Consumption Inequality and Family Labor Supply

Chair Lecture "Professor Carlos Lloyd Braga"

Richard Blundell  University College London & IFS

University of Minho, 2013
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2. Taxes and welfare: (earnings → income)
3. Assets: Saving and borrowing (income → consumption)
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How should we design policies to best insure these shocks?
**Overview**

- Seek to answer the question: How do individuals and families deal with labour market shocks over their working life?
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Investigate how assets and labor market shocks combine to impact on household consumption.
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Draw on panel and administrative data from the US, UK and Norway.... and make use of new information on consumption, earnings and assets.

We show that family labor supply, credit market and the tax/welfare system all have key roles to play in the 'insurance' of shocks.

Finding: Once assets, family labor supply and taxes (and welfare) are properly accounted for, we can explain the link between these series and there is less evidence for additional insurance.

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- Some consumption inequality descriptives....
CONSUMPTION INEQUALITY IN THE UK
By age and birth cohort

Variance of log nondurable consumption

Age

Variance

1940 1950 1960 1970
Income Inequality in the UK
By age and birth cohort

Variance of log net income

Age

Var iance

20 30 40 50 60 70

1940 1950

1960 1970

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CONSUMPTION INEQUALITY IN THE US

By age and birth cohort
Labour Market Shocks and Consumption

- We focus on income, consumption and wage dynamics. Why?
  - It is a key way of thinking about the transmission of shocks over the life-cycle and the mechanisms used by families to ‘insure’ against shocks.
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- A little background on the empirical strategy for income and consumption dynamics behind these results...
**Income Dynamics**

To set the scene, consider consumer $i$ (of age $a$) in time period $t$, has log income $y_{it}(\equiv \ln Y_{i,a,t})$ written

$$y_{it} = Z_{it}'\varphi + f_{oi} + y_{it}^P + y_{it}^T$$
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and where $y^T_{it}$ is a transitory shock represented by some low order MA process, say

$$y^T_{it} = \varepsilon_{it} + \theta_1 \varepsilon_{i,t-1}$$
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- Detailed work on Norwegian population register panel data....
**LIFE-CYCLE INCOME DYNAMICS**

Variance of permanent shocks over the life-cycle

![Graph showing the variance of permanent shocks over the life-cycle.](image)

Source: Blundell, Graber and Mogstad (2013), Norwegian Population Panel.
LIFE-CYCLE INCOME DYNAMICS
Norwegian population panel (low skilled)

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CONSUMPTION GROWTH AND INCOME "SHOCKS"

To account for the impact of income shocks on consumption introduce transmission parameters: \( \kappa_{cvt} \) and \( \kappa_{c\epsilon t} \), writing consumption growth as:

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\Delta \ln C_{it} \approx \Gamma_{it} + \Delta Z_{it}' \phi^c + \kappa_{cvt} v_{it} + \kappa_{c\epsilon t} \epsilon_{it} + \xi_{it}
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For example, Blundell, Low and Preston (QE, 2013) show in the permanent-transitory model, for any birth-cohort

$$\Delta \ln C_{it} \approx \Gamma_{it} + \Delta Z_{it}' \varphi^c + (1 - \pi_{it}) v_{it} + (1 - \pi_{it}) \gamma_{Lt} \epsilon_{it} + \xi_{it}$$

where

$$\pi_{it} \approx \frac{\text{Assets}_{it}}{\text{Assets}_{it} + \text{Human Wealth}_{it}}$$

and $\gamma_{Lt}$ is the annuity value of a transitory shock for an individual aged $t$ retiring at age $L$. 
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- With $(1 - \pi_{it})$ measured through asset data we can examine mechanisms in addition to self-insurance.

- But typically use (1), as asset data is poorly measured and estimate the $\kappa_{t}'s$ as a catch-all for all forms of insurance - until recently!
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And "non-separabilities" between consumption and work?
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4. **Other** (un-modeled) mechanisms ‘$\beta$’, - and check for advance information.

Empirical results allow for non-separability, heterogeneous assets, correlated shocks to individual wages in families.

Here I'll briefly present results with new data from the PSID 1999-2009.

More comprehensive consumption measure - over 70% of the budget.

Asset data collected in every wave - housing, financial, mortgage and other debt.
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## Descriptive Statistics for Consumption

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>27,290</td>
<td>31,973</td>
<td>35,277</td>
<td>41,555</td>
<td>45,863</td>
<td>44,006</td>
</tr>
<tr>
<td>Nondurable</td>
<td>6,859</td>
<td>7,827</td>
<td>7,827</td>
<td>8,873</td>
<td>9,889</td>
<td>9,246</td>
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<tr>
<td>Food (at home)</td>
<td>5,471</td>
<td>5,785</td>
<td>5,911</td>
<td>6,272</td>
<td>6,588</td>
<td>6,635</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1,387</td>
<td>2,041</td>
<td>1,916</td>
<td>2,601</td>
<td>3,301</td>
<td>2,611</td>
</tr>
<tr>
<td>Services</td>
<td>21,319</td>
<td>25,150</td>
<td>28,419</td>
<td>33,755</td>
<td>36,949</td>
<td>35,575</td>
</tr>
<tr>
<td>Food (out)</td>
<td>2,029</td>
<td>2,279</td>
<td>2,382</td>
<td>2,582</td>
<td>2,693</td>
<td>2,492</td>
</tr>
<tr>
<td>Health Insurance</td>
<td>1,056</td>
<td>1,268</td>
<td>1,461</td>
<td>1,750</td>
<td>1,916</td>
<td>2,188</td>
</tr>
<tr>
<td>Health Services</td>
<td>902</td>
<td>1,134</td>
<td>1,334</td>
<td>1,447</td>
<td>1,615</td>
<td>1,844</td>
</tr>
<tr>
<td>Utilities</td>
<td>2,282</td>
<td>2,651</td>
<td>2,702</td>
<td>4,655</td>
<td>5,038</td>
<td>5,600</td>
</tr>
<tr>
<td>Transportation</td>
<td>3,122</td>
<td>3,758</td>
<td>4,474</td>
<td>3,797</td>
<td>3,970</td>
<td>3,759</td>
</tr>
<tr>
<td>Education</td>
<td>1,946</td>
<td>2,283</td>
<td>2,390</td>
<td>2,557</td>
<td>2,728</td>
<td>2,584</td>
</tr>
<tr>
<td>Child Care</td>
<td>601</td>
<td>653</td>
<td>660</td>
<td>689</td>
<td>648</td>
<td>783</td>
</tr>
<tr>
<td>Home Insurance</td>
<td>430</td>
<td>480</td>
<td>552</td>
<td>629</td>
<td>717</td>
<td>729</td>
</tr>
<tr>
<td>Rent (or rent equivalent)</td>
<td>8,950</td>
<td>10,645</td>
<td>12,464</td>
<td>15,650</td>
<td>17,623</td>
<td>15,595</td>
</tr>
<tr>
<td>Observations</td>
<td>1,872</td>
<td>1,951</td>
<td>1,984</td>
<td>2,011</td>
<td>2,115</td>
<td>2,221</td>
</tr>
</tbody>
</table>

Notes: PSID data from 1999-2009 PSID waves. PSID means are given for the main sample of estimation: married couples with working males aged 30 to 65. SEO sample excluded. PSID rent is imputed as 6% of reported house value for homeowners. Missing values in consumption and assets sub-categories were treated as zeros.
### Descriptive Statistics for Assets and Earnings

