Strategic Interactions between Parents and Daughters: Co-residence, Marriage, and Intergenerational Transfers in Japan*

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Abstract

Over the last few decades, the fraction of young adults residing with their parents has risen in many countries. In this paper, to understand the extent of the determinants of intergenerational co-residence, we develop and estimate a model of decision-making about family co-residence, intergenerational monetary transfers, and marriage. The model incorporates differences in parents' tastes about marriage and co-residence of their child, cultural heterogeneity, and altruism within the family. As environmental factors that influence the co-residence and marriage decisions, we consider housing market conditions (housing rent)

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and marriage market conditions (matching probability). The model is estimated using a unique panel dataset on young women in Japan, which contains unusually rich information on monetary transfers between parents and children, regardless of whether the child resides with the parent. The estimated model is used to study the effects of strategic parental transfers and to perform a variety of counterfactual policy experiments of the kind recently introduced or being considered in Japan. For example, we assess how the strategic transfers affect the choices and the welfare of the parents and the children. We also evaluate the quantitative impact of housing policies, such as rent subsidy programs aimed at young people. In addition, we analyze the effect of government intervention in the marriage market in the form of the newly instituted and government-supported matching services.

Keywords: Co-residence, Strategic Interactions, Intergenerational Transfers, Marriage

JEL Classifications: D13, J12, J18

1 Introduction

In many countries, young people tend to live with their parents well into adulthood. For example, in Greece, Italy, and Japan, more than 40% of young adults aged 25-34 lived with their parents in 2000. As can be seen in Figure 1, many countries have seen an increase in the fraction of co-residing young adults over the last few decades.[1] Young adults usually have the option of living alone or with spouses, which suggests that there must be some perceived psychic or economic benefit from parental co-residence, either to the parents or to the children. Co-residence often ends when children get married, although, interestingly, in Japan it is fairly common for children to live with their parents even after marriage.

Another interesting pattern in cross country comparisons is that co-residence rates vary significantly. For instance, a much larger fraction of young adults in the southern European countries (such as Italy, Greece, Spain, and Portugal) and Asian counties (such as Japan) live with their parents than those in some other European countries (such as the United Kingdom, Germany, France, Belgium, Luxembourg, and the Netherlands), Canada, and the United States. As Figure 2 shows, there is significant difference between the first group of countries and the second group.[2] Such differences can arise from different housing market conditions, different marriage markets, or different roles played by parents. This paper develops an economic model of decision-making about co-residence and marriage and uses the model to explore the major determinants of observed patterns of residence, marriage, and monetary transfers. The model is

[1] From the Census of Japan reported by the Statistics Bureau, we calculate the statistics for Japan. The statistics for Italy, Greece, Spain, and Portugal are based on the EU Labour Force Survey. In the United States, the fraction of young adults aged 25-34 has increased from 10.1% in 1980 to 14.2% in 2000. We construct these statistics using the Integrated Public Use Microdata Series (IPUMS).

[2] The statistics in the United States are constructed from IPUMS, and those in European countries are calculated from the EU Labour Force Survey, as we explain before. The co-residence rate in Japan is obtained as the fraction of young adults in the age group living with parents by summing up the total number of people whose ages are in the age range using the statistics of co-residence reported in the Census of Japan. They have reported the statistics of co-residence since the year 1995.

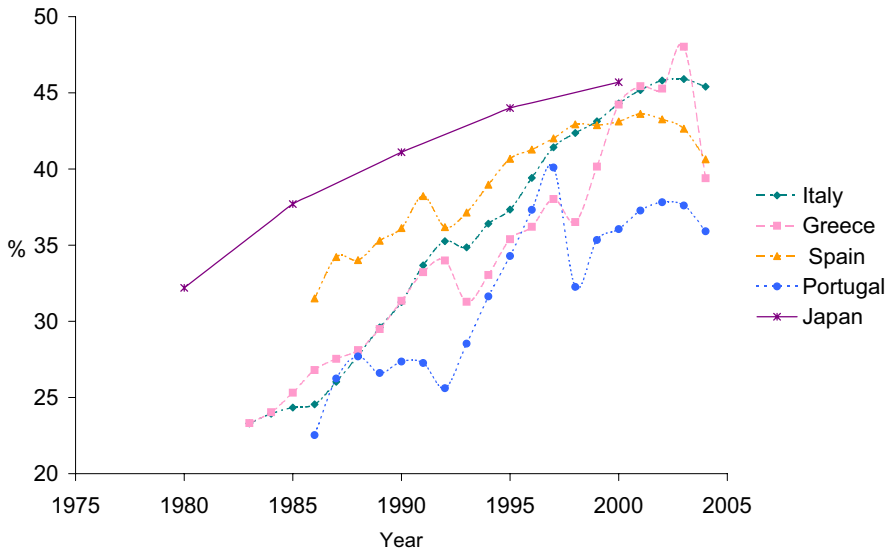

Figure 1: Young adults aged 25-34 living with parent(s)

estimated using data from the Japanese Panel Survey of Consumers.

In analyzing the determinants of co-residence decisions, there are several important factors to consider. The first is marriage. Never-married young adults are more likely to live with their parents than married young adults in all countries. In 2000, the fraction of single young adults aged 25-34 living with their parents is 81% in Italy, 65% in Japan, and 28% in the United States. In contrast, the fraction of married adults living with their parents is only 5%, 16%, and 5%, respectively.[3] One of the characteristics of co-residence in Japan is that the proportion of married adult children residing with parents is significantly higher than those in other countries such as European countries and the United States.

The second factor that affects living arrangements is housing cost. A shared residence brings potential economies of scale in housing cost, but also comes with costs such as loss of privacy. Patterns in the data indicate, however, that housing prices

[3]The statistics of singles exclude the widowed and the divorced. We construct the statistics in Italy using the EU Labour Force Survey, and the statistics in the United States using IPUMS. We calculate the statistics in Japan using the information on co-residence in the Census of Japan.

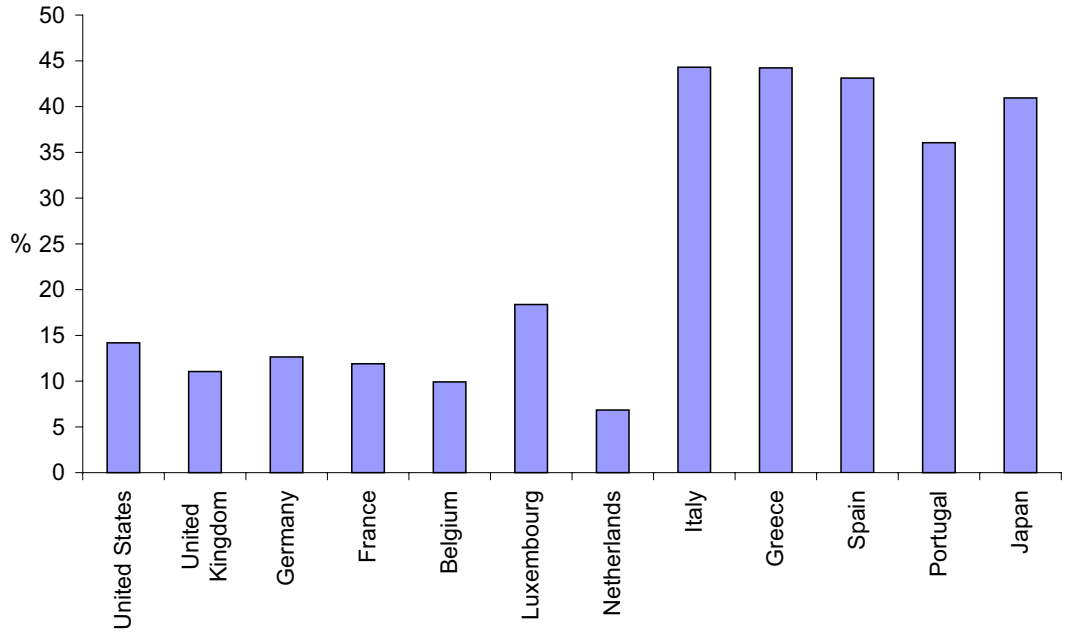

Figure 2: Young adults aged 25-34 living with parent(s) in year 2000

cannot be the sole determinant of co-residence behavior. For example, in 2000, the proportion of young adults aged 25-34 living with their parents in Japan is 41%, which is much higher than the corresponding number in the United Kingdom (11%). Both countries have relatively high housing prices, but we observe a large heterogeneity even within this high-housing-price group of countries. Across some regions in Japan, the housing price and co-residence pattern even have a *negative* correlation. For example, the proportion of young adults aged 25-34 living with their parents is 32% in Tokyo, but is around 55-60% in agricultural areas (with cheaper housing cost) in 2000.

Cultural heterogeneity provides a possible explanation for these patterns, because families in rural areas may be more likely to adopt more traditional living arrangements. The model estimated in this paper aims to distinguish separate effects of housing costs and of cultural values, which is modeled as a source of unobserved heterogeneity. An example of a cultural value is that, in Japan, married couples are more likely to live with the husband's parents than with the wife's parents. The likeliness of co-residence also

differs by birth orderings of siblings. Among married young couples living with parents, 77% live with the husband's parents according to a household survey in Japan.[4] This percentage is higher (91%) for the eldest son than the non-eldest son (42%). Existing norms may have arisen as conventional wisdoms that provide priority and duty to particular children, so that conflicts in a family associated with these decisions do not arise. We estimate the importance of these type of cultural norms in determining co-residence patterns.

The fourth factor that is key to understanding the co-residence behavior is the existence of monetary and in-kind transfers. Co-residence can be regarded as an in-kind transfer from parents to their children. In Japan, financial transfers between parents and their children are also quite common, and it appears that financial transfers are closely linked to the co-residence decision. The frequency of intra-household transfers of money surpasses that of inter-household transfers. In 2000, about 20% of single adults aged 20-34 living with parents receive financial transfers from parents, while only 9% of singles living alone do.[5] This implies that a child who receives in-kind transfers also tends to receive monetary transfers. Most existing studies about intergenerational financial transfers consider only transfers from parents to children.[6] In reality, however, monetary transfers in the opposite direction often happen. Tranfers from children to parents are closely related to co-residence patterns. In 2000 Japan, 60% of single young adults aged 20-34 living with their parents hand some money to their parents, while 30% of singles living alone do.[7]

[4]Later we explain the dataset, the Japanese Panel Survey of Consumers.

[5]These statistics are reported by the cabinet office, the government of Japan.

[6]Most of the empirical literature (for example, Bernheim, Shleifer, and Summers, 1985; Brown, 2003; Horioka, 2001; and Ohtake and Horioka, 1994) analyzes bequests, although some researches such as Cox (1987, 1990) and Cox and Rank (1992) analyze inter-vivos transfers. The theoretical work of Kotlikoff, Razin, and Rosenthal (1990) considers transfers in both directions.

[7]Similarly, 47% of co-resident married young adults hand monetary transfers to their parents, while only 8% of non-co-resident counterparts do. About 18% of co-resident married young adults receive monetary transfers, whereas 12% of non-co-resident counterparts do. This phenomenon is not particular to Japan. For instance, Kochar (2000) also points out that "only 4 percent of parents

As noted above, the model developed in this paper is estimated using the Japanese Panel Survey of Consumers, a unique dataset that permits estimation of a rich model that incorporates all of the above elements. It is a panel dataset on young women in Japan that includes information on co-residence, parental income, siblings and siblings' gender composition, housing rent, marital status, and spouse characteristics. Importantly, the data contain information on monetary transfers between parents and children (in both directions), regardless of whether children co-reside with their parents. Transfer data of this sort are rarely available, but they are invaluable for empirically studying strategic parent-child interactions.

In the behavioral model, parents behave strategically in a way that may affect their daughter's choices about co-residence and marriage. Specifically, daughters possibly receive marriage offers and parents offer a menu of co-residence and monetary transfer options that can depend on whether the daughter accepts the marriage offer. The daughters choose one of the options (including the possibility of staying single), according to the utility that each option provides. When making the offer, parents take into account their children's tastes and the economic environment, such as the level of housing rents within their region of residence. Taste and cultural heterogeneity, housing market conditions, and the condition of the marriage market all potentially influence the choices that parents and children make. For example, parents with a strong preference for co-residence may offer a large financial transfer to their daughter contingent on living with them, while strongly altruistic parents may offer a large unconditional transfer. As described in detail in the paper, the model is estimated using indirect inference and simulation methods.

After estimating the model, we use it to perform a variety of counterfactual and policy experiments. First, we assess how parental strategic transfers affect the choices and the welfare of the parents and the daughters. We find that the co-residence rate increases by 6.2 percentage points and the marriage rate decreases by 2.6 percentage

received income transfers from non-resident children, whereas as many as 85 percent of the elderly aged 60 or more co-resided with adult sons in the household survey data of rural Pakistan."

points if there is no strategic money between parents and children. According to the estimated model, some parents would charge their children more than imputed rent contingent on co-residence so that parents and children divide net monetary gain in terms of housing rent. Many parents provide larger net transfers contingent on their daughters getting married. Eliminating strategic monetary transfers reduces the marriage rate. Second, we evaluate the effects of parental involvement; in-kind transfers and monetary transfers. We find that the marriage rate increases by 2.6 percentage points in the absence of parental involvement. We also find that there is large welfare loss for parents and daughters if no intergenerational transfers exist.

Third, we assess the impact of a variety of government interventions of the kind recently introduced or being contemplated in Japan. For example, we evaluate the impact of government intervention in the marriage market, notably of the recently introduced government-supported matching services that can be thought to affect marriage offer probabilities. We find that the government policy, which raises matching probabilities by 5 percentage points, increases the marriage rate by 2.4 percentage points, and decreases co-residence by 1.4 percentage points. We also study the impact of housing rent subsidy programs for young people. We find that even if the government provides financial support of a half of rent to young people living alone, the co-residence rate decreases by only 2.6 percentage points on average.

