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Consumption Inequality across Heterogeneous Families

Alexandros **THELOUDIS**[1]

[1] LISER, Luxembourg

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Alexandros Theloudis*

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Abstract

This paper studies the transmission of wage shocks into consumption across families that exhibit unobserved preference heterogeneity. Heterogeneity and preferences over consumption and family labor supply are nonparametric. I show that any moment of the joint distribution of policy-relevant wage elasticities of consumption and labor supply is identified separately from the distributions of incomes and outcomes. I decompose consumption inequality into components pertaining to wage inequality, preference heterogeneity and heterogeneity in wealth, and I show that preference heterogeneity always increases consumption inequality. To illustrate these points empirically, I fit second and third moments of consumption, earnings and wages in the PSID. I find that: (i) the distributions of permanent and transitory wage shocks exhibit strong negative skewness; (ii) there is substantial heterogeneity in consumption elasticities but not in elasticities of labor supply; (iii) consumption is on average fully insured against transitory shocks but tracks permanent shocks much more closely than previously found; moreover, there is substantial heterogeneity in the response of consumption to such shocks involving both the magnitude and the sign of the response; (iv) preference heterogeneity accounts for up to 58% of consumption inequality in the US since 1999. Seen together, these results suggest that preference heterogeneity has substantial implications for consumption inequality and partial insurance.

Keywords: unobserved preference heterogeneity, consumption inequality, family labor supply, wage shocks, lifecycle model, liquidity constraints, adjustment costs, PSID

JEL classification: D12, D30, D91, E21

*Alexandros Theloudis: Luxembourg Institute for Socio-Economic Research (LISER) and Department of Economics, University College London (email: a.theloudis@gmail.com). This paper is based on the third chapter of my dissertation. I am grateful to Richard Blundell, Pierre-André Chiappori, Sam Cosaert, Jan Eeckhout, Eric French, Magne Mogstad, Luigi Pistaferri, Ian Preston and Itay Saporta-Eksten for numerous discussions on issues related to this paper, as well as participants in various conferences for helpful comments. I am thankful for financial support through a Royal Economic Society Junior Fellowship and Richard Blundell's ERC advanced grant 'MicroConLab'.

1 Introduction

This paper develops a lifecycle model for consumption and family labor supply in order to study the transmission of wage shocks into consumption. Its distinctive feature is that households have heterogeneous nonparametric preferences over consumption and labor supply. The paper establishes identification of the cross-sectional joint distribution of unobserved household preferences, namely consumption and labor supply elasticities, separately from the observed distributions of incomes and outcomes. In addition, it illustrates that preference heterogeneity always increases consumption inequality. The model is implemented empirically on recent data from the Panel Study of Income Dynamics (PSID) revealing large amounts of preference heterogeneity across households. The paper then shows that such heterogeneity has substantial implications for consumption inequality and consumption partial insurance.

A consistent empirical finding is that consumption inequality is significantly lower than income inequality (Blundell and Etheridge, 2010; Heathcote et al., 2010). This holds across different measures of income or earnings, even for total income after taxes and transfers, and suggests that households have access to some consumption insurance. The degree of consumption insurance varies across households (Blundell et al., 2008; Hryshko and Manovskii, 2017) reflecting heterogeneity in preferences, assets or other factors. Such heterogeneity has potentially important implications for consumption inequality: consider two households who differ in their respective consumption preferences but otherwise face the same economic circumstances. These households will likely adjust their consumption differently in response to a similar wage shock implying that consumption inequality between them reflects both wage shocks *and* preference heterogeneity.

The paper formally incorporates preference heterogeneity into a lifecycle model for consumption and labor supply of two-earner households. The treatment of unobserved heterogeneity is general: (i) heterogeneity is nonseparable from within-period preferences; (ii) preferences are nonparametric; (iii) heterogeneity is not restricted to a single dimension (to a single parameter in the analog of parametric preferences); instead it is multi-dimensional meaning that any within-period preference parameter in the parametric analog might be independently or jointly heterogeneous; (iv) the multi-variate distribution of preferences is itself nonparametric. The specific workings of the household are as follows: two adult members (namely two spouses) make unitary lifecycle choices over consumption and labor supply. They can borrow and save at the market interest rate. Each member chooses working hours endogenously and, for each hour of work, receives a market wage that is subject to permanent and transitory wage/productivity shocks. Such shocks, potentially correlated between members, are the only source of uncertainty the household faces. To the best of my knowledge, this is the first paper that models general nonparametric heterogeneity on the nexus of lifecycle consumption and family labor supply.[1]

How do I solve the model? Following Blundell and Preston (1998) and a sequence of papers thereafter, I derive analytical expressions for consumption and household members' labor supply from first- and second-order Taylor approximations to the lifetime budget constraint and the problem's first-order conditions. These analytical expressions relate the growth rates of consumption and family labor supply to wage shocks, 'deep' preferences (namely household-specific Frisch elasticities of consumption and labor supply), and a number of parameters pertaining to financial and human wealth in the household. The second and higher moments of the empirical joint distribution of consumption, earnings and wage growth have, thanks to the aforementioned analytical expressions, clear theoretical counterparts.

The mapping between data and theory provides restrictions that can be used to identify first and higher moments of the cross-sectional joint distribution of household preferences. I show that *any* moment of the distribution of wage elasticities of consumption and labor supply is identified

[1] Alan et al. (2017) and Arellano et al. (2017) model consumption and income jointly allowing for heterogeneity but abstracting from labor supply. Blundell et al. (2016) model consumption and family labor supply but abstract from unobserved heterogeneity.

separately from the distribution of consumption, earnings, wages or assets. Such wage elasticities describe preferences in an ordinal way and are not specific to a particular parametrization of the household utility function. Identification rests on the idea that cross-sectional variation in consumption or working hours that occurs at fixed prices/wages conditional on individual and household characteristics masks heterogeneity in consumption or labor supply preferences. Identification requires panel data on consumption, hours and earnings, and variation in prices. Lack of observed cross-sectional variation in the price of consumption prohibits identification of the distribution of elasticities with respect to that price, including the consumption substitution elasticity. The analytical expressions also permit the decomposition of consumption inequality into terms that pertain to market wage inequality, heterogeneity in preferences, and heterogeneity in financial and human wealth (what I subsequently call 'initial conditions'). I establish analytically and numerically that preference heterogeneity always increases consumption growth inequality (i.e. the variance of consumption growth across households).

To illustrate these points empirically I fit second and third moments of the joint distribution of consumption, earnings and wages in the PSID in survey years 1999-2011. This permits the estimation of second and third moments of permanent and transitory wage shocks as well as first and second moments of preferences (wage elasticities of consumption and labor supply). The model fits the data reasonably well. Below I summarize four main findings from this exercise.

First, the cross-sectional distributions of wage shocks have a long left tail. This is true for permanent and transitory shocks to male and female wages. This negative skewness implies that negative shocks are more unsettling than positive ones as they are on average further away from the zero mean compared to positive shocks. This is consistent with Guvenen et al. (2015) who establish negative skewness of *earnings* shocks using data from the US Social Security Administration.

Second, although household consumption is *on average* fully insured against transitory shocks (as in Attanasio and Davis, 1996; Blundell et al., 2008), I find substantial cross-household heterogeneity in the magnitude and the sign of the consumption response to such shocks. Two standard deviations of the marginal distributions of wage elasticities of consumption about their means fall within the range $(-1.23, 1.15)$; this implies that consumption in some households does not respond to transitory shocks while in others it responds 1-to-$\pm$1. Moreover, the elasticity with respect to one spouse's wage is positively and strongly correlated with the elasticity with respect to the other spouse's wage magnifying households' (in)ability to insulate themselves from such shocks.

Third, I find limited heterogeneity (in statistical or economic sense) in labor supply elasticities after accounting for a large number of covariates including household demographics, type of employment and more. Men's and women's average labor supply elasticities are lower than average estimates in the literature reported by Keane (2011) (but still lie within the range of estimates therein). As in Ghosh (2016) this is partly because the model matches not only second but also third moments of earnings and wages. Family labor supply plays a relatively small role in consumption smoothing and, as a consequence, consumption tracks permanent wage shocks more closely than previously found. While on average 42% (28%) of a male (female) permanent shock passes through to consumption compared to 34% (20%) in Blundell et al. (2016), a substantial portion of households lacks partial insurance completely as in Hryshko and Manovskii (2017).

Fourth, approximately 58% of consumption inequality across US households since 1999 is due to preferences heterogeneity among them. I show, however, that the pattern of preference heterogeneity is also approximately consistent with an environment where households are differentially affected by unobserved liquidity constraints coupled with adjustment costs of work. The data provide some empirical support for this, albeit weakly. By contrast, the results cannot reflect cross-household heterogeneity in intra-family bargaining power, taxes, or consumption prices; while I do not formally model these features, I present informal tests for all.

Contribution and relation to literature. The paper offers four main contributions: (i) it embeds nonparametric unobserved preference heterogeneity into a lifecycle model of consumption and labor supply and shows identification of the joint distribution of preferences (elasticities) separately from that of incomes and outcomes, (ii) it illustrates that preference heterogeneity always increases consumption inequality, (iii) it estimates the location and spread of the distribution of consumption and labor supply elasticities in the US, and (iv) it quantifies the implications of preference heterogeneity for consumption inequality and partial insurance.

As such the paper contributes primarily to the growing literature that studies the link between idiosyncratic income changes and consumption. The goal in that literature is to characterize the joint dynamics of income and consumption inequality, measure consumption smoothing, identify mechanisms behind such smoothing, and often estimate preferences. Krueger and Perri (2006), Blundell et al. (2008), Kaplan and Violante (2010), Guvenen and Smith (2014), Alan et al. (2017), and Arellano et al. (2017) investigate the link between income and consumption in a household environment that abstracts from labor supply. Attanasio et al. (2002) model a two-earner household where labor market participation of the second earner is stochastic while Heathcote et al. (2014) model the labor supply of one earner in a general equilibrium framework. Hyslop (2001) investigates the link between wage and earnings inequality focusing explicitly on family labor supply as an insurance mechanism against wage shocks. A similar focus is shared by Blundell, Pistaferri, and Saporta-Eksten (2016), BPS hereafter, who study the transmission of wage shocks into consumption through a model of family labor supply, savings, and external insurance. BPS estimate preferences homogeneously and find that once family labor supply, wealth and the welfare system are accounted for, there is little room for additional insurance. The model in the present paper is similar to BPS in many respects; unlike BPS however, I explicitly allow households to differ in their consumption and labor supply preferences, therefore in their willingness, ceteris paribus, to smooth consumption. Using the same data as BPS (augmented by an additional wave), preference heterogeneity turns out, as argued above and detailed subsequently, to be important for our understanding of both consumption inequality and consumption smoothing. Jappelli and Pistaferri (2010) and Meghir and Pistaferri (2011) provide an overview of the extensive literature.

With the exception of the following three studies, a consistent feature in this literature is that households are ex ante identical. Conditional on observables and idiosyncratic incomes, any two households behave the same when a given shock hits them. This is a poor feature especially in the light of extensive empirical, experimental, or direct evidence on heterogeneity.[2] Heathcote et al. (2014) admit that part of the cross-sectional dispersion in consumption and hours is unrelated to income or price variation and allow for unobserved heterogeneity which is, however, additively separable and specific to the parametrization of household preferences they employ. Alan et al. (2017) allow for joint heterogeneity in income and preferences; however, they abstract from labor supply and they parametrize preferences and their distribution. Arellano et al. (2017) develop a nonlinear framework for the consumption response to income shocks allowing for flexible heterogeneity in such response; they too abstract from labor supply. Although the present paper uses a simpler process for wages than the last two papers (but one that fits the PSID well), it allows for joint heterogeneity in family labor supply and consumption while leaving within-period preferences and their distribution nonparametric.

Finally, the paper shares a common goal with the extensive literature on consumer demand, namely the identification of preferences from observed behavior. Lewbel (2001) studies various forms of random preferences, with and without nonseparable heterogeneity, and argues that the usual practice to restrict heterogeneity to additive errors is similar to enforcing a representative agent assumption. A number of recent consumer demand and revealed preferences studies present identification results and empirical applications when preferences exhibit nonseparable unobserved

[2]For example, Abowd and Card (1989) find large dispersion in working hours at fixed wage rates. Alan and Browning (2010) find heterogeneity in the discount factor and the elasticity of intertemporal substitution across education groups in the PSID. Andersen et al. (2008) and other experimental studies find substantial dispersion in risk and time preferences while Guiso and Paiella (2008) observe directly from survey data large amounts of unexplained heterogeneity in risky preferences. See Heckman (2001) for a theoretical discussion.

heterogeneity; examples are Matzkin (2003), Blundell et al. (2017), and Cosaert and Demuynck (2017). The paper complements these studies by point-identifying first and higher moments of elasticities in the context of lifecycle consumption and labor supply and then estimating a subset of them. The usefulness of these results is that they can serve as inputs in welfare or program evaluations (eg. French, 2005) where heterogeneity in the behavioral response of consumption and labor supply may crucially determine the policy conclusions.

The paper is organized as follows. Section 2 presents the model and derives analytical expressions for consumption and hours. It discusses consumption inequality and provides a first characterization of the effects of preference heterogeneity. Section 3 shows identification of the parameters of wages and the preference distribution. Section 4 presents the empirical application and the results. Section 5 discusses the implications for consumption insurance and inequality and investigates a number of alternative explanations for preference heterogeneity. Section 6 concludes.

2 A Lifecycle Household Model for Consumption and Labor Supply

2.1 The Model

A household consists of two earners, each one subscripted by j. To fix ideas suppose the two earners are a male ($j = 1$) and a female ($j = 2$) spouse; however, the model applies to any modern or traditional two-member household. In lifecycle period t the spouses make choices over household consumption C_t, their future assets A_{t+1}, and hours of work in the labor market H_{1t} and H_{2t} respectively (intensive margin labor supply only).

I assume the spouses stay together and commit to one another for life (the length of which is a known T). I model the household problem as unitary, that is as the problem of a single economic agent. This facilitates the discussion of cross-sectional preference heterogeneity without confounding it with issues pertaining to intra-household heterogeneity and commitment.[3]

Household i in the cross-section chooses $\{C_{it}, A_{it+1}, H_{1it}, H_{2it}\}$ over its lifecycle to maximize its expected discounted lifetime utility

$$\max_{\{C_{it},A_{it+1},H_{1it},H_{2it}\}_{t=0}^{T}} \mathbb{E}_0 \sum_{t=0}^{T} \beta^t U_i(C_{it}, H_{1it}, H_{2it}; \mathbf{Z}_{it}) \tag{1}$$

subject to the lifetime budget constraint, the sequential version of which at time $t = \{0, \ldots, T\}$ is

$$A_{it} + \sum_{j=1}^{2} W_{jit} H_{jit} = C_{it} + \frac{A_{it+1}}{1+r}. \tag{2}$$

In the budget constraint, A_{it} is beginning-of-period assets, W_{1it} is the male hourly wage in the labor market, W_{2it} is the female hourly wage, and r is the deterministic market interest rate.

In the objective function, U_i is household utility from consumption and (disutility from) labor supply; β is the geometric discount factor which is, for simplicity, the same across households.[4]

[3] In the absence of a formal collective modeling of the household, cross-household and intra-household heterogeneity may be mixed in the spirit of Lise and Seitz (2011) for inequality. I discuss this issue in section 5.3. Chiappori (1988) introduced the static collective model where household members with heterogeneous preferences make Pareto efficient choices. Browning and Chiappori (1998) and Cherchye et al. (2007) provide a characterization of this model; Mazzocco (2007) extended the collective model to allow for intertemporal dynamics.

[4] Alan et al. (2017) allow for heterogeneity in β relying on parametric preferences and distributions. A heterogeneous discount factor in the present paper would complicate the solution of the model substantially. However, it would not jeopardize identification of within-period preference heterogeneity: it will soon become clear that such heterogeneity is identified through the transmission of transitory wage shocks into outcomes while β (in a reasonable range) only affects the transmission of permanent shocks.

Vector $\mathbf{Z}_{it}$ includes observable taste shifters such as spouses' education or age (thus captures *observed* preference heterogeneity). Household preferences U_i are subscripted by i to indicate unobserved preference heterogeneity across households, strictly speaking household-specific preferences not captured by the conditioning observed taste shifters. This is a general way to model such heterogeneity and is consistent with various different sources that preference heterogeneity may stem from, such as cross-household differences in labor market attachment or in consumption-leisure complementarities. I do not parameterize U_i but I do require it have continuous first- and second-order derivatives.

I model spousal wages W_1 and W_2 using a permanent-transitory process.[5] Specifically, I decompose log wages $\ln W_{jit}$ into the sum of a deterministic component, a permanent stochastic component that follows a unit root, and a transitory shock; namely

$$\begin{aligned}\ln W_{jit} &= \mathbf{X}'_{jit}\boldsymbol{\alpha}_{W_j} + \ln W^p_{jit} + u_{jit}\\ \ln W^p_{jit} &= \ln W^p_{jit-1} + v_{jit}.\end{aligned}$$

Here $\mathbf{X}_{jit}$ is a vector of observable or predictable conditioning covariates (such as age or education) and $\boldsymbol{\alpha}_{W_j}$ is their coefficient. $\ln W^p_{jit}$ is the permanent component, u_{jit} is the transitory shock, and v_{jit} is the permanent shock; all for spouse $j = \{1, 2\}$ in household i at time $t = \{0, \dots, T\}$. The wage process can be written compactly as

$$\Delta w_{jit} = v_{jit} + \Delta u_{jit} \tag{3}$$

where $\Delta w_{jit} = \Delta \ln W_{jit} - \Delta\mathbf{X}'_{jit}\boldsymbol{\alpha}_{W_j}$. The permanent shock reflects a permanent change in the returns to one's skills in the labor market, such as a skill-specific technical change, whereas the transitory shock indicates short-lived mean reverting fluctuations in productivity, such as fluctuations in effort when effort is observed and tied to one's wage. Spousal wage shocks are the only source of labor market uncertainty the household encounters.

Properties of shocks. Wage shocks are idiosyncratic in nature with zero cross-sectional means and n^{th} moments $(n > 1)$ given by

$$\mathbb{E}(v^{\nu}_{1it} v^{n-\nu}_{2it+s}) = \begin{cases} m_{v_1^{\nu} v_2^{n-\nu}(t)} & \text{for } s = 0 \text{ and } \nu = \{0, \dots, n\} \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}(u^{\nu}_{1it} u^{n-\nu}_{2it+s}) = \begin{cases} m_{u_1^{\nu} u_2^{n-\nu}(t)} & \text{for } s = 0 \text{ and } \nu = \{0, \dots, n\} \\ 0 & \text{otherwise} \end{cases}$$

and $v_{jit} \perp u_{j'it+s}$, for any combination of $j, j' = \{1, 2\}$, and $s = \{0, \dots, T\}$.

As an illustration, the second moments $(n = 2)$ of permanent and transitory shocks are given respectively by

$$\mathbb{E}(v^{\nu}_{1it} v^{2-\nu}_{2it+s}) = \begin{cases} \sigma^2_{v_j(t)} & \text{if } s = 0 \text{ and } \nu = 2, j = 1 \text{ or } \nu = 0, j = 2 \\ \sigma_{v_1 v_2(t)} & \text{if } s = 0 \text{ and } \nu = 1 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}(u^{\nu}_{1it} u^{2-\nu}_{2it+s}) = \begin{cases} \sigma^2_{u_j(t)} & \text{if } s = 0 \text{ and } \nu = 2, j = 1 \text{ or } \nu = 0, j = 2 \\ \sigma_{u_1 u_2(t)} & \text{if } s = 0 \text{ and } \nu = 1 \\ 0 & \text{otherwise} \end{cases}$$

[5] The permanent-transitory process has been used extensively in the income dynamics literature and beyond, for example in MaCurdy (1982), Abowd and Card (1989), Attanasio et al. (2002), Meghir and Pistaferri (2004), Attanasio et al. (2008), Blundell et al. (2008) and BPS. This process results in 'restricted income profiles' as agents have the same ex-ante income growth conditional on observables but differ in the idiosyncratic shocks they are hit by. An alternative family of income processes supports ex-ante idiosyncratic income growth and results in 'heterogeneous income profiles' (see, for example, Guvenen, 2007; Browning et al., 2010).

and the third moments ($n = 3$) by

$$\mathbb{E}(v_{1it}^{\nu} v_{2it+s}^{3-\nu}) = \begin{cases} \gamma_{v_j(t)} & \text{if } s = 0 \text{ and } \nu = 3, j = 1 \text{ or } \nu = 0, j = 2 \\ \gamma_{v_1 v_2^2(t)} & \text{if } s = 0 \text{ and } \nu = 1 \\ \gamma_{v_1^2 v_2(t)} & \text{if } s = 0 \text{ and } \nu = 2 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}(u_{1it}^{\nu} u_{2it+s}^{3-\nu}) = \begin{cases} \gamma_{u_j(t)} & \text{if } s = 0 \text{ and } \nu = 3, j = 1 \text{ or } \nu = 0, j = 2 \\ \gamma_{u_1 u_2^2(t)} & \text{if } s = 0 \text{ and } \nu = 1 \\ \gamma_{u_1^2 u_2(t)} & \text{if } s = 0 \text{ and } \nu = 2 \\ 0 & \text{otherwise.} \end{cases}$$

Across all expressions above, $\mathbb{E}(\cdot)$ denotes the mean over i. I assume the spouses hold no advance information about future shocks.[6]

I allow for non-zero *cross*-moments, a feature consistent with a general joint distribution of shocks. For example, assortative mating in the family implies that the covariance between spousal shocks is non-zero, and possibly so for higher cross-moments too. The indexing of moments by t indicates that moments can vary with time. The logic is that different times may be associated with different amounts of wage inequality, skewness, etc (Guvenen et al., 2014). Note that lifecycle effects are partly captured by conditioning observables (age) in $\mathbf{X}_j$.

Dynamics of consumption and hours. I derive analytical expressions for the growth rates of consumption and individual labor supply in terms of (the growth in) spousal wages and the marginal utility of wealth. A first-order Taylor approximation to the intra-temporal first-order conditions of household problem (1) *s.t.* (2) yields

$$\begin{aligned} \Delta c_{it} &\approx \eta_{c,w_1(i)} \Delta w_{1it} + \eta_{c,w_2(i)} \Delta w_{2it} \\ &\quad + \left(\eta_{c,p(i)} + \eta_{c,w_1(i)} + \eta_{c,w_2(i)}\right) \Delta \ln \lambda_{it} \\ \Delta h_{jit} &\approx \eta_{h_j,w_1(i)} \Delta w_{1it} + \eta_{h_j,w_2(i)} \Delta w_{2it} \\ &\quad + \left(\eta_{h_j,p(i)} + \eta_{h_j,w_1(i)} + \eta_{h_j,w_2(i)}\right) \Delta \ln \lambda_{it} \end{aligned} \tag{4}$$

with details reported in appendix A. The notation is as follows: $\Delta c_{it} = \Delta \ln C_{it}$ and $\Delta h_{jit} = \Delta \ln H_{jit}$, both net of the effect of observable covariates such as age or education;[7] λ_{it} is the marginal utility of wealth (the Lagrange multiplier on the sequential budget constraint).

Parameters η are Frisch (λ-constant) elasticities defined at the household level. As an illustration, $\eta_{c,w_1(i)} = \frac{\partial C}{\partial W_1} \frac{W_1}{C}\Big|_{\lambda\text{-const.}}^{i}$ is the Frisch elasticity of consumption with respect to male wage W_1, $\eta_{c,p(i)}$ is the Frisch elasticity of consumption with respect to the price of consumption P, and $\eta_{h_j,w_2(i)}$ is the Frisch labor supply elasticity of spouse j with respect to female wage W_2; all are i-specific. A full list of elasticities is presented in table 1 and defined formally in appendix B.

The Frisch elasticities, 9 in total per household, provide an ordinal representation of household i's preferences over consumption and labor supply. As preferences U_i are household-specific even after conditioning on observables $\mathbf{Z}_{it}$, there is a multivariate distribution of such elasticities across

[6] This assumption is testable and often not rejected; see Meghir and Pistaferri (2011).

[7] Specifically,

$$\Delta c_{it} = \Delta \ln C_{it} - \eta_{c,p(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_C\right) - \eta_{c,w_1(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_{H_1}\right) - \eta_{c,w_2(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_{H_2}\right)$$
$$\Delta h_{jit} = \Delta \ln H_{jit} - \eta_{h_j,p(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_C\right) - \eta_{h_j,w_1(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_{H_1}\right) - \eta_{h_j,w_2(i)} \Delta \left(\mathbf{Z}_{it}' \boldsymbol{\alpha}_{H_2}\right)$$

where $\mathbf{Z}_{it}' \boldsymbol{\alpha}_C$ captures the effect of observable taste shifters $\mathbf{Z}_{it}$ on household consumption ($\boldsymbol{\alpha}_C$ is the regression coefficient of log consumption on $\mathbf{Z}_{it}$) and $\mathbf{Z}_{it}' \boldsymbol{\alpha}_{H_j}$ captures the effect of observable taste shifters on spouse j's hours. $\Delta(\cdot)$ is the first difference operator. The η's are Frisch elasticities defined in the text and in appendix B.

Table 1 – Frisch Elasticities of Household i

Consumption elasticities		
$\eta_{c,w_1(i)}$	:	with respect to male wage W_1
$\eta_{c,w_2(i)}$	:	with respect to female wage W_2
$\eta_{c,p(i)}$	:	with respect to the price of consumption P
Male labor supply elasticities		
$\eta_{h_1,w_1(i)}$	:	with respect to male wage W_1
$\eta_{h_1,w_2(i)}$	:	with respect to female wage W_2
$\eta_{h_1,p(i)}$	:	with respect to the price of consumption P
Female labor supply elasticities		
$\eta_{h_2,w_1(i)}$	:	with respect to male wage W_1
$\eta_{h_2,w_2(i)}$	:	with respect to female wage W_2
$\eta_{h_2,p(i)}$	:	with respect to the price of consumption P

Notes: The table presents the Frisch (λ-constant) elasticities of household i. These elasticities constitute an ordinal representation of preferences U_i. There are 9 elasticities in total, 3 own-price and 6 cross-price elasticities. The rule governing the notation of elasticities is: $\eta_{x,\chi(i)}$ is household i's elasticity of outcome variable $x = \{c, h_1, h_2\}$ with respect to price $\chi = \{w_1, w_2, p\}$. Each elasticity is subscripted by (i) to denote that elasticities are household-specific.

households in the economy. This distribution of preferences, denoted by $F_{\boldsymbol{\eta}}$, is the epicentre of unobserved preference heterogeneity in the paper.[8]

Expressions (4) are empirically unattractive because the marginal utility of wealth λ is unobserved. Following Blundell and Preston (1998) and BPS, I overcome this in two steps. First, I apply a second-order Taylor approximation to the Euler equation and decompose $\Delta \ln \lambda_{it}$ into an innovation that captures idiosyncratic revisions to λ due to wage shocks and a second term that captures the effect of the interest and discount rates on consumption growth. I assume that the second term is deterministic. Second, I apply a first-order Taylor approximation to the lifetime budget constraint and map the innovation to λ into wage shocks.[9] The details of both steps appear in appendix A.

These approximations combined produce analytical expressions for the (growth in residual) outcome variables as functions of wage shocks, Frisch elasticities, and financial and human wealth. The analytical expressions are given by

$$\begin{aligned}\Delta c_{it} &\approx \eta_{c,w_1(i)}\Delta u_{1it} + \eta_{c,w_2(i)}\Delta u_{2it} \\ &\quad + \left(\eta_{c,w_1(i)} + \bar{\eta}_{c(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{1it} \\ &\quad + \left(\eta_{c,w_2(i)} + \bar{\eta}_{c(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{2it}\end{aligned} \tag{5}$$

$$\begin{aligned}\Delta h_{1it} &\approx \eta_{h_1,w_1(i)}\Delta u_{1it} + \eta_{h_1,w_2(i)}\Delta u_{2it} \\ &\quad + \left(\eta_{h_1,w_1(i)} + \bar{\eta}_{h_1(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{1it} \\ &\quad + \left(\eta_{h_1,w_2(i)} + \bar{\eta}_{h_1(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{2it}\end{aligned} \tag{6}$$

$$\begin{aligned}\Delta h_{2it} &\approx \eta_{h_2,w_1(i)}\Delta u_{1it} + \eta_{h_2,w_2(i)}\Delta u_{2it} \\ &\quad + \left(\eta_{h_2,w_1(i)} + \bar{\eta}_{h_2(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{1it} \\ &\quad + \left(\eta_{h_2,w_2(i)} + \bar{\eta}_{h_2(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right) v_{2it},\end{aligned} \tag{7}$$

[8] For simplicity I assume that the distribution of preferences $F_{\boldsymbol{\eta}}$ is time-invariant. This assumption is not needed for any of the results in the paper and can be relaxed.

[9] This approach draws on Campbell (1993)'s log-linear approximation to the intertemporal budget constraint. See Blundell et al. (2013) for a detailed illustration of the approximation.

where $\bar{\eta}_{c(i)} = \eta_{c,p(i)} + \eta_{c,w_1(i)} + \eta_{c,w_2(i)}$ and $\bar{\eta}_{h_j(i)} = \eta_{h_j,p(i)} + \eta_{h_j,w_1(i)} + \eta_{h_j,w_2(i)}$ for $j = \{1,2\}$.[10] $\varepsilon_j(\cdot)$ reflects the impact spouse j's permanent wage shock has on the intertemporal budget constraint (more precisely, on growth of the marginal utility of wealth λ) and is derived analytically in appendix A. $\varepsilon_j(\cdot)$ is a function of the 'initial conditions' parameters π_{it} and $\mathbf{s}_{it} = (s_{1it}, s_{2it})'$, as well as the household-specific vector of Frisch elasticities $\boldsymbol{\eta}_i$.

The 'partial insurance' parameter $\pi_{it} \approx \text{Assets}_{it}/(\text{Assets}_{it} + \text{Human Wealth}_{it})$, term due to Blundell et al. (2008), is approximately equal to the share of financial wealth in the household's total wealth at t. A higher π_{it} implies a smaller impact of permanent shocks on consumption because the household holds assets to absorb such shocks. $s_{jit} \approx \text{Human Wealth}_{jit}/\text{Human Wealth}_{it}$ measures approximately the share of spouse j's human wealth (expected discounted lifetime earnings) in total human wealth at t. A high s_{jit} implies that spouse j's permanent shocks are relatively more important for consumption because such spouse commands larger share of family earnings.

Although permanent wage shocks impact on the marginal utility of wealth λ, transitory shocks do not. Transitory shocks are mean-reverting after one period and, as long as the time horizon of the household is sufficiently long, their effect on the lifetime budget constraint is negligible. Appendix A illustrates this point analytically.