#### PSID Assets, Hours and Earnings

<table>
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<tbody>
<tr>
<td>Total assets</td>
<td>332,625</td>
<td>352,247</td>
<td>382,600</td>
<td>476,626</td>
<td>555,951</td>
<td>506,823</td>
</tr>
<tr>
<td>Housing and RE assets</td>
<td>159,856</td>
<td>187,969</td>
<td>227,224</td>
<td>283,913</td>
<td>327,719</td>
<td>292,910</td>
</tr>
<tr>
<td>Financial assets</td>
<td>173,026</td>
<td>164,567</td>
<td>155,605</td>
<td>192,995</td>
<td>228,805</td>
<td>214,441</td>
</tr>
<tr>
<td>Total debt</td>
<td>72,718</td>
<td>82,806</td>
<td>98,580</td>
<td>115,873</td>
<td>131,316</td>
<td>137,348</td>
</tr>
<tr>
<td>Mortgage</td>
<td>65,876</td>
<td>74,288</td>
<td>89,583</td>
<td>106,423</td>
<td>120,333</td>
<td>123,324</td>
</tr>
<tr>
<td>Other debt</td>
<td>7,021</td>
<td>8,687</td>
<td>9,217</td>
<td>9,744</td>
<td>11,584</td>
<td>14,561</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First earner (head)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings</td>
<td>54,220</td>
<td>61,251</td>
<td>63,674</td>
<td>68,500</td>
<td>72,794</td>
<td>75,588</td>
</tr>
<tr>
<td>Hours worked</td>
<td>2,357</td>
<td>2,317</td>
<td>2,309</td>
<td>2,309</td>
<td>2,284</td>
<td>2,140</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second earner (wife)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation rate</td>
<td>0.81</td>
<td>0.8</td>
<td>0.81</td>
<td>0.81</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Earnings (conditional on participation)</td>
<td>26,035</td>
<td>28,611</td>
<td>31,693</td>
<td>33,987</td>
<td>36,185</td>
<td>39,973</td>
</tr>
<tr>
<td>Hours worked (conditional on participation)</td>
<td>1,666</td>
<td>1,691</td>
<td>1,697</td>
<td>1,707</td>
<td>1,659</td>
<td>1,648</td>
</tr>
<tr>
<td>Observations</td>
<td>1,872</td>
<td>1,951</td>
<td>1,984</td>
<td>2,011</td>
<td>2,115</td>
<td>2,221</td>
</tr>
</tbody>
</table>

**Notes:** PSID data from 1999-2009 PSID waves. PSID means are given for the main sample of estimation: married couples with working males aged 30 to 65. SEO sample excluded. PSID rent is imputed as 6% of reported house value for homeowners. Missing values in consumption and assets sub-categories were treated as zeros.
Wage Process

For earner $j = \{1, 2\}$ in household $i$, period $t$, wage growth is:

$$\Delta \log W_{i,j,t} = \Delta X'_{i,j,t} \beta_j + \Delta u_{i,j,t} + v_{i,j,t}$$
Wage Process

For earner $j = \{1, 2\}$ in household $i$, period $t$, wage growth is:

$$\Delta \log W_{i,j,t} = \Delta X'_{i,j,t} \beta_{j} + \Delta u_{i,j,t} + v_{i,j,t}$$

\[
\begin{pmatrix}
    u_{i,1,t} \\
    u_{i,2,t} \\
    v_{i,1,t} \\
    v_{i,2,t}
\end{pmatrix}
\sim i.i.d.
\begin{pmatrix}
    0 \\
    0 \\
    0 \\
    0
\end{pmatrix}
,
\begin{pmatrix}
    \sigma_{u,1}^2 & \sigma_{u,1,u_2} & 0 & 0 \\
    \sigma_{u,1,u_2} & \sigma_{u,2}^2 & 0 & 0 \\
    0 & 0 & \sigma_{v,1}^2 & \sigma_{v,1,v_2} \\
    0 & 0 & \sigma_{v,1,v_2} & \sigma_{v,2}^2
\end{pmatrix}
\]
**Wage Process**

For earner \( j = \{1, 2\} \) in household \( i \), period \( t \), wage growth is:

\[
\Delta \log W_{i,j,t} = \Delta X'_{i,j,t} \beta_j + \Delta u_{i,j,t} + v_{i,j,t}
\]

\[
\begin{pmatrix}
  u_{i,1,t} \\
  u_{i,2,t} \\
  v_{i,1,t} \\
  v_{i,2,t}
\end{pmatrix} \sim \text{i.i.d.} \begin{pmatrix}
  0 \\
  0 \\
  0 \\
  0
\end{pmatrix}, \begin{pmatrix}
  \sigma^2_{u,1} & \sigma_{u,1,u2} & 0 & 0 \\
  \sigma_{u,1,u2} & \sigma^2_{u,2} & 0 & 0 \\
  0 & 0 & \sigma^2_{v,1} & \sigma_{v,1,v2} \\
  0 & 0 & \sigma_{v,1,v2} & \sigma^2_{v,2}
\end{pmatrix}
\]

- Allow the variances to differ by across the life-cycle and across the business cycle.
## Wage Parameters Estimates

Baseline

<table>
<thead>
<tr>
<th>Sample</th>
<th>All</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trans.</td>
<td>Perm.</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>$\sigma^2_{u_1}$</td>
<td>$\sigma^2_{v_1}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.033</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.007)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td>$\sigma^2_{u_2}$</td>
<td>$\sigma^2_{v_2}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.012</td>
<td>0.043</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.006)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Correlation of shocks</td>
<td>Trans.</td>
<td>$\rho_{u_1,u_2}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.244</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.22)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\rho_{v_1,v_2}$</td>
<td>0.113</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.07)</td>
</tr>
</tbody>
</table>
**Extended Transmission Parameters:**

Consumption growth:

\[ \Delta \ln C_{it} \approx \kappa_{cv1} v_{i1t} + \kappa_{cv2} v_{i2t} + \kappa_{cu1} \Delta u_{i1t} + \kappa_{cu2} \Delta u_{i2t} + \xi_{it} \]
EXTENDED TRANSMISSION PARAMETERS:

Consumption growth:

\[ \Delta \ln C_{it} \simeq \kappa_{cv1} t v_{i,1t} + \kappa_{cv2} t v_{i,2t} + \kappa_{cu1} t u_{i,1t} + \kappa_{cu2} t u_{i,2t} + \xi_{it} \]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[ \kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left( 1 + \eta_{h,w_j} \right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}} \]
**Extended Transmission Parameters:**

Consumption growth:

\[
\Delta \ln C_{it} \approx \kappa_{cv1} \nu_{i,1t} + \kappa_{cv2} \nu_{i,2t} + \kappa_{cu1} \Delta u_{i,1t} + \kappa_{cu2} \Delta u_{i,2t} + \xi_{it}
\]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[
\kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left( 1 + \eta_{h,j,w_j} \right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}}
\]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
**Extended Transmission Parameters:**

Consumption growth:

\[ \Delta \ln C_{it} \approx \kappa_{cv1} v_{i,1t} + \kappa_{cv2} v_{i,2t} + \kappa_{cu1} \Delta u_{i,1t} + \kappa_{cu2} \Delta u_{i,2t} + \zeta_{it} \]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[ \kappa_{c,vj} = (1 - \beta)(1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h,wj}\right)}{\eta_{c,p} + (1 - \beta)(1 - \pi_{i,t}) \eta_{h,w}} \]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
- declines with \( \beta \) (outside insurance allows more smoothing)
**Extended Transmission Parameters:**

Consumption growth:

\[
\Delta \ln C_{it} \approx \kappa_{cv_1} v_{i,1t} + \kappa_{cv_2} v_{i,2t} + \kappa_{cu_1} \Delta u_{i,1t} + \kappa_{cu_2} \Delta u_{i,2t} + \xi_{it}
\]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[
\kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) \frac{s_{i,j,t} \eta_{c,p} \left(1 + \eta_{h,w_j}\right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}}
\]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
- declines with \( \beta \) (outside insurance allows more smoothing)
- increases with \( s_{i,j,t} \) (j’s earning share)
EXTENDED TRANSMISSION PARAMETERS:

Consumption growth:

\[ \Delta \ln C_{it} \approx \kappa_{cv1t} v_{i,1t} + \kappa_{cv2t} v_{i,2t} + \kappa_{cu1t} \Delta u_{i,1t} + \kappa_{cu2t} \Delta u_{i,2t} + \xi_{it} \]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[ \kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left( 1 + \eta_{h,j,w_j} \right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}} \]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
- declines with \( \beta \) (outside insurance allows more smoothing)
- increases with \( s_{i,j,t} \) (j’s earning share)
- increases with tolerance of intertemporal fluctuations.
EXTENDED TRANSMISSION PARAMETERS:

Consumption growth:

\[ \Delta \ln C_{it} \approx \kappa_{cv1} v_{i,1t} + \kappa_{cv2} v_{i,2t} + \kappa_{cu1} \Delta u_{i,1t} + \kappa_{cu2} \Delta u_{i,2t} + \xi_{it} \]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[ \kappa_{c,vj} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left( 1 + \eta_{h,j,wj} \right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}} \]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
- declines with \( \beta \) (outside insurance allows more smoothing)
- increases with \( s_{i,j,t} \) (j’s earning share)
- increases with tolerance of intertemporal fluctuations.
- declines with "added worker" effect - Marshallian labour supply elasticity.
EXTENDED TRANSMISSION PARAMETERS:

Consumption growth:

\[ \Delta \ln C_{it} \approx \kappa_{cv1t} v_{i,1t} + \kappa_{cv2t} v_{i,2t} + \kappa_{cu1t} \Delta u_{i,1t} + \kappa_{cu2t} \Delta u_{i,2t} + \xi_{it} \]

- Key transmission parameter: consumption response to a permanent wage shock, becomes:

\[ \kappa_{c,vj} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} (1 + \eta_{h,w})}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}} \]

- declines with \( \pi_{i,t} \) (accumulated assets allow better insurance)
- declines with \( \beta \) (outside insurance allows more smoothing)
- increases with \( s_{i,j,t} \) (j’s earning share)
- increases with tolerance of intertemporal fluctuations.
- declines with "added worker" effect - Marshallian labour supply elasticity.
- similar transmission equations for family labour supply.
IDENTIFICATION WITH ASSET DATA

- Note that $\beta$ is not identified separately from $\pi$
- Back out $\pi$ from the data and estimate $\beta$

$$\pi_{i,t} \approx \frac{\text{Observed in PSID}}{\text{Projected lifetime earnings}} = \frac{\text{Assets}_{i,t}}{\text{Human Wealth}_{i,t} + \text{Assets}_{i,t}}$$

- Human wealth is projected using observables that evolve deterministically (e.g. age).
Distribution of individuals by age

\[ s_{i,t} \approx \frac{\text{Human Wealth}_{\text{male},i,t}}{\text{Human Wealth}_{i,t}} \]

Age of household head

30-34 35-39 40-44 45-49 50-54 55-59 60-65
Distribution of $s$ by Age

$$s_{i,t} \approx \frac{\text{Human Wealth}_{i,t}^{\text{male}}}{\text{Human Wealth}_{i,t}}.$$
Distribution of $\pi$ by Age

$\pi_{i,t} \approx \frac{\text{Assets}_{i,t}}{\text{Assets}_{i,t} + \text{Human Wealth}_{i,t}}$:
**Distribution of $\pi$ by Age**

\[ \pi_{i,t} \approx \frac{\text{Assets}_{i,t}}{\text{Assets}_{i,t} + \text{Human Wealth}_{i,t}} \]

---

The Distribution of Pi and Assets by Age of Household Head

- **Pi (5th to 95th Percentiles) - Left axis**
- **Total Assets (Median, Thousands of Dollars) - Right axis**

---

*Blundell, UCL & IFS (*)  Inequality and Family Labor Supply  University of Minho, 2013*
## Results: With and Without Separability

<table>
<thead>
<tr>
<th></th>
<th>Additive separ.</th>
<th>Non-separable</th>
<th>Non-separable</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E (\pi)$</td>
<td>0.181 (0.008)</td>
<td>0.181 (0.008)</td>
<td>0.181 (0.008)</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.741 (0.085)</td>
<td>-0.120 (0.098)</td>
<td>0</td>
</tr>
<tr>
<td>$\eta_{c,p}$</td>
<td>0.201 (0.077)</td>
<td>0.437 (0.124)</td>
<td>0.448 (0.126)</td>
</tr>
<tr>
<td>$\eta_{h1,w1}$</td>
<td>0.431 (0.097)</td>
<td>0.514 (0.150)</td>
<td>0.497 (0.150)</td>
</tr>
<tr>
<td>$\eta_{h2,w2}$</td>
<td>0.831 (0.133)</td>
<td>1.032 (0.265)</td>
<td>1.041 (0.275)</td>
</tr>
<tr>
<td>$\eta_{c,w1}$</td>
<td>- -</td>
<td>-0.141 (0.051)</td>
<td>-0.141 (0.053)</td>
</tr>
<tr>
<td>$\eta_{h1,p}$</td>
<td>- -</td>
<td>0.082 (0.030)</td>
<td>0.082 (0.031)</td>
</tr>
<tr>
<td>$\eta_{c,w2}$</td>
<td>- -</td>
<td>-0.138 (0.139)</td>
<td>-0.158 (0.121)</td>
</tr>
<tr>
<td>$\eta_{h2,p}$</td>
<td>- -</td>
<td>0.162 (0.166)</td>
<td>0.185 (0.145)</td>
</tr>
<tr>
<td>$\eta_{h1,w2}$</td>
<td>- -</td>
<td>0.128 (0.052)</td>
<td>0.120 (0.064)</td>
</tr>
<tr>
<td>$\eta_{h2,w1}$</td>
<td>- -</td>
<td>0.258 (0.103)</td>
<td>0.242 (0.119)</td>
</tr>
</tbody>
</table>
MARSHALLIAN ELASTICITIES: BY AGE

Marshallian Elasticities

Age of household head

- .1 0 .1 .2 .3 .4
30-34 35-39 40-44 45-49 50-54 55-59 60-65

Wife's Marshallian Elasticity
Head's Marshallian Elasticity

B. LUNDELL, UCL & IFS ()
INEQUALITY AND FAMILY LABOR SUPPLY
UNIVERSITY OF MINHO, 2013
Marshallian Elasticities: By Age

Wife's Marshallian Elasticity ($\kappa_{12}$)

Age of household head

30-34 to 60-65

5th perc. to 95th perc.
Marshallian Elasticities: By Age

Head's Marshallian Elasticity (κ₇)

Age of household head

30-34 35-39 40-44 45-49 50-54 55-59 60-65

95th perc. 90th perc. 75th perc. 50th perc. 25th perc. 10th perc. 5th perc.
**INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES)**

The average response of total earnings \( (y = y_1 + y_2) \) to a permanent shock to the male’s wages:

\[
\frac{\partial \Delta y}{\partial v_1} = s \frac{\partial \Delta y_1}{\partial v_1} + (1 - s) \frac{\partial \Delta y_2}{\partial v_1} = 0.44
\]

\( s = 0.69 \)
\( \hat{k}_{y_1,v_1} = 0.98 \)
\( 1 - s = 0.31 \)
\( \hat{k}_{y_2,v_1} = -0.81 \)
The average response of total earnings ($y = y_1 + y_2$) to a permanent shock to the male’s wages:

$$\frac{\partial \Delta y}{\partial v_1} = s \cdot \frac{\partial \Delta y_1}{\partial v_1} + (1 - s) \cdot \frac{\partial \Delta y_2}{\partial v_1} = 0.44$$

Response of consumption to a 10% permanent decrease in the male’s wage rate ($v_1 = -0.1$):

one earner, fixed labor supply and no insurance -10%
**INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES)**

The average response of total earnings \( (y = y_1 + y_2) \) to a permanent shock to the male’s wages:

\[
\frac{\partial \Delta y}{\partial v_1} = \left( s \right) \left( \frac{\partial \Delta y_1}{\partial v_1} \right) + \left( 1 - s \right) \left( \frac{\partial \Delta y_2}{\partial v_1} \right) = 0.44
\]

\( \hat{s} = 0.69 \)

\( \hat{\kappa}_{y_1,v_1} = 0.98 \)

\( 1 - \hat{s} = 0.31 \)

\( \hat{\kappa}_{y_2,v_1} = -0.81 \)

Response of consumption to a 10% permanent decrease in the male’s wage rate \( (v_1 = -0.1) \):

- one earner, fixed labor supply and no insurance -10%
- two earners, fixed labor supply and no insurance -6.9%
INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES)

The average response of total earnings \((y = y_1 + y_2)\) to a permanent shock to the male’s wages:

\[
\frac{\partial \Delta y}{\partial v_1} = \frac{s}{\hat{s} = 0.69} \cdot \frac{\partial \Delta y_1}{\partial v_1} + (1 - s) \cdot \frac{\partial \Delta y_2}{\partial v_1} = 0.44
\]

Response of consumption to a 10% permanent decrease in the male’s wage rate \((v_1 = -0.1)\):

- one earner, fixed labor supply and no insurance -10%
- two earners, fixed labor supply and no insurance -6.9%
- with husband labor supply adjustment -6.8%
- with family labor supply adjustment -4.4%
- with family labor supply adjustment and other insurance -3.8%

BLUNDELL, UCL & IFS ()
INEQUALITY AND FAMILY LABOR SUPPLY UNIVERSITY OF MINHO, 2013 28 / 60
INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES)