This paper is organized as follows. The next section briefly reviews the related literature. Section 3 describes our model. Section 4 explains the data. We estimate the model in Section 5 and describe the result in Section 6. In Section 7, we perform a variety of counterfactual experiments. Section 8 concludes.

2 Literature

Intergenerational co-residence of young adults and their parents[8] is related to important economic behaviors and welfare programs. Hence, the existing literature studies its relationship with those variables. However, the progress on empirical research is still in the early stages. The empirical literature in this area consists of mainly two different streams. The first approach (method A) estimates relationships between variables, and interprets the obtained relationships with or without an economic model, which is not technically connected to the estimation procedures. The second approach (method B) is considered to estimate a discrete choice model of one representative economic agent given indirect utility.

Along with the method A, Manacorda and Moretti (2005) study the correlation between the co-residence fraction of young men and parental income, while Kochar (2000) analyzes the correlation between fathers' labor participation and the income of the co-resident sons. Manacorda and Moretti (2005) interpret that young Italian men living with parents financially benefit from co-residence, whereas Kochar (2000) interprets that fathers in rural Pakistan financially benefit from intergenerational co-residence.

Each existing study using method B incorporates different variables as covariates in their regressions, which can be interpreted as explanatory variables in a linear indirect utility function of an economic agent. In Hu's (2001) results, welfare benefits to parents, which differ by living arrangements, affect the choice of whether parents and child live apart. The results of Hu (2001) and Haurin, Hendershott, and Kim (1993) imply that welfare benefits to children do not influence co-residence decisions. Haurin, Hendershott, and Kim (1993), and Börsch-Supan (1986) consider more than two alternatives related to housing and living arrangements, but they do not use infor-

[8]We study the co-residence of young adults and their parents rather than that of elderly parents and their child, as in Pezzin and Schone (1999). In their study, as the parents' generation consists of the elderly, they analyze issues about informal care-giving from daughters to parents and work participation of the daughters.

mation that can affect parental income in their regressions. Their results suggest that housing costs influence co-residence. Among these researches, Haurin, Hendershott, and Kim (1993) and Hu (2001) use instruments in order to control simultaneous bias of covariates.

In contrast, McElroy (1985) and Rosenzweig and Wolpin (1993, 1994a) directly endogenize economic variables that their analyses focus on. McElroy (1985) considers a joint decision of whether to live with parents and labor supply by a young never-married male. Rosenzweig and Wolpin (1993, 1994a) consider co-residence and whether children receive financial transfers or not as discrete alternatives.

All the above research except Kochar (2000) and Rosenzweig and Wolpin (1993, 1994a) implicitly assumes that there is no unobserved permanent heterogeneity such as culture or innate ability that possibly affects covariates. In contrast, among the studies using the method B, Ermisch (1999), which studies the correlation between housing price and co-residence, and Rosenzweig and Wolpin (1993, 1994a) allow individual specific heterogeneity.

The first limitation of the existing literature is that estimated parameters are not fundamental parameters or a mixture of fundamental parameters in a particular environment only. The results using method A show only an aggregated relationship between co-residence and the variable of their interests in a specific situation, which is realized and observed in the data. Even if they use a random utility model by using the method B, a decision maker is either a child only or a single economic agent who represents a pair of parents and a child. They estimate indirect utility of a whole aggregated household rather than an individual's utility function. However, it is natural to presume that individuals, that is, parents and their young adult offspring, can be endowed with different preferences concerning co-residence, and that they negotiate about family decisions of co-residence. In these papers, we can measure the impact on co-residence by altering values of an explanatory variable. However, to the extent that the aggregated relationship between variables in a particular environment does not represent the true technological relationship, experiments based on these estimates cannot

derive appropriate outcomes corresponding to a hypothetical change in the variable.

Second, there is a limitation regarding unobserved permanent heterogeneity. Intergenerational co-residence decisions seem to be closely related to culture and social norms, which can be considered as individual specific unobserved heterogeneity. The existing literature either assumes that no individual specific effects exit, or estimates conditioning on the heterogeneity.[9] Since they exclude unobserved permanent heterogeneity either from a model or from an estimation, they cannot recover marginal distributions necessary to perform counter-factual experiments.

Third, the existing literature typically assumes that marital status is given, whereas marriage decisions must play a key rule in any study of co-residence decisions.

Fourth, the existing empirical literature lacks information about intergenerational transfers of money. Although studies such as Ermisch (1999) and Manacorda and Moretti (2005) discuss transfers from parents to their children contingent on co-residence as an interpretation, they do not use the information on transfers in their estimation. Rosenzweig and Wolpin (1993, 1994a) use information about an indicator of whether transfers take place when living apart only.

3 Model

We construct a model of a family in an environment, where the players are a young female (daughter) and her parents. The decision horizon begins at a year when the daughter is a never-married young adult. It is a repeated bargaining model in which parents and their daughter are involved in a sequence of one-shot transactions until the daughter gets married. We focus on the transition periods, in which youths are in their twenties or thirties and are most likely to form new families.[10] Economic

[9] In other words, they use sufficient statistics to identify only parameters other than the fixed effects.

[10] We exclude situations such that married couples live alone at early stages of their marriage and return to their parents' home, as such co-residence behavior when parents are elderly should be studied from a different angle, such as care-giving.

agents' decisions are static in the sense that history does not affect their decisions. However, the state variables which are not determined by the past actions, influence their decisions.

We describe decisions of a family as a bargaining game, because intergenerational co-residence and associated economic behavior can be considered as an agreement between parents and their children. A conflict of interests among family members possibly exists, as each individual could be endowed with different preferences about the outcome. Yet, both generations have to approve the intergenerational transaction.

Each period consists of a two-stage game. In the first stage, parents make an offer of net transfers contingent on the daughter's marital and co-residential status, $t^F \in \mathbb{R}^5$ (as we explain later, there are five possible combinations of marital and co-residence status). In the second stage, the daughter makes a decision about co-residence q and marriage x. There are five possible combinations of marital and co-residential choices: staying single and living alone ($x = s, q = 0$), staying single and living with her parents ($x = s, q = 1$), getting married and living alone ($x = m, q = 0$), getting married and living with her own parents ($x = m, q = 1$), and getting married and living with her husband's parents ($x = m, q = 2$). Parents decide net transfers in each of these states, $t^F \equiv (t^F_{s0}, t^F_{s1}, t^F_{m0}, t^F_{m1}, t^F_{m2})'$. Here, t^F_{ij} is the net amount of transfer when $x = i$ and $q = j$. As transfers are a contingent offer, the parents' strategy is represented as a five dimensional continuous variable. A daughter has the option to reject her parents' offer and not to live with them. In this case, she can choose from the options with $q \neq 1$, that is, $(s0, m0, m2)$. Therefore, there are eight possible alternatives a daughter decides on in total.

A daughter and parents respectively have their own tastes about intergenerational co-residence and marriage of the daughter. The daughter is endowed with preferences per period over c^F (daughter's consumption), c^P(parents' consumption), and q (co-residential status). The parents are endowed with preferences per period over c^P(parents' consumption), c^F (daughter's consumption), t^F(net transfers), x (marital status of daughter) and q (co-residential status). The utility of each economic agent

depends on the consumption of the other agent. Hence, we allow two-sided altruism.[11] The utility per period also depends on the vector of shocks per period to preferences over marital and co-residential status, ϵ, and their type of unobserved cultural heterogeneity, which we explain later. The detailed explanations are in the appendix.

When staying single, the daughter has to pay rent r_s in the market if she lives alone and imputed rent $\rho_s \cdot r_s$ if she lives with parents, where $\rho_s \geq 0$. The single daughter's budget constraint is, thus, $c^F + r_s \cdot I\{q = 0\} + \rho_s \cdot r_s \cdot I\{q = 1\} \leq y^F + t^F_{sq}$. Here, $I\{X\}$ is the indicator function which takes 1 if X is true and 0 if X is false. y^F is the daughter's income. When marriage is cooperative, a young couple pools income and transfers, and pays rent r_m if they live alone and imputed rent $\rho_m \cdot r_m$ if they live with parents, where $\rho_m \geq 0$. The married daughter's budget constraint is, thus, $c^F + c^M + r_m \cdot I\{q = 0\} + \rho_m \cdot r_m \cdot I\{q = 1 \vee q = 2\} \leq y^F + y^M + t^F_{mq} + t^M_q$, where c^M, y^M, t^M_q are the husband's consumption, income, and net transfer from his parents. The husband's transfer only depends on the living arrangement. Parents' consumption in each state is their income minus net transfer, $c^P = y^P - t^F_{xq}$. While parents and their offspring care about each other's welfare, they respectively face different budget constraints.[12]

Note that the daughter has to pay imputed rent when she lives with parents. Hence, we do not assume economies of scale. Shared residence potentially brings about economies of scale. At the same time, costs of privacy and congestion can arise. Parents possibly give up amenity to a certain degree. These costs to the parents are covered by the imputed rents they charge to their never-married daughter or to the young married couple. It is possible that parents provide a higher level of positive net transfers than the amount of imputed rent when they live together. In that case, the daughter receives the difference as financial transfer. The difference between mar-

[11] Becker (1974b) analyzes social interactions. Our model incorporates social interactions as parents' concern about marriage and co-residence status of their daughter and altruism between parents and a daughter.

[12] Altonji, Hayashi, and Kotlikoff (1992) empirically reject the hypothesis that all family members share a common budget constraint.

ket housing rent and imputed rent stems from the combined effect of housing market imperfection, economies of scale, and costs such as privacy. If the housing market is perfect, parents can rent a room to someone else, and provide positive financial transfer to their children out of the obtained rent, for example. The economies of scale may work in the same way regardless of whom parents share with. The costs, such as a lack of privacy, can be different in the case of sharing a house with someone else from in the case of living with their children. The costs may also be higher when parents live with their married couple children than when they live with their never-married daughter. The utility parents obtain from living with their children may offset the costs associated with co-residence. It is incorporated as preference of parents over residential status. If parents prefer to live with their daughter, overall net intergenerational transfer amount contingent on co-residence reflects the parents' utility.

Each economic agent does not observe random shocks to preferences of the other economic agent. Preference shocks consist of individual specific shocks and time varying shocks. Hence, we allow the correlation of unobserved preference shocks for each family member over time.

The timing and information each player observes in each period is the following. At the beginning of the first stage, economic agents receive their gross earnings. The parents receive their gross earnings, y^P. The daughter has her gross earnings, y^F. The daughter meets a young male who wants to marry her in the marriage market with probability p^M. This probability is a function of the characteristics of the young female. The matching probability is interpreted to reflect decisions of the young male. The young male is characterized by gross earnings, y^M, and net transfers from his parents contingent on his co-residential status, t^M. The net transfers are considered to reflect the preferences of the male's parents about co-residential status and their altruism. Next, random preference shocks of parents, ϵ^P, are realized. Observing this information, parents make an offer of contingent net transfers to the daughter in the first stage. Net transfers can be positive or negative. In other words, transfers can be

from parents to a child or from a child to parents.[13] Here, net transfers parents decide include both financial transfers and in-kind transfers of living together. The parents' offer specifies this total net amount of transfers from parents to their child, yet they take into account that they charge imputed rent if they live together. One incentive that the parents provide transfers to their daughter is altruism. The other incentive is that they are endowed with their own preference for co-residence and try to influence the action of their daughter. They may also provide negative net transfers because their budget is tight but their daughter's welfare is high enough, or because they do not like a specific option their daughter has and are trying to manipulate her decision.

At the beginning of the second stage, random shocks to a daughter's preference are realized. In the second stage, knowing parents' action and all the information above, the daughter makes a decision about marriage, co-residence, and whether to accept parents' offer. The daughter has the option to reject her parents' offer contingent on not living with her own parents. When the daughter rejects her parents' offer, the net transfer is zero. The daughter makes a choice considering her own preferences and caring about the welfare of both herself and her parents. She rejects an offer if it causes very low welfare for either of them. Note that the daughter is not passive as she can reject the offer. The option of rejection and altruism toward parents empowers the daughter. This can be the threat to parents when they make an offer in the first stage.

The parents and the daughter make choices considering their future consumption. The daughter's consumption when married is based on Nash bargaining between a husband and a wife, in which they jointly decide each of their consumption levels. The daughter's consumption when single is based on maximization of her own utility subject to her own budget constraint.

Each period is a finite extensive game with perfect information. Thus, we can solve the game by backward induction. The solution is characterized as a subgame perfect equilibrium. First, we solve a consumption choice problem of a single daughter. Second,

[13]Existing empirical literature typically does not take into account the fact that transfers can happen in both directions, even if their models include transfers from parents to a child.

we consider the Nash bargaining problem between the husband and the wife to obtain consumption when married. Third, we solve the marriage and co-residence decision by the daughter. Fourth, we discuss contingent net transfer decisions by parents.

The utility of a young female (daughter) can be written as

$$\begin{aligned} &W(c^F, c^P, q, \epsilon^F_{xq}) \\ &\quad = \max\{C^F(c^F, c^P, q, \gamma, \epsilon^F_{mq}), S^F(c^F, c^P, q, \epsilon^F_{sq})\}, \end{aligned} \tag{1}$$

where C^F is the utility of a married daughter, and S^F is the utility of a single daughter. The married daughter's utility depends on matching quality of γ. The matching quality is a surplus from marriage, which we explain later when we mention a Nash bargaining game between a husband and a wife.

