Household Risk and Insurance over the Life Cycle

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Motivation

The household is an important entity for studying

- the various risks individuals face (labor productivity, health)
- the way individuals react to and insure against these risks
- the effect of various government policies (e.g., UI, social programs)
- aggregate (Frisch and Hicks) labor supply elasticities

Motivation

- The focus has mostly been on individual risk and insurance, in isolation.
- Many papers on individual risk (labor productivity, health) and the way individuals insure against them.
    - Labor supply responses are one way to offset this risk: Low (2005), Pijoan-Mas (2006), Erosa, Fuster, and Kambourov (2011)
    - Low, Meghir, and Pistaferri (2010) look in greater detail at the sources of risk (employer mobility).

Contribution

1. Estimate a *quarterly* wage process for husbands and wives within households

    - Allow for correlation b/n husband and wife shocks
    - Correct for selection bias in male and female participation
    - Four household groups: *HH*, *CH*, *HC*, *CC*
    - Study a relatively long time period: 1984-2010
    - Use a fairly unrestricted sample

Hyslop (AER, 2001); Low, Meghir, and Pistaferri (AER, 2010)

Contribution

2. Develop a life-cycle model of the household

    - Quarterly model period
    - Four household groups: *HH*, *CH*, *HC*, *CC*
    - Intensive and extensive labor supply margin
    - Labor productivity risk and incomplete markets
    - Correlated wage shocks b/n husband and wife
    - Unemployment shocks and labor market frictions

Heathcote, Storesletten, and Violante (JPE, 2010);
Guner, Kaygusuz, and Ventura (ReStud, 2011)

Contribution

3. Study the aggregate (Frisch and Hicks) labor supply response (Erosa et al, 2011)

4. Study the effect of government policies (across countries):
    - Social security and labor supply late in the life cycle (Erosa et al, 2012)
    - Unemployment Insurance (UI)
    - Social Assistance Programs
        - Supplemental Nutrition Assistance Program (SNAP)
        - Temporary Assistance for Needy Families (TANF)

The Household Wage Process

Empirical Framework

Household wages follow the process (for a given household education group):

$$\begin{aligned}\ln w_{m,it} &= X'_{m,it}\zeta_m + u_{m,it} + v_{m,it} \\ \ln w_{f,it} &= X'_{f,it}\zeta_f + u_{f,it} + v_{f,it}\end{aligned}$$

- $w_{j,it}$ real hourly wage in period t
- $X'_{j,it}$ – observed variables such as age, race, region, time dummies
- $v_{j,it} \sim N(0, \sigma^2_{v_j})$ – measurement error (trans. shock)

- $u_{j,it}$ – random walk stochastic shock:

$$\begin{aligned} u_{m,it} &= u_{m,it-1} + \varepsilon_{m,it} \\ u_{f,it} &= u_{f,it-1} + \varepsilon_{f,it} \end{aligned}$$

- $\varepsilon \sim N_2(0, \Sigma)$, where

$$\Sigma = \begin{pmatrix} \sigma^2_{\varepsilon_m} & \rho_{\varepsilon_m,\varepsilon_f}\sigma_{\varepsilon_m}\sigma_{\varepsilon_f} \\ \rho_{\varepsilon_m,\varepsilon_f}\sigma_{\varepsilon_m}\sigma_{\varepsilon_f} & \sigma^2_{\varepsilon_f} \end{pmatrix}$$

Estimation of the Wage Process

- The household wage process is estimated in FD:

$$\begin{aligned}\Delta \ln w_{m,it} &= \Delta X'_{m,it}\zeta_m + \varepsilon_{m,it} + \Delta \nu_{m,it} \\ \Delta \ln w_{f,it} &= \Delta X'_{f,it}\zeta_f + \varepsilon_{f,it} + \Delta \nu_{f,it}\end{aligned}$$

- The selection equations are:

$$\begin{aligned}P^*_{m,it} &= Z'_{m,it}\xi_m + \pi_{m,it} \\ P^*_{f,it} &= Z'_{f,it}\xi_f + \pi_{f,it},\end{aligned}$$

