's, wife's, and joint decisions; dependent variable is the difference between later and sooner allocations $(c_{t+\tau} - c_t)$

Variables	Husband		Wife		Joint	
	(1)	(2)	(3)	(4)	(5)	(6)
Interest rate (ln(1+r))	110.025***	110.025***	118.737***	118.737***	111.131***	111.131***
	(5.156)	(5.167)	(4.745)	(4.754)	(4.533)	(4.547)
Present time dummy	-10.686***	-10.686***	-13.918***	-13.918***	-10.309***	-10.309***
(1=today)	(1.905)	(1.909)	(1.685)	(1.688)	(1.635)	(1.641)
Husband trust payments		6.496**				2.261
(scale from 1 to 5)		(2.647)				(1.879)
Husband age (years)		-0.034				-0.105
		(0.185)				(0.451)
Husband higher than primary		-4.830				-6.569*
school (1=yes)		(4.172)				(3.576)
Husband communist party		-1.122				7.090*
member (1=yes)		(4.730)				(3.688)
Wife trust payments				4.676**		0.772
(scale from 1 to 5)				(1.838)		(2.097)
Wife age (years)				0.311*		0.383
				(0.163)		(0.456)
Wife higher than primary school				-6.693		0.226
(1=yes)				(4.315)		(4.491)
Household is minority (1=yes)		-11.590*		0.991		-1.772
		(6.703)		(5.152)		(5.737)
Log of equivalence scaled total		0.089		-1.537		1.055
gross income (yuan)		(2.526)		(2.181)		(2.758)
The number of children below		-1.295		-3.449*		-3.657*
age 16		(2.190)		(1.834)		(1.891)
Constant	9.935	-11.682	12.127**	-3.595	13.344**	-17.598
	(6.844)	(29.759)	(5.758)	(22.601)	(6.630)	(30.103)
Utility curvature parameter($\hat{\rho}$)	0.009***		0.008***		0.009***	
	(0.0004)		(0.0003)		(0.0004)	
Present bias parameter($\hat{\beta}$)	0.907***		0.889***		0.911***	
	(0.016)		(0.013)		(0.013)	
Observations	1640	1640	1640	1640	1640	1640
R-squared	0.284	0.319	0.376	0.418	0.322	0.355

Notes: 1. Dependent variable is the difference between sooner and later allocations in level form: C1-C0.

2. Standard errors of utility curvature parameter and present bias parameter are obtained by delta method.

3. All regressions are clustered at household level. Figures in parentheses are robust standard errors.

4. We control for order and experimenter effects in all the regressions. We also control for initial control effects in Columns (5) and (6).

5. Village fixed effects are also controlled in all regressions.

6. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.

Table 6. Estimated results for regression models for joint allocation decisions; dependent variable is the difference between later and sooner allocations ($c_{t+\tau} - c_t$)

	(1)	(2)
Husband's decision	0.492***	0.508***
	(0.045)	(0.081)
Wife's decision	0.359***	0.353***
	(0.041)	(0.087)
Husband's decision× 20 tokens to wife		0.052
		(0.124)
Husband's decision× 20 tokens to husband		-0.142
		(0.116)
Husband's decision× 10 tokens to each		0.021
		(0.097)
Wife's decision × 20 tokens to wife		-0.037
		(0.134)
Wife's decision× 20 tokens to husband		0.081
		(0.120)
Wife's decision× 10 tokens to each		-0.020
		(0.101)
Constant	8.975**	9.276**
	(3.770)	(3.607)
Observations	1640	1640
R-squared	0.590	0.595

Notes: 1. Joint, husband's and wife's decision is the difference between sooner and later allocations in level form: C1-C0.
2. All the regressions are clustered at household level. Figures in the parentheses are robust standard errors.
3. We control for order and experimenter effects in all the regressions.
4. Village fixed effects are also controlled in all the regressions.
5. *, **, and *** represent the significant level at 10%, 5%, and 1%, respectively.

Table 7. Estimated results for regression models for joint allocation decisions; dependent variable is the difference between later and sooner allocations ($c_{t+\tau} - c_t$), with interaction terms for husband's and wife's decisions.