3.1 Single

The consumption choice of the daughter who chose to stay single is as follows. She chooses her consumption level to maximize her utility under her budget constraint. For each co-residence status, $q = 0, 1$, her utility is

$$\begin{aligned} &V^q_s \equiv \max_{c^F} S^F(c^F, c^P, q, \epsilon^F_{sq}) \\ &\quad s.t. \quad c^F + r_s \cdot I\{q = 0\} + \rho_s \cdot r_s \cdot I\{q = 1\} \leq y^F + t^F_{sq} \\ &\qquad\quad c^P = y^P - t^F_{sq}, \end{aligned} \tag{2}$$

where $\rho_s \cdot r_s$ is imputed rent paid to co-residing parents.

3.2 Nash bargaining

A married couple decides their consumption to maximize their Nash product under the pooled budget.[14] There is additional positive utility of matching quality, γ, when marriage is cooperative. When marriage is not cooperative, a husband and a wife do not pool their income and each pays half of the housing rent. Certain portions of

[14]Since the work by Becker (1973, 1974a) points out the important aspects of marriage decisions, the literature (for example, McElroy and Horney, 1981; Browning, Bourguignon, Chiappori, and Lechene, 1994) studies allocation decisions within a family.

income $(1-z_q^F, 1-z_q^M)$ are destroyed in this case. Threat points are their utility under non-cooperative marriage $(\overline{C_q^F}, \overline{U_q^M})$. The Nash bargaining of a married couple in each co-residence state is written as follows.

For $q = 0, 1, 2$, the Nash bargaining problem is

$$\begin{aligned} &\max_{c^F, c^M} \left(C_q^F - \overline{C_q^F}\right)^{\pi} \left(U_q^M - \overline{U_q^M}\right)^{1-\pi} \\ &\quad s.t. \quad c^F + c^M + r_m \cdot I\{q=0\} + \rho_m \cdot r_m \cdot I\{q=1 \vee q=2\} \\ &\qquad\qquad \leq y^F + y^M + t_{mq}^F + t_q^M \\ &\qquad c^P = y^P - t_{mq}^F, \end{aligned} \tag{3}$$

where $0 < \pi < 1$ is the wife's bargaining power and $\rho_m \cdot r_m$ is imputed rent paid to co-residing parents. Here, $C_q^F \equiv C^F(c^F, c^P, q, \gamma, \epsilon_{mq}^F)$ is the utility of a married daughter given q and $U_q^M \equiv U^M(c^M, q, \gamma)$ is the utility of a young male given q. Also,

$$\begin{aligned} &\overline{C_q^F} \equiv \max_{c^F} C^F(c^F, c^P, q, \gamma, \epsilon_{mq}^F) \\ &s.t. \quad c^F + \tfrac{r_m}{2} \cdot I\{q=0\} + \tfrac{\rho_m \cdot r_m}{2} \cdot I\{q=1 \vee q=2\} \leq z_q^F(y^F + t_{mq}^F) \\ &\qquad c^P = y^P - t_{mq}^F \\ &\qquad \gamma = 0, \end{aligned}$$

and $0 < z_q^F < 1$ is a portion of the daughter's own income, which is not destroyed under non-cooperative marriage. Similarly,

$$\begin{aligned} &\overline{U_q^M} \equiv \max_{c^M} U^M(c^M, q, \gamma) \\ &s.t. \quad c^M + \tfrac{r_m}{2} \cdot I\{q=0\} + \tfrac{\rho_m \cdot r_m}{2} \cdot I\{q=1 \vee q=2\} \leq z_q^M(y^M + t_q^M) \\ &\qquad \gamma = 0, \end{aligned}$$

and $0 < z_q^M < 1$ is a portion of a husband's own income, which is not destroyed under non-cooperative marriage.

3.3 Daughter's strategy

Let's define the utility of a daughter as a result of optimization in each state. When a single daughter accepts her parents' offer, the utility evaluated at optimal consumption given co-residence status $q \in \{0, 1\}$ and transfers t^F is denoted as $V_s^{qA} \equiv$

$S^F(c^F, c^P, q, \epsilon^F_{sq})$ with $c^F = c^F_{sq}$ and $c^P = y^P - t^F_{sq}$, where c^F_{sq} is the optimum to the problem (2). Similarly, let the utility of a married daughter evaluated at the Nash bargaining solution given $q \in \{0, 1, 2\}$ and t^F be $V^{qA}_m \equiv C^F(c^F, c^P, q, \gamma, \epsilon^F_{mq})$ with $c^F = c^F_{mq}$ and $c^P = y^P - t^F_{mq}$, where c^F_{mq} is the solution to the problem (3).

When the daughter rejects her parents' offer, the utility of a single daughter at optimal consumption given $q = 0$ and $t^F = 0$ is defined as $V^{0R}_s \equiv S^F(c^F, c^P, q, \epsilon^F_{sq})$ with $q = 0, t^F = 0, c^P = y^P$ and $c^F = c^F_{s0}$, where c^F_{s0} is the solution to (2) given $q = 0$ and $t^F = 0$. Similarly, the utility of a married daughter with rejection given $q \in \{0, 2\}$ and $t^F = 0$ is $V^{qR}_m \equiv C^F(c^F, c^P, q, \gamma, \epsilon^F_{mq})$ with $c^P = y^P$ and $c^F = c^F_{mq}$, where c^F_{mq} is the solution to (3) given $q \in \{0, 2\}$ and $t^F = 0$.

Then, a daughter makes a decision to maximize her utility:

$$\max_{(o,x,q)}\{V^{0A}_s, V^{1A}_s, V^{0A}_m, V^{1A}_m, V^{2A}_m, V^{0R}_s, V^{0R}_m, V^{2R}_m\}. \tag{4}$$

Her strategy is $\Upsilon^F : \Omega^F \to D$ such that (4) is satisfied, where $\Omega^F = \{t^F, y^P, y^F, t^M, y^M, \gamma, \epsilon^F, a, ed, sib, type\}$ is an information set, and $D = \{(A, s, 0), (A, s, 1), (A, m, 0), (A, m, 1), (A, m, 2), (R, s, 0), (R, m, 0), (R, m, 2)\}$ is the choice set. As we explain later in the section of culture heterogeneity, the information set includes *sib* (information about siblings of the daughter and those of her potential husband), and *type* (family type). a is the daughter's age, ed is her educational level. Among possible combinations in D, the daughter decides whether to accept or to reject $o \in \{A, R\}$, whether to stay single or to get married $x \in \{s, m\}$, and whether to live alone, to live with own parents, or to live with her husband's parents $q \in \{0, 1, 2\}$.

3.4 Parents' strategy

The daughter's preference shocks are uncertain to the parents. The parents construct expected utility based on their beliefs about their daughter's choice. Then, they make decisions about transfers to maximize their expected utility:

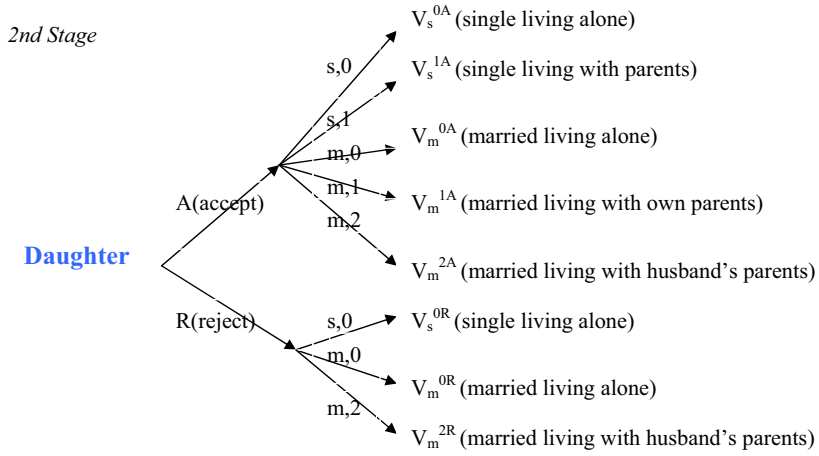

Figure 3: Daughter's actions

$$\begin{aligned} &\max_{t^F} EU^P(c^P, c^F, x, q, t^F, \epsilon^P) \\ &s.t.\ c^P_{xq} = y^P - t^F_{xq} \ \text{ for all } x, q. \end{aligned} \tag{5}$$

Parents' strategy is $\Upsilon^P : \Omega^P \to T$ such that (5) is satisfied, where $\Omega^P = \{y^P, y^F, t^M, y^M, \epsilon^P, a, ed, sib, type\}$ and $T = [-y^F, y^P]$[5] with minimum consumption restrictions. Note that consumption is always assumed to be equal to or greater than the minimum consumption level. Parents cannot offer a contingent transfer such that a consumption level of either themselves or the daughter is less than the minimum consumption. When parents cannot offer contingent transfer with which the minimum consumption restrictions are satisfied, the family cannot choose that marriage/co-residence combination.

3.5 Cultural heterogeneity

We assume that there exists culture heterogeneity. There are two types of families, modern family and traditional family. Economic agents know their own and others' family type. Econometricians cannot observe it, while they know that that there are two types of families. If a young daughter belongs to a traditional family, her choice

Choice set	#1	#2	#3	#4
Single live alone	o	o	o	o
Single live with parents	o	o	o	o
Married live alone	o	o	o	o
Married live with female's parents	o	x	o	x
Married live with husband's parents	o	o	x	x

Table 1: Choice set

of co-residing with her own parents when she is married is restricted depending on her siblings.[15] If she belongs to a modern family, she always has an option to live with her own parents.[16] Similarly, if a young male belongs to a traditional family, availability of co-residing with his parents is restricted depending on his siblings. If a male belongs to a modern family, the option to live with his parents is always available.

There are four possible combinations of a female's family type and her potential husband's family type, (modern, modern), (traditional,traditional), (modern,traditional), (traditional, modern). Let's name each family type combination A,B,C, and D, respectively.

Depending on family type combinations and siblings, there are four different sets of marital and co-residential choices. Table 1 displays possible choices in each set. Each row shows a marital and co-residential option. Each column represents a choice set. The mark of 'x' means that the choice is impossible and 'o' means possible.

In the choice set #1, all marital and co-residential choices are possible. The option to get married and to live with her own parents does not exist in the choice sets #2 and #4. The option of being married and living with her husband's parents is not allowed in the choice sets #3 and #4.

[15]Konrad et al. (2002) and Rosenzweig and Wolpin (1994b) find sibling inequality of co-residence in Germany, and in the United States, respectively. The latter empirically analyzes co-residence and public welfare conditioning on unobserved sibling and family characteristics.

[16]The option to get married and to live with her own parents is available as long as she receives a marriage offer and minimum consumption restrictions are satisfied in this case.

	Male is Eldest son	Male is Not eldest son
Female has a brother or she is Not eldest	#2	#4
Female has No brother and she is Eldest	#1	#3

Table 2: Choice set of family type combination B

	Male is Eldest son	Male is Not eldest son
Female has a brother or she is Not eldest	#1	#3
Female has No brother and she is Eldest	#1	#3

Table 3: Choice set of family type combination C

If a young female and a young male are both from modern family (family type combination A), the choice set is #1. Any choices are possible regardless of composition of siblings. The choice sets of family type combinations of B, C, and D are described in Tables 2, 3, and 4.

	Male is Eldest son	Male is Not eldest son
Female has a brother or she is Not eldest	#2	#2
Female has No brother and she is Eldest	#1	#1

Table 4: Choice set of family type combination D

Roughly speaking, if a young female belongs to a traditional family, she can have an option to live with her own parents even after getting married only when she has no brother and when she is the eldest daughter. If her potential husband is from a traditional family, the option to live with his parents is available only when he is the eldest son.

4 Data

We use micro data on households in Japan, and other data which allow us to match the micro data to the aggregated regional variables. The main data set used for the analysis comes from the Japanese Panel Survey of Consumers (JPSC) conducted by

the Institute for Research on Household Economics. The JPSC in the first survey had consisted of 1500 women in Japan, who were 24 to 34 years of age as of September 1993, and their family members. Beginning in 1997, the data for 500 women aged 24-27 as of year 1997, another cohort, were added. It is national random samples, hence, contains samples of all 47 prefectures in Japan. The sample proportions assigned to each region by age and by marital status is set to equal to the proportions in the census of Japan. The interviews have been conducted annually to the present. In this paper, we follow each woman who was single in the initial interview either until she got married or until the most recent interview.

5 Estimation

Due to the richness of the model, we can only solve the model numerically. We use a simulation based econometric method. There are three main difficulties. First, the model includes a five-dimensional continuous choice variable determined by parents. Because the set of choice variables is high dimensional, even a few points of grids of the choice variable generates a large choice set. As seen in the appendix, the observed data show that there exists both positive and negative net monetary transfers. Discretization to only a few points does not provide us with reasonable simulation outcomes. A larger number of grids makes the estimation infeasible. Moreover, we cannot use a gradient-based method, since the objective function of parents cannot guarantee smoothness and strict concavity. Hence, we use the simulated annealing method for the solution to parents' problem, which we explain in the appendix.

Second, even though the above method mitigates the computational burden, it still requires a lot of computation, and the simulation replication number cannot be very large. At the same time, we need a certain number of replications since the choice set in the model includes the continuous variable.[17] Estimation procedures which only provide consistency with an infinite number of replications are infeasible.

[17] In the estimation, we use one hundred replications.

Third, there are a lot of unobserved or missing values. For example, males' characteristics such as income and siblings are observable to an econometrician only when the respondents actually get married. Transfer data of married respondents are not observed until 1997. An exact likelihood based method requires us to integrate all these values over their distribution in order to construct the corresponding criterion function. By above reasons, we use indirect inference (Smith, 1993; Gouriéroux, Monfort and Renault, 1993; and Gallant and Tauchen, 1996).