- $\pi \sim N_2(0, \Pi)$, where

$$\Pi = \begin{pmatrix} 1 & \rho_{\pi_m,\pi_f} \\ \rho_{\pi_m,\pi_f} & 1 \end{pmatrix}$$

- Selection correlations: $\rho_{\varepsilon_m,\pi_m}$ and $\rho_{\varepsilon_f,\pi_f}$

Selection-Corrected Residual Wage Growth

- $E\left[\Delta \ln w_{m,it} | P_{m,it} = 1, P_{m,it-1} = 1\right] =$

$$
\begin{aligned}
&= \Delta X'_{m,it}\zeta_m + E\left[(\varepsilon_{m,it} + \Delta v_{m,it}) | P_{m,it} = 1, P_{m,it-1} = 1\right] \\
&= \Delta X'_{m,it}\zeta_m + E\left[(\varepsilon_{m,it} | \pi_{m,it} > -Z'_{m,it}\xi_m,\ \pi_{m,it-1} > -Z'_{m,it-1}\xi_m\right] \\
&= \Delta X'_{m,it}\zeta_m + \sigma_{\varepsilon m}\rho_{\varepsilon_m,\pi_m}\left(\frac{\phi(Z'_{m,it}\xi_m)}{\Phi(Z'_{m,it}\xi_m)}\right) \\
&= \Delta X'_{m,it}\zeta_m + \sigma_{\varepsilon m}\rho_{\varepsilon_m,\pi_m}\Lambda^P_{m,it}
\end{aligned}
$$

- Probit on participation to estimate the inverse Mills ratio $\Lambda^P_{m,it}$
- OLS to obtain consistent estimates of $\hat{\zeta}_m$
- $g_{m,it} = \Delta(\ln w_{m,it} - X'_{m,it}\hat{\zeta}_m) = \varepsilon_{m,it} + \Delta v_{m,it}$
- $g_{f,it} = \Delta(\ln w_{f,it} - X'_{f,it}\hat{\zeta}_f) = \varepsilon_{f,it} + \Delta v_{f,it}$

Moment Estimation: GMM

$$\{\ \sigma_{\varepsilon_m}; \rho_{\varepsilon_m,\pi_m}; \sigma_{v_m}; \sigma_{\varepsilon_f}, \sigma_{v_f}; \rho_{\varepsilon_f,\pi_f}; \rho_{\varepsilon_m,\varepsilon_f}\ \}$$

Erosa, Fuster, and Kambourov (2012) show that:

1. $E\left[g_{m,it} \mid \cdot\ \right] = \sigma_{\varepsilon_m}\rho_{\varepsilon_m,\pi_m}\hat{\Lambda}^P_{m,it}$
2. $E\left[g^2_{m,it} \mid \cdot\ \right] = \sigma^2_{\varepsilon_m}\left[1 - \rho^2_{\varepsilon_m,\pi_m}(Z'_{m,it}\hat{\xi}_m)\hat{\Lambda}^P_{m,it}\right] + 2\sigma^2_{v_m}$
3. $E\left[g_{m,it+1} \cdot g_{m,it} \mid \cdot\ \right] = \sigma^2_{\varepsilon_m}\rho^2_{\varepsilon_m,\pi_m}\hat{\Lambda}^P_{m,it+1}\hat{\Lambda}^P_{m,it} - \sigma^2_{v_m}$

4. $E\left[g_{f,it} \mid \cdot\ \right] = \sigma_{\varepsilon_f}\rho_{\varepsilon_f,\pi_f}\hat{\Lambda}^P_{f,it}$
5. $E\left[g^2_{f,it} \mid \cdot\ \right] = \sigma^2_{\varepsilon_f}\left[1 - \rho^2_{\varepsilon_f,\pi_f}(Z'_{f,it}\hat{\xi}_f)\hat{\Lambda}^P_{f,it}\right] + 2\sigma^2_{v_f}$
6. $E\left[g_{f,it+1} \cdot g_{f,it} \mid \cdot\ \right] = \sigma^2_{\varepsilon_f}\rho^2_{\varepsilon_f,\pi_f}\hat{\Lambda}^P_{f,it+1}\hat{\Lambda}^P_{f,it} - \sigma^2_{v_f}$

