Business Cycles and Household Formation: The Micro versus the Macro Labor Elasticity

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- Why do we care?
  1. Account for a large share of overall labor market fluctuations
  2. Demographic trends may lead to changes in labor market volatility
- Demonstrate that one cannot understand the labor market outcomes of these groups without understanding their living arrangements.

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  - Differences in the number and type of people with whom young people live (much, but not all, is due to parental coresidence)
- Average household size is volatile and counter-cyclical
- Labor market variables differ by living arrangements
  - Young people living with their parents: low wages, low hours, high cyclical volatility hours and wages.
  - Young people living independently: high wages, high hours, low cyclical volatility, more like the old

Detour: A quick history of thought

- Young have much higher cyclical volatility of hours than old (Ríos-Rull (1996),Gomme et al. (2005)). Early models: its due to different Frisch elasticity.

- Jaimovich and Siu (2009): demographic trends have big implications for overall volatility.

- Jaimovich et al. (2012): It can't be due to different Frisch
  - **Key insight:** Wage volatility is also higher for young than old. Must be labor demand differences - technology with imperfect substitutability.

- Problems with Jaimovich et al. (2012):
  1. Qualitative argument fails with Frisch elasticities for old are $< \infty$
  2. Quantitatively failure: closest they come requires Frisch for old $= \infty$, for young $=$ 7-25
  3. Living arrangements matter more than age

This paper

1. We provide a joint quantitative theory of living arrangements and labor market outcomes, that speaks to the facts documented in the empirical section.
   - Living with the old induces extra consumption through implicit transfers (unearned income) but also some disutility
   - Increased responsiveness of labor supply to wage changes: wedge between Marshallian elasticities of young alone and young living with old

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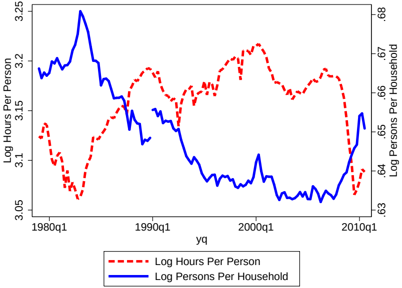
2. Use our model as a measurement device:
   - Quantify the wedge between the Marshallian elasticities: young together have it **38.9%** higher
   - Learn about the magnitude of the implicit transfers: **33%** of the consumption of the old
   - Infer the macro labor elasticity (Frisch) required in RA RBC model to account for hours volatility generated by our model: **62.7%** larger

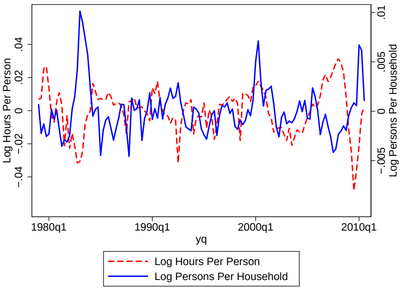
FACTS

Living arrangements are cyclically volatile...

Raw time series



HP-filtered series



Notes: All people 18 years and over. Households with no people aged 18 years and over included. Quarterly data, 1979:Q1-2010:Q3, authors' calculations from Basic Monthly CPS. Deseasonalized. HP-filtered before and after 1990 separately with parameter 1600.

… particularly for unstable individuals

Definition of Young	18-30	Never married	18-30 & never married

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Fraction young live with old	50%	52%	67%

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Fraction young	32%	26%	19%
Fraction young live with old	50%	52%	67%
St Dev log fraction live with old	0.83%	0.80%	0.66%

… particularly for unstable individuals

Definition of Young	18-30	Never married	18-30 & never married
Fraction young	32%	26%	19%
Fraction young live with old	50%	52%	67%
St Dev log fraction live with old	0.83%	0.80%	0.66%
Corr: log fraction young live with old log hours of 18-65	-0.48	-0.37	-0.33