The average response of total earnings ($y = y_1 + y_2$) to a permanent shock to the male’s wages:

$$\frac{\partial \Delta y}{\partial v_1} = s \cdot \frac{\partial \Delta y_1}{\partial v_1} + (1 - s) \cdot \frac{\partial \Delta y_2}{\partial v_1} = 0.44$$

Response of consumption to a 10% permanent decrease in the male’s wage rate ($v_1 = -0.1$):

- one earner, fixed labor supply and no insurance: -10%
- two earners, fixed labor supply and no insurance: -6.9%
- with husband labor supply adjustment: -6.8%
- with family labor supply adjustment: -4.4%
The average response of total earnings \((y = y_1 + y_2)\) to a permanent shock to the male’s wages:

\[
\frac{\partial \Delta y}{\partial v_1} = \underbrace{s}_{\hat{s}=0.69} \cdot \frac{\partial \Delta y_1}{\partial v_1} + (1-s) \cdot \underbrace{\frac{\partial \Delta y_2}{\partial v_1}}_{\hat{\kappa}_{y_1,v_1}=0.98, \hat{\kappa}_{y_2,v_1}=-0.81} = 0.44
\]

Response of consumption to a 10% permanent decrease in the male’s wage rate \((v_1 = -0.1)\):

- one earner, fixed labor supply and no insurance: -10%
- two earners, fixed labor supply and no insurance: -6.9%
- with husband labor supply adjustment: -6.8%
- with family labor supply adjustment: -4.4%
- with family labor supply adjustment and other insurance: -3.8%
INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES): BY AGE

Response of Consumption to a 10% Permanent Decrease in the Male’s Wage Rate

-7 -6 -5 -4 -3 -2
30-34 35-39 40-44 45-49 50-54 55-59 60-65
Age of household head

-7 -6 -5 -4 -3 -2
30-34 35-39 40-44 45-49 50-54 55-59 60-65
Age of household head

red diamond: fixed labor supply and no insurance
green circle: with family labor supply adjustment
blue triangle: with family labor supply adjustment and other insurance
INSURANCE VIA LABOR SUPPLY (SHOCK TO MALE WAGES): BY AGE

Consumption Response to a -10% Permanent Shock to Head's Wages ($\kappa_3$)
**INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO FEMALE WAGES)**

The average response of total earnings to a permanent shock to the female’s wages:

\[
\frac{\partial \Delta y}{\partial v_2} = s \cdot \frac{\partial \Delta y_1}{\partial v_2} + (1 - s) \cdot \frac{\partial \Delta y_2}{\partial v_2} = 0.25
\]

\[
\kappa_{y_1,v_2} = -0.23, \quad \kappa_{y_2,v_2} = 1.32
\]

Response of consumption to a 10% permanent decrease in the female’s wage rate \((v_2 = -0.1)\):

- two earners, fixed labor supply and no insurance -3.1%
The average response of total earnings to a permanent shock to the female’s wages:

\[
\frac{\partial \Delta y}{\partial v_2} = s \cdot \frac{\partial \Delta y_1}{\partial v_2} + (1 - s) \cdot \frac{\partial \Delta y_2}{\partial v_2} = 0.25
\]

\[
\kappa_{y_1,v_2} = -0.23 \quad \kappa_{y_2,v_2} = 1.32
\]

Response of consumption to a 10% permanent decrease in the female’s wage rate \((v_2 = -0.1)\):

- two earners, fixed labor supply and no insurance: -3.1%
- with family labor supply adjustment: -2.5%
**INTERPRETATION: INSURANCE VIA LABOR SUPPLY (SHOCK TO FEMALE WAGES)**

The average response of total earnings to a permanent shock to the female’s wages:

\[
\frac{\partial \Delta y}{\partial v_2} = s \cdot \frac{\partial \Delta y_1}{\partial v_2} + (1-s) \cdot \frac{\partial \Delta y_2}{\partial v_2} = 0.25
\]

Response of consumption to a 10% permanent decrease in the female’s wage rate \(v_2 = -0.1\):

- two earners, fixed labor supply and no insurance: -3.1%
- with family labor supply adjustment: -2.5%
- with family labor supply adjustment and other insurance: -2.1%
PUTTING THE PIECES TOGETHER...

Focus on understanding the transmission of inequality over the working life.
PUTTING THE PIECES TOGETHER...

- Focus on understanding the **transmission of inequality** over the working life.
- From *wages* $\rightarrow$ *earnings* $\rightarrow$ *joint earnings* $\rightarrow$ *income* $\rightarrow$ *consumption*.
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Addressing some of the key ‘puzzles’ in the literature.

Documenting the importance of four different ‘insurance’ mechanisms:

- Saving and credit markets
- Taxes and welfare
- Family labour supply
- Informal contracts, gifts, etc.
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- Documenting the importance of four different ‘insurance’ mechanisms:
  - Saving and credit markets
  - Taxes and welfare
  - Family labour supply
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- Showing the value, and possibilities for collecting, good panel data on consumption, earnings and assets.
AND GATHERING UP THE RESULTS...

- Need to allow for non-stationarity over the life-cycle and over time
  - variances (of persistent shocks) display an U-shape over the (working) life-cycle,
  - note the spike in the variance of permanent shocks during the 80s and 90s recessions.
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- Once family labor supply, assets and taxes (and benefits) are properly accounted for, there is little evidence for additional insurance
  - lots to be done to dig deeper into these, and other, mechanisms.
  - consider detailed consumption components....
Consumption Inequality and Family Labor Supply

Chair Lecture "Professor Carlos Lloyd Braga"

Richard Blundell
University College London & Institute for Fiscal Studies

University of Minho, 2013

Many thanks!
Extra Slides
## Results by Age, Education and Asset Selections

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Age 30-55</th>
<th>Some college+</th>
<th>Top 2 asset terc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E(\pi)$</td>
<td>0.181</td>
<td>0.142</td>
<td>0.202</td>
<td>0.245</td>
</tr>
<tr>
<td>$\beta$</td>
<td>-0.120</td>
<td>-0.177</td>
<td>0.117</td>
<td>-0.046</td>
</tr>
<tr>
<td></td>
<td>(0.098)</td>
<td>(0.089)</td>
<td>(0.072)</td>
<td>(0.084)</td>
</tr>
<tr>
<td>$\eta_{c,p}$</td>
<td>0.437</td>
<td>0.465</td>
<td>0.368</td>
<td>0.343</td>
</tr>
<tr>
<td></td>
<td>(0.124)</td>
<td>(0.044)</td>
<td>(0.05)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>$\eta_{h1,w1}$</td>
<td>0.514</td>
<td>0.467</td>
<td>0.542</td>
<td>0.388</td>
</tr>
<tr>
<td></td>
<td>(0.150)</td>
<td>(0.036)</td>
<td>(0.045)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>$\eta_{h2,w2}$</td>
<td>1.032</td>
<td>1.039</td>
<td>0.858</td>
<td>0.986</td>
</tr>
<tr>
<td></td>
<td>(0.265)</td>
<td>(0.099)</td>
<td>(0.097)</td>
<td>(0.105)</td>
</tr>
<tr>
<td>$\eta_{c,w1}$</td>
<td>-0.141</td>
<td>-0.113</td>
<td>-0.162</td>
<td>-0.127</td>
</tr>
<tr>
<td></td>
<td>(0.051)</td>
<td>(0.018)</td>
<td>(0.022)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>$\eta_{h1,p}$</td>
<td>0.082</td>
<td>0.065</td>
<td>0.087</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.01)</td>
<td>(0.012)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>$\eta_{c,w2}$</td>
<td>-0.138</td>
<td>-0.083</td>
<td>-0.142</td>
<td>-0.129</td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td>(0.029)</td>
<td>(0.032)</td>
<td>(0.154)</td>
</tr>
<tr>
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<td>0.162</td>
<td>0.097</td>
<td>0.169</td>
<td>0.154</td>
</tr>
<tr>
<td></td>
<td>(0.166)</td>
<td>(0.034)</td>
<td>(0.038)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>$\eta_{h1,w2}$</td>
<td>0.128</td>
<td>0.101</td>
<td>0.115</td>
<td>0.079</td>
</tr>
<tr>
<td></td>
<td>(0.052)</td>
<td>(0.011)</td>
<td>(0.012)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\eta_{h2,w1}$</td>
<td>0.258</td>
<td>0.205</td>
<td>0.255</td>
<td>0.172</td>
</tr>
<tr>
<td></td>
<td>(0.103)</td>
<td>(0.022)</td>
<td>(0.027)</td>
<td>(0.021)</td>
</tr>
</tbody>
</table>