In the estimation, we consider a rich auxiliary model and its parameters of φ. Using the auxiliary model, we obtain the pseudo- maximum likelihood estimator of φ_o based on the observed data ($\varphi_o \equiv argmax_\varphi L(\omega, \xi; \varphi)$, where $L(\cdot, \cdot; \cdot)$ is the likelihood function, ω denotes observations which correspond to endogenous variables in the behavioral model, and ξ denotes observations that correspond to exogenous variables), and that of φ_s based on simulation values conditional on initial exogenous conditions ($\varphi_s \equiv argmax_\varphi L(\omega, \xi^S(\theta); \varphi)$, where θ is a vector of parameters in the behavioral model, and $\xi^S(\theta)$ denotes simulation values of endogenous variables that depend on parameters). The estimator of parameters in the behavioral model is obtained by choosing the value which minimizes the distance between the estimates φ_o and φ_s with a metric. This procedure uses $dim\varphi$ information[18] to identify the parameters whose dimension is not larger than $dim\varphi$. The estimator is reduced to

$$\hat{\theta} \equiv argmin_{\theta \in \Theta} \{\varphi_o - \varphi_s(\theta)\}^\top \Lambda \{\varphi_o - \varphi_s(\theta)\}, \tag{6}$$

where the parameter set Θ satisfies the restrictions from the behavioral model, Λ is a symmetric positive semi-definite matrix that determines the metric. With moments as pseudo parameters, it is asymptotically equivalent to

$$\hat{\theta} \equiv argmin_{\theta \in \Theta} \{\textstyle\sum_{i=1}^n [K(\omega_i, \xi_i) - \frac{1}{S} \sum_{j=1}^S k(\omega_i, \epsilon_i^j; \theta)]\}^\top \Lambda \{\sum_{i=1}^n [K(\omega_i, \xi_i) - \frac{1}{S} \sum_{j=1}^S k(\omega_i, \epsilon_i^j; \theta)]\}, \tag{7}$$

[18]Here, $dim\varphi$ denotes the dimension of a vector φ. In the estimation, we use $dim\varphi = 503$.

where $K(\cdot,\cdot)$ and $k(\cdot,\cdot;\cdot)$ are functions, ω_i is a vector of exogenous variables, ξ_i is a vector of endogenous variables, ϵ_i^j is a vector of random draws, n is the total number of observations, and S is the total number of replications. It is a $\sqrt{n}$- consistent estimator with a fixed number of replications.

This can be viewed as the simulated method of moments on identity instruments (McFaddem, 1989; and Pakes and Pollard, 1989). To exploit as much information as possible from the observed data, we use conditional moment conditions. However, we do not use predetermined-ness assumption.

Note that the matching probability, the young male's earnings, and net transfers from the young male's parents are exogenous stochastic processes in the model. They are assumed to be functions of characteristics of the daughter and her family. These concepts are similar to "potential husband's earnings" ("matching equation") and "the arrival rate of a marriage opportunity" in Van Der Klaauw (1996). Since data on characteristics of males are available only when women are married, we estimate parameters in the stochastic processes together with all other parameters in the behavioral model in order to avoid selection bias problems. In contrast, Van Der Klaauw (1996) corrects selection bias after estimating choice probabilities and the equations separately.

6 Estimation Results

The figures 4, 5, 6, and 7 depict the fit of the model to the data.[19] The model captures patterns in the data well. The proportion of getting married declines as they get older. The proportion of co-residing with parents among women staying single decline as they get older. At a year of marriage, around 80% of young couples live alone, a larger portion lives with the husband's parents rather than the wife's parents. About 20% of women receive net transfers of money which are more than 5% of their parents'

[19] All the statistics are conditional on staying single until a previous year, but we abbreviate them.

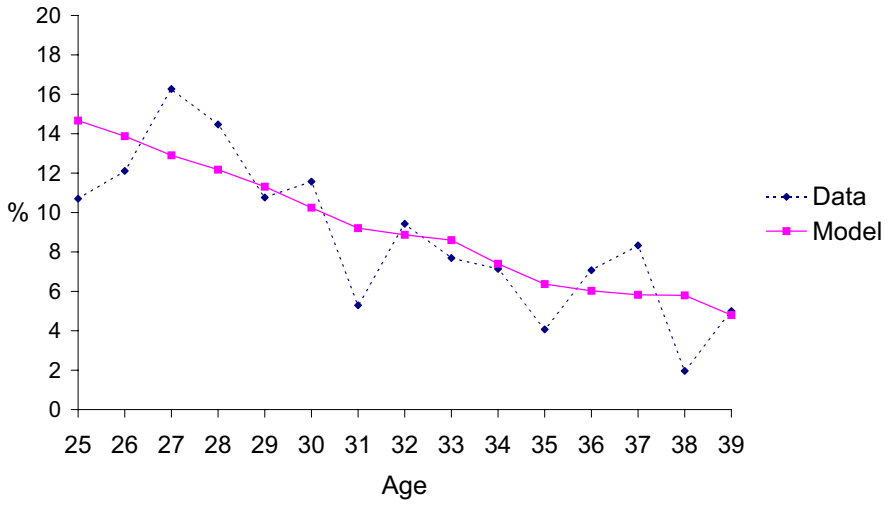

Figure 4: Percent getting married by age

incomes.[20] The details are in the appendix.

7 Counterfactual Experiments

Using the estimated model, we perform counterfactual experiments. At first, we explain the backgrounds. Intergenerational co-residence is an important issue in Japan. There are a lot of arguments such that some young adults do not start living on their own because they stay single and live with their parents.[21] As the parents' generation is relatively wealthier, they support their children's living costs and a large fraction of adult children do not become independent. In the first and second experiments, we assess how strategic behavior on the part of parents affects marriage and co-residence

[20]When daughters or young married couples live with parents, they can receive net real transfers, that is, net monetary transfers plus in-kind transfers of co-residence. According to the estimates of imputed rent, the net transfers associated with co-residence are positive. In other words, the net real transfers are larger than the net monetary transfers.

[21]The existing literature analyzes marriage rates conditional on co-residence status and other characteristics (for example, Raymo, 2003), or co-residence rates conditional on marriage status and other characteristics.

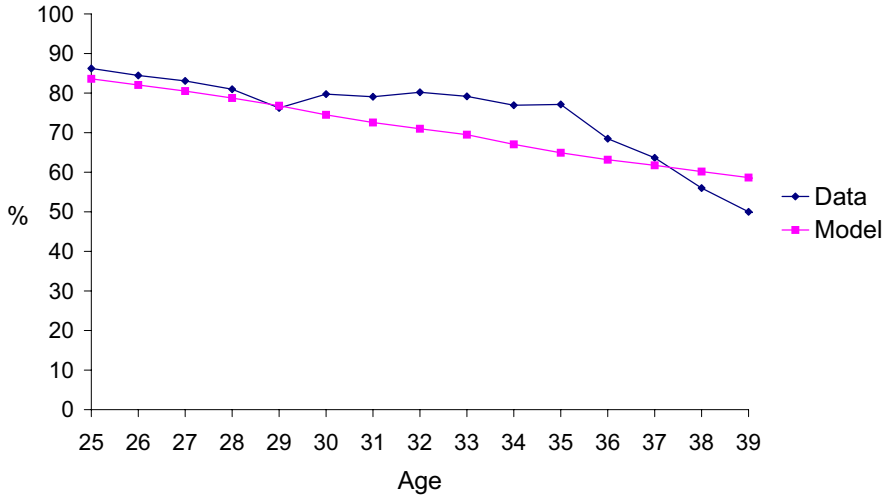

Figure 5: Percent residing with parents among staying single by age

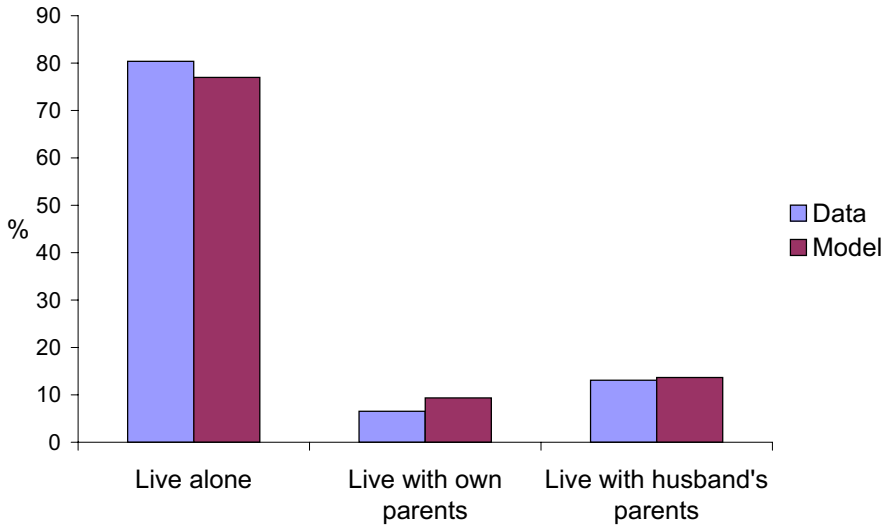

Figure 6: Co-residential status at a year of marriage

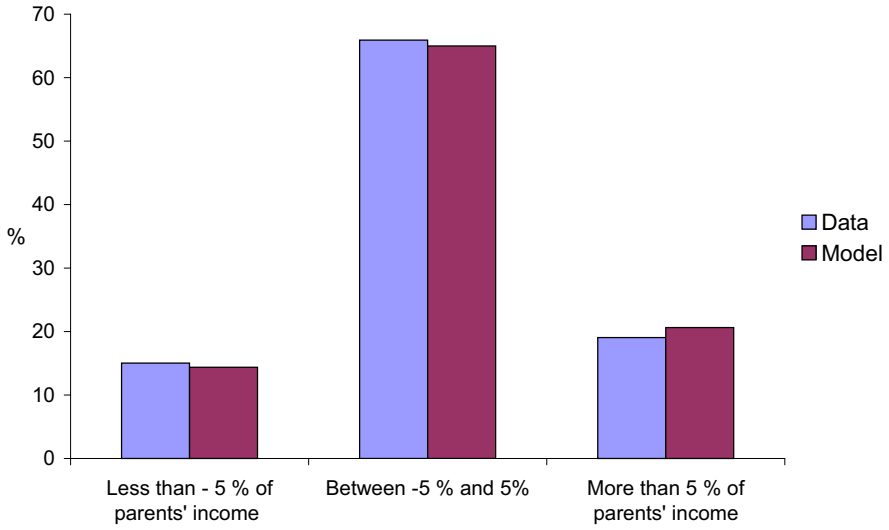

Figure 7: Net monetary transfers from parents

choices of daughters.

The delayed marriage is viewed as a serious problem in Japan. A number of government policies have been instituted to encourage earlier marriage and household formation. The average age of first marriage has been rising over the last few decades. Along with it, the average number of childbirth has fallen to 1.25 in year 2003. One of the policies executed is government-supported matching services. By conducting a lot of surveys, they consider that there are fewer matching opportunities for young people in recent years. In the past, parents and their community have encouraged the matching of youths. Such mechanisms have not functioned well in recent years. At the same time, the quality of current matching services provided by private companies is perceived to be low, and young adults hesitate to utilize those services. In order to enhance the matching probabilities, the government introduced the approval system to asses the quality of service each company provides and to support matching services industry.

7.1 Options to co-reside, but no strategic monetary transfers

We consider the hypothetical world where there are no strategic monetary transfers between parents and children. When children reside with parents, costs associated with co-residence arise. Co-resident children have to pay imputed rent to parents, but no other monetary transfers exist. When daughters get married, there is no strategic monetary transfer from their husbands' parents, either. In addition, the government provides financial support to low-income households. If consumption, after paying housing rent without any financial support, is lower than the minimum necessary consumption level, economic agents can receive social benefits. The benefits are the difference between the minimum level and the original consumption levels. Married couples are qualified to receive social benefits only when their consumption with pooled income is lower than the minimum. In other words, the government does not provide social benefits when their marriage is not cooperative and one of their consumption levels is lower than the minimum.

In the baseline model, parents offer contingent transfers strategically. In this hypothetical world, the government supports households with low income. There is no strategic consideration for the government.

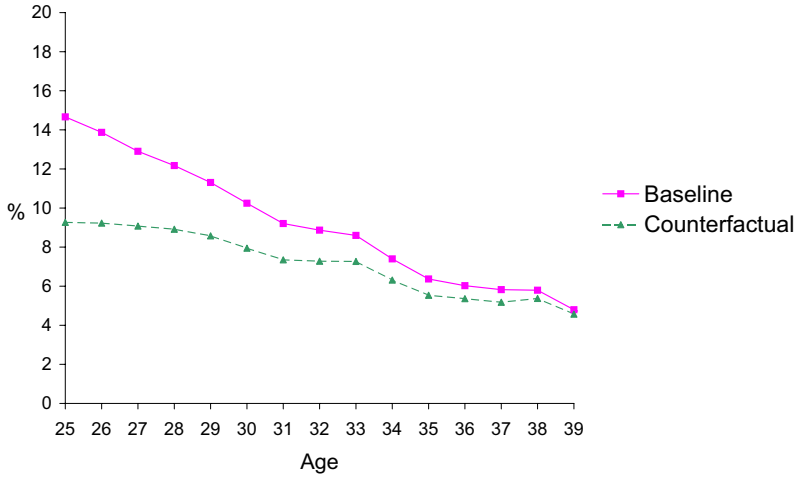

Figure 8: Percent getting married by age

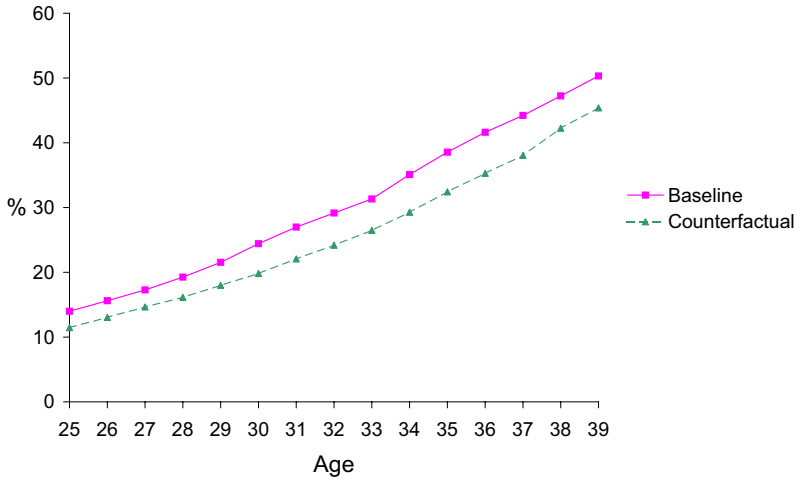

Figure 9: Percent staying single and living alone by age

Figures 8, 9 and 10 depict the comparisons of outcomes in the counterfactual world with those in the baseline model. On average, the percentage of co-residence increases by 6.2 percentage points (from 66.6% to 72.8%). Co-residence conditional on singles increases by 5.1 percentage points (from 71.7% to 76.8%). Co-residence conditional on married increases by 2.6 percentage points (from 23.0% to 25.6%). In the baseline model, some parents provide offers such that net transfers contingent on co-residence are smaller or (largely) negative, and their daughters decide to live alone. There is net monetary gain from co-residence in terms of rent; market rent − imputed rent. Those parents' offers are such that parents and their children divide the surplus, hence the children have to pay more than imputed rent to parents if co-residing. Some of the children alter their choices and decide to live with parents in the hypothetical world.

