Consumption Dynamics and Allocation in the Family*

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Abstract

This paper studies how individual and total consumption in the family respond to idiosyncratic wage changes using a collective life-cycle model for a family of two decision-making spouses. The model incorporates endogenous family labor supply, public and private consumption, asset accumulation, correlated wage shocks, and general nonseparable, spouse-specific preferences. Wages enter the household budget constraint, but also the spouses' intra-family bargaining powers implying lack of spousal commitment to future allocations. I derive analytical expressions for the dynamics of earnings and consumption; I show how those can be used to identify the household structure (spouse-specific preferences, allocation of consumption between spouses, a rich set of bargaining effects) with panel data on hours, earnings, assets, and household-level consumption only. The identifying assumption is that spouses have the same preferences with their single counterparts. Preliminary evidence from the PSID suggests strong labor and consumption response to wage shocks and that hours and consumption are substitute goods at the intensive margin of labor supply. Wages have an economically significant effect on intra-family bargaining power, but not statistically so.

Keywords: life-cycle collective model, lack of commitment, consumption, wages
JEL classification: D12, D13, D91, J12, J22

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1 Introduction

The transmission of idiosyncratic wage/income changes into household consumption, or the link between wage/income and consumption inequality, has been the focus of a large body of ongoing research (eg. Blundell and Preston, 1998; Krueger and Perri, 2006; Blundell et al., 2008). A consistent empirical finding is that household consumption is considerably smoothed with respect to wage/income shocks, even with respect to shocks to after-tax income.[1] Recent economic research attempts to understand theoretically and quantify empirically the mechanisms behind household consumption smoothing (eg. Heathcote et al., 2014; Blundell et al., 2016). But, although these studies explore a rich set of possible consumption smoothing mechanisms, such as family labor supply or external insurance, there is little work on *intra*-household consumption inequality or, more generally, on the internal workings of the household.[2] The goal of the present paper is precisely this: investigate the mechanisms of consumption smoothing within a collectivity of potentially different individuals that act together under common constraints (that is, within a household) and thus respect the fundamental principle of methodological individualism (Manser and Brown, 1980; McElroy and Horney, 1981; Chiappori, 1988). Treating the household as a collectivity of individuals opens up the discussion to new issues, such as how resources are shared within the household or how intra-household bargaining power influences consumption smoothing.

The paper develops a collective life-cycle model for consumption, savings, and labor supply of a household of two decision-making spouses.[3] The model takes into account a number of mechanisms that potentially come into play at the intersection of wages, earnings, and consumption. First, it allows for self-insurance through borrowing or saving in the credit markets. Second, it gives each spouse an endogenous labor supply choice at the intensive margin. Third, it gives each spouse an endogenous consumption choice over multiple consumption goods, namely over a private (or rival) good and a public (or non-rival) good. Fourth, it assigns intra-family bargaining (or decision) powers to the decision-making spouses conditional on which all other choices are made. Such bargaining powers reflect individual and household characteristics, as well as market conditions, and can change with them across as well as within households.

The life-cycle model has four important features. First, the model is collective in the spirit of the static implementations of Chiappori (1988, 1992) and, given the presence of a public good, of Blundell et al. (2005). The decision-making spouses have their own, egoistic, gender-specific preferences over their leisure and private consumption, and the household public good; and they devise a mechanism, summarized by their intra-family bargaining powers, to reach agreements between them. Second, each spouse's preferences are potentially nonseparable across the three goods they draw utility from. Such non-separability permits a rich pattern of complementarities among goods at the individual and household level. Third, each spouse/earner receives an idiosyncratic hourly market wage, the stochastic component of which is decomposed into

[1] Blundell and Etheridge (2010) and Heathcote et al. (2010) study the empirical patterns of inequality in consumption and various measures of income since the 1980s.

[2] Lise and Seitz (2011) is an exception; I discuss below how the present paper relates to it.

[3] Throughout the paper, I use the terms 'household' and 'family' interchangeably to refer to a two-member collectivity of financially dependent individuals. Whenever I need to make reference to single-member households, I clearly state so. I also use interchangeably the terms 'spouses', 'partners', 'individuals'.

a spouse-specific permanent and transitory shock (Abowd and Card, 1989; MaCurdy, 1982; Meghir and Pistaferri, 2004). These shocks are correlated between spouses reflecting positive or negative assortative mating (Blundell et al., 2016). Market wages are assumed exogenous to individual choices (albeit functions of age, gender, and other observables) and serve as the primitive source of uncertainty conditional on which the spouses make joint decisions. Fourth, the model features lack of spousal commitment to future allocations of resources in the spirit of Mazzocco (2007) and Lise and Yamada (2014). Formally, in each period the spouses stay together as members of a common household, they do so because they satisfy, separately, their participation constraints in the household. Such participation constraints take the form of lower bounds, often micro-founded as the value of the outside option/divorce (Voena, 2015), that the utility each spouse enjoys from within their joint household must respect.[4] These lower bounds may move with observable characteristics or market conditions triggering shifts in intra-family bargaining power. In this model, market wages enter the outside options and, therefore, affect intra-family bargaining power. Intra-family bargaining power may increase reflecting an improvement in one's market wage, although the direction of this effect is a priori unrestricted. Lack of commitment nests the full commitment benchmark, where intra-family bargaining power remains fixed over a given family's life-cycle, and allows tests of one setup against the other.

I derive closed-form analytical expressions for spousal earnings (labor supply) and consumption as functions of wage shocks, relying on Taylor approximations to the problem's first order conditions and the intertemporal budget constraint. Similar approximations within the unitary context appear in Blundell and Preston (1998) and a sequence of papers thereafter (Attanasio et al., 2002; Blundell et al., 2008, 2015, 2016). These expressions are convenient because they provide a neat picture for the contribution of various components (preferences, intra-family bargaining power, consumption sharing, etc.) to the transmission of wage shocks into earnings and consumption without resorting to any specific parametrization of individual preferences. To the best of my knowledge the present paper is the first one to implement such approximations in the context of the collective model.

Identification of the household structure is challenging for a number of reasons that are either inherent to the household model or relate to the availability of appropriate data. The first reason pertains to the non-observability of two outcome variables, namely of *individual* private consumption of each spouse. Unlike Cherchye et al. (2012) for the Netherlands and Lise and Yamada (2014) for Japan, there is no household survey in the US with comprehensive information on assignable or exclusive expenditure within the household. This is why, throughout this study, I assume one observes *total* private consumption in the household, but not its sharing between spouses. A second reason pertains to the rich complementarities allowed for by the non-separabilities in spousal preferences. The demand for any given good is a function of the quantity demanded for every other good separately, and, in the analog of a demand analysis, the demand system out of this household problem exhibits no exclusion restrictions. A third reason, inherent to the collective model, pertains to the indistinguishability of preferences

[4]Non-cooperation in the household may be seen as an alternative outside option available to spouses. Lechene and Preston (2011) and Cherchye et al. (2015) are recent studies of static noncooperative household models.

from intra-family bargaining power. The literature has often resorted to distribution factors, that is variables that affect bargaining power but not preferences, to overcome this problem (Chiappori et al., 2002; Voena, 2015). This problem is only aggravated here due to wages entering the budget set *and* intra-family bargaining powers. A final reason, not uncommon across applied consumer economics, is the lack of observable cross-sectional variation in the price of consumption (in here, in the prices of two consumption goods).[5]

With the aim to identify the household structure, that is preferences and the parameters of consumption sharing and intra-family bargaining power, I use information on single individuals of either gender before they form a joint household or after they separate from it. This approach has been used in Barmby and Smith (2001), Vermeulen (2006), Vermeulen et al. (2006), or, more recently, Browning et al. (2013). Assuming that each spouse's preferences are the same as their single counterparts', the full set of gender-specific preferences, the parameters of consumption sharing, and the effects of wages on household outcomes through their impact on intra-family bargaining power are identified. The rationale is the following: observability of singles suffices for recovering individual preferences over leisure and all types of consumption. When a given wage shock hits, and conditional on those preferences, the unobserved response of each spouse's private and public consumption *should they be single* becomes known. The observed response of consumption at the household level is then a weighted sum of the two individual responses; the weight is nothing but the consumption sharing between spouses in the case of private consumption or (a transformation of) their intra-family bargaining power in the case of public consumption.

The empirical implementation requires panel data on individual earnings and hours of work, household-level consumption, and household-level assets of single- and multi-member households. The Panel Study of Income Dynamics (PSID) is suitable as it collects such data biennially since 1999. I utilize 7 waves in total (1999-2011).

The results suggest sizeable Frisch own-elasticities of labor supply for both men and women, with women's labor supply being considerably more elastic than men's. I also find sizeable Frisch consumption substitution elasticities, with, perhaps surprisingly, the public good (comprising items such as housing services for renters and owners, household utilities, and children's expenditure) exhibiting a much higher elasticity than the private good. This may in part reflect higher variability in public expenditure due to house prices. The evidence from the cross-elasticities suggests that market hours are Frisch substitutes with all types of consumption and statistically significantly so far as public consumption is concerned. Note that this Frisch substitutability concerns the intensive margin of labor supply only. Overall, men seem to differ from women in their labor supply preferences but not in their consumption preferences. Finally, the bargaining effects of wages, that is the effects on household outcomes through the impact of wages on bargaining powers, are economically significant but not statistically so. At first sight, this suggests one cannot reject full commitment between spouses, but the result may mask, among other factors, unobserved heterogeneity across households.

This paper is related to two distinct strands of literature. A large literature in consumer analysis and labor economics is devoted to understanding household decisions respecting method-

[5] A general overview of identification in the static collective model is given in Chiappori and Ekeland (2009).

ological individualism. The most prominent approach, imposing efficiency of household decisions, has been the collective model introduced by Chiappori (1988, 1992) and Apps and Rees (1988). These first static implementations triggered a series of follow-up studies extending the basic model into home production (Chiappori, 1997), income taxation and discrete labor supply (Donni, 2003; Blundell et al., 2007), public goods (Blundell et al., 2005), multiple consumption items (Chiappori, 2011), and numerous other features. Browning and Chiappori (1998), Chiappori and Ekeland (2006, 2009), and Bourguignon et al. (2009) provide a theoretical overview of the collective model's features and implications for household behaviour.

Early empirical implementations of the static model include Bourguignon et al. (1993), Browning et al. (1994), or Chiappori et al. (2002). These studies were mostly concerned with testing the collective model or showcasing the relevance of distribution factors for household behaviour. More recently, Lise and Seitz (2011) use the collective model to infer the evolution of intra-household inequality in Britain. My paper differs from Lise and Seitz (2011) in that I develop a life-cycle collective model (theirs is static) with the aim to investigate the *mechanisms* of consumption smoothing and inequality transmission in the household. In a somehow related study, Browning et al. (2013) estimate the allocation of consumption and bargaining power in the household, as well as concepts of economies of scale due to living with a partner (as opposed to staying single) or equivalence scales for comparing the same individual across the two states of life (*i.e.* in a couple and as single).[6] Cherchye et al. (2012) estimate a collective model with home production while relying on variation in observed production shifters to achieve identification. Lewbel and Pendakur (2008) and Dunbar et al. (2013) estimate the household sharing rule, namely each spouse's share of household expenditure, using restrictions on Engel curves. Finally, Cherchye et al. (2009, 2011, 2015) apply a somehow distinct empirical methodology to the collective model, namely they set-identify the sharing rules from alternative versions of the model relying on revealed preferences principles.

The extension to the dynamics of the collective model opens up the discussion to new issues such as issues pertaining to inter-temporal commitment between spouses. Mazzocco (2007), the first implementation of the dynamic collective model, rejects full commitment on data from the US post 1980. Ever since, the dynamic collective model has been used to study a number of issues, such as household behaviour post the liberalization of divorce and property division laws in the US in the 1970s (Voena, 2015) and education investments of women (Bronson, 2014; Chiappori et al., 2015). Lise and Yamada (2014), who also provide evidence against full commitment, and Mazzocco et al. (2014) extend the dynamic collective model to home production and general preferences.[7]

Another literature, at the intersection of macro- and microeconomics, studies the relation between wage/income and household consumption growth. Recent papers include Blundell and Preston (1998), Attanasio et al. (2002), Krueger and Perri (2006), Blundell et al. (2008), Kaplan and Violante (2010), Heathcote et al. (2014), and, more recently, Blundell et al. (2016). Most of these papers have a life-cycle focus and investigate the transmission of wage/income changes, expected and unexpected, into household consumption in a variety of alternative environments

[6] Chiappori and Meghir (2014) provide an overview of these concepts.

[7] Browning et al. (2014) and Chiappori and Mazzocco (2014) provide an overview of the static and intertemporal collective models.

(stretching from exogenous income and no insurance against permanent shocks to endogenous labor supply and partial insurance). What they all have in common, however, is their modeling of the household as a single economic agent, and therefore, their abstracting from issues pertaining to the internal workings of the household or intertemporal commitment.[8]

The present paper advances this literature into the realm of the collective model. It contributes by studying the transmission of idiosyncratic wage/income changes into household consumption, or the link between wage/income and consumption inequality, when household members have their own preferences and an efficient decision mechanism, which reflects in part their outside options, is put in place among them.

The paper proceeds as follows: section 2 presents the life-cycle collective model and discusses identification. Section 3 presents a parallel model for singles and discusses how the two models can be of use together. Section 4 is concerned with the empirical implementation of the model(s) whereas section 5 presents the results. Section 6 concludes.

2 A Life-Cycle Collective Model without Commitment

This section presents the life-cycle collective model without commitment for the family of two decision-making partners. Specifically, section 2.1 develops the model, section 2.2 overviews the solution to the household problem, section 2.3 illustrates the family response to wage shocks, and section 2.4 is dedicated to the identification of the household structure.

The model of this section describes the household *after* the spouses have decided to form one and *before* they possibly decide to dissolve it. Specifically, the model is conditional on the spouses meeting, say, in the marriage market, and deciding to live together in one household. Assortative mating is taken care by conditioning observables and unrestricted correlations between spousal wage shocks. Divorce or, more generally, household dissolution exists as threat, but I do not model spousal choices in case those events actually materialize. Instead I model spousal choices for so long as the spouses find their joint arrangement (their joint household) superior to their outside options, *i.e.* for so long as they do not exercise the threat of divorce or household dissolution.

2.1 The Model

Formally, let H_{jit} be the continuous hours of market work of spouse j in family i at time t; to fix ideas suppose a male-female couple where $j = 1$ denotes the male spouse ('the husband') and $j = 2$ the female spouse ('the wife'). I normalize the total time endowment available to each spouse to 1 so that $H_{jit} \in (0, 1]$ (time can only be allocated between market work and leisure). I abstract from modeling labor supply at the extensive margin too, as in Blundell et al. (2007), because this would render the preferred model solution method, namely the Taylor approximations to the first-order conditions and the intertemporal budget constraint, inapplicable.

Let C_{it} be *total private* consumption of the household at t and K_{it} be its *public* consumption; both C_{it} and K_{it} are composite Hicksian goods. C_{it} is the sum of C_{1it} and C_{2it} where C_{jit} is

[8] Jappelli and Pistaferri (2010) and Meghir and Pistaferri (2011) provide an overview of this literature.

spouse j's *individual private* consumption.

A good is private if consumption of one unit by one spouse deprives the other spouse from that particular unit. Consider a meal at the local coffee shop or a subway ticket; both goods are private in that their consumption (or use) by one spouse renders the goods unavailable to the other spouse.

On the contrary, a good is public if consumption by one spouse does not reduce the amount available to the other spouse. Consider a car journey to the countryside, or the gas required to heat the house in the winter; if a spouse consumes (purchases) a unit of these goods, the exact same unit is always available for the other spouse to enjoy. In a seminal paper, Blundell et al. (2005) consider children's expenditure in the household as a public good for their parents.[9] The existence of public goods generates economies of scale in the family as the spouses share the expenditure on them, an expenditure which they would otherwise have to bear by themselves alone.

Throughout this study I assume the econometrician observes C_{it} separately from K_{it} given the itemized household expenditure data available nowadays. However, the econometrician does not observe the partition of C_{it} into C_{1it} and C_{2it} as consumption information is usually collected at the *household* rather than the *individual* level.[10]

Spouse j's within-period and gender-specific preferences are given by

$$U_j(K_{it}, C_{jit}, 1 - H_{jit}; \mathbf{z}_{jit})$$

where $1 - H_{jit}$ denotes leisure and $\mathbf{z}_{jit}$ an $m_j \times 1$ vector of observable taste shifters such as race, age, or education.[11] I do not parameterize U_j but I assume it has continuous second-order derivatives in K, C_j, H_j, and $U_{j,K} > 0$, $U_{j,C_j} > 0$, $U_{j,H_j} < 0$ (first derivatives), $U_{j,KK} < 0$, $U_{j,C_jC_j} < 0$, $U_{j,H_jH_j} > 0$ (second derivatives).

The household solves over the life-cycle

$$\max_{\{K_{it}, C_{jit}, H_{jit}, A_{it+1}\}_{\forall t,j}} \mathbb{E}_0 \sum_{t=0}^{T} \beta_t U_1\big(K_{it}, C_{1it}, 1 - H_{1it}; \mathbf{z}_{1it}\big) \tag{1}$$

subject to constraints

$$\mathbb{E}_0 \sum_{t=0}^{T} \beta_t U_2\big(K_{it}, C_{2it}, 1 - H_{2it}; \mathbf{z}_{2it}\big) \geq \mathcal{U}_2\big(\mathbf{X}_{i0}\big) \tag{2}$$

$$U_1\big(K_{it}, C_{1it}, 1 - H_{1it}; \mathbf{z}_{1it}\big) \geq \bar{U}_{1t}\big(W_{1it}, \mathbf{d}_{it}\big) \quad \forall t \tag{3}$$

$$U_2\big(K_{it}, C_{2it}, 1 - H_{2it}; \mathbf{z}_{2it}\big) \geq \bar{U}_{2t}\big(W_{2it}, \mathbf{d}_{it}\big) \quad \forall t \tag{4}$$

$$A_{it} + W_{1it}H_{1it} + W_{2it}H_{2it} = K_{it} + P_tC_{it} + \frac{A_{it+1}}{1+r}, \quad A_{iT+1} = 0, \quad \forall t. \tag{5}$$

[9] Even though the couple may have children in this model, children themselves are not decision makers.

[10] There exists a limited only number of household surveys with individual consumption information; Cherchye et al. (2012) gather detailed assignable expenditure through the Longitudinal Internet Studies for the Social sciences whereas Lise and Yamada (2014) use the Japanese Panel Survey of Consumption with detailed information on individual expenditures in the household. To the best of my knowledge there is no household survey in the US that provides such information comprehensively.

[11] I treat leisure as private good. Allowing for publicness in spousal leisure, as in Fong and Zhang (2001), together with publicness of K, will likely jeopardize the model's empirical tractability.

Constraint (2) is a promise keeping constraint, set out at time $t = 0$, that spouse 2's lifetime utility will not fall below a threshold $\mathcal{U}_2(\mathbf{X}_{i0})$. $\mathbf{X}_{i0}$ is a set of covariates known at $t = 0$ (or expected at time $t = 0$) that determine the promise keeping threshold; possible examples are spousal education, their age difference, their occupation or expected lifetime earnings.

Constraints (3) and (4), repeated over time, are the partners' participation constraints in the family; they ensure that each spouse is always at least as well off in their joint household as they could possibly be if they 'fall back' on their outside option at t, $\bar{U}_{jt}$. I do not have to specify the context of the outside option explicitly although one can think of $\bar{U}_{jt}$ as the value of divorce (for example see Voena, 2015). I assume that spousal hourly market wages W_{1it} and W_{2it}, as well as distribution factors $\mathbf{d}_{it}$, affect the value of the outside option.[12]

Constraint (5) is the sequential budget constraint; A_{it} is common household assets at t, P_t is the relative price of the private good when the price of the public good is normalized to 1 (I assume P_t exhibits no cross-sectional variation), and r is the non-stochastic and known real interest rate.[13] For tractability, discounting β_t is common between spouses. The household problem can be decentralized using personal (Lindahl) prices for the public good (Chiappori and Meghir, 2014).

Let $\vartheta_{2it=0}$ be the Lagrange multiplier on (2), $\widetilde{\vartheta}_{1it}$ be the Lagrange multiplier on (3), and $\widetilde{\vartheta}_{2it}$ on (4). Then the above household problem is equivalent to

$$\max_{\{K_{it},C_{jit},H_{jit},A_{it+1}\}_{\forall t,j}} \mathbb{E}_0 \sum_{t=0}^{T} \beta_t \Big[\mu_{1it} U_1(K_{it}, C_{1it}, 1 - H_{1it}; \mathbf{z}_{1it}) + \mu_{2it} U_2(K_{it}, C_{2it}, 1 - H_{2it}; \mathbf{z}_{2it})\Big] \tag{1'}$$

subject to the budget constraint (5) only. Here, $\mu_{1it} = 1 + \widetilde{\vartheta}_{1it}\beta_t^{-1}$ denotes spouse 1's intra-family bargaining power at t and $\mu_{2it} = \vartheta_{2it=0} + \widetilde{\vartheta}_{2it}\beta_t^{-1}$ spouse 2's intra-family bargaining power. I normalize the sum of the powers to 1 so that $\mu_{2it} = 1 - \mu_{1it}$. Therefore, μ_{1it} and μ_{2it} can also be seen as the Pareto weights a social planner attaches to each partner's preferences in the social planning problem (1') subject to (5).[14]

The two formulations of the household problem, (1) and (1'), are equivalent so long as reservation utilities $\bar{U}_{1t}$ and $\bar{U}_{2t}$ do not depend on endogenous choices (Chiappori and Mazzocco, 2014). Formulation (1') is more convenient for empirical purposes as it subsumes a number of constraints into intra-family bargaining powers μ_{1it} and μ_{2it}.

