Household Sharing and Commitment: Evidence from Panel Data on Individual Expenditures and Time Use

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In this paper, we analyze the dynamics of intra-household allocations using unique panel data on individual-specific consumption expenditures and time used for leisure, market production and home production. Cross sectional differences at the time of marriage in expected wage profiles between a husband and wife strongly affect the allocation of private consumption expenditures and time use by households in the cross section. There are substantial gender asymmetries in these allocations. Even for households where the husband and wife have identical wages, the private consumption expenditures for the wife are about half those for the husband. Within a given household over time, shocks to wages lead households to shift the relative weights in favor of the spouse receiving the favorable shock. Additionally we find that households adjust the weights in response to large but not to small shocks; the adjustment to the weights is twice as large in the year leading up to a divorce; and adjustments are more frequent in dual- than in single-earner households. We interpret the data using a dynamic collective model of the household with potentially limited commitment.

Keywords: Intra-household allocations, dynamic collective model, limited commitment.

JEL classification: D12, D13, J22.

1. INTRODUCTION

There are substantial benefits to individuals from living in a household. Individuals gain from sharing public goods within the household, and can take advantage of specialization resulting from comparative advantage in home or market production. Within a household individuals can pool income risk, sharing in each other’s gains and insuring one another in the case of poor health or job loss. It is natural to think that an individual cares about the wellbeing of their spouse. At the same time they are very likely to have distinct preferences for the share of household resources devoted to the public (non-rival) good relative to own private consumption and leisure. The final allocation of household resources then will necessarily depend on each individual’s weight, or bargaining power, in household decision making.

In this paper we present novel results on how the allocations of time and individual consumption expenditures differ between households in the cross section, as well as how these allocations change over time within households. We relate these cross sectional differences in allocations to differences across households in information known at the time of marriage. We relate the changes in allocations within households over time to updates in information available to the household. These patterns are informative for understanding how households determine the relative weights attached to the utilities
of the husband and wife at the time of marriage, and how these weights might evolve during marriage as new information becomes available.

We are able to distinguish between heterogeneity across households and changes over time within households by exploiting a unique data set from Japan that contains repeated observations of the same households over time. We have a panel of households, observed for up to 20 years. In each year we have information on the private consumption expenditures of the wife, the private consumption expenditures of the husband, and expenditures for everyone in the household. In addition, we have information each year on the number of hours each member spends on market work, home production, and leisure, as well as measures of individual wages, households characteristics and other demographic information. As far as we are aware this is the only data set available that has repeated observations over time on the consumption and time allocations of individual household members.

We first present direct empirical evidence on the within household distribution of expenditures and time use. The first thing to note is that there is substantial heterogeneity across households in terms of individual private consumption, time use and the relative wages of husbands and wives. Some striking gender differences are evident. On average 79% of household expenditures are for items shared by all family members. Of the remaining purely private expenditures, on average 31% are consumed by the wife, implying husbands consume more than double the private consumption of their wives. In terms of time use, wives contribute 30% of household market hours and 86% of home production hours. Leisure hours are only slightly lower for wives than husbands. Finally, on average the husband’s wage is 1.8 times higher than the wife’s wage.

Next we use a dynamic model of the household to infer what these empirical patterns imply for the determination of the weight placed on the wife’s utility relative to the husband’s utility within the household, and how the relative weight adjusts during marriage. Our main findings are summarized as follows: 1) Differences between wives and husbands at the time of marriage in expected wage profiles strongly influence the household weight in the cross section. Households in which the wife’s expected relative wage and wage growth are higher place a larger weight on the wife’s utility at the time of marriage. 2) Realized deviations from expected wages trigger a move in the weight. During marriage, shocks to relative wages cause the households to revise the weight in favor of the spouse receiving the positive wage shock. 3) The weight responds to large but not to small wage shocks. This is consistent with, for example, limited commitment in the household where the participation constraints of both spouses must be satisfied, and participation constraints are more likely to bind in the face of large shocks. 4) For the subset of households whose marriage end in divorce, the weight is twice as responsive to shocks during the last year of marriage. Marital surplus is likely to be low in the time leading up to divorce, making it more likely that any shock would cause a participation constraint to bind. 5) There is a structural difference in the response of the weight between households in which both spouses are employed compared to those in which only the husband works. The weight at time of marriage is less favorable to the wife in single earner households, but it is also less responsive to wage shocks during the marriage. 6) We find substantial gender asymmetries. Even in the case where the wife and husband have equal wages, the wife has a lower share of private consumption. There is, on average,

1. Data sets containing individual consumption and time allocation also exist for the Netherlands and Denmark (see Browning and Gortz, 2012; Cherchye, De Rock, and Vermeulen, 2012), but these do not contain repeated observations for the same households.
a gender difference in the preference for private versus public consumption. This finding is important as it implies that policies that change the relative weight of husbands and wives within a household will have an impact on resources devoted to children in the household, confirming the well-known findings of Lundberg, Pollak, and Wales (1997).

7) We find that future news has no effect on the weight in the current period, indicating that our measured innovation is not anticipated by the household. 8) We also find that the weight is less responsive to wage shocks in households who share a common bank account and in households that do not work in the same industry.

Our key assumption in interpreting the data is that the allocations we observe are constrained efficient, following the literatures on the collective model of the household (Chiappori, 1988, 1992; Mazzocco, 2007) and dynamic risk sharing (Kocherlakota, 1996; Ligon, 1998; Ligon, Thomas, and Worrall, 2002). Our approach does not fully specify a model for the unobserved values the husband and wife would attain either outside of marriage or at an inefficient allocation within marriage. Instead, we model the household weight on the wife relative to the husband directly as a function of state variables and proxies for states variables that we expect to be relevant for the relative outside options of the spouses. Specifically, we will base our estimating equations on the within period optimality conditions relating relative marginal utilities of consumption (leisure) to relative households weights (and relative wages). Differences across households tell us about the sources of differences in bargaining positions at time of marriage. Changes over time for a given household are informative about the sources of changes in the relative household weights. We explore what types of constraints are preventing households from attaining \textit{ex ante} efficient allocations by introducing additional variables in the Pareto weight that proxy for the relative size of marital surplus, the size of shocks, or other frictions.

The remainder of the paper is organized as follows. In Section 2 we review the related literature. In Section 3 we present the dynamic household model that we will use to interpret the data. In Section 4 we discuss the data set and present summary statistics as well as the general patterns in the raw data. In Section 5 we derive the equations that will form the basis of estimation and present the estimation procedure in detail. We present the estimation results and analysis, along with tests and robustness checks, in Section 6 and the conclusions in Section 7.

2. RELATED LITERATURE

Over the last few decades the literature on intra-household allocations has moved away from the unitary approach of Becker (1973, 1974, 1981), in which households behave as if there is a single decision maker, to models of strategic interaction between household members. The literature has developed models of intra-household interactions based on both cooperative (see, for example, Manser and Brown, 1980; McElroy and Hornery, 1981) and non cooperative bargaining solutions (see, for example, Lundberg and Pollak, 1993; Del Boca and Flinn, 2012; Doepke and Tertilt, 2017). Common to both cooperative and non-cooperative bargaining approaches is the need to fully specify the outside option, or threat point, of the husband and wife. The difficulty for empirical work is that we cannot observe outcomes for the same household both in marriage and at their threat points. Estimating the value of the outside option then requires additional structural assumptions.

One approach that avoids the need to fully specify the threat point is the collective model of the household (Chiappori, 1988, 1992; Apps and Rees, 1988). The key
assumption of the collective model is that households arrive at Pareto efficient allocations, while the exact intra-household bargaining process is left unspecified. An important result, which is very useful for empirical analysis, is that by observing an assignable good (for example leisure or private consumption), it is possible to identify how the share of total household resources allocated to the husband and wife differs by differences in individual bargaining power, without fully specifying the outside options of the spouses.

There are now a substantial number of cross-sectional empirical studies demonstrating, in a wide variety of contexts, that allocations within households are related to the source of income and other factors such as the sex ratio and divorce legislation. Recently, Attanasio and Lechene (2014) provide compelling evidence from a randomized control trial rejecting the unitary model of the household in favor of a collective model. They use the exogenous variation in the wife’s share of household income induced by a cash transfer program in Mexico (PROGRESSA) to implement the test of the collective model proposed by Bourguignon, Browning, and Chiappori (2009) and find that Pareto efficiency of the resulting expenditures cannot be rejected.

In an important paper, Mazzocco (2007) highlights the substantial issues raised by the degree of commitment when modeling the inter-temporal behavior of households. He characterizes the Euler equations for total household private and public consumption expenditures implied by the dynamics of collective household behavior, and proposes a test for full commitment (ex ante efficiency), against no commitment (a series of static interactions) or limited commitment (limited only by participation constraints). The data used does not allow him to measure separately the private consumption of the husband and the wife and does not contain a panel dimension. As a result it is not possible to estimate the relative importance of cross-sectional dispersion in weights from changes accruing during marriage.

Recently, Voena (2015) studied the effect of changes in divorce laws across the US states (from mutual consent to unilateral), combined with different rules as to how assets are allocated at divorce (title based or equal division), on the savings and labor supply behavior of households. She finds that the observed responses of household asset accumulation and the labor supply response of the wife support a model of limited commitment in households. This analysis, however, assumes that the household weight at time of marriage is identical for all households.

3. A DYNAMIC MODEL OF HOUSEHOLD DECISION MAKING

Our estimation approach and interpretation will be based on the following dynamic model of household decision making, which builds on the model and insights of Mazzocco (2007). It includes a role for private consumption, public consumption, and time used for leisure, market production and home production. Consider a household comprising two decision makers, a wife \((W)\) and a husband \((H)\). In order to reduce notational clutter we will suppress the explicit household index \(i\) unless it is necessary for clarity. Each spouse \(j \in \{W, H\}\) in period \(t\) cares about his or her own private consumption \(c_{jt}\), private
leisure $\ell_{jt}$, and a household public good $q_t$. In addition to leisure, individuals spend time on market production $m_{jt}$ and home production $h_{jt}$. The household public good is produced using a combination of market purchased goods $g_t$ and time spent by the partners in home production $h_{jt}$. Wives and husbands will, in general, have distinct utility functions $u^W(t \cdot)$ and $u^H(t \cdot)$, where the subscript $t$ on the utility functions allows for observed and unobserved preference shifters. We assume that children are not decision makers in the household but that they consume the public good. The relative extent to which wives and husbands care about the children is captured by their preferences for the public good, and the sensitivity of these preferences to the presence of children. We assume that utility is additively separable over time, with individual-specific discount factor $\delta_j$. The weight the household puts on the utility of the wife in period $t$ is given by $\mu_t$, with complementary weight $(1 - \mu_t)$ placed on the husband. The household is assumed to maximize the expected, discounted, weighted sum of the spouses’ period utilities:

$$U_0 = \mathbb{E}_0 \sum_{t=0}^{T} \left[ \delta^W_t \mu_t u^W_t(c_{Wt}, \ell_{Wt}, q_t) + \delta^H_t (1 - \mu_t) u^H_t(c_{Ht}, \ell_{Ht}, q_t) \right],$$

subject to a constant returns to scale home production function:

$$q_t = q(g_t, h_{Wt}, h_{Ht});$$

the per-period time constraint:

$$\ell_{jt} + h_{jt} + m_{jt} = 1, \quad j \in \{W, H\},$$

the period-by-period budget constraint:

$$c_{Wt} + c_{Ht} + g_t + w_{Wt} (\ell_{Wt} + h_{Wt}) + w_{Ht} (\ell_{Ht} + h_{Ht}) = w_{Wt} + w_{Ht} + (1 + r_t) a_t - a_{t+1} \equiv y_t,$$

where $y_{jt}$ denotes period $t$ full income, the non-negativity constraints:

$$c_{jt}, \quad g_{jt}, \quad \ell_{jt}, \quad h_{jt}, \quad m_{jt} \geq 0,$$

and the stochastic process for wages, comprising forecastable and unforecastable components (conditional on information available at marriage):

$$\log w_{jt} = w(x_{jt}, \varepsilon_{jt}).$$

The shock to wages $\varepsilon_{jt}$ is discussed in detail below. We have written the household problem in sequence form, indicating that the household is choosing state contingent plans.