Daughters are more likely to stay single in the counterfactual world. On average, the percentage of getting married decreases by 2.6 percentage points (from 10.5% to 7.9%). In the baseline model, parents offer larger transfers contingent on getting married. Parents are altruistic and expect that their daughters' consumption is higher when the daughters get married. On average, males' income is higher than females' income. When women get married, they financially benefit from pooling a budget. In

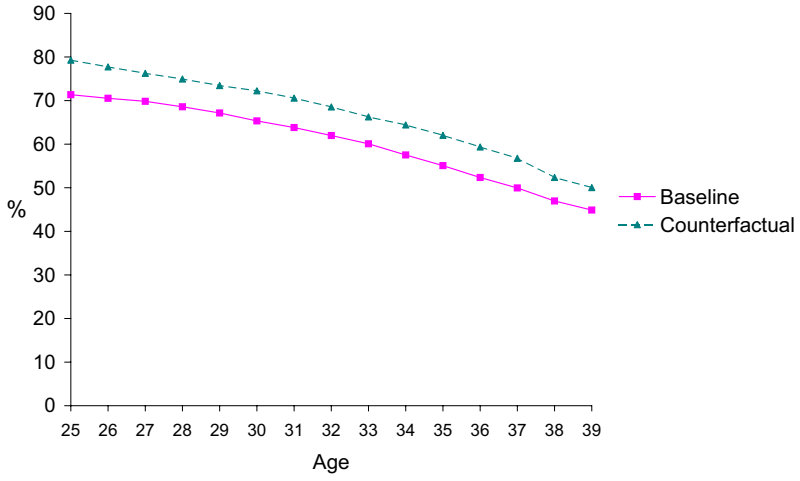

Figure 10: Percent staying single and living with parents by age

addition, due to the economies of scale, housing rent per person is less expensive for married couples than for singles. Parents are also endowed with strong preference for marriage of their daughters. In the absence of such strategic transfers, some daughters decide not to get married.

The welfare of both parents and daughters decreases. As in Tables 18 and 19 in the appendix, the decreases in the welfare are larger in the groups of high housing rent, high income of daughters, and high education. The percentage decreases in the welfare are larger when daughters are old, and when parental income is low. The average welfare loss of daughters worths 2.4 million yen per year.

7.2 No options to co-reside, and no monetary transfers

In this counterfactual experiment, we assume that no intergenerational transfers (no in-kind transfers, and no monetary transfers) exist. Daughters' choices are either to stay single and live alone, or to get married and live alone. The same social welfare program as in the first experiment is instituted. Because there is no option to live with parents, everyone has to pay market housing rent. As housing rent is a large portion

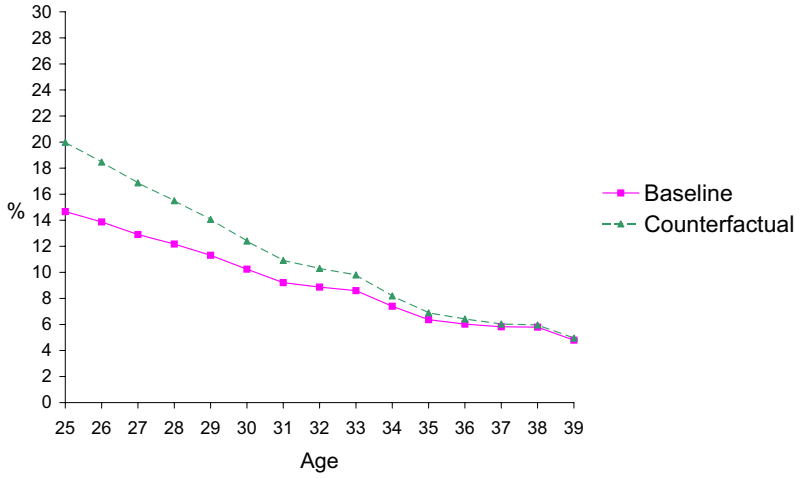

Figure 11: Percent getting married by age

in households' expenditures, social benefits can be viewed as rent subsidies.

Figure 11 shows behavioral alteration in the hypothetical world. The percentage of women getting married increases by 2.6 percentage points (from 10.5% to 13.1%). Especially, the impact is 4.5 percentage points (from 13.6% to 18.1%) in the young age group, and 4.7 percentage points (from 15.4% to 20.1%) in the group of low income of daughters.

If parents are not involved at all, daughters tend to get married. Note that they married despite that young people with low income can receive rent subsidies by staying single. There are two main reasons. First, daughters obtain more utility from getting married rather than staying single and living alone. Second, as we discussed in the previous section, there are expected financial benefits when getting married. The combined financial benefits are larger than the social benefits they would receive from the government when staying single.

The welfare of both parents and daughters decreases. As in Tables 20 and 21 in the appendix, the decreases in the welfare of daughters are larger when housing rent is higher, when daughters' income is higher, and when daughters' education levels are higher. The decreases in the welfare of parents are larger in the groups of old, high

	Counterfactual	Baseline	Change
Single living alone	27.81	25.35	2.46
Single living with parents	61.72	64.14	-2.42
Married living alone	8.25	8.09	0.16
Married living with own parents	0.94	0.98	-0.04
Married living with husband's parents	1.28	1.44	-0.16

Table 5: Marriage and co-residence status (%): Housing rent subsidy

housing rent, high income of daughters, and high education. The percentage decreases in their welfare are larger when daughters are old and when parental income is low. The average welfare loss of daughters worths 2.4 million yen per year.

7.3 Housing rent subsidy

Next, we analyze the effect of housing rent subsidies to young people. Suppose that the government provides rent subsidies of a half of market housing rent to young people if they live alone. Table 5 shows the comparison of marriage and co-residence outcomes in the baseline model and those under the housing policy. Due to the governmental support for housing rent, the average decrease in the choice of "single and living with parents" is around 2.4 percentage points. However, the impact is relatively larger in the group of high housing rent, that is, 3.9 percentage points. In the group of high housing rent and low parental income, the effect is 4.7 percentage points, and its elasticity with respect to market housing rent is 0.1.

Table 6 shows the impact of rent subsidies on monetary transfers by marriage and co-residence status. Conditional on living together, net monetary transfers from parents to daughters that are more than 5% of parental income increase. In contrast, they decrease conditional on living separately. The impact conditional on the choice of "single living with parents" is larger in the groups of high housing rent, and high income of daughters, as in Table 22 in the appendix.

	Counterfactual	Baseline	Change	Elasticity
Single living alone	4.74	6.06	-1.32	0.44
Single living with parents	30.00	25.02	4.97	-0.40
Married living alone	25.65	29.65	-4.00	0.27
Married living with own parents	4.34	3.84	0.50	-0.26
Married living with husband's parents	3.68	7.66	-3.98	1.04

Table 6: Net monetary transfers from parents more than 5% of parental income (%)

Overall, parents and daughters respond to the rent subsidy policy more by changing monetary transfers rather than by altering co-residence and marriage choices. When market housing rent is less expensive, parents have less incentive to provide monetary transfers contingent on that daughters live alone. These results imply that altruism plays an important role in family decision-making.

7.4 Government intervention in the marriage market

We study the impact of government intervention in the marriage market. In the counterfactual world, due to the intervention, matching probability distributions are assumed to shift upward by 5 percentage points. Figure 12 depicts the impacts on marriage outcomes. Overall, the percentage of women getting married increases by 2.4 percentage points (from 10.5% to 12.9%). The percentage of women co-residing decreases by 1.4 percentage points (from 66.6% to 65.2%). Co-residence conditional on staying single decreases by 0.3 percentage points (from 71.7% to 71.4%).

Parents' transfers become more strategic rather than altruistic when daughters' consumption levels are guaranteed to reach certain levels due to the marriage opportunities and the expected financial benefits. Since the parents want their daughters to get married and co-reside, they increase net transfers contingent on that state. Knowing that daughters prefer to stay single and to co-reside, some parents strategically charge (more) money to their daughters contingent on single living with them. Therefore, the

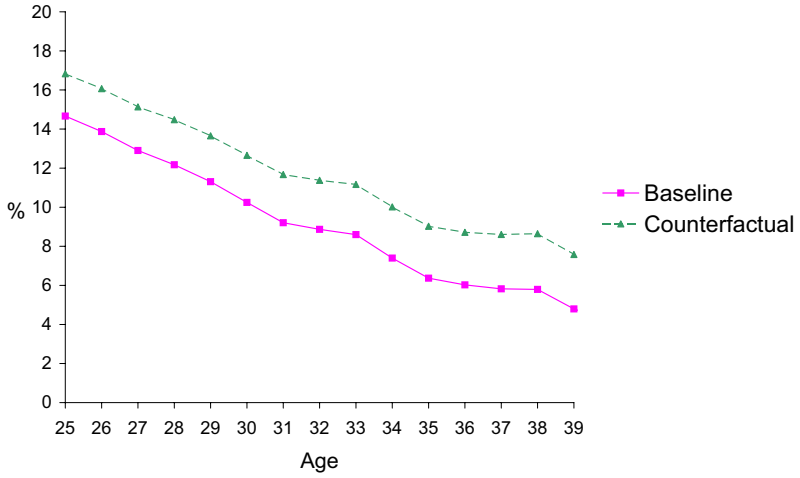

Figure 12: Percent getting married by age

co-residence rate conditional on staying single decreases.

8 Conclusion

In this paper, we develop and structurally estimate a behavioral model of family co-residence, marriage and intergenerational monetary transfers decisions using the Japanese Panel Survey of Consumers. Then we study how (a) the role played by parents, (b) marriage market conditions, and (c) housing market conditions affect the extent of intergenerational co-residence and the welfare of the parents and the daughters.

The obstacles of the estimation and simulation have been overcome by utilizing the indirect inference method and the simulated annealing method. We find that the model performs well to fit the data on co-residence, marriage and intergenerational transfers of money. The inclusion of unobserved heterogeneity in culture allows it to fit the co-residence patterns better.

Using the estimated model, we assess how the strategic transfers affect the choices and the welfare of the parents and the daughters. First, we find that co-residence

increases by 6.2 percentage points and marriage rate decreases by 2.6 percentage points if there are no strategic monetary transfers between parents and children. This is because some parents would charge their children more than imputed rent contingent on co-residence so that parents and children will divide net monetary gain in terms of housing rent. Parents offer larger net transfers contingent on getting married. No strategic monetary transfers reduce the marriage rate. Second, we find that marriage increases by 2.6 percentage points if there is no parental involvement at all (no option to co-reside, no intergenerational monetary transfers). In the absence of intergenerational transfers, there is large welfare loss of both parents and daughters.

Third, we evaluate the impact of rent subsidy programs such that the government financially supports a half of market housing rent if young people live alone. The fraction of women staying single and co-residing with their parents decreases by only 2.5 percentage points on average. However, the impact is relatively large on families residing in the regions of relatively high housing rent and on families such that parents' income is low.

Fourth, we find that government intervention in the marriage market, which raises matching probabilities by 5 percentage points, increases the marriage rate by 2.4 percentage points, and decreases the co-residence rate by 1.4 percentage points.

A Appendix

A.1 Utility functions

- Utility of parents[22][23][24]

$$
\begin{aligned}
&U^P(c^P, c^F, t^F, x, q, \epsilon^P_{xq}, type) \\
&\equiv u^P(c^P, x, q, \epsilon^P_{xq}, type) + \mu^P c^F + \alpha_{11}|t^F| \cdot I\{t^F < 0\} \\
&= \log(c^P) + \mu^P \cdot c^F + \tilde{\alpha_7} \cdot I\{(x,q) = (s,1)\} + \tilde{\alpha_8} \cdot I\{(x,q) = (m,0)\} \\
&+\tilde{\alpha_9} \cdot I\{(x,q) = (m,1)\} + \tilde{\alpha_{10}} \cdot I\{(x,q) = (m,2)\} + \alpha^P \cdot I\{q \neq 0\} I\{type = trad\} \\
&+\alpha_{11}|t^F| \cdot I\{t^F < 0\}
\end{aligned} \tag{8}
$$

$\alpha_{11}, \alpha_{12} < 0,\ 0 < \mu^P$

- Utility of a daughter[25]

$$
\begin{aligned}
&W(c^F, c^P, q, \epsilon^F_{xq}, type) \\
&\equiv \max\{S^F(c^F, c^P, q, \epsilon^F_{sq}, type), C^F(c^F, c^P, q, \gamma, \epsilon^F_{mq}, type)\}
\end{aligned} \tag{9}
$$

[22]The utility function needs to be strictly concave with respect to consumption to ensure uniqueness and to avoid a corner solution.