2.1.1 Intra-Family Bargaining Powers

Intra-family bargaining powers μ_{jit} are functions of the factors entering the constraints to which their components, $\vartheta_{2it=0}$ and $\widetilde{\vartheta}_{jit}$, serve as Lagrange multipliers. As a result I model μ_{1it} as

$$\mu_{1it} = \mu\left(W_{1it}, W_{2it}, \mathbf{d}_{it}; \mu_{1it-1}, \mathbf{X}_{i0}\right) \tag{6}$$

[12] By distribution factors I refer to any variable that affects the spouses' outside options but not their preferences or the budget set (Bourguignon et al., 2009). Chiappori et al. (2002) and Voena (2015) use the sex ratio in the local marriage market or laws governing divorce and property sharing as distribution factors.

[13] If P_t^k is the price of the public good at t, and P_t^c is the price of the private good, then the relative price of private consumption is defined as $P_t = {}^{P_t^c}/_{P_t^k}$. In other words, P_t^k is the deflator of all other monetary figures in the model, including assets and wages.

[14] This normalization is possible if β_t is appropriately redefined in each period to avoid distorting the intertemporal incentives when $\mu_{1it} + \mu_{2it} \neq \mu_{1is} + \mu_{2is}$ for $t \neq s$.

where the dependence on μ_{1it-1} and $\mathbf{X}_{i0}$ will become clearer below. Starting from a generic $\mu_{jit} = \frac{1}{2}$, spouse j becomes relatively more (less) powerful when $\mu_{jit'} > \frac{1}{2}$ ($\mu_{jit'} < \frac{1}{2}$) for a future period t'.

With full commitment between spouses, the partners stick to their initial intra-family bargaining powers throughout their life-cycle. In this case

$$\mu_{1it} = \mu_{1it-1} = \cdots = \mu_{1i0}(\mathbf{X}_{i0})$$

and revelation of new information about wages or distribution factors does not affect the intra-family bargaining powers. Notice that the beginning-of-life bargaining power μ_{1i0} still depends on $\mathbf{X}_{i0}$ and is household-specific.

If full commitment is not possible, two possibilities open up. *Limited* commitment, on one hand, implies that the spouses update their bargaining powers whenever any of the participation constraints (3) or (4) bind as a result of changing wages or distribution factors. In this case

$$\mu_{1it} = \begin{cases} \mu\left(W_{1it}, W_{2it}, \mathbf{d}_{it}; \mu_{1it-1}, \mathbf{X}_{i0}\right) & \text{if (3) or (4) bind} \\ \mu_{1it-1} & \text{otherwise.} \end{cases}$$

The partners reallocate power between them to reward the spouse who receives favorable news, say a sudden promotion and a higher permanent wage. As one's outside option gets more attractive due to the favorable news, meaning an increase in $\bar{U}_{jt}$ in (3)-(4), one must be rewarded with a higher intra-family bargaining power so as to keep satisfying one's participation constraint and remain in the family. This case is introduced in Kocherlakota (1996) and Ligon et al. (2002) and explored empirically in Mazzocco et al. (2014).

Lack of commitment, on the other hand, implies that the spouses update their bargaining powers at any time their wages or distribution factors shift. This case, originally explored in Mazzocco (2007), is equivalent to a series of static interactions between spouses if other dynamic features in the family, such as savings, are assumed away. Full commitment is nested within lack of commitment *and* limited commitment; however lack of commitment is not nested within limited commitment or vice versa. In this paper, strictly speaking, I model *lack* of commitment because I allow intra-family bargaining powers to respond to wages (and distribution factors) at all times; however I cannot distinguish empirically lack of- from limited commitment.

As Browning et al. (2014, section 6.2.2) point out, the outcome of problem (1') is ex-post (second-best) efficient under lack or limited commitment; once news regarding wages and distribution factors are revealed and bargaining powers determined, no other allocation of resources, other than the chosen one, can induce Pareto improvements without violating the prevailing budget constraint.

2.1.2 Prices

There are two types of prices in the model: one is hourly wages W_{1it} and W_{2it} the spouses earn in the labor market, the other is the relative price of private consumption P_t and the interest rate r. As I cannot exploit cross-sectional variation in the latter prices, a feature that would help considerably in the identification of the household structure and the estimation of the

model, the rest of this subsection is devoted exclusively to spousal wages.[15]

The primitive source of uncertainty the partners face is the hourly wages they earn. Other things remaining fixed, the partners are hit by unexpected changes in W_{jit} and respond by shifting their choices appropriately.

I adopt a permanent-transitory process for each earner's wage in the household. The log of spouse j's real hourly wage at t is given by

$$\begin{aligned}\ln W_{jit} &= \mathbf{x}_{jit}^{W\prime}\boldsymbol{\zeta}_{jt}^{W} + \ln w_{jit}^{P} + u_{jit} \\ \ln w_{jit}^{P} &= \ln w_{jit-1}^{P} + v_{jit}.\end{aligned}$$

The vector $\mathbf{x}_{jit}^{W}$ contains observable characteristics known at t such as race, age, or education; $\boldsymbol{\zeta}_{jt}^{W}$ is the vector of time-varying parameters. The permanent component $\ln w_{jit}^{P}$ follows a unit-root and v_{jit} is the (permanent) shock to this process. Transitory deviations from one's wage profile are captured by the transitory shock u_{jit}. Rewriting I get

$$\Delta w_{jit} = v_{jit} + \Delta u_{jit} \tag{7}$$

where $\Delta w_{jit} = \Delta \ln W_{jit} - \Delta(\mathbf{x}_{jit}^{W\prime}\boldsymbol{\zeta}_{jt}^{W})$ captures wage growth net of growth in observable characteristics and Δ is the first difference operator.

Deviations from the deterministic path for wages ($\mathbf{x}_{jit}^{W\prime}\boldsymbol{\zeta}_{jt}^{W}$) occur because permanent and transitory shocks hit the partners. A permanent shock shifts the value of one's skills in the market permanently (for example, a promotion shifting wages permanently up); a transitory shock is mean reverting (for example, a short illness affecting productivity). When shocks hit, I assume the spouses can perfectly observe and distinguish between them; moreover they hold no advance information on them.

All shocks have zero cross-sectional means and second moments given by

$$\mathbb{E}\left(v_{jit}v_{kit+s}\right) = \begin{cases} \sigma^2_{v_j,t} & \text{if} \quad j=k, s=0 \\ \sigma_{v_j v_k,t} & \text{if} \quad j\neq k, s=0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}\left(u_{jit}u_{kit+s}\right) = \begin{cases} \sigma^2_{u_j,t} & \text{if} \quad j=k, s=0 \\ \sigma_{u_j u_k,t} & \text{if} \quad j\neq k, s=0 \\ 0 & \text{otherwise} \end{cases}$$

for $j,k \in \{1,2\}$. Permanent shocks are independent of transitory, $v_{jit} \perp u_{kit+s}$ $\forall j,k,i,t,s$. The second moments are time-varying to reflect, for instance, the possibility that some periods of time are more turbulent than others. Shocks of the same type are correlated between spouses reflecting assortative mating (positive correlation) or risk sharing agreements (negative correlation). Finally, shocks are serially uncorrelated.

Although the permanent-transitory process for wages may seem restrictive, it fits the PSID

[15] There is variation in P_t over time but this is absorbed by conditioning private consumption on time dummies (see section 4.3). Cross-sectional variation in P_t could be obtained by exploiting regional (state or county) variation in prices or by constructing family-specific prices given the basket of goods a household consumes (as in Kiefer, 1984).

data well (for example Blundell et al., 2016). Recent generalizations of this process or alternative formulations include Blundell et al. (2015), Guvenen (2007), and Browning et al. (2010).

2.2 The Solution to the Family Problem

Without parameterizing or restricting spousal preferences in (1'), I obtain analytical closed-form expressions linking the growth rates of earnings (labor supply) and consumption to wage shocks that hit the household. To achieve this, I apply first- and second-order Taylor approximations to the problem's first order conditions and the intertemporal budget constraint following Blundell and Preston (1998) and a sequence of papers thereafter (Attanasio et al., 2002; Blundell et al., 2008, 2015, 2016).

Specifically, I derive the necessary first order conditions of the household problem (1'), subject to (5), assuming an interior solution. These are given by

$$\begin{aligned}
[K_{it}]: &\quad \mu_{1it}U_{1,K} + \mu_{2it}U_{2,K} = \lambda_{it} \\
[C_{1it}]: &\quad \mu_{1it}U_{1,C_1} = \lambda_{it}P_t \\
[C_{2it}]: &\quad \mu_{2it}U_{2,C_2} = \lambda_{it}P_t \\
[H_{1it}]: &\quad \mu_{1it}(-U_{1,H_1}) = \lambda_{it}W_{1it} \\
[H_{2it}]: &\quad \mu_{2it}(-U_{2,H_2}) = \lambda_{it}W_{2it} \\
[A_{it+1}]: &\quad \lambda_{it} = \beta(1+r)\mathbb{E}_t\lambda_{it+1}
\end{aligned} \tag{8}$$

where λ_{it} is the Lagrange multiplier on the sequential budget constraint at t (the marginal utility of wealth) and μ_{jit}, $j = \{1, 2\}$, is given by (6). U_{j,x_j}, the first order partial derivative of U_j with respect to $x_j = \{K, C_j, H_j\}$, $j = \{1, 2\}$, is i- and t-specific but I omit these subscripts to ease the notation.

There are five *intra*-temporal and one *inter*-temporal optimality conditions in each period t. With unrestricted spousal preferences the first order conditions for C_{jit} and H_{jit} are functions of K_{it}, C_{jit}, and H_{jit}, whereas the first-order condition for K_{it} is a function of K_{it}, C_{1it}, C_{2it}, H_{1it}, and H_{2it}. The latter is so because K_{it} bridges partners' preferences and is therefore interrelated with all other choice variables.

Applying Taylor approximations to the first order conditions (more on this below) enables me to relate the growth rates of labor supply and consumption to wage shocks *and* an innovation to the marginal utility of wealth. As the latter is not appealing empirically, I apply a Taylor approximation to the intertemporal budget constraint (more on this below), which enables me to replace the aforementioned innovation to λ_{it} by a function of wage shocks. I combine these approximations into a single set of equations for the growth rates of household outcomes as functions of permanent and transitory wage shocks only.

To render such equations empirically useful, 1.) I add up individual private consumption, which is not observed in the data, to total private consumption in the household, and 2.) I replace market hours with earnings using the identity $Y_{jit} = W_{jit}H_{jit}$, $j = \{1, 2\}$. The final set

of equations is

$$\begin{pmatrix} \Delta k_{it} \\ \Delta c_{it} \\ \Delta y_{1it} \\ \Delta y_{2it} \end{pmatrix} \approx \mathbf{T}_{it} \begin{pmatrix} v_{1it} \\ v_{2it} \\ \Delta u_{1it} \\ \Delta u_{2it} \end{pmatrix} \tag{9}$$

where lower case variables denote logged outcomes net of observable characteristics (*i.e.* $\Delta k_{it} = \Delta \ln K_{it}$ net of the change in covariates).[16]

$\mathbf{T}_{it}$ is a 4×4 matrix of 'transmission parameters' (loading factors) of shocks into outcomes. Such transmission parameters are nonlinear functions of a large set of gender-specific Frisch (λ-constant) elasticities of each spouse plus additional parameters pertaining to financial and human wealth in the family, as well as bargaining power and the allocation of private consumption between spouses. I report the transmission parameters in $\mathbf{T}_{it}$ analytically in appendix D after I present the details of the approximations to the first order conditions in appendix B and the intertemporal budget constraint in appendix C.

The gender-specific Frisch elasticities ordinally describe spousal preferences over public consumption, private consumption, and leisure. Table 1 introduces the full set of such elasticities and appendix A defines them analytically.

The advantage of the aforementioned approximations over, for example, a full numerical solution to the household problem, is summarized in (9). Such analytical equations provide a neat picture for the contribution of wage shocks, preferences, bargaining power, consumption sharing etc. to consumption and earnings growth and, therefore, a straightforward way to identify the household structure through, for example, the covariance matrix of (9).

The rest of this section is devoted to a more detailed description of the steps I take to reach equations (9):

1. I approximate the intra-temporal first order conditions in (8) around $t-1$'s prices, choices, and intra-family bargaining power. These approximations appear in detail in appendix B. The approximated equations constitute a 5×5 system in (the $t-1 \to t$ growth in) K, C_1, C_2, H_1, and H_2. Solving for the choice variables results in approximate closed-form expressions for each one of them as functions of (the growth in) wages, intra-family bargaining power, and the marginal utility of wealth. This is equation (B.7) in the appendix.

2. As the growth in intra-family bargaining power in (B.7) is unobserved, I exploit (6), which relates bargaining power to wages and distribution factors, and log-linearize μ_{1it} to get

$$\Delta \ln \mu_{1it} \approx \eta_{\mu,w_1} \Delta \ln W_{1it} + \eta_{\mu,w_2} \Delta \ln W_{2it} + \sum_n \eta_{\mu,d^n} \Delta \ln d^n_{it}. \tag{10}$$

   Here the 'surplus extraction' elasticity η_{μ,w_j}, $j = \{1,2\}$, captures the sensitivity of function $\mu(\cdot)$ to each spouse's wage and η_{μ,d^n} captures the sensitivity to distribution factor d^n. If $\mu(\cdot)$ in (6) remains unrestricted, then η_{μ,w_j} and η_{μ,d^n} vary with μ_{1it-1} and last period's wages and distribution factors.

[16] I assume that changes in observable covariates are anticipated by partners (and ex ante contracted upon) and therefore already accounted for in their optimal choices.

Table 1 – Frisch Elasticities of Spouse j

j's labor supply elasticities...		
$\eta_{j,h,w}$	:	with respect to own wage W_j
η_{j,h,p^c}	:	with respect to the price of private consumption P^c
η_{j,h,p^k}	:	with respect to the price of public consumption P^k
j's private consumption elasticities...		
$\eta_{j,c,w}$	:	with respect to own wage W_j
η_{j,c,p^c}	:	with respect to the price of private consumption P^c
η_{j,c,p^k}	:	with respect to the price of public consumption P^k
j's public consumption elasticities...		
$\eta_{j,k,w}$	:	with respect to own wage W_j
η_{j,k,p^c}	:	with respect to the price of private consumption P^c
η_{j,k,p^k}	:	with respect to the price of public consumption P^k

Notes: This table presents the full set of Frisch (λ-constant) elasticities of spouse j. These elasticities constitute an ordinal representation of j's preferences U_j. There are 9 elasticities per gender in total, 3 own-price and 6 cross-price elasticities. The rule governing the notation of Frisch elasticities in this paper: $\eta_{j,x,\chi}$ is individual j's elasticity of own outcome variable $x = \{h_j, c_j, k\}$ with respect to price $\chi = \{w_j, p^c, p^k\}$.

I assume that only *permanent* wage shocks shift intra-family bargaining power in (10). As transitory shocks are rapidly mean-reverting, one can expect that they do not reflect serious enough events that can alter the allocation of bargaining power between spouses.[17]

3. As the growth in the marginal utility of wealth in (B.7) is unobserved, I apply a second order Taylor approximation to the Euler equation in (8) and decompose $\Delta \ln \lambda_{it}$ into two additive terms (see appendix B and equation (B.8) for details). The first term, ω_{it}, reflects spousal motives for precautionary savings over their life-cycle. The second component ϵ_{it} is a 0-mean innovation term which captures idiosyncratic revisions to λ_{it} in response to wage shocks. Blundell et al. (2013, appendix A.1) show that ω_{it} converges to a constant as the variance of ϵ_{it} tends to 0. To achieve tractability I assume that $\omega_{it} \equiv \omega_t$ does not vary cross-sectionally (Blundell et al., 2016, appendix).

4. Combining results from points 2-3 above, namely equations (10) and (B.8), I update equation (B.7) and write (the $t-1 \to t$ growth in) K, C_1, C_2, H_1, and H_2 as functions of wage shocks and the components of λ_{it} only. This is equation (B.9) in the appendix; to obtain it I have assumed away any variation in distribution factors.[18]

5. I use the intertemporal budget constraint (the sequential version of which appears in (5) above) to link ϵ_{it} to the wage shocks that hit the spouses. My aim is to replace the

[17] Lise and Yamada (2014) find that unpredicted deviations in the spouses' relative wages during marriage impact on intra-family bargaining powers but *not* for all households. They report that the mode of revisions (to the Pareto weight) is one, indicating no revisions at all. This evidence motivates the exclusion of transitory shocks, namely the least important shocks over the family life-cycle, from the revisions to μ_{1it}.

[18] Lise and Yamada (2014) find no effect of distribution factors other than the spouses' relative wages on the allocation of resources in the household.

innovation to the marginal utility of wealth ϵ_{it} by an expression involving wage shocks only so as to render equation (B.9) empirically useful.

Specifically, I apply a first order Taylor approximation to each side of the intertemporal budget constraint around the path that would be followed if wage shocks were zero. The approximation draws on Campbell (1993); Blundell et al. (2013, 2016) are recent applications of such approximation to budget constraints that are similar to (5). If either spouse's current earnings are negligible compared to their expected lifetime earnings, the approximation enables me to map *permanent* wage shocks v_{jit}, $j = \{1, 2\}$, into ϵ_{it}. The details appear in appendix C.

The mapping from permanent wage shocks to ϵ_{it}, given by (C.1) in the appendix, involves spousal preferences (the full set of gender-specific Frisch elasticities in table 1), parameters pertaining to the allocation of private consumption (more on this below) and bargaining power in the household, as well as three 'quasi-reduced-form' parameters pertaining to expectations about the allocation of future household resources. These are: $\xi_{it} \approx \frac{\text{Lifetime Spending on } K_{it}}{\text{Lifetime Spending on } K_{it}+C_{it}}$ is the share of public in total expected lifetime expenditure, $s_{it} \approx \frac{\text{Lifetime Earnings}_{1it}}{\text{Lifetime Earnings}_{it}}$ is the share of the male spouse's expected lifetime earnings (his human wealth) in total lifetime earnings in the family, and $\pi_{it} \approx \frac{\text{Assets}_{it}}{\text{Assets}_{it}+\text{Lifetime Earnings}_{it}}$ is the 'partial insurance' parameter (term due to Blundell et al., 2008) that reflects the share of assets (financial wealth) in the family's total financial and human wealth combined.

6. A final step is needed to obtain equations (9); this involves replacing individual private consumption C_1 and C_2, which is not observed in the data, by *total* private consumption using the approximation

$$\Delta \ln C_{it} \approx \varphi_{it-1} \Delta \ln C_{1it} + (1 - \varphi_{it-1}) \Delta \ln C_{2it}. \tag{11}$$

Here $\varphi_{it} = \frac{C_{1it}}{C_{it}}$ is the male spouse's share of private consumption; φ_{it} will serve as a parameter to be identified in the data.

2.3 The Family Response to Wage Shocks

Wage shocks induce three types of effects on household outcomes, namely on public and private consumption, and spousal earnings (or labor supply). Permanent shocks induce static, bargaining, and wealth effects whereas transitory shocks induce static effects only.

The static effects summarize the impact a price change, in this case a *wage* change, has on outcomes in the exact same period when the price change occurs. Such effects are, by definition, identical across a dynamic model, like the present one, and a static one-period model. They reflect the standard substitution effect the price change induces by tilting the *contemporaneous* budget constraint and altering the marginal rate of substitution among the different goods the spouses enjoy. Permanent and transitory shocks (for a given spouse) induce identical static effects as there is no distinction between such shocks in an one-period environment.

On top of their static effects, permanent shocks induce bargaining effects through shifting intra-family bargaining power in (10). Changes in intra-family bargaining power further alter the

marginal rate of substitution among goods promoting those goods that the relatively powerful spouse prefers more.

Finally, permanent shocks induce wealth/income effects through shifting the *intertemporal* budget constraint as a result of a permanent change in household earnings. As household earnings are an endogenous household outcome, and therefore depend on the spouses' response to shocks through the aforementioned static and bargaining channels, the wealth effects themselves depend on (are a function of) the static and bargaining effects.

With reference to the transmission matrix $\mathbf{T}_{it}$ in (9), its first two columns are the transmission parameters of permanent wage shocks comprising the sums of the static, bargaining, and wealth effects by each spouse's permanent wage shock. The last two columns are the transmission parameters of transitory wage shocks, therefore comprising the static effects only.

Bargaining effects do not operate in the unitary model. Static and wealth effects do (Blundell et al., 2016). However, in contrast to the unitary model, static effect in the collective model are explicit functions of both spouses' preferences (Frisch elasticities), the prevailing intra-family bargaining power, as well as the prevailing allocation of private consumption (the latter matters for the transmission of shocks into private consumption only). Wealth effects, being a function of static and bargaining effects, are themselves structurally richer in the collective as opposed to the unitary model.

To help build intuition, I illustrate how a transitory wage shock transmits into selected household outcomes. Without loss of generality, consider the ceteris-paribus[19] transmission of $\Delta u_{1it} > 0$, a positive transitory shock to the male wage at t, into public consumption K_{it} and his leisure L_{1it}. I study the response of leisure to the transitory shock, instead of earnings or labor supply, because leisure facilitates the present illustration; recall that there is 1-to-1 mapping between leisure and earnings/labor supply in the absence of home production.