Expressions (5)-(6)-(7) appeal because they are empirically tractable and provide a neat picture for how shocks, preferences, and other factors contribute to consumption and hours growth. They offer a theoretical interpretation of consumption and hours inequality as well as of other moments (including moments of earnings).

Intertemporal equilibrium consumption in (5) responds to a marginal-utility-of-wealth- or λ-constant wage change (i.e. a transitory wage shock) because of the non-separability between consumption and labor supply in U_i. Such response reflects the intertemporal substitution between consumption and leisure and measures, by definition, the consumption-wage elasticities $\eta_{c,w_j(i)}$. Ceteris paribus, the response/sensitivity of consumption to transitory shocks may differ across households, thus giving rise to heterogeneity in consumption-wage elasticities.

Intertemporal equilibrium hours of spouse j in (6)-(7) respond to own transitory wage shock Δu_j reflecting the intertemporal substitution between hours and leisure induced by a λ-constant shift in one's wage. Such response measures, by definition, the own-wage Frisch labor supply elasticities $\eta_{h_j,w_j(i)}$. As an illustration, suppose that $\Delta u_{2it} > 0$ implying that the female spouse experiences a temporary wage rise in period t. One would expect her to increase her hours in response, that is $\Delta h_{2it} > 0$, when her labor supply elasticity $\eta_{h_2,w_2(i)}$ is positive (which is what the literature usually finds).

Intertemporal equilibrium hours of spouse j in (6)-(7) respond to the other spouse's transitory wage shock Δu_{-j} (where $-j$ reflects j's partner) due to complementarities between spouses' hours in U_i. Such response measures the cross-wage elasticities $\eta_{h_j,w_{-j}(i)}$ and reflects the intertemporal substitution between spouses' leisure.

In the model, the consumption-wage and the hours-wage Frisch elasticities serve as transmission parameters of transitory wage shocks into consumption and labor supply. They also serve as transmission parameters of *permanent* wage shocks. Conditional on lifetime income, permanent shocks induce the same substitution effects as transitory ones do because the only difference between the two is the effect the former cause on the lifetime budget constraint. This is reflected by the first component in the coefficients on permanent shocks in (5)-(6)-(7). The second component

[10] Growth in outcome variables is net of the effect of observable covariates. Specifically,

$$\begin{aligned}
\Delta c_{it} = \;& \Delta \ln C_{it} - \eta_{c,p(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_C\right) - \eta_{c,w_1(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_{H_1}\right) - \eta_{c,w_2(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_{H_2}\right) \\
& - \eta_{c,w_1(i)}\Delta\left(\mathbf{X}'_{1it}\boldsymbol{\alpha}_{W_1}\right) - \eta_{c,w_2(i)}\Delta\left(\mathbf{X}'_{2it}\boldsymbol{\alpha}_{W_2}\right) - \bar{\eta}_{c(i)}\omega_{it} \\
\Delta h_{jit} = \;& \Delta \ln H_{jit} - \eta_{h_j,p(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_C\right) - \eta_{h_j,w_1(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_{H_1}\right) - \eta_{h_j,w_2(i)}\Delta\left(\mathbf{Z}'_{it}\boldsymbol{\alpha}_{H_2}\right) \\
& - \eta_{h_j,w_1(i)}\Delta\left(\mathbf{X}'_{1it}\boldsymbol{\alpha}_{W_1}\right) - \eta_{h_j,w_2(i)}\Delta\left(\mathbf{X}'_{2it}\boldsymbol{\alpha}_{W_2}\right) - \bar{\eta}_{h_j(i)}\omega_{it}
\end{aligned}$$

where ω_{it} is the deterministic component of $\Delta \ln \lambda_{it}$ and is derived in appendix A.

in these coefficients captures the income effect that permanent shocks induce through shifting the lifetime budget constraint. Such income effect is proportional on $\varepsilon_j(\cdot)$ and the entire set of Frisch elasticities per outcome variable.

As an illustration, consumption is more sensitive to a permanent wage shock the higher $|\eta_{c,w_j(i)}|$ is. This is because a 'large' $\eta_{c,w_j(i)}$ reflects a larger substitution between consumption and leisure, as well as a higher sensitivity of consumption to changes in lifetime income as $\eta_{c,w_j(i)}$ is one of the components of $\bar{\eta}_{c(i)}$ which transmits shifts in lifetime income into current consumption. Another component of $\bar{\eta}_{c(i)}$ is $\eta_{c,p(i)}$, the consumption substitution elasticity ($\eta_{c,p(i)} < 0$). The larger (towards zero) such elasticity is, the less willing the household is to trade consumption intertemporally and the less responsive consumption is, ceteris paribus, to lifetime income and permanent wage shocks. While the response of consumption and hours to transitory shocks captures substitution effects only, thus measures *Frisch* elasticities, the response to permanent wage shocks captures substitution and income/wealth effects and, therefore, measures approximately *Marshallian* elasticities of consumption and labor supply. I refer to BPS for a detailed discussion of the transmission mechanisms of permanent shocks.

2.2 Analytical Expressions for Inequality

The analytical expressions (5)-(6)-(7) permit the characterization of consumption, earnings and hours inequality across households. Before showing this I first ask how wage shocks relate to preferences.

Independence of wage shocks and preferences. I assume that wage shocks are independent of preferences, namely $v_{jit} \perp \boldsymbol{\eta}_i$ and $u_{jit} \perp \boldsymbol{\eta}_i$ for all j, i, t, conditional on observables. Suppose, for example, the spouses in a given household are strongly attached to the labor market and their labor supply is relatively insensitive to wage changes (namely they have small labor supply elasticities). The independence assumption states that, regardless the sign and magnitude of their idiosyncratic wage shocks, the spouses will remain as strongly attached to the labor market as always. This is not saying that their hours will not respond to shocks. On the contrary, they will; but, conditional on observables, their hours will respond to a shock of a given type in a constant proportion to the magnitude of such shock and irrespective of its sign.

That preferences $\boldsymbol{\eta}_i$ are independent of wage shocks obviously implies that wage shocks too are independent of household preferences. Nevertheless, the latter is harder to justify in a dynamic context. Past choices that obviously depend on preferences may affect current wages. One can deal with this by removing the effect of past choices from spousal wages, so long as such effect materialises through observables only. The independence of wage shocks and preferences then boils down to assuming that any effect of past choices on current wages passes through observable characteristics only.[11]

Wage shocks are also independent of the 'initial conditions' parameters π_{it} and s_{jit}, that is $v_{jit} \perp \pi_{it}, s_{1it}, s_{2it}$ and $u_{jit} \perp \pi_{it}, s_{1it}, s_{2it}$ for all j, i, t. Note that this is a result rather than an assumption as both π_{it} and s_{jit} pertain to $t-1$ expectations (see appendix A for their analytical expressions) and therefore are non-random at t.

Dynamics of inequality. I define consumption inequality as the variance of unexplained consumption growth across households like Blundell et al. (2008) and BPS (but unlike Deaton and Paxson, 1994; Blundell and Preston, 1998). In other words, this paper discusses inequality in *growth rates* rather than *levels*. A similar definition applies whenever I make reference to wage, earnings or hours inequality. Using expression (5), the properties of shocks in section 2.1, and the

[11] A common assumption in consumer demand is that preferences are independent of prices (for example Lewbel, 2001; Cosaert and Demuynck, 2017). The independence of wage shocks and preferences is a weaker assumption as it only requires that preferences are independent of the *stochastic* component of prices.

independence of preferences and wage shocks, I obtain a closed-form expression for consumption inequality given by

$$
\begin{aligned}
\operatorname{Var}(\Delta c_{it}) \approx\ & \underbrace{\mathbb{E}(\eta^2_{c,w_1(i)})}_{\text{involves heterogeneity in } \eta_{c,w_1(i)}} \times \left(\sigma^2_{u_1(t)} + \sigma^2_{u_1(t-1)}\right) \\
& + \underbrace{\mathbb{E}(\eta^2_{c,w_2(i)})}_{\text{involves heterogeneity in } \eta_{c,w_2(i)}} \times \left(\sigma^2_{u_2(t)} + \sigma^2_{u_2(t-1)}\right) \\
& + 2\underbrace{\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)})}_{\text{involves \textit{joint} heterogeneity in } \eta_{c,w_1(i)} \text{ and } \eta_{c,w_2(i)}} \times \left(\sigma_{u_1u_2(t)} + \sigma_{u_1u_2(t-1)}\right) \\
& + \underbrace{\mathbb{E}\left(\left(\eta_{c,w_1(i)} + \bar{\eta}_{c(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)^2\right)}_{\text{involves heterogeneity in preferences and initial conditions}} \times \sigma^2_{v_1(t)} \\
& + \underbrace{\mathbb{E}\left(\left(\eta_{c,w_2(i)} + \bar{\eta}_{c(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)^2\right)}_{\text{involves heterogeneity in preferences and initial conditions}} \times \sigma^2_{v_2(t)} \\
& + 2\underbrace{\mathbb{E}\left(\left(\eta_{c,w_1(i)} + \bar{\eta}_{c(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)\left(\eta_{c,w_2(i)} + \bar{\eta}_{c(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)\right)}_{\text{involves heterogeneity in preferences and initial conditions}} \times \sigma_{v_1v_2(t)},
\end{aligned}
\tag{8}
$$

where $\operatorname{Var}(\cdot)$ denotes the cross-sectional variance and $\mathbb{E}(\cdot)$ denotes the cross-sectional mean. To obtain (8) I use results from Goodman (1960) and Bohrnstedt and Goldberger (1969) who provide tools for the second moments of products of random variables. Appendix C details this derivation.

Expression (8) shows that consumption inequality is the result of three distinct forces: (1.) wage inequality (second moments of wage shocks), (2.) preferences including unobserved preference heterogeneity, (3.) heterogeneity in initial conditions (financial and human wealth). Each line in expression (8) consists of two distinct parts, one pertaining to wage inequality (the second term in each line) and another one pertaining to preferences, preference heterogeneity, and, possibly, heterogeneity in initial conditions (the first term highlighted by braces).

Wage shocks contribute to consumption inequality because of their variability in the cross section (wage inequality).[12] Consumption inequality can be decomposed into two parts given the type of wage inequality behind it: *consumption instability* due to the transitory wage components (first three lines) and *permanent inequality* due to the permanent wage components (last three lines).[13] For given preferences, preference heterogeneity, and heterogeneity in initial conditions, the higher the variances of wage shocks, the higher consumption inequality is. Expression (8) allows different types of shocks to have different welfare consequences, a point made by Blundell and Preston (1998) and Blundell et al. (2008), as each distinct variance and covariance is associated with a unique loading factor onto consumption inequality. For example, Blundell et al. (2008) find that the representative household is fully insured against transitory shocks but only partially so against permanent shocks. Assuming away the covariance of shocks, this translates in the present context to $\mathbb{E}(\eta^2_{c,w_j(i)}) \approx 0$ and $0 < \mathbb{E}\left(\left(\eta_{c,w_j(i)} + \bar{\eta}_{c(i)}\varepsilon_j(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)^2\right) < 1$.

Preferences contribute to consumption inequality through their first and second moments. Consider the loading factors of the variances and covariances of transitory shocks; these are re-

[12] Higher moments of shocks do not enter the variance of consumption growth because I ignore terms higher than first-order in the approximations to the lifetime budget constraint and the intra-temporal first-order conditions.

[13] Gottschalk and Moffitt (2009) use the term ‘income instability’ to refer to short-term transitory fluctuations in income that contribute to overall income inequality.

spectively

$$\begin{aligned}\mathbb{E}(\eta^2_{c,w_j(i)}) &= \left(\mathbb{E}(\eta_{c,w_j(i)})\right)^2 + \text{Var}\left(\eta_{c,w_j(i)}\right), \\ \mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)}) &= \mathbb{E}(\eta_{c,w_1(i)})\mathbb{E}(\eta_{c,w_2(i)}) + \text{Cov}\left(\eta_{c,w_1(i)}, \eta_{c,w_2(i)}\right).\end{aligned} \tag{9}$$

Ceteris paribus, the higher (the absolute value of) the mean consumption-wage elasticities, the higher consumption inequality is as consumption in the representative household is relatively more responsive to wage fluctuations. This is captured by the first terms above involving the $\mathbb{E}(\eta_{c,w_j(i)})$'s and is a point also made by BPS. In addition, the larger unobserved preference heterogeneity is, captured by the second terms involving the variances and covariance of elasticities, the higher consumption inequality is.

Now consider the loading factors of the variances and covariances of permanent shocks; take, for instance, the loading factor of $\sigma^2_{v_1(t)}$. Suppose for the sake of illustration that $\varepsilon_1(\cdot) = 1$. Then the loading factor is

$$\begin{aligned}\mathbb{E}\left(\left(\eta_{c,w_1(i)} + \bar{\eta}_{c(i)}\varepsilon_1\right)^2 \mid \varepsilon_1 = 1\right) &= \mathbb{E}\left(\eta^2_{c,w_1(i)}\right) + \mathbb{E}\left(\bar{\eta}^2_{c(i)}\right) + 2\mathbb{E}\left(\eta_{c,w_1(i)}\bar{\eta}_{c(i)}\right) \\ &= \left(\mathbb{E}(\eta_{c,w_1(i)})\right)^2 + \left(\mathbb{E}(\bar{\eta}_{c(i)})\right)^2 + 2\mathbb{E}(\eta_{c,w_1(i)})\mathbb{E}(\bar{\eta}_{c(i)}) \\ &\quad + \text{Var}\left(\eta_{c,w_1(i)}\right) + \text{Var}\left(\bar{\eta}_{c(i)}\right) + 2\text{Cov}\left(\eta_{c,w_1(i)}, \bar{\eta}_{c(i)}\right).\end{aligned} \tag{10}$$

Ceteris paribus, the higher (the absolute value of) the mean consumption elasticities, the higher consumption inequality is. This is captured by the penultimate line in (10). In addition, the larger marginal or joint unobserved heterogeneity is, captured by the last line in (10), the higher consumption inequality is. Note that $\text{Var}\left(\bar{\eta}_{c(i)}\right)$ involves the variances of all three consumption elasticities of table 1 as well as their respective covariances.

Expressions (9) and (10) reveal that, conditional on wage inequality, initial conditions and $\varepsilon_j(\cdot) = 1$ (more on this to follow; the conditioning is for facilitating the illustration), preference heterogeneity *always* increases consumption inequality. Let ϕ_{it} be a generic transmission parameter of a shock into consumption (for example, $\phi_{it} = \eta_{c,w_1(i)}$ for u_{1it} or $\phi_{it} = \eta_{c,w_1(i)} + \bar{\eta}_{c(i)}$ for v_{1it}). Preference heterogeneity implies that $\text{Var}(\phi_{it}) > 0$; from (8)-(10) it then follows that $\partial\text{Var}(\Delta c_{it})/\partial\text{Var}(\phi_{it}) > 0$. Therefore preference heterogeneity increases consumption inequality compared to the representative consumer's case ($\text{Var}(\phi_{it}) = 0$). The logic is straightforward: households who differ in preferences respond differently to a similar wage shock and lead to divergent consumption paths. The greater preference heterogeneity is, the further apart their consumption responses are and the higher consumption inequality is.

While this analytical result is always true for consumption instability (expression (9)), it is derived for permanent inequality under the ad hoc assumption that $\varepsilon_j = 1$ (expression (10)). Term $\varepsilon_j(\cdot)$ is a complicated function of preferences and initial conditions; due to this, unconditional permanent inequality cannot be written in closed-form in terms of first and second moments of preferences. However, simulations of permanent inequality in section 5.2 that fully account for the structure of $\varepsilon_j(\cdot)$ reveal that preference heterogeneity *always* increases permanent inequality.

Heterogeneity in initial conditions contributes to consumption inequality by inducing inequality in the ability households have to insulate their lifetime budgets from permanent wage shocks; that is by inducing variability in $\varepsilon_j(\cdot)$. As $\text{Var}(\varepsilon_j(\cdot))$ is a complicated implicit function of moments of π_{it} and s_{it} as well as preferences, I cannot sign analytically how such heterogeneity affects inequality. However, simulations in section 5.2 illustrate that heterogeneity in initial conditions, that is in financial and human wealth, *always* increases consumption inequality.

A few additional remarks are due here. First, the analytical expression for inequality is consistent with Blundell et al. (2008)'s remark that factors other than income inequality also contribute to consumption inequality. They refer to factors pertaining to "measurement error in consumption, preference shocks, innovations to higher moments of the income process, etc" (p.1897). While I discuss measurement error in section 4 and higher wage moments do not enter the variance of consumption growth by assumption, household-specific preferences *is* a general way through which preference shocks impact inequality.

Second, positive assortative mating in the family, as captured by a positive covariance of wage shocks, may not increase consumption inequality. The reason is the concept of 'double assortative mating' that the model allows for, one on wages and another one on preferences. To see this, observe the loading factor of the covariance of transitory shocks in (9). What matters for loading such covariance is (also) the correlation between spousal consumption preferences. In the case when $\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)}) < 0$ because of a strong negative correlation of such preferences, then positive assortative mating on wages actually decreases inequality. Similar arguments apply for negative assortative mating on wages etc.

Third, the analytical expression for consumption inequality implies that second moments of shocks and mean preferences alone underestimate consumption inequality. Similarly, using observed consumption and wage inequality to estimate mean preferences biases preferences upwards unless preference heterogeneity is accounted for.

One can obtain similar analytical expressions and explanatory statements for inequality in earnings and hours, as well as all possible covariances among them. Such expressions describe fully the dynamics of consumption, earnings, and hours inequality across households. For completeness, appendix C presents the analytical expressions for earnings and hours inequality.

3 Identification

This section discusses identification of the parameters of the wage process and the cross-sectional joint distribution of preferences $F_{\boldsymbol{\eta}}$ from longitudinal data on wages, earnings and consumption. Appendix D provides a more detailed treatment.

3.1 Wage Process

Identification of the second moments of wage shocks ($\sigma^2_{v_j(t)}$, $\sigma^2_{u_j(t)}$, $\sigma_{v_1v_2(t)}$, $\sigma_{u_1u_2(t)}$; $j = \{1,2\}$) follows Meghir and Pistaferri (2004) and earlier studies and requires second moments of the joint distribution of spouses' wages across households. Consider the wage process in (3). The covariance between consecutive wage growths $\mathbb{E}\left(\Delta w_{jit}\Delta w_{jit+1}\right)$ identifies the variance of the transitory shock due to mean-reversion. The covariance between contemporaneous wage growth and a sum of three consecutive wage growths $\mathbb{E}\left(\Delta w_{jit}\sum_{\varsigma=-1}^{\varsigma=1}\Delta w_{jit+\varsigma}\right)$ identifies the variance of the permanent shock because the sum strips Δw_{jit} of its mean-reverting transitory shock at t. Similar arguments apply to the covariances of shocks.

Identification of the third moments of shocks ($\gamma_{v_j(t)}$, $\gamma_{u_j(t)}$, $\gamma_{v_1v_2^2(t)}$, $\gamma_{v_1^2v_2(t)}$, $\gamma_{u_1u_2^2(t)}$, $\gamma_{u_1^2u_2(t)}$; $j = \{1,2\}$) requires third moments of the joint distribution of spouses' wages across households. As an illustration

$$\gamma_{v_j(t)} = \mathbb{E}\left((\Delta w_{jit})^2(\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right)$$
$$\gamma_{u_j(t)} = -\mathbb{E}\left((\Delta w_{jit})^2\Delta w_{jit+1}\right).$$

Similar expressions identify the third cross-moments. The intuition behind identification parallels that for the second moments above while there are many over-identifying restrictions.[14]

General identification. These results can be generalized to the n^{th} moment ($n > 1$) of shocks as follows. The n^{th} own-moment of spouse j's permanent wage shock $\mathbb{E}(v^n_{jit})$ is identified through

[14] In the permanent-transitory specification the variance of the transitory shock is not separately identified from the variance of measurement error (a point made, among others, in Blundell et al., 2008). The empirical application of section 4 addresses this in practice. Identification of the third moments of transitory shocks obtains under the assumption that wage measurement error has zero skewness (as in the case of a normally distributed error).

the n^{th} moment of wages

$$\mathbb{E}\left((\Delta w_{jit})^{n-1}(\Delta w_{jit-1}+\Delta w_{jit}+\Delta w_{jit+1})\right); \quad j=\{1,2\}. \tag{11}$$

Moment (11) carries information on $\mathbb{E}(v_{jit}^n)$ *plus* a sum of products of lower-order moments (up to $n-2\geq 2$) of spouse j's permanent and transitory wage shocks at times t and $t-1$. Such lower-order moments are identified sequentially relying on results for the variance and skewness and then moving up, if required, until reaching moments of order $n-2$. Similar arguments apply to the identification of the n^{th} cross-moment $\mathbb{E}(v_{1it}^{\nu}v_{2it}^{n-\nu})$, $\nu=\{1,\dots,n-1\}$.

Three remarks are in order. First, unlike the variance and skewness, it is not possible to identify higher than third moments of permanent shocks without relying on lower-order moments, that is, without previously identifying lower-order moments. Second, no unique generic formula can be derived relating moment (11) to $\mathbb{E}(v_{jit}^n)$ *for every* n. The reason is the accompanying sum of products of lower-order moments in each case. Such term depends on (and increases with) n; lower-order sums are not nested within higher-order sums thus ruling out a generic formula *for every* n. Third, over-identifying restrictions exist for all own- and cross-moments of permanent wage shocks of order higher than 2.

The n^{th} own-moment of spouse j's transitory shock $\mathbb{E}(u_{jit}^n)$ is identified through the n^{th} autocovariance of wages

$$\mathbb{E}\left((\Delta w_{jit})^{n-1}\Delta w_{jit+1}\right); \quad j=\{1,2\}. \tag{12}$$

Moment (12) carries information on $\mathbb{E}(u_{jit}^n)$ *plus*, like previously, a sum of products of lower-order moments (order up to $n-2\geq 2$) of spouse j's permanent and transitory wage shocks at times t and $t-1$. Identification of the n^{th} cross-moment $\mathbb{E}(u_{1it}^{\nu}u_{2it}^{n-\nu})$, $\nu=\{1,\dots,n-1\}$, is similar. As with permanent shocks, identification of higher moments of transitory shocks is sequential (knowledge of lower moments is required to obtain higher moments), one unique generic formula linking wage moment (12) to $\mathbb{E}(u_{jit}^n)$ *for every* n does not exist, and over-identifying restrictions are available for all own- and cross-moments of order higher than 2.[15]

3.2 Preferences

The preference parameters of interest are the unconditional first, second, and higher moments of the 9-dimensional joint distribution $F_{\boldsymbol{\eta}}$ of Frisch elasticities across households.

There are 9 parameters that characterize the unconditional first moment: $\mathbb{E}(\eta_{c,w_j(i)})$, $\mathbb{E}(\eta_{c,p(i)})$, $\mathbb{E}(\eta_{h_{j'},w_j(i)})$, and $\mathbb{E}(\eta_{h_{j'},p(i)})$ for $j,j'=\{1,2\}$. These means are taken across households i assuming they are time t invariant.

There are 45 parameters characterizing the unconditional second moment; these are the cross-sectional variances of each Frisch elasticity of table 1 (9 parameters) as well as all possible co-variances between them (36 parameters). Table D.1 in the appendix lists these parameters. The variances and covariances are taken across households assuming, again, they are time t invariant.

In general, there are $\left(\prod_{i=1}^{8}(n+i)\right)/8!$ parameters characterizing the unconditional $n^{\text{th}}=\{1,2,3,\dots\}$ moment of $F_{\boldsymbol{\eta}}$, assuming that such moment exists and is finite.

I group these parameters (moments) into two categories. The first includes moments that refer exclusively to *wage elasticities*, such as the mean female labor supply elasticity $\mathbb{E}(\eta_{h_2,w_2(i)})$, the variance of the consumption-wage elasticity $\text{Var}(\eta_{c,w_j(i)})$, or the covariance $\text{Cov}(\eta_{c,w_1(i)},\eta_{c,w_2(i)})$. The second category includes all remaining parameters; that is moments that involve elasticities *with respect to the price of consumption* such as the mean and variance of the consumption substitution elasticity, $\mathbb{E}(\eta_{c,p(i)})$ and $\text{Var}(\eta_{c,p(i)})$ respectively, or its covariance with women's labor supply elasticity $\text{Cov}(\eta_{c,p(i)},\eta_{h_2,w_2(i)})$.

[15] Identification of n^{th} moments of shocks requires moments of the distribution of wage measurement error up to order n. If high-order error moments are non-zero, then wage moments (11)-(12) pick up economically relevant parameters (moments of shocks) as well as moments of the error. Information on the variance of measurement error in survey data is often available through validation studies (for the PSID see Bound et al., 1994). For the rest of this paper I assume that all moments of wage measurement error other than the variance are zero.

3.2.1 Wage Elasticities

First moments. Identification of the first moments of wage elasticities follows BPS and relies on the transmission of transitory wage shocks into consumption and hours of work (or earnings). Such transmission is captured by the first-order autocovariance $\mathbb{E}(\Delta c_{it}\Delta w_{jit+1})$ in the case of consumption and $\mathbb{E}(\Delta y_{jit}\Delta w_{j'it+1})$, $j, j' = \{1, 2\}$, in the case of earnings y.[16] It reflects the variance of the mean-reverting transitory shock weighed by the average loading factor of such shock onto consumption and hours (or earnings), that is by the average consumption-wage or labor supply elasticity respectively.[17]

The rationale behind identification is as follows. The average own-wage Frisch elasticity of labor supply reflects the average sensitivity of hours to a transitory wage change; this is precisely what the average response of hours to transitory shocks measures. As transitory shocks do not shift the lifetime budget constraint while they shift labor supply, the average response of consumption to such shocks uncovers the average complementarity of consumption and hours, namely the average consumption-wage Frisch elasticity. By a similar argument the average response of hours to the partner's transitory shock uncovers the average complementarity between spouses' hours.

Second moments. Identification of the second moments of wage elasticities rests on the idea that cross-sectional variation in consumption or hours that occurs at fixed prices and covariates reflects heterogeneity in preferences. This is motivated empirically by the observation of Abowd and Card (1989, p.411) who find that "most of the covariation of earnings and working hours occurs at fixed wage rates". This suggests that the variation in hours that remains after removing variation in wages and observables masks heterogeneity in labor supply preferences; the argument can be extended to cover consumption and consumption preferences too.

As an illustration, consider expressions (5) and (6) for consumption and male hours/earnings growth; assume for now that female transitory shocks are zero ($u_{2it} = 0\ \forall i, t$) and recall the independence assumption between shocks and preferences. Variation in consumption growth across consecutive periods, given by the first-order autocovariance $\mathbb{E}(\Delta c_{it}\Delta c_{it+1}) = -\mathbb{E}(\eta^2_{c,w_1(i)})\sigma^2_{u_1(t)}$, is due to the variance of the mean-reverting transitory shock *and* heterogeneity across households in the consumption response to such shock, that is, in the consumption elasticity η_{c,w_1}. Similarly, intertemporal variation in earnings growth, given by $\mathbb{E}(\Delta y_{1it}\Delta y_{1it+1}) = -\mathbb{E}\big((1+\eta_{h_1,w_1(i)})^2\big)\sigma^2_{u_1(t)}$, is due to the variance of the shock *and* heterogeneity in the male labor supply elasticity, while covariation in consumption and earnings growth across periods, given by $\mathbb{E}(\Delta c_{it}\Delta y_{1it+1}) = -\mathbb{E}\big(\eta_{c,w_1(i)}(1+\eta_{h_1,w_1(i)})\big)\sigma^2_{u_1(t)}$, is due to the variance of the shock *and* the *joint* variation in the consumption and male labor supply elasticities. Scaling these covariances by the inverse variance of the shock removes variation in wages and identifies $\mathrm{Var}(\eta_{c,w_1(i)})$, $\mathrm{Var}(\eta_{h_1,w_1(i)})$ and $\mathrm{Cov}(\eta_{c,w_1(i)}, \eta_{h_1,w_1(i)})$ respectively.[18] Covariates are kept fixed by using consumption, earnings and wage moments net of individual- and household-level observables.

The previous lines convey the intuition behind identification in the simplest terms. Relaxing the assumption that there is no female transitory shock renders identification slightly more demanding but the basic logic remains unchanged. One has to take into account the joint variation in spouses' shocks as well as all possible covariances between different elasticities. As an illustration for consumption, the first-order autocovariance becomes

$$\mathbb{E}(\Delta c_{it}\Delta c_{it+1}) = -\mathbb{E}(\eta^2_{c,w_1(i)})\sigma^2_{u_1(t)} - \mathbb{E}(\eta^2_{c,w_2(i)})\sigma^2_{u_2(t)} - 2\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)})\sigma_{u_1u_2(t)}$$

[16] Earnings Y_j are given by the product of wage and hours of spouse j. Growth in earnings from time $t-1$ to t net of the effect of observable and predictable covariates is given by $\Delta y_{jit} = \Delta w_{jit} + \Delta h_{jit}$ with Δw_{jit} given by (3) and Δh_{jit} given by (6)-(7).

[17] If measurement error in earnings varies with measurement error in wages identification still obtains so long as information on the variance of error in wages, earnings, and hours is available. This if often the case through validation studies (see, for example, Bound et al., 1994, for the PSID). Section 4 illustrates this point empirically. Identification requires that measurement errors in spouses' earnings do not covary.

[18] Identification of the second central moments requires prior identification of the first moments.

and no longer identifies $\text{Var}(\eta_{c,w_1(i)})$; such autocovariance now reflects variation in spouses' transitory shocks as well as marginal and joint heterogeneity in all consumption-wage elasticities. We are in need of additional identifying equations. Consumption preference heterogeneity affects a number of higher joint moments of consumption and wages such as the intertemporal covariance between wage and squared consumption growth $\mathbb{E}((\Delta c_{it})^2 \Delta w_{jit-1})$ (a total of two additional moments as $j = \{1, 2\}$). Essentially, this is a form of an 'impulse response' function. The extent to which squared consumption growth varies intertemporally with wage growth reflects skewness in the distribution of shocks upscaled by dispersion in consumption preferences, therefore providing additional information to (in this case just-) identify such dispersion, namely $\text{Var}(\eta_{c,w_j(i)})$ and $\text{Cov}(\eta_{c,w_1(i)}, \eta_{c,w_2(i)})$. Similar arguments apply to all other second moments of wage elasticities.