There is also an implicit constraint that at any point in time for married couples, the joint value of marriage must be greater than the joint value of divorce, otherwise the match would terminate.

3. This setting is equivalent to a model in which individuals also care about the wellbeing of their spouse (see Browning, Chiappori, and Lechene (2006) and Web Appendix B.1 for a presentation of a version of that model, which produces identical estimating equations).

4. In general the weights need not sum to one each period (see Marcit and Marimon, 2011), however, in the current context we will work with the relative weights and this normalization is not important.
3.1. Dynamic (in)efficiency

The key data series that inform us about dynamic efficiency relate to dynamics of the relative marginal utilities of consumption and leisure of the wife and husband:

\[
\frac{\partial u_W}{\partial c_W} = \frac{\partial u_W}{\partial \ell_W} = \theta_t, \\
\frac{\partial u_H}{\partial c_H} = \frac{\partial u_H}{\partial \ell_H} = \frac{w_{Wt}}{w_{Ht}} \theta_t,
\]

where \( \theta_t = (1 - \mu_t) / \mu_t \) is the household weight on the husband relative to the wife. With full commitment and full information the relative marginal utilities of consumption may differ across households but will be constant at \( \theta_t = \theta \) over time within household. Similarly, the relative marginal utilities of leisure will move over time only in response to changes in the relative wage. We will interpret fluctuations over time in \( \theta_t \) as a wedge between the allocations we observe in the data and the ex ante efficient allocations that would arise under full commitment and full information. In Sections 6.2 and 6.3 we examine the sources of these wedges, guided by the implications of models of limited commitment and asymmetric information.

3.1.1. Limited commitment. In the case of a household which is constrained by limited commitment (but has full information) there is a clean interpretation to fluctuations in the relative household weights. Following the insights of Mazzocco (2007), we can fully characterize commitment in terms of the household-specific Pareto weight \( \mu_t \). The distinction between full and limited commitment within the household boils down to whether the Pareto weight is fixed at time zero, or is revised during the marriage with the revelation of new information. If households are able to fully commit at the time of marriage, then all household decisions are efficient in the sense that they are always on the ex ante Pareto frontier. In this case the only thing that matters for determining the Pareto weight is the relative decision power at the time of marriage. In other words the Pareto weight is only a function of information available at the time of marriage (including the forecastable components \( z_0 \equiv \{E_0 z_t\}_{t=0}^T \)):

\[
\mu_t = \mu(z_0) \quad \forall t.
\]

The vector \( z_t \) contains all the relevant variables that influence the relative power in the household. This may include total resources available to the household (in terms of initial financial and human wealth) as well as variables that capture bargaining power of the household members, but do not shift preferences, the home production technology, or the budget set (termed extra-environmental parameters by McElroy (1990) or distribution factors by Browning, Bourguignon, Chiappori, and Lechene (1994)). Note that with full commitment all variation in the Pareto weight is cross-sectional.

With limited commitment (or no commitment), the Pareto weight may change as information is revealed through period \( t \). In this case the Pareto weight depends both on the date zero forecastable components \( z_0 \) and the realized deviations from this forecast \( z_{1t} \equiv z_t - E_0 z_t \):

\[
\mu_t = \mu(z_0, z_{1t}).
\]

We explicitly allow \( z_0 \) and \( z_{1t} \) to have independent effects on the Pareto weight.

In the absence of full commitment there are several alternatives for how the Pareto weight may be updated with new information. It could be that the dynamics of household allocations are well represented by a sequence of repeated static problems, in which
case the Pareto weight would update period by period. Alternatively, it may be that renegotiation takes place only when the participation constraint of one of the household members is binding; the member would be better off single than married given the current allocation, but both members would be better off by renegotiating and remaining married. In the second case the Pareto weight only moves with \( z_{1t} \) when the new information indicates a binding participation constraint. As a result, the Pareto weight may remain constant in the face of small realized deviations and only change in response to large deviations that are indicative of a binding participation constraint. Mazzocco (2007) adopts the approach developed by Marcet and Marimon (1992, 2011) and shows that the Pareto weight will remain constant unless the participation constraint binds for one of the spouses. For example, the Pareto weight will change whenever \( z_{1t} \) reveals new information such that for one of the spouses, 

\[
\mathbb{E}_{\tau} \sum_{\tau=0}^{T-\tau} \delta_{\tau} \mu_{t} \nu_{j}(c_{jt}, l_{jt}, q_{t}) < \nu_{j}(z_{1t}),
\]

where \( \nu_{j}(z_{1t}) \) is the value of being single for spouse \( j \). In this case the Pareto weight is updated to satisfy the binding participation constraint. The reduced form of this process is that the Pareto weight is updated whenever the update to \( z_{1t} \) is "large enough". Here large is defined relative to the size of match surplus. We will explore this implication empirically in Section 6.

The limited commitment case nests the full commitment case, which in turn nests the case in which the Pareto weight does not depend on any of the factors in \( z \):

\[ \mu_{t} = \mu \ \forall t, \]

generally called a unitary model of the household.

3.1.2. Information frictions. An alternative to commitment frictions, which will also imply a distortion to dynamic efficiency, are information asymmetries. For example, it may be possible for one spouse to hide a wage rise (or effort) from the other, and simply increase own consumption (or leisure). A constrained efficient allocation in the face of information frictions requires a truth telling constraint to induce full reporting of wage shocks or effort levels. These constraints will distort dynamic efficiency, but they may also distort static efficiency, depending on the nature of the information problem (see, for example, Doepke and Tertilt, 2016, section 2.6). In Section 6.3 we explore some information frictions. The results here need to be considered with the the caveat that the estimates assume static efficiency (an identifying assumption) which will not in general be consistent with a dynamic model with information frictions.

4. DATA

Estimation requires using panel data containing information on expenditures on assignable private and public goods and on time used for market work, home production, and leisure. A unique data set that satisfies these requirements is the Japanese Panel Survey of Consumers (JPSC).

4.1. Description of JPSC data

We use the JPSC data covering the period from 1993 to 2013. The data include four cohorts: cohort 1 comprising 1,500 women aged 24 to 34 in 1993, cohort 2 comprising

5. See Browning, Chiappori, and Lechene (2006) for a discussion of the extent to which it is possible to distinguish a static collective model from a unitary model with arbitrary preference heterogeneity.
500 women aged 24 to 27 in 1997, cohort 3 comprising 836 women aged 24 to 29 in 2003, and cohort 4 comprising 636 women aged 24 to 28 in 2008. In addition to rich data on demographics, education, wages and labor supply, the JPSC has a consumption expenditure module and a time use module. We keep married women and their husbands for whom we observe, for both spouses, (i) their demographic characteristics, such as current age, age at marriage, and education; (ii) their expenditures and time use for at least two consecutive years; and (iii) their wages for at least two consecutive years. The sample used in the baseline analysis includes 1,149 households (12,615 household-year observations).  

The JPSC asks the following question about the components of household expenditures:

Please write down your household expenditure in September this year, including not only cash purchases, but also purchases with the credit loan(s), or those charged to your bank/post office account. (If there was no expenditure corresponding to the items below, put “0” for each answer.)

Importantly for our purposes, the JPSC also asks for the breakdown of total household expenditures into the following five categories: 1) Expenses for all of your family, 2) Expenses for you, 3) Expenses for your husband, 4) Expenses for your child(ren), 5) Expenses for other(s).

We treat categories 1, 4 and 5 as expenditures used to produce the household public good $g$, category 2 as private consumption of the wife $c_{W}$, and category 3 as the private consumption of the husband $c_{H}$.

In addition the JPSC has relatively detailed information on the time use of individuals. Specifically it asks the following question (answered for both the wife and the husband):

How many hours do you or does your husband spend in total per workday and day off (if you don’t work, answer about your husband’s day off.) for each of 6 activities listed below? (Enter the time in hour and decade of minutes.) If you or your husband has two or more activities in the same period of time, choose the most important of them: 1) For attending school or workplace; 2) For work; 3) For schoolwork (studies); 4) For housekeeping and child care; 5) For hobby, leisure,
TABLE 1

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Notes: All monetary values are in 2013 Japanese Yen. The sample comprises 1,149 households.

We categorize activities 1, 2, and 3 as market hours $m_j$, activity 4 as home hours $h_j$, and activities 5 and 6 as leisure hours $\ell_j$. 9

4.2. Summary statistics

Basic demographic characteristics of the households are presented in the bottom panel of Table 1. On average the women in our sample are 36.5 years old, with husbands who are, on average, 2.4 years older. The average number of years of education is quite similar between men and women at 13.5 and 13.2 years respectively. The average number of children under the age of seven is 0.62, while the average number between the ages of seven and 17 is 0.87.

In the top panel of Table 1 we present the average expenditures (and shares) on private consumption of the wife, private consumption of the husband, and consumption for the household (expenditures for the family, children and others). On average 79% of expenditures are reported as public expenditures, leaving 21% of household expenditures reported as private for either the wife or the husband. There is a substantial difference between the average share of expenditures devoted to the private consumption of the wife, 6.5%, and husband, 14.5%.

There are also notable differences in the average share of time spent by women and men on market work and home production. Women spend 17.7% of their time on market

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9. Hours spent on schoolwork is negligible for the sample of married couples we use in estimation. Only 13 out of 12,615 observations used in estimation involve any hours related to attending school for either the husband or the wife.
work and 26.2% on home production. The corresponding shares for men in the sample are 37.3 and 4.4. There appears to be substantial specialization. Time spent commuting is included in the hours of market work and time spent on child care is included in home production. In terms of leisure, there is much less difference, with women spending on average 56.1% of their time and men 58.3% of their time on hobbies, recreation, entertainment, sleep, meals, and personal care.\(^{10}\)

### 4.3. Expenditure, time-use, and wage shares

In Figure 1 we plot the cross sectional distributions of the wife’s wage share along with her share in each of the allocations and the share of expenditures devoted to public goods. Specifically, we plot the histograms of \(\frac{c_w}{c_w + c_h}\), \(\frac{\ell_w}{\ell_w + \ell_H}\), \(\frac{h_w}{h_w + h_H}\), \(\frac{m_w}{m_w + m_H}\), \(\frac{g}{c_w + c_h + g}\), and \(\frac{w}{w + w_H}\). For the figure, we take an average of the shares over the sample period within each household. The mean and standard deviation are presented below each histogram.

There is substantial dispersion in the wife’s wage share across households in our sample. The mode is below 0.3, indicating that in most households the wife has a market wage less than half of her husband. In the majority of households the wife’s share of private consumption is also below half, although there is substantial dispersion across households. Looking at leisure, the average share is much closer to one half, and there is much less dispersion, with the female leisure share for all households essentially lying between one third and two thirds. Looking at the share of home hours and market hours, we see that the share of home hours by the wife is above half in almost all households, and the share of market hours is below one half in almost all households. Finally, we see that the share of expenditures for the household is centered around 0.79, with almost all households allocating more than half of the budget to public expenditures.

In Figure 2 we present scatter plots of each of the shares against the wage share, along with a line of the slope from a univariate median regression. The raw correlation coefficient is presented below each scatter plot. In the raw data, there is a clear positive relationship between cross sectional consumption and wage shares. The relationship between leisure and wage shares is nearly flat, while it is clearly negative for the share of home hours and positive for market hours. The share of expenditures allocated to household public goods is also mildly negative. While we cannot conclude much directly from these plots of raw data, the patterns will be very informative for estimating the degree of complementarity between consumption and leisure as well as the parameters of the Pareto weight. For example, on their face, these patterns are inconsistent with a unitary model with separability between private consumption and leisure, which would imply no relationship between the wage share and the consumption share and a negative relationship between wage share and leisure share.