From appendix D the response of those outcomes to Δu_{1it} is given analytically by

$$\begin{aligned}\Delta k_{it} &\approx \eta_{1,k,w} \times \nu_{it-1} \times \frac{\eta_{2,k,p^k}}{\bar{\eta}_{k,p^k}} \times \Delta u_{1it} \\ \Delta l_{1it} &\approx -\kappa \times \left(\eta_{1,h,w} - \eta_{1,k,w} \times (1 - \nu_{it-1}) \times \frac{\eta_{1,h,p^k}}{\bar{\eta}_{k,p^k}} \right) \times \Delta u_{1it}\end{aligned} \tag{12}$$

where $\eta_{1,k,w}$ is the male elasticity of the public good with respect to his wage, $\eta_{1,h,w}$ is his own-wage labor supply elasticity, and η_{1,h,p^k} is his labor supply elasticity with respect to the price of the public good (see table 1). ν_{it-1} is a mixture of preferences and the prevailing (*i.e.* last period's) intra-family bargaining power; $\bar{\eta}_{k,p^k} = (1-\nu_{it-1})\eta_{1,k,p^k} + \nu_{it-1}\eta_{2,k,p^k}$ is a weighted average of the spouses' elasticities η_{j,k,p^k} of the public good with respect to its price.[20,21]

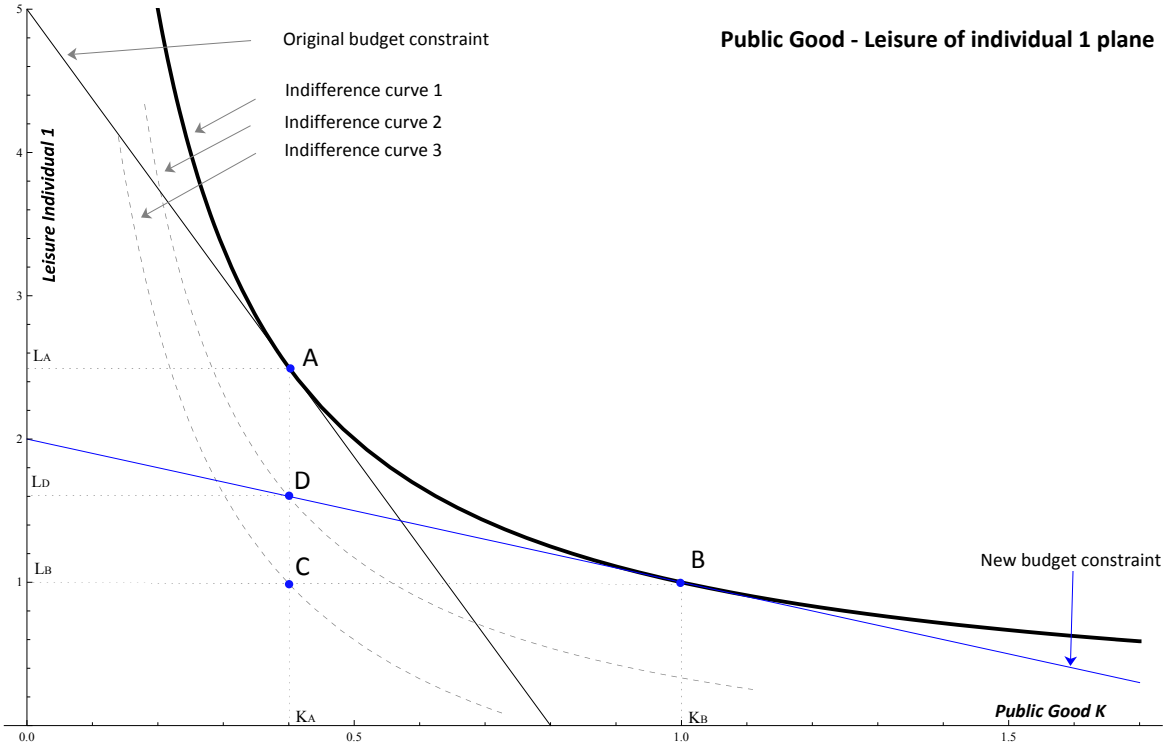
In figure 1 I draw the male spouse's hypothetical preferences for leisure and the public good assuming that these goods are imperfect substitutes (this assumption is used for the purposes of this illustration only). The bold downward sloping curve ('`Indifference curve 1`') depicts

[19] Ceteris-paribus implies $v_{1it} = v_{2it} = \Delta u_{2it} = 0$.

[20] $\nu_{it-1} = \mu_{1it-1}U_{1,K}(\mu_{1it-1}U_{1,K} + \mu_{2it-1}U_{2,K})^{-1}$ where $U_{j,K}$ is j's marginal utility of the public good at t. Expect that $\nu \in [0, 1]$.

[21] In the absence of home production Δl_{1it} is obtained from (9) as $\Delta l_{1it} = -\kappa \Delta h_{1it} = -\kappa(\Delta y_{1it} - \Delta w_{1it})$ where $\kappa > 0$ reflects Jensen's inequality when translating logged market hours to logged leisure. As a result, κ in expression (12) reflects that leisure elasticities are a *scaled* translation of labor supply elasticities.

FIGURE 1 – THE TRANSMISSION OF $\Delta u_{1it} > 0$ INTO PUBLIC CONSUMPTION AND LEISURE



his preferences across the two goods at the beginning of t, that is before the realization of the transitory shock. The straight line passing through A represents the original contemporaneous budget constraint at the same time. The scale of the axes is irrelevant. The spouse consumes initially at A (L_A and K_A respectively).

The positive transitory wage shock does not shift the contemporaneous budget constraint outwards. Section 2.2 and appendix C show that, under weak assumptions, transitory shocks do not induce wealth/income effects and, therefore, leave the total available budget at t unchanged. However, such shock, once it realizes, tilts the budget constraint around the initial indifference curve rendering leisure relatively more expensive (because $\Delta u_{1it} > 0$ and the wage is the price of leisure) and the public good relatively cheaper. The new budget constraint is the straight line passing through B.

If the male spouse can adjust his leisure and the public good freely, he will move consumption to bundle B on the plane (L_B and K_B respectively) in response to the tilting of the budget constraint. In this case the change in his leisure is proportional to his own-wage labor supply elasticity, namely $\Delta l_{1it} = -\kappa \times \eta_{1,h,w} \times \Delta u_{1it}$, and he cuts down leisure from L_A to L_B (assuming $\eta_{1,h,w} > 0$). The change in the public good is given by his elasticity of the public good with respect to his wage, namely $\Delta k_{it} = \eta_{1,k,w} \times \Delta u_{1it}$, and he increases public consumption from K_A to K_B (assuming $\eta_{1,k,w} > 0$ in this case). These responses stem from (12) after setting $\nu_{it-1} = 1$ and observing that, as a result, $\frac{\eta_{2,k,p^k}}{\bar{\eta}_{k,p^k}} = 1$; $\nu_{it-1} = 1$ corresponds to the extreme case where $\mu_{1it-1} = 1$ and the male spouse acts as a 'dictator', *i.e.* he completely imposes his preferences onto household outcomes. Consumption bundle B is one extreme possible outcome in response to the positive transitory shock.

In the opposite extreme case, the male spouse holds no power in the household and his

partner becomes the 'dictator'. This case can be obtained when $\mu_{2it-1} = 1$ implying $\nu_{it-1} = 0$. From (12), $\Delta l_{1it} = -\kappa \times (\eta_{1,h,w} - \eta_{1,k,w} \times \frac{\eta_{1,h,p^k}}{\eta_{1,k,p^k}}) \times \Delta u_{1it}$ whereas $\Delta k_{it} = 0$. The (lack of) response of public consumption is straightforward: a shock to *his* wage does not alter the female spouse's tradeoffs (marginal rates of substitution) among the goods she enjoys and, as a result, she does not change her (the household) demand for the public good. The response of his leisure is less straightforward. As μ_{2it-1} tends to 1 and the public good tends to remain at $\mathtt{K_A}$, it is suboptimal for the male spouse to shift his leisure like he would if he was the 'dictator': in such case he would consume at $\mathtt{C}$ ($\mathtt{L_B}$ and $\mathtt{K_A}$ respectively) which is below the applicable budget frontier and a profound deterioration in his welfare. Instead he adjusts his leisure so that he ends up on the budget frontier given $k_{it} = \mathtt{K_A}$: that is consumption bundle $\mathtt{D}$. This adjustment differs from the first best response $-\kappa \times \eta_{1,h,w} \times \Delta u_{1it}$ by $\kappa \times \eta_{1,k,w} \times \frac{\eta_{1,h,p^k}}{\eta_{1,k,p^k}} \times \Delta u_{1it}$, that is by the product of his optimal response of K had he been able to adjust it freely ($\eta_{1,k,w}$) and his sensitivity of leisure relative to the public good ($\kappa \times \frac{\eta_{1,h,p^k}}{\eta_{1,k,p^k}}$).

In more realistic cases, neither partner would act as 'dictator' and spouse 1 should land somewhere between the extreme bundles $\mathtt{B}$ and $\mathtt{D}$. The final response of the public good, given by (12), is a fraction ν_{it-1} of his unrestricted response $\eta_{1,k,w} \times \Delta u_{1it}$ weighed by a term $\frac{\eta_{2,k,p^k}}{\bar{\eta}_{k,p^k}}$ that reflects the female spouse's relative sensitivity for the public good. The last term appears because, as the public good enters both spouses' preferences, changes in its demand have to be agreed by both. The final response of his leisure, given by (12), is equal to his unrestricted response $-\kappa \times \eta_{1,h,w} \times \Delta u_{1it}$ plus an additional feedback term in response to the household-wide shift in the public good; such adjustment is captured by $\kappa \times \eta_{1,k,w} \times (1 - \nu_{it-1}) \times \frac{\eta_{1,h,p^k}}{\bar{\eta}_{k,p^k}} \times \Delta u_{1it}$ and exists because 1.) leisure and public consumption are nonseparable in spousal preferences, 2.) the response of public consumption, whatever that may be, reflects not just *his* but *both* spouses' preferences.

Extending the discussion to all outcome variables is straightforward. The difference between the impact of Δu_{1it} on k_{it}, l_{1it} (or y_{1it}), c_{1it} on one hand and l_{2it} (or y_{2it}), c_{2it} on the other is that there are direct and indirect static effects induced on the former set, whereas there are only indirect ones induced on the latter. The direct effects capture the direct response to a transitory wage shock which, in all cases except leisure, exists because of non-separabilities in spousal preferences. The indirect effects capture adjustments in the demand of a good in response to household-wide shifts in public consumption.

The response to a permanent shock follows a similar discussion. In addition to their static effects, permanent shocks induce bargaining effects, which, in the analog of figure 1, restrict or expand the admissible range of outcomes between points $\mathtt{B}$ and $\mathtt{D}$, and wealth/income effects that move the budget constraint inwards or outwards.

2.4 Identification of the Family Structure

In this section I discuss the identification of the household structure from panel data on consumption (household-level public and private consumption), spousal earnings, and spousal wages only. In each period t there are 6 wage variances and covariances ($\sigma^2_{v_1,t}$, $\sigma^2_{v_2,t}$, $\sigma_{v_1v_2,t}$, $\sigma^2_{u_1,t}$, $\sigma^2_{u_2,t}$, $\sigma_{u_1u_2,t}$), 18 Frisch elasticities (2 spouses $\times$ 9 elasticities each; see table 1), a parameter reflecting the allocation of private consumption between spouses (φ_{it}), the Pareto weight on male prefer-

ences (μ_{1it}), 2 'surplus extraction' elasticities (η_{μ,w_j}), and a parameter reflecting a mixture of preferences and intra-family bargaining power (ν_{it}). These amount to 29 parameters in total. Three additional parameters, ξ_{it}, s_{it}, and π_{it}, enter the wealth effects but, as they are obtainable directly from the data (section 4.2), I treat them as known in this discussion.

Several parameters vary cross-sectionally with observables; for example the allocation of private consumption φ_{it} varies with the *level* of consumption C_{it}, the Pareto weight μ_{1it} varies with initial conditions or last period's Pareto weight μ_{1it-1}, the 'surplus extraction' elasticities η_{μ,w_j} vary with last period's wage levels W_{jit-1} and the Pareto weight μ_{1it-1}. I discuss identification of such parameters assuming they do not vary with observables; once identification is established in such case, the extension to when they vary with observables is straightforward. Identification does not require any parameter to be stationary over time.

The parameters of the wage process are identified by wage moments only (*i.e.* independently of preferences). Specifically

$$\begin{aligned}
\sigma^2_{v_j,t} &= \mathbb{E}[\Delta w_{jit}(\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})] \\
\sigma_{v_1v_2,t} &= \mathbb{E}[\Delta w_{1it}(\Delta w_{2it-1} + \Delta w_{2it} + \Delta w_{2it+1})] \\
\sigma^2_{u_j,t} &= \mathbb{E}[\Delta w_{jit}\Delta w_{jit+1}] \\
\sigma_{u_1u_2,t} &= \mathbb{E}[\Delta w_{1it}\Delta w_{2it+1}]
\end{aligned} \tag{13}$$

where Δw_{jit} is given by (7), $j = \{1, 2\}$, and $\mathbb{E}[\cdot]$ denotes the first moment. Identification follows the logic in Meghir and Pistaferri (2004) and earlier studies. $\sum_{t-1}^{t+1} \Delta w_{jit}$ strips Δw_{jit} of its transitory component and, as a result, the covariance $\mathbb{E}[\Delta w_{jit} \sum_{t-1}^{t+1} \Delta w_{jit}]$ identifies the variance of the permanent shock. Similarly, the covariance of Δw_{jit} and $\sum_{t-1}^{t+1} \Delta w_{kit}$, $j \neq k$, identifies the covariance between the partners' permanent shocks. The covariance of Δw_{jit} and Δw_{jit+1} identifies the variance of the transitory shock because consecutive transitory shocks are autocorrelated due to mean reversion. Similarly, the covariance of Δw_{jit} and Δw_{kit+1}, $j \neq k$, identifies the covariance between transitory shocks. Overidentifying restrictions are available.

The average transmission parameters of shocks into consumption and earnings, namely the components of matrix $\mathbf{T}_{it}$ in (9), are identified by second moments of the joint distribution of wages, earnings, and consumption. Consider, as an example, the transmission of shocks into the public good and define the following moments

$$\begin{aligned}
m^{k1}_t &= \mathbb{E}[\Delta k_{it}(\Delta w_{1it-1} + \Delta w_{1it} + \Delta w_{1it+1})] \\
m^{k2}_t &= \mathbb{E}[\Delta k_{it}(\Delta w_{2it-1} + \Delta w_{2it} + \Delta w_{2it+1})] \\
m^{k3}_t &= \mathbb{E}[\Delta k_{it}\Delta w_{1it+1}] \\
m^{k4}_t &= \mathbb{E}[\Delta k_{it}\Delta w_{2it+1}]
\end{aligned}$$

where Δk_{it} is given by (9). The average transmission parameters into the public good are

identified as

$$\mathbb{E}[\tau_{it}^{11}] = \frac{m_t^{k1}\sigma_{v_2,t}^2 - m_t^{k2}\sigma_{v_1v_2,t}}{\sigma_{v_1,t}^2\sigma_{v_2,t}^2 - \sigma_{v_1v_2,t}^2} \qquad \mathbb{E}[\tau_{it}^{13}] = -\frac{m_t^{k3}\sigma_{u_2,t}^2 - m_t^{k4}\sigma_{u_1u_2,t}}{\sigma_{u_1,t}^2\sigma_{u_2,t}^2 - \sigma_{u_1u_2,t}^2}$$

$$\mathbb{E}[\tau_{it}^{12}] = \frac{m_t^{k1}\sigma_{v_1v_2,t} - m_t^{k2}\sigma_{v_1,t}^2}{\sigma_{v_1v_2,t}^2 - \sigma_{v_1,t}^2\sigma_{v_2,t}^2} \qquad \mathbb{E}[\tau_{it}^{14}] = -\frac{m_t^{k3}\sigma_{u_1u_2,t} - m_t^{k4}\sigma_{u_1,t}^2}{\sigma_{u_1u_2,t}^2 - \sigma_{u_1,t}^2\sigma_{u_2,t}^2}$$

where $\left(\tau_{it}^{11}, \tau_{it}^{12}, \tau_{it}^{13}, \tau_{it}^{14}\right)$ is the first row of the transmission matrix $\mathbf{T}_{it}$ in (9).

Identification rests on the following idea: if permanent wage shocks transmit into public consumption, the contemporaneous covariance between spouse j's wage growth (striped of its transitory components) and public consumption growth picks up the variance of spouse j's permanent shock scaled by its transmission parameter into public consumption. Similarly, the covariance between contemporaneous growth in public consumption and next period's wage growth picks up (minus) the variance of the mean reverting transitory shock weighed by its loading factor onto public consumption. In both cases adjustments are made to account for the correlation of wages in the family.

Identification of the remaining transmission parameters (into total private consumption and individual earnings) follows the same logic and requires analogous moment conditions. A total of 16 transmission parameters are identified.

The question that emerges is whether such transmission parameters convey sufficient information for the identification of the underlying household structure. The answer is negative; there are only 16 transmission parameters comprising a total of 29 structural parameters and most one can identify is a few uninformative ratios of Frisch elasticities. Reasons behind the lack of identification include 1.) the lack of variation in the price of the consumption goods, 2.) the non-observability of individual private consumption, 3.) the existence of a public good bridging spousal preferences and the interdependence of goods allowed for by non-separabilities in spousal preferences, and 4.) the indistinguishability between preferences and intra-family bargaining power.

I explore two possibilities in order to overcome the lack of identification. In section 2.4.1 I impose restrictions on spousal preferences, rendering the public good additively separable from private consumption and leisure, and enforce full commitment. In section 2.4.2 I maintain nonseparable spousal preferences and lack of commitment but I bring additional information into (9), namely information on single individuals of each gender. In both cases I obtain partial identification of the household structure.

2.4.1 Separable Public Good and Full Commitment

Additive separability of the public good implies that, conditional on household income, public consumption does not change with wages or the price of private consumption, leading to $\eta_{j,k,w} = \eta_{j,k,p^c} = \eta_{j,h,p^k} = \eta_{j,c,p^k} = 0$ for $j = \{1, 2\}$. Changes in wages still trigger shifts in the public good through the budget constraint only. Full commitment implies that bargaining power in a given household remains fixed over time ($\mu_{1it} = \mu_{1it=0}, \forall t$) leading to $\eta_{\mu,w_j} = 0$ and 0 bargaining effects.

The transmission parameters of wage shocks into household outcomes are obtained from

the expressions in appendix D plugging in the aforementioned restrictions. Note that private consumption and leisure remain nonseparable.

It is straightforward to see that the response of spousal earnings to own transitory shocks identifies the own-wage labor supply elasticities $\eta_{j,h,w}$, $j = \{1, 2\}$. Such response reflects the direct static effect on earnings (the indirect static effect, which would feed back should public consumption also shift, is 0) which is proportional to one's labor supply elasticity.

The response of private consumption to transitory shocks identifies the private consumption elasticities $\eta_{j,c,w}$ *up to scale* where the scale is given by a spouse's share of private consumption in the household. Specifically, the response of private consumption to the male transitory shock identifies $\mathbb{E}[\varphi_{it}]\eta_{1,c,w}$ whereas the response to the female shock identifies $\mathbb{E}[1-\varphi_{it}]\eta_{1,c,w}$. Again, such responses reflect the direct static effect on private consumption, which is proportional to one's own-wage private consumption elasticity *and* their share of private consumption. It is not possible to separate the two.

To identify the hours elasticities with respect to the price of private consumption (η_{j,h,p^c}) I exploit a natural set of theoretical restrictions, that is symmetry of each spouse's matrix of substitution effects. After a constant marginal-utility-of-wealth price change (essentially a transitory shock), the matrix of substitution effects, that is (A.1) in the appendix, is equal to the (scaled) inverse Hessian of the individual utility function. Symmetry of this matrix follows from symmetry of the Hessian. In the present context, this symmetry implies one linear restriction per spouse involving their non-zero cross-price elasticities, namely $\eta_{1,h,p^c} = -\eta_{1,c,w} \times \varphi_{it} \times \frac{P_t^c C_{it}}{W_{1it} H_{1it}}$ and $\eta_{2,h,p^c} = -\eta_{2,c,w} \times (1-\varphi_{it}) \times \frac{P_t^c C_{it}}{W_{2it} H_{2it}}$.[22]

The response of consumption to permanent shocks identifies two quasi-reduced-form consumption substitution elasticities at the household level. Specifically, the response of public consumption identifies $\widetilde{\eta}_{k,p^k} = \mathbb{E}\left[\eta_{1,k,p^k}\eta_{2,k,p^k} / \left((1-\nu_{it-1})\eta_{1,k,p^k} + \nu_{it-1}\eta_{2,k,p^k}\right)\right]$ whereas the response of private consumption identifies $\widetilde{\eta}_{c,p^c} = \mathbb{E}\left[\varphi_{it-1}\eta_{1,c,p^c} + (1-\varphi_{it-1})\eta_{2,c,p^c}\right]$. The former parameter coincides with the *household-level* public consumption substitution elasticity, *i.e.* the substitution elasticity of public consumption when the household acts as a single economic agent (the case of the unitary model). The latter parameter coincides with the *household-level* private consumption substitution elasticity, *i.e.* the substitution elasticity of private consumption in a unitary household. The response of earnings to permanent shocks provides overidentifying restrictions for $\widetilde{\eta}_{k,p^k}$ and $\widetilde{\eta}_{c,p^c}$.

A note of caution is due here: even though additive separability of public consumption delivers identification of a number of structural parameters, the demand for 'public' items, such as water or electricity, is likely to co-move with hours of work (see, for example, Browning and Meghir, 1991). Casual arguments suggest that water or electricity consumption may increase if individuals work less and spend more time at home. In the present model, additive separability of K also implies that one partner's earnings do not vary with their spouse's wage, thus stripping earnings of the 'added worker' effect (Lundberg, 1985). This is because such effect operates here through the interdependence of preferences due to a nonseparable public good and it vanishes otherwise. Finally, in the absence of bargaining effects, full commitment renders the model

[22] See appendix A for details. Frisch symmetry is not the only way to identify η_{j,h,p^c}, $j = \{1, 2\}$. In principle, those elasticities can also be identified from the transmission of *permanent* shocks into household outcomes. In practice the transmission of permanent shocks alone could not pin down η_{j,h,p^c} precisely.

indistinguishable from a unitary one unless $\widetilde{\eta}_{k,p^k}$ varies with past wages through its dependence on ν_{it-1} and last period's Pareto weight.[23]

2.4.2 Nonseparable Public Good and Lack of Commitment

Suppose single and married individuals of gender $j = \{1, 2\}$ have the same preferences across the two states of life (as singles, in couples). Suppose, also, that the entire set of Frisch elasticities per gender $\eta_j = \{\eta_{j,h,w}, \eta_{j,h,p^c}, \eta_{j,h,p^k}; \eta_{j,c,w}, \eta_{j,c,p^c}, \eta_{j,c,p^k}; \eta_{j,k,w}, \eta_{j,k,p^c}, \eta_{j,k,p^k}\}$ is available through, say, observing singles. Then the second moments of the joint distribution of wages, earnings, and consumption in the family, whose theoretical counterpart is the covariance matrix of (9), suffice for the (over)-identification of the remaining household structure.