Note: Specifications (2) to (4) - Non-bootstrap s.e.’s
Concavity and Advance Information

- **Concavity of preferences.** Use the fact that:

\[
\begin{pmatrix}
\eta_{cp} & \frac{c}{p} & \eta_{cw_1} & \frac{c}{w_1} & \eta_{cw_2} & \frac{c}{w_2} \\
-\eta_{h_1} & \frac{h_1}{p} & -\eta_{h_1} & \frac{h_1}{w_1} & -\eta_{h_1} & \frac{h_1}{w_2} \\
-\eta_{h_2} & \frac{h_2}{p} & -\eta_{h_2} & \frac{h_2}{w_1} & -\eta_{h_2} & \frac{h_2}{w_2}
\end{pmatrix}
= \lambda
\begin{pmatrix}
\frac{d^2u}{dc^2} & \frac{d^2u}{dcdl_1} & \frac{d^2u}{dcdl_2} \\
\frac{d^2u}{dl_1dc} & \frac{d^2u}{dl_1} & \frac{d^2u}{dl_1dl_2} \\
\frac{d^2u}{dl_2dc} & \frac{d^2u}{dl_2dl_1} & \frac{d^2u}{dl_2^2}
\end{pmatrix}^{-1}
\]

- Appendix shows concavity cannot be rejected, and is numerically satisfied at average values of wages, hours, consumption.
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-\eta_{h2p} \frac{h_2}{p} & -\eta_{h2w1} \frac{h_2}{w_1} & -\eta_{h2w2} \frac{h_2}{w_2}
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\begin{pmatrix}
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- Appendix shows concavity cannot rejected, and is numerically satisfied at average values of wages, hours, consumption.

- **Advance Information.** Consumption growth should be correlated with future wage growth (Cunha et al., 2008, and BPP 2008).
  - Test has p-value 13%
RESULTS: EXTENSIVE MARGIN

Estimate a "conditional" Euler equation, controlling for changes in hours (intensive margin) and changes in participation (extensive margin)

Regression results First stage F-stats

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta EMP_t$ (Male)</td>
<td>0.144</td>
<td>($0.269$)</td>
<td>23.4</td>
<td></td>
</tr>
<tr>
<td>$\Delta h_t$ (Male)</td>
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<td>($0.075$)</td>
<td>0.013</td>
<td>($0.021$)</td>
</tr>
<tr>
<td>$\Delta EMP_t$ (Female)</td>
<td>0.356</td>
<td>($0.169$)</td>
<td>0.362</td>
<td>($0.176$)</td>
</tr>
<tr>
<td>$\Delta h_t$ (Female)</td>
<td>0.220</td>
<td>($0.100$)</td>
<td>0.171</td>
<td>($0.094$)</td>
</tr>
</tbody>
</table>

Sample All EMP $t$ (Male) = 1

Instruments 2nd, 4th lags 2nd, 4th lags

Note: $\Delta x_t$ is defined as $(x_t - x_{t-1}) / [0.5(x_t + x_{t-1})]$
**Results: Extensive Margin**

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## Wage Parameters by Assets and Age

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>All</td>
<td>1\textsuperscript{st} asset tercile</td>
<td>2\textsuperscript{nd}, 3\textsuperscript{rd} asset terciles</td>
<td>age&lt;40</td>
<td>age&gt;=40</td>
</tr>
<tr>
<td>Males Trans. σ\textsubscript{u1}</td>
<td>0.033 \ (0.007)</td>
<td>0.03 \ (0.009)</td>
<td>0.042 \ (0.009)</td>
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<td>0.028 \ (0.008)</td>
</tr>
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<td>Perm. σ\textsubscript{v1}</td>
<td>0.035 \ (0.005)</td>
<td>0.027 \ (0.006)</td>
<td>0.039 \ (0.007)</td>
<td>0.025 \ (0.009)</td>
<td>0.039 \ (0.007)</td>
</tr>
<tr>
<td>Females Trans. σ\textsubscript{u2}</td>
<td>0.012 \ (0.005)</td>
<td>0.023 \ (0.009)</td>
<td>0.011 \ (0.007)</td>
<td>0.02 \ (0.015)</td>
<td>0.01 \ (0.005)</td>
</tr>
<tr>
<td>Perm. σ\textsubscript{v2}</td>
<td>0.046 \ (0.004)</td>
<td>0.036 \ (0.007)</td>
<td>0.05 \ (0.006)</td>
<td>0.053 \ (0.013)</td>
<td>0.042 \ (0.005)</td>
</tr>
<tr>
<td>Correlations of Shocks Trans. σ\textsubscript{u1,u2}</td>
<td>0.202 \ (0.159)</td>
<td>-0.264 \ (0.181)</td>
<td>0.39 \ (0.197)</td>
<td>0.459 \ (0.28)</td>
<td>0.115 \ (0.201)</td>
</tr>
<tr>
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<td>0.153 \ (0.06)</td>
<td>0.366 \ (0.142)</td>
<td>0.096 \ (0.066)</td>
<td>0.041 \ (0.174)</td>
<td>0.162 \ (0.063)</td>
</tr>
<tr>
<td>Observations</td>
<td>8,191</td>
<td>2,626</td>
<td>5,565</td>
<td>2,172</td>
<td>6,019</td>
</tr>
</tbody>
</table>
Transmission Parameters:
Consumption response to $j$’s permanent wage shock:

$$
\kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h,j,w_j}\right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w}}
$$
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\]

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- declines with $\eta_{h_j,w_j}$ ("added worker" effect)
- declines with $\eta_{h_j,w_j}$ only if $j$’s labor supply responds negatively to own permanent shock. In one-earner case, true if

\[ (1 - \beta) (1 - \pi_{i,t}) - \eta_{c,p} > 0 \]
**Data and Sample Selection**

- **PSID biennial 1999-2009:**
  - PSID consumption went through a major revision in 1999
    - ~70% of consumption expenditures. Good match with NIPA
    - The sum of food at home, food away from home, gasoline, health, transportation, utilities, etc.
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- **Methodology:** Use structural restrictions that ‘theory’ imposes on the variance covariance structure of $\Delta c_{i,t}$, $\Delta y_{i,1,t}$ and $\Delta y_{i,2,t}$
Some Econometrics Issues

- Measurement error
  - For consumption, use martingale assumption and mean-reversion
  - For wages, use external estimates from Bound et al. (1994)
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- **Inference**
  - Multi-step procedure
  - Block bootstrap standard errors
Inference

- Multi-step estimation procedure:
  - Regress $c_{i,t}, y_{i,j,t}, w_{i,j,t}$ on observable characteristics, and construct the residuals $\Delta c_{i,t}, \Delta y_{i,j,t}$ and $\Delta w_{i,j,t}$
  - Estimate the wage parameters using the conditional second order moments for $\Delta w_{i,1,t}$ and $\Delta w_{i,2,t}$
  - Estimate $\pi_{i,t}$ and $s_{i,t}$ using asset and (current and projected) earnings data
  - Estimate preference parameters using restrictions on the joint behavior of $\Delta c_{i,t}, \Delta y_{i,j,t}$ and $\Delta w_{i,j,t}$

- GMM with standard errors corrected by the block bootstrap.
Non-Separability and Measurement Errors

\[
\begin{pmatrix}
\Delta w_{i,1,t} \\
\Delta w_{i,2,t} \\
\Delta c_{i,t} \\
\Delta y_{i,1,t} \\
\Delta y_{i,2,t}
\end{pmatrix}
\sim
\begin{pmatrix}
1 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 1 & 1 \\
\kappa_{c,u_1} & \kappa_{c,u_2} & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_1,u_1} & \kappa_{y_1,u_2} & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
\kappa_{y_2,u_1} & \kappa_{y_2,u_2} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{i,1,t} \\
\Delta u_{i,2,t} \\
\nu_{i,1,t} \\
\nu_{i,2,t}
\end{pmatrix}
+ \begin{pmatrix}
\Delta \zeta_{i,1,t}^w \\
\Delta \zeta_{i,2,t}^w \\
\Delta \zeta_{i,t}^c \\
\Delta \zeta_{i,1,t}^y \\
\Delta \zeta_{i,2,t}^y
\end{pmatrix}
\]

- where \( \zeta_{i,j,t}^w, \zeta_{i,t}^c \) and \( \zeta_{i,j,t}^y \) are measurement errors in log wages of earner \( j \), log consumption, and log earnings of earner \( j \).
Our focus here is on non-stationarity, heterogenous profiles, and shocks of varying persistence.
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Individual $i$ of age $a$ in time period $t$, has log income $y_{i,a} (\equiv \ln Y_{i,a,t})$

$$y_{i,a} = Z^T_{i,a} \phi_a + f_0 + f_1 + \beta_i + \epsilon_{i,a}$$

where $\beta_i$ is an individual-specific trend, allow non-zero covariance between $f_0$ and $f_1$. 