[23]If parents are concerned about their daughter's whole utility rather than consumption only, we need to numerically integrate over a high dimensional distribution when calculating parents' expected utility. It requires a lot of computation, and makes the estimation infeasible.

[24]Parents' preference can depend on net transfer as we allow asymmetry of parents' altruism. For example, parents can obtain additional negative utility by receiving money from their daughter.

[25]A linear utility function of a daughter and that of her future husband provides a closed form solution to a Nash bargaining, which reduces a lot of computation and makes the estimation feasible.

– Utility of a single daughter

$$S^F(c^F, c^P, q, \epsilon^F_{sq}, type)$$
$$\equiv c^F + \mu^F \log(c^P) + \tilde{\alpha_1} \cdot I\{q = 1\} + \alpha^F \cdot I\{q \neq 0\} I\{type = trad\}$$

– Utility of a married daughter

$$C^F(c^F, c^P, q, \gamma, \epsilon^F_{mq}, type)$$
$$\equiv c^F + \mu^F \log(c^P) + \tilde{\alpha_2} \cdot I\{q = 0\} + \tilde{\alpha_3} \cdot I\{q = 1\}$$
$$+\tilde{\alpha_4} \cdot I\{q = 2\} + \alpha^F \cdot I\{q \neq 0\} I\{type = trad\} + \gamma$$

$0 < \mu^F$

γ is positive when marriage is cooperative, and is zero when marriage is not cooperative.

- Utility of a young male adult

$$U^M(c^M, q, \gamma)$$
$$= c^M + \alpha_5 \cdot I\{q = 1\} + \alpha_6 \cdot I\{q = 2\} + \gamma \tag{10}$$

The preference parameters of ($\tilde{\alpha_1}$,$\tilde{\alpha_2}$,$\tilde{\alpha_3}$,$\tilde{\alpha_4}$, $\tilde{\alpha_7}$, $\tilde{\alpha_8}$,$\tilde{\alpha_9}$, $\tilde{\alpha_{10}}$) are random coefficients.

$$\tilde{\alpha_1} \equiv \alpha_1 + \epsilon^F_{s1}$$
$$\tilde{\alpha_2} \equiv \alpha_2 + \epsilon^F_{m0}$$
$$\tilde{\alpha_3} \equiv \alpha_3 + \epsilon^F_{m1}$$
$$\tilde{\alpha_4} \equiv \alpha_4 + \epsilon^F_{m2}$$
$$\tilde{\alpha_7} \equiv \alpha_7 + \epsilon^P_{s1}$$
$$\tilde{\alpha_8} \equiv \alpha_8 + \epsilon^P_{m0}$$
$$\tilde{\alpha_9} \equiv \alpha_9 + \epsilon^P_{m1}$$
$$\tilde{\alpha_{10}} \equiv \alpha_{10} + \epsilon^P_{m2}$$

where $\alpha_1 \equiv \alpha_{13} + \alpha_{14} \cdot (a - 20)$, and a is the daughter's age. The utility of the daughter when staying single and residing with parents depends on the years of her adulthood. The preference shocks in each state (x, q), $\breve{\epsilon}^F_{xq}$, consist of two components; an individual

specific taste shock of $\bar{\varepsilon}^F_{xq}$, and a time-varying random shock of $\acute{\varepsilon}^F_{xq}$. We assume that random shocks to a daughter's preference, $\acute{\varepsilon}^F_{xq}$'s, are drawn from i.i.d. type I extreme value distributions, and that $\bar{\varepsilon}^F_{xq}$'s are drawn from a multinomial normal distribution. Then parents' beliefs become a mixed logistic form, which allows correlation among the alternatives. To simplify notation, we subtract $\breve{\varepsilon}^F_{s0}$ from utility in each state and rewrite them as $(\epsilon^F_{s1}, \epsilon^F_{m0}, \epsilon^F_{m1}, \epsilon^F_{m2}) \equiv (\breve{\epsilon}^F_{s1} - \breve{\epsilon}^F_{s0}, \breve{\epsilon}^F_{m0} - \breve{\epsilon}^F_{s0}, \breve{\epsilon}^F_{m1} - \breve{\epsilon}^F_{s0}, \breve{\epsilon}^F_{m2} - \breve{\epsilon}^F_{s0})$. That is, $(\epsilon^F_{s1}, \epsilon^F_{m0}, \epsilon^F_{m1}, \epsilon^F_{m2}) = (\bar{\varepsilon}^F_{s1} - \bar{\varepsilon}^F_{s0}, \bar{\varepsilon}^F_{m0} - \bar{\varepsilon}^F_{s0}, \bar{\varepsilon}^F_{m1} - \bar{\varepsilon}^F_{s0}, \bar{\varepsilon}^F_{m2} - \bar{\varepsilon}^F_{s0}) + (\acute{\varepsilon}^F_{s1} - \acute{\varepsilon}^F_{s0}, \acute{\varepsilon}^F_{m0} - \acute{\varepsilon}^F_{s0}, \acute{\varepsilon}^F_{m1} - \acute{\varepsilon}^F_{s0}, \acute{\varepsilon}^F_{m2} - \acute{\varepsilon}^F_{s0})$.

Preference shocks to parents are drawn from a normal distribution of $\bar{\varepsilon}^P$. ϵ^P is defined as $\epsilon^P \equiv (\epsilon^P_{s1}, \epsilon^P_{m0}, \epsilon^P_{m1}, \epsilon^P_{m2})' \equiv (\bar{\varepsilon}^P_{s1} - \bar{\varepsilon}^P_{s0}, \bar{\varepsilon}^P_{m0} - \bar{\varepsilon}^P_{s0}, \bar{\varepsilon}^P_{m1} - \bar{\varepsilon}^P_{s0}, \bar{\varepsilon}^P_{m2} - \bar{\varepsilon}^P_{s0})'$. $\varepsilon^P \sim N(0, \Sigma_P)$.

Hence, in this paper, utility means transformed utility of fundamental utility minus a preference shock in state $x = s, q = 0$. In addition, we normalize the variance.

A.2 Solutions of Nash bargaining

$$
\begin{aligned}
c^F_{m0} &= z^F_0(y^F + t^F_{m0}) - \tfrac{r_m}{2} + \pi\{2\gamma + (1 - z^F_0)(y^F + t^F_{m0}) + (1 - z^M_0)(y^M + t^M_0)\} - \gamma \\
c^M_{m0} &= z^M_0(y^M + t^M_0) - \tfrac{r_m}{2} + (1 - \pi)\{2\gamma + (1 - z^F_0)(y^F + t^F_{m0}) + (1 - z^M_0)(y^M + t^M_0)\} - \gamma
\end{aligned}
$$

$$
\begin{aligned}
c^F_{m1} &= z^F_1(y^F + t^F_{m1}) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z^F_1)(y^F + t^F_{m1}) + (1 - z^M_1)(y^M + t^M_1)\} - \gamma \\
c^M_{m1} &= z^M_1(y^M + t^M_1) - \tfrac{\rho_m r_m}{2} + (1 - \pi)\{2\gamma + (1 - z^F_1)(y^F + t^F_{m1}) + (1 - z^M_1)(y^M + t^M_1)\} - \gamma
\end{aligned}
$$

$$
\begin{aligned}
c^F_{m2} &= z^F_2(y^F + t^F_{m2}) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z^F_2)(y^F + t^F_{m2}) + (1 - z^M_2)(y^M + t^M_2)\} - \gamma \\
c^M_{m2} &= z^M_2(y^M + t^M_2) - \tfrac{\rho_m r_m}{2} + (1 - \pi)\{2\gamma + (1 - z^F_2)(y^F + t^F_{m2}) + (1 - z^M_2)(y^M + t^M_2)\} - \gamma
\end{aligned}
$$

A.3 Solutions of a daughter's consumption

A daughter's consumption in each contingent state is as follows.

$$c^F_{s0} = y^F + t^F_{s0} - r_s$$
$$c^F_{s1} = y^F + t^F_{s1} - \rho_s r_s$$
$$c^F_{m0} = z^F_0(y^F + t^F_{m0}) - \tfrac{r_m}{2} + \pi\{2\gamma + (1 - z^F_0)(y^F + t^F_{m0}) + (1 - z^M_0)(y^M + t^M_0)\} - \gamma$$
$$c^F_{m1} = z^F_1(y^F + t^F_{m1}) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z^F_1)(y^F + t^F_{m1}) + (1 - z^M_1)(y^M + t^M_1)\} - \gamma$$
$$c^F_{m2} = z^F_2(y^F + t^F_{m2}) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z^F_2)(y^F + t^F_{m2}) + (1 - z^M_2)(y^M + t^M_2)\} - \gamma$$

A.4 Bounds of transfers

We assume that parents make an offer of contingent transfers that satisfies the minimum consumption restrictions. In other words, if there is no contingent transfer level which satisfies the restrictions, the family cannot choose that marital/co-residential combination. We also assume that a daughter cannot reject her parents' offer if her consumption is less than the minimum by rejecting the offer.

- Minimum consumption of a daughter: $\underline{c}$
- Minimum consumption of parents: $2\underline{c}$

Lower bounds of net transfers:

$$LB_{s0} = \underline{c} - y^F + r_s$$
$$LB_{s1} = \underline{c} - y^F + \rho_s r_s$$
$$LB_{m0} = \frac{\underline{c} + r_m/2 + \gamma - \pi\{2\gamma + (1 - z^M_0)(y^M + t^M_0)\}}{z^F_0 + \pi(1 - z^F_0)} - y^F$$
$$LB_{m1} = \frac{\underline{c} + \rho_m r_m/2 + \gamma - \pi\{2\gamma + (1 - z^M_1)(y^M + t^M_1)\}}{z^F_1 + \pi(1 - z^F_1)} - y^F$$
$$LB_{m2} = \frac{\underline{c} + \rho_m r_m/2 + \gamma - \pi\{2\gamma + (1 - z^M_2)(y^M + t^M_2)\}}{z^F_2 + \pi(1 - z^F_2)} - y^F$$

Upper bound of net transfers:

$$UB = y^P - 2\underline{c}$$

A.5 Contingent utility of a daughter

The followings are a daughter's utility contingent on each marital and co-residential status, given parameters, exogenous variables, and contingent transfers from parents. There is an option to reject an offer contingent on single living alone (s0), on married living alone (m0), and on married living with her husband's parents (m2). Below, "*trad*" denotes traditional family.

$$W_{s0} = \max\{W_{s0}^A, W_{s0}^R\}$$

$$W_{s0}^A = y^F + t_{s0}^F - r_s + \mu^F \log(y^P - t_{s0}^F)$$
$$W_{s0}^R = y^F - r_s + \mu^F \log(y^P)$$

$$W_{s1} = y^F + t_{s1}^F - \rho_s r_s + \alpha_1 + \alpha^F \cdot I\{type = trad\} + \mu^F \log(y^P - t_{s1}^F) + \epsilon_{s1}^F$$

$$W_{m0} = \max\{W_{m0}^A, W_{m0}^R\}$$

$$W_{m0}^A = z_0^F(y^F + t_{m0}^F) - \tfrac{r_m}{2} + \pi\{2\gamma + (1 - z_0^F)(y^F + t_{m0}^F) + (1 - z_0^M)(y^M + t_0^M)\}$$
$$+\alpha_2 + \mu^F \log(y^P - t_{m0}^F) + \epsilon_{m0}^F,$$

$$W_{m0}^R = z_0^F y^F - \tfrac{r_m}{2} + \pi\{2\gamma + (1 - z_0^F)y^F + (1 - z_0^M)(y^M + t_0^M)\} + \alpha_2 + \mu^F \log(y^P) + \epsilon_{m0}^F$$

$$W_{m1} = z_1^F(y^F + t_{m1}^F) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z_1^F)(y^F + t_{m1}^F) + (1 - z_1^M)(y^M + t_1^M)\}$$
$$+\alpha_3 + \alpha^F \cdot I\{type = trad\} + \mu^F \log(y^P - t_{m1}^F) + \epsilon_{m1}^F$$

$$W_{m2} = \max\{W_{m2}^A, W_{m2}^R\}$$

$$W_{m2}^A = z_2^F(y^F + t_{m2}^F) - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z_2^F)(y^F + t_{m2}^F) + (1 - z_2^M)(y^M + t_2^M)\}$$
$$+\alpha_4 + \alpha^F \cdot I\{type = trad\} + \mu^F \log(y^P - t_{m2}^F) + \epsilon_{m2}^F,$$

$$W_{m2}^R = z_2^F y^F - \tfrac{\rho_m r_m}{2} + \pi\{2\gamma + (1 - z_2^F)y^F + (1 - z_2^M)(y^M + t_2^M)\} + \alpha_4$$
$$+\alpha^F \cdot I\{type = trad\} + \mu^F \log(y^P) + \epsilon_{m2}^F$$

A.6 Parents' beliefs

$$P_{xq} = \int \frac{\exp(\widetilde{W}_{xq})}{\sum \exp(\widetilde{W}_{xq})} df_{\bar{\epsilon}^F},$$

where $\widetilde{W}_{s0} = W_{s0}$,
and $\widetilde{W}_{xq} = W_{xq} - \acute{\epsilon}^F_{xq}$ for $(x,q) = (s,1),(m,0),(m,1),(m,2)$

A.7 Male's characteristics

A.7.1 Male's income

$$y^M = \beta_{M1} + \beta_{M2} \cdot \bar{y}^M + \beta_{M3} \cdot a + \beta_{M4} \cdot ed + \epsilon_{yM}$$

$\bar{y}^M$: Average income of males in the region

ed: =I{A daughter went to a junior college or a university.}

$\epsilon_{yM} = \sigma_{yM} \cdot N(0,1)$

A.7.2 Net transfers from male's parents

For $q = 0,1,2$,
$t^M_q = \beta_{M5} + \beta_{M6} \cdot I\{4.5 <= y^P\} + (\beta_{M7} + \epsilon_{tM0}) \cdot I\{q = 0\} + (\beta_{M8} + \epsilon_{tM2}) \cdot I\{q = 2\} + \epsilon_{tM1}$
where $\epsilon_{tM,k} = \sigma_{tM,k} \cdot N(0,1), k = 0,1,2.$

A.8 Marriage offer probability

$p^M = \frac{\exp(X)}{1+\exp(X)}$
where
$X = p^M_0 + p^M_1 \cdot a + p^M_2 \cdot I\{y^F <= 2.0\} + p^M_3 \cdot I\{3.3 < y^F\}$
$+p^M_4 \cdot I\{y^P <= 3.7\} + p^M_5 \cdot I\{6.5 < y^P\} + p^M_6 \cdot ed$

A.9 Imputed rents

Imputed rents for singles= $\rho_s \times r_s$,

Imputed rents for married= $\rho_m \times r_m$,

where $\rho_s \geq 0$ and $\rho_m \geq 0$.[26]

$$\ln \rho = \beta_{r1} \cdot I\{x = s\} + \beta_{r2} \cdot I\{x = m\} + \beta_{r3} \cdot I\{4.5 <= y^P\} + \beta_{r4} \cdot n_{sib}$$

where n_{sib} is the number of siblings.