Once spousal preferences (the Frisch elasticities) are known, the response of public consumption to either spouse's transitory shock identifies $\mathbb{E}[\nu_{it-1}]$. ν_{it-1} is a 'preference aggregator'; it determines the extent to which shifts in the household demand for the public good reflect one or another spouse's preferences. Similarly, the response of private consumption to either spouse's transitory shock identifies the average consumption allocation between them $\mathbb{E}[\varphi_{it-1}]$. The response of earnings provides over-identifying restrictions.

In both cases the rationale behind identification is the following: knowledge of spousal preferences implies knowledge of how each spouse would, hypothetically, change their consumption *as single*. The actual consumption response at the family level is a weighted sum/product of the two individual responses; the weight is given by ν in the case of public consumption and by φ in the case of private consumption. An equivalent interpretation is the following: the extent to which the response of family consumption to wage shocks resembles the way one or another partner would have responded had they been single is informative about the decision process for the public good as well as the allocation of the private good.

The response of household outcomes to permanent shocks identifies 8 bargaining effects (4 bargaining effects -on public consumption, private consumption, and earnings- by *each* spouse's permanent shock). Permanent shocks induce bargaining and wealth effects; as the latter are functions of the former *and* the static effects that are identified from transitory shocks and singles, the response to permanent shocks just identifies the bargaining effects.[24] It is not pos-

[23] One cannot distinguish this model from the unitary if φ_{it} alone and, therefore $\widetilde{\eta}_{c,p^c}$ or the response of private consumption to transitory shocks, varies with wages or other observables. The non-separability of leisure and private consumption implies that the allocation of private consumption will vary with wages even when the unitary model is the 'correct' representation of the household.

[24] Without loss of generality consider the bargaining effects β_{k,w_1}, β_{c,w_1}, β_{y_1,w_1}, and β_{y_2,w_1} and the wealth effects γ_{k,w_1}, γ_{c,w_1}, γ_{y_1,w_1}, and γ_{y_2,w_1} induced by men's permanent shock. I write

$$\begin{pmatrix} \beta_{k,w_1} + \gamma_{k,w_1} \\ \beta_{c,w_1} + \gamma_{c,w_1} \\ \beta_{y_1,w_1} + \gamma_{y_1,w_1} \\ \beta_{y_2,w_1} + \gamma_{y_2,w_1} \end{pmatrix} = \begin{pmatrix} \varpi_{k,w_1} \\ \varpi_{c,w_1} \\ \varpi_{y_1,w_1} \\ \varpi_{y_2,w_1} \end{pmatrix}$$

where $(\varpi_{k,w_1}, \varpi_{c,w_1}, \varpi_{y_1,w_1}, \varpi_{y_2,w_1})' \neq \mathbf{0}$ is the difference between the transmission parameters of permanent and transitory shocks to men's wage. Conditional on the static effects, the wealth effects γ are linear functions of the bargaining effects (see appendix D). Manipulating this system appropriately, I write

$$\mathbf{M}_{it} \left(\beta_{k,w_1}, \beta_{c,w_1}, \beta_{y_1,w_1}, \beta_{y_2,w_1}\right)' = \mathbf{m}_{it}.$$

$\mathbf{M}_{it}$ is a data-dependent matrix that is unlikely to be singular. $\mathbf{m}_{it}$ is also unlikely to be the zero vector. There is a unique solution for $(\beta_{k,w_1}, \beta_{c,w_1}, \beta_{y_1,w_1}, \beta_{y_2,w_1})'$ which is given by $\mathbf{M}_{it}^{-1}\mathbf{m}_{it}$.

sible to delve deeper and identify components of the bargaining effects, namely η_{μ,w_j} or μ_{1it-1}. The 'surplus extraction' elasticities η_{μ,w_j} cannot be separately identified from the (prevailing) Pareto weight μ_{1it-1}. Indeed, inspecting the bargaining effects in appendix D, these elasticities appear always together with and multiplicatively to the Pareto weight.

But how can one obtain η_j? The following section (section 3) develops a life-cycle model for consumption and leisure of singles. Based on such model I show how the entire set of Frisch elasticities per gender η_j can be identified and used as input to the model for couples.

3 A Life-Cycle Model for Singles

Single individuals of gender $j = \{1, 2\}$ live alone and consume the same set of goods as their non-single counterparts, namely 'public' consumption K, 'private' consumption C, and leisure $1 - H$. Public consumption is no longer 'public' in the sense that it is enjoyed together with a spouse because such spouse does not exist; however, it still comprises the same goods that spouses would generally consume together (such as last section's car journey to the countryside or the gas to heat the house). Private consumption C also comprises the same goods as in section 2 (e.g. a meal at the local coffee shop or a subway ticket). Although a distinction between K and C is now less meaningful, I do not collapse them to a single commodity because I want to maintain consistency with the family problem of section 2.

I illustrate the main points of the model focusing on single j. Using a time index s, the single individual's problem is given by

$$\max_{\{K_{jis},C_{jis},H_{jis},A_{jis+1}\}_{\forall s}} \mathbb{E}_0 \sum_{s=0}^{\mathcal{S}} \beta_s U_j(K_{jis}, C_{jis}, 1 - H_{jis}; \mathbf{z}_{jis}) \tag{14}$$

subject to the sequential budget constraint

$$A_{jis} + W_{jis}H_{jis} = K_{jis} + P_t C_{jis} + \frac{A_{jis+1}}{1+r}, \quad A_{ji\mathcal{S}+1} = \widetilde{A}, \quad \forall t. \tag{15}$$

Here $\mathcal{S}$ indicates the horizon of the single's lifetime and deserves some attention. In the case of a young single individual who may get married in the future, $\mathcal{S}$ reflects the uncertain future time when he/she gets married; $\widetilde{A}$ reflects assets, positive or negative, the single transfers to his/her future family. In the case of an older single who was married in the past but is now divorced or widowed, $\mathcal{S}$ reflects the end of lifetime (assuming no remarriage) and $\widetilde{A} = 0$ is the usual no-Ponzi terminal condition. (14)-(15) could also reflect the problem of a person who remains single for their entire lifetime, in which case $\mathcal{S}$ and $\widetilde{A}$ are like for the older single above.

The public good is now subscripted by j to indicate its assignability to single j; assets are also assignable and thus also subscripted by j. Private consumption C_{jis} is observed and fully assignable to individual j. The wage process is given by (7). The rest of the notation, as well as the properties of U_j, remain exactly the same as in section 2.1.

I solve the problem following the same procedure like before (section 2.2): I obtain the problem's first order conditions, I apply first and second order Taylor approximations to them, I log-linearize the singles' intertemporal budget constraint. I obtain a set of closed-form equations

for (growth in) singles' consumption and earnings as functions of their permanent and transitory wage shocks. These equations are given by

$$\begin{pmatrix} \Delta k_{jis} \\ \Delta c_{jis} \\ \Delta y_{jis} \end{pmatrix} \approx \begin{pmatrix} \eta_{j,k,w} + (\eta_{j,k,w} + \eta_{j,k,p^c} + \eta_{j,k,p^k})\ell^s_{jit} & \eta_{j,k,w} \\ \eta_{j,c,w} + (\eta_{j,c,w} + \eta_{j,c,p^c} + \eta_{j,c,p^k})\ell^s_{jit} & \eta_{j,c,w} \\ \eta_{j,h,w} + (\eta_{j,h,w} + \eta_{j,h,p^c} + \eta_{j,h,p^k})\ell^s_{jit} + 1 & \eta_{j,h,w} + 1 \end{pmatrix} \begin{pmatrix} v_{jis} \\ \Delta u_{jis} \end{pmatrix} \tag{16}$$

and they are the singles' analog of equations (9) in the family problem. The transmission of the permanent shock differs from that of the transitory shock solely by the wealth/income effect it induces as there are no bargaining effects in a single-member household. The wealth/income effect is captured by ℓ^s_{jit},which stems from the log-linearization of the intertemporal budget constraint and is defined analytically in appendix C, and the terms multiplying it.[25]

The response of public consumption to the transitory wage shock identifies the public consumption wage elasticity $\eta_{j,k,w}$. Specifically, $\mathbb{E}[\Delta k_{jis}\Delta w_{jis+1}]$ identifies (minus) this elasticity scaled by the variance of the transitory shock; the latter is identified by (13). Similarly, the response of private consumption (earnings) identifies the private consumption wage elasticity $\eta_{j,c,w}$ (the own-wage labor supply elasticity $\eta_{j,h,w}$). Identification of $\eta_{j,k,w}$ and $\eta_{j,c,w}$, and symmetry of the matrix of substitution effects (illustrated in section 2.4.1 and appendix A), brings about identification of the 'reciprocal' labor supply elasticities $\eta_{j,h,p^k} = -\eta_{j,k,w}\frac{P^k_s K_{jis}}{W_{jis}H_{jis}}$ and $\eta_{j,h,p^c} = -\eta_{j,c,w}\frac{P^c_s C_{jis}}{W_{jis}H_{jis}}$.

The response of consumption to permanent shocks identifies two sums of consumption substitution elasticities, namely $\eta_{j,k,p^c} + \eta_{j,k,p^k}$ and $\eta_{j,c,p^c} + \eta_{j,c,p^k}$. Importantly, identification of the sums is robust to misspecification in the single person's intertemporal budget constraint due to over- or under-estimating the true horizon $\mathcal{S}$ of the single.[26]

It is not possible to separate the components of those sums, namely η_{j,k,p^c} from η_{j,k,p^k} or η_{j,c,p^c} from η_{j,c,p^k}, even if one restricts the 'reciprocal' elasticities η_{j,k,p^c} and η_{j,c,p^k} by exploiting the symmetry in the matrix of substitution effects. Lack of variation in the prices of the two consumption goods is the fundamental reason. But even if such variation was obtainable in the data, it would be even harder to obtain *independent* variation in price P^c from price P^k. This observation motivates the restriction $P^c = P^k = P$ which implies $\eta_{j,k,p^c} = \eta_{j,k,p^k}$ and $\eta_{j,c,p^c} = \eta_{j,c,p^k}$.[27] These additional restrictions complete the identification of the entire set of Frisch elasticities per gender.

Conditional on these elasticities and as illustrated in section 2.4.2, the response of consumption to transitory shocks in a two-member household identifies, among other things, the sharing of private consumption between spouses; the response of consumption to permanent shocks identifies the bargaining effects on household outcomes. In practice, one would estimate the

[25] Transitory shocks do not induce wealth/income effects provided that the lifetime horizon *as single* is sufficiently long and earnings within a given period are negligible compared to lifetime earnings as single.

[26] The response of earnings to permanent shocks identifies $\mathbb{E}[\ell^s_{jit}]$ conditional on $\eta_{j,h,w}$, η_{j,h,p^c}, and η_{j,h,p^k}. Even though ℓ^s_{jit} depends on the singles's horizon $\mathcal{S}$ through (C.2) in the appendix, identification of $\mathbb{E}[\ell^s_{jit}]$ does not. Indeed one could replace ℓ^s_{jit} by a flexible variable b_{jit} (which, unlike ℓ^s_{jit}, has an unknown analytical representation), so that the response of earnings to permanent shocks identifies $\mathbb{E}[b_{jit}]$. Conditional on this, the response of consumption to permanent shocks identifies the aforementioned sums $\eta_{j,k,p^c} + \eta_{j,k,p^k}$ and $\eta_{j,c,p^c} + \eta_{j,c,p^k}$. Of course, if the true horizon of the single *is* known, then the analytical representation of ℓ^s_{jit} has the advantage of providing overidentifying restrictions.

[27] It also implies $\eta_{j,h,p^c} = \eta_{j,h,p^k}$.

gender-specific preferences (Frisch elasticities) and the parameters of the collective household *jointly* across married couples, single males, and single females; therefore the Frisch elasticities would need to satisfy a big number of overidentifying restrictions across singles *and* couples.

The critical assumption that makes this identification strategy work is that spousal, gender-specific, preferences do not change across the two states of life, namely across single and married individuals, or change only through their dependence on taste shifters and observables. A number of studies have employed this assumption to identify the structure of the collective household, such as Barmby and Smith (2001), Vermeulen (2006), Vermeulen et al. (2006), or, more recently, Browning et al. (2013).

There are a few different ways to weaken such assumption empirically. For example, one may restrict the estimation sample to singles who have preferences for marriage, or otherwise for forming a household, by only admitting those who were married in the past or will get married in the future. Alternatively, one may admit singles in a short window of time around the 'marriage cutoff', that is for a few only periods before one gets married or after one divorces. I impose the first restriction in the subsequent empirical application (section 4).

Note that a class of preferences are excluded from U_j upon assuming preferences are state-of-life invariant. Spouse j in the family cannot be altruistic, therefore caring for his/her partner, as that would imply a change of preferences across the two states of life. As single, one cannot care for another person because there is no one else in the household to care for. When partnered, one will still have to *not* care for their partner's utility, other than caring through the common public good, because, otherwise, preferences would change violating the aforementioned assumption.

4 Empirical Implementation

The model is estimated on seven waves of the PSID between 1999 and 2011; the 1997 wave is used for initial conditions.[28] The PSID started in 1968 interviewing a -then- nationally representative core sample of roughly 3,000 households; repeated annually until 1997 the survey collected information on employment, income, health, education and other demographics of the adult household members and their linear descendants should they split off and establish their own households. A second smaller sample of low income households, consisting roughly of 2,000 units in 1968, was also interviewed consistently. I estimate the model on the core sample only.

The survey becomes biennial after 1997 but, starting in 1999, it collects richer information including information on expenditure, wealth, philanthropy, and numerous other topics. The sample size has grown consistently over the years reaching 5,495 core sample households in 2011 (this reflects tracking of an increasing number of the original families' first and subsequent generations split-offs).

The PSID is suitable for the model in this paper due to a number of desirable features: (i) detailed data on household assets and spending are available after 1999, along with data on earnings, hours of work, and demographics for the main earners, (ii) consecutive information on the same households is available, and (iii) multi-member, as well as single-member households are interviewed.

[28] More information on the PSID, as well as access to all the data, is available online at psidonline.isr.umich.edu.

4.1 Sample Selection and Definition of Variables

I consider opposite-sex married couples; I exclude those cohabiting (a tiny fraction in the data). I assign the model spouse $j = 1$ to the male spouse in the data and the model spouse $j = 2$ to the female. Their single counterparts in the data are single men and single women respectively.

I select a baseline sample of stable[29] couples such that both partners are between 25 and 65 years old and have no missing demographics such as race, education, employment status, or state of residence. Both spouses must participate in the labor market and earn an hourly wage at least equal to half the applicable state minimum wage. The family must consume non-zero amounts of both the public and the private goods and report usable information on their wealth (precise definitions of the variables follow). I remove observations with extreme values for wages, earnings, or family consumption; these variables must also not experience extreme jumps from one period to another (jumps that probably signal measurement error).

Singles are selected according to the same exactly criteria like couples; their only difference is that they live in single-member households. I restrict my attention to single men and women who were married in the past or will get married in the future. In other words, I drop singles who may have tastes against marriage, something which would go against the assumption that preferences are state-of-life invariant.

In total there are 10,232 married couple-year observations satisfying the above selection criteria, 853 single male-year, and 1,109 single female-year (the totals include calendar year 1996).[30] There are more single women than men because of more widowed or divorced women in all years of the data.

Table 2 presents information on demographics and labor market outcomes by year (1996-2010), gender (male-female), and marital status (married, single). Mean age of individuals in couples is in the early 40s (with women approximately two years younger than their husbands). Mean age of singles trends upwards over time reflecting that the majority of young singles in the later survey waves are not included in the sample because I cannot observe them getting married in the future. Approximately 90% of couples comprise white individuals; this figure is slightly lower among single men (-4pct) and considerably lower among single women (-12pct). Average years of education, as well as the likelihood of having been to college, increases over time for married men and women; the latter almost always outperform the former. There is mixed evidence on the educational attainment of singles: single men have progressively fewer years of schooling, possibly reflecting changes in the age composition of single men, whereas single women maintain stable schooling levels despite that.

Earnings are defined on an annual basis and include labor income (including tips and overtime) and the labor part of business income from unincorporated businesses. Hourly wages are defined as annual earnings over annual hours of market work. Women earn consistently less than men across both marital states but they also work fewer hours. Single men work approx-

[29] By stable households I refer to households whose lead couple (husband-wife) remains intact. If a new spouse enters a household, because, say, of divorce and remarriage, I drop the household the period this occurs and reinstate it in the following period as a new household. I also drop intermittent households, *i.e.* households that appear in the survey only once or in waves too far apart.

[30] The PSID data are retrospective, *i.e.* information in the 1997 survey wave refers to calendar year 1996. I report descriptive statistics respecting this feature.

Table 2 – Demographics and Labor Market Outcomes by Year, Gender, and Marital Status

	1996				**1998**			
	Couples		Singles		Couples		Singles	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
# of children	1.21		0·25	0·92	1.13		0·29	1·02
Age	41·46	39·49	33·82	33·60	42·62	40·60	36·04	36·15
Race: white %	90·25	90·82	90·00	76·71	90·19	90·97	86·61	81·90
Race: black %	4·69	3·94	3·33	17·81	4·60	3·74	6·25	12·93
Years of schooling	14·12	14·11	14·18	14·44	14·10	14·17	14·18	14·18
Been to college %	64·67	66·82	66·67	75·34	64·49	67·76	66·07	68·97
Hours of work	2245·64	1702·04	2092·92	2080·75	2314·40	1693·95	2277·21	2016·11
Earnings	62128·75	33595·15	49882·41	36042·82	66903·14	34819·23	54236·60	37753·33
Hourly wage	28·69	19·91	24·23	17·23	29·70	20·72	24·30	19·07
Observations	1067		60	73	1284		112	116

	2000				**2002**			
	Couples		Singles		Couples		Singles	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
# of children	1.06		0·24	0·92	0.99		0·30	0·84
Age	43·36	41·35	37·45	37·72	43·52	41·50	38·50	39·99
Race: white %	89·72	91·33	86·67	80·00	89·82	91·04	84·89	78·91
Race: black %	4·53	3·68	6·67	12·31	4·13	3·45	7·19	12·24
Years of schooling	14·15	14·27	14·05	14·05	14·21	14·38	14·09	13·92
Been to college %	65·31	68·69	62·22	66·15	65·70	70·90	65·47	65·31
Hours of work	2276·58	1716·42	2325·59	1915·23	2266·93	1741·58	2291·68	1836·51
Earnings	70501·86	37083·09	56672·66	38274·12	67114·87	39305·18	58799·85	31587·42
Hourly wage	31·65	21·70	26·03	20·14	30·28	22·91	27·03	17·32
Observations	1303		135	130	1306		139	147

(PREVIOUS TABLE CONTINUED)

	2004				2006			
	Couples		Singles		Couples		Singles	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
# of children	0.96		0·37	0·95	0.95		0·29	0·98
Age	43·79	41·93	40·14	40·54	44·03	42·25	42·16	41·08
Race: white %	90·15	90·68	87·79	78·85	90·63	90·99	89·91	78·48
Race: black %	4·06	3·46	6·11	12·82	3·82	3·39	6·42	13·92
Years of schooling	14·31	14·50	14·04	13·89	14·33	14·60	13·99	14·02
Been to college %	68·50	73·76	64·89	65·38	68·49	75·99	60·55	67·72
Hours of work	2280·20	1748·17	2329·37	1876·85	2247·03	1714·82	2091·02	1985·60
Earnings	68983·63	39717·41	63084·30	32968·85	70084·23	39904·72	53837·94	35567·90
Hourly wage	30·98	22·98	27·71	17·42	31·48	23·41	26·54	18·70
Observations	1330		131	156	1387		109	158

	2008				2010			
	Couples		Singles		Couples		Singles	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
# of children	0.97		0·22	0·85	0.98		0·20	0·85
Age	43·84	41·99	46·20	42·86	45·14	43·37	48·99	45·02
Race: white %	90·33	91·53	85·71	77·30	89·98	92·18	85·51	75·69
Race: black %	4·02	3·25	8·16	10·81	4·04	3·16	8·70	11·11
Years of schooling	14·36	14·66	13·90	14·17	14·40	14·72	13·77	14·19
Been to college %	69·58	77·21	58·16	68·65	69·86	77·33	56·52	70·83
Hours of work	2133·30	1708·51	2067·77	1825·87	2135·16	1723·74	1962·77	1845·67
Earnings	68921·86	41683·20	60421·64	36851·53	69804·70	42263·06	49002·61	36506·96
Hourly wage	32·81	24·17	28·00	19·98	33·66	24·26	23·90	19·55
Observations	1417		98	185	1138		69	144

Notes: This table presents averages of demographics and labor market outcomes by year (1996-2010), gender (male-female), and marital state (married, single). '# of children' indicates the average number of children. 'Been to college %' indicates the proportion of people with more than 12 years of formal schooling. Monetary amounts (earnings and hourly wages) are expressed in $2010.

Table 3 – Private Consumption by Year and Marital Status

	1998	2000	2002	2004	2006	2008	2010
couples $	11155.9	11561.9	11593.9	11965.5	11683.3	11243	11961.8
single males %	63.9%	65.7%	69.0%	74.7%	65.9%	64.4%	60.8%
single females %	64.3%	64.4%	61.3%	59.8%	59.7%	64.2%	66.3%
Breakdown of Private Consumption of Couples:							
Food at Home	6959.5	6947.4	6935	6920	6779.3	6654.5	7033.3
prepared at home	6781.1	6767.4	6720.4	6731.5	6616.4	6505.7	6904.3
delivered at home	178.3	180	214.5	188.4	162.9	148.9	129
Food Out	2791.2	2942.7	2952.8	3111	2875.3	2615.7	2896
Public Transport	262.2	382.5	304.5	251.8	234.4	205.4	167.9
buses and trains	53.7	66.7	58.4	60.3	54.1	64.5	82.7
all other means	208.5	315.9	246.1	191.4	180.3	140.9	85.2
Medical Services	895.3	934.2	1008.4	1201.3	1319.3	1316.4	1391
nurses-hospitals	262.2	245.6	267.6	333.9	433.4	429.1	497.1
professionals	633.2	688.6	740.8	867.4	886	887.4	893.9
Prescriptions	247.7	355.1	393.2	481.5	474.9	450.9	473.7

Notes: The first row presents the average real private expenditure on goods by couples. The second and third rows present average real private expenditure by single males and females respectively as a *percentage* of the expenditure of couples in the same year. In the subsequent rows I break down private expenditure *of couples* to its elementary components. Food at home comprises food prepared at home and food delivered at home (for recipients and non-recipients of food stamps). Public transport comprises buses and trains and all other means (including taxicabs). Medical services comprise payments to nurses, hospitals, physicians, and other professionals. All monetary figures are expressed in $2010.

imately the same hours as men in couples but they earn less; single women work more than their married counterparts but earn slightly less.

