Human Capital Accumulations in Economics

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[1] The views of this research are only author's one. Any error is mine.

Motivation

- Human capital
  - Ben-Porath (1967, BP): Schooling, intercept/starting point
  - Learning-By-Doing (LBD): Accumulating during working periods, slope

- Literature: Has used BP or LBD for each research question
  - Huggett, Ventura and Yaron (2011, HVY), Kim (2020): BP to explore sources of life-cycle inequalities
  - Griffy (2021): BP with search frictions
  - Blandin (2018) and Blandin and Peterman (2019): Optimal taxation for *each* BP and LBD

- What We Have Learned from Literature
  1. Endogenous human capital investment itself does matter for life-cycle economy – HVY, Kim (2020), Griffy (2021)
  2. Optimal fiscal policy is affected by the way of human capital accumulation
  3. Search friction matters: Griffy (2021)

Motivation for the Project last year

- Literature: Has studied really well using BP OR LBD
  - However, it is worth to explore BP AND LBD
- In the real world, we have all: BP, LBD and search frictions
  - Under search frictions, it is natural to think of
    - LBD during employment
    - BP during unemployment
- Background
  - BP explains data relatively better than LBD
  - But as Jeong, Kim and Manovskii (2015) shows: LBD crucial + working periods $>>$ schooling periods

Research Questions

- What if we consider all together, what are implications of sources of life-cycle inequalities and policies?
- That is, what policy implications would we have for each BP vs. LBD vs. BP and LBD?

Model: Environment

- Time: Discrete(vs. Continuous) & Finite(vs. Infinite)

- Labor market
  - McCall type search friction & Indivisible labor (Full & Part-time work)
  - Working period: $j = 1, \ldots, J^R - 1$. Retirement for $j = J^R, \ldots, J$

- Asset market: Incomplete. Only risk-free asset

- Agents
  - Ex-ante hetero: $(a_0, h_0, l_0) \sim \mathbb{N}(M, \Sigma)$ and age j
  - Ex-post hetero: Wealth (a), Human capital (h) and labor status (Emp. & Non-emp. & Ret.)

- Endogenous human capital
  - Employment: LBD $-$ $h' = (1 - \delta_h)\, h + l\left(h^{\phi_h} n^{\phi_n}\right)$
  - Unemployment: BP $-$ $h' = (1 - \delta_h)\, h + l\left(h^{\phi_h} s^{\phi_s}\right)$

Value Functions: Retirement

Retired agent whose age is j, national pension Ret and wealth a solves the following Bellman equation optimally:

$$V^R(a, Ret, j) = \max_{c,a'} \left\{ u(c) + \beta V^R\left(a', Ret, j+1\right) \right\} \tag{1}$$

subject to

$$(1+\tau_c)\, c + a' = Ret + (1+r)a$$

Value Functions: Employment

The employed worker with individual state $\Omega = (a, h, l, j)$ with the piece rate μ solves the following Bellman equation optimally:

$$V^E(\Omega, \mu) = \max_{c,a',n} \left\{ u(c,n) + \beta \left[(1-\theta_{j+1}) \left\{ \lambda_e \int_{\mu^*}^{\bar{\mu}} \left\{ V^E(\Omega', \mu') - V^E(\Omega', \mu) \right\} dF(\mu') + V^E(\Omega', \mu) \right\} + \theta_{j+1} V^U(\Omega', B') \right] \right\} \tag{2}$$

subject to

$$\text{Budget Constraint: } (1+\tau_c)\,c + a' = (1-\tau_w)\,\mu h n + (1+r)a$$

$$\text{Law of Motion for Human Capital: } h' = (1-\delta_h)h + l\left(h^{\phi_h} n^{\phi_n}\right)$$

$$\text{U.I Benefit formula: } B' = \min\{\max\{b\mu h n, \underline{b}\}, \bar{b}\}$$

where θ: job separation rate, λ_e: the probability of getting another job offer, $F(\mu')$: distribution function of job offer measured by the piece rate μ'