Source: CPS Basic monthly surveys, 1979:Q1-2010:Q3

Sample: Civilians aged 18-65 not in school

Living arrangements and the labor market

Definition of Young		18-30	Never married	18-30 never married
Av Hours	All young	0.91		
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	Young alone	0.72		
	Young with old	0.43		
Var log hours	All young	2.74		
	Young alone	1.78		
	Young with old	4.01		

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Var log wages	All young	2.08		
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	Young with old	2.57		

Table reports statistics Young relative alone to those for the old group. Source: CPS Basic monthly surveys, 1979:Q1-2010:Q3, March supplement for wage data. Sample: Civilians aged 18-65 not in school

Living arrangements and the labor market

Definition of Young		18-30	Never married	18-30 never married
Av Hours	All young	0.91	0.89	0.84
	Young alone	1.06	1.03	1.06
	Young with old	0.75	0.75	0.73
Av Wages	All young	0.57	0.62	0.51
	Young alone	0.72	0.82	0.72
	Young with old	0.43	0.43	0.40
Var log hours	All young	2.74	2.69	3.36
	Young alone	1.78	1.77	1.84
	Young with old	4.01	4.22	4.63
Var log wages	All young	2.08	1.48	2.22
	Young alone	2.21	1.63	2.23
	Young with old	2.57	1.99	2.70

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Decomposition: hours per household vs hours per person

- Let hours be denoted by H, the number of employed individuals by E, the number of households by F, and the total number of individuals by N. Then we can decompose total hours per person as

$$\frac{H}{N} = \frac{H}{F} \times \frac{F}{N}.$$

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- Taking logs and variances yields

$$V\left(\log\frac{H}{N}\right) = V\left(\log\frac{H}{F}\right) + V\left(\log\frac{F}{N}\right) + 2COV\left(\log\frac{H}{F}, \log\frac{F}{N}\right).$$

Contribution of cyclical movements in household size

	Quarterly Data		Annual Data	
	HP-filter (%)	Linear trend (%)	HP-filter (%)	Linear trend (%)
Hours: $V\left(\log \frac{H}{N}\right)$				
Hholds per person + covar.	15.2	25.5	13.7	21.7
Employment: $V\left(\log \frac{E}{N}\right)$				
Hholds per person + covar.	16.4	39.5	19.0	28.9

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- Between **13%** and **19%** of fluctuations in per person labor market variables over the business cycle are offset at the household level by endogenous changes in household structure

Measuring contribution of varying living arrangements

- Let x denote the fraction of young living in larger household, h^{yT} their hours worked and h^{yA} hours of young living alone.

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- Define a moment M

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\begin{aligned}
M &= \frac{Var\left(\log\left[x_{SS}h^{yT} + (1-x_{SS})\,h^{yA}\right]\right)}{Var\left(\log\left[xh^{yT} + (1-x)\,h^{yA}\right]\right)} \\
&= \frac{Var\left(\log\left[x_{SS}h^{yT} + (1-x_{SS})\,h^{yA}\right]\right)}{Var\left(\log h^{y}\right)}
\end{aligned}
$$

Measuring contribution of varying living arrangements

- Let x denote the fraction of young living in larger household, h^{yT} their hours worked and h^{yA} hours of young living alone.

- Define a moment M

$$M = 1 - \frac{Var\left(\log\left[x_{SS}h^{yT} + (1 - x_{SS})\,h^{yA}\right]\right)}{Var\left(\log\left[xh^{yT} + (1 - x)\,h^{yA}\right]\right)}$$

$$= 1 - \frac{Var\left(\log\left[x_{SS}h^{yT} + (1 - x_{SS})\,h^{yA}\right]\right)}{Var\left(\log h^{y}\right)}$$

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\end{aligned}
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- The difference between the volatility the counterfactual series and the volatility of total hours of the unstable measures the contribution of volatility in living arrangements to hours volatility.

- For young 18-30, the contribution is **11%**.