The PSID collects information on numerous elementary expenditure items (see Blundell et al., 2016, for how the PSID compares in that respect to the National Income and Product Accounts). To meet the requirements of the model I categorize and aggregate the elementary items into a private and a public good considering which items may be rival among family members and which may not. There is no easy way to draw a line between private and public and I treat the following categorization as *baseline* – private consumption comprises food at home, food out, transport on public means, medical services excluding health insurance, and prescriptions; public consumption comprises housing services, home insurance, health insurance, utilities including gas, electricity, water and sewer, children's schooling and child care, and vehicle utilization costs including motor fuel.[31]

Tables 3 and 4 present summary statistics for private and public consumption respectively. Across the two tables, the first row presents by year average real expenditure on goods by couples (expressed in $2010). The second and third rows present average real expenditure by single males and females respectively as a *percentage* of the expenditure of couples in the same year. In the subsequent rows I break down expenditure *of couples* to its elementary components. I do not repeat for single men or women as their small sample sizes along with the infrequency

[31]This categorization excludes goods that were added in the PSID after wave 2005 such as clothing and recreational goods.

Table 4 – Public Consumption by Year and Marital Status

	1998	2000	2002	2004	2006	2008	2010
couples $	26243.9	29417.9	30923.2	36532.1	38057.3	34046.4	36820.3
single males %	66.2%	61.9%	60.1%	59.1%	60.6%	65.3%	49.0%
single females %	62.0%	61.8%	55.1%	57.8%	61.1%	65.0%	59.5%
Breakdown of Public Consumption of Couples:							
Housing Services	11742.5	13215.9	14422.9	16939.9	17719.4	15392.3	15424.7
renters	953.6	993.6	965.3	973.5	1102.8	1200.7	1171
owners	10710.5	12155	13397.7	15885.7	16464.5	14098.1	14171.4
Home Insurance	583.9	630.9	685.1	737.5	758	746.4	861
Health Insurance	1341.6	1596.7	1845.2	2075.3	2088.7	2198.4	2392.4
Utilities	3053.4	3393.1	3190.5	5443.9	5705.8	5860.9	6172.1
heating-electricity	2312.6	2602.1	2378.5	2517.3	2622.9	2680	2742.6
water and sewer	408	442.9	440.7	426.6	436	460.5	515.7
Children's Education	2598.6	2917.6	2991	3126.3	3366.8	2745.2	3115.6
Child Care	937.5	941.5	988.1	941	800.2	936.8	1150.9
Auto Vehicles	5986.4	6722.2	6800.5	7268.2	7618.5	6166.5	7703.7
motor fuel	1898.1	2692.2	2415.5	3204.9	3727.1	2759.7	4037.4
insurance	2051.8	1960.7	2438.6	2277.5	1966.7	1674.7	1787.2
repairs	1965.8	2002.9	1869.6	1708.9	1862.2	1669.1	1825.2

Notes: The first row presents the average real public expenditure on goods by couples. The second and third rows present average real public expenditure by single males and females respectively as a *percentage* of the expenditure of couples in the same year. In the subsequent rows I break down public expenditure *of couples* to its elementary components. Housing services comprise services rendered to renters and services rendered to owners. I proxy the latter as 6% of the self-reported house value per year. For those who have been offered public or similar housing I utilize a self-reported estimate of a rent-equivalent. Utilities comprise gas, electricity, water and sewer, and miscellaneous items. Auto vehicles comprise vehicle insurance, motor fuel, repair costs, and parking fees. All monetary figures are expressed in $2010.

Table 5 – Household Wealth by Year and Marital Status

	1998	2000	2002	2004	2006	2008	2010
couples $	330469.6	348666.8	328168.7	390873.9	441436.4	332819	339367.7
single males %	32.3%	44.5%	46.3%	56.9%	44.8%	93.1%	53.8%
single females %	22.2%	24.9%	59.2%	35.8%	36.3%	34.2%	31.4%
Breakdown of Wealth of Couples:							
Home Equity	91892	105776	113968	142933	149007	108541	102634
Other Assets	247732	253485	225693	261094	306048	239540	252372
other real estate	29480	39093	29075	42415	54764	42212	33960
vehicles	24592	24093	24257	23544	22850	20580	21703
farms-businesses	53745	59818	55969	51621	74252	53620	54297
stocks-shares	55653	44376	37055	46719	47198	31978	34606
IRA-annuities	46895	50014	43123	49036	61905	44288	67739
savings accounts	20509	20151	21778	25394	29171	26339	26341
other assets	16858	15939	14437	22364	15909	20522	13725
Other Debts	9155	10594	11492	13153	13619	15263	15638

Notes: The first row presents average net worth of couples by year. The second and third rows present average net worth of single males and females respectively as a *percentage* of the net worth of couples in the same year. In the subsequent rows I break down *couples'* net worth to its elementary components. Net worth comprises home equity (house value net of any mortgages) and value of other assets net of other debts. Other assets comprise other real estate, vehicles, farms and businesses, stocks, shares and other investments, individual retirement accounts and annuities, savings accounts, and miscellaneous assets. Other debts comprise credit card debt, student loans, medical and legal bills, and loans to relatives, but excludes vehicle loans. All monetary figures are expressed in $2010.

of purchases of disaggregated items prohibits such illustration.

The average private expenditure of couples, expressed in $2010, is approximately $11,500 over the period from 1998 to 2010; interestingly this average does not fluctuate over time. The average private expenditure of single men is approximately 65% of the couples' average; single women's is slightly less but still above 60% of the couples' average.

The average public expenditure of couples, expressed in $2010, is $26,244 in 1998; this increases steadily to $38,057 in 2006 but drops sharply in the years of the financial crisis. The average public expenditure of single men is approximately 60%-65% of the couples' average; this fluctuates considerably over time reflecting, possibly, the compositional changes in the age of singles in the sample. The average public expenditure of single women is again slightly lower than single men's and also fluctuates with time.

Expenditure on public goods is consistently the largest part of household expenditure across marital states; it amounts approximately to 72.1% of a married couple's total expenditure, 70.3% of a single male's, and 71.8% of a single female's. Interestingly, for all marital states the share of public expenditure in total expenditure increases, slowly but steadily, over time.

Information on assets is needed for the construction of the 'partial insurance' parameter π_{it}. The PSID collects data on home equity (house value net of mortgages), value of other real estate, vehicles, farms and businesses, shares, stocks and other investments, savings accounts and bond holdings, individual retirement accounts and annuities, and miscellaneous assets. Data on household debt are also collected including credit card debt, student loans, medical

and legal bills, and loans to relatives. I am interested in the household net worth, therefore I aggregate the various asset components into one figure ('wealth') that captures total household assets and home equity net of outstanding debts (excluding vehicle loans).

Table 5 mimics the style of the consumption tables and presents summary statistics for assets and their components (expressed in \$2010). The average net worth of couples is positive at \$330,470 in 1998; this increases steadily until 2006 but drops sharply afterwards. The averages for singles are less reliable as, due to the small sample sizes, they are often impacted by extreme values. Nevertheless, net worth of singles appears to trend upwards with time possibly reflecting the shifting age composition of their samples.

4.2 Pre-Estimated Parameters

Three parameters pertaining to the log-linearization of the intertemporal budget constraint (appendix C) are estimated outside the structural model. These are

$$\begin{aligned}
\xi_{it} &\approx \frac{\mathbb{E}_t\left[\text{Lifetime Expenditure on } K_{it}\right]}{\mathbb{E}_t\left[\text{Lifetime Total Expenditure}_{it}\right]} \\
s_{it} &\approx \frac{\mathbb{E}_t\left[\text{Lifetime Earnings}_{1it}\right]}{\mathbb{E}_t\left[\text{Lifetime Earnings}_{it}\right]} \\
\pi_{it} &\approx \frac{\text{Assets}_{it}}{\text{Assets}_{it} + \mathbb{E}_t\left[\text{Lifetime Earnings}_{it}\right]}
\end{aligned}$$

where 'Lifetime' here spans the period between $t = 0$ and $t = T$. Similar parameters are also defined for singles. Identification of the household structure does not, however, require a log-linearization of the singles' budget constraint (section 3) and, as a result, I do not estimate the singles' counterparts of those parameters.

To deal with the expectations, first notice that

$$\mathbb{E}_t\left[\text{Lifetime Expenditure on } K_{it}\right] = K_{it} + \sum_{\varsigma=1}^{T} \frac{\mathbb{E}_t K_{it+\varsigma}}{(1+r)^{\varsigma}}.$$

I estimate $\mathbb{E}_t K_{it+\varsigma}$ by pooling K_{it} across all periods of time and regressing it on a set of predictable characteristics including each spouse's race, education, year of birth, a quartic polynomial in age, and a rich set of interactions. This regression can be written as $K_{it} = \mathbf{Q}_{it}^{k\prime}\boldsymbol{\beta}^k + \varepsilon_{it}^k$ where the notation is obvious. To obtain the time t-expected household public consumption, say, at $t+2$ ($\varsigma = 2$), I use $\mathbb{E}_t K_{it+2} = \mathbf{Q}_{it+2}^{k\prime}\hat{\boldsymbol{\beta}}^k$. I set the interest r at 2%. I repeat the same for private consumption C_{it}. It follows that $\mathbb{E}_t\left[\text{Lifetime Total Expenditure}_{it}\right] = \mathbb{E}_t\left[\text{Lifetime Expenditure on } K_{it}\right] + \mathbb{E}_t\left[\text{Lifetime Expenditure on } C_{it}\right]$.

As for s_{it}, notice that

$$\mathbb{E}_t\left[\text{Lifetime Earnings}_{jit}\right] = Y_{jit} + \sum_{\varsigma=1}^{T} \frac{\mathbb{E}_t Y_{jit+\varsigma}}{(1+r)^{\varsigma}}.$$

I pool spouse j's earnings over the years and I regress them on his/her race, education, year of birth, a quartic in age, and their interactions. This regression is given by $Y_{jit} = \mathbf{Q}_{jit}^{y\prime}\boldsymbol{\beta}_j^y + \varepsilon_{jit}^y$. Like before, I obtain j's expected earnings, say, at $t+2$ ($\varsigma = 2$) setting $\mathbb{E}_t Y_{jit+2} = \mathbf{Q}_{jit+2}^{y\prime}\hat{\boldsymbol{\beta}}_j^y$.

I repeat the same steps for each spouse's earnings separately; then $\mathbb{E}_t\left[\text{Lifetime Earnings}_{it}\right] = \sum_j^2 \mathbb{E}_t\left[\text{Lifetime Earnings}_{jit}\right]$.

Constructing π_{it} requires knowledge of beginning-of-period assets (section 4.1) and expected human wealth $\mathbb{E}_t\left[\text{Lifetime Earnings}_{it}\right]$. I assume assets at t are prior to any consumption-leisure choices in the same period.

Figure 2 plots average values of the (pre-estimated) parameters ξ_{it}, s_{it}, and π_{it} against the age of the male spouse. The grey dashed lines plot the average values; a 95% confidence interval around them appears in a grey shade. The red solid lines plot a 5-point moving average around the average values in order to ease legibility of the graphs.

According to graph 2a, the share of expected lifetime public in total expenditure drops slightly over the life-cycle, from around .82 at age 25 to .72 by age 65. Graph 2b informs that men's share of expected lifetime earnings is around .6 of combined lifetime earnings in the family over the first 2/3 of the life-cycle. Post age 50, however, this share drops, initially slowly but subsequently faster, to less less than .5, reflecting the presence of a relatively younger spouse and, therefore, different retirement ages. Graph 2c illustrates that young households hold very little assets at the beginning of their life-cycle but π_{it} steadily increases in a convex way. By age 60, assets constitute approximately half of their financial and (remaining) human wealth combined. Note that graphs 2b-2c are very similar quantitatively to the 'partial insurance' graphs in Blundell et al. (2016).

4.3 Estimation Procedure

In this section I describe the steps I take to estimate the structural parameters and I discuss issues pertaining to measurement error in the data and inference. The 'chronology' of the model estimation is as follows. First, I clear wages, earnings, and consumption from the effect of observable characteristics. Subsequently, I estimate the parameters of the wage process. Finally, I estimate the parameters of the structural model conditional on the estimated wage parameters.

I regress $\ln W_{jit}$, $j = \{1, 2\}$, on a set of observable characteristics that include dummies for calendar year, age, education, race, state of residence, and education-year and race-year interactions, and I obtain the residual. I carry out such regression separately for men and women, married and singles. If wages suffer from measurement error, and if such error is classical (which implies, among others, that it is independent of the covariates), the wage residual is

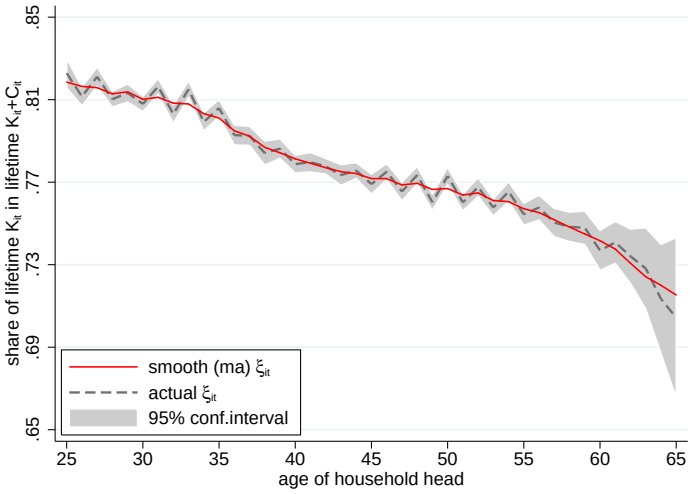
$$\widetilde{w}_{jit} = w_{jit} + e^w_{jit}$$

where w_{jit} is the error-free (economically relevant) residual and e^w_{jit} is the measurement error.

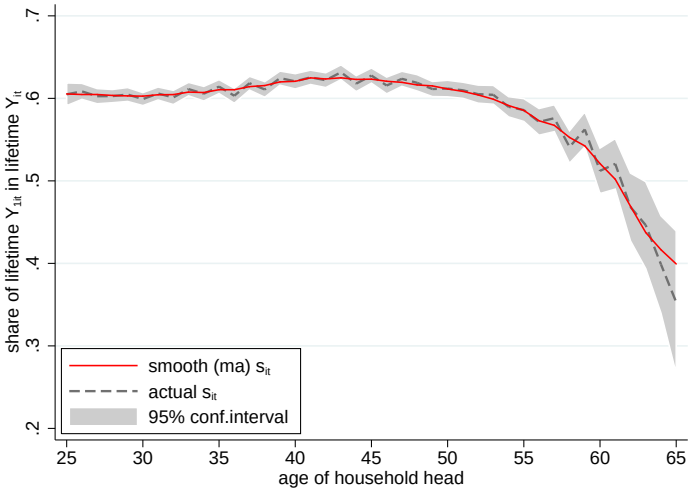
I stack together growth in residual wages $\widetilde{w}_{jit}$ from one period to another, that is $\boldsymbol{\Delta}\widetilde{\mathbf{w}}_{ji} = (\Delta\widetilde{w}_{ji1999}; \Delta\widetilde{w}_{ji2001}; \ldots \Delta\widetilde{w}_{ji2011})'$. Motivated by the theoretical representation (7), I use the second moments of $\boldsymbol{\Delta}\widetilde{\mathbf{w}}_{ji}$ to estimate the parameters of the gender-specific wage process, *i.e.* the second moments of wage shocks. I estimate those separately for married and singles. I use the GMM estimator and I weigh the moments by the identity matrix.

The measurement error presents a challenge as it is not possible to estimate the variance of

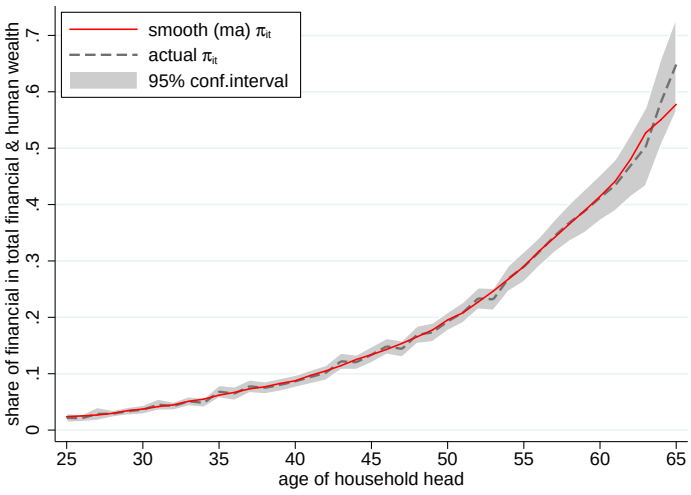
Figure 2 – Pre-Estimated Parameters



(A) ξ_{it}



(B) s_{it}



(C) π_{it}

Notes: These figures plot the average ξ_{it}, s_{it}, and π_{it} against the age of the household head. The red line depicts a 5-point moving average over the series (averages by age of household head), the grey dashed line depicts the actual means, and the grey shade is the 95% confidence interval around the actual mean.

the transitory shock separately from the variance of the error. To get around this, I remove a priori the variability in wages that is attributed to error using a well-known validation study for the PSID. Bound et al. (1994) compare interview responses and official records for a sample of workers in a single large manufacturing firm; they extrapolate their findings appropriately to representative samples and argue that measurement error is responsible for 7.2% to 16.2% of the variability in log hourly wages. I adopt an estimate in the middle of that range (13%; Blundell et al., 2016, use the same number too) and I assume that measurement error is serially uncorrelated as well as uncorrelated across partners.[32]

I regress $\ln Y_{jit}$ on the same set of observables like above, as well as dummies for the number of children, number of household members, employment status at the time of the interview, for additional earners in the household other than the main two (main one for single-member households) and for outside recipients of financial support. I also include the first difference of those variables and employment status-year interactions. I carry out the regressions separately for married and singles; for married I also control for the characteristics of the spouse.

If earnings suffer from (classical) measurement error, the earnings residual is

$$\widetilde{y}_{jit} = y_{jit} + e^y_{jit}$$

where y_{jit} is the error-free residual and e^y_{jit} is the measurement error. I stack together growth in residual earnings $\widetilde{y}_{jit}$ from one period to another and I obtain $\mathbf{\Delta}\widetilde{\mathbf{y}}_{ji}$. Bound et al. (1994) report that roughly 4% of the variability in log earnings is attributed to measurement error; I use this estimate to correct the second moments of $\mathbf{\Delta}\widetilde{\mathbf{y}}_{ji}$. I also remove the error variance from $E[\mathbf{\Delta}\widetilde{\mathbf{w}}_{ji}\mathbf{\Delta}\widetilde{\mathbf{y}}_{ji}]$. Given that log hourly wages are calculated as log annual earnings minus log annual hours

$$E[e^w_{jit}e^y_{jit}] = E[(e^y_{jit} - e^h_{jit})e^y_{jit}] = E[{e^y_{jit}}^2] - E[e^h_{jit}e^y_{jit}]$$

and

$$E[e^h_{jit}e^y_{jit}] = 1/2\left(E[{e^y_{jit}}^2] + E[{e^h_{jit}}^2] - E[{e^w_{jit}}^2]\right)$$

where e^h_{jit} is the measurement error in spouse j's log annual working hours at t. Bound et al. (1994) report that between 17.9% and 26.6% of the variability in log annual hours is due to measurement error; I adopt an estimate in the middle of that range (23%). Again, I assume that the errors are serially uncorrelated and uncorrelated across partners.

Finally, I remove the effect of observables from private and public consumption regressing $\ln C_{it}$ and $\ln K_{it}$ respectively on the same set of covariates that I used in the earnings regressions above. If consumption suffers from (classical) measurement error, the estimated residuals are respectively

$$\widetilde{c}_{it} = c_{it} + e^c_{it}$$

[32] The major caveat using Bound et al. (1994)'s validation study is that their sample of workers comes from years 1982 and 1986, *i.e.* almost two decades before the bulk of the data I am using in this paper. It is unclear how the importance of measurement error has changed over time or after the restructuring of the PSID in 1997. Another caveat comes from using the same estimates to correct female wages too even though the validation study sampled male workers only.

$$\widetilde{k}_{it} = k_{it} + e^k_{it}$$

where c_{it} and k_{it} are the error-free residuals and e^c_{it} and e^k_{it} are measurement errors. I stack together growth in residual consumption from one period to another to obtain $\mathbf{\Delta}\widetilde{\mathbf{c}}_i$ and $\mathbf{\Delta}\widetilde{\mathbf{k}}_i$ (with Δc_{i1999} and Δk_{i1999} both missing as consumption information was first collected in 1999). For singles these variables are all subscripted by $j = \{1, 2\}$ to indicate assignability of consumption. I identify the variance of the measurement error by the first-order auto-covariance of consumption given that the transmission of transitory shocks into consumption is identified by the covariance between consumption and wages.[33]

I estimate the parameters of the structural model by assigning the empirical second moments of wages, earnings and consumption of couples to their theoretical counterparts, *i.e.* to the covariance of (9). For estimating the full version of the structural model (with nonseparable preferences and lack of commitment) I also use the empirical second moments of wages, earnings and consumption of singles.[34] I use GMM and the identity matrix as weights. For inference I adopt the block bootstrap (see for example Section 4 in Horowitz, 2001). I draw 1,000 random samples from the original samples (by marital status) and repeat all stages of the estimation for each bootstrap resample (i.e. first stage regressions for wages, earnings, consumption; GMM estimation of the parameters of the wage process; GMM estimation of the remaining parameters). I account in this way for arbitrary forms of heteroscedasticity across and serial correlation within blocks as well as the fact that I use pre-estimated residuals in the main GMM estimation.