$y_{T,i,a}$ is the persistent process with variance $\sigma^2_a$

$y_{T,i,a} = \rho y_{T,i,a} + v_{i,a} + \epsilon_{i,a}$

and $\epsilon_{i,a}$ is a transitory process (can be low order MA) with variance $\omega^2_a$ (can be low order MA).

Allow variances (or factor loadings) of $v_{i,a}$ and $\epsilon_{i,a}$ to vary with age/time for each birth cohort and education group.
Our focus here is on non-stationarity, heterogenous profiles, and shocks of varying persistence.

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$$y_{i,a} = Z_{i,a}^T \varphi_a + f_{0i} + f_{1i} p_a + y^P_{i,a} + \varepsilon_{i,a}$$

where $\beta_i p_a$ is an individual-specific trend, allow non-zero covariance between $f_0$ and $f_1$.

$y^T_{i,a}$ is the persistent process with variance $\sigma^2_a$

$$y^T_{i,a} = \rho y^T_{i,a-1} + \nu_{i,a}$$

and $\varepsilon_{i,a}$ is a transitory process (can be low order MA) with variance $\omega^2_a$ (can be low order MA).
Our focus here is on non-stationarity, heterogeneous profiles, and shocks of varying persistence.

Individual $i$ of age $a$ in time period $t$, has log income $y_{i,a}(\equiv \ln Y_{i,a,t})$

$$y_{i,a} = Z_{i,a}^T \varphi_a + f_{0i} + f_{1i}p_a + y_{i,a}^p + \varepsilon_{i,a}$$

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$y_{i,a}^T$ is the persistent process with variance $\sigma_a^2$

$$y_{i,a}^T = \rho y_{i,a-1}^T + \upsilon_{i,a}$$

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The idiosyncratic trend term $p_t f_{1i}$ could take a number of forms. Two alternatives are worth highlighting:

- (a) deterministic idiosyncratic trend:
  
  $$p_t f_{1i} = r(t) f_{1i}$$

  where $r$ is a known function of $t$, e.g. $r(t) = t$. 

- (b) stochastic trend in 'ability prices':

  $$p_t = p_t^1 + \xi_t$$ with

  $$E_t \xi_t = 0.$$
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  $$p_t = p_{t-1} + \xi_t$$

  with $E_{t-1} \xi_t = 0$. 

Evidence points to some periods of time where each of these is of key importance. Deterministic trends as in (a), appear most prominently early in the working life. Formally, this is a life-cycle effect. Alternatively, stochastic trends (b) are most likely to occur during periods of technical change when skill prices are changing across the unobserved ability distribution. Formally, this is a calendar time effect.
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**Idiosyncratic Trends**

- For each cohort we consider several alternative models for the heterogenous profile $\beta_ip_a$:
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For each cohort we consider several alternative models for the heterogenous profile $\beta_i p_a$:

1. **Baseline Specification:** $f_{1i} = 0$
2. **Linear Specification:** $p_a = \gamma_1 a + \gamma_0$, so that

   \[ \Delta^\rho p_a = (1 - \rho) \gamma_0 i + \gamma_1 \xi_0 \]

   where $\xi_0 \equiv [a - \rho (a - 1)]$. 

3. **Quadratic Specification:**

4. **Piecewise-Linear Specification:**

   $p_a = \begin{cases} \kappa_1 a + 35 (1 - \kappa_1) a \kappa_2 a + 52 (1 - \kappa_2) a & \text{if } a < 35 \\ & \text{otherwise} \end{cases}$

   with knots at age 35 and age 52.

5. **Polynomials up to degree 4.**
**Idiosyncratic Trends**

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Suppose we observe individual $i$ at age $a = 1, ..., T$, we then have $T - 1$ equations $\Delta^\rho y_{ia} (\equiv y_{i,a} - \rho y_{i,a-1})$. In vector form

$$\Delta^\rho y_i = ((1 - \rho) \iota, \Delta^\rho p_a) \begin{pmatrix} f_{0i} \\ f_{1i} \end{pmatrix} + v_i + \Delta^\rho \epsilon_i.$$
Covariance structure

Suppose we observe individual $i$ at age $a = 1, ..., T$, we then have $T - 1$ equations $\Delta^\rho y_{ia} \equiv y_{i,a} - \rho y_{i,a-1}$. In vector form

$$\Delta^\rho y_i = ((1 - \rho) \iota, \Delta^\rho p_a) \begin{pmatrix} f_{0i} \\ f_{1i} \end{pmatrix} + \nu_i + \Delta^\rho \varepsilon_i.$$ 

The Variance-Covariance matrix in general has the form: $\text{Var}(\Delta^\rho y_i) = \Omega + W$ where $W =$

$$
\begin{pmatrix}
\sigma_2^2 + \omega_2^2 + \rho^2\omega_1^2 & -\rho\omega_2^2 & 0 & 0 \\
-\rho\omega_2^2 & \sigma_3^2 + \omega_3^2 + \rho^2\omega_2^2 & -\rho\omega_3^2 & 0 \\
0 & -\rho\omega_3^2 & \cdot & -\rho\omega_{T-1}^2 \\
0 & 0 & -\rho\omega_{T-1}^2 & \sigma_T^2 + \omega_T^2 + \rho^2\omega_{T-1}^2
\end{pmatrix}$$
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-\rho \omega_2^2 & \sigma_3^2 + \omega_3^2 + \rho^2 \omega_2^2 & -\rho \omega_3^2 & 0 \\
0 & -\rho \omega_3^2 & \ddots & -\rho \omega_{T-1}^2 \\
0 & 0 & -\rho \omega_{T-1}^2 & \sigma_T^2 + \omega_T^2 + \rho^2 \omega_{T-1}^2
\end{pmatrix}
$$

For the linear heterogeneous profiles case:

$$\Omega = [(1 - \rho) \iota, \xi_0] \begin{pmatrix}
\sigma_0^2 & \rho_{01} \sigma_0 \sigma_1 \\
\rho_{01} \sigma_0 \sigma_1 & \sigma_1^2
\end{pmatrix} [(1 - \rho) \iota, \xi_0]^T.$$

Removing Additive Separability: Theory

- Approximating the first order conditions (intensive margin):

\[
\Delta c_{i,t} \approx \left( \eta_{c,w_1} + \eta_{c,w_2} - \eta_{c,p} \right) \Delta \ln \lambda_{i,t} \\
+ \eta_{c,w_1} \Delta w_{i,1t+1} + \eta_{c,w_2} \Delta w_{i,2t+1}
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  \]

- Interpretation:
  - C and H substitutes \((\eta_{c,w_j} < 0) \Rightarrow\) Excess smoothing
  - C and H complements \((\eta_{c,w_j} > 0) \Rightarrow\) Excess sensitivity
REMOVING ADDITIVE SEPARABILITY: THEORY

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Interpretation:

- C and H substitutes (\(\eta_{c,w_j} < 0\)) ⇒ Excess smoothing
- C and H complements (\(\eta_{c,w_j} > 0\)) ⇒ Excess sensitivity

Moments

\[
\begin{pmatrix}
\Delta c_{i,t} \\
\Delta y_{i,1,t} \\
\Delta y_{i,2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
\kappa_{i,c,u_1} & \kappa_{i,c,u_2} & \kappa_{i,c,v_1} & \kappa_{i,c,v_2} \\
\kappa_{i,y_1,u_1} & \kappa_{i,y_1,u_2} & \kappa_{i,y_1,v_1} & \kappa_{i,y_1,v_2} \\
\kappa_{i,y_2,u_1} & \kappa_{i,y_2,u_2} & \kappa_{i,y_2,v_1} & \kappa_{i,y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{i,1,t} \\
\Delta u_{i,2,t} \\
v_{i,1,t} \\
v_{i,2,t}
\end{pmatrix}
\]

where (for \(j = 1, 2\))

\[ \kappa_{i,c,u_j} = \eta_{c,w_j}; \quad \kappa_{i,y_j,u_j} = 1 + \eta_{h_j,w_j}; \quad \kappa_{i,y_j,u_{-j}} = \eta_{h_j,w_{-j}} \]
Non-linear Taxes

\[ \tilde{Y}_{it} = (1 - \chi_t) \left( H_{1,t} W_{1,t} + H_{2,t} W_{2,t} \right)^{1-\mu_t} \]
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- Implications for underlying structural preference parameters, e.g.