MODEL

Demographics:

- Old agents Continuum of agents of measure (μ)
  - Live in groups of size γ: there are μ/γ households
  - Can be invaded by a young agent, but only after choice of consumption and hours has been made
- Young agents measure $(1-\mu)$
  - Can join (invade) a stable household after observing state and realization of an IID idiosyncratic shocks:
    - Individual productivity $\varepsilon \sim F_\varepsilon$
    - Disutility from living with the old $\eta \sim F_\eta$
  - Fraction of young who invade an old household: x
- At any point there are three types of agents:
  1. Old
  2. Young alone
  3. Young together (with old)

Timing

1. All shocks (aggregate technology shock z and idiosyncratic shocks: productivity η and disutility from living with the old ε) are realized.
2. Old make their labor and consumption choices.(This way history of young living at home is irrelevant)
3. Young choose where to live and next how much to work.
4. Production and consumption take place.

Old agents: Expected utility over being invaded

$$u(c^o, h^o, x) = \left[\log \frac{c^o}{\zeta^{oo}} - \psi^o \frac{(h^o)^{1+\frac{1}{\nu^o}}}{1+\frac{1}{\nu^o}}\right]$$

- Economies of scale among old: ζ^{oo}
- Frisch elasticity: ν^o

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- Economies of scale among old: ζ^{oo}
- Frisch elasticity: ν^o
- (Meager) economies of scale from young: ζ^o
- Discount future at rate β

Young agents

- Young alone

$$u\left(c^{yA},h^{yA}\right)=\frac{\left(c^{yA}\right)^{\left(1-\sigma^{y}\right)}}{1-\sigma^{y}}-\psi^{y}\frac{\left(h^{yA}\right)^{1+\frac{1}{\nu^{y}}}}{1+\frac{1}{\nu^{y}}}$$

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- Young together

$$u\left(c^{yT}, h^{yT}, \eta\right) = \frac{\left(c^{yT} + \zeta\, c^{o}\right)^{(1-\sigma^{y})}}{1-\sigma^{y}} - \psi^{y}\frac{\left(h^{yT}\right)^{1+\frac{1}{\nu^{y}}}}{1+\frac{1}{\nu^{y}}} - \eta$$

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- Dislike of living with old: η. This is an iid, shock across all young. Some hate living with their parents more than others.

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- Economies of scale: ζc^{o}

Budget constraints

- Old have a standard budget constraint

$$c^o + a' \;=\; w^o h^o + (1 + r)\, a,$$

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- Young are hand-to-mouth with productivity ε

$$c^{yT} = w^y h^{yT} \, \varepsilon \qquad\qquad c^{yA} = w^y h^{yA} \, \varepsilon$$

  - Idiosyncratic efficiency units ε. This is an iid, shock across all young.

Technology

- Nested CES with capital-experience complementarity and labor productivity shocks

$$F(z, K, N^y, N^o) = \left[\mu_F (zN^y)^\sigma + (1-\mu_F)(\lambda_F K^\rho + (1-\lambda_F)(zN^o)^\rho)^{\sigma/\rho}\right]^{1/\sigma}$$

where N^y and N^o are labor inputs from the young and old.

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where N^y and N^o are labor inputs from the young and old.

- This technology allows the model to generate $var(N^y) > var(N^o)$ and $var(W^y) > var(W^o)$ jointly.

Aggregation

- Equilibrium indifference condition for the young is

$$\eta^* (\varepsilon) = \frac{\left(c^{yT} + \zeta c^{o}\right)^{1-\sigma^y}}{1-\sigma^y} - \varphi^y \frac{\left(h^{yT}\right)^{1+\frac{1}{\nu^y}}}{1+\frac{1}{\nu^y}} - \left[\frac{\left(c^{yA}\right)^{1-\sigma^y}}{1-\sigma^y} - \varphi^y \frac{\left(h^{yA}\right)^{1+\frac{1}{\nu^y}}}{1+\frac{1}{\nu^y}} \right]$$

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- Then the fraction of the young living together with old is given by

$$x = \int_0^{\infty} \int_{-\infty}^{\eta^*(\varepsilon)} dF_\eta \; dF_\varepsilon$$

Aggregation cont.