A few remarks are in order. First, identification of the second moments requires second *and* third moments of the joint consumption-earnings-wage distribution while identification of mean preferences required second moments only. Restricting severely the distributions of preferences and shocks permits identification without third moments. Second, identification of selected covariances relies on symmetry of the matrix of Frisch substitution effects, a natural theoretical restriction discussed in appendix B. Third, identification obtains even if $\sigma_{u_1 u_2} = 0$ *or* $\gamma_{u_1^2 u_2} = \gamma_{u_1 u_2^2} = 0$. If all cross-moments of shocks are zero, the variances of all wage elasticities are still identified but selected covariances are not. Fourth, the distribution of measurement error, including consumption error, is not separately identified from preference heterogeneity. However, measurement error may be accounted for using external information whenever available. Finally, identification relies exclusively on the response to transitory shocks and makes no use of moments that pertain to permanent shocks, a point to which the paper soon returns.

Higher moments. Identification of higher moments obeys a similar idea: consumption skewness reflects skewness in wage shocks as well as skewness in consumption preferences; earnings kurtosis reflects kurtosis in the distribution of shocks as well as in labor supply preferences, etc. Practically, however, identification is not as parsimonious as for the second moments due to the ever-increasing number of parameters involved.

As an illustration, the four parameters characterizing (co-)skewness in the $\eta_{c,w_j(i)}$'s are over-identified by $\mathbb{E}((\Delta c_{it})^2 \Delta c_{it+1})$, $\mathbb{E}(\Delta w_{jit-1} (\Delta c_{it})^2 \Delta c_{it+1})$ and $\mathbb{E}((\Delta w_{jit-1})^2 (\Delta c_{it})^2 \Delta c_{it+1})$, $j = \{1, 2\}$. The use of third and fourth moments parallels the use of second and third moments before; the only difference is that the third moment involves $(\Delta c_{it})^2 \Delta c_{it+1}$ rather than $(\Delta c_{it})^3$ as the intertemporal product helps avoid high-order moments of permanent shocks and their coefficients. Third and fourth moments, however, do not suffice to identify all four parameters unless one restricts co-skewness across the $\eta_{c,w_j(i)}$'s. To avoid such restrictions, the fifth moment above provides additional identifying equations and completes identification. All other third moments of wage elasticities are identified similarly.

The discussion extends to the n^{th} moment of wage elasticities. This involves an ever-longer intertemporal product of consumption or earnings growth (for consumption: $\prod_{\tau=0}^{n-3} \Delta c_{it-\tau} \Delta c_{it} \Delta c_{it+1}$, $n \geq 3$) as well as empirical moments of order at least $n+2$. The data requirements quickly become tedious and restrictions on higher cross-moments only partly alleviate such requirements.

3.2.2 Other Parameters

The elasticities with respect to the price of consumption matter for the sensitivity of the lifetime budget constraint to permanent shocks. In the absence of observed cross-sectional variation in this price, identification of moments of such elasticities must come from the transmission of permanent wage shocks into consumption and hours. In practice, however, the transmission of such shocks cannot point-identify any moment of these elasticities in the presence of preference heterogeneity.

Assume for simplicity that consumption and hours are separable within the utility function as are also spouses' respective hours; in addition assume $\pi_{it} = 0$ (no financial wealth) and $s_{1it} =$

$s_{2it} = 1/2$ (the spouses have equal expected lifetime earnings). Consider the transmission of the male permanent shock into consumption, controlled by the quasi-reduced-form parameter

$$\kappa_{c,v_1(i)} \equiv \frac{\eta_{c,p(i)}(1+\eta_{h_1,w_1(i)})}{2\eta_{c,p(i)} - \eta_{h_1,w_1(i)} - \eta_{h_2,w_2(i)}}.$$[19]

Identification of the average Marshallian elasticity $\mathbb{E}(\kappa_{c,v_1(i)})$ is straightforward from concurrent consumption and wage data. Abstracting from preference heterogeneity, BPS recover a homogeneous $\eta_{c,p}$ from $\mathbb{E}(\kappa_{c,v_1(i)})$: conditional on the labor supply elasticities, the level of the Marshallian elasticity reflects and depends on the willingness of households to trade consumption intertemporally, therefore it pins down $\eta_{c,p}$. In the presence of multidimensional preference heterogeneity, however, $\mathbb{E}(\kappa_{c,v_1(i)})$ depends on a plethora of parameters, namely the mean and variance of $\eta_{c,p(i)}$, its covariance with the labor supply elasticities, higher own and cross-moments, as well as moments pertaining exclusively to $\eta_{h_j,w_j(i)}$ (one can see this by a Taylor expansion of $\kappa_{c,v_1(i)}$ around mean preferences). Even if the latter moments are identified as per section 3.2.1, one cannot separate the mean from the variance of $\eta_{c,p(i)}$ or from any of its covariances. Identification even of $\mathbb{E}(\eta_{c,p(i)})$ fails and no other Marshallian elasticity (e.g. of hours) can help overcome this as the number of involved parameters is large, especially so when preferences are nonseparable.[20]

Why does $\mathbb{E}(\kappa_{c,v_1(i)})$ depend on various moments of $\eta_{c,p(i)}$? Abstract from female labor supply and consider households who, on average, dislike fluctuations in consumption ($\mathbb{E}(\eta_{c,p(i)}) \to 0^-$) and male labor supply ($\mathbb{E}(\eta_{h_1,w_1(i)}) \to 0^+$). Furthermore, suppose that households with *less* elastic labor supply (low $\eta_{h_1,w_1(i)}$) are also *less* reluctant to intertemporal consumption fluctuations ($\eta_{c,p(i)}$ more negative but correlates positively with $\eta_{h_1,w_1(i)}$). Because those who barely use labor supply to smooth shocks (smallest η_{h_1,w_1}) are also those who do not resent passing such shocks into consumption (largest absolute $\eta_{c,p}$), average consumption across households is more responsive to permanent shocks (higher Marshallian elasticity) than without the preference correlation.[21] Ignoring the correlation results in overestimating $|\mathbb{E}(\eta_{c,p(i)})|$ and mistakenly deeming the average household more willing to trade consumption intertemporally.

The rest of the paper focuses on wage elasticities. However, I will revisit the consumption substitution elasticity for a short empirical discussion in section 5.

4 Application

This section presents the empirical implementation of the model. I fit second and third moments of the cross-sectional joint distribution of household-level consumption growth, individual-level earnings growth, and individual-level wage growth in the PSID. This enables me to estimate second and third moments of shocks as well as first and second moments of wage elasticities.

4.1 Data and Implementation

Data. I use data from the PSID in waves 1999-2011 (7 waves as data are collected every second year).[22] The PSID started in 1968 tracking a -then- nationally representative sample of households ('SRC' sample) as well as a second sample of lower-income households ('SEO' sample); repeated annually until 1997 the survey collected detailed information on incomes, employment,

[19] One can obtain this simplified transmission parameter from expression (5) for consumption growth by plugging in $\eta_{c,w_j(i)} = \eta_{h_j,p(i)} = 0$, $\eta_{h_j,w_{j'}} = 0$, $\pi_{it} = 0$ and $s_{jit} = 0.5$.

[20] One can use moments of the consumption-wage elasticities and restrictions implied by Frisch symmetry to identify moments of the 'reciprocal' hours elasticities with respect to the price of consumption. One would still be unable to separate the mean from the variance of $\eta_{c,p(i)}$ or from any of its covariances in $\mathbb{E}(\kappa_{c,v_1(i)})$.

[21] For example, $\mathbb{E}(\eta_{c,p(i)}) = -0.05$ & $\mathbb{E}(\eta_{h_j,w_j(i)}) = 0.2$ imply $\partial\mathbb{E}(\kappa_{c,v_1(i)})/\partial\mathrm{Cov}(\eta_{c,p(i)},\eta_{h_1,w_1(i)}) = 1.28$. At these values $\mathbb{E}(\kappa_{c,v_1(i)})$ increases more than 1-to-1 with a positive correlation in preferences.

[22] I also use data from 1997 for the estimation of wage shocks. More information on the PSID, as well as access to the data, is available online at psidonline.isr.umich.edu.

food expenditure and demographics of the adult household members and their linear descendants should they split off and establish their own households. The survey became biennial after 1997 to enable the collection of detailed information on household consumption and wealth. The PSID is ideal for the empirical implementation of this model because it provides longitudinal information jointly on demographics, wages, earnings and consumption in the household.

I select married opposite-sex couples between 30 and 60 years old from the 'SRC' sample. I require consistent information on age, education, race and no missing information on employment or state of residence. I focus on stable couples; if a spouse remarries, I drop the household in the year when remarriage occurs and reinstate it subsequently as a new household. As the estimating equations are in first differences, I drop households that appear in the sample only once.

Identification requires wages for both spouses; therefore I require that spouses participate in the labor market and earn positive amounts. I discuss potential selectivity issues below. I construct hourly wages as earnings over total hours of work on a yearly basis and I drop observations for which wages are below half the applicable state minimum wage in a given year.[23]

I construct consumption (expenditure) as the Hicksian aggregate of a number of elementary consumption items.[24] I treat missing values in elementary items as zeros but I drop a few observations for which (i) total consumption is zero, or (ii) an elementary item is censored, or (iii) the reported time period a given expenditure is incurred in is missing. I impute the expenditure value of housing for homeowners as 6% of the self-reported value of their house.

Finally, I remove observations for which wages, earnings or consumption experience an extreme drop (jump) in a given period followed by an extreme jump (drop) in the next one as such movements may reflect measurement error.[25] In addition, I remove households whose wealth[26] is higher than \$20M or whose wages, earnings or consumption lie in the top 0.25% of the respective (where applicable, spouse-specific) distributions by age. Table 2 presents descriptive statistics for the baseline estimation sample (columns (1)-(3)) and for four subsamples of relatively wealthy households (columns (W1)-(W4)). I postpone the discussion of the wealthy for section 5.3.

Average earnings of men in the baseline sample are 78% higher than average earnings of women; men, however, work on average 526 hours more, almost a third more than women. Women are 70% likely to have had some college education; men are slightly less likely. Household consumption is, on average, a fraction of men's earnings but greater than women's. The largest single component within the consumption basket is housing, followed by vehicles (including gasoline) and food at home. On average, there is one child under 18 in the household.

Implementation. The estimation is implemented in three stages corresponding respectively to covariates, wages, and preferences. In the first stage, I regress $\Delta \ln W_{jit}$ on a set of observable characteristics including year, age, education, race, and state of residence dummies, as well as year-education and year-race interactions. I carry out the regression separately by spouse $j = \{1, 2\}$. If wages are measured with error the residual from this regression is $\Delta w^*_{jit} = \Delta w_{jit} + \Delta e^w_{jit}$ where w_{jit}

[23]Earnings are defined as labor income from all jobs (including overtime, tips, bonuses, commissions etc.) plus the labor part of business income from unincorporated businesses. I exclude the labor part of farm income because this is not measured consistently over time. Participation requires strictly positive earnings *and* hours of work. The latter is defined as actual realized (but self-reported) hours on all jobs including overtime.

[24]Elementary items are: food (prepared or delivered at home and food away from home; all food items are for recipients and non-recipients of food stamps), vehicle expenses (car insurance, repairs, parking, gasoline), transportation costs (bus and train tickets, taxicabs, other costs), child care, school expenses for children, medical costs (health insurance, nursing homes and hospital bills, doctor, surgery, and dentist costs, prescriptions), utilities (gas, electricity, water and sewage costs, other utilities such as telecommunications), home insurance, rent for renters and rent equivalent for homeowners or those in other housing arrangements.

[25]Given the biennial nature of the data, I construct the distribution of $(\chi_{it} - \chi_{it-2})(\chi_{it+2} - \chi_{it})$ by available year and I drop observations with values in the bottom 0.25% ($\chi_{it} = \{\ln W_{jit}, \ln Y_{jit}, \ln C_{it}\}$, $j = \{1, 2\}$).

[26]Household wealth comprises the present value of the primary dwelling net of outstanding mortgages, other real estate, savings, IRA and annuities, the value of vehicles, farms and businesses, any investment in stocks and shares, and any other assets net of credit card debt, student loans, medical or legal bills, and loans from relatives.

Table 2 – Descriptive Statistics

	baseline sample			$A > \overline{C}$	$A > 2\overline{C}$	$A > \overline{C}$ no debt	$A > \overline{C}$ liquid
	(1) Mean	(2) Med.	(3) St.d.	(W1) Mean	(W2) Mean	(W3) Mean	(W4) Mean
Male earner							
Earnings	71159	57717	56281	77784	82168	78075	85054
Hours of work	2253	2202	610	2257	2262	2228	2252
Hourly wage	32.2	26.1	25.5	35.3	37.3	35.4	38.4
Age	45.1	45.0	7.8	46.9	47.4	47.4	47.9
Some college %	66.8	100.0	47.1	71.2	74.7	70.0	75.6
Female earner							
Earnings	40023	34190	30102	42484	43869	41176	44033
Hours of work	1727	1880	659	1723	1712	1673	1665
Hourly wage	23.2	19.4	15.3	24.8	25.8	24.9	26.9
Age	43.4	43.0	7.6	45.2	45.7	45.6	46.1
Some college %	70.3	100.0	45.7	73.2	75.6	72.0	76.1
Household consumption							
Total consumption	46212	40536	23768	49725	52451	47334	50504
food at home	7058	6523	3505	7170	7278	6840	6930
food out	2951	2313	2594	3140	3271	2986	3194
vehicles[a]	7087	5264	6582	7327	7524	6557	6728
public transport	313	0.0	2339	369	419	294	329
childcare	921	0.0	3008	842	828	687	701
education	3303	0.0	8772	4048	4504	3428	3877
medical expenses[b]	3591	2536	3860	3723	3849	3437	3700
utilities	4798	4413	2726	4843	4905	4388	4465
housing[c]	16191	12871	12371	18264	19873	18716	20581
Household assets and debts [in thousands]							
Total wealth	382.9	177.5	790.0	503.0	587.5	624.2	751.9
Home equity[d]	126.0	80.3	160.1	163.8	186.8	193.3	218.0
Other debt	12.2	2.7	28.7	9.1	8.9	0.1	0.1
All other assets	269.1	81.6	721.6	348.3	409.5	431.0	534.1
other real estate	42.1	0.0	289.6	54.1	64.7	61.0	71.1
savings accounts	25.0	6.9	61.7	31.6	36.3	46.1	56.7
stocks-shares	45.7	0.0	299.5	61.0	72.8	84.5	108.8
# of children	1.0	1.0	1.1	0.9	0.9	0.9	0.8
Obs. [households × years]		8177		5635	4649	2336	1794

Notes: The table presents summary statistics for the baseline sample (columns (1)-(3)) and for four subsamples of relatively wealthy households (columns (W1)-(W4)) in waves 1999-2011. All monetary amounts are expressed in 2010 dollars. Earnings, hours, consumption and wealth/debt are in annual amounts. Column (W1) is for households with annual wealth A_t at least as much as average annual consumption $\overline{C}_t$ in the baseline sample (see footnote 26 for definition of wealth). Column (W2) is for households with annual wealth at least twice as much as average annual consumption. Column (W3) is like column (W1) with the additional condition that households hold real debt that does not exceed $2K. Column (W4) is like column (W3) but the relevant measure of wealth excludes home equity (i.e. the value of one's home net of outstanding mortgages), therefore it better proxies for liquid assets. [a] including gasoline; [b] including health insurance and prescriptions; [c] including home insurance, rent and rent equivalent for homeowners and those in alternative housing arrangements; [d] refers to the present value of owned house net of outstanding mortgages.

is the unexplained part of wages and e^w_{jit} is wage measurement error. The statistical/theoretical counterpart of Δw_{jit} is given by (3).[27]

I regress earnings growth $\Delta \ln Y_{jit}$ on the above set of observable characteristics for oneself *and* their spouse, as well as indicators for the number of children in the household, the number of household members, employment status of either spouse, and whether the household supports members outside the household (such as a child studying abroad) or receives income from members other than the head couple. I also include changes in those variables over time and interactions with year dummies. I carry out the regression separately for each spouse. If earnings are measured with error the residual out of this regression is $\Delta y^*_{jit} = \Delta y_{jit} + \Delta e^y_{jit}$ where y_{jit} is the unexplained part of earnings and e^y_{jit} is measurement error. The theoretical counterpart of Δy_{jit} is $\Delta w_{jit} + \Delta h_{jit}$ with Δh_{jit} given by (6)-(7). Similarly, I regress consumption growth $\Delta \ln C_{it}$ on the same covariates as in the case of earnings. The residual from this regression is $\Delta c^*_{it} = \Delta c_{it} + \Delta e^c_{it}$ where c_{it} is the unexplained part of household consumption and e^c_{it} denotes consumption measurement error. The theoretical counterpart of Δc_{it} is (5).

The purpose of all first-stage regressions is to remove the effect of observables on wages and outcomes. In other words, the conditioning covariates serve to capture *observed* heterogeneity in wages, earnings, and consumption ($\mathbf{X}_{jit}$ and $\mathbf{Z}_{it}$ in model notation). Following the model and abstracting from measurement error, any remaining variation in wages is due to wage shocks and any remaining variation in earnings or consumption is due to wage shocks, *unobserved* preference heterogeneity, and heterogeneity in initial conditions π_{it} and $\mathbf{s}_{it}$.

In the second stage, I use second and third moments of the joint distribution of residual wages to estimate second and third moments of permanent and transitory shocks. The estimation fits moments of shocks to multiple empirical wage moments accounting for many over-identifying restrictions. I deal with this using GMM and the identity weighting matrix.

In the third stage, I use selected second and, depending on the model specification, third moments of the joint distribution of residual wages, earnings, and consumption to estimate first and second moments of wage elasticities. The estimation fits theoretical joint moments of wage, earnings and consumption growth to their empirical counterparts conditional on moments of wage shocks from the second stage. I deal with multiple moments and over-identifying restrictions using GMM and the identity weighting matrix.

Fitting joint moments of wages, earnings and consumption requires information on π_{it} and $\mathbf{s}_{it}$. These parameters, which can be inferred directly from the data, enter the theoretical moments of earnings and consumption through the transmission of permanent shocks. Such transmission, however, also depends on elasticities with respect to the price of consumption, the distribution of which is not identified in the presence of unobserved preference heterogeneity (see section 3.2.2). Therefore, I only fit joint moments of wages, earnings, and consumption that pertain exclusively to the transmission of transitory shocks. These are moments of variables across *consecutive* rather concurrent time periods. I am not using information on the transmission of permanent shocks, therefore π_{it} and $\mathbf{s}_{it}$ are not needed in the estimation (however see section 5.2). Appendix E lists all moments targeted in the second and third stages. The estimation requires information and assumptions on measurement error, a matter which I discuss below.

Measurement error. Measurement error in the data presents the following challenges: (1.) wage measurement error relates to earnings measurement error because wages are constructed as earnings over hours; (2.) the variance of the transitory shock is not separately identified from the variance of wage measurement error (a point made, among others, in Blundell et al., 2008); in general, third moments of transitory shocks are not separately identified from third moments of the error; (3.) the variance of consumption measurement error is not identified in the presence

[27] Given the biennial nature of the data, the theoretical notation $\Delta \ln W_{jit} = \ln W_{jit} - \ln W_{jit-1}$ is equivalent to the empirical $\Delta^2 \ln W_{jit} = \ln W_{jit} - \ln W_{jit-2}$. I will maintain the first notation throughout the text, but note that $\Delta \ln W_{jit}$ actually refers to a first difference over two years.

of consumption preference heterogeneity; in general, preference heterogeneity is not separately identified from moments of measurement error without restrictions on its distribution.

To overcome challenge (1.) and partly (2.) I remove a priori the variability in wages and earnings that is due to measurement error. I obtain the variance of measurement error in the PSID from Bound et al. (1994) who report findings from a validation study.[28] Their study provides a range for measurement error in wages, earnings, and hours, the mid-point of which I use as follows: I set $\mathrm{Var}(e^w_{jit}) = 0.13\mathrm{Var}(\ln W_{jit})$ and $\mathrm{Var}(e^y_{jit}) = 0.04\mathrm{Var}(\ln Y_{jit})$; for the covariance I use $\mathrm{Cov}(e^w_{jit}, e^y_{jit}) = 0.5\mathrm{Var}(e^y_{jit}) - 0.5(\mathrm{Var}(e^h_{jit}) - \mathrm{Var}(e^w_{jit}))$ where $\mathrm{Var}(e^h_{jit}) = 0.23\mathrm{Var}(\ln H_{jit})$ is the variance of error in log hours worked.[29]

As the validation study does not go beyond the error variances, I assume that all third moments of the error are zero (as in the case of normally distributed errors), wage and consumption errors are independent, as are also men's and women's respective errors in wages and earnings. The study does not provide information on consumption measurement error. In specifications when I cannot separately identify the error variance from heterogeneity in consumption preferences, I only identify an upper bound to such heterogeneity (but see section 5.3 for a further discussion).

Inference. Given the multi-stage estimation, I adopt the block bootstrap as means to conduct inference (Horowitz, 2001). I draw 1,000 random samples from the baseline sample described in table 2 and I repeat each stage of the estimation for each such sample.

A major challenge arises because some parameters are on the boundary of the parameter space when the model is estimated on the original data or/and on the bootstrap samples. The bootstrap is inconsistent in such cases (Andrews, 2000). This affects all heterogeneity parameters that are subject to non-negativity inequality constraints, namely the variances $\mathrm{Var}(\eta_{c,w_j(i)})$, $\mathrm{Var}(\eta_{h_1,w_j(i)})$, $\mathrm{Var}(\eta_{h_2,w_j(i)})$, $j = \{1, 2\}$. It does not affect the variances of wage shocks whose estimates on the original and bootstrap samples are always away from the zero lower bound.

I adopt the following rule to overcome this challenge. I report standard errors $\hat{\sigma}$ for wage or preference parameters *not* subject to non-negativity constraints. I calculate $\hat{\sigma}$ as $\hat{\sigma} = (\hat{F}^{-1}(0.75) - \hat{F}^{-1}(0.25))/(\Phi^{-1}(0.75) - \Phi^{-1}(0.25))$; the numerator is the interquartile range of the bootstrap distribution $\hat{F}$ of the relevant parameter and Φ is the standard normal cdf.[30]

For parameters subject to non-negativity constraints I report the p-value associated with the null hypothesis that the respective parameter θ is zero ($\mathcal{H}_0 : \theta = 0$) against the one-sided alternative ($\mathcal{H}_a : \theta > 0$). I obtain the p-value as one minus the share of bootstrap replications for which $n^{1/2}\hat{\theta} > n^{1/2}(\hat{\theta}^* - \hat{\theta})$, where $\hat{\theta}^*$ is a bootstrap estimate of θ and $\hat{\theta}$ is the original parameter estimate. Andrews (2000) shows that the bootstrap test of $\mathcal{H}_0$ against $\mathcal{H}_a$ has the correct asymptotic rejection rate for $p \in (0, 1/2)$.

Selection into labor market. Participation in the labor market is relatively high in the sample: around 95% of men and 82% of women work. Even though it may be important to account for endogenous participation of women, BPS find that this does not matter. They follow

[28] The PSID validation study used by Bound et al. (1994) surveys workers from a single manufacturing company in 1983 and 1987. The study obtains information on earnings and hours of these workers in a way that parallels the PSID questionnaire and coding practises. It compares the responses to administrative data obtained directly from the firm. The main caveat is that the sample of workers comes from two decades prior to the data I am using in this paper. Whether and how the nature of measurement error changed ever since, especially after the redesign of the PSID in 1997, is unknown. Another caveat comes from using the same estimates to correct male and female earnings or wages, even though the validation study sampled male workers only.

[29] Log wages are constructed as log earnings minus log hours. Therefore, $e^w_{jit} = e^y_{jit} - e^h_{jit}$ and $\mathrm{Cov}(e^w_{jit}, e^y_{jit}) = \mathrm{Var}(e^y_{jit}) - \mathrm{Cov}(e^h_{jit}, e^y_{jit})$. Moreover $\mathrm{Cov}(e^h_{jit}, e^y_{jit}) = \frac{1}{2}(\mathrm{Var}(e^y_{jit}) + \mathrm{Var}(e^h_{jit}) - \mathrm{Var}(e^w_{jit}))$.

[30] For normal distributions $iqr = (\Phi^{-1}(0.75) - \Phi^{-1}(0.25))\sigma$ where iqr is the interquartile range of the distribution (the difference between the 75th and 25th percentiles), Φ is the standard normal cdf, and σ is the standard deviation of the distribution. Calculating the standard errors in this way is equivalent to applying a normal approximation to the distribution of bootstrap replications, thus shielding standard errors from extreme bootstrap draws. Before imposing normality I verify that the unrestricted distribution of the relevant parameter is approximately normal.

Table 3 – Estimates of Wage Parameters

	(1) Men		(2) Women		(3) Family			
			Panel A: *Second moments*					
permanent	$\sigma^2_{v_1}$	0.0370	$\sigma^2_{v_2}$	0.0356	$\sigma_{v_1v_2}$	0.0041	$\rho_{v_1v_2}$	0.1132
		(0.0049)		(0.0037)		(0.0018)		(0.0545)
transitory	$\sigma^2_{u_1}$	0.0290	$\sigma^2_{u_2}$	0.0132	$\sigma_{u_1u_2}$	0.0041	$\rho_{u_1u_2}$	0.2105
		(0.0054)		(0.0042)		(0.0022)		(0.1325)
			Panel B: *Third moments*					
permanent	γ_{v_1}	-0.0050	γ_{v_2}	-0.0174	$\gamma_{v_1v_2^2}$	0.0006	$\gamma_{v_1^2v_2}$	0.0037
		(0.0085)		(0.0051)		(0.0015)		(0.0018)
transitory	γ_{u_1}	-0.0167	γ_{u_2}	-0.0077	$\gamma_{u_1u_2^2}$	-0.0004	$\gamma_{u_1^2u_2}$	0.0003
		(0.0075)		(0.0051)		(0.0013)		(0.0039)

Notes: The table presents GMM estimates of the parameters of the wage process (second and third moments of shocks) under stationarity over time. Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications subject to a normal approximation to the interquartile range of the bootstrap replications. Panel A presents the estimates for the second moments; panel B presents the estimates for the third moments.

two empirical approaches to deal with this: the first corrects women's selection using conditional covariance restrictions in the spirit of Low et al. (2010); the second assumes the decision to work is driven by wages and demographics. Neither approach makes a difference to their results: average preferences are indistinguishable with or without the correction. In the light of this and given the difficulty to find a convincing exclusion restriction or to model participation explicitly (this would render the approximations infeasible), I do not apply any participation correction.

4.2 Empirical Results

Wage parameters. Table 3 presents the estimates of second and third moments of wage shocks assuming stationarity of those moments over time. Given that time effects are captured by first-stage conditioning covariates, relaxing stationarity makes little difference to the estimates but inflates the standard errors as a smaller sample is applicable per parameter in such case.[31]

Panel A presents the second moments. The variance of permanent shocks is effectively the same for men and women. Permanent shocks covary within the couple (the correlation coefficient is $\rho_{v_1v_2} = 0.113$ and statistically significant) suggesting that spouses face similar wage risks due to possessing similar skills, working in similar industries, or pursuing similar occupations (perhaps as a result of assortative matching). The variance of men's transitory shocks is more than double that of women's signaling higher wage instability possibly due to higher job mobility (Gottschalk and Moffitt, 2009). Transitory shocks covary positively within the couple; the correlation coefficient $\rho_{u_1u_2} = 0.211$ is higher than for permanent shocks but not statistically significant.

Panel B presents the third moments. Three points are worth noting. First, all own moments are negative implying that the marginal distributions of wage shocks are left-skewed, that is, they have a long left tail. Guvenen et al. (2015) confirm this on earnings of million of workers from the US Social Security Administration. Permanent and transitory shocks to both male and female wages feature left skewness: the corresponding third standardized moments are $\widetilde{\gamma}_{v_1} = -0.50$, $\widetilde{\gamma}_{v_2} = -1.83$, $\widetilde{\gamma}_{u_1} = -3.37$ and $\widetilde{\gamma}_{u_2} = -5.08$. Such left tail suggests that negative shocks are more devastating, more unsettling, than positive ones because they are on average further away from the zero mean. Second, all cross-moments except $\gamma_{v_1^2v_2}$ are effectively zero; there is limited co-

[31] BPS estimate second moments of permanent-transitory wage shocks allowing the moments to vary over predefined age brackets. The variance of permanent shocks follows an U-shape over the lifetime but this makes little difference to their estimates of consumption and labor supply preferences.

skewness between spouses' permanent shocks and practically no co-skewness between transitory shocks. Third, women's distribution of permanent shocks is substantially more left skewed than men's ($\widetilde{\gamma}_{v_2} < \widetilde{\gamma}_{v_1}$) pointing to gender differences in the left tail of permanent shocks. Wage penalties that hit women in particular, for example due to incidents of fertility, may explain this discrepancy. The opposite is true for transitory shocks ($\widetilde{\gamma}_{u_1} < \widetilde{\gamma}_{u_2}$).

Preference parameters. Tables 4 and 5 present the main results under a number of alternative specifications. Column (2) presents estimates of wage elasticities of consumption and labor supply *without* preference heterogeneity targeting second moments of wages, earnings and consumption. These results are the closest to the benchmark results of BPS, reported in column (1), who also estimate similar parameters without heterogeneity from wage, earnings and consumption second moments.[32] Three things are worth noting.

First, the consumption-wage elasticities $\eta_{c,w_1} \equiv \mathbb{E}(\eta_{c,w_1(i)}) = 0.08$ and $\eta_{c,w_2} \equiv \mathbb{E}(\eta_{c,w_2(i)}) = -0.15$ have opposite signs and are not statistically different from zero.[33] In a statistical sense this implies $\mathbb{E}(\partial\Delta c_{it}/\partial\Delta u_{jit}) = \mathbb{E}(\eta_{c,w_j(i)}) \approx 0$ reflecting and confirming that, on average, consumption is fully insured against transitory shocks (Blundell et al., 2008). It also implies that there is no complementarity between consumption and labor supply at the intensive margin; it contrasts BPS who find evidence of Frisch substitution between consumption and male hours through a negative and statistically significant consumption-male wage elasticity ($\eta_{c,w_1} = -0.15$, $s.e. = 0.06$). What explains this discrepancy? BPS estimate the consumption-wage elasticity from the joint response of consumption to transitory *and* permanent shocks. The latter is the sum of two forces: a compensated response of consumption to wages (substitution effect) and an uncompensated response as permanent shocks shift the lifetime budget constraint (income effect). η_{c,w_1} captures the substitution effect by definition but also co-determines the income effect. Despite a strong income effect, BPS find an excess smoothness of consumption to permanent shocks; this can be reconciled by a negative substitution effect rendering consumption and male hours Frisch substitutes. By abstracting from the income effect here the response to transitory shocks alone does not provide evidence for complementarity between consumption and labor supply. However, the response to transitory shocks alone may partially reflect liquidity constraints. If the true preference relationship between consumption and labor supply is one of Frisch substitution ($\eta_{c,w_j} < 0$), the presence of binding liquidity constraints would bias such substitution towards zero as a liquidity constrained household would tend to move consumption in the same direction with wages.