Our objective is to estimate the extent to which these differences in allocations between men and women reflect differences in preferences, market opportunities, and relative decision making power within the household.

\(^{10}\) In Web Appendix B.2 we show that the JPSC sample data lines up well with other Japanese data sources. We also compare the Japanese time and consumption shares to similar cross-sectional data for other countries.
Figure 1
Distributions across households of consumption, hours and wage shares
Notes: Mean and standard deviation in parenthesis.

5. ESTIMATION

5.1. Parametrization of preferences and technology
For estimation it is necessary to parametrize the utility and home production functions.\footnote{For the purposes of testing and estimating the Pareto weight we can relax the functional form assumptions for utility and home production, and use fewer of the first-order conditions. We include} Given the patterns presented in Figure 2 we want a specification in which the ratio of
the marginal utility of consumption between the wife and husband is not assumed to be independent of the level of individual hours choices and the level of public goods expenditures. To allow for relatively flexible substitution patterns across hours and consumption expenditures, we consider the following CES specification for the individual flow utilities:

\[ u_j(c_{jt}, \ell_{jt}, q_t) = \xi_j t^{1-\sigma_j} \left( \alpha_{1t}^j c_{jt}^{\phi_j} + \alpha_{2t}^j \ell_{jt}^{\phi_j} + \left(1 - \alpha_{1t}^j - \alpha_{2t}^j\right) q_t^{\phi_j} \right)^{\frac{1-\sigma_j}{\phi_j}} \]

and the following constant returns to scale specification for the home production function:

\[ q(h_{Wt}, h_{Ht}, g_t) = (\pi_t h_{Wt}^\gamma + (1 - \pi_t) h_{Ht}^\gamma) g_t^{1-\rho}. \]

With this specification, spousal preferences for own private consumption and leisure are weakly separable from home production hours and expenditures from the point of view of the individual spouses. At the same time, from the point of view of the household, the ratio of marginal utilities between the wife and husband of both private consumption and leisure depend on the full allocation of time and expenditure within the household. Preference and home productivity parameters with a subscript \( t \) will depend on possibly such a specification as a robustness check in Web Appendix B.3.
time varying observable characteristics such as age, education and the presence of children in the household (see Section 5.2.2 for the empirical implementation). Thus there is substantial heterogeneity both across households and between spouses within households.

5.2. Optimality conditions

We base our estimating equations on the full set of optimality conditions that characterize the intra-temporal allocations of the household. We can do this only because the JPSC survey asks about the private consumption of the husband and wife, their individual time use and expenditures on public goods. Since we have panel data, we can learn about preference changes and shifts in the relative household weights by observing how the relative consumption and hours choices change over time for a given household. In principle the inter-temporal Euler equations contain additional information that would add to the efficiency of our estimates. We choose to only use the intra-temporal conditions as these are robust to, among other things, the presence of liquidity constraints. The inter-temporal Euler equations do not hold for liquidity constrained households. As noted by Mazzocco (2007), a test using the household Euler equation designed to detect liquidity constraints has no power against the alternative of no commitment within the household, and vice versa. However, the intra-temporal conditions hold for any full information constrained efficient allocation, regardless of the presence or absence of liquidity constraints.12

5.2.1. Intra-temporal first-order conditions.

Home production technology. The first-order conditions for the optimal choice of home production inputs \( \{g_t, h_{Wt}, h_{Ht}\} \) imply, with the current functional forms, the following marginal rate of transformation equations:

\[
\frac{\pi_t}{1 - \pi_t} \left( \frac{h_{Wt}}{h_{Ht}} \right)^{\gamma - 1} = \frac{w_{Wt}}{w_{Ht}}, \tag{5.1}
\]

\[
\pi_t \left( \frac{\rho}{1 - \rho} \right) \left( \frac{h_{Wt}^{\gamma - 1}}{G_t} \right) g_t = w_{Wt}, \tag{5.2}
\]

\[
(1 - \pi_t) \left( \frac{\rho}{1 - \rho} \right) \left( \frac{h_{Ht}^{\gamma - 1}}{G_t} \right) g_t = w_{Ht}, \tag{5.3}
\]

where we define \( G_t = \pi_t h_{Ht}^\gamma + (1 - \pi_t) h_{Wt}^\gamma \). It is worth noting that the ratio of hours spent in home production by the wife and husband does not depend on the household Pareto weights, it is governed solely by efficiency conditions implied by the home production technology and the relative cost of inputs into the production of the public good. The same is true for home hours relative to market purchased inputs. Of course the

12. An additional problem that arises when trying to use the inter-temporal conditions is that, as noted by Carroll (2001) and Attanasio and Low (2004), without a sufficiently long time-series, the log linearized Euler equation produces substantially biased estimates. For our baseline estimates we choose to sacrifice some degree of precision to avoid introducing this bias, and to ensure our tests and estimates are robust to the presence or absence of liquidity constraints. For this reason we exclude the Euler equations from our baseline estimates. Since we do not use any data on how households substitute resources across periods in response to variation in the interest rates, we do not have very credible identification of the inter-temporal elasticity of substitution. For this reason we follow Attanasio and Low (2004) and fix \( \sigma_W = \sigma_H = 1.5 \), implying an elasticity of inter-temporal substitution of 0.66. We present estimation results including the Euler equations (B.3) and (B.4) in Web Appendix B.4, Table B.2.
levels of hours and market expenditures devoted to home production will depend on the relative weights if husbands and wives have different preferences for private versus public consumption.

**Private consumption and leisure.** The first-order conditions for the optimal within-period allocation of private consumption and leisure \(\{c_{Wt}, \ell_{Wt}, c_{Ht}, \ell_{Ht}\}\) imply the marginal rate of substitution conditions:

\[
\frac{\alpha_j^t}{\alpha_{2t}} \left( \frac{c_{jt}}{\ell_{jt}} \right)^{\phi^j-1} = \frac{1}{w_{jt}}, \quad j \in \{W, H\},
\]

(5.4)

\[
\left( \frac{\mu_t}{1-\mu_t} \right) \left( \frac{A_{Wt}^{t-1} - \phi W t_{Wt}}{A_{Ht}^{t-1} - \phi H t_{Ht}} \right) \left( \frac{c_{Wt}^{t-1}}{c_{Ht}^{t-1}} \right) = 1, \quad \mu_t \neq 0.
\]

(5.5)

\[
\left( \frac{\mu_t}{1-\mu_t} \right) \left( \frac{A_{Wt}^{t-1} - \phi W t_{Wt}}{A_{Ht}^{t-1} - \phi H t_{Ht}} \right) \left( \frac{c_{Wt}^{t-1}}{c_{Ht}^{t-1}} \right) = \frac{w_{Wt}}{w_{Ht}},
\]

(5.6)

where we define \(A_j t = \alpha_{1j}^t c_{jt}^{\gamma - 1} + \alpha_{2j}^t \phi_j^{\gamma - 1} + (1 - \alpha_{1j}^t - \alpha_{2j}^t) q_{jt}^{\gamma - 1}\). From equations (5.5) and (5.6) we see that in general the ratio of the marginal utility of consumption (leisure) of the wife to the husband will depend on the entire allocation of hours and expenditures in the household. The exception is at the particular parameters of \(\sigma^j + \phi^j = 1\) for \(j = W, H\).

**Public consumption.** In addition, we have four conditions relating the optimal choice of home production inputs to the optimal within-period allocation of private consumption and leisure:

\[
\mu_t^t \xi_j^t A_j t^{1-\rho} \alpha_j^{t-1} c_{jt}^{\rho j - 1} = \pi s \rho h_j t^{1-\rho} c_{jt}^{\rho j - 1} g_t^{\rho j} \gamma_t^{\rho j} D_t,
\]

(5.7)

\[
\mu_t^t \xi_j^t A_j t^{1-\rho} \alpha_j^{t-1} c_{jt}^{\rho j - 1} = (1 - \rho) g_t^{\rho} \gamma_t^{\rho} D_t,
\]

(5.8)

where we define the household’s marginal value of public consumption by

\[
D_t = \sum_{j \in \{W, H\}} \mu_t^t \xi_j^t A_j t^{1-\rho} \left( 1 - \alpha_{1j}^t - \alpha_{2j}^t \right) q_{jt}^{\rho j - 1},
\]

and adopt the notation \(\mu_t^W = \mu_t\) and \(\mu_t^H = (1 - \mu_t)\).

**5.2.2. Heterogeneity and the stochastic process for wages.** We parametrize the heterogeneity in preferences and home productivity in terms of observable characteristics of the two household members \(\{x_{Wt}, x_{Ht}\}\). The Pareto weight is parametrized in terms of observable distribution factors \(\{z_0, z_{1t}\}\).

**Preference heterogeneity.** Theory requires that \(\alpha_{1t}^j \geq 0, \alpha_{2t}^j \geq 0, \alpha_{1j}^t + \alpha_{2j}^t \leq 1, \) and \(\xi_j^t \geq 0\). We respect these restrictions and model preference heterogeneity using the
specifications:

$$\alpha_{kt}^j = \frac{\exp \left( \alpha_{kt}^j x_{jt} \right)}{1 + \exp \left( \alpha_{kt}^1 x_{jt} \right) + \exp \left( \alpha_{kt}^2 x_{jt} \right)} \quad \text{for } k = 1, 2,$$

where $x_{jt}$ is a vector of observables for household member $j$ at time $t$ that shift preferences. Specifically, $x_{jt}$ contains a constant, age, education and the number of children in the household.

**Home production heterogeneity.** Theory requires that $0 \leq \pi_t \leq 1$, $0 \leq \rho \leq 1$, and $\gamma \leq 1$. We impose this requirement and model home productivity shifters by the specification:

$$\pi_t = \frac{\exp (\pi' x_t)}{1 + \exp (\pi' x_t)} \quad \text{and} \quad \rho = \frac{\exp (\rho_0)}{1 + \exp (\rho_0)},$$

where $x_t$ contains a constant and the number of children in the household under the age of seven.