5 Preliminary Results

This section presents the main estimation results, namely the GMM estimates of the parameters of the wage process and of the household structure, including the gender-specific Frisch elasticities, the allocation of private consumption, and the bargaining effects due to lack of commitment.

I estimate the wage process of male and female earners imposing stationarity of the parameters over time. I present two sets of results: panel A of table 6 presents the estimates for married individuals whereas panel B presents the estimates for singles.

The variance of female shocks is effectively unchanged across states of life (across panels A and B); the variance of male shocks is, however, slightly lower among single men as opposed to men who are married. Men exhibit higher transitory variability/instability than women across both states of life possibly reflecting higher job mobility (Gottschalk and Moffitt, 2009). Overall, the relatively higher variance of women's permanent shocks may reflect wider dispersion of returns to skills and labor market experience compared to men.

The covariance of shocks between spouses is always positive, although this is estimated less precisely than the variance; it implies a correlation of $\rho_{v_1 v_2} = 0.15$ for permanent shocks and $\rho_{u_1 u_2} = 0.17$ for transitory shocks. These correlations suggest that, possibly due to positive

[33] I allow the variance of the measurement error in consumption to differ across couples, single men, and single women. See table E.1 in appendix E for estimates of the variance.

[34] I use the empirical variances and first order auto-covariances of the joint distribution of wages, earnings, and consumption over time. Higher-order auto-covariances are almost always insignificantly different from 0.

Table 6 – Estimates of Wage Parameters

	I. Men		II. Women		III. Family			
Panel A: *Married couples*								
Permanent:	$\sigma^2_{v_1}$	0.0343	$\sigma^2_{v_2}$	0.0343	$\sigma_{v_1v_2}$	0.0051	$\rho_{v_1v_2}$	0.1481
		(0.0045)		(0.0032)		(0.0020)		(0.0619)
Transitory:	$\sigma^2_{u_1}$	0.0366	$\sigma^2_{u_2}$	0.0157	$\sigma_{u_1u_2}$	0.0040	$\rho_{u_1u_2}$	0.1660
		(0.0063)		(0.0039)		(0.0023)		(0.1144)
Panel B: *Single individuals*								
Permanent:	$\sigma^2_{v_1}$	0.0258	$\sigma^2_{v_2}$	0.0335	$\sigma_{v_1v_2}$	n/a	$\rho_{v_1v_2}$	n/a
		(0.0081)		(0.0087)		(n/a)		(n/a)
Transitory:	$\sigma^2_{u_1}$	0.0211	$\sigma^2_{u_2}$	0.0173	$\sigma_{u_1u_2}$	n/a	$\rho_{u_1u_2}$	n/a
		(0.0080)		(0.0094)		(n/a)		(n/a)

Notes: The table presents the GMM estimates of the parameters of the wage process under stationarity. Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications. Panel A presents the estimates for married spouses; panel B presents the estimates for single individuals.

assortative mating, the spouses work in similar industries or sectors, or their skills are similar, implying that they are hit by shocks that co-move.

Stationarity is not a restrictive assumption in practice. Although relaxing it renders the model more flexible, in practice the results change very little. The standard errors, however, are inflated due to the smaller sample sizes that are applicable per estimable parameter. These results are available upon request.

Subsequently, I present the estimates for the main set of model parameters. Following the illustration of identification in section 2.4, I present two sets of results. In section 5.1 the public good is additively separable in individual preferences; moreover spouses fully commit to each other for life. To estimate the (applicable) model parameters in this case I rely on wage estimates from panel A in table 6. In section 5.2 preferences are nonseparable and full commitment relaxed; but spousal preferences are assumed common among married and singles. To estimate the model parameters in this case I rely on wage estimates from both panels A and B in table 6.

5.1 Results with Separable Public Good and Full Commitment

The results appear in columns 1 across blocks I-III of table 7. The own-wage labor supply elasticity, at $\eta_{1,h,w} = 0.349$ for men and $\eta_{2,h,w} = 0.992$ for women, is within the range of other studies (and consistent with them, women's elasticity is higher than men's; for a review see Keane, 2011).

The cross-elasticity of labor supply with respect to the price of the private good, at $\eta_{1,h,p^c} = 0.016$ for men and $\eta_{2,h,p^c} = 0.039$ for women, is statistically insignificant but positive, implying that market hours and private consumption are Frisch substitutes at the intensive margin of labor supply (leisure and private consumption are Frisch complements).[35] The 'reciprocal'

[35] Blundell et al. (2016) also find evidence of Frisch complementarity between spousal leisure and consumption. Theirs is a study using the unitary model though.

cross-elasticities, of private consumption with respect to wages, weighed by the average private consumption share of each spouse, are effectively the same between men and women. Note that Frisch symmetry *cannot* be used to infer the consumption share *given* η_{1,h,p^c} and η_{2,h,p^c}, because Frisch symmetry *is* already used to identify η_{1,h,p^c} and η_{2,h,p^c} in the first place.

The *household-level* private consumption substitution elasticity $\widetilde{\eta}_{c,p^c} = \mathbb{E}\left[\varphi_{it-1}\right]\eta_{1,c,p^c} + \mathbb{E}\left[1-\varphi_{it-1}\right]\eta_{2,c,p^c}$ is estimated at -0.331 whereas the *household-level* public consumption substitution elasticity $\widetilde{\eta}_{k,p^k} = \mathbb{E}\left[\eta_{1,k,p^k}\eta_{2,k,p^k}/\left((1-\nu_{it-1})\eta_{1,k,p^k} + \nu_{it-1}\eta_{2,k,p^k}\right)\right]$ at -0.645. Given the average shares of public and private consumption over the period 1999-2011, these numbers imply a total consumption substitution elasticity, *i.e.* a parameter estimated in standard unitary models, approximately equal to -0.55 (similar estimate found in Blundell et al., 2016).

5.2 Results with Nonseparable Public Good and Lack of Commitment

The results appear in columns 2 across blocks I-III of table 7. A number of restrictions are imposed on the model parameters that deviate from (and are stronger than) the set of restrictions, described in section 2.4.2, that suffice for identification of the household structure. Specifically, i) I enforce a separability between the public and the private good, meaning that $\eta_{j,c,p^k} = \eta_{j,k,p^c}$, $j = \{1,2\}$; ii) I impose equal intra-family bargaining power $\mu_{1it} = \mu_{2it} = 1/2$, $\forall i,t$, and $\nu_{it} = 1/2$ ($\forall i,t$; recall that $\nu \in [0,1]$ reflects a mixture of preferences and bargaining power); iii) I impose equal sharing of private consumption between spouses, that is $\varphi_{it} = 1/2$, $\forall i,t$; and iv) I restrict the consumption substitution elasticities to be the same across spouses, that is $\eta_{1,c,p^c} = \eta_{2,c,p^c}$ and $\eta_{1,k,p^k} = \eta_{2,k,p^k}$. These restrictions serve the purpose of obtaining a robust but meaningful first set of estimates and will be relaxed in further versions of the paper.[36]

The own-wage labor supply elasticity, at $\eta_{1,h,w} = 0.339$ for men and $\eta_{2,h,w} = 0.734$ for women, is again within the range of other studies (Keane, 2011). Note that men's elasticity changes very little from when preferences are separable (however, the standard error is almost doubled). The cross-elasticity of hours with respect to the price of the private good, at $\eta_{1,h,p^c} = 0.0004$ for men and $\eta_{2,h,p^c} = 0.013$ for women, is statistically insignificant but, albeit marginally, positive. The cross-elasticity of hours with respect to the price of the public good, at $\eta_{1,h,p^k} = 0.282$ for men and $\eta_{2,h,p^k} = 0.380$ for women, is positive, implying that market hours and public consumption are Frisch substitutes at the intensive margin of labor supply, and, at least for men, statistically significant. Across all prices, and consistent with previous evidence, women's labor supply is more elastic than men's.

The cross-elasticity of private consumption with respect to the wage is negative and statistically insignificant as expected by being a function of the hours elasticity with respect to the price of the private good. I estimate the private consumption substitution elasticity, that is the elasticity of private consumption with respect to its price η_{j,c,p^c}, $j = \{1,2\}$, at -0.421 (and statistically significant).

The cross-elasticity of public consumption with respect to the wage is negative and, at least for men, statistically significant as expected by being a function of the hours elasticity with respect to the price of the public good. The public consumption substitution elasticity, that is

[36] The results presented in this section reflect the specific restrictions currently imposed on the parameters. These results will likely change while I implement the full estimation in future versions of the paper.

Table 7 – Estimates of Frisch Elasticities

	I. Men			II. Women	
	(1) separable	(2) nonseparable		(1) separable	(2) nonseparable
$\eta_{1,h,w}$	0.3493	0.3390	$\eta_{2,h,w}$	0.9923	0.7340
	(0.0629)	(0.1158)		(0.1791)	(0.2963)
η_{1,h,p^c}	0.0162	0.0004	η_{2,h,p^c}	0.0391	0.0134
	(0.0141)	(0.0128)		(0.0394)	(0.0402)
η_{1,h,p^k}		0.2822	η_{2,h,p^k}		0.3804
		(0.1139)			(0.4697)
$\eta_{1,c,w}$		-0.0027	$\eta_{2,c,w}$		-0.0390
		(0.0874)			(0.1164)
$\mathbb{E}[\varphi_1] \times \eta_{1,c,w}$	-0.0550		$\mathbb{E}[\varphi_2] \times \eta_{2,c,w}$	-0.0568	
	(0.0481)			(0.0572)	
η_{1,c,p^c}		-0.4209	η_{2,c,p^c}		-0.4209
		(0.2045)			(0.2045)
η_{1,c,p^k}		0	η_{2,c,p^k}		0
		(n/a)			(n/a)
$\eta_{1,k,w}$		-0.3633	$\eta_{2,k,w}$		-0.2329
		(0.1461)			(0.2885)
η_{1,k,p^c}		0	η_{2,k,p^c}		0
		(n/a)			(n/a)
η_{1,k,p^k}		-1.5386	η_{2,k,p^k}		-1.5386
		(0.8064)			(0.8064)

	III. Family	
	(1) separable	(2) nonseparable
$\widetilde{\eta}_{k,p^k}$	-0.6454	-1.5386
	(0.1098)	(n/a)
$\bar{\eta}_{c,p^c}$	-0.3306	-0.4209
	(0.0763)	(n/a)

Notes: The table presents the GMM estimates of gender-specific Frisch elasticities when the public good is additively separable from private consumption and leisure (columns 1) and when it is nonseparable (columns 2). Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications. The full set of Frisch elasticities are defined in table 1. φ_1 is men's share of private consumption in the household and $\varphi_2 = 1 - \varphi_1$ is women's.

Table 8 – Bargaining Effects

	(1) from v_1	(2) from v_2
on y_1	0.0681	-0.0939
	(0.0692)	(0.0843)
on y_2	-0.1611	0.2223
	(0.1632)	(0.1731)
on c	0.0043	-0.0060
	(0.0173)	(0.0252)
on k	-0.0156	0.0215
	(0.0800)	(0.1098)

Notes: The table presents the GMM estimates of the bargaining effects induced by permanent shocks. Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications. Column 1 presents the effects from men's permanent shocks; column 2 presents the effects from women's permanent shocks.

the elasticity of public consumption with respect to its price η_{j,k,p^k}, $j = \{1, 2\}$, is estimated at -1.539 (and marginally significant).

As a means to compare the results with the estimated parameters when the public good is separable and full commitment imposed (section 5.1), I construct the implied *household-level* consumption substitution elasticities; $\widetilde{\eta}_{c,p^c} = -0.421$ is close to its counterpart in the former case; however $\widetilde{\eta}_{k,p^k} = -1.539$ is nearly 2.5 times larger (in absolute value) than its counterpart in the former case. The presence of bargaining effects, or a poor choice of restrictions (see beginning of this section), may explain this discrepancy.

Overall, men's Frisch elasticities seem to be estimated more precisely than women's. This is an interesting finding that is also confirmed by the main estimation results (again on Frisch elasticities) of Blundell et al. (2016).

Table 8 presents the estimates of the (average) bargaining effects induced by permanent shocks on household outcomes through the dependence of intra-family bargaining power (6) on wages. Column 1 presents the bargaining effects from men's permanent shock v_1 whereas column 2 presents the effects from women's permanent shock v_2.

Two things are worth noting. First, all bargaining effects, as well as the 'surplus extraction' elasticities, are insignificant from a statistical point of view. This suggests that the spouses do not engage in reallocation of intra-family power when permanent shocks hit. This contradicts Mazzocco (2007) and serves as evidence against lack of commitment.

Second, the bargaining effects on earnings have the opposite signs than one would expect. One would expect a *negative* bargaining effect from one's own wage on one's own earnings and a *positive* on their partner's earnings. The idea is the following: as one's wage increases permanently ($v_j > 0$), one should, if anything, gain in bargaining power. Ceteris paribus, this should result in reducing one's market hours in order to enjoy more leisure and, therefore, it would also result in a reduction in one's earnings. The opposite would hold for their partner's

market hours and earnings. As one becomes relatively more powerful due to a positive wage shock, their partner becomes relatively less powerful and, therefore, increases their market hours and reduces their leisure. In practice, however, a positive male permanent shock of 0.1 (10% permanent wage increase) increases his earnings by 0.068×0.1 (0.68% increase) whereas it reduces his wife's earnings by -0.161×0.1 (1.61% decrease). A positive female permanent shock of 0.1 increases her earnings by 0.222×0.1 (2.22% increase) whereas it reduces her husband's earnings by -0.094×0.1 (0.94% decrease).

The bargaining effects on consumption are harder to sign. The estimates suggest that the empowerment of women in the household results in a reduction in private consumption and a boost in public consumption. The opposite holds for men.

The reason why the earnings bargaining effects have opposite signs is attributed to the signs of the 'surplus extraction' elasticities η_{μ,w_j}. These are estimated at $\eta_{\mu,w_1} = -0.239$ $(s.e. = 0.290)$ and $\eta_{\mu,w_2} = 0.330$ $(s.e. = 0.345)$. Note that the reason why I identify these parameters is because I set the Pareto weight to $1/2$. Their signs are opposite than one would expect (they imply that a positive permanent shock makes its recipient less powerful in their household); flipping their signs would mechanically reverse the signs of the bargaining effects. A possible reason why these elasticities end up having the 'wrong' signs is the definition I employ for the consumption substitution elasticities. I define η_{j,c,p^c} and η_{j,k,p^k}, $j = \{1, 2\}$, as negative whereas Blundell et al. (2016) define them as positive; flipping their sign would likely result in flipped signs for η_{μ,w_j} and the bargaining effects too. Another reason may pertain to the presence of cross-sectional heterogeneity in the bargaining effects that may imply that their unconditional first moment is a poor choice of parameter to estimate.

6 Discussion & Conclusions

This paper presents and estimates a life-cycle collective household model with the aim of understanding how shocks to spousal wages transmit into earnings and household consumption. The model allows for a number of important features such as intra-family correlation of wages, wage shocks of various persistence, the distinction of consumption to public and private, asset accumulation, endogenous labor supply, and lack of spousal commitment to future allocations. Specifically, permanent wage shocks enter the spouses' outside options and, therefore, also affect their intra-family bargaining powers.

I obtain analytical expressions for earnings and household consumption applying Taylor approximations to the problem's first order conditions and the lifetime budget constraint. I show how, using those expressions and information on singles of either gender, one can identify the household structure, namely a rich set of spouse-specific Frisch elasticities for labor supply and consumption, the unobserved sharing of private consumption between spouse, as well as the bargaining effects of wages. Importantly, information on assignable or exclusive consumption is not required.

Using PSID data post 1999 I find sizeable Frisch labor supply as well as consumption substitution elasticities. Consistent with the bulk of previous empirical evidence, women's labor supply is considerably more elastic than men's. The public consumption elasticities are up to

two and a half times as large as the private consumption ones. The evidence on the cross-elasticities points to market hours being Frisch substitutes to all types of consumption at the intensive margin of labor supply. The bargaining effects are economically, but not statistically, significant although they appear to have the opposite sign than one would expect.

The paper, at its current state, is subject to a number of limitations. The signs of the bargaining effects remain a puzzle that must be better understood. At the same time, the current estimation results reflect a much stricter set of restrictions than what suffices for identification and an important parameter, the sharing of private consumption between spouses, remains fixed at an arbitrary 1/2 in the cross-section and over time. Subsequently, robustness checks are missing such as checks involving alternative categorizations within private and public consumption, or checks involving a proper treatment of the selection into market work (which, at least for women, may be important). All these are issues that deserve further investigation.

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A Frisch Elasticities

There are 9 Frisch (λ-constant) elasticities for each spouse j in the family (see Table 1 in the main text for verbal descriptions). The analytical expressions for these elasticities are

$$
\begin{aligned}
\eta_{j,h,w} &\equiv \left.\frac{\partial H_j}{\partial W_j}\frac{W_j}{H_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,H_j}}{H_j}(U_{j,KK}U_{j,C_jC_j} - U_{j,KC_j}^2)\\
\eta_{j,h,p^c} &\equiv \left.\frac{\partial H_j}{\partial P^c}\frac{P^c}{H_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,C_j}}{H_j}(U_{j,KC_j}U_{j,KH_j} - U_{j,KK}U_{j,C_jH_j})\\
\eta_{j,h,p^k} &\equiv \left.\frac{\partial H_j}{\partial P^k}\frac{P^k}{H_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,K}}{H_j}(U_{j,KC_j}U_{j,C_jH_j} - U_{j,C_jC_j}U_{j,KH_j})\\
\eta_{j,c,w} &\equiv \left.\frac{\partial C_j}{\partial W_j}\frac{W_j}{C_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,H_j}}{C_j}(U_{j,KH_j}U_{j,KC_j} - U_{j,KK}U_{j,C_jH_j})\\
\eta_{j,c,p^c} &\equiv \left.\frac{\partial C_j}{\partial P^c}\frac{P^c}{C_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,C_j}}{C_j}(U_{j,KK}U_{j,H_jH_j} - U_{j,KH_j}^2)\\
\eta_{j,c,p^k} &\equiv \left.\frac{\partial C_j}{\partial P^k}\frac{P^k}{C_j}\right|_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,K}}{C_j}(U_{j,KH_j}U_{j,C_jH_j} - U_{j,KC_j}U_{j,H_jH_j})\\
\eta_{j,k,w} &\equiv \left.\frac{\partial K}{\partial W_j}\frac{W_j}{K}\right|^{j}_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,H_j}}{K}(U_{j,KC_j}U_{j,C_jH_j} - U_{j,KH_j}U_{j,C_jC_j})\\
\eta_{j,k,p^c} &\equiv \left.\frac{\partial K}{\partial P^c}\frac{P^c}{K}\right|^{j}_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,C_j}}{K}(U_{j,KH_j}U_{j,C_jH_j} - U_{j,KC_j}U_{j,H_jH_j})\\
\eta_{j,k,p^k} &\equiv \left.\frac{\partial K}{\partial P^k}\frac{P^k}{K}\right|^{j}_{\lambda\text{-const.}} &&= D_j^{-1}\frac{U_{j,K}}{K}(U_{j,C_jC_j}U_{j,H_jH_j} - U_{j,C_jH_j}^2)
\end{aligned}
$$

The partial effects are calculated at the individual level (*not* the household level) keeping everything else fixed and λ constant in expectation. D_j is the determinant of the hessian matrix of U_j and is given by

$$D_j = U_{j,KK}\left(U_{j,C_jC_j}U_{j,H_jH_j} - U_{j,C_jH_j}^2\right) - U_{j,KC_j}^2U_{j,H_jH_j} - U_{j,KH_j}^2U_{j,C_jC_j} + 2U_{j,KH_j}U_{j,KC_j}U_{j,C_jH_j}.$$

U_{j,x_j} is the first-order and $U_{j,x_j\chi_j}$ is the second-order partial derivative of U_j with respect to $x_j, \chi_j = \{K, C_j, H_j\}$, $j = \{1, 2\}$. The partial derivatives are i- and t-specific but I suppress such subscripts to ease the notation.

From Phlips (1974, section 2.4) the matrix of substitution effects after a marginal-utility-of-wealth-compensated price change is

$$\begin{pmatrix} -\frac{dH_j}{dW_j} & -\frac{dC_j}{dW_j} & -\frac{dK}{dW_j} \\ \frac{dH_j}{dP^c} & \frac{dC_j}{dP^c} & \frac{dK}{dP^c} \\ \frac{dH_j}{dP^k} & \frac{dC_j}{dP^k} & \frac{dK}{dP^k} \end{pmatrix} = \lambda_j \mathbf{I}_3 \mathbf{H}_j^{-1} \tag{A.1}$$

where λ_j is the Lagrange multiplier on the sequential budget constraint from the budget-constrained maximization of individual j's utility function U_j ('individual problem'). $\mathbf{I}_3$ is a 3×3 identity matrix and $\mathbf{H}_j$ is the hessian matrix of U_j. One can obtain the matrix of substitution effects by totally differentiating the intra-temporal first order conditions of the individual

problem with respect to prices and noting that $\Delta\lambda = 0$ in expectation.[37]

As the right hand side of (A.1) is a 3×3 symmetric matrix (the Hessian is symmetric by Young's theorem and standard regularity assumptions on U_j), it follows that $\frac{dH_j}{dP^c} = -\frac{dC_j}{dW_j}$, $\frac{dH_j}{dP^k} = -\frac{dK}{dW_j}$, and $\frac{dC_j}{dP^k} = \frac{dK}{dP^c}$. Simple manipulations yield the restrictions on the Frisch elasticities that are used for identification of the household structure (sections 2.4.1-2.4.2).