Second, the own-wage labor supply elasticities are substantial and, in line with the literature, men's elasticity $\eta_{h_1,w_1} \equiv \mathbb{E}(\eta_{h_1,w_1(i)}) = 0.24$ is notably lower than women's $\eta_{h_2,w_2} \equiv \mathbb{E}(\eta_{h_2,w_2(i)}) = 0.59$. Keane (2011) surveys the labor supply literature and reports estimates in the range $0.03-6.25$ for men's Frisch elasticity (the reported average is 0.85 while the median is lower) and $0.03-3.05$ for women's. With the caveat that the surveyed studies may differ in their respective specifications and reported parameters, the present estimates fall well within those ranges. They are, however, substantially lower than those of BPS who estimate labor supply elasticities from the joint response of hours to own transitory and permanent shocks. The latter reflects the usual tension between the substitution effect (captured by the own-wage labor supply elasticity) and the income effect. BPS find a nearly-zero (a positive) overall response of male (female) hours to own permanent shocks; given a substantial and negative income effect depressing labor supply in both cases, they require that a large substitution effect operates on men's labor supply and an even larger one on

[32] There are a few important differences between the model specification in BPS and column (2) herein. BPS estimate preferences allowing the wage variances to vary with age (however this turns out to be unimportant). By contrast, the wage variances used here are age-invariant. In addition, BPS use moments pertaining to the transmission of permanent as well as transitory wage shocks into earnings and consumption, whereas I only use the latter in order to keep the empirical information consistent across specifications.

[33] A joint test of the hypothesis $\mathcal{H}_0 : \mathbb{E}(\eta_{c,w_1(i)}) = \mathbb{E}(\eta_{c,w_2(i)}) = 0$ has p-value $= 0.76$. I implement this as a standard Wald test. I estimate the covariance matrix of the relevant parameters from the bootstrap replications. No parameter is subject to inequality constraints in this specification, therefore this covariance matrix is consistent.

women's. In the absence of income effects in the present study, the response of hours to transitory shocks alone attenuates these own-wage labor supply elasticities.

Third, the cross-elasticities of labor supply $\eta_{h_1,w_2} \equiv \mathbb{E}(\eta_{h_1,w_2(i)})$ and $\eta_{h_2,w_1} \equiv \mathbb{E}(\eta_{h_2,w_1(i)})$ are statistically zero ruling out complementarities between spouses' leisure.[34] What explains the discrepancy between this and BPS who find evidence that spouses' hours/leisures co-move? The cross-elasticities contribute to the 'added-worker' effect, namely the overall response of hours to the partner's permanent shock (Lundberg, 1985). Although BPS estimate strong 'added-worker' effects, these are not as large as implied by the income effect from the partner's permanent shock only. A complementarity between spouses' hours, namely that the spouses enjoy leisure together even if this is suboptimal from a risk sharing perspective, attenuates the overall 'added-worker' effect. Abstracting from permanent shocks here, the response of hours to the spouse's transitory shock alone does not uncover such complementarity. If anything, the signs of the cross-elasticities turn negative implying a (statistically insignificant) substitution between spouses' leisure.

Column (3) presents estimates of wage elasticities without preference heterogeneity targeting second *and third* moments of wages, earnings and consumption. This specification estimates the same parameters as column (2) but uses additional information from selected third moments of the joint distribution of wages and outcomes. Three things are worth noting.

First, the consumption-wage elasticities are attenuated as the model attempts to match third moments, particularly the intertemporal covariance of consumption and squared wage growth. Both elasticities preserve their respective signs but their magnitudes are reduced by more than half compared to column (2); they remain statistically not different from zero reflecting again that, on average, consumption is fully insured against transitory shocks.

Second, the own-wage labor supply elasticities $\eta_{h_1,w_1} \equiv \mathbb{E}(\eta_{h_1,w_1(i)}) = 0.27$ and $\eta_{h_2,w_2} \equiv \mathbb{E}(\eta_{h_2,w_2(i)}) = 0.38$ remain substantial; however, the wedge between them is greatly reduced compared to BPS and to column (2). The model further attenuates the female elasticity in its attempt to match third moments, particularly joint moments of female earnings and wages.

Third, the cross-elasticities of labor supply are also attenuated as the model attempts to fit the aforementioned wage-earnings moments as well as the intertemporal covariance between male wage and squared earnings growth. The elasticities preserve their signs but remain statistically insignificant. In line with intuition and evidence, women's labor supply, described ordinally by $\eta_{h_2,w_2} \equiv \mathbb{E}(\eta_{h_2,w_2(i)})$ and $\eta_{h_2,w_1} \equiv \mathbb{E}(\eta_{h_2,w_1(i)})$, is always more elastic than men's; however the differences are not significant in a statistical sense.[35]

Column (4) presents estimates of preferences and preference heterogeneity from second and third moments of wages, earnings and consumption. The treatment of heterogeneity in this specification is restricted as preferences can vary across households independently per parameter. In other words, preferences do not *co*-vary. Three things are worth noting.

First, the variances of consumption elasticities $\mathrm{Var}(\eta_{c,w_1(i)}) = 0.30$ and $\mathrm{Var}(\eta_{c,w_2(i)}) = 0.57$ are large pointing to substantial heterogeneity in consumption preferences across households. Note, however, that these estimates are not statistically significant at conventional levels.[36] At face value these numbers imply that: (i) two standard deviations of η_{c,w_1} about its cross-sectional mean fall approximately within the interval $(-1.08; 1.12)$; (ii) two standard deviations of η_{c,w_2} about its mean fall approximately within the interval $(-1.54; 1.47)$. These intervals suggest that for some households consumption responds negatively to wages (as in the case of consumption and hours being Frisch substitutes) while for other households consumption co-moves with wages (as in the case of binding liquidity constraints or when consumption and hours are Frisch complements).

[34] To increase efficiency of these estimates I impose symmetry of the matrix of Frisch substitution effects (see appendix B). A joint test of the hypothesis $\mathcal{H}_0 : \mathbb{E}(\eta_{h_1,w_2(i)}) = \mathbb{E}(\eta_{h_2,w_1(i)}) = 0$ has p-value $= 0.82$; a joint test of $\mathcal{H}_0 : \mathbb{E}(\eta_{c,w_1(i)}) = \mathbb{E}(\eta_{c,w_2(i)}) = \mathbb{E}(\eta_{h_1,w_2(i)}) = \mathbb{E}(\eta_{h_2,w_1(i)}) = 0$ has p-value $= 0.95$.

[35] A joint test of $\mathcal{H}_0 : \mathbb{E}(\eta_{c,w_1(i)}) = \mathbb{E}(\eta_{c,w_2(i)}) = 0$ has p-value $= 0.91$. A joint test of $\mathcal{H}_0 : \mathbb{E}(\eta_{h_1,w_2(i)}) = \mathbb{E}(\eta_{h_2,w_1(i)}) = 0$ has p-value of 0.92; a joint test that all average cross elasticities are zero has p-value of 0.99.

[36] This is partly due to the relative imprecision of the joint consumption-wage third moments in the PSID and partly due to design as few only moments contribute to the estimation of these variances.

Table 4 – Estimates of Preferences: Means and Variances

	(1) BPS No taxes	(2) 2^{nd} moments no p.h.	(3) 2^{nd} & 3^{rd} moments no p.h.	(4) 2^{nd} & 3^{rd} moments restr. p.h.	(5) 2^{nd} & 3^{rd} moments full p.h.	(6) 2^{nd} & 3^{rd} moments preferred
		response to transitory shocks only				
Mean consumption elasticities						
$\mathbb{E}(\eta_{c,w_1(i)})$	-0.148	0.084	0.024	0.017	-0.054	-0.056
	(0.060)	(0.088)	(0.060)	(0.047)	(0.066)	(0.070)
$\mathbb{E}(\eta_{c,w_2(i)})$	-0.030	-0.152	-0.061	-0.037	-0.009	-0.024
	(0.059)	(0.164)	(0.120)	(0.076)	(0.081)	(0.074)
Mean male labor supply elasticities						
$\mathbb{E}(\eta_{h_1,w_1(i)})$	0.594	0.239	0.266	0.250	0.240	0.239
	(0.155)	(0.101)	(0.080)	(0.095)	(0.093)	(0.095)
$\mathbb{E}(\eta_{h_1,w_2(i)})$	0.104	-0.044	-0.018	-0.017	-0.018	0
	(0.053)	(0.053)	(0.043)	(0.043)	(0.042)	
Mean female labor supply elasticities						
$\mathbb{E}(\eta_{h_2,w_1(i)})$	0.212	-0.092	-0.038	-0.036	-0.037	0
	(0.108)	(0.113)	(0.090)	(0.090)	(0.088)	
$\mathbb{E}(\eta_{h_2,w_2(i)})$	0.871	0.588	0.380	0.380	0.379	0.366
	(0.221)	(0.301)	(0.208)	(0.221)	(0.222)	(0.194)
Variances [p-values in brackets]						
$\mathrm{V}(\eta_{c,w_1(i)})$				0.303	0.287	0.346
				[0.107]	[0.099]	[0.003]
$\mathrm{V}(\eta_{c,w_2(i)})$				0.565	0.489	0.346
				[0.188]	[0.146]	[0.003]
$\mathrm{V}(\eta_{h_1,w_1(i)})$				0.052	0.081	0.076
				[0.314]	[0.260]	[0.249]
$\mathrm{V}(\eta_{h_1,w_2(i)})$				0.000	0.000	0
				[0.274]	[0.285]	
$\mathrm{V}(\eta_{h_2,w_1(i)})$				0.001	0.002	0
				[0.270]	[0.287]	
$\mathrm{V}(\eta_{h_2,w_2(i)})$				0.000	0.002	0
				[0.055]	[0.183]	

Notes: The table presents GMM estimates of the first and second moments of wage elasticities. Column (1) 'BPS No taxes' reports estimates of wage elasticities from table 4 column 2 in BPS. Column (2) '2^{nd} moments, no p.h.' reports estimates of wage elasticities without preference heterogeneity ('no p.h.') from second moments of wages, earnings and consumption. The first two columns are closely comparable even though BPS estimate the parameters from the joint response of consumption and family labor supply to permanent and transitory shocks whereas I exploit the response to transitory shocks only. Column (3) '2^{nd} & 3^{rd} moments, no p.h.' reports estimates of preferences without preference heterogeneity ('no p.h.') from second and third moments of wages, earnings and consumption. Column (4) '2^{nd} & 3^{rd} moments, restr. p.h.' reports estimates of preferences allowing preferences to vary independently. Column (5) '2^{nd} & 3^{rd} moments, full p.h.' reports estimates from the unrestricted multivariate preference distribution. Column (6) '2^{nd} & 3^{rd} moments, preferred' reports estimates from the 'general-to-specific' preferred specification where I shut down parameters previously reported as zero. Standard errors appear in parentheses and, whenever applicable, p-values in square brackets for the one-sided test that the respective parameter equals zero.

The proportions of households that fall in each category cannot be estimated without additional information or assumptions about the distribution of $\eta_{c,w_j(i)}$.[37]

[37] Estimation of higher moments of preferences would enable an approximation of these proportions. Unfortu-

Table 5 – Estimates of Preferences: Covariances

		response to transitory shocks only				
	(1) BPS No taxes	(2) 2^{nd} moments no p.h.	(3) 2^{nd} & 3^{rd} moments no p.h.	(4) 2^{nd} & 3^{rd} moments restr. p.h.	(5) 2^{nd} & 3^{rd} moments full p.h.	(6) 2^{nd} & 3^{rd} moments preferred
Covariances						
$C(\eta_{c,w_1(i)}, \eta_{c,w_2(i)})$					0.373	0.346
					(0.352)	(0.092)
$C(\eta_{c,w_1(i)}, \eta_{h_1,w_1(i)})$					0.127	0.136
					(0.068)	(0.071)
$C(\eta_{c,w_1(i)}, \eta_{h_1,w_2(i)})$					-0.001	0
					(0.011)	
$C(\eta_{c,w_1(i)}, \eta_{h_2,w_1(i)})$					-0.002	0
					(0.023)	
$C(\eta_{c,w_1(i)}, \eta_{h_2,w_2(i)})$					-0.019	0
					(0.041)	
$C(\eta_{c,w_2(i)}, \eta_{h_1,w_1(i)})$					0.160	0.136
					(0.131)	(0.071)
$C(\eta_{c,w_2(i)}, \eta_{h_1,w_2(i)})$					-0.002	0
					(0.012)	
$C(\eta_{c,w_2(i)}, \eta_{h_2,w_1(i)})$					-0.004	0
					(0.026)	
$C(\eta_{c,w_2(i)}, \eta_{h_2,w_2(i)})$					-0.025	0
					(0.044)	
$C(\eta_{h_1,w_1(i)}, \eta_{h_1,w_2(i)})$					0.002	0
					(0.014)	
$C(\eta_{h_1,w_1(i)}, \eta_{h_2,w_1(i)})$					0.004	0
					(0.030)	
$C(\eta_{h_1,w_1(i)}, \eta_{h_2,w_2(i)})$					-0.010	0
					(0.066)	
$C(\eta_{h_1,w_2(i)}, \eta_{h_2,w_1(i)})^{\#}$				0.000	0.000	0
				(0.020)	(0.024)	
$C(\eta_{h_1,w_2(i)}, \eta_{h_2,w_2(i)})$					0.000	0
					(0.004)	
$C(\eta_{h_2,w_1(i)}, \eta_{h_2,w_2(i)})$					0.000	0
					(0.008)	
value obj. function		*0.0208*	*0.0691*	*0.0673*	*0.0670*	*0.0671*

See notes of table 4 and: In the estimation of the covariances I require that the Pearson correlation coefficients of any pair of elasticities are within $[-1; 1]$ and that the matrix of preference second moments is positive semi-definite. $^{\#}$Frisch symmetry implies that $\mathrm{Cov}(\eta_{h_1,w_2(i)}, \eta_{h_2,w_1(i)})$ is a positive transformation of $\mathrm{Var}(\eta_{h_1,w_2(i)})$. The standard error is consistent because the covariance is on the space boundary defined by an *equality* constraint (Andrews, 2000).

Second, the variances of male and female labor supply elasticities are economically or statistically zero suggesting there is not much unobserved heterogeneity in labor supply preferences. $\mathrm{Var}(\eta_{h_2,w_2(i)}) = 0.00$ suggests that, once wage variation and observed heterogeneity from household demographics and the spouses' employment status are accounted for, there is no additional

nately this is not possible in the PSID.

variability in female earnings that can be rationalized as heterogeneity in women's ordinal preferences at the intensive margin of labor supply. $\text{Var}(\eta_{h_1,w_1(i)}) = 0.05$ suggests that, at face value, two standard deviations of η_{h_1,w_1} about its mean $\mathbb{E}(\eta_{h_1,w_1(i)}) = 0.25$ fall approximately within the interval $(-0.21; 0.71)$; with a p-value of 0.31 $\text{Var}(\eta_{h_1,w_1(i)})$ is, however, highly insignificant.

Third, the first moments of preferences remain effectively unchanged from column (3) despite the introduction of six additional parameters (note, however, that the consumption-wage elasticities are slightly attenuated further). In this specification I do not test that a subset of parameters, the most interesting one being the subset of variances, is jointly significant. Such test requires the asymptotic covariance matrix of the parameters but bootstrap does not estimate this consistently when a parameter is on the boundary of its space (Andrews, 2000). Nevertheless, table 5 reports the value of the objective function across specifications (the GMM distance metric) as informal evidence for the relative importance of each specification for fitting the data.

Column (5) presents estimates of preferences and preference heterogeneity from second and third moments of wages and outcomes. The treatment of heterogeneity here is the most general as preference parameters can vary jointly across households. Four things are worth noting.

First, the variances of consumption elasticities $\text{Var}(\eta_{c,w_1(i)}) = 0.29$ and $\text{Var}(\eta_{c,w_2(i)}) = 0.49$ are only sightly smaller than in column (4) reflecting and confirming that consumption preferences exhibit substantial heterogeneity across households. The first variance is marginally significant at the 10% level while the second one remains insignificant (p-value $= 0.15$). At face value these numbers imply that: (i) two standard deviations of η_{c,w_1} about its cross-sectional mean $\mathbb{E}(\eta_{c,w_1(i)}) = -0.05$ fall approximately in the range $(-1.13; 1.02)$; (ii) two standard deviations of η_{c,w_2} about its mean $\mathbb{E}(\eta_{c,w_2(i)}) = -0.01$ fall approximately in the range $(-1.41; 1.39)$. Consumption elasticities correlate almost perfectly across households; I estimate $\text{Cov}(\eta_{c,w_1(i)}, \eta_{c,w_2(i)}) = 0.37$ implying a Pearson correlation coefficient $corr = 0.996$. The positive correlation, albeit statistically insignificant, helps the model better fit (i) all joint third-moments of consumption and wages, and (ii) the auto-covariance of consumption growth.

Second, the variances of labor supply elasticities remain economically or statistically zero. The variance of the male elasticity increases slightly to $\text{Var}(\eta_{h_1,w_1(i)}) = 0.08$ implying that two standard deviations of η_{h_1,w_1} about its mean now fall approximately in the range $(-0.33; 0.81)$. Importantly, η_{h_1,w_1} co-varies positively with the consumption elasticities: I estimate $\text{Cov}(\eta_{c,w_1(i)}, \eta_{h_1,w_1(i)}) = 0.13$ ($corr = 0.83$) and $\text{Cov}(\eta_{c,w_2(i)}, \eta_{h_1,w_1(i)}) = 0.16$ ($corr = 0.80$). Even though one only covariance is statistically significant at the 10% level, both parameters help the model better fit the auto-covariance between male earnings and consumption growth, as well as other moments.

Third, with the exception of $\text{Cov}(\eta_{c,w_1(i)}, \eta_{c,w_2(i)})$ and $\text{Cov}(\eta_{c,w_j(i)}, \eta_{h_1,w_1(i)})$, $j = \{1, 2\}$, all other covariances are economically and statistically zero. The fully flexible model, specifically with regards to women's labor supply preferences, albeit appealing from a theoretical perspective, does not add much to explaining the joint distribution of wages and outcomes across households. This is also confirmed by the small only reduction in the value of the GMM metric.

Fourth, the mean consumption elasticities turn negative as in BPS. The pattern of statistical (in)significance as well as all other first moments remain effectively unchanged from column (4).

Interim summary and preferred specification. The results so far can be summarized as follows: (1.) consumption elasticities exhibit substantial heterogeneity across households, (2.) once wage variation and observable characteristics are accounted for, there is little evidence of heterogeneity in male- and no evidence of heterogeneity in female labor supply elasticities, (3.) consumption-wage elasticities are on average small and do not uncover complementarities between consumption and hours, (4.) labor supply elasticities are smaller than in the literature as the model attempts to match third moments of earnings and wages, (5.) cross-elasticities of labor supply are zero, (6.) preference heterogeneity helps better fit the joint distribution of wages and outcomes but the fully unrestricted model, albeit theoretically appealing, does not fare much better compared to a version with restricted preference heterogeneity.

Despite parameters such as the variances of consumption elasticities being economically large, statistical significance is at best rather weak. For example, only two parameters in specification (5), $\text{Var}(\eta_{c,w_1(i)})$ and $\text{Cov}(\eta_{c,w_1(i)}, \eta_{h_1,w_1(i)})$, are significant at the 10% level only. The estimation is underpowered due to the large number of parameters, the relative imprecision of third moments in the PSID, and the fact that few only moments contribute to the estimation of heterogeneity as information from the response to permanent shocks cannot be used. To improve power I implement a 'general-to-specific' specification search as is common in models that are a priori very flexible (e.g. Alan et al., 2017). Column (6) reports the preferred specification which shuts down preference parameters that were found previously to be zero in a statistical *and* economic sense.[38] In addition, it restricts the variances of consumption elasticities to equal (their magnitudes are always comparable across baseline and bootstrap estimations) and the correlation between these elasticities to 1 (as is mostly the case across baseline and bootstrap estimations).

Five observations emerge. First, consumption preference heterogeneity remains substantial. The variance of consumption elasticities, now statistically significant at the 1% level, implies that two standard deviations of η_{c,w_1} about its mean fall approximately in the range $(-1.23; 1.12)$ while two standard deviations of η_{c,w_2} within $(-1.20; 1.15)$. Second, the consumption elasticities correlate positively and statistically significantly with men's labor supply elasticity ($corr = 0.84$); however, the variance of men's labor supply elasticity remains insignificant. Third, the average consumption-wage elasticities remain small and statistically zero. Fourth, the average labor supply elasticities remain substantial but lower than in the literature. Fifth, the restricted version of the model improves greatly on the efficiency of the estimates without substantially increasing the value of the GMM metric, thus without providing a worse fit compared to the unrestricted version of column (5). Appendix E provides numerical evidence for the fit of the preferred model.

Distribution of preferences. Figure 1 visualizes the distribution of preferences (marginal cumulative distributions and joint densities) implied by the preferred model. To construct these plots I assume that the respective distribution is the joint normal. Plot (a) illustrates that the cumulative distributions of η_{c,w_1} and η_{c,w_2} are both gradual and centered around zero; plot (c) illustrates that the distribution of η_{h_1,w_1} is steeper than that of η_{c,w_1} (but still not degenerate) while the distribution of η_{h_2,w_2} is degenerate. The joint density of η_{c,w_1} and η_{c,w_2}, viewed from above in plot (b), depicts the substantial heterogeneity in consumption preferences (and that such heterogeneity is perfectly aligned between the two parameters); plot (d) depicts the strong positive joint heterogeneity in η_{c,w_1} and η_{h_1,w_1}.

5 Discussion

This section discusses the implications of preference heterogeneity for consumption insurance and inequality and it investigates a number of alternative explanations for preference heterogeneity.

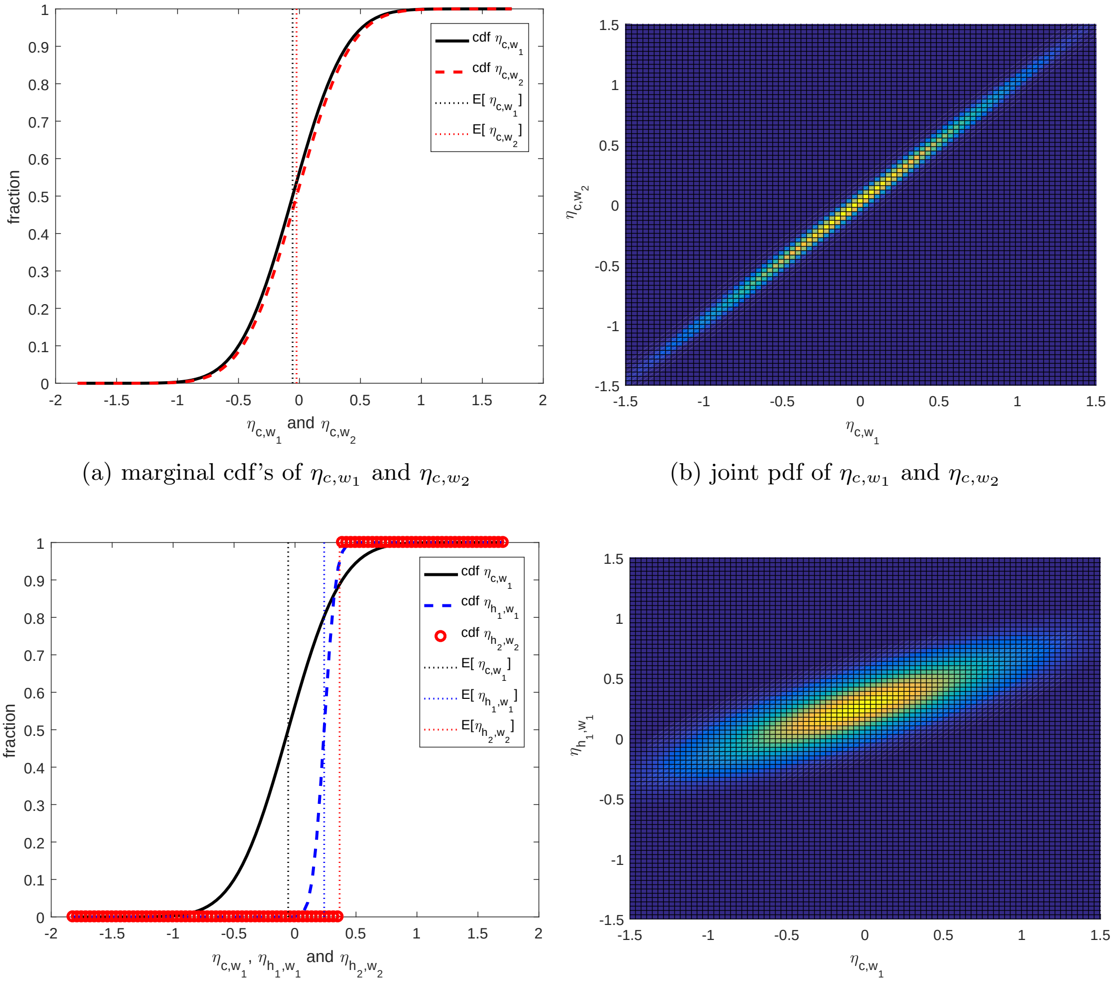
5.1 Implications for Consumption Insurance

What fraction of a transitory shock passes through to consumption? And what fraction of a permanent shock? How do the transmission rates change along the distribution of preferences? These are some of the questions this subsection addresses.

Insurance against transitory shocks. The average transmission parameter of transitory shock u_{jit} is $\mathbb{E}(\partial \Delta c_{it} / \partial u_{jit}) = \mathbb{E}(\eta_{c,w_j(i)})$. By construction, this is also the transmission parameter of the representative household in the economy (the household with average preferences). The parameter

[38] This applies to the cross-elasticities of labor supply (all moments), the variance of the female labor supply elasticity $\text{Var}(\eta_{h_2,w_2(i)})$, and all covariances apart from $\text{Cov}(\eta_{c,w_1(i)}, \eta_{c,w_2(i)})$ and $\text{Cov}(\eta_{c,w_j(i)}, \eta_{h_1,w_1(i)})$. I retain the mean consumption-wage elasticities although this makes little difference to the results of column (6).

Figure 1 – Distributions of Selected Frisch Elasticities



(a) marginal cdf's of η_{c,w_1} and η_{c,w_2} (b) joint pdf of η_{c,w_1} and η_{c,w_2}

(c) marginal cdf's of η_{c,w_1}, η_{h_1,w_1} and η_{h_2,w_2} (d) joint pdf of η_{c,w_1} and η_{h_1,w_1}

Notes: The figures visualize the distributions (marginal and joint) of selected pairs of Frisch elasticities. Labels in or under each figure report the parameters each distribution corresponds to. The joint densities are viewed from above: an area of darker color implies less mass in that area, while an area of brighter color implies more mass.

measures the fraction of a transitory shock that passes through to consumption. It is estimated at -0.056 (*s.e.* 0.070) for male and at -0.024 (*s.e.* 0.074) for female transitory shocks in the preferred model. The parameter has a dual interpretation: *on average*, $1 - |\mathbb{E}(\partial \Delta c_{it}/\partial u_{jit})|$ of a transitory shock is insured; that amounts to 94.4% of a male and 97.6% of a female shock. Both numbers are indistinguishable from the full insurance benchmark implying that consumption is on average fully insured against transitory shocks. Blundell et al. (2008) attribute this to self insurance over the lifecycle (their setting, however, is not directly comparable to this one as their transitory shocks are post labor supply adjustments thus harder to insure in principle).

As the pass-through rate of transitory shocks is measured by the consumption-wage elasticities, heterogeneity in such elasticities implies (and is implied by) heterogeneity in the transmission of transitory shocks across households. Panel (a) of figure 2 illustrates the distribution of pass-through rates when the consumption-wage elasticities are jointly normal parameterized at the estimated first and second moments. While consumption for many households is fully insured against transitory shocks, there are households for whom consumption moves 1-to-1 (as well as anything in-between) with or against such shocks. What fraction of households is fully insured and what fraction responds 1-to-$\pm$1? The graph trivially provides an answer but, assuming normality

Table 6 – Pass-Through Rates of Transitory Shocks into Consumption

	$\mathbb{E}(\frac{\partial \Delta c_{it}}{\partial u_j})$	**$\partial\Delta c_{it}/\partial u_j$ for household with preferences at:** mean	mean + 0.5 s.d.	mean + 1.5 s.d.	mean − 0.5 s.d.	mean − 1.5 s.d.
u_{1it}	-0.056	-0.056	0.238	0.826	-0.350	-0.939
u_{2it}	-0.024	-0.024	0.270	0.859	-0.318	-0.906

Notes: The table presents the transmission parameters (pass-through rates) of transitory wage shocks into consumption. The first column reports the average pass-through rates across households; this is equal to the pass-through rates of the representative household (the household with average preferences) in the second column. The remaining columns report pass-through rates for households with preferences 0.5 and 1.5 standard deviations away from the mean. The means and standard deviations are taken from the preferred model of column (6), table 4.

away, an answer is not possible without estimating higher preference moments. As the data requirements in such case go beyond the PSID, I postpone this for future research.

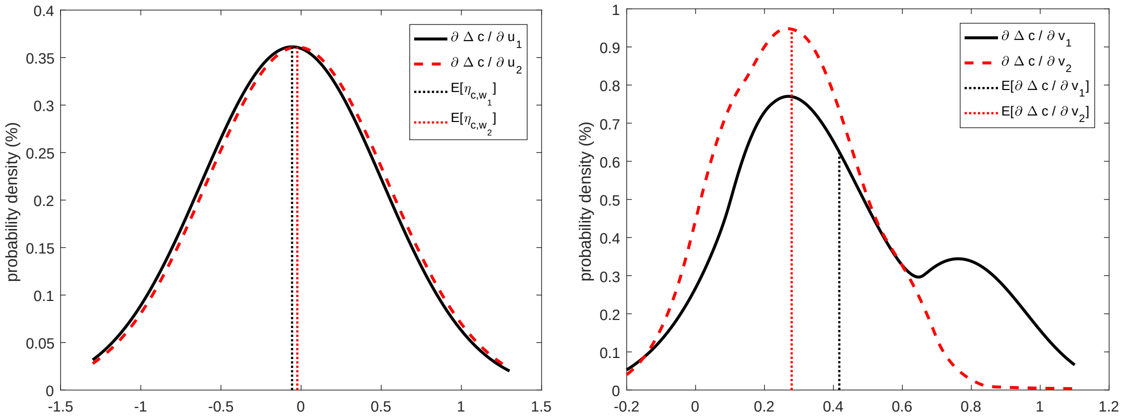
Table 6 reports the pass-through rates for households with preferences $x = \{0.5, 1.5\}$ standard deviations above and below the mean ($\partial\Delta c_{it}/\partial u_{jit}|_{\eta_{c,w_j(i)}=\text{mean}\pm x\text{ s.d.}}$); these numbers are *not* specific to a particular preference distribution. The consumption response to transitory shocks already becomes substantial ($\approx \pm 0.3$) when preferences are at half standard deviation from the mean; at one and a half standard deviation consumption responds approximately 1-to-$\pm$1. Moreover, the perfect positive correlation between elasticities implies that households who fully (hardly) insure one spouse's transitory shock do so for the other spouse's shock too magnifying the overall extent of insurance (or lack thereof) in the household. At face value, this heterogeneity reflects heterogeneity in the *direction* of complementarity between consumption and hours/leisure as well as a varying degree of such complementarity. It may also reflect liquidity constraints. If the true relationship between consumption and hours is one of negative complementarity ($\eta_{c,w_j(i)} < 0$) as in BPS, then liquidity constraints mitigate the negative complementarity or even flip its sign. Liquidity constrained households tend to move consumption in the same direction with wages and a varying degree of tightness of such constraints induces heterogeneity in the consumption response. A deeper investigation of this issue is left for section 5.3.