\[ \tilde{\eta}_{h_j,w_j} = \frac{\eta_{h_j,w_j} (1 - \mu)}{1 + \mu \eta_{h_j,w_j}} \text{ (with } \tilde{\eta}_{h_j,w_j} \leq \eta_{h_j,w_j} \text{ for } 0 \leq \mu \leq 1) \]
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- Labor supply elasticities (w.r.t. \( W \)) are dampened: Return to work decreases as people cross tax brackets
## Loading Factor Matrix: Estimates

### Table

<table>
<thead>
<tr>
<th>Response to</th>
<th>Separable case</th>
<th></th>
<th>Non-separable case</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consump.</td>
<td>Husband’s earnings</td>
<td>Wife’s earnings</td>
<td>Consump.</td>
</tr>
<tr>
<td>$v_1$</td>
<td>0.13</td>
<td>1.15</td>
<td>−0.54</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.067)</td>
<td>(0.206)</td>
<td>(0.057)</td>
</tr>
<tr>
<td>$v_2$</td>
<td>0.07</td>
<td>−0.16</td>
<td>1.53</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.057)</td>
<td>(0.101)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>$\Delta u_1$</td>
<td>0</td>
<td>1.43</td>
<td>0</td>
<td>−0.14</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td>(0.097)</td>
<td>(0.091)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>$\Delta u_2$</td>
<td>0</td>
<td>0</td>
<td>1.83</td>
<td>−0.14</td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td>(0.133)</td>
<td>(0.133)</td>
<td>(0.139)</td>
</tr>
</tbody>
</table>
## Heterogeneity:

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Age 30-55</th>
<th>(3) Some college+</th>
<th>(4) Top 2 asset terc.</th>
<th>(5) Age variance</th>
<th>(6) Sel.correct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E(\pi)$</td>
<td>0.181</td>
<td>0.142</td>
<td>0.202</td>
<td>0.245</td>
<td>0.181</td>
<td>0.176</td>
</tr>
<tr>
<td>$\beta$</td>
<td>$-0.120$</td>
<td>$-0.177$</td>
<td>0.117</td>
<td>$-0.046$</td>
<td>$-0.109$</td>
<td>$-0.129$</td>
</tr>
<tr>
<td>$\eta_{c,p}$</td>
<td>0.437</td>
<td>0.465</td>
<td>0.368</td>
<td>0.343</td>
<td>0.42</td>
<td>0.473</td>
</tr>
<tr>
<td>$\eta_{h_1,w_1}$</td>
<td>0.514</td>
<td>0.467</td>
<td>0.542</td>
<td>0.388</td>
<td>0.575</td>
<td>0.509</td>
</tr>
<tr>
<td>$\eta_{h_2,w_2}$</td>
<td>1.032</td>
<td>1.039</td>
<td>0.858</td>
<td>0.986</td>
<td>1.005</td>
<td>1.095</td>
</tr>
<tr>
<td>$\eta_{c,w_1}$</td>
<td>$-0.141$</td>
<td>$-0.113$</td>
<td>$-0.162$</td>
<td>$-0.127$</td>
<td>$-0.15$</td>
<td>$-0.150$</td>
</tr>
<tr>
<td>$\eta_{h_1,p}$</td>
<td>0.082</td>
<td>0.065</td>
<td>0.087</td>
<td>0.07</td>
<td>0.087</td>
<td>0.088</td>
</tr>
<tr>
<td>$\eta_{c,w_2}$</td>
<td>$-0.138$</td>
<td>$-0.083$</td>
<td>$-0.142$</td>
<td>$-0.129$</td>
<td>$-0.11$</td>
<td>$-0.122$</td>
</tr>
<tr>
<td>$\eta_{h_2,p}$</td>
<td>0.162</td>
<td>0.097</td>
<td>0.169</td>
<td>0.154</td>
<td>0.129</td>
<td>0.143</td>
</tr>
<tr>
<td>$\eta_{h_1,w_2}$</td>
<td>0.128</td>
<td>0.101</td>
<td>0.115</td>
<td>0.079</td>
<td>0.141</td>
<td>0.125</td>
</tr>
<tr>
<td>$\eta_{h_2,w_1}$</td>
<td>0.258</td>
<td>0.205</td>
<td>0.255</td>
<td>0.172</td>
<td>0.285</td>
<td>0.253</td>
</tr>
</tbody>
</table>

Note: Specifications (2) to (6) - Non-bootstrap s.e.’s
**Approximation of the Euler Equation (1)**

- From $\lambda_{i,t} = \frac{1+\delta}{1+r} E_t \lambda_{i,t+1}$, use a second order Taylor approximation (with $r = \delta$) to yield:

  \[
  \Delta \ln \lambda_{i,t+1} \approx \omega_t + \varepsilon_{i,t+1}
  \]

  where

  \[
  \omega_t = -\frac{1}{2} E_t (\Delta \ln \lambda_{i,t+1})^2
  \]

  \[
  \varepsilon_{i,t+1} = \Delta \ln \lambda_{i,t+1} - E_t (\Delta \ln \lambda_{i,t+1})
  \]

- Then use the fact that

  \[
  \Delta \ln U_{C_{i,t+1}} = \Delta \ln \lambda_{i,t+1}
  \]

  \[
  \Delta \ln U_{H_{i,j,t+1}} = -\Delta \ln \lambda_{i,t+1} - \Delta \ln W_{i,j,t+1}
  \]
Consider now Taylor expansion of $U_{C_{i,t+1}} (= \lambda_{i,t+1})$:

$$
\frac{U_{C_{i,t+1}} - U_{C_{i,t}}}{U_{C_{i,t}}} \approx \frac{U_{C_{i,t}} + (C_{i,t+1} - C_{i,t}) U_{C_{i,t}} C_{i,t}}{U_{C_{i,t}} C_{i,t}} \approx -\frac{1}{\eta_{c,p}} \Delta \ln C_{i,t+1}
$$

and therefore, from

$$
\Delta \ln \lambda_{i,t+1} \approx \omega_{t+1} + \varepsilon_{i,t+1}
$$

get

$$
\Delta \ln C_{i,t+1} = -\eta_{c,p} (\omega_{t+1} + \varepsilon_{i,t+1})
$$
APPROXIMATION OF THE LIFE TIME BUDGET CONSTRAINT

- Use the fact that

\[
E_I \left[ \ln \sum_{i=0}^{T-t} X_{t+i} \right] = \ln \sum_{i=0}^{T-t} \exp E_{t-1} \ln X_{t+i} \\
+ \sum_{i=0}^{T-t} \frac{\exp E_{t-1} \ln X_{t+i}}{\sum_{j=0}^{T-t} \exp E_{t-1} \ln X_{t+j}} (E_I - E_{t-1}) \ln X_{t+i} \\
+ O \left( E_I \| \xi^T_t \|^2 \right)
\]

for \( X = C, WH \) and appropriate choice of \( E_I \).