**Wage process.** We assume that the wages of member $j$ evolve as a first-order autoregressive process with individual fixed effects (we again suppress the household $i$ subscript):

$$\log w_{jt} = \vartheta_j + \theta_1 a_{jt} + \theta_2 a_{jt}^2 + \varepsilon_{jt}, \quad j \in \{W, H\}$$

$$\varepsilon_{jt} = g_{jt} + e_{jt},$$

$$g_{jt} = g_{j,t-1} + v_{jt}, \quad g_{j,-1} = 0,$$

where $\vartheta_j$ is an individual fixed effect, and $a_{jt}$ is potential experience (age minus years of schooling minus 6, the age of starting school). The unobservable (in addition to the fixed effect to be estimated) is $\varepsilon_{jt}$ and comprises a permanent component $g_{jt}$, plus measurement error $e_{jt}$. The permanent shock, $v_{jt}$, is assumed to be serially uncorrelated and uncorrelated with the measurement error, $e_{jt}$.\(^{13}\)

Now, the time zero (time at marriage) prediction of the wage at any future time is given by

$$\omega_{jt} \equiv \hat{\vartheta}^j + \hat{\theta}_1 a_{j,0} + \hat{\theta}_2 a_{j,0}^2.$$

Note that $\hat{\omega}^j$ will contain the accumulated permanent shocks that occurred prior to our sample period. The wage level and expected 10-year growth at the time of marriage are given by

$$\omega_{j,0} = \hat{\vartheta}^j + \hat{\theta}_1 a_{j,0} + \hat{\theta}_2 a_{j,0}^2,$$

and

$$\Delta \omega_{j,10} \equiv \omega_{j,10} - \omega_{j,0} = 10 \hat{\theta}_1 + 100 \hat{\theta}_2 + 200 \hat{\theta}_2 a_{j,0},$$

\(^{13}\) By modeling wages as depending on potential, rather than actual experience, we are assuming wages are exogenous. We are not able to accommodate endogenous human capital accumulation within our testing and estimation strategy. Mazzocco, Ruiz, and Yamaguchi (2013) jointly model labor supply, home production, human capital accumulation, and marriage decisions in a fully specified dynamic programming model.
where $a_{j,0}$ is the potential experience at marriage of spouse $j$. Now, the realized deviation of the wage from the time zero forecast (plus measurement error) is given by

$$
\varepsilon_{jt} = \sum_{s=0}^{t} v_{js} + e_{jt} \equiv \log w_t - \omega_{jt},
$$

which is the residual from the wage regression. The innovation in time $t$ (plus change in measurement error) is given by

$$
\Delta \varepsilon_{jt} = v_{jt} + \Delta e_{jt}.
$$

We also estimate the following process of full income:

$$
\log y_{jt} = \theta_{1} a_{Wt} + \theta_{2} a_{Ht} + \theta_{3} a_{Ht} + \theta_{4} a_{Ht} + \varepsilon_{yt},
$$

to obtain a predicted value for the income level at the time of marriage:

$$
\nu_{0} = \hat{\theta}_{1} a_{W,0} + \hat{\theta}_{2} a_{W,0} + \hat{\theta}_{3} a_{H,0} + \hat{\theta}_{4} a_{H,0}.
$$

*The Pareto weight.* To facilitate interpretation we specify the weight on the wife’s utility as

$$
\mu_{t} = \exp \left( \mu_{0} z_{0} + \mu_{1} z_{1t} \right) / \left( 1 + \exp \left( \mu_{0} z_{0} + \mu_{1} z_{1t} \right) \right),
$$

where $z_{0}$ are distribution factors known or forecast at the time of marriage, and $z_{1t} \equiv z_{t} - E_{0} z_{t}$ is the realized deviation from this time zero prediction. Information known or forecast at the start of marriage fixes the cross-sectional weight, while information revealed at time $t$ potentially shifts the weight around. Breaking the distribution factors into the forecastable component at date zero and the date $t$ forecast error allows us to distinguish between full commitment and limited commitment.

As the primary distribution factors known at the time of marriage in our baseline specification we include the difference between the log wage fixed effect for the wife and husband, the difference in predicted growth in wages over the first ten years of marriage, and log full income at the time of marriage:

$$
z_{0} = \{ \omega_{W,0} - \omega_{H,0}, \Delta \omega_{W,10} - \Delta \omega_{H,10}, \nu_{0} \}.
$$

We also examine other distribution factors in $z_{0}$: (1) the log of the geometric mean of male and female sex ratios in their birth years and prefectures; (2) the log differential between wife’s parental income and husband’s parental income. We use the predicted log income from the linear regression of log annual parental income on time-invariant characteristics including dummies for father’s and mother’s education and father’s and mother’s birth years; (3) the log differential between wife’s father’s occupational prestige and husband’s father’s occupational prestige. We use predicted log occupational prestige from the linear regression of log occupational prestige on time-invariant characteristics including dummies for father’s education and father’s birth years. Occupational prestige is measured using the Treiman (1977) scale; (4) the log differential between wife’s age and husband’s age.

We include in $z_{1t}$ the difference in accumulated shocks since marriage between the wife and husband

$$
z_{1t} \equiv \varepsilon_{Wt} - \varepsilon_{Ht},
$$

along with a set of interactions described below.
For interpretation and testing, using the fact that $z_{1t} = z_{1,t-1} + \Delta z_{1t}$, we break $z_{1t}$ into the difference in accumulated shocks until time $t-1$ between the wife and husband, $z_{1,t-1}$, and the difference in innovation in time $t$ between the wife and the husband, $\Delta z_{1t}$. To gain further insight into which class of models are consistent with the estimated patterns, we also explore potential nonlinearities of the effect of $z_{1t}$ (small and large shocks); the interaction of $z_{1t}$ with the arrival of a new child (a proxy for marital surplus); the effect of $z_{1t}$ in the year prior to a divorce; potential structural differences in the effect of $z_{1t}$ between dual and single earner households; and the effects of some proxy measures for the likelihood of information frictions about wage innovations between the husband and wife.

Our parametrization of heterogeneity assumes that an individual’s age, education, and the number of children in the household may shift their relative preferences for private consumption, leisure and the public good, but their spouse’s age and education do not. We assume that the Pareto weight may be shifted by the relative age and education of the husband and the wife, or the number of children in the household interacted with the shock to relative wages. Specifically, the wife’s preference for consumption is allowed to depend on her age but not her husband’s age, and the Pareto weight is allowed to vary with the relative age of the wife and husband, but not the levels of their age.

5.3. GMM

We estimate the model parameters by nonlinear generalized method of moments (GMM). The estimating equations (A9) to (A19) are formed by taking logs of equations (5.1) to (5.8) which characterize optimal household allocations (see Appendix A.2). We assume an interior solution for private consumption, public consumption, leisure and home hours. We treat observations of zero for private consumption or home hours as resulting from infrequency. Consumption and hours are endogenous variables which will be correlated with unobserved preference shocks. Wages are assumed to be measured with error. To instrument for the endogenous variables and the measurement error in wages, we use the levels of consumption, hours and wages lagged one year as the instruments for the logs of consumption, hours and wages in the intra-temporal conditions from equation (A9) to (A17). Since the set of endogenous and exogenous variables differs across estimating equations, the set of instrumental variables differs across estimating equations. Observable preference and productivity shifters, as well as the observable distribution factors are treated as exogenous variables. When estimating the fixed effects and expected age profiles in wages we control for selection into employment. We estimate the wage process using the Heckman (1979) two-step procedure, where we include all observable preference shifters in the first stage probit, including the inverse Mills ratio as a control variable in the second stage.

5.4. Identification of the Pareto weight

It is important to note that in the JPSC data, we observe the allocation of private consumption between the husband and the wife, as well as the private leisure allocation, division of market and home work, and the public goods expenditure. From these observations we know the share of the household’s full income allocated to the husband

14. See Web Appendix B.5 for the details of the correction for infrequency of private consumption and home production hours.
and the wife. In other words, we directly observe the sharing rule in the data. Since we are also interested in issues of commitment in the household, it is convenient to estimate the Pareto weight that would give rise to this allocation. Using the observed distribution factors $z_0$ and $z_{1,t}$, which enter the Pareto weight but neither preferences nor the budget constraint, we can estimate how the Pareto weight differs across households by differences in these time of marriage distribution factors and how it changes within households in response to changes in the distribution factors (bargaining position).

The key to identifying how changes in the distribution factors $z_{1,t}$ (the realized deviations in relative wages from time of marriage predictions) affect the Pareto weight comes from the fact that for each household we observe the private consumption expenditures of the husband and wife; their allocation of time between market work, home production and leisure; and the household expenditure on the market good used in home production. Importantly, we observe how these within household allocations change over time in response to changes in wages, observable preference shifters, and distribution factors.

Examination of equation (5.5) is particularly informative for understanding the sources of identification. In the special case of additive separability ($\sigma^j + \phi^j = 1$ for $j = W$ and $H$), any observed changes over time in the ratio of private consumption of the wife to the husband must come either from changes in preferences $x_{jt}$, or shifts in the Pareto weight due to changes in distribution factors $z_{1t}$. To the extent that there is within household variation in private consumption that cannot be explained by changes in observed preference shifters, and can be explained by changes in observed distribution factors, we infer the Pareto weight is updating over time.

With strong separability the identification is especially clear since wages of the husband and wife have no effect on the ratio of marginal utilities of private consumption. Any effect of wages on relative consumption must be coming via the effect on the Pareto weight via the distribution factors. In general we do not expect preferences to be strongly separable. In this case wage changes have a direct effect on the choice of leisure hours, which will then shift the marginal utility of private consumption in the absence of strong separability. Therefore, in general wage changes will affect relative consumption through the effect on leisure. That said, we still have clean identification since for each spouse the ratio of private consumption to leisure is pinned down by the private marginal rate of substitution and own wage, which is independent of the Pareto weight (see equation (5.4)).

We have direct observations on distribution factors and can estimate the effect of differences in distribution factors across households on differences in Pareto weights across households, as well as the effect of changes over time in distribution factors within households on changes in Pareto weights within households. What we do not have direct information on is why some households, which are observationally equivalent at the time of marriage, would allocate more resources to the wife than others. This could result either from differences across men and women in unobserved bargaining power (possibly due to social norms), or to unobserved differences in preferences between spouses (husbands and wives may, on average, place different relative weights on public goods vis-à-vis private consumption and leisure).

As a result, it is not possible to identify the mean of the Pareto weight separately from preference heterogeneity. Looking at estimating equations (A14) to (A19), we find that in all cases $\mu^j_t$ appears together with $\alpha^j_k, j \in \{W, H\}, k \in \{1, 2\}$. We can always find a value for the constant in $\alpha^j_k$ that will rationalize any value for the constant in $\mu^j_t$. To
make a meaningful distinction between sharing/bargaining and preferences, we make an
identifying assumption that $\mu_t$ is equal to one half at the mean of full income when
the husband and wife have equal wages. In other words, if we observe a household in which
the husband and wife have equal wages, but different private consumption and leisure,
we will attribute this difference to preference heterogeneity, not bargaining power.\textsuperscript{15}

\section*{6. RESULTS}

We present the baseline parameter estimates in column I of Table 2.\textsuperscript{16} The estimates for
preference and technology shifters are evaluated at the sample mean of the data.\textsuperscript{17}

\subsection*{6.1. Home production and preferences}

The estimates indicate that the home hours of the wife and husband are quite
substitutable, with the elasticity of substitution, $1/(1 - \gamma)$, equal to 3.1. Additionally,
the estimate of $\pi$ indicates that women are moderately less productive at home than
men (at the mean observables). Taken together, the point estimates indicate that absent
any differences in market opportunities, wives would actually supply 0.60 hours of home
production for every 1 hour supplied by their husband. Relative market opportunities,
rather than relative productivity at home, explains the large differences in hours of home
production within Japanese households.

Interestingly, the preference estimates are quite different for husbands and wives.
The elasticity of substitution between consumption and hours is lower for wives than for
husbands, 1.19 compared to 2.66. Evaluated at the mean of observables, the weights on
private consumption, leisure and public consumption are 0.18, 0.26 and 0.56 for wives
and 0.42, 0.18 and 0.4 for husbands. Our estimates indicate wives put more weight on
the public good than their husbands, consistent with the findings of Lundberg, Pollak,
and Wales (1997). While the weight that both place on the public good increases in
the number of children present in the household, the increase is larger for the wife, as
illustrated in Table 3.\textsuperscript{18}

\subsection*{6.2. The Pareto weight}

Evaluated at the mean of the data, the estimate of the weight placed on the wife’s
utility in the household is 0.44. There is substantial variation across households ranging

\textsuperscript{15}As a robustness check we consider the identifying assumption of identical preferences and home
productivity for men and women, and then attribute variation in allocations at identical wages to the
mean of the Pareto weight.

With similar cross sectional data, Cherchye, De Rock, and Vermeulen (2012) attain identification
of the location of the sharing rule by assuming no preference heterogeneity. Recently Cherchye, De Rock,
Lewbel, and Vermeulen (2015) prove the location of the sharing rule can be set identified by combining
revealed preference restrictions with the estimated demand functions.