7. $E\left[g_{m,it} \cdot g_{f,it} \mid \cdot\ \right] = \sigma_{\varepsilon_m}\sigma_{\varepsilon_f}\left[\rho_{\varepsilon_m,\varepsilon_f} + \rho_{\varepsilon_m,\pi_m}\rho_{\varepsilon_f,\pi_f}\hat{\Lambda}^P_{m,it;f,it}\right]$

Data: 1990 SIPP

- Monthly information on income and welfare program participation for individuals and households
- October 1989 – August 1992 (8 waves)
- High-school: 22-61; College: 25-61
- Sample sizes:
  - *HH*: 53,907.
  - *CH*: 16,056.
  - *HC*: 14,693.
  - *CC*: 25,800.

Data: 1990 SIPP

- Merge couples into households (families)
- Probit on male participation: obtain the inverse Mills ratio, trend in log wages, and residual wage growth (controlling for selection in participation).
- Probit on female participation: obtain the inverse Mills ratio, trend in log wages, and residual wage growth (controlling for selection in participation).
- Bivariate probit on husband and wife participation: obtain inverse Mills ratio.
- Construct 7 moments using husband and wife residual wage growth.
- Estimate the 7 parameters of interest.

Estimation Results

Group	*HH*	*CH*	*HC*	*CC*
σ_{ε_m}	**0.046**	**0.052**	**0.041**	**0.045**
$\rho_{\varepsilon_m,\pi_m}$	**-0.18**	**-0.06**	**-0.13**	**-0.05**
σ_{ν_m}	0.000	0.000	0.008	0.000
σ_{ε_f}	**0.045**	**0.047**	**0.044**	**0.045**
$\rho_{\varepsilon_f,\pi_f}$	**-0.07**	0.02	**-0.09**	**0.04**
σ_{ν_f}	0.000	0.000	0.000	0.000
$\rho_{\varepsilon_m,\varepsilon_f}$	**0.055**	0.039	**0.089**	0.044

The Model

The Model

- The economy is populated by overlapping generations of households
- Households differ in education (e_m, e_f) and labor productivity (z_m, z_f)
- The education decision is exogenous and there are two types of education e_i $-$ college and non-college
- The marriage decision is exogenous, and there are 4 types of households: *HH*, *CH*, *HC*, *CC*

Preferences

Households value consumption c and leisure (l_m, l_f). The period utility functions is:

$$u(c, l_m, l_f) = \ln c + \varphi_m \frac{l_m^{1-\sigma}}{1-\sigma} + \varphi_f \frac{l_f^{1-\sigma}}{1-\sigma} - F_m P_{m>0} - F_f P_{f>0}$$

- F_j – fixed cost of work;
- P_j – participation indicator;
- An individual is endowed with 1 unit of time each period.

Household Risk

1. Labor productivity risk
   - As described earlier.
2. Employment risk
   - δ: job destruction rate for employed indiv. each period.
   - λ: job offer rate for non-employed individuals each period.
   - δ and λ are education- and gender-specific.

Government and Credit Markets

- Government taxes consumption, capital and labor income (τ_c, τ_k, τ_h).
  - τ_h – proportional in this presentation.
  - τ_h – progressive in the future.
- No borrowing.
- No insurance against idiosyncratic labor income risk.

Government Programs: Social Security

- Pay-as-you-go social security system.
- High-school retire at 62; College – at 65.
- Payroll tax τ_{ss}.
- Pension benefits $b_s(x)$ depend on education and the permanent labor productivity shock at the age of retirement.

Government Programs: Unemployment Insurance

- Individuals who exogenously separate from their job receive unemployment insurance, $b_u(x)$.
- $b_u(x)$ is received only for one period (quarter).
- $b_u(x)$ depends on last period's wage (the labor productivity shock).
- Individuals who quit their jobs (decide not to work) are not eligible for unemployment insurance.