Insurance against permanent shocks. The average transmission parameter of permanent shock v_{jit} is $\mathbb{E}(\partial\Delta c_{it}/\partial v_{jit})$. This cannot be expressed in closed form in terms of the preference parameters of tables 4-5. It is a function of all Frisch elasticities and their distribution $F_{\boldsymbol{\eta}}$ as well as of initial conditions π_{it} and $\mathbf{s}_{it}$. To calculate it I simulate preferences in 1,000 populations of 10,000 households each drawing from the multivariate normal parameterized at the estimated first and second moments. The simulations require information on the consumption substitution elasticity $\eta_{c,p(i)}$ and the hours elasticities with respect to the price of consumption $\eta_{h_j,p(i)}$. I fix the former at -0.372 homogeneously across households (this is BPS's estimate abstracting from taxes) while I infer the latter from their 'reciprocal' counterparts $\eta_{c,w_j(i)}$ through symmetry of the matrix of Frisch substitution effects (appendix B). I also need information on initial conditions; currently abstracting from heterogeneity there, I set $\pi_{it} = \mathbb{E}(\pi_{it}) = 0.187$ and $s_{1it} = \mathbb{E}(s_{1it}) = 0.616\ \forall i, t$ (appendix E details their estimation on the PSID).

The first column of table 7 reports $\mathbb{E}(\partial\Delta c_{it}/\partial v_{jit})$ at 0.417 (simulation *st.d.* 0.006 across populations) for male and 0.279 (simulation *st.d.* 0.002) for female permanent shocks. Unlike transitory shocks these parameters are not estimated; they are rather *implied* by preferences under the additional assumption of joint normality. As a means to gauge the magnitude of simulation error, I report the standard deviation of the mean across the simulated populations.[39] These

[39] To be clear, $\mathbb{E}(\partial\Delta c_{it}/\partial v_{1it}) = 0.417$ and $\mathbb{E}(\partial\Delta c_{it}/\partial v_{2it}) = 0.279$ are the average transmission parameters across all 10M households ($= 1,000$ populations $\times$ $10,000$ households). Given that all populations have equal size,

Figure 2 – Distributions of Pass-Through Rates of Shocks into Consumption



(a) transitory shocks (b) permanent shocks

Notes: The figures visualize the distributions of pass-through rates of transitory and permanent shocks across 10 million households whose preferences are drawn from the multivariate normal parameterized according to column (6), tables 4-5. Extreme preference draws are trimmed. For the pass-through rates of permanent shocks I fix $\eta_{c,p(i)} = -0.372$ and I infer the hours elasticities with respect to the price of consumption $\eta_{h_j,p(i)}$ from their 'reciprocal' counterparts $\eta_{c,w_j(i)}$ through symmetry of the matrix of Frisch substitution effects (appendix B). I also fix $\pi_{it} = \mathbb{E}(\pi_{it}) = 0.187$ and $s_{1it} = \mathbb{E}(s_{1it}) = 0.616$ (appendix E).

pass-through rates suggest that there is some degree of partial insurance against permanent wage shocks; *on average*, 58.3% of male and 72.1% of female permanent shocks are insured. There is more insurance against female shocks simply because female earnings are a smaller share in total household earnings (the average share is approximately $1 - \mathbb{E}(s_{1it}) = 0.38$). The pass-through rates are substantially higher (thus less insurance) than BPS who estimate them at 0.34 and 0.20 respectively (higher 7.7 percentage points (*p.p.*) or by 23%, and 7.9 *p.p.* or by 40% respectively). This is because of the relatively lower male and, primarily, female labor supply elasticities herein partly due to the inclusion of third moments. Labor supply is less responsive to wage shocks compared to BPS, therefore its capacity to provide insurance is more limited. Interestingly, Ghosh (2016) reaches a similar conclusion albeit in the extreme: once consumption and earnings third moments are targeted she finds no insurance against persistent shocks but full insurance against transitory ones. As she abstracts from labor supply, however, her estimates likely underestimate the degree of partial insurance (overestimate the pass-through rate) compared with the case when labor supply is endogenous.[40]

The pass-through rates of the representative household, at 0.37 and 0.26 respectively, are lower than the average rates above but still higher than BPS. These parameters are better suited to compare with BPS as they are net of the effect of preference heterogeneity. Two remarks are in place. First, preference heterogeneity increases the average pass-through rates as it moves mass away from the representative household towards the extremes of full (complete markets) and no

another way to obtain these numbers is to calculate the mean transmission parameter in each population and then average over populations. The reported standard deviation is for the cross-population distribution of the within-population mean.

[40]The pass-through rates of permanent shocks are also higher than in Blundell et al. (2008) at 0.31 at the *household* level (table 7 therein with earnings being the closest variable to wages). They too abstract from higher moments. Alan et al. (2017) find that the central 80% of the distribution of pass-through rates of income shocks falls in the interval 0.05-0.69. This is only slightly narrower than the central 80% of the distribution of implied pass-through rates in panel (b) of figure 2. However, Alan et al. (2017) use food as a proxy for consumption while I use a more comprehensive consumption measure (food may be smoother than other consumption items). Moreover, they do not distinguish between permanent and transitory shocks: bundling both types of shocks together makes it likelier to find higher consumption insurance because transitory shocks are on average fully insured. Finally, they abstract from labor supply, thus from higher moments of earnings and wages. I estimate lower labor supply elasticities precisely because of such moments, which then subsequently suppresses partial insurance.

Table 7 – Pass-Through Rates of Permanent Shocks into Consumption

	baseline		no labor supply responses by: men		women		both
	$\mathbb{E}(\frac{\partial \Delta c_{it}}{\partial v_j})$	average hh	$\mathbb{E}(\frac{\partial \Delta c_{it}}{\partial v_j})$	average hh	$\mathbb{E}(\frac{\partial \Delta c_{it}}{\partial v_j})$	average hh	$\mathbb{E}(\frac{\partial \Delta c_{it}}{\partial v_j})$
v_{1it}	0.417	0.370	0.359	0.381	0.463	0.453	0.501
st.deviation#	(0.006)		(0.002)		(0.004)		
v_{2it}	0.279	0.260	0.314	0.319	0.248	0.235	0.312
st.deviation#	(0.002)		(0.002)		(0.003)		

Notes: The table presents the average transmission parameters (pass-through rates) of permanent wage shocks into consumption as well as the transmission parameters of the representative/average household (the household with average preferences) across a number of specifications. 'Baseline' refers to the preferred specification of column (6), tables 4-5. The remaining specifications shut down male labor supply, or female labor supply, or both.
#Standard deviation of the distribution of the within-population mean pass-through rate across 1,000 populations.

insurance (autarky). Under joint normality and the specific choice for $\eta_{c,p(i)}$ more households feature autarky than full insurance (figure 2). Second, as women's labor supply is more elastic than men's, it serves better as an insurance instrument against male shocks (à la Lundberg, 1985) than male labor supply does against female shocks. This explains the relatively smaller increase in the pass-through rate of *male* shocks from the BPS benchmark.

The pass-through rates of households with preferences away from the mean are not as informative as in the case of transitory shocks. The pass-through rates are locally monotone around the representative household but, owing to different numerical combinations of the parameters, this monotonicity is not maintained as we move further out. Panel (b) of figure 2 illustrates the distribution of rates across all simulated households although this cannot be linked monotonically to the distribution of preferences. Note the substantial mass on the right of the respective averages, especially in the case of the male permanent shock. Interestingly, this is consistent with Hryshko and Manovskii (2017) who find that partial insurance in the US features two extreme modes.

As the response of consumption to permanent shocks is partly mitigated by labor supply ($\partial \Delta c_{it}/\partial v_{jit}$ depends on labor supply elasticities), it is interesting to investigate what role labor supply precisely plays. Table 7 reports the average pass-through rates as well as the pass-through rates of the representative household when men ($\eta_{h_1,w_1(i)} = 0$), women ($\eta_{h_2,w_2(i)} = 0$), or both do not adjust their labor supply. Labor supply nonresponse implies $\eta_{c,w_j(i)} = 0$ per case as the complementarity between consumption and hours is defined only when hours are variable.

When *male* labor supply does not respond, the pass-through rates of *female* shocks increase compared to the baseline because women lose their husbands' 'added-worker' insurance channel. In the representative household, the pass-through rate of *male* shocks also increases due to the loss of the negative complementarity $\mathbb{E}(\eta_{c,w_1(i)}) = -0.056$ that previously provided additional consumption smoothness. Interestingly, this is not reflected on the *average* pass-through rate of male shocks, which is lower compared to the baseline as the pervasive effect of preference heterogeneity is reduced when $\eta_{h_1,w_1(i)} = \eta_{c,w_1(i)} = 0$. When *female* labor supply does not respond, the pass-through rates of *male* shocks increase substantially as men lose their wives' 'added-worker' insurance. The increase is greater than for female shocks previously because women's endogenous labor supply is a more effective insurance mechanism as opposed to men's ($\mathbb{E}(\eta_{h_2,w_2(i)}) > \mathbb{E}(\eta_{h_1,w_1(i)})$). On the contrary, the pass-through rates of female shocks uniformly decline despite the loss of the complementarity $\mathbb{E}(\eta_{c,w_2(i)}) = -0.024$. This is because female hours no longer respond positively to own shocks, thus no longer amplify their effect on the lifetime budget constraint.[41]

[41] A similar argument applies when male labor supply is inoperative: male hours do not respond positively to own shocks preventing an amplification of their effect on lifetime budget. The loss of the negative complementarity

When neither male nor female labor supply respond, the pass-through rates increase to 0.501 for male and 0.312 for female shocks reflecting the loss of insurance through family labor supply (the average rates equal the rates of the representative household as preference heterogeneity is completely eliminated here). Overall, out of 58.3 *p.p.* (72.1 *p.p.*) of partial insurance to male (female) shocks available in the baseline, 8.4 *p.p.* or 14.4% (3.3 *p.p.* or 4.6%) come from family labor supply;[42] the remaining comes from self-insurance and the mere presence of *two* earners financing consumption at any given time.[43] Compared to BPS, family labor supply plays a relatively smaller role in consumption insurance due to the lower labor supply elasticities I estimate herein.

5.2 Implications for Consumption Inequality

What fraction of consumption inequality is due to preference heterogeneity? The wage and preferred preference parameters enable us to infer the level of *consumption instability* in the data. The parameters do not directly permit inference on *permanent inequality* because permanent inequality does not have a closed form in terms of these parameters in the presence of preference heterogeneity. However, consumption instability and permanent inequality must add up to observed consumption inequality, therefore I deduce permanent inequality as the difference between observed inequality and consumption instability. Table 8 reports the results. Consumption instability accounts for a substantial 48.9% of overall consumption inequality after 1999; permanent inequality accounts for the remaining 51.1%.[44] There is not much variability in $\mathrm{Var}(\Delta c_{it})$ over this short period (if anything, earlier years exhibit slightly higher inequality), so I estimate this moment imposing stationarity.

Consumption preference heterogeneity is responsible for nearly all (99.4% of) consumption instability. This is because the average consumption-wage elasticities are almost zero. Consumption would hardly respond to transitory shocks if every household had the same average preferences and the contribution of transitory shocks to consumption inequality would be negligible. In practice, a distribution of consumption-wage elasticities about the mean implies a distribution of consumption responses to transitory shocks (figure 2a) inducing consumption instability. Consumption instability increases with consumption preference heterogeneity (section 2.2) and the rate of increase is faster the smaller is the absolute value of the mean consumption-wage elasticities.

If every household has the same average consumption preferences, consumption instability measures a mere 0.6% of the baseline figure implied by the parameter estimates. In the presence of preference heterogeneity, a 99.4% reduction in the second moments of transitory shocks is needed to compensate for instability induced by such heterogeneity. In this case instability *with* preference heterogeneity evaluated at the counterfactual transitory shocks equals instability *without* preference heterogeneity evaluated at the original shocks.

The accounting decomposition so far provides no insights into how preference heterogeneity affects *permanent inequality* and whether permanent inequality implied by the above accounting decomposition is consistent with the estimated preference parameters and the empirical distribution of initial conditions. To address this I simulate consumption growth across 1,000 populations of 10,000 households each under a number of specifications for preferences and initial conditions. I calculate permanent inequality within each population as the variance of consumption growth that is driven by permanent shocks; I then take the average variance across populations and treat it as the overall permanent inequality.

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overshadows this resulting in an overall increase in the pass-through rate of at least the representative household.

[42] The baseline degree of partial insurance expressed in *p.p.* is $(1 - \mathbb{E}(\partial \Delta c_{it}/\partial v_{jit})|_{\text{baseline}}) * 100$. The fraction for which family labor supply is responsible is $\mathbb{E}(\partial \Delta c_{it}/\partial v_{jit})|_{\text{no labor supply}} - \mathbb{E}(\partial \Delta c_{it}/\partial v_{jit})|_{\text{baseline}}$.

[43] Male shocks still exhibit higher pass-through rates (less insurance) because of the higher share of male earnings in total household earnings. Even with fixed labor supply the presence of a spouse provides consumption insurance to one's own shocks because the spouse's salary also contributes to financing consumption.

[44] These numbers quantify the shares of consumption instability and permanent inequality into the variance of *biennial* consumption growth directly observed in the data.

Table 8 – Accounting Decomposition of Consumption Inequality

		share in $\text{Var}(\Delta c_{it})$	share in cons. instability
$\text{Var}(\Delta c_{it})$	0.0718	100%	
standard error	(0.0019)		
consumption instability	0.0351	48.9%	100%
without pref. heterogeneity	0.0002		0.6%
pref. heterogeneity induced	0.0349		99.4%
permanent inequality	0.0367	51.1%	

Notes: The table presents the accounting decomposition of consumption inequality into consumption instability and permanent inequality. Consumption inequality $\text{Var}(\Delta c_{it})$ is estimated biennially using GMM pooling all years together. A block bootstrap standard error from 1,000 replications is reported in parentheses. 'Consumption instability' is the fraction of consumption inequality driven by transitory shocks (given by the first three lines of expression (8)). 'Permanent inequality' is the fraction of consumption inequality driven by permanent shocks (given by the last three lines of (8)). The first column reports the estimates or fitted values of the various components of inequality; the second column presents the shares of the main components in $\text{Var}(\Delta c_{it})$; the third column decomposes consumption instability.

Table 9 reports the results. Panel A fixes $\eta_{c,p(i)} = -0.372$ across all households as in BPS. In the baseline, households exhibit no heterogeneity in preferences and initial conditions: they all have the same average preferences from table 4 and share the same initial conditions $\pi_{it} = \mathbb{E}(\pi_{it}) = 0.187$ and $s_{1it} = \mathbb{E}(s_{1it}) = 0.616$ (appendix E). There is too little inequality in this case; at a value of 0.0165, which is the same across all populations, permanent inequality amounts to only 45.1% of the figure implied by the accounting decomposition (0.0367). Subsequently I introduce heterogeneity in initial conditions drawing random values from the empirical distributions of π_{it} and $\mathbf{s}_{it} = (s_{1it}, s_{2it})'$; I leave household preferences homogeneous. At a value of 0.0170 inequality is only marginally larger (by 3%) than the baseline and it still is too little (46.4%) compared to the target level. Additional simulations not shown here indicate that the means $\mathbb{E}(\pi_{it})$ and $\mathbb{E}(s_{1it})$ have much greater effect on inequality than dispersion around them.

In a new simulation I draw preferences from the multivariate normal (parameterized at the estimated moments of tables 4-5) while I hold initial conditions at their average levels. At a value of 0.0516, permanent inequality increases more than twofold compared to the baseline and surpasses the figure implied by the accounting decomposition (140.7% thereof). In a final simulation, I allow heterogeneity in initial conditions together with heterogeneity in preferences; both heterogeneities are respectively like previously and independent from one another. Permanent inequality further rises to 0.0632 representing an almost threefold increase from the baseline and amounting to 172.3% of the figure obtained from the accounting decomposition.

Some remarks are due here. First, the simulations suggest that preference heterogeneity *always* increases permanent inequality. This is seen from the averages across populations (to which I referred above) as well the minimum value permanent inequality takes in any given population: its lowest value is 0.0388 at average initial conditions or 0.0461 with heterogeneous initial conditions. Both are more than twice as high as the homogeneity benchmark of 0.0165. Given that preference heterogeneity also always increases consumption instability (section 2.2), it follows that preference heterogeneity *always* increases consumption inequality. Second, heterogeneity in assets and human wealth *always* increases permanent inequality and, consequently, overall consumption inequality. Heterogeneity in initial conditions increases inequality by less than preference heterogeneity does and has a larger impact on inequality when coupled with preference heterogeneity rather than without it. Third, although $\text{Var}(\Delta c_{it})$ is not targeted in the estimation exercise and $\eta_{c,p(i)}$ is fixed using external information, the estimated parameters imply levels of consumption instability and permanent inequality that are not far off from their observed sum. As inequality is too low without preference heterogeneity but somewhat high at the estimated levels of heterogeneity, it is

Table 9 – Simulations of Consumption Permanent Inequality

		change from baseline	share of target inequality	minimum; maximum
target permanent inequality from table 8	0.0367		100%	
A. Simulations with $\eta_{c,p} = -0.372$:				
baseline, no heterogeneity	0.0165		45.1%	0.0165; 0.0165
heterogeneity in π_{it}, $\mathbf{s}_{it}$	0.0170	+3%	46.4%	0.0169; 0.0172
st.deviation#	(0.0000)			
heterogeneity in preferences	0.0516	+212.1%	140.7%	0.0388; 0.0677
st.deviation#	(0.0046)			
heterogeneity in preferences, π_{it}, $\mathbf{s}_{it}$	0.0632	+282.4%	172.3%	0.0461; 0.0991
st.deviation#	(0.0080)			
B. Simulations with $\eta_{c,p} = -0.815$:				
no heterogeneity	0.0260		70.8%	0.0260; 0.0260
heterogeneity in preferences	0.0330		89.9%	0.0317; 0.0349
st.deviation#	(0.0006)			
heterogeneity in preferences, π_{it}, $\mathbf{s}_{it}$	0.0368		100.3%	0.0338; 0.0530
st.deviation#	(0.0017)			

Notes: The table presents permanent inequality under different specifications for preferences and initial conditions by simulating 1,000 populations of 10,000 households each. Panel A fixes $\eta_{c,p(i)}$ at -0.372 (BPS's point estimate without taxes) while panel B at -0.815 (conditionally estimated). In both cases $\eta_{c,p(i)}$ is homogeneous across households. The first column reports average permanent inequality across populations: *within* a population, permanent inequality is the variance of consumption growth due to permanent wage shocks; then the first column reports the average variance as well as its standard deviation *across* populations. The second column reports the percentage change in average permanent inequality from the baseline of no heterogeneity. The third column reports the fraction that average permanent inequality is of the target figure implied by the accounting decomposition of table 8. The last column reports the minimum and maximum values of permanent inequality across the simulated populations.
#Standard deviation of the distribution of within-population average permanent inequality across populations.

likely that the model can exactly match consumption inequality either at different values for the consumption substitution elasticity or at slightly lower levels of overall preference heterogeneity.

Implications for the consumption substitution elasticity. To understand how permanent inequality changes with the elasticity of consumption substitution, I simulate permanent inequality over a range of reasonable values for $\eta_{c,p} < 0$, common for all households. The details of the simulation remain like above. The top solid line in figure 3 visualizes permanent inequality when preferences are drawn from the multivariate normal and initial conditions from the empirical distributions (i.e. similar to the last specification in panel A of table 9). The non-monotone relation crucially depends on the magnitude of $\eta_{c,p}$ relative to $\mathbb{E}(\eta_{c,w_j(i)})$ as well as the extent of heterogeneity in $\eta_{c,w_j(i)}$ and the other parameters. To help intuition the bottom line through the hollow circles illustrates permanent inequality when everyone has the same average preferences.

At low levels of $|\eta_{c,p}|$, for example when $|\eta_{c,p}| \to 0$, households dislike intertemporal fluctuations in consumption. Labor supply responds strongly to permanent shocks in order to prevent fluctuations in lifetime income and, consequently, consumption. In the extreme case when $\eta_{c,p} = 0$ and preferences are homogeneous and separable, labor supply responds 1-to-1 to a permanent shock but consumption does not respond at all ($\Delta c_{it} = 0$). Permanent inequality is zero in that case. When preferences are non-separable but still homogeneous, consumption responds to permanent shocks due to non-separability. This induces permanent inequality that equals approximately the variance of permanent wage shocks weighed by (the square of) the consumption-wage elasticity.

This is the point where the bottom line intersects the right axis. Inequality is too low because the average consumption-wage elasticities are almost zero as if preferences were separable. When preferences are heterogeneous, permanent inequality is much higher reflecting not only the variability of shocks but also households' heterogeneous responses to them. This corresponds to the rightmost point along the top solid line.[45] The wedge between permanent inequality with and without preference heterogeneity at $\eta_{c,p} = 0$ increases with heterogeneity and decreases with $|\mathbb{E}(\eta_{c,w_j(i)})|$.

At high levels of $|\eta_{c,p}|$ households like intertemporal fluctuations in consumption. When preferences are homogeneous and separable, consumption may respond up to 1-to-1 to a permanent shock (the response depends also on π_{it}) and permanent inequality almost entirely reflects (and at $\eta_{c,p} \to -\infty$ equals) permanent wage inequality. When preferences are non-separable but still homogeneous, consumption may respond more or less than 1-to-1 depending on the direction of non-separability. A large $|\eta_{c,p}|$ implies a large proportional shift in lifetime income due to non-adjustment of labor supply. Inequality in this case mainly reflects variability in lifetime income due to wage shocks, π_{it} and $\mathbf{s}_{it}$. The consumption response to lifetime income is primarily determined by the large $|\eta_{c,p}|$ which overshadows (any reasonable values of) the consumption-wage elasticities. Heterogeneity in such elasticities makes little difference to inequality as the large $|\eta_{c,p}|$ remains homogeneous. This is why at high levels of $|\eta_{c,p}|$ inequality flattens out asymptotically irrespective of the presence or absence of preference heterogeneity in $\eta_{c,w_j(i)}$.

At intermediate levels of $|\eta_{c,p}|$ permanent inequality rises and drops (the result of different numerical combinations of the parameters) exhibiting extrema that are informative about values of $\eta_{c,p}$ for which permanent inequality matches the target level implied by the accounting decomposition. This is illustrated in figure 3. A quadratic distance metric between simulated inequality and the target level of 0.0367 is minimized at $\eta_{c,p} = -0.815$ (inequality = 0.0368) implying a coefficient of relative risk aversion equal to 1.23.[46] Panel B of table 9 presents additional results for permanent inequality when $\eta_{c,p} = -0.815$. At $\eta_{c,p} = -0.815$ preference heterogeneity accounts for approximately 19% of permanent inequality while, as shown previously, for 99.4% of consumption instability. Heterogeneity in initial conditions (reflecting heterogeneity in financial and human wealth) accounts for 10% of permanent inequality.[47] A back-of-the-envelope calculation suggests that preference heterogeneity accounts then for approximately 58% of *overall* consumption inequality, while heterogeneity in initial conditions for 5%. The remaining portion ($\approx$ 37%) is due to permanent wage inequality.

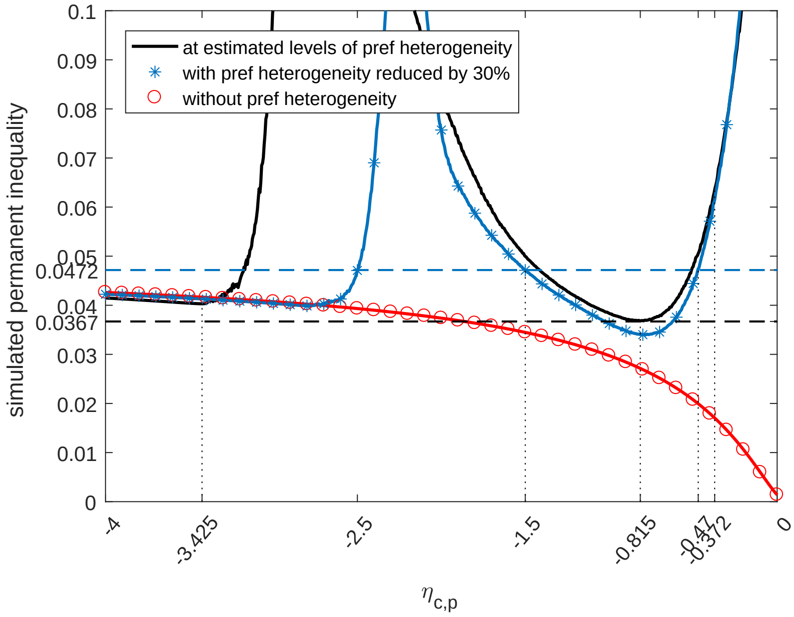
Three remarks emerge. First, the levels of consumption instability and permanent inequality implied by the parameter estimates align perfectly with the observed levels of consumption inequality even though this was not (could not be) targeted in the estimation. This serves as an 'out-of-sample' validation of identification. Second, the alignment between observed and implied consumption inequality implies a higher absolute consumption substitution elasticity than BPS. The search for the most suitable $\eta_{c,p}$ above is similar in flavor to a formal estimation of this parameter albeit conditionally on the other parameters rather than jointly with them. Allowing

[45] The top solid line intersects the right axis at 0.19 but this is not shown to ease legibility.

[46] I calculate the coefficient of relative risk aversion as $-\eta_{c,p}^{-1}$. Although there is no consensus about the value of this parameter, positive single digit numbers are most often met in the literature. Chetty (2006) uses labor supply data and a general life-cycle model for consumption and labor supply to calculate an upper bound on this coefficient. He obtains an average upper bound of 0.97 when consumption and labor supply are complements. Abstracting from labor supply, Kimball et al. (2009) impute the coefficient of relative risk aversion from hypothetical gamble responses in the PSID. They report a range of 1.4-6.7. Guiso and Sodini (2013) calculate household risk aversion based on portfolio risk shares in the US Survey of Consumer Finances. They report a median coefficient of relative risk aversion at 3.5 with the central 90% of the distribution lying in the range 1.6-30.8 skewed to the left. Cohen and Einav (2007) estimate risk preferences from a structural model of deductible choices in the auto insurance market. They find a median coefficient of relative risk aversion at 0.37 with the average being much higher.

[47] See panel B of table 9. The contribution of initial conditions heterogeneity to permanent inequality is 0.0368-0.0330=0.0038. The contribution of preference heterogeneity is (0.0368-0.0260)-0.0038=0.007. This decomposition is approximate because the interaction of the two types of heterogeneity amplifies each one's share into inequality; here I have attributed such interaction effects exclusively to initial conditions.

Figure 3 – Permanent Inequality against the Consumption Substitution Elasticity $\eta_{c,p}$



Notes: The figure illustrates how permanent inequality in three heterogeneity regimes changes with the consumption substitution elasticity $\eta_{c,p}$. Consistent with intuition and evidence, $\eta_{c,p}$ is restricted to negative values larger than -4. The top solid line and the middle line through the asterisks plot permanent inequality when preferences are drawn from the multivariate normal and initial conditions from their empirical distributions. In the first case the multivariate normal is parametrized at the first and second moments of column (6), tables 4-5; in the second case the second moments are reduced by 30%. The bottom line through the hollow circles plots permanent inequality when preferences are homogeneous while initial conditions are kept like above. Inequality is always finite and bounded below 0.35.

for preference heterogeneity changes our view of the average consumption and labor supply elasticities by lowering the former and increasing the (absolute value of the) latter compared to BPS. Third, heterogeneity in assets and human wealth plays unsurprisingly a minor role in inequality in consumption *growth*; one would expect a greater influence on inequality in consumption levels.

For completeness, the middle line through the asterisks plots permanent inequality when preference heterogeneity is counterfactually reduced by 30%. This lowers consumption instability and increases the target level of permanent inequality to 0.0472. A quadratic distance metric between simulated and target inequality is now minimized at $\eta_{c,p} = -0.47$, $\eta_{c,p} = -1.5$ and higher values.

5.3 Alternative Explanations for Preference Heterogeneity

In this last subsection I investigate a number of alternative explanations for the pattern of preference heterogeneity I estimate in the data. I present the most important sources of potential misspecification in household preferences or the budget constraint and discuss whether and how they interfere with preference heterogeneity. I discuss intra-family bargaining power, taxes, consumption measurement error, missing covariates including household-specific consumption prices, and unobserved liquidity constraints. The list is certainly incomplete but it does cover the most prominent features of the household that this paper has not modeled.

Collective household and intra-family bargaining power. Suppose that the true nature of the household is collective with the objective function $\mathbb{E}_0 \sum_{t=0}^{T} \beta^t \{\mu_{1i} U_{1i}(C_{it}, H_{1it}; \mathbf{Z}_{it}) + \mu_{2i} U_{2i}(C_{it}, H_{2it}; \mathbf{Z}_{it})\}$ replacing (1). Suppose that consumption C_{it} is a public/non-rival good, that preferences are egoistic, and the spouses fully commit to each other for life. Intra-family bargaining power is given by $\boldsymbol{\mu}_i = (\mu_{1i}, \mu_{2i})$; as usual, the powers sum up to 1. This environment extends Blundell et al. (2005) to the dynamics case.