\textsuperscript{16}The sample comprises 1,149 households. The number of observations used for the estimation
of the process of individual wages and household full income and of the frequency of purchase is 12,615.
The number of observations used for the estimation of the system of the optimality conditions is 4,685,
6,544, 7,674, 5,587, 9,247, 6,153, 8,006, 10,731, 8,240, 8,220, and 9,489 in respective estimating equations
from A9 to A19. The observations that are not used in any estimating equations are excluded.

\textsuperscript{17}None of our conclusions about home production or preferences depend on whether we include
or exclude the Euler equations. Additionally we cannot reject the null hypothesis that the means of $\xi_t^W$
and $\xi_t^H$ are equal to 1, which we impose in the baseline estimation. (see Table A.3 in the Appendix).

\textsuperscript{18}We present the details of the underlying coefficient estimates for preferences and technology in
Table A.2 in the Appendix.
### TABLE 2

<table>
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<tr>
<th>Home production</th>
<th>Estimates</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
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<tbody>
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<td>( \alpha ) (at sample mean)</td>
<td></td>
<td>0.080</td>
<td>0.079</td>
<td>0.077</td>
<td>0.078</td>
<td>0.080</td>
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<tr>
<td>( \rho )</td>
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<td>0.079</td>
<td>0.077</td>
<td>0.078</td>
<td>0.080</td>
<td>0.079</td>
<td>0.079</td>
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<td>0.184</td>
<td>0.184</td>
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<td>( \phi^N )</td>
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<td>0.624</td>
<td>0.607</td>
<td>0.576</td>
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</thead>
<tbody>
<tr>
<td>( \mu ) (at sample mean)</td>
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<td>0.438</td>
<td>0.435</td>
<td>0.437</td>
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</tbody>
</table>

Notes: Standard errors in parentheses are computed by block bootstrap with 300 replications. The thresholds of \( z_1 \) in column V are \( (q_1, q_2, q_3, q_4) = (-0.224, -0.057, 0.065, 0.226) \).
between 0.2 and 0.75. Relative market opportunity has a positive effect on the Pareto weight. Evaluated at the sample mean in the cross section, a ten% difference in wages at marriage results in a 2.3% difference in the Pareto weight. Differences in expected wage growth are only statistically significant at the 10% level in our baseline specification. The point estimates imply that in the cross section, a 10% difference in predicted wage growth over the ten years after marriage results in a 1.7% difference in the household weight on the wife. The effect of differences in full income across households at the time of marriage is small (significant at the 5% level), a 10% difference in full income implies a 0.16% difference in the household weight.

We also introduce five additional distribution factors, the geometric mean of the cohort sex ratios in the year and prefecture where the husband and wife were born; the relative incomes of the parents of the couple; the sum of the parental income of the couple; the relative occupational prestige of their fathers' jobs; and finally, the relative age of the wife and husband. Even when introduced separately, the only one of these distribution factors that turns out to be statistically significant is the spousal age difference. The younger the wife is relative to the husband, the more favorable the Pareto weight is to the wife (see Table A.3 in the Appendix).

Based on these estimates, we can reject the strong (distribution factor free) version of the unitary model in favor of the collective household model. Spousal differences in relative wages and expected wage growth have an effect on the relative weight in the household. Next we turn to the estimates that are informative on the degree of commitment within the household.

We find that innovations to the relative wage during marriage (the deviation of the realized log relative wage in period $t$ from the time zero prediction) also have a positive

19. The elasticity of the Pareto weight with respect to distribution factor $k$ is given by $\frac{\partial \eta}{\partial z_k} = \frac{\eta z_k}{1 + \exp(\eta + z_k \beta)}$. We evaluate the elasticity at the mean of the data.

20. To the extent differences in parental resources result in differences in investment in human capital, they may already be fully reflected in the relative log wage fixed effects of the husband and wife.
Decomposition of the relative Pareto weight $\mu_t/(1-\mu_t) = \mu_0(z_0) \times \mu_1(z_{1,t})$

Notes: The Pareto weight is based on the results reported in column I of Table 2, using data for the last period the household is observed in the data.

Effect on the Pareto weight, although smaller than the effect in the cross section. A 10% increase in the realized relative wages (relative to time of marriage forecast) results in a 1.9% increase in the Pareto weight. This suggests that not all households respond to wage shocks in the same way as they do to information realized at the time of marriage. We explore this further in Section 6.3, where we allow a different effect of small and large shocks, as would be consistent with a model of limited commitment.

Changes in relative wages within households have a somewhat smaller effect on relative allocations than differences in relative wages across households (the elasticity is 16% lower). Additionally, the variation in the innovations to relative wages during marriage is substantially smaller than the heterogeneity across households in spousal wage differences at the time of marriage. To obtain a sense of the relative importance of the initial setting of the Pareto weight and the revisions over time we decompose the estimated Pareto weight for the last period they appear in our sample into the time-constant and time-varying components. Note that, given our specification, the relative Pareto weights are multiplicatively separable

$$\frac{\mu(z_0,z_{1t})}{1-\mu(z_0,z_{1t})} = \mu_0(z_0) \mu_1(z_{1t}),$$

with $\mu_0(z_0) = \exp(\mu'_0z_0)$ and $\mu_1(z_{1t}) = \exp(\mu'_1z_{1t})$. We plot the histograms of $\mu_0(z_0)$ and $\mu_1(z_{1t})$ in Figure 3. We can interpret the left hand panel as the relative weight established at marriage and the right hand panel as proportional shifters of the relative weight over time.

The main source of dispersion in the Pareto weight comes at the time of marriage. In the cross section the relative weight ranges between 0.22 and 2.1, with a mean of 0.80 (on average the weight on the husband is 1.25 times the weight on the wife). Looking at the revisions over time, we see that the mode is one, indicating no revision to the initial weight. About two thirds (65.1%) of all revisions are in the range 0.9 to 1.1, indicating that the majority of households do not revise the initial relative weight up or down by more than 10% over our sample period. Indeed, only 11.4% of households revise the relative weight either up or down by more than 20% and only 4.8% of households revise the weight by more than 30%.
Most of the variation in household Pareto weights over our 20 year sample period comes from heterogeneity across households at time of marriage. Decomposing the total variance in log $\hat{\mu}_i$ into the between household variance (heterogeneity) and the within households variance (renegotiating over time) we have

$$\text{Var}(\log \hat{\mu}_i) = \text{Var} \left( E[\log \hat{\mu}_i|i] \right) + E \left( \text{Var}[\log \hat{\mu}_i|i] \right).$$

Of the total variation in Pareto weights across households and over time, 78.1% is accounted for by heterogeneity across households and 21.9 is accounted for by updates over time within households. While the non-zero estimates of the effect of realized deviations in relative wages clearly rejects the null hypothesis of full commitment, the effect of the revisions is small relative to differences in initial conditions at marriage.\textsuperscript{21}

6.3. What drives revisions over time?

The baseline estimates discussed above provide strong support for the idea that the Pareto weight within a household is updated over time, specifically in response to deviations in relative spousal wages from time of marriage predictions. Our results on the effect of shocks on the weight are semi-structural. We have assumed and imposed that household allocations are constrained efficient, but we have not fully specified the constraints or imposed the full set of restrictions that would be implied by a particular structural model. This has the advantage of being flexible, allowing us to test hypotheses about commitment without imposing additional assumptions about the environment, but it comes at the cost of limited ability to interpret exactly why households cannot fully commit. We turn next to exploring what constraints or frictions households might be facing. We present additional results exploring the memoryless properties of the Pareto weight; whether households have advance information on what we measure as shocks; the effect of proxy measures for the size of marital surplus and for the likelihood of informational constraints on the response to shocks; the possibility of a structural difference for dual and single earner households, as well as several robustness checks related to symmetry of preferences, and alternative calculations for leisure time and public goods expenditures.

A sufficient statistic. Kocherlakota (1996) and Ligon, Thomas, and Worrall (2002) prove that a testable implication of efficient allocations without commitment is that the Pareto weight, and by implication allocations, will be memoryless. That is, once we condition on the current value of the Pareto weight (the inverse marginal utility of consumption), previous values have no predictive power for future values. We can always decompose the current value of $z_{1,t}$ into last periods value plus news. In column II of Table 2 we include $z_{1,t-1}$ and $\Delta z_{1,t}$ separately and find identical coefficient estimates. In column III we test the hypothesis that once we condition on last period’s Pareto weight, earlier information has no predictive power for the current Pareto weight. Indeed we find that information available in $z_{1,t-2}$, does not have a statistically significant effect on the current Pareto weight; the point estimate is 0.001 with a standard error of 0.022.

\textsuperscript{21} In Appendix A.3 we present some additional results based on direct empirical measures of the wife’s share of total household resources. These results are useful in that they help to illustrate the sources of identification in the data, but are not easily interpreted since they do not control for preference or home productivity differences.
Advance information. Our strategy for identifying the Pareto weight requires that our measured deviations in relative wages from the forecasts at marriage reflect news to the household. That is, that the households base their predictions on the same information set we used to forecast wages. If the households have better information on which to base their wage forecasts than we do, then our innovations will partly reflect information the households already have at time of marriage. To test whether there is evidence that households are acting on information we are treating as news we follow Cunha, Heckman, and Navarro (2005) and check whether future values of what we measure as the relative wage innovation affect household behavior in the current period. Specifically, we add $\Delta z_{1,t+1}$, the innovation to relative wages in period $t+1$ to the estimation. The results are presented in column IV of Table 2. We cannot reject the hypothesis of no advance information. Indeed the point estimates for the coefficient is 0.023 (with a standard error of 0.022) compared to the coefficients on $\Delta z_{1,t}$ of 0.351 (with a standard error of 0.039). The effect of next period’s information on current household behavior is zero, both statistically and economically, providing strong support for the assumption that our measure of news in indeed unknown to the household in the previous period.

Large vs small shocks. As discussed in Section 3.1, if a household is constrained by limited commitment an implication is that the Pareto weight should only change when a shock is large enough to cause the participation constraint of one of the spouses to bind, providing them a credible threat to trigger renegotiation.\footnote{A fully specified model needs to also specify and estimate the value of the threat point. Potential candidates for this value include the value of divorce (Mazzocco, Ruiz, and Yamaguchi, 2013; Voena, 2015) or the value associated with non-cooperative interactions within the household (Lundberg and Pollak, 1993; Del Boca and Flinn, 2012).} The reduced form implication of limited commitment is that we expect the Pareto weight to respond to large shocks, but not to small shocks. To check if this holds in our data, we split $z_{1t}$ into quintiles of the shock distribution, and allow the effect of the shock on the Pareto weight to vary arbitrarily by the size of the shock. Recall that $z_{1t}$ is the log of the realized wage of the wife relative to the husband, minus the time of marriage prediction. The cutoffs point for the quintiles of $z_{1t}$ are $(q_1, q_2, q_3, q_4) = (-0.224, -0.057, 0.065, 0.226)$. A value of $z_{1t}$ in the first quintile corresponds to a realization of the wife’s relative to the husband’s wage which is more than 22.4 % below the time of marriage prediction. Values in the fifth quintile correspond to realizations at least 22.6% larger than the forecast. Values in the third quintile are realizations in the range of 5.7% below to 6.5% above the prediction.

The results of this specification are presented in column V of Table 2 and are consistent with the implications of limited commitment discussed above. The effect of shocks in the first and fifth quintiles (large negative or positive deviations from forecast) have large and statistically significant effects on the Pareto weight, while the effect of shocks in the third quintile (small deviations from forecast) have a small and statistically insignificant effect.

There is also an asymmetry in how the realized deviations affect the Pareto weight. In cases where either the husband does better than expected or the wife does worse than expected (negative deviations) the effect is stronger and the threshold is lower. Specifically, we estimate large and statistically significant effects for both quintiles one and two, with elasticities of 0.21 and 0.28, meaning the Pareto weight is adjusted down for realizations that fall below prediction by more than 5.7%. In contrast, in cases where either the wife does better or the husband does worse than expected the threshold is
higher, and the effect is lower. The effect is statistically significant for the fifth, but not the fourth, quintile. The Pareto weight is adjusted up for realizations that are 22.8% larger than the forecast, with an elasticity of 0.16, which is 24 to 43% lower than for negative realizations.