A.10 Family types

$v^F \equiv I\{$The daughter (female) is from a modern family.$\}$

$v^M \equiv I\{$The male is from a modern family.$\}$

The fraction of each family type combination is defined as[27]

$$P(v^F, v^M) = \frac{\exp(\alpha_{21}(v^F + v^M) + \alpha_{22} v^F v^M)}{1 + 2\exp(\alpha_{21}) + \exp(2\alpha_{21} + \alpha_{22})}.$$

[26]The coefficients of imputed rents ρ_s and ρ_m are not restricted to be less than one. We allow the situation such that young people live in a more luxurious house when co-residing than when living alone.

[27]$\alpha_{21} + \alpha_{22} \geq 0$: A person from a modern family is more likely to meet a person from a modern family. $\alpha_{21} \leq 0$: A person from a traditional family is more likely to meet a person from a traditional family. We do not impose such restrictions in the estimation. The estimation results show these relationships hold.

B Appendix

B.1 Variables

Marital status

At each interview, respondents are asked about their current marital status. The interview is composed of some different questions depending on whether the respondent is single or married, as well as of common questions. From the second survey, married respondents who got married during the past year are asked about additional questions.

Living arrangements

The residential status is constructed from the information about persons with whom a respondent lives. Living together means living either under the same roof or on the same lot of land. The classifications of relationship with a respondent includes parents of a respondent (female) and parents of a spouse (the respondent's husband). For instance, if there is at least one person who lives together with a respondent and whose relationship is her own parents, she is considered as co-residing with her own parents.

Region

We use the data on the name of a prefecture each respondent lives in and on whether it is one of the thirteen or fourteen largest cities in Japan.

Siblings

The data used are the numbers of sisters respondents have, the number of brothers, and the birth orderings of themselves among sisters regardless of marital status. Regarding married women, the data on birth orderings of their husbands among brothers indicate whether they are the eldest sons.

Education

Retrospective questions about respondents' education levels are asked at the initial interview, and they update the information by questioning educational experience during the past year in the later surveys. Using the information, we construct the variable of whether a respondent graduated a four-year university or a junior college.

Income

(1) Incomes for young women and those for their husbands respectively are the data on previous years' incomes from salary, business, assets and social security benefits. (2) Parents' total annual income is categorized into eight classifications. The intermediate value of each bin is used as parents' income. They did not collect this information in year 1995 and 1999, and collected these data only of the second cohort in 1997. We integrated using all available data per each observation for missing values. Parental income is available regardless of living arrangements.

Transfers

The data on net transfers of money are constructed from several kinds of questions associated with intergenerational transfers of money. They ask different questions to single women and to married women so that the questions suit their household structures. The questions include amounts of money women receive from their parents as allowance or remittance, whether women hand their earnings to their parents, amounts of money women hand to their parents out of their earnings, financial assistance from parents as expenditures for housing and marriage respectively, and amounts of money from adult children to their parents as basic living expenditures. To married women, they ask these questions related to women's own parents and their husbands' parents respectively. The detailed explanations are in the next section of the appendix. The data on financial transfers are available for all years in samples of single women, but these data in samples of married women are only available since 1998.

Housing rents

Housing rents are the amounts of money a respondent's household pay per month if they live in private rented housing. We exclude the data on rents for public rented housing, company houses or dormitories including rented company houses, as they are usually heavily subsidized.

Other

We use land price in each prefecture reported by the Ministry of Land, Infrastructure and Transport. It is the average price of one m^2 size for residential areas in the prefecture. The average incomes of males in each prefecture are from the Basic Survey on Wage Structure reported by the Ministry of Health, Labour and Welfare.

B.2 Sample

The sample used for the analysis consists of 709 women who are never-married when they were initially interviewed. The first cohort is composed of 454 individuals aged from 24 to 34 in the first interview in 1993. The second cohort, which begins four years later, is composed of 255 women aged from 24 to 27 in their initial interview. Overall, there are 3,078 person-periods of women in the data used for this analysis.

45.3% of these respondents get married during the periods observed. 65.3% of respondents' husbands are eldest sons.

Age	Freq.	Percent	Cum.
24	104	22.91	22.91
25	88	19.38	42.29
26	57	12.56	54.85
27	45	9.91	64.76
28	43	9.47	74.23
29	34	7.49	81.72
30	29	6.39	88.11
31	19	4.19	92.29
32	20	4.41	96.70
33	8	1.76	98.46
34	7	1.54	100.00
Total	454	100.00	

Table 7: Age distribution of women in 1993

Age	Freq.	Percent	Cum.
24	83	16.37	16.37
25	79	15.58	31.95
26	57	11.24	43.20
27	36	7.10	50.30
28	42	8.28	58.58
29	38	7.50	66.07
30	34	6.71	72.78
31	27	5.33	78.11
32	25	4.93	83.04
33	23	4.54	87.57
34	20	3.94	91.52
35	13	2.56	94.08
36	15	2.96	97.04
37	5	0.99	98.03
38	10	1.97	100.00
Total	507	100.00	

Table 8: Age distribution of women in 1997

	Percent
Single living alone	19.6
Single living with parents	69.9
Married living alone	8.4
Married living with own parents	0.7
Married living with husband's parents	1.4

Table 9: Marriage and co-residence status

	Mean	Std. Dev.
Total floor area of houses (m^2)	96.92414	67.66737
Housing rent of private rented houses (monthly, thousand yen)	70.06638	33.50469
Housing rent of married	72.22564	33.70304
Housing rent of singles	63.0541	31.88488
Regional average income of males (annual, million yen)	5.638957	.6881042
Land price (m^2, hundred thousand yen)	1.687741	1.288703
City	.3164392	.4651621
Expenditures of household (monthly, thousand yen)		
Foods	56.09891	37.77134
Rent, home repairment	20.08079	41.23175
Utilities	16.65889	14.33852
Furniture, housekeeping equipments	4.849202	15.51875
Expenditures of married (monthly, thousand yen)		
Foods	67.44507	35.53896
Rent, home repairment	22.7597	45.48944
Utilities	20.90147	13.41842
Furniture, housekeeping equipments	5.845286	17.08053
Expenditures of singles (monthly, thousand yen)		
Foods	23.05191	20.89168
Rent, home repairment	12.27989	23.31776
Utilities	4.296321	8.646516
Furniture, housekeeping equipments	1.945431	9.009588

Table 10: Descriptive statistics

	Mean	Std. Dev.
Monetary transfers to married couple for living expenses (monthly, thousand yen)		
From husband's parents	51.14173	47.63316
From wife's parents	41.9812	36.68978
Monetary transfers to parents (monthly, thousand yen)		
To husband's parents	42.76496	42.89488
To wife's parents	34.76064	43.30801
Monetary transfers, Single (monthly, thousand yen)		
To parents	40.19865	32.37556
From parents	33.2	14.40402
Monetary transfers from parents, Single (annual, ten thousand yen)		
Remittance	82.31481	70.92617
Allowance or handed money	10.50235	13.61749
Number of brothers	.7128005	.7224781
Number of sisters (including herself)	1.684211	.7258298
Whether woman is the eldest daughter.	.7120908	.4529399
Whether husband is the eldest son.	.6612882	.2683129
Education of woman: Whether she went to university or junior college.	.4346979	.4957978
Woman's annual income (million yen)	2.692609	1.532896
Husband's annual income (million yen)	4.524179	3.550972
Parents' annual income (million yen)	5.713301	3.884426

Table 11: Descriptive statistics (continued)

C Appendix

C.1 Net transfers of money

We explain the data on net financial transfers from parents to their young adult children by marital and co-residential status.

C.1.1 Net financial transfers from non-co-residing parents to married couples

Net transfers of money from a respondent's parent(s) and from her husband's parent(s) are, for $g = F, M$,

$$Transfer^g = 12 \cdot (Qm2^g - Qm1^g) + 10 \cdot (Qm4^g + Qm5^g).$$

- $Qm1^F \equiv$ amount of money a married couple provided to the wife's parents, in thousands of yen per month (in September). It is an answer to questions about the expenditures of the respondent's household. The survey questions did not specify which parents receive it in year 2001. In that year, we consider half amount of the money the married couple provided to the unspecified parents as the variable.

- $Qm2^F \equiv$ amount of money the wife's parents pay for costs such as housing loan repayment, rent(s), living expenses.

- $Qm4^F \equiv$ financial assistance from the wife's parents for marriage expenses;including moving expenses when they rend a new house/apartment, in ten thousands of yen. It does not include loans from parents.

- $Qm5^F \equiv$ financial assistance from wife's parents for purchasing a house/both a house and a lot, in ten thousands of yen. The reasons for the financial support include a newly built house, or a house/lot purchased under joint ownership with the parents. It does not include loans from parents. In 1999, they ask

these questions to all married women. In 1998, 2000, and 2001, they ask these questions only to married women who got married during the past year.

The variables of $Qm1^M, Qm2^M, Qm3^M, Qm4^M, Qm5^M$ are the same questions associated with the husband's parents.

C.1.2 Net financial transfers from co-residing parents to married couples

We exploit the information about how they share the livelihood when married young couples co-reside with their parents. Net transfers of money from co-residing parents are as follows. For $g = F, M$,

$$Transfer^g = 12 \cdot (Qm2^g - Qm1^g) + 10 \cdot (Qm4^g + Qm5^g)$$
$$-12 \cdot Qm6 \cdot I\{\text{Married couple and co-residing parents share same livelihood}\}.$$

$Qm6 \equiv$ Basic living costs for parents, in thousands of yen per month. By regressing the data of (a) basic living costs per person on (b) land price in the prefecture, (c) city dummy, and (d) total floor area per person, we obtain basic living costs per person. Parents' basic living costs are twice the per-person basic living costs.

(a) The data of basic living costs per person are the amounts of expenditures for foods, utilities, furniture, housekeeping equipments in a respondent's household divided by the number of household members. We exclude samples with zero basic living costs.

(c) The city dummy variable is an indicator of whether the respondent lives in one of the 13 largest cities or not. The survey questions in 2001 classify the 14 largest cities instead.

(d) We use total floor area (in hundreds of m^2) of housing a respondent lives in order to obtain total floor area per person. We divide it by the number of household members when the respondent is single living with parents, by two if she is married living alone or married living with parents in the same lot but at a

different house, by four if she is married living with parents in the same house. The survey questions from 1995 to 2001 ask directly about total floor area in which the respondent's family lives. The data in 1993 and 1994 are categorized into seven bins. For those years, we use the median value in each bin.

C.1.3 Net financial transfers from parents to a single respondent living alone

$$Transfer^F = 10 \cdot Qs2 - 12 \cdot Qs1$$

- $Qs1 \equiv$ amount of money a respondent handed to her parents out of her earnings: take-home pay, that is, total pay after taxes and social insurance, in thousands of yen per month (in September).

  $= -$ her earnings,
  if the respondent handed all of her earnings to her parents, and received no money from her parents for her own living expenses or allowances.

  = amount of money from the parents $-$ the respondent's earnings,
  if she handed all of her earnings to her parents, and received money from her parents for her own living expenses or allowances.

  $= -$ amount of money the respondent handed to parents,
  if she handed a part of her earnings to her parents.

  $= 0$,
  if the respondent has no earnings.

- Qs2$\equiv$ amount of money the parents provided to the respondent as remittance or allowance/handed money, in ten thousands of yen per year.
  =(remittance during the past year) + (handed money during the past year)

C.1.4 Net financial transfers from parents to a single respondent living with parents

$$Transfer^F = 10 \cdot Qs2 - 12 \cdot Qs1 + Qs4$$

The variable of $Qs4$ is the basic living costs per person we explained above.

	More than 5% of parental income	Less than -5% of parental income
Single living alone	9 %	5 %
Single living with parents	18%	21%
Married	45%	

Table 12: Net monetary transfers from parents

	More than 5% of parental income	Less than -5% of parental income
all	57.02	-57.27
Single living alone	94.26	-36.58
Single living with parents	29.92	-58.64
Married living alone	191.22	
Married living with own parents	142.54	-54.93
Married living with husband's parents	113.13	

Table 13: Average net monetary transfers from parents (ten thousand yen)

C.2 Housing rent

We exploit the information about observed housing rents from the micro data and regional variation in order to construct the data on housing rents. Conditional on

marital status of respondents, we project rents for private housing on the average land price in the prefecture and on the city dummy variable. From the estimated coefficients and the corresponding regional variables, we construct the data on housing rents for each observation. Therefore, we assume that people living in the same region face the same housing market rents of r_s and r_m.