- Total labor inputs of young alone and young together

$$N^{yA} = \int_0^{\infty} \int_{\eta^*(\varepsilon)}^{\infty} \varepsilon h^{yA}(\varepsilon)\, dF_\eta dF_\varepsilon, \quad N^{yT} = \int_0^{\infty} \int_{-\infty}^{\eta^*(\varepsilon)} \varepsilon h^{yT}(\varepsilon)\ dF_\eta dF_\varepsilon.$$

- Total hours worked of young alone and young together

$$H^{yA} = \int_0^{\infty} \int_{\eta^*(\varepsilon)}^{\infty} h^{yA}(\varepsilon)\, dF_\eta dF_\varepsilon, \quad H^{yT} = \int_0^{\infty} \int_{-\infty}^{\eta^*(\varepsilon)} h^{yT}(\varepsilon)\, dF_\eta dF_\varepsilon.$$

- Total consumptions of young alone and young together

$$C^{yA} = \int_0^{\infty} \int_{\eta^*(\varepsilon)}^{\infty} w^y \varepsilon h^{yA}(\varepsilon)\, dF_\eta dF_\varepsilon, \quad C^{yT} = \int_0^{\infty} \int_{-\infty}^{\eta_T^*(\varepsilon)} w^y \varepsilon h^{yT}(\varepsilon)\ dF_\eta dF_\varepsilon.$$

Aggregation cont.(2)

- The aggregate values for consumption (C), labor inputs (N^y, N^o), capital stock (K) and hours (H), are given by

$$\begin{aligned}
C &= \frac{\mu}{\gamma} c^o + (1-\mu)\,[C^{yT} + C^{yA}], \\
N^o &= \frac{\mu}{\gamma} h^o \\
N^y &= (1-\mu)\,[N^{yT} + N^{yA}] \\
H &= \frac{\mu}{\gamma} h^o + (1-\mu)\,[H^{yT} + H^{yA}], \\
K &= \frac{\mu}{\gamma} a
\end{aligned}$$

- Structure is on top of a standard RBC model

$$C + K' = F(z, K, N^y, N^o) + (1-\delta)K$$

where z is an AR(1) productivity shock.

Equilibrium

A set of functions for:

(i) consumption $\{c^{yA}(s), c^{yT}(s), c^{o}(s)\}$
(ii) hours worked $\{h^{yA}(s), h^{yT}(s), h^{o}(s)\}$
(iii) threshold for staying at home $\eta^*(s, \varepsilon)$; and
(iv) fraction of young that move in with their old $x(s)$,

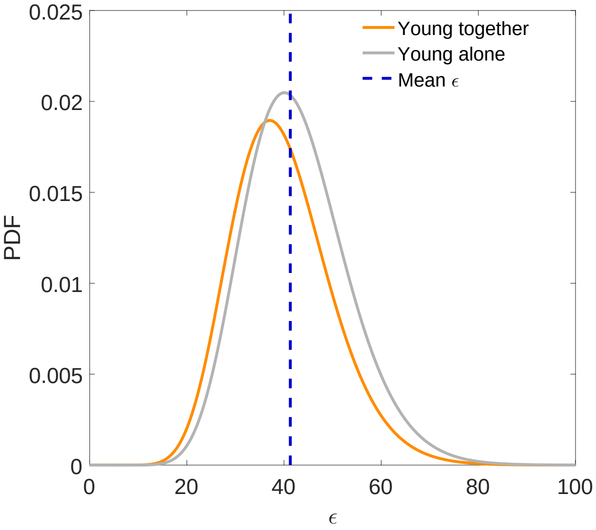
such that:

(i) the young maximize given the choice of the old
(ii) the old maximize given the expected choices of the young
(iii) prices are competitive; and
(iv) fraction of households moving with their elderly satisfies