The size of marital surplus. Whether or not a shock of given size results in renegotiation will depend on the value of marriage relative to the alternative (presumably divorce). Without additional information on the household members value of leaving the marriage we cannot directly measure the size of marital surplus in a match. As a proxy for the size of marital surplus we interact the $z_{1t}$ shock with two different variables which we expect to be correlated with the size of marital surplus. The first measure is an indicator that takes a value of one in period $t$ if the couple divorces in period $t+1$. Here we expect that, on average, the value of marriage relative to divorce is smallest in the period leading up to divorce, implying the probability of binding participation constraint should be high in this period. The second measure is an indicator that takes a value of one if the couple have a new child in the period. On average, we expect that the value of marriage relative to divorce increases with the arrival of a child, and the probability of binding participation constraints falls. The implication for our estimates is that we expect to find a stronger response of the Pareto weight to shocks for the subset of couples who divorce next period (a larger share of these couples are expected to hit the participation constraint for one of the spouses) and we expect a milder response of the Pareto weight to shocks for the couples who just had a new child (fewer of these couples should hit a participation constraint). We present these results in columns VI and VII of Table 2.

For households who end up divorcing in the next period, the Pareto weight is twice as responsive to shocks. The elasticity rises from 0.18 to 0.37 for this group. This is strongly indicative of a shrinking surplus in the lead-up to divorce (at which time the surplus must be negative), and an increased likelihood of renegotiation due to binding participation constraints. Turning to the case of households who experience the arrival of new child, the effect has the expected negative sign, but it is small and not statistically different from zero.

Information. Another friction that could constrain households is the presence of asymmetric information about income shocks. In an environment where income shocks are not fully observed by a spouse, a constrained efficient allocation will incentivize truthful reporting by providing additional consumption to the partner with the good wage shock. As a proxy for the likely presence of informational constraints we interact the $z_{1t}$ shock with two measures that could be correlated with the informational frictions. The first is an indicator for how the household conducts its finances. Specifically it takes a value of one if the spouses both deposit their wages into a common account. We expect, on average, these households to have better information about spousal wage shocks and to be less subject to informational constraints. The second measure is an indicator for whether or not the husband and wife work in the same industry. Spouses who work in the same industry may be better placed to verify reported wage shocks, leading to few informational constraints.23 We present these results in columns VIII and IX of Table 2.

23. Kinnan (2017) tests for informational frictions as a barrier to insurance in Thai villages. Her main test uses the inter-temporal consumption equation and requires assuming additively separable preferences for consumption, no preference heterogeneity across households, and no liquidity constraints. She also considers a more robust test that uses information about how predictable income from different
In the first case we find that for households who deposit their incomes into a common account the weight is 19% less responsive to shocks, the elasticity is 0.17 for these households compared to 0.21 for the rest. This is consistent with informational constraints being less binding for these households. In the second case we find that when spouses work in different industries the weight is actually 17% less sensitive to wage shocks than when they work in the same industry. This is not what we would expect if spouses in the same industry had better verifiability of wage shocks. There are, of course, other important differences across these households. To the extent that shocks across industries are less correlated than shocks within industry, households in which spouses are employed in different industries have an easier time providing insurance, which may outweigh the informational differences.

**Dual versus single earner households.** One might expect that single and dual earner households have structurally different Pareto weight functions. Indeed, in a static setting, Blundell, Chiappori, Magnac, and Meghir (2007) show that this must be the case. If the wife is indifferent to working or not at her reservation wage, the husband must also be indifferent. At her reservation wage the wife is indifferent between more leisure and more income. In a constrained efficient allocation the husband must also be indifferent between the wife working or not at this reservation wage. Since not working implies less total income for the household, the husband will generally need to receive a larger share to remain indifferent. This “double indifference” in general implies that how the Pareto weight responds to shocks will differ when both spouses are employed and when only one spouse is employed. We re-estimate the model allowing for completely different Pareto weight functions for households in which both spouses work, only the husband works and only the wife works.24 We present the Pareto weight estimates in Table 4.

For households where only one partner is working at time of marriage, the Pareto weight is less than half as responsive to differences in the relative wage of the wife and husband. The effect of differences in expected wage growth is, however, substantially greater for households in which only the husband works. During marriage, the Pareto weight is also much less sensitive to realized deviations in relative wages in single earner households. The elasticity for single earner households is 0.12 compared to 0.21 for households where both spouses are employed, although the difference is not statistically significant when only the wife works. Interpreting these results requires some caution as the choice to work or not is endogenous, and these households also differ in the magnitudes of both the relative difference in wages at time of marriage and the realized difference in relative wages.

We can see the combined effect of the differences in the Pareto weight function and the differences in wage processes in Figure 4. Here we plot the same decomposition of the relative weight as in Figure 3, separately for each household type: dual earner, only the husband works and only the wife works. In the left hand panel we plot the distribution of initial weights. At time of marriage the average weight on the wife is substantially lower in households where only the husband works, 0.4 compared to 0.45 when either both work or only the wife works. While the modal dual earner household still places more weight on the husband, there is substantial mass around equal weights. In the right hand sources is to inform which households are more likely to suffer from informational frictions. Our proxies are in the spirit of this latter approach The caveats raised in Section 3.1.2 should be kept in mind.

24. Our approach allows for a structural difference in how shocks are translated into movements in the Pareto weight, but does not impose the full set of restrictions implied by the results in Blundell, Chiappori, Magnac, and Meghir (2007), which are derived only for the case of a static model.
## Table 4

### Dual vs Single Earner Households

<table>
<thead>
<tr>
<th>Pareto weight (at sample mean)</th>
<th>0.434 (0.009)</th>
<th>( \omega_{W,0} - \omega_{H,0} )</th>
<th>0.477 (0.022)</th>
<th>( \nu_0 )</th>
<th>0.026 (0.022)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \omega_{W,0} - \omega_{H,0} ) \times 1 {m_{Wt} = 0}</td>
<td>-0.274 (0.055)</td>
<td>( \nu_0 \times 1 {m_{Wt} = 0} )</td>
<td>-0.011 (0.021)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \omega_{W,0} - \omega_{H,0} ) \times 1 {m_{Ht} = 0}</td>
<td>-0.283 (0.105)</td>
<td>( \nu_0 \times 1 {m_{Ht} = 0} )</td>
<td>0.077 (0.075)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \omega_{W,10} - \Delta \omega_{H,10} )</td>
<td>0.108 (0.174)</td>
<td>( z_{1t} \times 1 {m_{Wt} = 0} )</td>
<td>0.380 (0.017)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \omega_{W,10} - \Delta \omega_{H,10} ) \times 1 {m_{Wt} = 0}</td>
<td>1.396 (0.381)</td>
<td>( z_{1t} \times 1 {m_{Wt} = 0} )</td>
<td>-0.174 (0.044)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \omega_{W,10} - \Delta \omega_{H,10} ) \times 1 {m_{Ht} = 0}</td>
<td>0.869 (0.581)</td>
<td>( z_{1t} \times 1 {m_{Ht} = 0} )</td>
<td>-0.194 (0.119)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Standard errors in parentheses are computed by block bootstrap with 300 replications.

### Figure 4

**Decomposition of the relative Pareto weight**

\[
\mu_t/(1 - \mu_t) = \mu_0(z_0) \times \mu_1(z_1,t)
\]

**Notes:** The differences in the distribution of Pareto weights reflect both structural differences in how the weights relate to initial wage differences and innovations but also differences between these groups in relative wages and innovations.

In the面板我们绘制了修订的分布与原始权重的关系图。在我们的数据中，有7.1%的家庭在上一个我们观察到的时期只有一人工作，其中只有丈夫工作的家庭中，权重的修订上、下超过10%的比例只有3.87%。作为比较，多Earners家庭中超过10%的修订比例。修订少可能的情形是当一方在市场中专长而另一方在家庭中专长时，这符合婚姻带来的联合收益。然而，这并不告诉我们，是否是婚姻的价值高还是外部选择低。提供零市场小时可以更高水平的家庭生产，但也显示出相对较低的市场机会，以及相对较
poor options outside of marriage.

Homogeneous preferences and home productivity. As discussed above, we make an identifying assumption that the weights on the husband and wife are equal when husbands and wives have identical wages, and expected wage growth. We then attribute any observed differences between spouses in private consumption and leisure at identical wages to differences in preferences. Conversely, one could assume complete symmetry of preferences and home productivity, and then identify the intercept of the Pareto weight by assuming that any differences in private consumption and leisure at equal wages are due to unequal initial Pareto weights, possibly reflecting social norms. We have re-estimated the model under the latter identifying assumption (see Table A.4 in the Appendix). Under the assumption of gender symmetry, we estimate the mean Pareto weight to be substantially lower than our baseline estimates, 0.31 compared to 0.44. While the mean weight differs, the effect of relative wages at time of marriage and the effect of innovations to the relative wage are unchanged, the elasticities are essentially the same as the baseline specification. One difference is that in the specification assuming symmetry in preferences and home productivity, the effect of differences in expected wage growth becomes stronger, with an elasticity of 0.38 compared to 0.17 in the baseline specification. In the baseline specification, differences in the age profile of preferences soaked up some of this variation.

Expenditures on others and sleep. Finally we re-estimate the model excluding expenditures on others from our definition of public expenditures and by excluding sleep from leisure (by subtracting eight hours from the time budget). All parameter estimates are robust to these differences. (see Table A.4 in the Appendix).

6.4. Leisure elasticities and passthrough of wage shocks to consumption

As highlighted in Section 3.1, the fact that the Pareto weight moves with realized innovations to the wage means the household is not able to attain *ex ante* efficient allocations, there are dynamic inefficiencies. From an *ex ante* perspective, the household responds in an inefficient way to wage changes; relative hours respond too little to changes in relative wages while private consumption fluctuates too much relative to the first best allocation.

In Table 5 we present the Frisch elasticities of all the endogenous variables with respect to the wages of the wife and husband, evaluated at the means of the data.\(^{25}\) To separate the direct price effect from the bargaining effect we first hold the Pareto weight constant and present the intermediate elasticities in the first and third columns. We then allow the Pareto weight to vary with the wage to calculate the total elasticity in columns two and four.\(^{26}\)

Consider first the own wage elasticity holding the Pareto weight constant (columns one and three). For both wives and husbands an increase in own wage results in a reduction in both leisure and home production as they supply more hours in the market.

\(^{25}\) The Frisch elasticities are calculated holding constant the household’s marginal utility of wealth. The full expressions are provided in Web Appendix B.6.

\(^{26}\) Our estimate of the wife’s elasticity of leisure with respect to own wage is consistent with the estimates in Yamada (2011) who uses tax reforms in Japan as exogenous variation. Both the male and female elasticities we estimate are at the upper end of the range of Frisch elasticities reported in the literature (see Meghir and Phillips, 2010; Keane, 2011, for recent surveys of the empirical estimates).
TABLE 5

<table>
<thead>
<tr>
<th>Frisch elasticity of</th>
<th>Elastocities w.r.t. $w$</th>
<th>w.r.t. $w_H$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed $\mu$</td>
<td>Varying $\mu$</td>
</tr>
<tr>
<td>$c_w$</td>
<td>0.201 (0.026)</td>
<td>0.369 (0.032)</td>
</tr>
<tr>
<td>$c_H$</td>
<td>-0.018 (0.008)</td>
<td>-0.199 (0.015)</td>
</tr>
<tr>
<td>$\ell_w$</td>
<td>-0.988 (0.060)</td>
<td>-0.819 (0.056)</td>
</tr>
<tr>
<td>$\ell_H$</td>
<td>-0.018 (0.008)</td>
<td>-0.199 (0.015)</td>
</tr>
<tr>
<td>$h_w$</td>
<td>-1.430 (0.091)</td>
<td>-1.401 (0.092)</td>
</tr>
<tr>
<td>$h_H$</td>
<td>1.711 (0.303)</td>
<td>1.740 (0.303)</td>
</tr>
<tr>
<td>$g$</td>
<td>0.075 (0.013)</td>
<td>0.104 (0.020)</td>
</tr>
</tbody>
</table>

Notes: All elasticities are evaluated at sample means and correspond to the estimates in column I of Table 2. Standard errors in parentheses are computed by block bootstrap with 300 replications.