Individual decisions × Individual characteristics	Level form regression		
	(1)	(2)	(3)
Husband decision	0.489**	0.474**	0.381*
	(0.218)	(0.218)	(0.225)
Wife decision	0.196	0.179	0.289
	(0.193)	(0.185)	(0.198)
Husband decision × absolute difference between husband and wife sooner decision	0.005	0.005	0.004
	(0.003)	(0.003)	(0.004)
Wife decision × absolute difference between husband and wife sooner decision	0.000	0.000	-0.004
	(0.004)	(0.003)	(0.004)
Husband decision × dummy if husband is more patient than wife			0.146
			(0.104)
Wife decision × dummy if husband is more patient than wife			-0.074
			(0.112)
Husband decision × husband age (years)	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.004)
Husband decision × husband higher than primary school (1=yes)	-0.006	-0.014	-0.012
	(0.036)	(0.037)	(0.037)
Husband decision × husband communist party member (1=yes)	-0.061	-0.048	-0.042
	(0.048)	(0.047)	(0.045)
Husband decision × If husband answered financial conflict with spouse (1=yes)		-0.060	-0.067
		(0.066)	(0.064)
Husband decision × If husband answered it's him making decisions on financial savings (1=yes)		0.062*	0.061*
		(0.034)	(0.034)
Wife decision × wife age (years)	0.005	0.005	0.005
	(0.004)	(0.004)	(0.004)
Wife decision × wife higher than primary school (1=yes)	0.073*	0.081*	0.083**
	(0.041)	(0.041)	(0.040)
Wife decision × If wife answered financial conflict with spouse (1=yes)		0.026	0.033
		(0.043)	(0.043)
Wife decision × If wife answered it's her making decisions on financial savings (1=yes)		0.049	0.054
		(0.036)	(0.035)
Constant	9.824**	9.873**	8.176*
	(4.373)	(4.350)	(4.271)
Observations	1640	1640	1640
R-squared	0.596	0.599	0.600

Notes: 1. Joint, husband's and wife's decision is the difference between sooner and later allocations in level form: C1-C0.
2. All regressions are clustered at household level. Figures in parentheses are robust standard errors.
3. We control for initial control effects, order effects and experimenter effects in all the regressions.
4. Village fixed effects are also controlled in all the regressions.
5. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.

Table 8. Estimated results for husbands' and wives' influence, and wives' relative influence

Individual influence	Mean	Std. Dev	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
Husband's influence	0.46	0.05	0.41	0.43	0.46	0.49	0.51
Wife's influence	0.44	0.05	0.38	0.40	0.43	0.47	0.50
Wife's relative influence	0.97	0.17	0.76	0.84	0.96	1.08	1.20

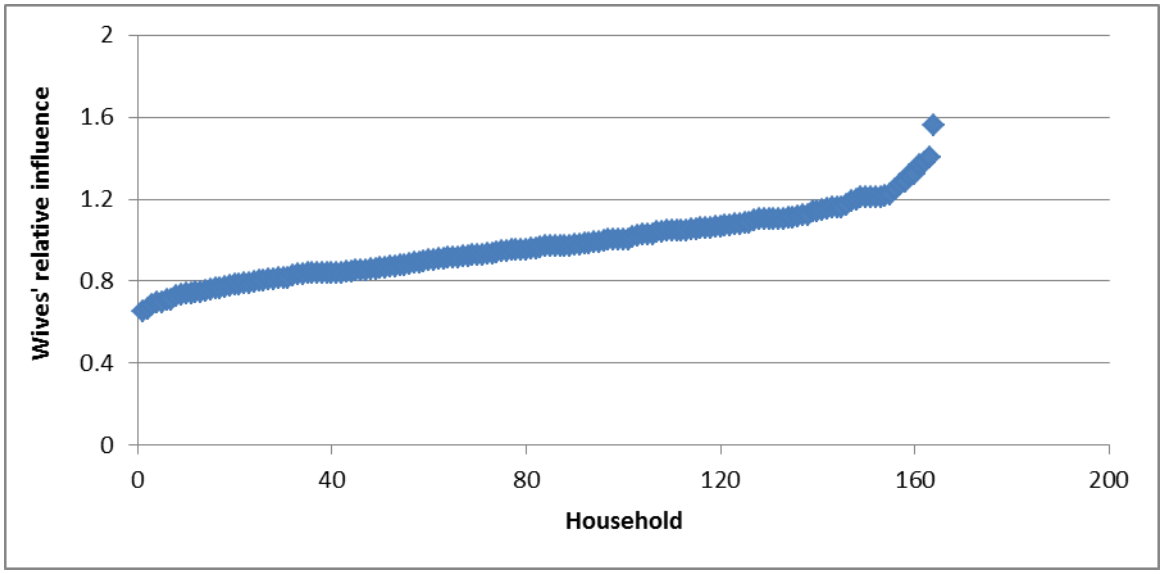

Figure 1. The distribution of wives' relative influences

Table 9. Estimated results for regression model on wives' relative influence

Household characteristics	Coefficients
Wife older (1=yes)	0.012
	(0.033)
Wife more educated (1=yes)	0.041
	(0.031)
Wife's income contribution (%)	-0.020
	(0.075)
Household is minority (1=yes)	-0.069**
	(0.031)
Log of equivalence scaled total gross income (yuan)	0.009
	(0.015)
Length of marriage (years)	0.011***
	(0.001)
Number of children under 16 years old	-0.022*
	(0.013)
If household experienced serious illness or death in the past two years (1=yes)	-0.005
	(0.022)
If couple is living with husband's parents(1=yes)	-0.023
	(0.025)
If financial conflict with spouse(1=yes)	0.017
	(0.023)
If both husband and wife agreed that husband makes decisions on savings (1=yes)	-0.045**
	(0.023)
If both husband and wife agreed that they jointly make decisions on savings (1=yes)	0.013
	(0.033)
Constant	0.667***
	(0.149)
Observations	164
R-squared	0.464

Notes: 1. Figures in parentheses are standard errors.

2. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.