B Approximations to First Order Conditions

In this appendix I show how I approximate the first order conditions of the household problem, given by (8). For convenience suppose that $U_j(K_{it}, C_{jit}, 1 - H_{jit}; \mathbf{z}_{jit}) = U_j(\widetilde{K}_{it}, \widetilde{C}_{jit}, 1 - \widetilde{H}_{jit})$ where $\widetilde{K}_{it} = K_{it} \exp(-\sum_j \mathbf{z}_{jit}^{K\prime} \boldsymbol{\zeta}_{jt}^{K})$, $\widetilde{C}_{jit} = C_{jit} \exp(-\mathbf{z}_{jit}^{C\prime} \boldsymbol{\zeta}_{jt}^{C})$, and $\widetilde{H}_{jit} = H_{jit} \exp(-\mathbf{z}_{jit}^{H\prime} \boldsymbol{\zeta}_{jt}^{H})$. $\mathbf{z}_{jit}^{K}$, $\mathbf{z}_{jit}^{C}$, and $\mathbf{z}_{jit}^{H}$ are spouse-specific covariates, such as race, age, or education.

Consider the first order condition for H_{1it}; applying logs and taking a first difference in time yields

$$\Delta \ln \left(-U_{1,H_1}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) \right) = \Delta \ln \lambda_{it} + \Delta \ln W_{1it} - \Delta \ln \mu_{1it}.$$

A first order Taylor approximation to $\ln(-U_{1,H_1}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}))$ about $\widetilde{K}_{it-1}$, $\widetilde{C}_{1it-1}$, $\widetilde{H}_{1it-1}$ yields

$$\Delta \ln \left(-U_{1,H_1}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) \right) \approx \frac{U_{1,H_1K}}{U_{1,H_1}} \Delta \widetilde{K}_{it} + \frac{U_{1,H_1C_1}}{U_{1,H_1}} \Delta \widetilde{C}_{1it} + \frac{U_{1,H_1H_1}}{U_{1,H_1}} \Delta \widetilde{H}_{1it}. \tag{B.1}$$

All partial derivatives in (B.1) are evaluated at $\widetilde{K}_{it-1}$, $\widetilde{C}_{1it-1}$, and $\widetilde{H}_{1it-1}$.

The first order conditions for H_{2it}, C_{1it}, and C_{2it} are all approximated in a similar way. All four of them together are

$$\frac{U_{1,H_1K}}{U_{1,H_1}} \Delta \widetilde{K}_{it} + \frac{U_{1,H_1C_1}}{U_{1,H_1}} \Delta \widetilde{C}_{1it} + \frac{U_{1,H_1H_1}}{U_{1,H_1}} \Delta \widetilde{H}_{1it} \approx \Delta \ln \lambda_{it} + \Delta \ln W_{1it} - \Delta \ln \mu_{1it} \tag{B.2}$$

$$\frac{U_{2,H_2K}}{U_{2,H_2}} \Delta \widetilde{K}_{it} + \frac{U_{2,H_2C_2}}{U_{2,H_2}} \Delta \widetilde{C}_{2it} + \frac{U_{2,H_2H_2}}{U_{2,H_2}} \Delta \widetilde{H}_{2it} \approx \Delta \ln \lambda_{it} + \Delta \ln W_{2it} - \Delta \ln \mu_{2it} \tag{B.3}$$

$$\frac{U_{1,C_1K}}{U_{1,C_1}} \Delta \widetilde{K}_{it} + \frac{U_{1,C_1C_1}}{U_{1,C_1}} \Delta \widetilde{C}_{1it} + \frac{U_{1,C_1H_1}}{U_{1,C_1}} \Delta \widetilde{H}_{1it} \approx \Delta \ln \lambda_{it} + \Delta \ln P_t - \Delta \ln \mu_{1it} \tag{B.4}$$

$$\frac{U_{2,C_2K}}{U_{2,C_2}} \Delta \widetilde{K}_{it} + \frac{U_{2,C_2C_2}}{U_{2,C_2}} \Delta \widetilde{C}_{2it} + \frac{U_{2,C_2H_2}}{U_{2,C_2}} \Delta \widetilde{H}_{2it} \approx \Delta \ln \lambda_{it} + \Delta \ln P_t - \Delta \ln \mu_{2it}. \tag{B.5}$$

As I do not observe cross-sectional variation in P_t, I assume $\Delta \ln P_t = 0$ (or equivalently, aggregate shocks are captured by conditioning year dummies).

The approximation to the first order condition for K_{it} is trickier as it involves both partners' marginal utilities. Applying logs and taking a first difference in time yields

$$\Delta \ln \left(\mu_{1it} U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) + \mu_{2it} U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it}) \right) = \Delta \ln \lambda_{it}.$$

I approximate $\ln \left(\mu_{1it} U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) + \mu_{2it} U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it}) \right)$ about $\widetilde{K}_{it-1}$, $\widetilde{C}_{jit-1}$, $\widetilde{H}_{jit-1}$,

[37] The first order conditions of the individual problem are $U_{j,K} = \lambda_j P^k$, $U_{j,C_j} = \lambda_j P^c$, $U_{j,H_j} = -\lambda_j W_j$, and the Euler equation.

$j = \{1, 2\}$, and I get

$$\begin{aligned}
&\Delta \ln \left(\mu_{1it} U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) + \mu_{2it} U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it}) \right) \\
&\quad \approx \left(\mu_{1it-1} U_{1,K} + \mu_{2it-1} U_{2,K} \right)^{-1} \left(\Delta\big(\mu_{1it} U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it})\big) + \Delta\big(\mu_{2it} U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it})\big) \right) \\
&\quad \approx \nu_{it-1} \left(\mu_{1it-1} U_{1,K} \right)^{-1} \Delta\big(\mu_{1it} U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it})\big) \\
&\qquad + (1 - \nu_{it-1}) \left(\mu_{2it-1} U_{2,K} \right)^{-1} \Delta\big(\mu_{2it} U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it})\big) \\
&\quad \approx \nu_{it-1} \left(\Delta \ln \mu_{1it} + \Delta \ln U_{1,K}(\widetilde{K}_{it}, \widetilde{C}_{1it}, \widetilde{H}_{1it}) \right) \\
&\qquad + (1 - \nu_{it-1}) \left(\Delta \ln \mu_{2it} + \Delta \ln U_{2,K}(\widetilde{K}_{it}, \widetilde{C}_{2it}, \widetilde{H}_{2it}) \right)
\end{aligned}$$

where $\nu_{it-1} = \mu_{1it-1} U_{1,K} (\mu_{1it-1} U_{1,K} + \mu_{2it-1} U_{2,K})^{-1}$ is a mixture of preferences (marginal utilities of the public good) and bargaining power. Again, all partial derivatives are evaluated at $t-1$ values of the relevant variables. Expanding $\ln U_{j,K}(\widetilde{K}_{it}, \widetilde{C}_{jit}, \widetilde{H}_{jit})$, $j = \{1, 2\}$, follows the same logic as in (B.1). Combining the results I get

$$\begin{aligned}
&\left(\nu_{it-1} \frac{U_{1,KK}}{U_{1,K}} + (1 - \nu_{it-1}) \frac{U_{2,KK}}{U_{2,K}} \right) \Delta \widetilde{K}_{it} + \\
\nu_{it-1} \left(\frac{U_{1,KC_1}}{U_{1,K}} \Delta \widetilde{C}_{1it} + \frac{U_{1,KH_1}}{U_{1,K}} \Delta \widetilde{H}_{1it} \right) &+ (1 - \nu_{it-1}) \left(\frac{U_{2,KC_2}}{U_{2,K}} \Delta \widetilde{C}_{2it} + \frac{U_{2,KH_2}}{U_{2,K}} \Delta \widetilde{H}_{2it} \right) \approx \\
&\Delta \ln \lambda_{it} - \nu_{it-1} \Delta \ln \mu_{1it} - (1 - \nu_{it-1}) \Delta \ln \mu_{2it}.
\end{aligned} \tag{B.6}$$

I solve the system of equations (B.2)-(B.6) for $\Delta \widetilde{K}_{it}$, $\Delta \widetilde{C}_{jit}$, and $\Delta \widetilde{H}_{jit}$ ($j = \{1, 2\}$, 5 equations in 5 choice variables) and I get approximate analytical expressions for the growth of labor supply and consumption as functions of the growth rates of wages, bargaining power, and the marginal utility of wealth. Given that $\mu_{1it} + \mu_{2it} = 1$ (see section 2.1.1), I approximate $\Delta \ln \mu_{2it} \approx -\widetilde{\mu}_{it-1} \Delta \ln \mu_{1it}$ where $\widetilde{\mu}_{it} = \frac{\mu_{1it}}{\mu_{2it}}$, so the aforementioned analytical expressions become

$$\begin{pmatrix} \Delta \widetilde{K}_{it} \\ \Delta \widetilde{C}_{1it} \\ \Delta \widetilde{C}_{2it} \\ \Delta \widetilde{H}_{1it} \\ \Delta \widetilde{H}_{2it} \end{pmatrix} \approx \mathbf{M}_{it} \begin{pmatrix} \Delta \ln W_{1it} \\ \Delta \ln W_{2it} \\ \Delta \ln \mu_{1it} \\ \Delta \ln \lambda_{it} \end{pmatrix} \tag{B.7}$$

where $\mathbf{M}_{it}$ is a 5×4 matrix of loading factors.[38]

Equation (B.7) is still not very useful empirically because it involves the unobserved growth in the marginal utility of wealth $\Delta \ln \lambda_{it}$. To help characterize this object I apply a second order Taylor approximation to the Euler equation in (8). Let $\exp(\rho) = \frac{1}{\beta(1+r)}$ for an appropriate ρ. I approximate the exponential function evaluated at λ_{it+1} about $\ln \lambda_{it} + \rho$ and I get

$$\begin{aligned}
\exp(\ln \lambda_{it+1}) &\approx \exp(\ln \lambda_{it} + \rho) + \exp(\ln \lambda_{it} + \rho)(\Delta \ln \lambda_{it+1} - \rho) + \exp(\ln \lambda_{it} + \rho) \frac{1}{2} (\Delta \ln \lambda_{it+1} - \rho)^2 \\
&= \lambda_{it} \exp(\rho) [1 + \Delta \ln \lambda_{it+1} - \rho + \frac{1}{2} (\Delta \ln \lambda_{it+1} - \rho)^2].
\end{aligned}$$

[38] As matrix $\mathbf{M}_{it}$ constitutes an intermediate output towards the solution of the household problem, I do not present its elements in detail but I can make them available upon request.

Taking expectations at time t and noting that $\lambda_{it}\exp(\rho) = \mathbb{E}_t\lambda_{it+1}$ (the Euler equation) yields $\mathbb{E}_t\Delta\ln\lambda_{it+1} \approx \rho - \frac{1}{2}\mathbb{E}_t(\Delta\ln\lambda_{it+1} - \rho)^2$ which in turn can be written as

$$\Delta\ln\lambda_{it+1} \approx \omega_{it+1} + \epsilon_{it+1} \tag{B.8}$$

with $\omega_{it+1} = \rho - \frac{1}{2}\mathbb{E}_t(\Delta\ln\lambda_{it+1} - \rho)^2$ and ϵ_{it+1} an expectations error with $\mathbb{E}_t\epsilon_{it+1} = 0$. A log-linearization of the intertemporal budget constraint, presented in appendix C, will help relate the components of $\Delta\ln\lambda_{it+1}$ to spousal wage shocks.

Using equations (10) in the main text and (B.8) above, together with the assumption that transitory wage shocks do not shift intra-family bargaining power, I write equation (B.7) as

$$\begin{pmatrix} \Delta\widetilde{K}_{it} \\ \Delta\widetilde{C}_{1it} \\ \Delta\widetilde{C}_{2it} \\ \Delta\widetilde{Y}_{1it} \\ \Delta\widetilde{Y}_{2it} \end{pmatrix} \approx \begin{pmatrix} \alpha_{k,w_1} + \beta_{k,w_1} & \alpha_{k,w_2} + \beta_{k,w_2} & \alpha_{k,w_1} & \alpha_{k,w_2} & \alpha_{k,\lambda} \\ \alpha_{c_1,w_1} + \beta_{c_1,w_1} & \alpha_{c_1,w_2} + \beta_{c_1,w_2} & \alpha_{c_1,w_1} & \alpha_{c_1,w_2} & \alpha_{c_1,\lambda} \\ \alpha_{c_2,w_1} + \beta_{c_2,w_1} & \alpha_{c_2,w_2} + \beta_{c_2,w_2} & \alpha_{c_2,w_1} & \alpha_{c_2,w_2} & \alpha_{c_2,\lambda} \\ \alpha_{y_1,w_1} + \beta_{y_1,w_1} & \alpha_{y_1,w_2} + \beta_{y_1,w_2} & \alpha_{y_1,w_1} & \alpha_{y_1,w_2} & \alpha_{y_1,\lambda} \\ \alpha_{y_2,w_1} + \beta_{y_2,w_1} & \alpha_{y_2,w_2} + \beta_{y_2,w_2} & \alpha_{y_2,w_1} & \alpha_{y_2,w_2} & \alpha_{y_2,\lambda} \end{pmatrix} \begin{pmatrix} v_{1it} \\ v_{2it} \\ \Delta u_{1it} \\ \Delta u_{2it} \\ \omega_{it} + \epsilon_{it} \end{pmatrix} \tag{B.9}$$

where I replace hours of market work by earnings using the identity $Y_{jit} = W_{jit}H_{jit}$, $j = \{1, 2\}$. To obtain (B.9) I have assumed away variation in any distribution factor in (10). The transmission parameters β above, which reflect the difference between the impact of permanent and transitory wage shocks on household outcomes (conditional on $\Delta\ln\lambda_{it}$), capture the *bargaining* effects of permanent wages shocks, *i.e.* the effects through shifting intra-family bargaining power. The transmission parameters are reported analytically in appendix D.

C Approximation to Intertemporal Budget Constraint

Let $F(\boldsymbol{\psi}) = \ln\sum_{s=0}^{J}\exp\psi_s$ with $\boldsymbol{\psi} = (\psi_0, \psi_1, \ldots, \psi_J)'$; a first order Taylor approximation of $F(\boldsymbol{\psi})$ around $\boldsymbol{\psi^0}$ yields

$$F(\boldsymbol{\psi}) \approx \ln\sum_{s=0}^{J}\exp\psi_s^0 + \sum_{s=0}^{J}\frac{\exp\psi_s^0}{\sum_{s=0}^{S}\exp\psi_s^0}\left(\psi_s - \psi_s^0\right).$$

Consider the left hand side of the intertemporal budget constraint implied by (5); that is given by $A_{i0} + \mathbb{E}_0\sum_{t=0}^{T}\frac{W_{1it}H_{1it}}{(1+r)^t} + \mathbb{E}_0\sum_{t=0}^{T}\frac{W_{2it}H_{2it}}{(1+r)^t}$. Making this look similar to $F(\boldsymbol{\psi})$ above, I define

$$F^{LH}(\boldsymbol{\psi}) = \ln\left[\exp(\ln A_{i0}) + \sum_{t=0}^{T}\exp\left(\ln\frac{W_{1it}H_{1it}}{(1+r)^t}\right) + \sum_{t=0}^{T}\exp\left(\ln\frac{W_{2it}H_{2it}}{(1+r)^t}\right)\right]$$

where, in this case, $J = 2T + 2$ and

$$\psi_s = \begin{cases} \ln A_{is} & s = 0 \\ \ln W_{1is-1}H_{1is-1} - (s-1)\ln(1+r) & s = 1, \ldots, T+1 \\ \ln W_{2is-(T+2)}H_{2is-(T+2)} - (s-(T+2))\ln(1+r) & s = T+2, \ldots, 2T+2. \end{cases}$$

Also define

$$\psi_s^0 = \begin{cases} \mathbb{E}_{-1} \ln A_{is} & s = 0 \\ \mathbb{E}_{-1} \ln W_{1is-1} H_{1is-1} - (s-1)\ln(1+r) & s = 1, \ldots, T+1 \\ \mathbb{E}_{-1} \ln W_{2is-(T+2)} H_{2is-(T+2)} - (s-(T+2))\ln(1+r) & s = T+2, \ldots, 2T+2 \end{cases}$$

$$D_{i0} = \exp(\mathbb{E}_{-1} \ln A_{i0}) + \sum_{k=0}^{T} \exp\left(\mathbb{E}_{-1} \ln \frac{W_{1ik} H_{1ik}}{(1+r)^k}\right) + \sum_{k=0}^{T} \exp\left(\mathbb{E}_{-1} \ln \frac{W_{2ik} H_{2ik}}{(1+r)^k}\right)$$

$$\pi_{i0} = \frac{\exp(\mathbb{E}_{-1} \ln A_{i0})}{D_{i0}}$$

$$s_{i0} = \frac{\sum_{k=0}^{T} \exp(\mathbb{E}_{-1} \ln W_{1ik} H_{1ik} - k \ln(1+r))}{D_{i0} - \exp(\mathbb{E}_{-1} \ln A_{i0})}$$

$$\theta_{jit} = \frac{\exp(\mathbb{E}_{-1} \ln W_{jit} H_{jit} - t \ln(1+r))}{\sum_{k=0}^{T} \exp(\mathbb{E}_{-1} \ln W_{jik} H_{jik} - k \ln(1+r))}$$

where $\mathbb{E}_{-1}$ defines expectations at time $t = -1$ (while the intertemporal budget constraint covers periods 0 through T).

Parameter π_{i0} is approximately equal to the $(t = -1)$-expected ratio of financial wealth at $t = 0$ over total human and financial wealth in the household over the period between $t = 0$ and $t = T$.[39] s_{i0} is the $(t = -1)$-expected ratio of the male spouse's lifetime human wealth over total lifetime human wealth in the household. θ_{jit}, $j = \{1, 2\}$, is the $(t = -1)$-expected ratio of spouse j's earnings at t over the same person's lifetime human wealth.

Expanding the left hand side of the intertemporal budget constraint around $\boldsymbol{\psi^0}$ and taking expectations conditional on an information set I, where such information set includes information known at $t = -1$, I get

$$\begin{aligned} \mathbb{E}_I F^{LH}(\boldsymbol{\psi}) \approx \mathbb{E}_I F^{LH}(\boldsymbol{\psi^0}) &+ \frac{\exp(\mathbb{E}_{-1} \ln A_{i0})}{D_{i0}} (\mathbb{E}_I - \mathbb{E}_{-1}) \ln A_{i0} \\ &+ \sum_{t=0}^{T} \frac{\exp(\mathbb{E}_{-1} \ln W_{1it} H_{1it} - t \ln(1+r))}{D_{i0}} (\mathbb{E}_I - \mathbb{E}_{-1}) \ln W_{1it} H_{1it} \\ &+ \sum_{t=0}^{T} \frac{\exp(\mathbb{E}_{-1} \ln W_{2it} H_{2it} - t \ln(1+r))}{D_{i0}} (\mathbb{E}_I - \mathbb{E}_{-1}) \ln W_{2it} H_{2it} \end{aligned}$$

$$\begin{aligned} \mathbb{E}_I F^{LH}(\boldsymbol{\psi}) \approx \mathbb{E}_I F^{LH}(\boldsymbol{\psi^0}) &+ \pi_{i0} (\mathbb{E}_I - \mathbb{E}_{-1}) \ln A_{i0} \\ &+ (1 - \pi_{i0}) s_{i0} \sum_{t=0}^{T} \theta_{1it} (\mathbb{E}_I - \mathbb{E}_{-1})(\Delta \ln Y_{1it} + \ln Y_{1it-1}) \\ &+ (1 - \pi_{i0})(1 - s_{i0}) \sum_{t=0}^{T} \theta_{2it} (\mathbb{E}_I - \mathbb{E}_{-1})(\Delta \ln Y_{2it} + \ln Y_{2it-1}), \end{aligned}$$

where $(\mathbb{E}_I - \mathbb{E}_{-1})\chi = \mathbb{E}_I(\chi) - \mathbb{E}_{-1}(\chi)$ for a generic variable χ.

Replacing $\Delta \ln Y_{jit}$ by its analytical expression in (B.9) (note that $(\mathbb{E}_I - \mathbb{E}_{-1})\Delta \ln Y_{jit} = (\mathbb{E}_I - \mathbb{E}_{-1})\Delta \widetilde{Y}_{jit}$ because changes in the observable characteristics are in the spouses' information sets and therefore canceled out by the first difference $\mathbb{E}_I - \mathbb{E}_{-1}$), assuming that each spouse's

[39] By 'lifetime human wealth' I refer to expected lifetime earnings over $t = 0, \ldots, T$.

current earnings are negligible compared to their expected lifetime earnings,[40] placing ω_{it} in the spouses' information sets, and taking a first difference of $\mathbb{E}_I F^{LH}(\boldsymbol{\psi})$ across $I : t = 0$ and $I : t = -1$, I get

$$\begin{aligned}(\mathbb{E}_0 - \mathbb{E}_{-1})F^{LH}(\boldsymbol{\psi}) \approx{}& (1-\pi_{i0})s_{i0}\big((\alpha_{y_1,w_1}+\beta_{y_1,w_1})v_{1i0} + (\alpha_{y_1,w_2}+\beta_{y_1,w_2})v_{2i0} + \alpha_{y_1,\lambda}\epsilon_{i0}\big)\\ &+ (1-\pi_{i0})(1-s_{i0})\big((\alpha_{y_2,w_1}+\beta_{y_2,w_1})v_{1i0} + (\alpha_{y_2,w_2}+\beta_{y_2,w_2})v_{2i0} + \alpha_{y_2,\lambda}\epsilon_{i0}\big).\end{aligned}$$

Similarly for the right hand side of the intertemporal budget constraint, define

$$F^{RH}(\boldsymbol{\psi}) = \ln\left[\sum_{t=0}^{T}\exp\left(\ln\frac{K_{it}}{(1+r)^t}\right) + \sum_{t=0}^{T}\exp\left(\ln\frac{P_tC_{it}}{(1+r)^t}\right)\right]$$

$$\psi_s = \begin{cases} \ln K_{is} - s\ln(1+r) & s = 0,\dots,T \\ \ln P_{s-(T+1)}C_{is-(T+1)} - (s-(T+1))\ln(1+r) & s = T+1,\dots,2T+1. \end{cases}$$

Also define

$$\xi_{it} = \frac{\sum_{k=0}^{T}\exp(\mathbb{E}_{-1}\ln\frac{K_{ik}}{(1+r)^k})}{\sum_{k=0}^{T}\exp(\mathbb{E}_{-1}\ln\frac{K_{ik}}{(1+r)^k}) + \sum_{k=0}^{T}\exp(\mathbb{E}_{-1}\ln\frac{P_kC_{ik}}{(1+r)^k})}$$

as the $(t=-1)$-expected share of lifetime family expenditure on the public good over total lifetime family expenditure on all goods between $t=0$ and $t=T$.