In ongoing work (Theloudis, 2016) I show that the analytical expressions for consumption and (without loss of generality, female) hours in such environment are given by

$$\Delta c_{it} \approx \eta^{(1)}_{c,w_1(i)} \nu^c_1 \left(\eta^{(1)}_{c,p^c(i)}, \eta^{(2)}_{c,p^c(i)}; \boldsymbol{\mu}_i\right) \Delta u_{1it} + \eta^{(2)}_{c,w_2(i)} \nu^c_2 \left(\eta^{(1)}_{c,p^c(i)}, \eta^{(2)}_{c,p^c(i)}; \boldsymbol{\mu}_i\right) \Delta u_{2it} + g^c_{it}(v_{1it}, v_{2it})$$

$$\Delta h_{2it} \approx \widetilde{\eta}_{h_2,w_1(i)} \nu^{h_2}_1 \left(\eta^{(1)}_{c,p^c(i)}, \eta^{(2)}_{c,p^c(i)}; \boldsymbol{\mu}_i\right) \Delta u_{1it} + \eta^{(2)}_{h_2,w_2(i)} \nu^{h_2}_2 \left(\eta^{(1)}_{c,p^c(i)}, \eta^{(2)}_{c,p^c(i)}; \boldsymbol{\mu}_i\right) \Delta u_{2it} + g^{h_2}_{it}(v_{1it}, v_{2it})$$

for well defined smooth functions ν^c_j and $\nu^{h_2}_j$, $j = \{1, 2\}$. There are notable differences between these equations and the benchmark ones in (5)-(7). First, Frisch elasticities are defined at the individual level, thus superscripted by the spouse j they refer to. Second, cross-wage elasticities are not defined as each egoistic spouse does not have preferences over the other's leisure; nevertheless, cross-wage quasi-elasticities still exist at the household level (as a function of individual level elasticities) due to the implicit complementarity induced on spousal leisures by the public good. The tilde above $\eta_{h_2,w_1(i)}$ reflects precisely this. Third, adjustments in the public good are mutually agreed by both spouses given their respective preferences for it ($\eta^{(j)}_{c,p^c(i)}$) and bargaining powers; such adjustments feed back on the demand of all goods with feedback captured by ν^c_j, $\nu^{h_2}_j$.

Cross-sectional heterogeneity in intra-family bargaining power introduces additional variation in consumption or hours growth above and beyond variation due to preference heterogeneity. Previously I identified heterogeneity in consumption elasticities through the variance of the transmission parameter of u_j into consumption. In the collective environment this now picks up $\mathrm{Var}(\eta^{(j)}_{c,w_j(i)} \nu^c_j(\cdot; \boldsymbol{\mu}_i))$ instead of $\mathrm{Var}(\eta_{c,w_j(i)})$, that is heterogeneity in true consumption preferences $\eta^{(j)}_{c,w_j(i)}$ *and* cross-sectional heterogeneity in intra-family bargaining power $\boldsymbol{\mu}_i$ and other parameters. Assuming the elasticities are independent from bargaining power, heterogeneity in the latter likely inflates $\mathrm{Var}(\eta^{(j)}_{c,w_j(i)} \nu^c_j(\cdot; \boldsymbol{\mu}_i))$ inducing an upward bias on the variance of the true consumption elasticity. The same, however, applies to what I previously identified as heterogeneity in *labor supply elasticities.* However, $\mathrm{Var}(\eta_{h_2,w_j(i)})$ and other related moments are found to be precisely zero ruling out cross-sectional heterogeneity in intra-family bargaining power conditional on observables: such heterogeneity would imply strictly positive variances of the transmission parameters of transitory shocks into female hours, which is clearly not supported by the data. Similar arguments apply when consumption is a private good or when its type is unknown.

Taxes. Suppose that the true sequential budget constraint is $A_{it} + T(\sum_{j=1}^2 W_{jit} H_{jit}) = C_{it} + A_{it+1}/(1 + r)$, $t = \{0, \ldots, T\}$. Function $T(\cdot)$ captures transfers and progressive joint taxation of family earnings. In other words, $T(\cdot)$ maps before-tax/transfers family earnings into after-tax/transfers disposable income; it may depend on household characteristics, for example the presence of children. Following Heathcote et al. (2014) and BPS, I approximate $T(\sum_{j=1}^2 W_{jit} H_{jit}) \approx (1 - \chi_{it})(\sum_{j=1}^2 W_{jit} H_{jit})^{1-\nu_{it}}$; this approximation is convenient because it facilitates the analytical expressions of this paper. Here χ_{it} and ν_{it} are household- and time-specific tax parameters that determine the proportionality and progressivity of the tax system; different values of those parameters give rise to different tax systems.

BPS show that the analytical expressions for consumption and female hours in such environment (here I assume for simplicity that male hours are invariable) are given by

$$\Delta c_{it} \approx -\frac{\eta_{c,w_2(i)} \nu_{it} q_{1it^-}}{1 + \eta_{h_2,w_2(i)} \nu_{it} q_{2it^-}} \Delta u_{1it} + \eta_{c,w_2(i)} \frac{1 - \nu_{it} q_{2it^-}}{1 + \eta_{h_2,w_2(i)} \nu_{it} q_{2it^-}} \Delta u_{2it} + f^c_{it}(v_{1it}, v_{2it})$$

$$\Delta h_{2it} \approx -\frac{\eta_{h_2,w_2(i)} \nu_{it} q_{1it^-}}{1 + \eta_{h_2,w_2(i)} \nu_{it} q_{2it^-}} \Delta u_{1it} + \eta_{h_2,w_2(i)} \frac{1 - \nu_{it} q_{2it^-}}{1 + \eta_{h_2,w_2(i)} \nu_{it} q_{2it^-}} \Delta u_{2it} + f^{h_2}_{it}(v_{1it}, v_{2it})$$

where q_{jit^-} is the share of spouse j's earnings in total family earnings at time $t^- = t - 1$. The consumption or hours response to *female* transitory shocks is no longer a function of the respective female wage elasticities only; it also depends on the disincentives that taxes induce on female labor supply. The response to *male* shocks also depends on the tax disincentives on female labor supply: the additional tax the family has to pay out of an increase in male earnings depresses women's hours and partially offsets the increase in family earnings.

Like in the case of intra-family bargaining power, these expressions illustrate that what I previously identified as consumption preference heterogeneity $\text{Var}(\eta_{c,w_2(i)})$ is actually picking up $\text{Var}(\eta_{c,w_2(i)}(1-\nu_{it}q_{2it^-})/(1+\eta_{h_2,w_2(i)}\nu_{it}q_{2it^-}))$, that is heterogeneity in true consumption preferences $\eta_{c,w_2(i)}$ *and* heterogeneity in the tax parameter, earnings shares and female labor supply preferences.[48] Assuming preferences are independent from the tax parameter, cross-household heterogeneity in the latter likely inflates the identified variance and induces an upward bias on the variance of the true consumption elasticity. The same, however, applies to what I previously identified as labor supply preference heterogeneity $\text{Var}(\eta_{h_2,w_2(i)})$. But, as $\text{Var}(\eta_{h_2,w_2(i)})$ and other related second moments are found to be zero, I conclude that preference heterogeneity is not picking up variation from neglected taxes. This is confirmed by BPS who estimate average preferences allowing for taxes as well as abstracting from them. The latter induces a small downward bias on the average labor supply elasticities but the bias is never statistically significant. It is thus not surprising that taxes do not matter for the second moments either.

Consumption measurement error. The variance of e^c_{it} enters the first-order consumption autocovariance $\mathbb{E}(\Delta c_{it}\Delta c_{it+1})$; this is *one* of the identifying moments for consumption preference heterogeneity. No other moment is affected by e^c_{it} assuming error is classical. An inspection of the estimated heterogeneity pattern suggests that preference heterogeneity is not picking up $\sigma^2_{e^c}$. Two sets of parameters are consistently large in economic and/or statistical sense: those pertaining to marginal heterogeneity in consumption preferences (eg. $\text{Var}(\eta_{c,w_1(i)})$) and those pertaining to joint heterogeneity in consumption and male labor supply preferences (eg. $\text{Cov}(\eta_{c,w_1(i)},\eta_{h_1,w_1(i)})$). For both sets to be picking up measurement error, one would need consumption error to covary with error in male earnings. This is hard to identify without severely restricting the underlying household structure; in addition, consumption error should also covary with error in female earnings, something that is not supported by the estimated heterogeneity pattern.

Although $\sigma^2_{e^c}$ is not identified in the general unrestricted model (column (5) of tables 4-5), this is not the case in the preferred specification (column (6)). The intertemporal covariances between wage and squared consumption growth $\mathbb{E}((\Delta c_{it})^2\Delta w_{jit+1})$ over-identify consumption preference heterogeneity, thus enabling the first-order consumption autocovariance to identify $\sigma^2_{e^c}$. Numerically this equals the difference between the fitted and empirical values of $\mathbb{E}(\Delta c_{it}\Delta c_{it+1})$ which, according to table E.4 in the appendix, amounts to $\sigma^2_{e^c}=0.005$.

Missing prices or covariates. Suppose that the true sequential budget constraint is $A_{it}+\sum_{j=1}^2 W_{jit}H_{jit}=P_{it}C_{it}+A_{it+1}/(1+r)$, $t=\{0,\dots,T\}$, where P_{it} is the real price of consumption. While in theory this price serves as the numeraire deflating all other monetary variables, in practice a *single* consumer price index is used as common deflator across all households. This single index does not capture household specific prices, namely the possibility that different households face different prices for the same goods. P_{it} captures such unobserved price heterogeneity above and beyond the standard deflation of monetary figures typically done in applied work. As a consequence, cross-sectional variation in expenditure now reflects variation in unobserved household-specific prices *and* heterogeneity in consumption choices (thus consumption preferences).

Assuming for simplicity that $v_{1it}=v_{2it}=u_{1it}=0$, the analytical expressions for consumption and (without loss of generality, female) hours are given by $\Delta c_{it}\approx\eta_{c,w_2(i)}\Delta u_{2it}+\eta_{c,p(i)}\Delta p_{it}$ and $\Delta h_{2it}\approx\eta_{h_2,w_2(i)}\Delta u_{2it}+\eta_{h_2,p(i)}\Delta p_{it}$. Let Δp_{it} be a crude measure of $\Delta\ln P_{it}$ net of any hypothetical deterministic component; p_{it} is an idiosyncratic price shock with zero mean. As long as the price shock is independent of the transitory wage shock ($p\perp u_2$), the second

[48] The variance of the coefficient on male transitory shocks appears to not pick up the variance of the consumption-male wage elasticity. This follows mechanically from the stylistic assumption that male hours are fixed.

moment of the consumption elasticity is still identified through the main identifying equations $\mathbb{E}(\Delta c_{it}\Delta c_{it+1}) = -\mathbb{E}(\eta^2_{c,w_2(i)})\sigma^2_{u_2(t)}$ and $\mathbb{E}((\Delta c_{it})^2\Delta w_{2it+1}) = -\mathbb{E}(\eta^2_{c,w_2(i)})\gamma_{u_2(t)}$. Troubles arise when the price and wage shocks are related as, for example, when a short illness induces a productivity decline (wage shock) and necessitates a switch to a more expensive drug (price shock). To reflect this I write $\Delta p_{it} = \varphi_i(\Delta u_{2it}) = \varphi_i \Delta u_{2it}$ where the last equality is for the sake of simplicity. The main identifying moments now become equal to $-\mathbb{E}((\eta_{c,w_2(i)} + \eta_{c,p(i)}\varphi_i)^2)\sigma^2_{u_2(t)}$ and $-\mathbb{E}((\eta_{c,w_2(i)} + \eta_{c,p(i)}\varphi_i)^2)\gamma_{u_2(t)}$ respectively and pick up variability in the consumption elasticity *and* other parameters. Neglecting unobserved household-specific prices likely induces an upward bias to the estimated second moments of $\eta_{c,w_2(i)}$. The same, however, applies to the second moments of $\eta_{h_2w_2(i)}$ (thus in principle I identify $\mathrm{Var}(\eta_{h_2,w_2(i)} + \eta_{h_2,p(i)}\varphi_i)$ instead of $\mathrm{Var}(\eta_{h_2,w_2(i)})$). But as $\mathrm{Var}(\eta_{h_2,w_2(i)})$ is estimated at zero, I conclude that preference heterogeneity is not picking up variation from neglected prices. Similar arguments apply to missing covariates so long as such covariates affect both consumption and earnings.

Unobserved liquidity constraints and adjustment costs of work. Suppose that a proportion ϱ of households solves the baseline problem (1) s.t. (2). I call these households 'unconstrained'. In addition, suppose that a proportion $1-\varrho$ solves a different problem with two distinct features: liquidity constraints and adjustment costs of work. I call those households 'constrained'. Below I sketch a model that allows (or, better, proxies) for both features while minimizing the changes required to the analytical framework used so far.

Let the objective function of constrained households be $\mathbb{E}_0 \sum_{t=0}^{T} \beta^t U_i(C_{it}, \bar{H}_{1it}, \bar{H}_{2it}; \mathbf{Z}_{it})$ while their sequential budget constraint be $\sum_{j=1}^{2} W_{jit}H_{jit} = C_{it}$, $t = \{0, \ldots, T\}$. Assets are removed from the budget constraint in order to capture (extreme) liquidity constraints in a crude way. More specifically, there are no assets for households to fall upon ($A_{it} = 0$) and there is no capacity to save for or borrow from the future ($A_{it+1} = 0$). This renders constrained household 'hand-to-mouth' as consumption always equals available income. This is not unrealistic for young or poor households during a span of time. In addition, hours of work $\bar{H}_j$ are fixed in order to capture (extreme) adjustment costs to work. Wages are still subject to productivity shocks but such shocks do not shift labor supply due to, for example, institutional or contractual constraints. This is not unrealistic for small shocks or workers without negotiating power.[49]

The solution to this problem is trivial. Hours are fixed ($\Delta h_{jit} = 0$) and earnings growth reflects wage shocks only ($\Delta y_{jit} = \Delta w_{jit}$). A first-order Taylor approximation to the budget constraint yields $\Delta c_{it} \approx q_{1it^-}(v_{1it} + \Delta u_{1it}) + q_{2it^-}(v_{2it} + \Delta u_{2it})$ where q_{jit^-} is the share of spouse j's earnings in total family earnings at $t-1$. All shocks, permanent and transitory, pass through to consumption. A generalization of this is

$$\Delta c_{it} \approx q_{1it^-}(\vartheta_{1it}v_{1it} + \theta_{1it}\Delta u_{1it}) + q_{2it^-}(\vartheta_{2it}v_{2it} + \theta_{2it}\Delta u_{2it}) \tag{13}$$

where each shock is associated with a different loading factor. In the context of liquidity constraints the thetas can be seen as reflecting the tightness of such constraints by household and time. In the extreme case without any capacity to save/borrow, $\vartheta_{jit} = \theta_{jit} = 1$. On the contrary, if liquidity constraints do not bind and saving/borrowing is reinstated then $\theta_{jit} = 0$ and $\vartheta_{jit} \approx 1 - \pi_{it} > 0$ corresponding to the case of self-insurance with exogenous labor supply.[50]

To understand the implications of this environment for preference heterogeneity it helps to focus on the transmission of women's transitory shock u_2 while abstracting from all other shocks as if $v_j = u_1 = 0$. The transmission parameter of u_2 into consumption that previously identified $\mathbb{E}(\eta_{c,w_2(i)})$ among unconstrained households now also reflects the degree of liquidity tightness.

[49] A lifecycle model with adjustment costs of work is in principle nonseparable over time. This introduces complications that go beyond the scope of this paper. To retain the advantages of the analytical framework herein, I treat fixed labor supply as a crude proxy for extreme adjustment costs of work.

[50] When liquidity constraints do not bind, one obtains $\theta_{jit} = 0$ and $\vartheta_{jit} \approx 1 - \pi_{it}$ from the baseline expression (5) when, due to fixed labor supply, all hours and consumption-wage elasticities are zero.

Pooling constrained and unconstrained households together, this transmission parameter identifies $\varrho\mathbb{E}(\eta_{c,w_2(i)}) + (1-\varrho)\mathbb{E}(\theta_{2it}q_{2it^-})$. This is larger than $\mathbb{E}(\eta_{c,w_2(i)})$ if consumption and hours are Frisch substitutes ($\eta_{c,w_2(i)} < 0$) and the measure of tightness positive ($\theta_{2it} > 0$); liquidity constraints then bias $\mathbb{E}(\eta_{c,w_2(i)})$ upwards. The pooled second moment of the same transmission parameter is $\varrho\mathbb{E}(\eta^2_{c,w_2(i)}) + (1-\varrho)\mathbb{E}(\theta^2_{2i}q^2_{2i})$ where θ_2 and q_2 are made time-invariant for simplicity. The implied pooled variance now picks up heterogeneity in $\eta_{c,w_2(i)}$ *and* variability in liquidity tightness and women's earnings shares. This likely biases $\mathrm{Var}(\eta_{c,w_2(i)})$ upwards overstating true preference heterogeneity.[51] In a similar spirit, the transmission of u_2 into female earnings, pooled across constrained and unconstrained households, identifies $\varrho\mathbb{E}(\eta_{h_2,w_2(i)})$ and understates the true average female labor supply elasticity. Its implied pooled variance identifies $\varrho\mathrm{Var}(\eta_{h_2,w_2(i)}) + \varrho(1-\varrho)(\mathbb{E}(\eta_{h_2,w_2(i)}))^2$. This can be smaller *or* larger than $\mathrm{Var}(\eta_{h_2,w_2(i)})$. It is smaller if the proportion of unconstrained households or the average labor supply elasticity are relatively small and the elasticity exhibits substantial variability across households; it is larger when the opposite conditions hold.

These implications are in principle testable. Suppose that the researcher knows which households are unconstrained. For those households (1.) the average consumption elasticities should be smaller (more negative) than in the baseline assuming consumption and hours are Frisch substitutes as in BPS; (2.) the variance of the consumption elasticities should also be smaller; (3.) the average male and female labor supply elasticities should be larger assuming all characteristics that determine labor market attachment are like in the baseline. The difficulty lies in determining which households are indeed unconstrained. Given that the PSID does not provide consistent information on this, I consider different subsamples of relatively wealthy households and I re-estimate the preferred specification of the model on them. Wealthy households are likely to have sufficient assets to fall upon when adverse conditions arise while their wealth should also permit relatively flexible arrangements on the job market if the spouses so desire; wealthy households can therefore serve as the empirical counterpart of the theoretically unconstrained.

Table 2 presents descriptive statistics for four subsamples of gradually more stringently defined 'wealthy' households. The relevant measure of wealth comprises the present value of the household's primary residence, the value of other real estate and vehicles, the value of farms and businesses, liquid assets (savings, stocks etc), as well as the value of retirement accounts and other annuities net of debts (see footnote 26 for precise definition). Column (W1) describes households whose annual wealth A_t is at least as much as average annual consumption $\overline{C}_t$ in the baseline sample. These are households who can fund at least a year's consumption even if they encounter adverse conditions in the labor market. Although this condition sounds loose, nearly one third of the baseline sample does not meet it. Column (W2) describes households whose annual wealth is at least twice as much as average annual consumption. Column (W3) is like column (W1) with the additional condition that households hold real debt that does not exceed \$2K in annual terms. Nearly 70% of the baseline sample does not meet this condition. Finally, column (W4) is like column (W3) but the relevant measure of wealth now excludes home equity (i.e. the value of one's home net of outstanding mortgages), therefore it better proxies for liquid assets. Nearly 80% of the baseline sample is excluded.

How do the wealthy compare to the baseline? Average male and female earnings gradually increase as one moves towards the wealthiest group while hours remain flat (with the exception of a small drop in women's hours in (W3) and (W4)). Age and education also increase reflecting the well known positive correlations among age, education, earnings and wealth; the average number of children drops slightly. Average wealth nearly doubles. Home equity increases but by not as much as overall wealth. Liquid wealth, comprising savings and shares & stocks, more than doubles.

[51] The pooled variance of the transmission parameter of u_2 is $\varrho\mathrm{Var}(\eta_{c,w_2(i)}) + (1-\varrho)\mathrm{Var}(\theta_{2i}q_{2i}) + \varrho(1-\varrho)(\mathbb{E}(\eta_{c,w_2(i)}) - \mathbb{E}(\theta_{2i}q_{2i}))^2$ and overstates $\mathrm{Var}(\eta_{c,w_2(i)})$ iff $\mathrm{Var}(\theta_{2i}q_{2i}) + \varrho(\mathbb{E}(\eta_{c,w_2(i)}) - \mathbb{E}(\theta_{2i}q_{2i}))^2 > \mathrm{Var}(\eta_{c,w_2(i)})$. The last condition should generally hold when liquidity tightness varies substantially across households or when preference heterogeneity is rather limited.

Table 10 – Estimates of Preferences: Wealthy Households

	preferred specification			
	(1)	(2)	(3)	(4)
	$A > \overline{C}$	$A > 2\overline{C}$	$A > \overline{C}$ no debt	$A > \overline{C}$ liquid
Mean consumption elasticities				
$\mathbb{E}(\eta_{c,w_1(i)})$	-0.038	-0.029	-0.056	0.059
	(0.049)	(0.051)	(0.114)	(0.103)
$\mathbb{E}(\eta_{c,w_2(i)})$	0.009	-0.025	0.154	0.044
	(0.066)	(0.055)	(0.118)	(0.093)
Mean labor supply elasticities				
$\mathbb{E}(\eta_{h_1,w_1(i)})$	0.103	0.077	0.188	-0.029
	(0.085)	(0.086)	(0.195)	(0.209)
$\mathbb{E}(\eta_{h_2,w_2(i)})$	0.281	0.185	0.295	-0.156
	(0.177)	(0.160)	(0.354)	(0.224)
Variances [p-values in brackets]				
$\mathrm{V}(\eta_{c,w_1(i)})$	0.253	0.214	0.182	0.082
	[0.000]	[0.003]	[0.043]	[0.062]
$\mathrm{V}(\eta_{c,w_2(i)})$	0.253	0.214	0.182	0.082
	[0.000]	[0.003]	[0.043]	[0.062]
$\mathrm{V}(\eta_{h_1,w_1(i)})$	0.008	0.006	0.035	0.085
	[0.206]	[0.236]	[0.259]	[0.203]
Covariances				
$\mathrm{C}(\eta_{c,w_1(i)}, \eta_{c,w_2(i)})$	0.253	0.214	0.182	0.082
	(0.069)	(0.057)	(0.095)	(0.051)
$\mathrm{C}(\eta_{c,w_1(i)}, \eta_{h_1,w_1(i)})$	0.043	0.034	0.078	0.055
	(0.028)	(0.028)	(0.065)	(0.046)
$\mathrm{C}(\eta_{c,w_2(i)}, \eta_{h_1,w_1(i)})$	0.043	0.034	0.078	0.055
	(0.028)	(0.028)	(0.065)	(0.046)

Notes: The table presents GMM estimates of first and second moments of wage elasticities from the preferred specification. Column (1) is for households with annual wealth A_t at least as much as average annual consumption $\overline{C}_t$ in the baseline sample (see footnote 26 for definition of wealth). Column (2) is for households with annual wealth at least twice as much as average annual consumption. Column (3) is like column (1) with the additional condition that households hold real debt that does not exceed $2K. Column (4) is like column (3) but the relevant measure of wealth excludes home equity (i.e. the value of one's home net of outstanding mortgages), therefore it better proxies for liquid assets. Standard errors appear in parentheses and, whenever applicable, p-values in square brackets for the one-sided test that the respective parameter equals zero.

Importantly, average consumption does not change much between wealthy and the baseline; it is higher by at most 13% among the wealthy with the biggest part of this increase attributed to housing. The breakdown to elementary items does not reveal striking differences between wealthy and baseline indicating that consumption preferences may not differ much among them.

Table 10 presents the results across the four subsamples. Five observations emerge. First, the average consumption elasticities are statistically insignificant and in most cases small. These parameters do not seem to become smaller (more negative) upon departure from the baseline sample, thus contradicting the first testable implication. Note, however, that both parameters in the last column are positive and larger in absolute value than in the less stringent subsamples. Given that average labor supply elasticities across those households are negative (more on this below), the point estimates are consistent with consumption and hours being Frisch substitutes as in BPS. Second, the variances of the consumption elasticities (most of which are highly statistically significant) still reveal substantial consumption preference heterogeneity across households. These parameters, however, are always smaller than the baseline by at least a quarter and get even smaller the more stringent the definition of 'wealthy' is. I deem this pattern consistent with the second testable implication: consumption preference heterogeneity is partly eaten away as one moves towards households who are likelier to be unconstrained. Although the model is not well suited to quantify the effects of liquidity constraints and adjustment costs, the pattern for $\mathrm{Var}(\eta_{c,w_j(i)})$ suggests that at least a quarter of consumption preference heterogeneity in the baseline may be due to such constraints. Third, average labor supply elasticities get smaller the more stringent 'wealthy' is, thus invalidating the third testable implication. This is not entirely unexpected: as spouses in these households are on average more educated, it is likely that they are also more attached to the labor market and less responsive to wage changes. Interestingly, the elasticities turn negative (albeit insignificant) in the top group indicating a strong income effect. Fourth, the variance of men's labor supply elasticity remains zero in economic or statistical terms. Fifth, the consumption elasticities correlate positively (but insignificantly) with men's labor supply elasticity.

Finally, three points stand out on wages of wealthy households. The detailed results are suppressed for brevity but they are available upon request. First, the variances of all types of shocks are remarkably similar between wealthy and the baseline. If anything, the variance of women's permanent shock is only slightly higher among the wealthiest. Second, the correlation between permanent shocks in the family is also remarkably similar but the correlation of transitory ones increases as one moves towards the top group. The pattern is, however, statistically insignificant. Third, permanent shocks exhibit substantially longer left tail compared to the baseline; the third standardized moments, averaged over the four subsamples, are $\widetilde{\gamma}_{v_1} = -2.11$ (previously $\widetilde{\gamma}_{v_1} = -0.50$) and $\widetilde{\gamma}_{v_2} = -3.09$ (previously $\widetilde{\gamma}_{v_2} = -1.83$). Guvenen et al. (2015) find that the tail becomes longer the higher one's earnings are, and this is exactly what I find here too. Skewness of transitory shocks remains comparable to the baseline.

6 Conclusions

This paper studies the link between wages of individual family members and consumption. This is not a new topic in itself: most recently, Blundell et al. (2016) estimate a lifecycle model of consumption and family labor supply and find that family labor supply is a crucial insurance mechanism against wage shocks; Alan et al. (2017) estimate household income and consumption processes together and find substantial and economically important amounts of joint heterogeneity. The present paper distinctively brings a general preference heterogeneity into the nexus of wages, family labor supply, and consumption. By doing so, it formalizes a rather intuitive idea: inequality is driven not only by wages (or generally incomes) and assets but also by individual preferences. Understanding the implications of the latter for consumption inequality and partial insurance is important from a policy and positive perspective.

The paper presents a tractable lifecycle model for consumption, savings, and family labor supply. I introduce a general form of unobserved heterogeneity by allowing within-period preferences to be household-specific. I show identification of all moments of the cross-sectional joint distribution of wage elasticities of consumption and labor supply. Identification exploits Abowd and Card (1989)'s remark that working hours vary substantially even at fixed wages rates. I apply their insight to the realm of lifecycle consumption and family labor supply with observed and unobserved preference heterogeneity. Importantly, identification here does not rely on any specific parametrization of household preferences or their distribution. In addition, I show that preference heterogeneity always increases consumption growth inequality.

The empirical implementation of the model involves fitting second and third moments of the joint distribution of consumption, earnings and wages in the PSID. The distribution of wage shocks is left-skewed (especially so for the wealthiest households) implying that negative shocks are, on average, further away from the zero mean than positive ones. There is substantial heterogeneity in consumption elasticities across households; heterogeneity in labor supply elasticities is rather limited and statistically insignificant. Preference heterogeneity has substantial implications for consumption insurance. On average, a larger fraction of permanent wage shocks passes through to consumption than previously found in the literature. This is partly because the insurance role of family labor supply becomes less important when the model matches third moments of wages and earnings. Transitory shocks are, on average, fully insured. In both cases there is a distribution of partial insurance across households that includes both the full insurance and autarky benchmarks as in Hryshko and Manovskii (2017). Allowing for preference heterogeneity renders male and female labor supply elasticities smaller and the absolute consumption substitution elasticity larger than previously found. The usefulness of these results, mean and spread of preferences together, is that they can serve as inputs to welfare and program evaluations (French, 2005) or studies of consumption and wealth inequality (DeNardi et al., 2016) where heterogeneity in the behavioral response may crucially affect the efficacy of policy.

The analytical framework of this paper enables the decomposition of consumption inequality into components pertaining to preference heterogeneity (accounts for 58% of inequality after 1999), wage inequality (37%), and heterogeneity in financial and human wealth (5%). Even though the paper does not want to put too much emphasis on these numbers due to limitations of the data (small cross-section and short time series) and the approximate nature of the model, this *is* strong evidence of the pervasive implications of preference heterogeneity. I investigate a number of prominent alternative explanations for the pattern of heterogeneity I document; I explore the role of intra-family bargaining power, taxes, consumption measurement error, missing prices, and unobserved liquidity constraints coupled with adjustment costs of work. I provide formal arguments and informal tests for all. I cannot rule out that at least some part of consumption preference heterogeneity is due to liquidity constraints and adjustment costs of work.

A number of important issues are left for future research. The paper only estimates unconditional central moments of preferences; higher than second moments are not estimated at all. While these are constraints ultimately imposed by my data, the ongoing efforts of researchers to obtain joint register income and consumption data should relax much of these constraints. New data developments should also enable the nonparametric estimation of the entire distribution of consumption insurance. A striking observation is that female labor supply does not exhibit unobserved preference heterogeneity. Although this may be due to the specific sample or the focus on hours rather participation, it is certainly a feature that deserves a deeper investigation. Finally, work is required to obtain identification results when preferences relate to wage shocks while they are still kept nonparametric.

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Appendices

A Taylor Approximations to First-Order Conditions and Lifetime Budget Constraint

Utility from consumption and labor supply is affected by observable taste shifters $\mathbf{Z}_{it}$ such as age, education, or the presence and age of children. Suppose the effect of such taste shifters enters utility as

$$U_i(C_{it}, H_{1it}, H_{2it}; \mathbf{Z}_{it}) \equiv \widetilde{U}_i(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it})$$

where

$$\begin{aligned}\widetilde{C}_{it} &= C_{it} \exp(-\mathbf{Z}_{it}'\boldsymbol{\alpha}_C) \\ \widetilde{H}_{jit} &= H_{jit} \exp(-\mathbf{Z}_{it}'\boldsymbol{\alpha}_{H_j}), \quad j = \{1, 2\}.\end{aligned}$$

Assuming an internal solution, the first-order conditions of household problem (1) *s.t.* (2) are

$$\begin{aligned}[C_{it}]: &\quad \widetilde{U}_{iC}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it}) \exp(-\mathbf{Z}_{it}'\boldsymbol{\alpha}_C) = \lambda_{it} \\ [H_{jit}]: &\quad -\widetilde{U}_{iH_j}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it}) \exp(-\mathbf{Z}_{it}'\boldsymbol{\alpha}_{H_j}) = \lambda_{it} W_{jit}, \quad j = \{1, 2\} \\ [A_{it+1}]: &\quad \beta(1 + r)\mathbb{E}_t \lambda_{it+1} = \lambda_{it}\end{aligned}$$

where $\widetilde{U}_{iC}'$ denotes the marginal utility of consumption and $\widetilde{U}_{iH_j}'$ denotes the marginal utility of hours of spouse j; λ_{it} is the marginal utility of wealth (the Lagrange multiplier on the sequential budget constraint).