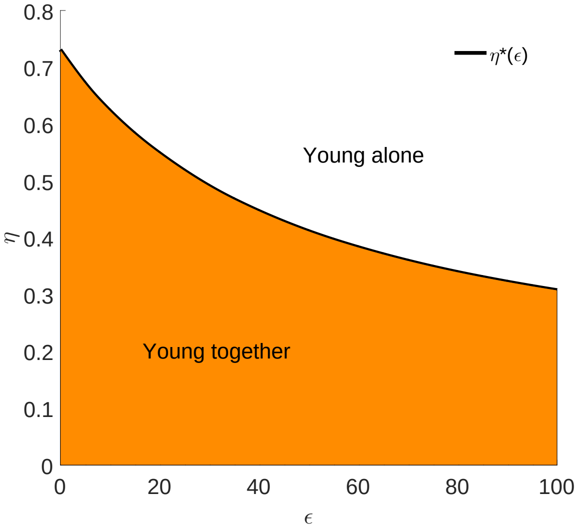
$$x = \int_0^{\infty} \int_{-\infty}^{\eta^*(\varepsilon)} dF_\eta \, dF_\varepsilon \quad (1)$$

where $\eta^*(s, \varepsilon)$ satisfies the indifference condition for all ε.

Productivity densities of young workers



Partition of young workers



Calibration Strategy

- Use technological (elasticities) estimates of Jaimovich et al. (2012), demographic structure, economies of scale
- Microeconomicly measured Frisch of old (.72)
- Target
  1. Standard Aggregates (r, I/Y, capital share, Solow residual)
  2. Average hours of old, young alone, young together
  3. Average Wages of young together and alone
  4. Living Arrangement x
  5. Relative (to hours of old) volatilities of: hours of young alone, young together and fraction of young living with parents.
  6. Correlation between x and total hours h.

Details

Model performance in replicating key moments

Moments	Data	Baseline Economy	% of the data accounted for
Relative hours			
$\sigma\left(h^{y}\right)/\sigma\left(h^{o}\right)$	1.65	1.65	100.0
$\sigma\left(h^{yA}\right)/\sigma\left(h^{o}\right)^{*}$	1.33	1.35	101.5
$\sigma\left(h^{yT}\right)/\sigma\left(h^{o}\right)^{*}$	2.00	1.96	98.0
Relative wages			
Other moments			

*Calibrated moments

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$\sigma\left(h^{yT}\right)/\sigma\left(h^{o}\right)^{*}$	2.00	1.96	98.0
Relative wages			
$\sigma\left(w^{y}\right)/\sigma\left(w^{o}\right)$	1.44	1.28	88.9
$\sigma\left(w^{yA}\right)/\sigma\left(w^{o}\right)$	1.49	1.31	87.9
$\sigma\left(w^{yT}\right)/\sigma\left(w^{o}\right)$	1.60	1.19	74.3
Other moments			

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$\sigma\left(w^{yT}\right)/\sigma\left(w^{o}\right)$	1.60	1.19	74.3
Other moments			
Contr F/N	15.2%	13.4%	88.2
M - moment	11.0%	8.4%	76.3
$\sigma\left(x\right)$	0.67	0.25	37.3
$\sigma(h)$	1.42	0.44	31.0

*Calibrated moments

A tale of two elasticities

- Marshallian elasticity of labor supply for young alone

$$\eta_{w^y}^{h^{yA}} = \frac{(1-\sigma^y)\,\nu^y}{1+\sigma^y\nu^y} = 0.47$$

- Marshallian elasticity of labor supply for young together

$$\eta_{w^y}^{h^{yT}}(\varepsilon) = \eta_{w^y}^{h^{yA}} \underbrace{\frac{\left[1+\left(\frac{\zeta c^o}{\varepsilon w^y h^{yT}}\right)\left(\frac{1}{1-\sigma^y}\right)\right]}{\left[1+\left(\frac{\zeta c^o}{\varepsilon w^y h^{yT}}\right)\left(\frac{1}{1+\sigma^y\nu^y}\right)\right]}}_{=1.64} = 0.77$$

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Two useful properties:

- If $\sigma^y < 1, \zeta > 0$, $\forall \varepsilon$ we have $\eta_{w^y}^{h^{yT}}(\varepsilon) > \eta_{w^y}^{h^{yA}}$
- $\eta_{w^y}^{h^{yT}}$ is increasing in ζ and for $\zeta = 0$ we have $\eta_{w^y}^{h^{yA}} = \eta_{w^y}^{h^{yT}}(\varepsilon) \quad \forall \varepsilon$.