I follow the same procedure as for the left-hand side and I get

$$\begin{aligned}(\mathbb{E}_0 - \mathbb{E}_{-1})F^{RH}(\boldsymbol{\psi}) \approx{}& \xi_{i0}\big((\alpha_{k,w_1}+\beta_{k,w_1})v_{1i0} + (\alpha_{k,w_2}+\beta_{k,w_2})v_{2i0} + \alpha_{k,\lambda}\epsilon_{i0}\big)\\ &+ (1-\xi_{i0})\varphi_{i,-1}\big((\alpha_{c_1,w_1}+\beta_{c_1,w_1})v_{1i0} + (\alpha_{c_1,w_2}+\beta_{c_1,w_2})v_{2i0} + \alpha_{c_1,\lambda}\epsilon_{i0}\big)\\ &+ (1-\xi_{i0})(1-\varphi_{i,-1})\big((\alpha_{c_2,w_1}+\beta_{c_2,w_1})v_{1i0} + (\alpha_{c_2,w_2}+\beta_{c_2,w_2})v_{2i0} + \alpha_{c_2,\lambda}\epsilon_{i0}\big).\end{aligned}$$

Here $\varphi_{it} = \frac{C_{1it}}{C_{it}}$ is the male spouse's share of private consumption at t. φ_{it} enters the result because $\Delta\ln C_{it} \approx \varphi_{it-1}\Delta\ln C_{1it} + (1-\varphi_{it-1})\Delta\ln C_{2it}$.

Noting that the budget constraint must balance, I bring the two sides together and solve for ϵ_{i0} to get

$$\epsilon_{i0} \approx \ell_{i0}^{w_1}v_{1i0} + \ell_{i0}^{w_2}v_{2i0} \tag{C.1}$$

where

$$\begin{aligned}\ell_{i0}^{w_1} ={}& (1/\ell_{i0}^{\lambda})\Big(\xi_{i0}(\alpha_{k,w_1}+\beta_{k,w_1}) + (1-\xi_{i0})\big(\varphi_{i,-1}(\alpha_{c_1,w_1}+\beta_{c_1,w_1}) + (1-\varphi_{i,-1})(\alpha_{c_2,w_1}+\beta_{c_2,w_1})\big)\\ &- (1-\pi_{i0})s_{i0}(\alpha_{y_1,w_1}+\beta_{y_1,w_1}) - (1-\pi_{i0})(1-s_{i0})(\alpha_{y_2,w_1}+\beta_{y_2,w_1})\Big)\\ \ell_{i0}^{w_2} ={}& (1/\ell_{i0}^{\lambda})\Big(\xi_{i0}(\alpha_{k,w_2}+\beta_{k,w_2}) + (1-\xi_{i0})\big(\varphi_{i,-1}(\alpha_{c_1,w_2}+\beta_{c_1,w_2}) + (1-\varphi_{i,-1})(\alpha_{c_2,w_2}+\beta_{c_2,w_2})\big)\\ &- (1-\pi_{i0})s_{i0}(\alpha_{y_1,w_2}+\beta_{y_1,w_2}) - (1-\pi_{i0})(1-s_{i0})(\alpha_{y_2,w_2}+\beta_{y_2,w_2})\Big)\\ \ell_{i0}^{\lambda} ={}& (1-\pi_{i0})(s_{i0}\alpha_{y_1,\lambda} + (1-s_{i0})\alpha_{y_2,\lambda}) - \xi_{i0}\alpha_{k,\lambda} - (1-\xi_{i0})(\varphi_{i,-1}\alpha_{c_1,\lambda} + (1-\varphi_{i,-1})\alpha_{c_2,\lambda}).\end{aligned}$$

For a generic period t the mapping between ϵ_{it} and the permanent shocks v_{1it} and v_{2it} looks alike. One has to follow the same steps, the only difference being that the budget constraint

[40] This implies that $\theta_{jit} \approx 0$, $j = \{1,2\}$, and transitory shocks to current earnings do not shift the intertemporal budget constraint.

must start counting at t (rather than 0) and the difference in expectations must be $\mathbb{E}_t - \mathbb{E}_{t-1}$.

Similar arguments can be used to show that an approximation to single j's intertemporal budget constraint, the sequential version of which appears in (15), results in a mapping from permanent shock v_{jis} to the innovation to the single's marginal utility of wealth ϵ_{jis}, given by $\epsilon_{jis} = \ell^s_{jit} v_{jis}$. Here

$$\ell^s_{jit} = \frac{\xi_{jis}\eta_{j,k,w} + (1-\xi_{jis})\eta_{j,c,w} - (1-\pi_{jis})(1+\eta_{j,h,w})}{(1-\pi_{jis})\sum \eta_{j,h} - \xi_{jis}\sum \eta_{j,k} - (1-\xi_{jis})\sum \eta_{j,c}} \tag{C.2}$$

and the notation is as follows: $\sum \eta_{j,h} = \eta_{j,h,w} + \eta_{j,h,p^c} + \eta_{j,h,p^k}$; $\sum \eta_{j,c} = \eta_{j,c,w} + \eta_{j,c,p^c} + \eta_{j,c,p^k}$; $\sum \eta_{j,k} = \eta_{j,k,w} + \eta_{j,k,p^c} + \eta_{j,k,p^k}$; ξ_{jis} is j's ratio of public to total expected expenditure as single; $\pi_{jis} \approx \text{Assets}_{jis}/(\text{Assets}_{jis} + \text{Earnings as Single}_{jis})$ is j's financial wealth relative to his/her total financial and human wealth as single.

D Transmission Parameters

In this appendix I report the transmission parameters of wage shocks into household outcomes, namely the elements of matrix $\mathbf{T}_{it}$ in (9). Less compactly, (9) can be written as

$$\begin{pmatrix} \Delta k_{it} \\ \Delta c_{it} \\ \Delta y_{1it} \\ \Delta y_{2it} \end{pmatrix} \approx \begin{pmatrix} \alpha_{k,w_1} + \beta_{k,w_1} + \gamma_{k,w_1} & \alpha_{k,w_2} + \beta_{k,w_2} + \gamma_{k,w_2} & \alpha_{k,w_1} & \alpha_{k,w_2} \\ \alpha_{c,w_1} + \beta_{c,w_1} + \gamma_{c,w_1} & \alpha_{c,w_2} + \beta_{c,w_2} + \gamma_{c,w_2} & \alpha_{c,w_1} & \alpha_{c,w_2} \\ \alpha_{y_1,w_1} + \beta_{y_1,w_1} + \gamma_{y_1,w_1} & \alpha_{y_1,w_2} + \beta_{y_1,w_2} + \gamma_{y_1,w_2} & \alpha_{y_1,w_1} & \alpha_{y_1,w_2} \\ \alpha_{y_2,w_1} + \beta_{y_2,w_1} + \gamma_{y_2,w_1} & \alpha_{y_2,w_2} + \beta_{y_2,w_2} + \gamma_{y_2,w_2} & \alpha_{y_2,w_1} & \alpha_{y_2,w_2} \end{pmatrix} \begin{pmatrix} v_{1it} \\ v_{2it} \\ \Delta u_{1it} \\ \Delta u_{2it} \end{pmatrix} \tag{D.1}$$

where $\mathbf{T}_{it}$ is the 4×4 matrix on the right-hand side.

I obtain (D.1) directly from (B.9) after replacing ϵ_{it} by (C.1) ($\omega_{it} \equiv \omega_t$ is absorbed by the conditioning observables) and collapsing individual private consumption into *total* private consumption using (11). The left-hand side vectors of outcome variables in (B.9) and (D.1) are equivalent because $\Delta k_{it} = \Delta \widetilde{K}_{it} = \Delta \ln K_{it} - \sum_j \Delta(\mathbf{z}^{K\prime}_{jit} \boldsymbol{\zeta}^K_{jt}) - \sum_j \Delta(\alpha_{k,w_j} \mathbf{x}^{W\prime}_{jit} \boldsymbol{\zeta}^W_{jt})$ (and similarly for the other variables).

Permanent and transitory wage shocks induce static effects on outcomes; these effects are captured by the α's. The static effects summarize the standard substitution effects that a price change (in this case a wage change) induces through tilting the *static* budget constraint. In addition, permanent shocks induce bargaining effects through their impact on intra-family bargaining power; these effects are captured by the β's. Finally, permanent shocks also induce wealth/income effects through shifting the *intertemporal*, and therefore also the *static*, budget constraint and impacting on the revisions to the marginal utility of wealth λ; such effects are captured by the γ's.

Static effects

$$\begin{aligned} \text{On } \Delta k_{it} \quad &: \quad \alpha_{k,w_1} = \nu_{it-1}\eta_{2,k,p^k}\eta_{1,k,w}(1/\bar{\eta}_{k,p^k}) \\ &: \quad \alpha_{k,w_2} = (1-\nu_{it-1})\eta_{1,k,p^k}\eta_{2,k,w}(1/\bar{\eta}_{k,p^k}) \end{aligned}$$

$$
\begin{aligned}
\text{On } \Delta c_{1it} \quad &: \quad \alpha_{c_1,w_1} = \eta_{1,c,w} - (1-\nu_{it-1})\eta_{1,c,p^k}\eta_{1,k,w}(1/\bar{\eta}_{k,p^k}) \\
&: \quad \alpha_{c_1,w_2} = (1-\nu_{it-1})\eta_{1,c,p^k}\eta_{2,k,w}(1/\bar{\eta}_{k,p^k}) \\
\text{On } \Delta c_{2it} \quad &: \quad \alpha_{c_2,w_1} = \nu_{it-1}\eta_{2,c,p^k}\eta_{1,k,w}(1/\bar{\eta}_{k,p^k}) \\
&: \quad \alpha_{c_2,w_2} = \eta_{2,c,w} - \nu_{it-1}\eta_{2,c,p^k}\eta_{2,k,w}(1/\bar{\eta}_{k,p^k}) \\
\text{On } \Delta c_{it} \quad &: \quad \alpha_{c,w_1} = \varphi_{it-1}\alpha_{c_1,w_1} + (1-\varphi_{it})\alpha_{c_2,w_1} \\
&: \quad \alpha_{c,w_2} = \varphi_{it-1}\alpha_{c_1,w_2} + (1-\varphi_{it})\alpha_{c_2,w_2} \\
\text{On } \Delta y_{1it} \quad &: \quad \alpha_{y_1,w_1} = 1 + \eta_{1,h,w} - (1-\nu_{it-1})\eta_{1,h,p^k}\eta_{1,k,w}(1/\bar{\eta}_{k,p^k}) \\
&: \quad \alpha_{y_1,w_2} = (1-\nu_{it-1})\eta_{1,h,p^k}\eta_{2,k,w}(1/\bar{\eta}_{k,p^k}) \\
\text{On } \Delta y_{2it} \quad &: \quad \alpha_{y_2,w_1} = \nu_{it-1}\eta_{2,h,p^k}\eta_{1,k,w}(1/\bar{\eta}_{k,p^k}) \\
&: \quad \alpha_{y_2,w_2} = 1 + \eta_{2,h,w} - \nu_{it-1}\eta_{2,h,p^k}\eta_{2,k,w}(1/\bar{\eta}_{k,p^k})
\end{aligned}
$$

Bargaining effects

$$
\begin{aligned}
\text{On } \Delta k_{it} \quad &: \quad \beta_{k,w_1} = \eta_{\mu,w_1}\beta_k \\
&: \quad \beta_{k,w_2} = \eta_{\mu,w_2}\beta_k \\
\text{On } \Delta c_{1it} \quad &: \quad \beta_{c_1,w_1} = \eta_{\mu,w_1}\beta_{c_1} \\
&: \quad \beta_{c_1,w_2} = \eta_{\mu,w_2}\beta_{c_1} \\
\text{On } \Delta c_{2it} \quad &: \quad \beta_{c_2,w_1} = \eta_{\mu,w_1}\beta_{c_2} \\
&: \quad \beta_{c_2,w_2} = \eta_{\mu,w_2}\beta_{c_2} \\
\text{On } \Delta c_{it} \quad &: \quad \beta_{c,w_1} = \varphi_{it-1}\beta_{c_1,w_1} + (1-\varphi_{it})\beta_{c_2,w_1} \\
&: \quad \beta_{c,w_2} = \varphi_{it-1}\beta_{c_1,w_2} + (1-\varphi_{it})\beta_{c_2,w_2} \\
\text{On } \Delta y_{1it} \quad &: \quad \beta_{y_1,w_1} = \eta_{\mu,w_1}\beta_{y_1} \\
&: \quad \beta_{y_1,w_2} = \eta_{\mu,w_2}\beta_{y_1} \\
\text{On } \Delta y_{2it} \quad &: \quad \beta_{y_2,w_1} = \eta_{\mu,w_1}\beta_{y_2} \\
&: \quad \beta_{y_2,w_2} = \eta_{\mu,w_2}\beta_{y_2}
\end{aligned}
$$

Wealth effects

$$
\begin{aligned}
\text{On } \Delta k_{it} \quad &: \quad \gamma_{k,w_1} = \alpha_{k,\lambda}\ell_{it}^{w_1} \\
&: \quad \gamma_{k,w_2} = \alpha_{k,\lambda}\ell_{it}^{w_2} \\
\text{On } \Delta c_{1it} \quad &: \quad \gamma_{c_1,w_1} = \alpha_{c_1,\lambda}\ell_{it}^{w_1} \\
&: \quad \gamma_{c_1,w_2} = \alpha_{c_1,\lambda}\ell_{it}^{w_2} \\
\text{On } \Delta c_{2it} \quad &: \quad \gamma_{c_2,w_1} = \alpha_{c_2,\lambda}\ell_{it}^{w_1} \\
&: \quad \gamma_{c_2,w_2} = \alpha_{c_2,\lambda}\ell_{it}^{w_2} \\
\text{On } \Delta c_{it} \quad &: \quad \gamma_{c,w_1} = \varphi_{it-1}\gamma_{c_1,w_1} + (1-\varphi_{it})\gamma_{c_2,w_1} \\
&: \quad \gamma_{c,w_2} = \varphi_{it-1}\gamma_{c_1,w_2} + (1-\varphi_{it})\gamma_{c_2,w_2} \\
\text{On } \Delta y_{1it} \quad &: \quad \gamma_{y_1,w_1} = \alpha_{y_1,\lambda}\ell_{it}^{w_1} \\
&: \quad \gamma_{y_1,w_2} = \alpha_{y_1,\lambda}\ell_{it}^{w_2}
\end{aligned}
$$

$$\begin{aligned}
\text{On } \Delta y_{2it} \quad &: \quad \gamma_{y_2,w_1} = \alpha_{y_2,\lambda}\ell_{it}^{w_1} \\
&: \quad \gamma_{y_2,w_2} = \alpha_{y_2,\lambda}\ell_{it}^{w_2}
\end{aligned}$$

where

$$\begin{aligned}
\bar{\eta}_{k,p^k} &= (1-\nu_{it-1})\eta_{1,k,p^k} + \nu_{it-1}\eta_{2,k,p^k} \\
\alpha_{k,\lambda} &= (1/\bar{\eta}_{k,p^k})\left(\eta_{1,k,p^k}\eta_{2,k,p^k} + \nu_{it-1}\eta_{2,k,p^k}(\eta_{1,k,p^c}+\eta_{1,k,w}) + (1-\nu_{it-1})\eta_{1,k,p^k}(\eta_{2,k,p^c}+\eta_{2,k,w})\right) \\
\alpha_{c_1,\lambda} &= \eta_{1,c,p^c} + \eta_{1,c,w} + (1/\bar{\eta}_{k,p^k})\left(\eta_{1,c,p^k}\eta_{2,k,p^k} + (1-\nu_{it-1})\eta_{1,c,p^k}(-\eta_{1,k,p^c}+\eta_{2,k,p^c}-\eta_{1,k,w}+\eta_{2,k,w})\right) \\
\alpha_{c_2,\lambda} &= \eta_{2,c,p^c} + \eta_{2,c,w} + (1/\bar{\eta}_{k,p^k})\left(\eta_{2,c,p^k}\eta_{1,k,p^k} - \nu_{it-1}\eta_{2,c,p^k}(-\eta_{1,k,p^c}+\eta_{2,k,p^c}-\eta_{1,k,w}+\eta_{2,k,w})\right) \\
\alpha_{y_1,\lambda} &= \eta_{1,h,w} + \eta_{1,h,p^c} + (1/\bar{\eta}_{k,p^k})\left(\eta_{1,h,p^k}\eta_{2,k,p^k} + (1-\nu_{it-1})\eta_{1,h,p^k}(-\eta_{1,k,p^c}+\eta_{2,k,p^c}-\eta_{1,k,w}+\eta_{2,k,w})\right) \\
\alpha_{y_2,\lambda} &= \eta_{2,h,w} + \eta_{2,h,p^c} + (1/\bar{\eta}_{k,p^k})\left(\eta_{2,h,p^k}\eta_{1,k,p^k} - \nu_{it-1}\eta_{2,h,p^k}(-\eta_{1,k,p^c}+\eta_{2,k,p^c}-\eta_{1,k,w}+\eta_{2,k,w})\right) \\
\beta_k &= \widetilde{\nu}_{it-1}\eta_{1,k,p^k}\eta_{2,k,p^k}(1/\bar{\eta}_{k,p^k}) - \nu_{it-1}\eta_{2,k,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{1,k,p^c}+\eta_{1,k,w}) \\
&\quad + \widetilde{\mu}_{it-1}(1-\nu_{it-1})\eta_{1,k,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{2,k,p^c}+\eta_{2,k,w}) \\
\beta_{c_1} &= \widetilde{\nu}_{it-1}\eta_{1,c,p^k}\eta_{2,k,p^k}(1/\bar{\eta}_{k,p^k}) - \eta_{1,c,p^c} - \eta_{1,c,w} \\
&\quad + (1-\nu_{it-1})\eta_{1,c,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{1,k,p^c} + \widetilde{\mu}_{it-1}\eta_{2,k,p^c} + \eta_{1,k,w} + \widetilde{\mu}_{it-1}\eta_{2,k,w}) \\
\beta_{c_2} &= \widetilde{\nu}_{it-1}\eta_{2,c,p^k}\eta_{1,k,p^k}(1/\bar{\eta}_{k,p^k}) + \widetilde{\mu}_{it-1}\eta_{2,c,p^c} + \widetilde{\mu}_{it-1}\eta_{2,c,w} \\
&\quad - \nu_{it-1}\eta_{2,c,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{1,k,p^c} + \widetilde{\mu}_{it-1}\eta_{2,k,p^c} + \eta_{1,k,w} + \widetilde{\mu}_{it-1}\eta_{2,k,w}) \\
\beta_{y_1} &= \widetilde{\nu}_{it-1}\eta_{1,h,p^k}\eta_{2,k,p^k}(1/\bar{\eta}_{k,p^k}) - \eta_{1,h,w} - \eta_{1,h,p^c} \\
&\quad + (1-\nu_{it-1})\eta_{1,h,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{1,k,p^c} + \widetilde{\mu}_{it-1}\eta_{2,k,p^c} + \eta_{1,k,w} + \widetilde{\mu}_{it-1}\eta_{2,k,w}) \\
\beta_{y_2} &= \widetilde{\nu}_{it-1}\eta_{2,h,p^k}\eta_{1,k,p^k}(1/\bar{\eta}_{k,p^k}) + \widetilde{\mu}_{it-1}\eta_{2,h,w} + \widetilde{\mu}_{it-1}\eta_{2,h,p^c} \\
&\quad - \nu_{it-1}\eta_{2,h,p^k}(1/\bar{\eta}_{k,p^k})(\eta_{1,k,p^c} + \widetilde{\mu}_{it-1}\eta_{2,k,p^c} + \eta_{1,k,w} + \widetilde{\mu}_{it-1}\eta_{2,k,w}) \\
\widetilde{\nu}_{it} &= (1-\nu_{it})\widetilde{\mu}_{it} - \nu_{it}.
\end{aligned}$$

Recall that the Frisch elasticities are presented in table 1 and defined in appendix A; also $\nu_{it} = \mu_{1it}U_{1,K}(\mu_{1it}U_{1,K} + \mu_{2it}U_{2,K})^{-1}$, $\widetilde{\mu}_{it} = \frac{\mu_{1it}}{\mu_{2it}}$, and $\ell_{it}^{w_1}$ & $\ell_{it}^{w_2}$ are defined in appendix C.

Whenever a transmission parameter involves ν, μ, ℓ^{w_1}, ℓ^{w_2}, or functions of them, then such parameter must be i- and t-specific. Such subscripts are removed here for simplicity of the notation; they are, however, implied.

E Measurement Error in Consumption

Table E.1 – Estimates of Consumption Measurement Error

	(1) separable	(2) nonseparable
	Couples	
c	0.0808	0.0827
	(0.0032)	(0.0030)
k	0.0404	0.0339
	(0.0023)	(0.0038)
	Single males	
c_1		0.0557
		(0.0126)
k_1		0.0561
		(0.0093)
	Single females	
c_2		0.0554
		(0.0144)
k_2		0.0474
		(0.0097)

Notes: The table presents the GMM estimates of the variance of measurement error in private and public consumption. Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications. Column 1 presents the estimates when the public good is additively separable from private consumption and leisure; column 2 presents the estimates when it is nonseparable.