Approximation to intra-temporal first-order conditions. Applying logs to the three intra-temporal first-order conditions and taking a first difference across time yields

$$\begin{aligned}[C_{it}]: &\quad \Delta \ln \widetilde{U}_{iC}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it}) - \Delta\left(\mathbf{Z}_{it}'\boldsymbol{\alpha}_C\right) = \Delta \ln \lambda_{it} \\ [H_{jit}]: &\quad \Delta \ln \left(-\widetilde{U}_{iH_j}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it})\right) - \Delta\left(\mathbf{Z}_{it}'\boldsymbol{\alpha}_{H_j}\right) = \Delta \ln \lambda_{it} + \Delta \ln W_{jit}\end{aligned}$$

for $j = \{1, 2\}$. A first-order Taylor approximation of $\ln \widetilde{U}_{iC}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it})$ around $\widetilde{C}_{it-1}$, $\widetilde{H}_{1it-1}$, and $\widetilde{H}_{2it-1}$ yields

$$\begin{aligned}\Delta \ln \widetilde{U}_{iC}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it}) \approx &\frac{1}{\widetilde{U}_{iC}'(\widetilde{C}_{it-1}, \widetilde{H}_{1it-1}, \widetilde{H}_{2it-1})} \times \\ &\Big(\widetilde{U}_{iCC}''(\widetilde{C}_{it-1}, \widetilde{H}_{1it-1}, \widetilde{H}_{2it-1})\widetilde{C}_{it-1}\Delta \ln C_{it} + \\ &\widetilde{U}_{iCH_1}''(\widetilde{C}_{it-1}, \widetilde{H}_{1it-1}, \widetilde{H}_{2it-1})\widetilde{H}_{1it-1}\Delta \ln H_{1it} + \\ &\widetilde{U}_{iCH_2}''(\widetilde{C}_{it-1}, \widetilde{H}_{1it-1}, \widetilde{H}_{2it-1})\widetilde{H}_{2it-1}\Delta \ln H_{2it}\Big)\end{aligned}$$

where $\widetilde{U}_{iCC}''$ denotes the derivative of $\widetilde{U}_{iC}'$ with respect to consumption C (similarly for $\widetilde{U}_{iCH_1}''$ and $\widetilde{U}_{iCH_2}''$).

I obtain a log-linear approximation for $\Delta \ln \left(-\widetilde{U}_{iH_j}'(\widetilde{C}_{it}, \widetilde{H}_{1it}, \widetilde{H}_{2it})\right)$, $j = \{1, 2\}$, following a similar procedure.

Returning to the intra-temporal first-order conditions and replacing $\Delta \ln \widetilde{U}_{iC}'$ and $\Delta \ln \left(-\widetilde{U}_{iH_j}'\right)$ with their log-linear approximations yields a system of 3 equations in (the growth rates of) 3 outcome variables: $\Delta \ln C_{it}$, $\Delta \ln H_{1it}$ and $\Delta \ln H_{2it}$. Solving the system and rearranging so that all outcome variables and observable taste shifters are on the left hand side results in system (4) in the main text.

Approximation to Euler equation. The approximation to the inter-temporal first-order condition (the Euler equation) involves future expectations. Suppose $\exp(\varrho) = {}^{1}/_{\beta(1+r)}$ for an appropriate ϱ. I apply a second-order approximation to $\exp(\ln \lambda_{it+1})$ around $\ln \lambda_{it} + \varrho$ to get

$$\exp(\ln \lambda_{it+1}) \approx \exp(\ln \lambda_{it} + \varrho) \left(1 + (\Delta \ln \lambda_{it+1} - \varrho) + \frac{1}{2}(\Delta \ln \lambda_{it+1} - \varrho)^2 \right).$$

Taking expectations at time t and noting that $\mathbb{E}_t \lambda_{it+1} = \lambda_{it} \exp(\varrho)$ (the Euler equation) yields

$$\mathbb{E}_t \left(\Delta \ln \lambda_{it+1} - \varrho + \frac{1}{2}(\Delta \ln \lambda_{it+1} - \varrho)^2 \right) \approx 0$$

which in turn implies

$$\begin{aligned}
\mathbb{E}_t \Delta \ln \lambda_{it+1} &\approx \varrho - \frac{1}{2}\mathbb{E}_t(\Delta \ln \lambda_{i,t+1} - \varrho)^2 \\
\Delta \ln \lambda_{it+1} &\approx \varrho - \frac{1}{2}\mathbb{E}_t(\Delta \ln \lambda_{it+1} - \varrho)^2 + \varepsilon_{it+1} \\
\Delta \ln \lambda_{it+1} &\approx \varepsilon_{it+1} + \omega_{it+1}
\end{aligned}$$

with $\omega_{it+1} = \varrho - \frac{1}{2}\mathbb{E}_t(\Delta \ln \lambda_{it+1} - \varrho)^2$. The first term is an innovation term that captures idiosyncratic revisions to λ due to wage shocks. The second term captures the effect of the interest and discount rates on the slope of consumption growth (assumed deterministic).

Approximation to lifetime budget constraint. The general form of household i's lifetime budget constraint is

$$A_{it} + \mathbb{E}_t \sum_{s=0}^{T-t} \sum_{j=1}^{2} \frac{W_{jit+s} H_{jit+s}}{(1+r)^s} = \mathbb{E}_t \sum_{s=0}^{T-t} \frac{C_{it+s}}{(1+r)^s}.$$

To ease the notation I will temporarily suppress cross-sectional subscript i.

Let $G(\boldsymbol{\xi}) = \ln \sum_{s=0}^{T-t} \exp \xi_s$ for $\boldsymbol{\xi} = (\xi_0, \xi_1, \ldots, \xi_{T-t})'$. A first-order Taylor approximation to $\mathbb{E}_I G(\boldsymbol{\xi})$, where I denotes some information set, around a deterministic $\boldsymbol{\xi}^0$ is

$$\mathbb{E}_I G(\boldsymbol{\xi}) \approx G(\boldsymbol{\xi}^0) + \sum_{s=0}^{T-t} \frac{\exp \xi_s^0}{\sum_{\kappa=0}^{T-t} \exp \xi_\kappa^0} \left(\mathbb{E}_I \xi_s - \xi_s^0 \right). \tag{A.1}$$

The logarithm of the right hand side of the budget constraint, assuming expectations away, is

$$G^{RH}(\boldsymbol{\xi}) = \ln \sum_{s=0}^{T-t} \exp \left(\ln \frac{C_{t+s}}{(1+r)^s} \right)$$

for $\xi_s = \ln C_{t+s} - s \ln(1+r)$. Suppose that $\xi_s^0 = \mathbb{E}_{t-1} \ln C_{t+s} - s \ln(1+r)$. Following (A.1) yields

$$\mathbb{E}_I G^{RH}(\boldsymbol{\xi}) \approx G^{RH}(\boldsymbol{\xi}^0) + \sum_{s=0}^{T-t} \theta_{t+s} \left(\mathbb{E}_I \ln C_{t+s} - \mathbb{E}_{t-1} \ln C_{t+s} \right)$$

where $\theta_{t+s} = \frac{\exp(\mathbb{E}_{t-1} \ln C_{t+s} - s\ln(1+r))}{\sum_{\kappa=0}^{T-t} \exp(\mathbb{E}_{t-1} \ln C_{t+\kappa} - \kappa \ln(1+r))}$ is approximately equal to the $t-1$-expected share of consumption at $t+s$ in the household's total lifetime consumption. Note that θ_{t+s} is known for any $t+s \geq t$ because it pertains to expectations at $t-1$.

Defining the information set to contain information known at time t, that is $I := t$, and replacing $\ln C_{t+s}$ consecutively by the analytical expression in (4) yields

$$\sum_{s=0}^{T-t} \theta_{t+s} \left(\mathbb{E}_t \ln C_{t+s} - \mathbb{E}_{t-1} \ln C_{t+s} \right) \approx \bar{\eta}_c \varepsilon_t + \sum_{j=1}^{2} \eta_{c,w_j} v_{jt} + \sum_{j=1}^{2} \theta_t \eta_{c,w_j} u_{jt},$$

where $\bar{\eta}_c = \eta_{c,p} + \eta_{c,w_1} + \eta_{c,w_2}$. Assuming the share of consumption in any given time period within the household's total lifetime consumption is negligible, that is $\theta_t \approx 0$, taking a first difference in expectations between t and $t-1$, and reinstating cross-sectional subscript i yields

$$\mathbb{E}_t G^{RH}(\boldsymbol{\xi}) - \mathbb{E}_{t-1} G^{RH}(\boldsymbol{\xi}) \approx \bar{\eta}_{c(i)} \varepsilon_{it} + \sum_{j=1}^{2} \eta_{c,w_j(i)} v_{jit}.$$

Applying similar arguments to the left hand side of the budget constraint and using information from (3) and (4) yields

$$\begin{aligned} \mathbb{E}_t G^{LH}(\boldsymbol{\xi}) - \mathbb{E}_{t-1} G^{LH}(\boldsymbol{\xi}) \approx & (1-\pi_{it}) \left(s_{1it} \bar{\eta}_{h_1(i)} + s_{2it} \bar{\eta}_{h_2(i)} \right) \varepsilon_{it} \\ & + (1-\pi_{it}) \left(s_{1it}(1+\eta_{h_1,w_1(i)}) + s_{2it} \eta_{h_2,w_1(i)} \right) v_{1it} \\ & + (1-\pi_{it}) \left(s_{1it} \eta_{h_1,w_2(i)} + s_{2it}(1+\eta_{h_2,w_2(i)}) \right) v_{2it} \end{aligned}$$

where, suppressing cross-sectional i, $\bar{\eta}_{h_j} = \eta_{h_j,p} + \eta_{h_j,w_1} + \eta_{h_j,w_2}$ for $j = \{1,2\}$. To get the expression above I have defined

$$G^{LH}(\boldsymbol{\xi}) = \ln \left(\exp\left(\ln A_t\right) + \sum_{s=1}^{T-t+1} \exp \left(\ln \sum_{j=1}^{2} \frac{W_{jt+s-1} H_{jt+s-1}}{(1+r)^{s-1}} \right) \right)$$

and

$$\xi_s = \begin{cases} \ln A_{t+s} & \text{for } s = 0 \\ \ln \sum_{j=1}^{2} W_{jt+s-1} H_{jt+s-1} - (s-1)\ln(1+r) & \text{for } s = 1, \dots, T-t+1 \end{cases}$$

$$\xi_s^0 = \begin{cases} \mathbb{E}_{t-1} \ln A_{t+s} & \text{for } s = 0 \\ \mathbb{E}_{t-1} \ln \sum_{j=1}^{2} W_{jt+s-1} H_{jt+s-1} - (s-1)\ln(1+r) & \text{for } s = 1, \dots, T-t+1. \end{cases}$$

The rest of the notation is as follows: $\pi_t = \frac{Q_{1t}}{Q_{1t}+Q_{2t}}$ with $Q_{1t} = \exp\left(\mathbb{E}_{t-1} \ln A_t\right)$ and $Q_{2t} = \sum_{\kappa=0}^{T-t} \exp\left(\mathbb{E}_{t-1} \ln \sum_j W_{jt+\kappa} H_{jt+\kappa} - \kappa \ln(1+r)\right)$ is the 'partial insurance' parameter approximately equal to the share of financial wealth in the household's total financial and human wealth at t. $s_{jt} = \sum_{s=0}^{T-t} \vartheta_{t+s} \widetilde{q}_{jt+s}$ with $\vartheta_{t+s} = \exp\left(\mathbb{E}_{t-1} \ln \sum_{j=1}^{2} W_{jt+s} H_{jt+s} - s\ln(1+r)\right) / Q_{2t}$ and $\widetilde{q}_{jt+s} = \frac{\mathbb{E}_{t-1} W_{jt+s} H_{jt+s}}{\sum_{\iota=1}^{2} \mathbb{E}_{t-1} W_{\iota t+s} H_{\iota t+s}}$ is approximately equal to the share of spouse j's human wealth (expected discounted lifetime earnings) in the household's total human wealth at t. Note that ϑ_{t+s} and $\widetilde{q}_{jt+s}$ are known for any $t+s \geq t$ because they both pertain to expectations at $t-1$. I assume that the share of earnings in any time given time period within the household's total lifetime earnings is negligible, that is $\vartheta_{t+s} \approx 0$.

I bring the two sides together following Blundell et al. (2013, p. 34) who point out that "the realized budget must balance" and, therefore, the objects on the two sides of the log-linearized budget constraint "have the same distribution". I solve for ε_{it} to get

$$\varepsilon_{it} \approx \varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i) v_{1it} + \varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i) v_{2it} \tag{A.2}$$

where

$$\begin{aligned} \varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i) &= \left(\bar{\eta}_{c(i)} - (1-\pi_{it}) \left(s_{1it} \bar{\eta}_{h_1(i)} + s_{2it} \bar{\eta}_{h_2(i)} \right) \right)^{-1} \times \\ & \quad \left((1-\pi_{it}) \left(s_{1it}(1+\eta_{h_1,w_1(i)}) + s_{2it} \eta_{h_2,w_1(i)} \right) - \eta_{c,w_1(i)} \right) \\ \varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i) &= \left(\bar{\eta}_{c(i)} - (1-\pi_{it}) \left(s_{1it} \bar{\eta}_{h_1(i)} + s_{2it} \bar{\eta}_{h_2(i)} \right) \right)^{-1} \times \\ & \quad \left((1-\pi_{it}) \left(s_{1it} \eta_{h_1,w_2(i)} + s_{2it}(1+\eta_{h_2,w_2(i)}) \right) - \eta_{c,w_2(i)} \right) \end{aligned}$$

and $\mathbf{s}_{it} = (s_{1it}, s_{2it})'$ and $\boldsymbol{\eta}_i$ is the 9×1 vector of household-specific Frisch elasticities presented in table 1 and defined in appendix B.[52]

[52]Note that having *both* s_{1it} and s_{2it} in $\mathbf{s}_{it}$ is superfluous as $s_{1it} + s_{2it} = 1$ by construction.

B Frisch Elasticities

Household preferences U_i over consumption and labor supply are represented ordinally by 9 Frisch (or λ-constant) elasticities presented in table 1 in the main text. There are 9 such elasticities because there are 3 goods (C, H_1, H_2) and 3 associated prices (P, W_1, W_2); consequently there are 3 own-price and 6 cross-price elasticities. The analytical expressions for these elasticities are

$$\begin{aligned}
\eta_{c,w_1(i)} &= \left.\frac{\partial C}{\partial W_1}\frac{W_1}{C}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_1}}{C}(U''_{CH_2}U''_{H_1H_2} - U''_{CH_1}U''_{H_2H_2}) \\
\eta_{c,w_2(i)} &= \left.\frac{\partial C}{\partial W_2}\frac{W_2}{C}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_2}}{C}(U''_{CH_1}U''_{H_1H_2} - U''_{CH_2}U''_{H_1H_1}) \\
\eta_{c,p(i)} &= \left.\frac{\partial C}{\partial P}\frac{P}{C}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{C}}{C}(U''_{H_1H_1}U''_{H_2H_2} - U''^{\,2}_{H_1H_2}) \\
\eta_{h_1,w_1(i)} &= \left.\frac{\partial H_1}{\partial W_1}\frac{W_1}{H_1}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_1}}{H_1}(U''_{CC}U''_{H_2H_2} - U''^{\,2}_{CH_2}) \\
\eta_{h_1,w_2(i)} &= \left.\frac{\partial H_1}{\partial W_2}\frac{W_2}{H_1}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_2}}{H_1}(U''_{CH_1}U''_{CH_2} - U''_{CC}U''_{H_1H_2}) \\
\eta_{h_1,p(i)} &= \left.\frac{\partial H_1}{\partial P}\frac{P}{H_1}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{C}}{H_1}(U''_{CH_2}U''_{H_1H_2} - U''_{CH_1}U''_{H_2H_2}) \\
\eta_{h_2,w_1(i)} &= \left.\frac{\partial H_2}{\partial W_1}\frac{W_1}{H_2}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_1}}{H_2}(U''_{CH_1}U''_{CH_2} - U''_{CC}U''_{H_1H_2}) \\
\eta_{h_2,w_2(i)} &= \left.\frac{\partial H_2}{\partial W_2}\frac{W_2}{H_2}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{H_2}}{H_2}(U''_{CC}U''_{H_1H_1} - U''^{\,2}_{CH_1}) \\
\eta_{h_2,p(i)} &= \left.\frac{\partial H_2}{\partial P}\frac{P}{H_2}\right|^{i}_{\lambda\text{-const.}} &&= Det^{-1}\frac{U'_{C}}{H_2}(U''_{CH_1}U''_{H_1H_2} - U''_{CH_2}U''_{H_1H_1})
\end{aligned}$$

where U'_x denotes the marginal utility with respect to outcome variable $x = \{C, H_1, H_2\}$ and $U''_{x\chi}$ denotes the derivative of U'_x with respect to $\chi = \{C, H_1, H_2\}$. Det is the determinant of the Hessian matrix of preferences given by

$$Det = U''_{CC}U''_{H_1H_1}U''_{H_2H_2} + 2U''_{CH_1}U''_{CH_2}U''_{H_1H_2} - U''_{CC}U''^{\,2}_{H_1H_2} - U''_{H_1H_1}U''^{\,2}_{CH_2} - U''_{H_2H_2}U''^{\,2}_{CH_1}.$$

All partial derivatives as well as outcome variables and the determinant Det are i-specific but I suppress this subscript to ease the notation. The partial effects are calculated at the household level holding λ constant in expectation.

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

$$\begin{pmatrix} \frac{dC}{dP} & -\frac{dC}{dW_1} & -\frac{dC}{dW_2} \\ \frac{dH_1}{dP} & -\frac{dH_1}{dW_1} & -\frac{dH_1}{dW_2} \\ \frac{dH_2}{dP} & -\frac{dH_2}{dW_1} & -\frac{dH_2}{dW_2} \end{pmatrix} = \lambda_i \mathbf{H}_i^{-1}\mathbf{I}_3 \tag{B.1}$$

where $\mathbf{H}_i$ is the Hessian of U_i and $\mathbf{I}_3$ is a 3×3 identity matrix. One can obtain the matrix of substitution effects by totally differentiating the three intra-temporal first-order conditions of the household problem with respect to prices while noting that $\Delta\lambda_{it} = 0$ in expectation.

As the right hand side of (B.1) is a 3×3 symmetric matrix (the Hessian is symmetric by Young's theorem and standard regularity conditions on U_i), it follows that $\frac{dH_j}{dP} = -\frac{dC}{dW_j}$, $j = \{1, 2\}$, and $\frac{dH_1}{dW_2} = \frac{dH_2}{dW_1}$. Simple manipulations of these restrictions translate into restrictions on the corresponding cross-price Frisch elasticities.

C Consumption, Earnings, and Hours Inequality

To simplify the illustration of the derivation of consumption inequality, I write consumption growth as

$$\Delta c_{it} \approx \psi_{1i}\Delta u_{1it} + \psi_{2i}\Delta u_{2it} + \phi_{1it}v_{1it} + \phi_{2it}v_{2it}.$$

This is the same as (but shorter than) expression (5) in the main text with $\psi_{ji} = \psi_j(\boldsymbol{\eta}_i)$ and $\phi_{jit} = \phi_j(\boldsymbol{\eta}_i, \pi_{it}, \mathbf{s}_{it})$, $j = \{1, 2\}$.

From the properties of the variance operator it follows that

$$\begin{aligned}
\mathrm{Var}\left(\Delta c_{it}\right) \approx\; & \mathrm{Var}\left(\psi_{1i}\Delta u_{1it}\right) + \mathrm{Var}\left(\psi_{2i}\Delta u_{2it}\right) + \mathrm{Var}\left(\phi_{1it}v_{1it}\right) + \mathrm{Var}\left(\phi_{2it}v_{2it}\right) \\
& + 2\mathrm{Cov}\left(\psi_{1i}\Delta u_{1it}, \psi_{2i}\Delta u_{2it}\right) + 2\mathrm{Cov}\left(\psi_{1i}\Delta u_{1it}, \phi_{1it}v_{1it}\right) \\
& + 2\mathrm{Cov}\left(\psi_{1i}\Delta u_{1it}, \phi_{2it}v_{2it}\right) + 2\mathrm{Cov}\left(\psi_{2i}\Delta u_{2it}, \phi_{1it}v_{1it}\right) \\
& + 2\mathrm{Cov}\left(\psi_{2i}\Delta u_{2it}, \phi_{2it}v_{2it}\right) + 2\mathrm{Cov}\left(\phi_{1it}v_{1it}, \phi_{2it}v_{2it}\right).
\end{aligned}$$

Using results from Goodman (1960) and noting that (i) shocks have zero means and (ii) wage shocks are independent of preferences, π_{it}, and $\mathbf{s}_{it}$, thus also independent of ψ_{ji} and ϕ_{jit}, $j = \{1, 2\}$, it can be shown that $\mathrm{Var}\left(\psi_{1i}\Delta u_{1it}\right) = \mathbb{E}\left(\psi_{1i}^2\right)\mathrm{Var}\left(\Delta u_{1it}\right)$ (and similarly for the other variances). Using results from Bohrnstedt and Goldberger (1969) it can be shown that all the covariances are 0 except those involving transitory shocks exclusively or permanent shocks exclusively. The covariances are zero because: (i) the shocks have zero means, (ii) permanent and transitory shocks are independent, (iii) wage shocks are independent of preferences, π_{it}, and $\mathbf{s}_{it}$. The remaining covariances are $\mathrm{Cov}\left(\psi_{1i}\Delta u_{1it}, \psi_{2i}\Delta u_{2it}\right) = \mathbb{E}\left(\psi_{1i}\psi_{2i}\right)\mathrm{Cov}\left(\Delta u_{1it}, \Delta u_{2it}\right)$ (and similarly for $\mathrm{Cov}\left(\phi_{1it}v_{1it}, \phi_{2it}v_{2it}\right)$). The resulting consumption variance is expression (8) in the main text.

Relying on these results and mimicking expression (8) in the main text, the analytical expression for hours inequality is given by

$$\begin{aligned}
\mathrm{Var}\left(\Delta h_{jit}\right) \approx\; & \mathbb{E}(\eta^2_{h_j,w_1(i)}) \times \left(\sigma^2_{u_1(t)} + \sigma^2_{u_1(t-1)}\right) \\
& + \mathbb{E}(\eta^2_{h_j,w_2(i)}) \times \left(\sigma^2_{u_2(t)} + \sigma^2_{u_2(t-1)}\right) \\
& + 2\mathbb{E}(\eta_{h_j,w_1(i)}\eta_{h_j,w_2(i)}) \times \left(\sigma_{u_1u_2(t)} + \sigma_{u_1u_2(t-1)}\right) \\
& + \mathbb{E}\left(\left(\eta_{h_j,w_1(i)} + \bar{\eta}_{h_j(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)^2\right) \times \sigma^2_{v_1(t)} \\
& + \mathbb{E}\left(\left(\eta_{h_j,w_2(i)} + \bar{\eta}_{h_j(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)^2\right) \times \sigma^2_{v_2(t)} \\
& + 2\mathbb{E}\left(\left(\eta_{h_j,w_1(i)} + \bar{\eta}_{h_j(i)}\varepsilon_1(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)\left(\eta_{h_j,w_2(i)} + \bar{\eta}_{h_j(i)}\varepsilon_2(\pi_{it}, \mathbf{s}_{it}; \boldsymbol{\eta}_i)\right)\right) \times \sigma_{v_1v_2(t)},
\end{aligned}$$

for $j = \{1, 2\}$. The expression for $\mathrm{Var}\left(\Delta y_{jit}\right)$ follows from the identity $\Delta y_{jit} = \Delta h_{jit} + \Delta w_{jit}$.

D Identification Details

In this appendix I provide detailed statements for the identification of the parameters of the wage process and the distribution of wage elasticities (first & second moments only).

Wage process. There are 6 parameters that characterize the cross-sectional dispersion of wage shocks and their correlation in the family at time t: $\sigma^2_{v_j(t)}$, $\sigma^2_{u_j(t)}$, $\sigma_{v_1v_2(t)}$, $\sigma_{u_1u_2(t)}$ ($j = \{1, 2\}$). Identification follows Meghir and Pistaferri (2004) and earlier studies and requires second moments of the joint distribution of spouses' wages across households; namely

$$\sigma^2_{v_j(t)} = \mathbb{E}\left(\Delta w_{jit}(\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right)$$

$$
\begin{aligned}
\sigma^2_{u_j(t)} &= -\mathbb{E}\left(\Delta w_{jit}\Delta w_{jit+1}\right) \\
\sigma_{v_1v_2(t)} &= \mathbb{E}\left(\Delta w_{1it}(\Delta w_{2it-1} + \Delta w_{2it} + \Delta w_{2it+1})\right) \\
\sigma_{u_1u_2(t)} &= -\mathbb{E}\left(\Delta w_{1it}\Delta w_{2it+1}\right)
\end{aligned}
$$

where Δw_{jit} is given by (3). I abstract from measurement error. The intuition behind identification is as follows: $\sum_{\varsigma=-1}^{\varsigma=1}\Delta w_{jit+\varsigma}$ strips $\Delta w_{j'it}$ of its mean-reverting transitory shock at t ($j' = \{1,2\}$); therefore, the covariance between this sum and $\Delta w_{j'it}$ identifies the (co-)variance of permanent shocks. The covariance between consecutive wage growths identifies (minus) the (co-)variance of transitory shocks due to mean-reversion.

There are 8 parameters that characterize the cross-sectional skewness of shocks at time t: $\gamma_{v_j(t)}$, $\gamma_{u_j(t)}$, $\gamma_{v_1v_2^2(t)}$, $\gamma_{v_1^2v_2(t)}$, $\gamma_{u_1u_2^2(t)}$, $\gamma_{u_1^2u_2(t)}$. Identification parallels that for the second moments and requires third moments of the joint distribution of spouses' wages across households; namely

$$
\begin{aligned}
\gamma_{v_j(t)} &= \mathbb{E}\left((\Delta w_{jit})^2(\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right) \\
\gamma_{u_j(t)} &= -\mathbb{E}\left((\Delta w_{jit})^2\Delta w_{jit+1}\right) \\
\gamma_{v_1v_2^2(t)} &= \mathbb{E}\left((\Delta w_{2it})^2(\Delta w_{1it-1} + w_{1it} + \Delta w_{1it+1})\right) \\
\gamma_{v_1^2v_2(t)} &= \mathbb{E}\left((\Delta w_{1it})^2(\Delta w_{2it-1} + \Delta w_{2it} + \Delta w_{2it+1})\right) \\
\gamma_{u_1u_2^2(t)} &= -\mathbb{E}\left((\Delta w_{2it})^2\Delta w_{1it+1}\right) \\
\gamma_{u_1^2u_2(t)} &= -\mathbb{E}\left((\Delta w_{1it})^2\Delta w_{2it+1}\right).
\end{aligned}
$$

Generalization to the n^{th} moment ($n > 1$) is straightforward. The n^{th} moments of permanent wage shocks are identified through the n^{th} moments $\mathbb{E}\left((\Delta w_{jit})^{n-1}(\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right)$ and $\mathbb{E}\left((\Delta w_{2it})^{n-\nu}\left(\Delta w_{1it-1} + \Delta w_{1it} + \Delta w_{1it+1}\right)^{\nu}\right)$ with $j = \{1,2\}$ and $\nu = \{1,\dots,n-1\}$. These moments convey information on $\mathbb{E}(v^n_{jit})$ and $\mathbb{E}(v^{\nu}_{1it}v^{n-\nu}_{2it})$ respectively *plus* a sum of products of lower-order moments (up to $n-2 \geq 2$) of the spouses' permanent and transitory shocks between times $t-2$ and $t-1$. Such lower-order moments are identified sequentially relying on results for the variance and skewness and then moving up, if required, until reaching moments of order $n-2$.

The n^{th} moments of transitory shocks are identified through the n^{th} autocovariances of wages; namely $\mathbb{E}\left((\Delta w_{jit})^{n-1}\Delta w_{jit+1}\right)$ and $\mathbb{E}\left((\Delta w_{2it})^{n-\nu}(\Delta w_{1it+1})^{\nu}\right)$. These autocovariances carry information on $\mathbb{E}(u^n_{jit})$ and $\mathbb{E}(u^{\nu}_{1it}u^{n-\nu}_{2it})$ respectively *plus*, like previously, a sum of products of lower-order moments (order up to $n-2 \geq 2$) of the spouses' permanent and transitory wage shocks between times $t-1$ and $t+1$.

Preferences. There are 9 parameters that characterize the unconditional first moment of the joint distribution $F_{\boldsymbol{\eta}}$ of Frisch elasticities across households: $\mathbb{E}(\eta_{c,w_j(i)})$, $\mathbb{E}(\eta_{c,p(i)})$, $\mathbb{E}(\eta_{h_{j'},w_j(i)})$, and $\mathbb{E}(\eta_{h_{j'},p(i)})$ for $j,j' = \{1,2\}$. There are 45 parameters characterizing the unconditional second moment; these are the cross-sectional variances of each Frisch elasticity (9 parameters) as well as all possible covariances between them (36 parameters). Table D.1 lists these parameters. In general, there are $\left(\prod_{i=1}^{8}(n+i)\right)/8!$ parameters characterizing the unconditional $n^{\text{th}} = \{1,2,3,\dots\}$ moment of $F_{\boldsymbol{\eta}}$, assuming that such moment exists and is finite.

I group these parameters (moments) into two categories. The first includes moments that refer exclusively to *wage elasticities*; the second category includes all remaining parameters, that is moments that involve elasticities *with respect to the price of consumption*. Table D.1 illustrates this categorization as it manifests in the case of second moments. Parameters belonging to the first category appear without shade, whereas parameters belonging to the second category appear in gray shade (lighter gray shade is applied to cross-moments with wage elasticities).