- Goal: obtain a **mapping** from wage innovations to innovations in consumption (marginal utility of wealth)
Household Decisions in a Unitary Framework

Household chooses \( \{ C_{i,t+j}, H_{i,1,t+j}, H_{i,2,t+j} \}_{j=0}^{T-t} \) to maximize

\[
\mathbb{E}_t \sum_{\tau=0}^{T-t} (1 + \delta)^{-\tau} v (C_{i,t+\tau}, H_{i,1,t+\tau}, H_{i,2,t+\tau}; Z_{i,t+\tau})
\]

subject to

\[
C_{i,t} + \frac{A_{i,t+1}}{1 + r} = A_{i,t} + H_{i,1,t} W_{i,1,t} + H_{i,1,t} W_{i,2,t}
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\]

Our approach

- Extend previous work and express the distributional dynamics of consumption and earnings growth as functions of Frisch elasticities, ‘insurance parameters’ and wage shocks
CONSUMPTION AND EARNINGS GROWTH

The ’Simple’ Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\sim
\begin{pmatrix}
0 & 0 & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_1,u_1} & 0 & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
0 & \kappa_{y_2,u_2} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]
CONSUMPTION AND EARNINGS GROWTH

The ‘Simple’ Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
0 & 0 & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_1,u_1} & 0 & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
0 & \kappa_{y_2,u_2} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_j,u_j} = \left(1 + \eta_{h_j,\omega_j}\right) \rightarrow \text{[Frisch]}
\]
Consumption and Earnings Growth

The ‘Simple’ Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix} 
\approx 
\begin{pmatrix}
0 & 0 & \kappa_{c_1, v_1} & \kappa_{c_2, v_2} \\
\kappa_{y_1, u_1} & 0 & \kappa_{y_1, v_1} & \kappa_{y_1, v_2} \\
0 & \kappa_{y_2, u_2} & \kappa_{y_2, v_1} & \kappa_{y_2, v_2}
\end{pmatrix} 
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_j, u_j} = \left(1 + \eta_{h_j, w_j}\right) \rightarrow \text{[Frisch]} \quad \kappa_{y_j, v_j} \rightarrow \text{[Marshall]}
\]
CONSUMPTION AND EARNINGS GROWTH

The ‘Simple’ Separable Case

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\begin{pmatrix}
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\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_j,u_j} = \left(1 + \eta_{h_j,w_j}\right) \rightarrow \text{[Frisch]} \quad \kappa_{y_j,v_j} \rightarrow \text{[Marshall]}
\]

\[
\kappa_{c,v_j} = \left(1 - \pi_{i,t}\right) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h_j,w_j}\right)}{\eta_{c,p} + \left(1 - \pi_{i,t}\right) \eta_{h,w}}
\]
CONSUMPTION AND EARNINGS GROWTH

The 'Simple' Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
0 & 0 & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_{1,u_1}} & 0 & \kappa_{y_{1,v_1}} & \kappa_{y_{1,v_2}} \\
0 & \kappa_{y_{2,u_2}} & \kappa_{y_{2,v_1}} & \kappa_{y_{2,v_2}}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_{j,u_j}} = \left(1 + \eta_{h_j,w_j}\right) \rightarrow \text{[Frisch]} \quad \kappa_{y_{j,v_j}} \rightarrow \text{[Marshall]}
\]

\[
\kappa_{c,v_j} = \left(1 - \pi_{i,t}\right) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h_j,w_j}\right)}{\eta_{c,p} + \left(1 - \pi_{i,t}\right) \eta_{h,w}}
\]

\[
\pi_{i,t} \approx \frac{\text{Assets}_{i,t}}{\text{Assets}_{i,t} + \text{Human Wealth}_{i,t}}
\]
CONSUMPTION AND EARNINGS GROWTH

The ‘Simple’ Separable Case

\[
\begin{pmatrix}
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\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
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\kappa_{y_{1,u_1}} & 0 & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
0 & \kappa_{y_{2,u_2}} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_j,u_j} = \left(1 + \eta_{h_j,w_j}\right) \rightarrow [\text{Frisch}] \quad \kappa_{y_j,v_j} \rightarrow [\text{Marshall}]
\]

\[
\kappa_{c,v_j} = (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h_j,w_j}\right)}{\eta_{c,p} + \left(1 - \pi_{i,t}\right) \eta_{h,w}}
\]

\[
s_{i,j,t} \approx \frac{\text{Human Wealth}_{i,j,t}}{\text{Human Wealth}_{i,t}}
\]
CONSUMPTION AND EARNINGS GROWTH

The 'Simple' Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
0 & 0 & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_1,u_1} & 0 & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
0 & \kappa_{y_2,u_2} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_1,t \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

where the key transmission parameters

\[
\kappa_{y_j,u_j} = \left(1 + \eta_{h_j,w_j}\right) \rightarrow \text{[Frisch]} \quad \kappa_{y_j,v_j} \rightarrow \text{[Marshall]}
\]

\[
\kappa_{c,v_j} = (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left(1 + \eta_{h_j,w_j}\right)}{\eta_{c,p} + (1 - \pi_{i,t}) \bar{\eta}_{h,w}}
\]

\[
\bar{\eta}_{h,w} = s_{i,j,t} \eta_{h_j,w_j} + s_{i,-j,t} \eta_{h_{-j},w_{-j}}
\]
CONSUMPTION AND EARNINGS GROWTH

The 'Simple' Separable Case

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\approx
\begin{pmatrix}
0 & 0 & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_{1,u_1}} & 0 & \kappa_{y_{1,v_1}} & \kappa_{y_{1,v_2}} \\
0 & \kappa_{y_{2,u_2}} & \kappa_{y_{2,v_1}} & \kappa_{y_{2,v_2}}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

- Introduce now \( \beta \), representing insurance over and above savings, taxes and labour supply \( \rightarrow \) networks, etc.
- Key transmission parameter becomes:

\[
\kappa_{c,v_j} = (1 - \beta) (1 - \pi_{i,t}) s_{i,j,t} \frac{\eta_{c,p} \left( 1 + \eta_{h,j,w_j} \right)}{\eta_{c,p} + (1 - \beta) (1 - \pi_{i,t}) \eta_{h,w_j}}
\]
## NIPA-PSID Comparison

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSID Total</strong></td>
<td>3,276</td>
<td>3,769</td>
<td>4,285</td>
<td>5,058</td>
<td>5,926</td>
<td>5,736</td>
</tr>
<tr>
<td><strong>NIPA Total</strong></td>
<td>5,139</td>
<td>5,915</td>
<td>6,447</td>
<td>7,224</td>
<td>8,190</td>
<td>9,021</td>
</tr>
<tr>
<td><strong>ratio</strong></td>
<td>0.64</td>
<td>0.64</td>
<td>0.66</td>
<td>0.7</td>
<td>0.72</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>PSID Nondurables</strong></td>
<td>746</td>
<td>855</td>
<td>887</td>
<td>1,015</td>
<td>1,188</td>
<td>1,146</td>
</tr>
<tr>
<td><strong>NIPA Nondurables</strong></td>
<td>1,330</td>
<td>1,543</td>
<td>1,618</td>
<td>1,831</td>
<td>2,089</td>
<td>2,296</td>
</tr>
<tr>
<td><strong>ratio</strong></td>
<td>0.56</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.57</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>PSID Services</strong></td>
<td>2,530</td>
<td>2,914</td>
<td>3,398</td>
<td>4,043</td>
<td>4,738</td>
<td>4,590</td>
</tr>
<tr>
<td><strong>NIPA Services</strong></td>
<td>3,809</td>
<td>4,371</td>
<td>4,829</td>
<td>5,393</td>
<td>6,101</td>
<td>6,725</td>
</tr>
<tr>
<td><strong>ratio</strong></td>
<td>0.66</td>
<td>0.67</td>
<td>0.7</td>
<td>0.75</td>
<td>0.78</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Note: PSID weights are applied for the non-sampled PSID data (47,206 observations for these years). Total consumption is defined as Nondurables + Services. PSID consumption categories include food, gasoline, utilities, health, rent (or rent equivalent), transportation, child care, education and other insurance. NIPA numbers are from NIPA table 2.3.5. All numbers are non-mninal.
Identification with non-separability

When preferences are non-separable, we have:

\[
\begin{pmatrix}
\Delta c_t \\
\Delta y_{1,t} \\
\Delta y_{2,t}
\end{pmatrix}
\sim
\begin{pmatrix}
\kappa_{c,u_1} & \kappa_{c,u_2} & \kappa_{c,v_1} & \kappa_{c,v_2} \\
\kappa_{y_1,u_1} & \kappa_{y_1,u_2} & \kappa_{y_1,v_1} & \kappa_{y_1,v_2} \\
\kappa_{y_2,u_1} & \kappa_{y_2,u_2} & \kappa_{y_2,v_1} & \kappa_{y_2,v_2}
\end{pmatrix}
\begin{pmatrix}
\Delta u_{1,t} \\
\Delta u_{2,t} \\
v_{1,t} \\
v_{2,t}
\end{pmatrix}
\]

- \( \kappa_{c,u_j} \rightarrow \) non-separability between consumption and leisure \( j \)
- \( \kappa_{y_j,u_k} \rightarrow \) non-separability between spouses’ leisures