Since preferences are non-separable, a reduction in leisure hours directly reduces the marginal utility of private consumption, which needs to be compensated by an increase in both private and public consumption expenditures. Holding the Pareto weight constant, the wife has fairly high leisure demand and home production elasticities (–0.99 and –1.43) and low elasticities (passthrough) for private and public consumption expenditures (0.20 and 0.08). The husbands have stronger leisure responses with an elasticity of –1.77 and consumption elasticities of 0.89 for private consumption and 0.23 for public consumption expenditures.

Looking at the cross-wage elasticities we see from column three that an increase in the husband’s wage, holding the Pareto weight constant, leads to a reduction in the wife’s leisure and private consumption (the elasticities are –0.09). The effect of the husband’s wage on the wife’s home hours is positive and significant (the elasticity is 0.72). In stark contrast to the response of the wife, we estimate that a change in the wife’s wage has little effect on the leisure and private consumption of her husband when the Pareto weight is held constant. The effect of the wife’s wage on the husband’s home hours is stronger.

The muted or nonexistent responses of the husband to spousal wage changes when we hold the Pareto weight fixed do not survive once we allow the wage change to affect the Pareto weight. When the Pareto weight is moved in favor of the spouse with the wage increase the response of own leisure is muted and the response of private consumption is strengthened. The leisure demand elasticity declines (in absolute value) to –0.82 for the wife and to –1.59 for the husband, while the private consumption elasticities rise to 0.37 for the wife and 1.07 for the husband. Additionally, when we allow the Pareto weight to move, expenditures on public consumption become more responsive to changes in the wife’s wage and less responsive to changes in the husband’s wage, reflecting the fact that wives put more weight on the public good than their husbands.

In terms of the cross-wage elasticities, the movement in the Pareto weight means that the response of leisure hours and private consumption to changes in the spouse’s
wage become stronger. The elasticity of husband’s leisure hours with respect to his wife’s wage is still small, –0.20, but the change in the Pareto weight means it is no longer zero. Similarly for the wife, the change in the Pareto weight means her leisure hours response to her husband’s wage strengthens from –0.09 to –0.25.

Our estimates indicate that leisure for both the husband and wife falls in response to increases in own or spousal wages. The response, however, is stronger to own than to spousal wages, and a husband responds less to a change in his wife’s wage than the wife does to her husband’s wage (elasticities of –0.20 compared to –0.25). The negative response of own leisure with respect to spousal wage is partly due to non-separable preferences (both spouses value the public good) but is mostly driven by the change in the Pareto weight resulting from the change in relative wages.27

7. CONCLUSION

We presented direct evidence on the gender asymmetries in private consumption and time use within Japanese households. Viewed through a dynamic model of the household with limited commitment, we find that expected relative wage profiles have a strong impact on the wife’s weight in household decision making at the time of marriage. We also find that, during marriage, unpredicted deviations in the relative wage impact this weight. This is not consistent with dynamic efficiency and indicates households face constraints preventing them from realizing the first best allocation, which would take full advantage of risk sharing and gains from specialization. Indeed we find that private consumption covaries too much and hours too little with changes in wages.

We explore several additional specifications in an attempt to shed some light on the likely constraints or frictions that households are facing. In particular we find that: the weight responds to large but not to small wage shocks; for the subset of households whose marriage end in divorce, the weight is twice as responsive to shocks during the last year of marriage; there is a structural difference in the response of the weight between households in which both spouses are employed compared to those in which only the husband works; there are substantial gender asymmetries in the relative preference for public consumption; our measured innovation is not anticipated by the household; finally, the weight is less responsive to wage shocks in households who share a common bank account and in households that do not work in the same industry.

It is worth noting that our estimates are obtained under the assumption that both market opportunities and home productivity are exogenous and that within period allocations are efficient. In a model where wages depend on market participation (learning by doing) we would expect substantial additional inefficiencies to arise within the household if participation in market work leads not only to increased income, but also to an increased share of household resources by shifting the Pareto weight (see, for example, Reynoso, 2017, 2018). In a model with information frictions additional inefficiencies are likely to arise due to distortions of the within period conditions. These, and other related issues, such as endogenous fertility and durable public goods, are the subject of our further research.

27. Blundell, Pistaferri, and Saporta-Eksten (2016) estimate a unitary model of family labor supply with only public consumption and no home production on the PSID. They also find that the Frisch elasticity of leisure is negative for both own and spousal wage changes, that the responses are stronger for own wage than for spousal wage, and that husbands respond less to changes in their wife’s wage than the other way around. Since they do not have direct data on the consumption allocations they maintain a unitary model of the household and cannot therefore separate the effect of non-separable preferences from changes in the Pareto weight.
### Appendix A.1

**Expenditure shares on items versus expenditure shares on individuals**

As discussed in Section 4, the JPSC data provides information on the breakdown of household expenditures into item categories and into expenditures on each individual in the household. It does not, however, provide information on the breakdown of each expenditure by individual household member. For estimation, we will treat expenditures for the wife and husband as private and the rest as public. To check the validity of this categorization we regress each item-expenditure share on the expenditure share for the wife, husband, family, children and others. In other words, we check which changes in expenditure categories are associated with changes in expenditures for different members of the household. The results are presented in Table A.1. In Panel A we pool all the data while in Panel B we include household fixed effects.

The regression results support our interpretation. When a household reports an increase in the expenditure share for the husband they also report an increase in the expenditure share for pocket money. An increase in the share for the wife is associated with an increase in the clothing share; an increase in the share for the whole family is associated with an increase in the food share, housing and utilities; and a reported increase in the share for children is accompanied by a reported increase in the share spent on education. These reduced form results are all statistically significant at the usual levels, although the relationship between the wife’s share and clothing expenditure is only marginally so in the fixed effect regression.

### APPENDIX A.2

**The estimating equations**

Taking logs of the optimality conditions in equations (5.1) to (5.8) and rewriting them as zero equations, we have the following set of errors ($e$) to form orthogonality conditions.
Home production technology

\[
\log \left( \frac{\pi_t}{\pi_t - \pi_t} \right) + (\gamma - 1) \log \left( \frac{h_{Wt}}{h_{Ht}} \right) - \log \left( \frac{w_{Wt}}{w_{Ht}} \right) = \epsilon_{1t}, \tag{A9}
\]

\[
\log \left( \frac{\rho}{1 - \rho} \right) + \log \pi_t + (\gamma - 1) \log h_{Wt} - \log G_t + \log g_t - \log w_{Wt} = \epsilon_{2t}, \tag{A10}
\]

\[
\log \left( \frac{\rho}{1 - \rho} \right) + \log (1 - \pi_t) + (\gamma - 1) \log h_{Ht} - \log G_t + \log g_t - \log w_{Ht} = \epsilon_{3t}, \tag{A11}
\]

Own private consumption and leisure

\[
\log \left( \frac{\alpha_{2t}}{\alpha_{2t}} \right) + (\phi^W - 1) \log \left( \frac{c_{Wt}}{\ell_{Wt}} \right) + \log w_{Wt} = \epsilon_{4t}, \tag{A12}
\]

\[
\log \left( \frac{\alpha_{1t}}{\alpha_{1t}} \right) + (\phi^H - 1) \log \left( \frac{c_{Ht}}{\ell_{Ht}} \right) + \log w_{Ht} = \epsilon_{5t}, \tag{A13}
\]

Relative consumption and leisure

\[
\log \left( \frac{\mu}{1 - \mu} \right) + \log \left( \frac{\xi^W}{\xi^W} \right) + \log \left( \frac{\alpha_{2t}}{\alpha_{2t}} \right) + \left( \frac{1 - \sigma^W - \phi^W}{\phi^W} \right) \log A_{Wt} - \left( \frac{1 - \sigma^H - \phi^H}{\phi^H} \right) \log A_{Ht} + \left( \phi^W - 1 \right) \log \ell_{Wt} - \left( \phi^H - 1 \right) \log \ell_{Ht} - \log \left( \frac{w_{Wt}}{w_{Ht}} \right) = \epsilon_{6t}, \tag{A14}
\]

Household public consumption and private leisure and consumption

\[
\log \mu_t + \log \xi^W_t + \log \alpha^W_t - \log \pi_t - \log \rho + \left( \frac{1 - \sigma^W - \phi^W}{\phi^W} \right) \log A_{Wt} + \left( \phi^W - 1 \right) \log \ell_{Wt} - (\gamma - 1) \log h_{Wt} - \left( \frac{1 - \rho}{\rho} \right) \log G_t - (1 - \rho) \log g_t - \log D_t = \epsilon_{8t}, \tag{A16}
\]

\[
\log \mu_t + \log \xi^H_t + \log \alpha^H_t - \log (1 - \rho) + \left( \frac{1 - \sigma^H - \phi^H}{\phi^H} \right) \log A_{Ht} + \left( \phi^H - 1 \right) \log \ell_{Ht} + \left( \phi^W - 1 \right) \log c_{Wt} + \rho \log g_t - \left( \frac{1 - \rho}{\rho} \right) \log G_t - \log D_t = \epsilon_{9t}, \tag{A17}
\]

\[
\log (1 - \mu_t) + \log \xi_t^H + \log \alpha_t^H - \log (1 - \pi_t) - \log \rho + \left( \frac{1 - \sigma^H - \phi^H}{\phi^H} \right) \log A_{Ht} + \left( \phi^H - 1 \right) \log \ell_{Ht} - (\gamma - 1) \log h_{Ht} - \left( \frac{1 - \rho}{\rho} \right) \log G_t - (1 - \rho) \log g_t - \log D_t = \epsilon_{10t}, \tag{A18}
\]

\[
\log (1 - \mu_t) + \log \xi_t^H + \log \alpha_t^H - \log (1 - \rho) + \left( \frac{1 - \sigma^H - \phi^H}{\phi^H} \right) \log A_{Ht} + \left( \phi^H - 1 \right) \log c_{Ht} + \rho \log g_t - \left( \frac{1 - \rho}{\rho} \right) \log G_t - \log D_t = \epsilon_{11t}, \tag{A19}
\]
#### Table A.2

**Details of parameter estimates**

<table>
<thead>
<tr>
<th>Preferences</th>
<th>Home production</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi^W$</td>
<td>0.158 (0.052)</td>
</tr>
<tr>
<td>$\phi^H$</td>
<td>0.624 (0.039)</td>
</tr>
<tr>
<td>$\alpha_{10}^W$: constant</td>
<td>-1.192 (0.179)</td>
</tr>
<tr>
<td>$\alpha_{10}^H$: wife's age</td>
<td>0.008 (0.003)</td>
</tr>
<tr>
<td>$\alpha_{10}^W$: wife's education</td>
<td>0.009 (0.011)</td>
</tr>
<tr>
<td>$\alpha_{10}^H$: children</td>
<td>-0.197 (0.018)</td>
</tr>
<tr>
<td>$\alpha_{11}^W$: constant</td>
<td>-1.367 (0.234)</td>
</tr>
<tr>
<td>$\alpha_{11}^H$: wife's age</td>
<td>0.031 (0.003)</td>
</tr>
<tr>
<td>$\alpha_{11}^W$: wife's education</td>
<td>-0.013 (0.008)</td>
</tr>
<tr>
<td>$\alpha_{12}^W$: children</td>
<td>-0.207 (0.016)</td>
</tr>
<tr>
<td>$\alpha_{12}^H$: constant</td>
<td>0.337 (0.104)</td>
</tr>
<tr>
<td>$\alpha_{12}^W$: husband's age</td>
<td>0.005 (0.002)</td>
</tr>
<tr>
<td>$\alpha_{12}^H$: husband's education</td>
<td>-0.022 (0.005)</td>
</tr>
<tr>
<td>$\alpha_{13}^W$: children</td>
<td>-0.105 (0.014)</td>
</tr>
<tr>
<td>$\alpha_{13}^H$: constant</td>
<td>-1.913 (0.141)</td>
</tr>
<tr>
<td>$\alpha_{13}^W$: husband's age</td>
<td>0.033 (0.002)</td>
</tr>
<tr>
<td>$\alpha_{13}^H$: husband's education</td>
<td>0.003 (0.006)</td>
</tr>
<tr>
<td>$\alpha_{13}^W$: children</td>
<td>-0.138 (0.017)</td>
</tr>
</tbody>
</table>

**Notes:** The details of the parameter estimates in column I of Table 2 are reported. Standard errors in parentheses are computed by block bootstrap with 300 replications.