D Appendix

D.1 Simulation

Given parameters in the behavior model, we simulate and obtain its moments of each observation. As uncertainty exists in the model, random shocks are drawn in each simulation replication, $j = 1, ..., S$. We use the same random draws of the jth replication for all observations, $i = 1, ..., n$. For each observation i and in each simulation j, we numerically solve the model by backward induction. When solving the optimization problem of parents, we use simulated annealing method combined with simplex method. The main reasons are as follows. First, the objective function to parents' optimization problem can be non-smooth (jump), because the daughter has an option to reject her parents' offer, and because the parents optimize their expected utility based on their expectation about their daughter's choice. Second, the parents' objective function can be non-quasi-concave in the sense that we cannot prove strict quasi-concavity analytically. Hence, we exploit Brownian motions in order to globally solve the parents' optimization problem.[28]

[28]The settings used are as follows. One unit of step size for the simplex method is 1% of parents' income. The tolerance parameter is 0.00001. For each observation i, starting simplex with the first random draws $j = 1$ consists of diagonal elements of 5% of parents' income corresponding to staying single, 2% of parents' income corresponding to getting married, and one diagonal element of zero, and off-diagonal elements of zeros. If the transfer level described above violates minimum consumption restrictions, we replace it it by an arbitrary level between lower and upper transfer bounds within which consumption levels of all economic agents are not less than the minimum restrictions. We use simulation results in the previous iteration $j - 1$ of an identical observation i when we construct

D.2 Asymptotic properties

Under regularity conditions,

$$\begin{aligned}
&\sqrt{n}(\hat{\theta}-\theta_0) \xrightarrow{d} \quad N(0, asyV) \qquad \text{as } n\to\infty, S\to\infty, \\
&\text{where} \\
&D \equiv E[\tfrac{\partial k}{\partial \theta^\top}(\omega,\epsilon;\theta_0)], \\
&\Sigma \equiv V[K(\omega,\xi)-k(\omega,\theta_0)], \\
&\Lambda \equiv diag(V[K(\omega,\xi)-k(\omega,\theta_0)]), \\
&\text{and } asyV \equiv [D^\top \Lambda D]^{-1} D^\top \Lambda \Sigma \Lambda D [D^\top \Lambda D]^{-1}.
\end{aligned} \tag{11}$$

Here, $E[X]$ denotes an expectation of X, and $V[X]$ represents a variance of X. Let $I\{i \in A_l\}$ be an indicator such that the lth event A_l is true for i, and $z_{i,l}$ be lth observation of individual i. Define $x_{i,l}$ as $z_{i,l} \cdot I\{i \in A_l\}$, and $x_i^\top \equiv (\omega_i^\top, \xi_i^\top)$. Suppose that $\kappa_i \equiv (x_i - \widehat{E}(x))/n$, and $\widehat{E}(x) \equiv$ a vector such that the lth element is $\frac{\sum_i x_{i,l}}{\sum_i I\{i\in A_l\}}$. We obtain the estimate of an asymptotic variance-covariance matrix as follows[29].

$$\begin{aligned}
&\widehat{asyV} = [\widehat{D}^\top \widetilde{\Lambda} \widehat{D}]^{-1} \widehat{D}^\top \widetilde{\Lambda} \widehat{\Sigma} \widetilde{\Lambda} \widehat{D} [\widehat{D}^\top \widetilde{\Lambda} \widehat{D}]^{-1}, \\
&\text{where} \\
&\widehat{D} = \frac{\sum_i \sum_j k(\omega_i, \epsilon_i^j; \widehat{\theta}+\triangle)/nS - \sum_i \sum_j k(\omega_i, \epsilon_i^j; \widehat{\theta})/nS}{\triangle}, \\
&\widehat{\Sigma} = \textstyle\sum_i \kappa_i \kappa_i^\top \\
&\widetilde{\Lambda} \equiv diag(\widehat{\Sigma}).
\end{aligned}$$

a starting matrix with different random draws of $j > 1$. Starting simplex after the first random draws comprises diagonal elements of 0.7 times the difference between the previous result and the lower transfer bound, and all other elements of zeros; If the transfer level violates the minimum consumption restrictions, it is replaced by an arbitrary level between transfer bounds. Let T be the temperature for the Brownian motion, and $itmove$=100 be the maximal number of total moves at each temperature. We use three different temperature, l=1,2,3. The maximal number of total moves is, $Titer$=300. Here, $T = (1 - \frac{l*itmove}{Titer})^4$.

[29]We use this form so that we obtain symmetric positive definite variance estimates allowing correlation between A_l's.

E Appendix

E.1 Parameter estimates

	Parameter	Estimate	Standard Error
Preference of the daughter			
	α_{13}	2.43140*	0.06353
	α_2	-0.15625*	0.02781
	α_3	-2.32217*	0.30134
	α_4	-2.46509*	0.10629
	α^F	0.47712*	0.04993
	α_{14}	-0.16294*	0.02901
Preference of the parents			
	α_7	0.26255*	0.00945
	α_8	0.38737*	0.01757
	α_9	0.98831*	0.09138
	α_{10}	0.30268*	0.04065
	α^P	-0.17984*	0.02339
	α_{11}	-0.37640*	0.08016
	μ^P	0.07348×10^{-2}	0.52109
	μ^F	0.07785×10^{-2}	0.41467
	$\log \gamma$	-0.44308*	0.03739
		$(\gamma = 0.642058)$	

Table 14: Parameter estimates

In the estimation, we assume that the bargaining power between a husband and a wife, π, is 0.5. The parameter of parents' altruism toward negative transfers are statistically significant, but the other altruistic parameters are not. The fraction of modern family is 50.6%. The fraction that both the daughter and her possible future husband are from traditional family is 44.6%. The fraction that the both are from modern family is 45.9%. The fraction that the one is from modern family and the other is from traditional family is 4.7%.

Parameter	Estimate	Standard Error
z_0^F	0.60154*	0.03161
z_0^M	0.82594*	0.17973
z_1^F	0.61095*	0.17481
z_1^M	0.76306*	0.26453
z_2^F	0.61316*	0.02244
z_2^M	0.84939*	0.12157
α_{21}	-2.23981*	0.09771
α_{22}	4.50850*	0.41614
β_{M1}	0.24713*	0.01753
β_{M2}	0.00849*	0.00149
β_{M3}	0.02323*	0.00223
β_{M4}	0.92057*	0.00748
β_{M5}	0.01678*	0.00333
β_{M6}	0.78372*	0.09231
β_{M7}	0.42915*	0.03148
β_{M8}	2.06542*	0.06468
β_{r1}	-1.71391*	0.02114
β_{r2}	-0.37709*	0.01979
β_{r3}	0.09668*	0.00388
β_{r4}	-0.00787*	0.00136

Table 15: Parameter estimates (continued)

	Parameter	Estimate	Standard Error
Cholesky matrix of $\Omega_{\bar{\varepsilon}^F_{xq}} = \begin{pmatrix} 1 & & & \\ a & 1 & & \\ b & d & 1 & \\ c & e & f & 1 \end{pmatrix}$			
	a	-0.11766*	0.00751
	b	-0.13307*	0.01644
	c	0.14067*	0.01069
	d	0.18842*	0.01495
	e	0.20874*	0.02187
	f	0.10882*	0.01065
Standard deviations of ϵ^P, y^M, and t^M			
	σ^P_{m0}	0.24598*	0.10602
	σ^P_{m1}	0.60169*	0.05302
	σ^P_{m2}	0.04170	0.26946
	σ_{yM}	0.51831*	0.02482
	σ_{tM}	1.30383*	0.00382
	p^M_0	2.19348	4.15490
	p^M_1	-0.12104	2.40982
	p^M_2	0.82476*	0.32395
	p^M_3	-0.07249	0.38445
	p^M_4	-0.25360	1.42352
	p^M_5	0.26649	1.29736
	p^M_6	-0.38843*	0.10778
	$\underline{c}$	0.04850	0.18468

Table 16: Parameter estimates (continued)

F Appendix

F.1 Model fit

	Data	Model
Daughter's age		
Young	13.60	13.62
Middle	11.10	10.95
Old	6.77	7.19
Housing rents		
Low	11.59	11.08
Middle	10.57	10.47
High	9.08	9.98
Daughter's income		
Low	15.23	15.43
Middle	8.63	8.92
High	7.43	7.20
Parents' income		
Low	7.39	8.31
Middle	10.99	10.16
High	12.36	13.02
Education		
Low	10.46	11.30
High	10.39	9.49

Table 17: Percent getting married

F.2 Counterfactual experiments

	Counterfactual	Baseline	Value Change	Percent Change
Total	0.31459	2.70409	-2.3895	-88.4
Daughter's age				
Young	0.47579	2.98777	-2.51198	-84.1
Old	0.2003	2.50298	-2.30268	-92.0
Housing rent				
Low	0.30874	2.55618	-2.24744	-87.9
High	0.32137	2.87525	-2.55388	-88.8
Daughter's income				
Low	0.29353	1.97372	-1.68019	-85.1
High	0.34034	3.59692	-3.25658	-90.5
Parents' income				
Low	0.24267	2.17009	-1.92742	-88.8
High	0.38026	3.19166	-2.8114	-88.1
Daughter's education				
Low	0.32198	2.34513	-2.02315	-86.3
High	0.30499	3.17094	-2.86595	-90.4
(a) No brother, eldest/ (b) At least one brother or not eldest				
(a)	0.28575	2.75194	-2.46619	-89.6
(b)	0.32384	2.68878	-2.36494	-88.0

Table 18: Daughter's welfare: Options to co-reside, but no strategic monetary transfers

	Counterfactual	Baseline	Value Change	Percent Change
Total	0.38483	2.07035	-1.68552	-81.4
Daughter's age				
Young	0.53821	2.2937	-1.75549	-76.5
Old	0.28219	1.91357	-1.63138	-85.3
Housing rent				
Low	0.37907	1.9789	-1.59983	-80.8
High	0.39921	2.17816	-1.77895	-81.7
Daughter's income				
Low	0.45667	1.97011	-1.51344	-76.8
High	0.30497	2.19494	-1.88997	-86.1
Parents' income				
Low	0.19521	1.39161	-1.1964	-86.0
High	0.5648	2.6918	-2.127	-79.0
Education				
Low	0.39208	1.87253	-1.48045	-79.1
High	0.38364	2.32974	-1.9461	-83.5
(a)No brother, eldest /(b)At least one brother or not eldest				
(a)	0.37617	2.11423	-1.73806	-82.2
(b)	0.39233	2.05751	-1.66518	-80.9

Table 19: Parents' welfare: Options to co-reside, but no strategic monetary transfers

	Counterfactual	Baseline	Value Change	Percent Change
Total	0.32294	2.70409	-2.38115	-88.1
Daughter's age				
Young	0.41414	2.98777	-2.57363	-86.1
Old	0.25828	2.50298	-2.2447	-89.7
Housing rent				
Low	0.34013	2.55618	-2.21605	-86.7
High	0.30305	2.87525	-2.5722	-89.5
Daughter's income				
Low	0.29386	1.97372	-1.67986	-85.1
High	0.35848	3.59692	-3.23844	-90.0
Parents' income				
Low	0.26098	2.17009	-1.90911	-88.0
High	0.37951	3.19166	-2.81215	-88.1
Education				
Low	0.31054	2.34513	-2.03459	-86.8
High	0.33907	3.17094	-2.83187	-89.3
(a)No brother, eldest /(b)At least one brother or not eldest				
(a)	0.31255	2.75194	-2.43939	-88.6
(b)	0.32627	2.68878	-2.36251	-87.9

Table 20: Daughter's welfare: No options to co-reside, no strategic monetary transfers

	Counterfactual	Baseline	Value Change	Percent Change
Total	0.40783	2.07035	-1.66252	-80.3
Daughter's age				
Young	0.5707	2.2937	-1.723	-75.1
Old	0.29235	1.91357	-1.62122	-84.7
Housing rent				
Low	0.39746	1.9789	-1.58144	-79.9
High	0.41983	2.17816	-1.75833	-80.7
Daughter's income				
Low	0.48039	1.97011	-1.48972	-75.6
High	0.31914	2.19494	-1.8758	-85.5
Parents' income				
Low	0.207	1.39161	-1.18461	-85.1
High	0.59118	2.6918	-2.10062	-78.0
Education				
Low	0.41433	1.87253	-1.4582	-77.9
High	0.39937	2.32974	-1.93037	-82.9
(a)No brother, eldest /(b)At least one brother or not eldest				
(a)	0.39071	2.11423	-1.72352	-81.5
(b)	0.41332	2.05751	-1.64419	-79.9

Table 21: Parents' welfare: No options to co-reside, no strategic monetary transfers

	Counterfactual	Baseline	Change	Elasticity
Daughter's age				
Young	24.976	19.899	5.077	-0.51028
Old	34.338	29.402	4.936	-0.33576
Housing rent				
Low	30.543	28.39	2.153	-0.15167
High	29.364	21.316	8.048	-0.75511
Daughter's income				
Low	26.891	23.507	3.384	-0.28791
High	33.834	26.871	6.963	-0.51825
Parents' income				
Low	12.211	10.263	1.948	-0.37962
High	44.191	36.91	7.281	-0.39453

Table 22: Impact of rent subsidy programs on percent net monetary transfers from parents that are more than 5% of parental income: Single living with parents

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