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3. Additional hours to be worked on the market by young together $\overline{h}^{yT}$ to compensate the transfer from the old:

$$\Delta_h = \left(\frac{\overline{h}^{yT} - h^{yT}}{h^{yT}}\right) \times 100 = 40.6\%$$

where h^{yT} is mean hours worked in baseline model.

Implications for the Frisch Elasticity in the RA models

- In the standard RA RBC model all what matters for the volatility of the aggregate hours is Frisch elasticity.
- Setting Frisch to 0.72 and imposing the aggregate TFP shock to have the properties as the Solow residual in the data, model generates $var(h) = 0.086$, which accounts for 4.3% of the data.
- Given the same restrictions on the Solow residual properties, our baseline economy generates $var(h) = 0.203$, which accounts for 10.1% of the data.
- To capture the existence of the coresidence margin and heterogeneity of young in terms of productivity one would require a Frisch elasticity of 1.17 in the RA RBC model, which is a 62.7% increase.

Conclusions

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- We have also documented the cyclical movements of the living arrangements.
- We have provided a theory of how it works and mapped it to the data. This theory accounts for the average and cyclical behavior of the young and the old.
- As a bonus we have provided a logical theory of the differences between the micro and the macro (which is 62.7% larger) Frisch elasticities.

Calibration: Technology

Table: Technological Parameters and Targets

Parameter	Description	Target variable	Target value	Model value	Parameter value
		Parameters set without solving the model			
ρ	CES elasticity	Micro estimates JPS	-	-	.201
σ	CES elasticity	Micro estimates JPS	-	-	.662
		Parameters that require solving the model			
δ	Depreciation rate	I/Y	.26	.26	.035
μ_F	Weight of young	K/Y	7.5	7.4	.044
λ_F	Weight of capital	Share of olds' income in total	.50	.51	.256
λ_ε^1	Shape par of gamma dist	w^{yA}/w^o	.72	.66	15.4
λ_ε^2	Scale par of gamma dist	w^{yT}/w^o	.42	.46	2.68
ρ_z	AR(1) prod shocks	Autocorr AR(1) RA Solow Res*	.94	.94	.934
σ_z	St Dev productivity shocks	Var Solow Res*	3.19	3.19	.010

* Unfiltered series.

Strategy

Calibration: Preferences of the old

Table: Parameters of preferences of the old

Parameter	Description	Target variable	Target value	Model value	Parameter value
	Parameters that can be set without solving the model				
μ	Fraction of old	Measurement	-	-	.684
γ	Old household size	Measurement	-	-	1.80
ζ^{oo}	Ec of scale for old	OECD	-	-	1.70
ζ^{o}	Additional Ec of scale	OECD	-	-	.50
ν^{o}	Frisch elast. of old	Measurement	-	-	.72
β	Discount rate	Interest rate	.04	.04	.99
	Parameters that require solving the model				
ψ^{o}	Weight of hours of old	Hours in Old Hholds	.50	.50	4.54

Calibration: Preferences of the young

Table: Parameters of preferences of the young

Parameter	Description	Target variable	Target value	Model value	Parameter value
		Parameters that require solving the model			
ψ^y	Weight of hours of Young	Hours of young together	.21	.19	5.20
σ^y	Risk Aversion of young	Hours of young alone	.30	.32	.341
λ^1	Mean of η	% of young with old	50.2	50.4	.463
ν^y	Labor elasticity of young	$Var(h^{yT})/Var(h^o)$	4.01	3.84	.931
λ^2	Std of η	$Var(x)/Var(h^o)$	.46	.46	.215
ζ	Ec of scale of Young	$Var(h^{yA})/Var(h^o)$	1.78	1.82	.331
-	-	$Corr(x, h)$	.48	.48	-

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