### Appendix A.3. Reduced form sharing rules

In this section we construct two direct empirical measures of the share of resources devoted to the wife in a household. These results provide a useful complement to the Pareto weight estimates, which are easier to interpret, but also rely on the estimation of preferences and home production parameters. The empirical measures are constructed directly from the data using the structure implied by the full income budget constraint:

$$c_W + c_H + g + w_W (\ell_W + h_W) + w_H (\ell_H + h_H) = w_W + w_H + (1 + r_t) a_t - a_{t+1} \equiv y_t.$$

Of the total resources the household has allocated to the current period, $y_t$, some go to public and some to private expenditures. Pricing the leisure of each spouse at their wage rate, the total resources devoted to the private consumption and leisure of the husband and wife are:

$$c_W + w_W \ell_W + w_H \ell_H.$$

We define $\psi$ as the share of these resources allocated to the wife:

$$\psi = \frac{c_W}{c_W + c_H + w_W \ell_W + w_H \ell_H}.$$

This is what Blundell, Chiappori, and Meghir (2005) call the conditional sharing rule, the share of resources allocated to the wife, conditional on the amount of resources devoted to public consumption. Since the average household in our data devotes almost 80% of expenditures and a substantial share of hours to public goods, the conditional sharing rule will, in general, overstate the extent of dispersion between spouses terms of total resource allocation.

With this in mind, we construct a measure $\varphi$, which includes household resources used in production of the public good. For the purpose of this measure we double count home hours and public consumption expenditures, assigning the full value to both the husband and the wife:

$$\varphi = \frac{c_W + w_W \ell_W + w_H h_W + w_H h_H + g}{c_W + w_W \ell_W + c_H + w_H \ell_H + 2 (w_W h_W + w_H h_H + g)}.$$

28. See Lise and Seitz (2011), Figure 10 for a similar object calculated for the United Kingdom.
### TABLE A.3

*Estimates with additional distribution factors*

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.670</td>
<td>0.683</td>
<td>0.682</td>
<td>0.677</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.037)</td>
<td>(0.037)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>$\pi$ (at sample mean)</td>
<td>0.463</td>
<td>0.459</td>
<td>0.459</td>
<td>0.461</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.018)</td>
<td>(0.017)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.079</td>
<td>0.080</td>
<td>0.080</td>
<td>0.079</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td><strong>Preferences</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\phi^W_W$</td>
<td>0.159</td>
<td>0.162</td>
<td>0.160</td>
<td>0.147</td>
</tr>
<tr>
<td></td>
<td>(0.055)</td>
<td>(0.053)</td>
<td>(0.052)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>$\phi^H$</td>
<td>0.625</td>
<td>0.627</td>
<td>0.626</td>
<td>0.628</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>$\alpha^W_1$ (at sample mean)</td>
<td>0.184</td>
<td>0.186</td>
<td>0.185</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.016)</td>
<td>(0.015)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>$\alpha^W_2$ (at sample mean)</td>
<td>0.256</td>
<td>0.257</td>
<td>0.258</td>
<td>0.260</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>$\alpha^H_1$ (at sample mean)</td>
<td>0.424</td>
<td>0.424</td>
<td>0.423</td>
<td>0.426</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>$\alpha^H_2$ (at sample mean)</td>
<td>0.179</td>
<td>0.179</td>
<td>0.180</td>
<td>0.180</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td><strong>Pareto weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu$ (at sample mean)</td>
<td>0.434</td>
<td>0.436</td>
<td>0.437</td>
<td>0.449</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>$\mu_01$: $\omega^W_0 - \omega^H_0$</td>
<td>0.406</td>
<td>0.404</td>
<td>0.403</td>
<td>0.417</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.027)</td>
<td>(0.027)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>$\mu_02$: $\Delta\omega^W_{10} - \Delta\omega^H_{10}$</td>
<td>0.243</td>
<td>0.340</td>
<td>0.311</td>
<td>0.163</td>
</tr>
<tr>
<td></td>
<td>(0.176)</td>
<td>(0.172)</td>
<td>(0.175)</td>
<td>(0.211)</td>
</tr>
<tr>
<td>$\mu_03$: $\nu_0$</td>
<td>0.027</td>
<td>0.026</td>
<td>0.028</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>$\mu_04$: $\frac{1}{4}\log\left(\text{sr}^W\text{sr}^H\right)$</td>
<td>-0.452</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.027)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_05$: $\log\left(\frac{y^W_t}{y^H_t}\right)$</td>
<td></td>
<td>-0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.034)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_06$: $\log\left(\frac{y^W_t}{y^H_t} + \mu^P_t\right)$</td>
<td></td>
<td>0.008</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.011)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_07$: $\log\left(\frac{\text{occ}^W_t}{\text{occ}^H_t}\right)$</td>
<td></td>
<td>0.120</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.084)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_08$: $\log\left(\frac{\text{age}_H}{\text{age}_W}\right)$</td>
<td></td>
<td>-0.487</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.052)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_{11}$: $z_{1t}$</td>
<td>0.335</td>
<td>0.338</td>
<td>0.339</td>
<td>0.340</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
</tbody>
</table>

*Notes:* Standard errors in parentheses are computed by block bootstrap with 300 replications.

In Figure A.1 we plot histograms of the time average $\psi$ and $\varphi$ for each household. In Figure A.2 we decompose these empirical sharing rules the same way we did for the estimated Pareto weight in Section 6.2. Specifically, we project $\psi_{it}/(1 - \psi_{it})$ and $\varphi_{it}/(1 - \varphi_{it})$ on our distribution factors $z_{i0}$ and $z_{1it}$. The regression results are presented in Table A.5. As expected, there is substantially less initial dispersion and substantially smaller changes over time for $\varphi$ than for $\psi$, reflecting the large contribution of public consumption. The resulting figures are drawn to be easily compared to the Pareto weight decomposition in Figure 3. The decomposition based on the estimated Pareto weight is closer to the empirical measure incorporating public goods expenditures, reflecting the substantial weight our estimates place on the preferences for public goods, especially for wives.
### TABLE A.4

**Estimation with additional restrictions**

<table>
<thead>
<tr>
<th></th>
<th>homogeneous preference &amp; technology</th>
<th>exclude expenditure for others</th>
<th>subtract eight hours from leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home production</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.618</td>
<td>0.686</td>
<td>0.681</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.037)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>$\pi$ (at sample mean)</td>
<td>0.5</td>
<td>0.457</td>
<td>0.459</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.018)</td>
<td></td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.082</td>
<td>0.086</td>
<td>0.080</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td><strong>Preferences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\phi^W$</td>
<td>0.281</td>
<td>0.166</td>
<td>0.174</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.045)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>$\phi^H$</td>
<td></td>
<td>0.629</td>
<td>0.645</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.041)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>$\alpha^W_1$ (at sample mean)</td>
<td>0.263</td>
<td>0.196</td>
<td>0.192</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.014)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>$\alpha^W_2$ (at sample mean)</td>
<td>0.264</td>
<td>0.268</td>
<td>0.237</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.023)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>$\alpha^H_1$ (at sample mean)</td>
<td></td>
<td>0.435</td>
<td>0.436</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.021)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>$\alpha^H_2$ (at sample mean)</td>
<td></td>
<td>0.184</td>
<td>0.171</td>
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<tr>
<td></td>
<td></td>
<td>(0.013)</td>
<td>(0.011)</td>
</tr>
<tr>
<td><strong>Pareto weight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu$ (at sample mean)</td>
<td>0.307</td>
<td>0.435</td>
<td>0.437</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>$\omega_{A,0} - \omega_{B,0}$</td>
<td>0.393</td>
<td>0.406</td>
<td>0.401</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.027)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>$\Delta \omega_{A,10} - \Delta \omega_{B,10}$</td>
<td>0.554</td>
<td>0.355</td>
<td>0.323</td>
</tr>
<tr>
<td></td>
<td>(0.177)</td>
<td>(0.172)</td>
<td>(0.174)</td>
</tr>
<tr>
<td>$\iota_0$</td>
<td>0.050</td>
<td>0.031</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.013)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>$\varepsilon_{1t}$</td>
<td>0.316</td>
<td>0.345</td>
<td>0.340</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>constant</td>
<td>-0.528</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Standard errors in parentheses are computed by block bootstrap with 300 replications.
(a) Share of private expenditures: $\psi$

(b) Share of private and public expenditures: $\varphi$

Figure A.1
Empirical sharing rules

TABLE A.5

Empirical sharing rules: $\frac{\psi}{1-\psi}$ and $\frac{\varphi}{1-\varphi}$

<table>
<thead>
<tr>
<th></th>
<th>$\frac{\psi}{1-\psi}$</th>
<th>$\frac{\varphi}{1-\varphi}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\omega_{A,0} - \omega_{B,0}$</td>
<td>0.813</td>
<td>0.191</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>$\Delta \omega_{A,10} - \Delta \omega_{B,10}$</td>
<td>0.597</td>
<td>0.186</td>
</tr>
<tr>
<td></td>
<td>(0.145)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>$\nu_0$</td>
<td>0.001</td>
<td>-0.0005</td>
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<td></td>
<td>(0.009)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>$z_{11}$</td>
<td>0.773</td>
<td>0.775</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.014)</td>
</tr>
</tbody>
</table>

fixed effect?  No  Yes  No  Yes

Notes: Standard errors in parentheses are clustered at the household level. Other regressors include the age of husband and wife, the years of schooling of husband and wife, and the number of children.
Figure A.2
Decomposition of empirical sharing rules
Acknowledgments: We would like to thank Orazio Attanasio, Richard Blundell, V.V. Chari, Pierre-André Chiappori, Koen Decancq, Jim Heckman, Ethan Ligon, Luigi Pistaferri, Steven Stern, Alessandra Voena and seminar participants at University of Chicago, Chinese University of Hong Kong, Georgetown, Hitotsubashi, IFS, Leuven, Oslo, Tohoku, Tokyo, UCL, Virginia, Washington St. Louis, Wisconsin, SED Annual Meeting, PoRESP workshop on Poverty and the Family, Zeuthen Workshop, Barcelona GSE summer forum, Family Macro in Edesheim, and Kyoto Summer Workshop on Applied Economics for very useful comments and discussions. We gratefully acknowledge permission to use the data from the Institute for Research on Household Economics, Tokyo, Japan. Yamada gratefully acknowledges financial support from JSPS KAKENHI grant numbers 15H06304 and 17H04782. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

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