Household's Employment Status

$$e = (e_m, e_f)$$

e_j for $j \in \{m, f\}$ takes the values:

- 1: the individual starts the period with a job offer;
- 2: the individual is non-employed and eligible for UI;
- 3: the individual is non-employed and not eligible for UI;

Then, the law of motion for e_j is:

$$e_j' = \begin{cases} 1 & \text{with probability } 1-\delta \text{ if } n_j > 0 \text{ and } \; e = 1 \\ 1 & \text{with probability } \lambda \text{ if } (e \neq 1) \text{ or } (e = 1 \text{ and } n = 0) \\ 2 & \text{with probability } \delta \text{ if } n_j > 0 \text{ and } \; e = 1 \\ 3 & \text{otherwise} \end{cases}$$

Government Programs: Social Assistance Programs

- Universal program that is means-tested on family income
- The transfer T is

$$T = \begin{cases} \overline{T} - 0.3 \times y & \text{if } y \leq \underline{y} \\ 0 & \text{otherwise} \end{cases}$$

- $\overline{T}$ is the maximum payment;
- $\underline{y}$ is the poverty line;
- y is household income net of taxes and deductions.

The Household's Problem

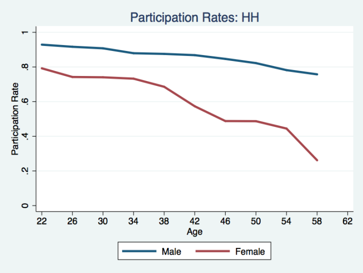
The household's state, x, for a given household group is:

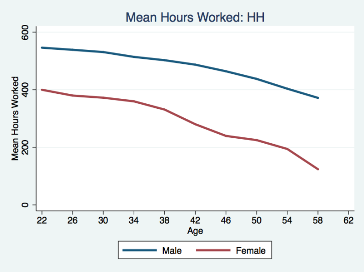
- j_m – husband's age;
- j_f – wife's age;
- e_m – husband's employment status;
- e_f – wife's employment status;
- z_m – husband's labor productivity;
- z_f – wife's labor productivity;
- a – household's assets;

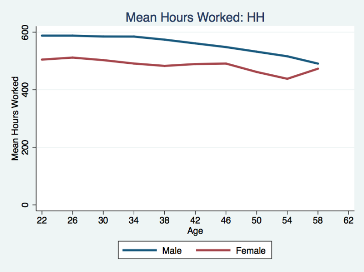
The Household's Problem

$$
\begin{aligned}
V(x) &= \max_{\{c,n_m,n_f,a'\}} \{u(c,l_m,l_f) + \beta E[V(x')]\} \\
& \quad s.t. \\
a' &= (1+r)\,a + w(z_m n_m P_m + z_f n_f P_f) - c + b_s(x) + b_u(x) - T(x) \\
a' &\geq 0 \\
l_j &= (1-n_j), \quad j \in \{m,f\} \\
P_j &= 1 \text{ if } e_j = 1 \text{ and } 0 \text{ otherwise}, j \in \{m,f\} \\
e'_j &= e\,(e_j)
\end{aligned}
$$

Preliminary Simulation Results: HH, $\sigma = 2.0$







Labor Supply Response

	HH		CH	
	$\Delta \ln z_m$	$\Delta \ln z_f$	$\Delta \ln z_m$	$\Delta \ln z_f$
	Intensive margin			
$\Delta \ln n_m$	0.36	-0.40	0.54	-0.46
$\Delta \ln n_f$	-0.80	0.46	-0.61	0.14
	Extensive margin			
$\Delta Prob(P'_m = 0 \| P_m = 1)$	-3.45	1.35	-2.61	1.40
$\Delta Prob(P'_f = 0 \| P_f = 1)$	4.55	-8.14	8.55	-16.80

Conclusion

- Estimate a quarterly wage process, within the family, correcting for selection bias in participation
- Develop a life-cycle model of the household
- Preliminary simulation results

Conclusion

The next step is to use the model to analyze

- household life-cycle risk and insurance
- aggregate labor supply responses (Erosa et al, 2011)
- labor supply late in the life cycle across countries (Erosa et al, 2012)
- the effects of government programs across countries (UI, taxes, social programs)

Additional Slides