Huggett (1996) Model

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Contents

Model Features

We compute a simplified version of Huggett (1996)
Households:

- Live for many (a_D) periods
- Earnings are random
- Age of retirement is fixed (a_R).

Government:

- Pays transfers to retired households (annuitized income in the data)

Simplifying assumptions:

- Partial equilibrium
- No random mortality
- No intergenerational links
- No labor-leisure choice.

Model Primitives

Demographics

Households live for exactly a_D periods.
Total mass of households is $N = 1$.

Preferences

$$\mathbb{E} \sum_{a=1}^{a_D} \beta^a u(c_a) \tag{1}$$

Endowments

Working agents are endowed with labor efficiency $\eta_a e_a$
η_a: age-efficiency profile
e_a: labor efficiency (wage) shock

- governed by a Markov chain: $\Pr(e' = \varepsilon_k | e = \varepsilon_j) = P_e(k, j)$.
- new agents draw labor endowments from a fixed distribution.
- number of states: N_e.

Markets

Labor: wage w
Capital rental: r
Goods: numeraire.

Government

Taxes labor income: $T = \tau_w w L$.
Pays retirement transfers: $\varpi(a) = \varpi$ if $a > a_R$.

Household Problem

Exogenous state variables are age a and labor endowment e: $s = (a, e)$.
Endogenous state variable: wealth k.
Borrowing constraint: $k \geq 0$.

Sequence problem

$$\max\ E\sum_{a=1}^{a_D}\beta^a\,u\left(c_a\right)$$

subject to

$$k_{a+1}=y_a-c_a\geq 0$$

$$y_a=R\,k_a+w(1-\tau_w)\eta_a e_a+\varpi\left(a\right) \tag{2}$$

Household Dynamic Program

$$V\left(k,s\right)=\max u\left(y\left(k,s\right)-k'\right)+\beta\mathbb{E}V\left(k',s'\right) \tag{3}$$

with

$$y\left(k,s\right)=Rk+w\left(1-\tau_w\right)\eta_a e+\varpi\left(s\right) \tag{4}$$

subject to $k'\geq 0$.

Euler equation:

$$u'(c)\geq\beta R\mathbb{E}u'(c') \tag{5}$$

with equality if $k'>0$.

Household Solution

Solution is a consumption function $c\left(k,a,e\right)$ which satisfies

$$u'(c\left[k,a,e\right])\geq\beta R\sum_{e'}P_e(e,e')u'\left(c\left[y-c\left(k,a,e\right),a+1,e'\right]\right)$$

In the last period, consume all income:

$$c\left(k,a_D,e\right)=y(k,a_D,e) \tag{6}$$

Parameter Choices

We simply take parameters from Huggett's paper.

Exercise: implement the calibration.

Calibrated parameters: β,δ,A.

Calibration targets: K/Y, $w=1$, R.

Preferences

$u(c) = c^{1-\sigma}/(1-\sigma)$
$\sigma = 2.$
Choose β to match $K/Y = 2.9/\lambda$.

Demographics

Households live from age 20 to 79.
Work from 20 to 64 (45 years).
Retire for 15 years.

Prices

- $w = 1$
- $R = 1.04$

Government

$\tau_w = 0.4$ (Trostel 1993).
Set transfers to 40% of average earnings.

- This can be done before computing equilibrium.

Labor Endowments

Can be set before equilibrium is computed.

Empirical studies estimate AR(1) processes for [log earnings] minus [mean log earnings, η_a] by age.
New agents draw endowments from exogenous distribution:
$\ln(e_1) \backsim N(0, \sigma_1^2)$.
Over time, endowments are drawn from an AR(1):
$\ln(e_a) = \eta_a + \gamma \ln(e_{a-1}) + \varepsilon_a$.
$\ln(\varepsilon_a) \backsim N(0, \sigma_\varepsilon^2)$.
We follow Huggett (1996):

- $\sigma_1^2 = 0.38$, $\sigma_\varepsilon^2 = 0.045$, $\gamma = 0.96$.

- Approximate the AR(1) on a grid of 18 states equally spaced over $\pm 4\,\sigma_1$.
- Add an additional state at $+6\,\sigma_1$ to capture skewness of earnings distribution.
- Use Tauchen (1986) (we have code for that)

Age-efficiency profile

From PSID data (Huggett, 1996)

References

Huggett, M. (1996): "Wealth distribution in life-cycle economies," *Journal of Monetary Economics*, 38, 469–494.

Tauchen, G. (1986): "Finite state markov-chain approximations to univariate and vector autoregressions," *Economics letters*, 20, 177–181.