Define the following moments involving consumption, earnings (the product of wages and hours), and wage data:

$$
m_{cw_j} = \mathbb{E}(\Delta c_{it}\Delta w_{jit+1}) \qquad = -\mathbb{E}(\eta_{c,w_j(i)})\sigma^2_{u_j(t)} - \mathbb{E}(\eta_{c,w_{j'}(i)})\sigma_{u_1u_2(t)}
$$

Table D.1 – Second Moments of Preference Distribution $F_{\boldsymbol{\eta}}$

	Consumption elasticities			*Male labor supply elasticities*			*Female labor supply elasticities*		
	$\eta_{c,w_1(i)}$	$\eta_{c,w_2(i)}$	$\eta_{c,p(i)}$	$\eta_{h_1,w_1(i)}$	$\eta_{h_1,w_2(i)}$	$\eta_{h_1,p(i)}$	$\eta_{h_2,w_1(i)}$	$\eta_{h_2,w_2(i)}$	$\eta_{h_2,p(i)}$
$\eta_{c,w_1(i)}$	$\mathrm{V}(\eta_{c,w_1(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{c,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{c,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_1,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_1,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_1,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_1(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{c,w_2(i)}$		$\mathrm{V}(\eta_{c,w_2(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{c,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_1,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_1,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_1,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,w_2(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{c,p(i)}$			$\mathrm{V}(\eta_{c,p(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_1,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_1,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_1,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{c,p(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_1,w_1(i)}$				$\mathrm{V}(\eta_{h_1,w_1(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_1(i)}\\ \eta_{h_1,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_1(i)}\\ \eta_{h_1,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_1(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_1(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_1(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_1,w_2(i)}$					$\mathrm{V}(\eta_{h_1,w_2(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_2(i)}\\ \eta_{h_1,p(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_2(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_2(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,w_2(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_1,p(i)}$						$\mathrm{V}(\eta_{h_1,p(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,p(i)}\\ \eta_{h_2,w_1(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,p(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_1,p(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_2,w_1(i)}$							$\mathrm{V}(\eta_{h_2,w_1(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{h_2,w_1(i)}\\ \eta_{h_2,w_2(i)}\end{pmatrix}$	$\mathrm{C}\begin{pmatrix}\eta_{h_2,w_1(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_2,w_2(i)}$								$\mathrm{V}(\eta_{h_2,w_2(i)})$	$\mathrm{C}\begin{pmatrix}\eta_{h_2,w_2(i)}\\ \eta_{h_2,p(i)}\end{pmatrix}$
$\eta_{h_2,p(i)}$									$\mathrm{V}(\eta_{h_2,p(i)})$

Notes: The table lists the 45 parameters that characterize the unconditional second moment of the distribution of preferences $F_{\boldsymbol{\eta}}$. Parameters that refer exclusively to wage elasticities appear without shade; parameters that involve elasticities with respect to the price of consumption appear in gray shade. A lighter gray shade is applied to cross-moments between wage elasticities and elasticities with respect to the price of consumption. V denotes the cross-sectional variance and C denotes the covariance.

$$
\begin{aligned}
m_{cc} &= \mathbb{E}(\Delta c_{it}\Delta c_{it+1}) &&= -\mathbb{E}(\eta^2_{c,w_1(i)})\sigma^2_{u_1(t)} - \mathbb{E}(\eta^2_{c,w_2(i)})\sigma^2_{u_2(t)} - 2\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)})\sigma_{u_1u_2(t)} \\
m_{c^2w_j} &= \mathbb{E}((\Delta c_{it})^2\Delta w_{jit+1}) &&= -\mathbb{E}(\eta^2_{c,w_j(i)})\gamma_{u_j(t)} - \mathbb{E}(\eta^2_{c,w_{j'}(i)})\gamma_{u_ju^2_{j'}(t)} - 2\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)})\gamma_{u^2_ju_{j'}(t)} \\
m_{y_jw_j} &= \mathbb{E}(\Delta y_{jit}\Delta w_{jit+1}) &&= -\mathbb{E}(1+\eta_{h_j,w_j(i)})\sigma^2_{u_j(t)} - \mathbb{E}(\eta_{h_j,w_{j'}(i)})\sigma_{u_1u_2(t)} \\
m_{y_jw_{j'}} &= \mathbb{E}(\Delta y_{jit}\Delta w_{j'it+1}) &&= -\mathbb{E}(1+\eta_{h_j,w_j(i)})\sigma_{u_1u_2(t)} - \mathbb{E}(\eta_{h_j,w_{j'}(i)})\sigma^2_{u_{j'}(t)} \\
m_{y_jy_j} &= \mathbb{E}(\Delta y_{jit}\Delta y_{jit+1}) &&= -\mathbb{E}((1+\eta_{h_j,w_j(i)})^2)\sigma^2_{u_j(t)} - \mathbb{E}(\eta^2_{h_j,w_{j'}(i)})\sigma^2_{u_{j'}(t)} \\
& && \quad - 2\mathbb{E}((1+\eta_{h_j,w_j(i)})\eta_{h_j,w_{j'}(i)})\sigma_{u_1u_2(t)} \\
m_{y^2_jw_j} &= \mathbb{E}((\Delta y_{jit})^2\Delta w_{jit+1}) &&= -\mathbb{E}((1+\eta_{h_j,w_j(i)})^2)\gamma_{u_j(t)} - \mathbb{E}(\eta^2_{h_j,w_{j'}(i)})\gamma_{u_ju^2_{j'}(t)} \\
& && \quad - 2\mathbb{E}((1+\eta_{h_j,w_j(i)})\eta_{h_j,w_{j'}(i)})\gamma_{u^2_ju_{j'}(t)} \\
m_{y^2_jw_{j'}} &= \mathbb{E}((\Delta y_{jit})^2\Delta w_{j'it+1}) &&= -\mathbb{E}((1+\eta_{h_j,w_j(i)})^2)\gamma_{u^2_ju_{j'}(t)} - \mathbb{E}(\eta^2_{h_j,w_{j'}(i)})\gamma_{u_{j'}(t)} \\
& && \quad - 2\mathbb{E}((1+\eta_{h_j,w_j(i)})\eta_{h_j,w_{j'}(i)})\gamma_{u_ju^2_{j'}(t)} \\
m_{cy_j} &= \mathbb{E}(\Delta c_{it}\Delta y_{jit+1}) &&= -\mathbb{E}(\eta_{c,w_j(i)}(1+\eta_{h_j,w_j(i)}))\sigma^2_{u_j(t)} - \mathbb{E}(\eta_{c,w_{j'}(i)}\eta_{h_j,w_{j'}(i)})\sigma^2_{u_{j'}(t)} \\
& && \quad - \big(\mathbb{E}(\eta_{c,w_j(i)}\eta_{h_j,w_{j'}(i)}) + \mathbb{E}(\eta_{c,w_{j'}(i)}(1+\eta_{h_j,w_j(i)}))\big)\sigma_{u_1u_2(t)} \\
m_{cy_jw_j} &= \mathbb{E}(\Delta c_{it}\Delta y_{jit}\Delta w_{jit+1}) &&= -\mathbb{E}(\eta_{c,w_j(i)}(1+\eta_{h_j,w_j(i)}))\gamma_{u_j(t)} - \mathbb{E}(\eta_{c,w_{j'}(i)}\eta_{h_j,w_{j'}(i)})\gamma_{u_ju^2_{j'}(t)} \\
& && \quad - \big(\mathbb{E}(\eta_{c,w_j(i)}\eta_{h_j,w_{j'}(i)}) + \mathbb{E}(\eta_{c,w_{j'}(i)}(1+\eta_{h_j,w_j(i)}))\big)\gamma_{u^2_ju_{j'}(t)} \\
m_{cy_jw_{j'}} &= \mathbb{E}(\Delta c_{it}\Delta y_{jit}\Delta w_{j'it+1}) &&= -\mathbb{E}(\eta_{c,w_j(i)}(1+\eta_{h_j,w_j(i)}))\gamma_{u^2_ju_{j'}(t)} - \mathbb{E}(\eta_{c,w_{j'}(i)}\eta_{h_j,w_{j'}(i)})\gamma_{u_{j'}(t)} \\
& && \quad - \big(\mathbb{E}(\eta_{c,w_j(i)}\eta_{h_j,w_{j'}(i)}) + \mathbb{E}(\eta_{c,w_{j'}(i)}(1+\eta_{h_j,w_j(i)}))\big)\gamma_{u_ju^2_{j'}(t)}
\end{aligned}
$$

where $j, j' = \{1, 2\}$ and $j \neq j'$. To obtain these expressions I rely on results in Bohrnstedt and Goldberger (1969) for the covariance of products of random variables and I assume (1.) independence of wage shocks and preferences (section 2.2) and (2.) no joint variation between wage and consumption measurement errors. All joint consumption-wage and earnings-wage moments may vary with t but I have removed such subscript to ease the notation.

The mean wage elasticities are identified through a combination of wage and joint consumption-wage and earnings-wage moments; namely

$$
\begin{aligned}
\mathbb{E}(\eta_{c,w_j(i)}) &= \frac{m_{cw_{j'}}\sigma_{u_1u_2} - m_{cw_j}\sigma^2_{u_{j'}}}{\sigma^2_{u_1}\sigma^2_{u_2} - (\sigma_{u_1u_2})^2} \\
\mathbb{E}(\eta_{h_j,w_j(i)}) &= \frac{m_{y_jw_{j'}}\sigma_{u_1u_2} - m_{y_jw_j}\sigma^2_{u_{j'}}}{\sigma^2_{u_1}\sigma^2_{u_2} - (\sigma_{u_1u_2})^2} - 1 \\
\mathbb{E}(\eta_{h_j,w_{j'}(i)}) &= \frac{m_{y_jw_j}\sigma_{u_1u_2} - m_{y_jw_{j'}}\sigma^2_{u_j}}{\sigma^2_{u_1}\sigma^2_{u_2} - (\sigma_{u_1u_2})^2}.
\end{aligned}
$$

These parameters are heavily over-identified by many additional moments. In addition, symmetry of the Hessian matrix of the household-specific utility function U_i implies symmetry of the matrix of Frisch substitution effects, which in turn implies linear restrictions among reciprocal cross-elasticities (see appendix B). As a result the following relation must hold: $\mathbb{E}(\eta_{h_2,w_1(i)}) = \mathbb{E}(\eta_{h_1,w_2(i)})\mathbb{E}({}^{Y_{1it}}/{}_{Y_{2it}})$ where Y_{jit} is earnings of spouse j.

The second moments of the consumption-wage elasticities (upper left triangle of table D.1) are identified from wage, consumption, and joint consumption-wage moments; namely

$$
\begin{pmatrix}
\sigma^2_{u_1(t)} & \sigma^2_{u_2(t)} & 2\sigma_{u_1u_2(t)} \\
\gamma_{u_1(t)} & \gamma_{u_1u^2_2(t)} & 2\gamma_{u^2_1u_2(t)} \\
\gamma_{u^2_1u_2(t)} & \gamma_{u_2(t)} & 2\gamma_{u_1u^2_2(t)}
\end{pmatrix}
\begin{pmatrix}
\mathbb{E}(\eta^2_{c,w_1(i)}) \\
\mathbb{E}(\eta^2_{c,w_2(i)}) \\
\mathbb{E}(\eta_{c,w_1(i)}\eta_{c,w_2(i)})
\end{pmatrix}
= -
\begin{pmatrix}
m_{cc} \\
m_{c^2w_1} \\
m_{c^2w_2}
\end{pmatrix}.
$$

The system is linear in the parameters. The matrix of coefficients involving exclusively wage moments is nonsingular if the distribution of shocks is asymmetric about the mean, that is if shocks are skewed. Note that the matrix is nonsingular also if $\sigma_{u_1u_2} = 0$ *or* $\gamma_{u_1^2u_2} = \gamma_{u_1u_2^2} = 0$. If all cross-moments of shocks are zero, the matrix *is* singular and the covariance of elasticities is not identified (but the variances are).

The second moments of the male and female labor supply elasticities (bottom middle and right triangles respectively) are identified in a similar way from wage, earnings, and joint earnings-wage moments; namely

$$\begin{pmatrix} \sigma^2_{u_j(t)} & \sigma^2_{u_{j'}(t)} & 2\sigma_{u_1u_2(t)} \\ \gamma_{u_j(t)} & \gamma_{u_ju^2_{j'}(t)} & 2\gamma_{u^2_ju_{j'}(t)} \\ \gamma_{u^2_ju_{j'}(t)} & \gamma_{u_{j'}(t)} & 2\gamma_{u_ju^2_{j'}(t)} \end{pmatrix} \begin{pmatrix} \mathbb{E}((1+\eta_{h_j,w_j(i)})^2) \\ \mathbb{E}(\eta^2_{h_j,w_{j'}(i)}) \\ \mathbb{E}((1+\eta_{h_j,w_j(i)})\eta_{h_j,w_{j'}(i)}) \end{pmatrix} = -\begin{pmatrix} m_{y_jy_j} \\ m_{y_j^2w_j} \\ m_{y_j^2w_{j'}} \end{pmatrix}.[53]$$

The second cross-moments of consumption and hours elasticities (upper middle and right rectangles respectively) are identified as follows. Consider the linear system

$$\begin{pmatrix} \sigma^2_{u_j(t)} & \sigma^2_{u_{j'}(t)} & \sigma_{u_1u_2(t)} & \sigma_{u_1u_2(t)} \\ \gamma_{u_j(t)} & \gamma_{u_ju^2_{j'}(t)} & \gamma_{u^2_ju_{j'}(t)} & \gamma_{u^2_ju_{j'}(t)} \\ \gamma_{u^2_ju_{j'}(t)} & \gamma_{u_{j'}(t)} & \gamma_{u_ju^2_{j'}(t)} & \gamma_{u_ju^2_{j'}(t)} \end{pmatrix} \begin{pmatrix} \mathbb{E}(\eta_{c,w_j(i)}(1+\eta_{h_j,w_j(i)})) \\ \mathbb{E}(\eta_{c,w_{j'}(i)}\eta_{h_j,w_{j'}(i)}) \\ \mathbb{E}(\eta_{c,w_j(i)}\eta_{h_j,w_{j'}(i)}) \\ \mathbb{E}(\eta_{c,w_{j'}(i)}(1+\eta_{h_j,w_j(i)})) \end{pmatrix} = -\begin{pmatrix} m_{cy_j} \\ m_{cy_jw_j} \\ m_{cy_jw_{j'}} \end{pmatrix}$$

repeated twice for $j = \{1, 2\}$ while $j' = \{1, 2\} \neq j$. This yields 6 equations in 8 parameters. In addition, symmetry of the matrix of Frisch substitution effects provides two linear restrictions $\mathbb{E}(\eta_{c,w_j(i)}\eta_{h_2,w_1(i)}) = \mathbb{E}(\eta_{c,w_j(i)}\eta_{h_1,w_2(i)})\mathbb{E}(Y_{1it}/Y_{2it})$; taken together these 8 equations just identify the parameters of interest. In practice the parameters are over-identified by at least as many additional equations. Finally, the second cross-moments of male and female labor supply elasticities (middle right rectangle) are identified in a similar manner.

E Estimation Details

This appendix details the estimation of two quasi-reduced-form parameters: the spousal shares of human wealth s_{jit} and the 'partial insurance' parameter π_{it}. In addition, it reports the empirical and fitted values of all moments targeted in the structural estimation.

Estimation of quasi-reduced-form parameters. Parameters $\mathbf{s}_{it} = (s_{1it}, s_{2it})'$ and π_{it} are only used in the simulations of consumption growth *after* preferences have been estimated. The simulations of Δc_{it} are required in the discussion of consumption insurance in section 5.1 and consumption inequality in section 5.2. From appendix A, $s_{jit} \approx \overline{\overline{Y}}_{jit}/\overline{\overline{Y}}_{it}$ and $\pi_{it} \approx \text{Assets}_{it}/(\text{Assets}_{it} + \overline{\overline{Y}}_{it})$, where $\overline{\overline{Y}}_{jit} = Y_{jit} + \mathbb{E}_t \sum_{\varsigma=1}^{T} \frac{Y_{jit+\varsigma}}{(1+r)^\varsigma}$ is spouse j's human wealth at the beginning of time t (expected discounted stream of lifetime earnings between t and end of working life) and $\overline{\overline{Y}}_{it} = \sum_j \overline{\overline{Y}}_{jit}$ is the sum of human wealth in the household; Y_{jit} is spouse j's labor earnings at t.

The main difficulty in estimating s_{jit} is that human wealth conforms to expectations through $\mathbb{E}_t Y_{jit+\varsigma}$. I estimate this as follows. I pool earnings of spouse j across all periods and I regress them on a set of predictable characteristics including a cubic polynomial in age, year of birth, race and education dummies, as well as interactions of the polynomial with the race and education dummies. I summarize this regression as $Y_{jit} = \mathbf{Q}'_{jit}\boldsymbol{\delta}_j + \epsilon_{jit}$. I then obtain $\mathbb{E}_t Y_{jit+\varsigma}$ as the appropriate fitted value from this regression, i.e. $\mathbb{E}_t Y_{jit+\varsigma} = \mathbf{Q}'_{jit+\varsigma}\hat{\boldsymbol{\delta}}_j$. I set the discount rate at 2% annually and the end of working life at 65. This then allows me to construct s_{jit}, $j = \{1, 2\}$, and π_{it} as assets/wealth are directly observed in the PSID. Table E.1 presents summary statistics. I estimate $\mathbb{E}(s_{1it}) = 0.616$ and $\mathbb{E}(\pi_{it}) = 0.187$. These moments as well as the patterns of s_{1it} and π_{it} with age are similar to BPS.

[53] Frisch symmetry requires a restriction between $\text{Var}(\eta_{h_1,w_2(i)})$ and $\text{Var}(\eta_{h_2,w_1(i)})$.

Table E.1 – Summary Statistics for s and π

s_{1it}					π_{it}				
mean	med.	st.d.	min	max	mean	med.	st.d.	min	max
0.616	0.621	0.091	0.125	0.996	0.187	0.129	0.179	0.000	0.959

Notes: The table presents summary statistics for men's share of human wealth (s_{1it}) and for the partial insurance parameter (π_{it}) in the baseline sample. Women's share of human wealth is $s_{2it} = 1 - s_{1it}$.

Targeted moments. The estimation of the model (stages 2 & 3) targets 80 moments of the joint distribution of wages, earnings, and consumption. The number of targeted moments increases to more than 400 if the distribution is allowed to vary with time. Tables E.2-E.4 lists the targeted moments alongside their empirical and theoretical (fitted) values. Block bootstrap standard errors for the empirical moments are in parentheses based on 1,000 bootstrap replications.

The reported t-statistics are for the null hypothesis that the respective theoretical moment equals its empirical counterpart. 90% of targeted moments are associated with an absolute t-statistic lower than the rule of thumb of 1.96. The magnitude and standard error of most of the 8 moments for which $|t\text{-stat}| > 1.96$ are very small, implying that even small, economically unimportant, departures from the target empirical value can easily generate large t-statistics.

Table E.2 – Targeted Wage Moments

	data	model	t-stat. diff.		data	model	t-stat. diff.
$\mathbb{E}((\Delta w_{1t})^2)$	0.132	0.132	0.000	$\mathbb{E}((\Delta w_{1t})^2 \Delta w_{2t})$	0.007	0.007	0.000
	(0.010)				(0.004)		
$\mathbb{E}(\Delta w_{1t} \Delta w_{1t'})$	-0.029	-0.029	-0.000	$\mathbb{E}((\Delta w_{1t})^2 \Delta w_{2t'})$	-0.012	-0.000	0.843
	(0.005)				(0.014)		
$\mathbb{E}((\Delta w_{2t})^2)$	0.098	0.098	0.000	$\mathbb{E}((\Delta w_{1t'})^2 \Delta w_{2t})$	-0.005	0.000	1.578
	(0.008)				(0.004)		
$\mathbb{E}(\Delta w_{2t} \Delta w_{2t'})$	-0.013	-0.013	-0.002	$\mathbb{E}(\Delta w_{1t} (\Delta w_{2t})^2)$	0.001	0.001	0.000
	(0.004)				(0.003)		
$\mathbb{E}(\Delta w_{1t} \Delta w_{2t})$	0.017	0.017	-0.000	$\mathbb{E}(\Delta w_{1t} (\Delta w_{2t'})^2)$	0.001	-0.000	-0.722
	(0.003)				(0.003)		
$\mathbb{E}(\Delta w_{1t} \Delta w_{2t'})$	-0.005	-0.004	0.253	$\mathbb{E}(\Delta w_{1t'} (\Delta w_{2t})^2)$	0.002	0.000	-0.466
	(0.003)				(0.003)		
$\mathbb{E}(\Delta w_{1t'} \Delta w_{2t})$	-0.003	-0.004	-0.270	$\mathbb{E}(\Delta w_{1t} \Delta w_{1t'} \Delta w_{2t})$	0.003	-0.000	-1.407
	(0.003)				(0.002)		
$\mathbb{E}((\Delta w_{1t})^3)$	-0.010	-0.010	0.000	$\mathbb{E}(\Delta w_{1t} \Delta w_{1t'} \Delta w_{2t'})$	-0.003	0.000	1.398
	(0.016)				(0.002)		
$\mathbb{E}(\Delta w_{1t} (\Delta w_{1t'})^2)$	-0.006	-0.017	-1.423	$\mathbb{E}(\Delta w_{1t} \Delta w_{2t} \Delta w_{2t'})$	0.001	0.000	-0.226
	(0.007)				(0.002)		
$\mathbb{E}(\Delta w_{1t'} (\Delta w_{1t})^2)$	0.027	0.017	-1.017	$\mathbb{E}(\Delta w_{1t'} \Delta w_{2t} \Delta w_{2t'})$	-0.001	-0.000	0.137
	(0.011)				(0.002)		
$\mathbb{E}((\Delta w_{2t})^3)$	-0.035	-0.035	0.000				
	(0.011)						
$\mathbb{E}(\Delta w_{2t} (\Delta w_{2t'})^2)$	-0.003	-0.008	-0.983				
	(0.005)						
$\mathbb{E}(\Delta w_{2t'} (\Delta w_{2t})^2)$	0.013	0.008	-0.836				
	(0.006)						

Notes: The table presents the list of targeted wage moments alongside their empirical and theoretical values. Block bootstrap standard errors for the empirical moments are in parentheses based on 1,000 bootstrap replications. The reported t-statistic is for the null hypothesis that *theoretical moment − empirical moment* = 0. $t' \equiv t + 1$.

Table E.3 – Targeted Earnings Moments

	data	model	t-stat. diff.		data	model	t-stat. diff.
$\mathbb{E}(\Delta w_{1t}\Delta y_{1t'})$	-0.036	-0.036	-0.021	$\mathbb{E}((\Delta w_{1t})^2\Delta y_{2t'})$	0.001	-0.000	-0.201
	(0.005)				(0.005)		
$\mathbb{E}(\Delta w_{1t'}\Delta y_{1t})$	-0.033	-0.036	-0.494	$\mathbb{E}((\Delta w_{1t'})^2\Delta y_{2t})$	0.002	0.000	-0.277
	(0.005)				(0.004)		
$\mathbb{E}(\Delta w_{2t}\Delta y_{1t'})$	-0.004	-0.005	-0.270	$\mathbb{E}((\Delta w_{2t})^2\Delta y_{2t'})$	0.017	0.011	-1.184
	(0.003)				(0.006)		
$\mathbb{E}(\Delta w_{2t'}\Delta y_{1t})$	-0.003	-0.005	-0.755	$\mathbb{E}((\Delta w_{2t'})^2\Delta y_{2t})$	-0.004	-0.011	-0.890
	(0.003)				(0.007)		
$\mathbb{E}(\Delta w_{1t}\Delta y_{2t'})$	-0.004	-0.006	-0.449	$\mathbb{E}(\Delta w_{1t}(\Delta y_{1t'})^2)$	-0.021	-0.027	-0.804
	(0.003)				(0.007)		
$\mathbb{E}(\Delta w_{1t'}\Delta y_{2t})$	0.000	-0.006	-1.741	$\mathbb{E}(\Delta w_{1t'}(\Delta y_{1t})^2)$	0.035	0.027	-0.798
	(0.003)				(0.010)		
$\mathbb{E}(\Delta w_{2t}\Delta y_{2t'})$	-0.035	-0.018	3.179	$\mathbb{E}(\Delta w_{2t}(\Delta y_{1t'})^2)$	-0.004	0.001	1.258
	(0.005)				(0.003)		
$\mathbb{E}(\Delta w_{2t'}\Delta y_{2t})$	-0.033	-0.018	2.610	$\mathbb{E}(\Delta w_{2t'}(\Delta y_{1t})^2)$	-0.009	-0.001	0.726
	(0.006)				(0.012)		
$\mathbb{E}(\Delta y_{1t}\Delta y_{1t'})$	-0.045	-0.047	-0.296	$\mathbb{E}(\Delta w_{1t}(\Delta y_{2t'})^2)$	0.005	-0.001	-1.512
	(0.005)				(0.004)		
$\mathbb{E}(\Delta y_{1t}\Delta y_{2t'})$	-0.007	-0.007	0.040	$\mathbb{E}(\Delta w_{1t'}(\Delta y_{2t})^2)$	0.000	0.001	0.058
	(0.003)				(0.005)		
$\mathbb{E}(\Delta y_{1t'}\Delta y_{2t})$	-0.002	-0.007	-1.236	$\mathbb{E}(\Delta w_{2t}(\Delta y_{2t'})^2)$	-0.005	-0.014	-1.355
	(0.004)				(0.007)		
$\mathbb{E}(\Delta y_{2t}\Delta y_{2t'})$	-0.024	-0.025	-0.101	$\mathbb{E}(\Delta w_{2t'}(\Delta y_{2t})^2)$	0.007	0.014	1.046
	(0.006)				(0.007)		
$\mathbb{E}((\Delta w_{1t})^2\Delta y_{1t'})$	0.033	0.021	-1.056	$\mathbb{E}(\Delta w_{1t}\Delta y_{1t'}\Delta y_{2t'})$	-0.005	0.001	2.473
	(0.012)				(0.002)		
$\mathbb{E}((\Delta w_{1t'})^2\Delta y_{1t})$	-0.016	-0.021	-0.643	$\mathbb{E}(\Delta w_{1t'}\Delta y_{1t}\Delta y_{2t})$	-0.001	-0.001	0.052
	(0.007)				(0.003)		
$\mathbb{E}((\Delta w_{2t})^2\Delta y_{1t'})$	-0.001	0.001	0.723	$\mathbb{E}(\Delta w_{2t}\Delta y_{1t'}\Delta y_{2t'})$	-0.002	-0.001	0.878
	(0.003)				(0.002)		
$\mathbb{E}((\Delta w_{2t'})^2\Delta y_{1t})$	0.002	-0.001	-1.063	$\mathbb{E}(\Delta w_{2t'}\Delta y_{1t}\Delta y_{2t})$	-0.003	0.001	1.243
	(0.002)				(0.003)		

Notes: The table presents the list of targeted earnings moments alongside their empirical and theoretical values. Block bootstrap standard errors for the empirical moments are in parentheses based on 1,000 bootstrap replications. The reported t-statistic is for the null hypothesis that *theoretical moment* $-$ *empirical moment* $= 0$. $t' \equiv t+1$.

Table E.4 – Targeted Consumption Moments

	data	model	t-stat. diff.		data	model	t-stat. diff.
$\mathbb{E}(\Delta w_{1t}\Delta c_{t'})$	-0.001	0.002	1.240	$\mathbb{E}(\Delta w_{1t}(\Delta c_{t'})^2)$	-0.000	-0.006	-6.648
	(0.002)				(0.001)		
$\mathbb{E}(\Delta w_{1t'}\Delta c_{t})$	0.000	0.002	0.631	$\mathbb{E}(\Delta w_{1t'}(\Delta c_{t})^2)$	-0.001	0.006	7.172
	(0.002)				(0.001)		
$\mathbb{E}(\Delta w_{2t}\Delta c_{t'})$	-0.000	0.001	0.587	$\mathbb{E}(\Delta w_{2t}(\Delta c_{t'})^2)$	0.001	-0.003	-7.947
	(0.002)				(0.001)		
$\mathbb{E}(\Delta w_{2t'}\Delta c_{t})$	0.002	0.001	-0.836	$\mathbb{E}(\Delta w_{2t'}(\Delta c_{t})^2)$	-0.000	0.003	4.849
	(0.002)				(0.001)		
$\mathbb{E}(\Delta y_{1t}\Delta c_{t'})$	-0.005	-0.002	1.171	$\mathbb{E}(\Delta w_{1t}\Delta y_{1t'}\Delta c_{t'})$	-0.002	-0.001	0.757
	(0.002)				(0.002)		
$\mathbb{E}(\Delta y_{1t'}\Delta c_{t})$	0.001	-0.002	-1.448	$\mathbb{E}(\Delta w_{1t'}\Delta y_{1t}\Delta c_{t})$	0.000	0.001	0.525
	(0.002)				(0.002)		
$\mathbb{E}(\Delta y_{2t}\Delta c_{t'})$	0.001	0.001	0.032	$\mathbb{E}(\Delta w_{2t}\Delta y_{1t'}\Delta c_{t'})$	0.001	0.000	-1.213
	(0.002)				(0.001)		
$\mathbb{E}(\Delta y_{2t'}\Delta c_{t})$	0.002	0.001	-0.818	$\mathbb{E}(\Delta w_{2t'}\Delta y_{1t}\Delta c_{t})$	-0.001	0.000	0.983
	(0.002)				(0.001)		
$\mathbb{E}(\Delta c_{t}\Delta c_{t'})$	-0.023	-0.018	4.170	$\mathbb{E}(\Delta w_{1t}\Delta y_{2t'}\Delta c_{t'})$	0.001	0.000	-1.012
	(0.001)				(0.001)		
$\mathbb{E}((\Delta w_{1t})^2\Delta c_{t'})$	-0.005	-0.001	0.617	$\mathbb{E}(\Delta w_{1t'}\Delta y_{2t}\Delta c_{t})$	0.002	0.000	-1.790
	(0.007)				(0.001)		
$\mathbb{E}((\Delta w_{1t'})^2\Delta c_{t})$	0.004	0.001	-0.890	$\mathbb{E}(\Delta w_{2t}\Delta y_{2t'}\Delta c_{t'})$	0.000	0.000	0.017
	(0.003)				(0.001)		
$\mathbb{E}((\Delta w_{2t})^2\Delta c_{t'})$	0.000	-0.000	-0.383	$\mathbb{E}(\Delta w_{2t'}\Delta y_{2t}\Delta c_{t})$	0.000	-0.000	-0.292
	(0.002)				(0.001)		
$\mathbb{E}((\Delta w_{2t'})^2\Delta c_{t})$	-0.001	0.000	0.489				
	(0.002)						

Notes: The table presents the list of targeted consumption moments alongside their empirical and theoretical values. Block bootstrap standard errors for the empirical moments are in parentheses based on 1,000 bootstrap replications. The reported t-statistic is for the null hypothesis that $\textit{theoretical moment} - \textit{empirical moment} = 0$. $t' \equiv t + 1$.

LUXEMBOURG INSTITUTE OF
SOCIO-ECONOMIC RESEARCH

11, Porte des Sciences
Campus Belval
L-4366 Esch-sur-Alzette

T +352 58 58 55-1
F +352 58 58 55-700

www.liser.lu