Value Functions: Unemployment

The unemployed job seeker with individual state $\Omega = (a, h, l, j)$ with the U.I benefit B solves the following Bellman equation optimally:

$$V^U(\Omega, B) = \max_{c,a',s} \Big\{ u(c,s) + \beta \Big[\lambda_u \int_{\mu_u^*}^{\bar{\mu}} V^E \left\{ V^E(\Omega', \mu') - \tilde{V}^U(\Omega', B'(B)) \right\} dF(\mu') + \tilde{V}^U(\Omega', B'(B)) \Big] \Big\} \tag{3}$$

subject to

$$\text{Budget Constraint: } (1+\tau_c)\,c + a' = B + (1+r)a$$

$$\text{Law of Motion for Human Capital: } h' = (1-\delta_h)h + l\left(h^{\phi_h} s^{\phi_s}\right)$$

where

$$\tilde{V}^U(\Omega', B'(B)) = \gamma V^U(\Omega', \underline{b}) + (1-\gamma)\, V^U(\Omega', B)$$

External Calibration

External Calibration			
Parameter	Description	Value	Reference/Target
σ	CRRA parameter	1.0000	Log utility
ψ	Frisch elasticity	1.0000	Literature
β	Time Discount Factor	0.9915	Quarterly frequency
r	Risk-free asset	0.0086	3-Yr bond yield, Quarterly return
$\bar{n}_1$	Full-Time working hours	0.4287	Survey report on labor conditions by employment type
$\bar{n}_2$	Part-Time working hours	0.2257	Survey report on labor conditions by employment type
m_a	Initial asset: Mean	0.4842	Kim (2020)
σ_a	Initial asset: Std. Dev	0.6638	Kim (2020)
τ_w	Labor income tax	0.1952	
τ_c	Value-added tax	0.1000	
λ_e	OJS job offer probability	0.5882	Griffy (2021)
b	Replacement ratio of U.I benefit	0.6000	60% replacement ratio
γ	Duration of U.I benefit	0.5400	Six-month
$\underline{b}$	Lower boundof U.I benefit		one-day lower bound $20,230$ won (**needs to be fixed**)
$\bar{b}$	Upper boundof U.I benefit		one-day upper bound $110,000$ won (**needs to be fixed**)
b_{ret}	Replacement ratio of National Pension	0.3120	NP/60-64 male income
ϕ	Return to investment	0.8000	Literature: $0.7 \sim 0.9$
$\mathbb{E}(\log \mu)$	LN Job offer distribution: Mean	0.5500	
$\sigma(\log \mu)$	LN Job offer distribution: Mean	0.3150	

Internal Calibration

Internal Calibration			
λ_u	Job finding probability	0.9000	EAPS employment rate for each age
$\{\theta_j\}_{j=1}^{J^R-1}$	Job separation rate		EAPS employment rate for each age
δ_h	Human capital depreciation	0.0650	KLIPS earnings mean & variance
m_h	Initial log human capital: Mean	4.3976	KLIPS earnings mean & variance
σ_h	Initial log human capital: Std.Dev	0.3744	KLIPS earnings mean & variance
m_l	Initial log learning ability: Mean	-1.1562	KLIPS earnings mean & variance
σ_l	Initial log learning ability: Std.Dev	0.1091	KLIPS earnings mean & variance
$\sigma_{a,h}$	Cov. b.w asset & human capital	0.1975	$\rho_{a,h} = 0.7946$
$\sigma_{h,l}$	Cov. b.w human capital & learning ability	0.0299	$\rho_{h,l} = 0.7316$
$\sigma_{a,l}$	Cov. b.w asset & learning ability	0.0414	$\rho_{a,l} = 0.5719$
Calibration in Kim(2020)			
μ_z	Labor productivity shock: Mean	-0.0311	Implied HC depreciation: 0.0278
m_h	Initial log human capital: Mean	4.299	KLIPS earnings mean & variance
σ_h	Initial log human capital: Std.Dev	0.3610	KLIPS earnings mean & variance
m_l	Initial log learning ability: Mean	-1.1050	KLIPS earnings mean & variance
σ_l	Initial log learning ability: Std.Dev	0.1110	KLIPS earnings mean & variance
$\sigma_{a,h}$	Cov. b.w asset & human capital		$\rho_{a,h} = 0.8420$
$\sigma_{h,l}$	Cov. b.w human capital & learning ability		$\rho_{h,l} = 0.7460$
$\sigma_{a,l}$	Cov. b.w asset & learning ability		$\rho_{a,l} = 0.5660$

Model Fit: Employment rate over the life-cycle

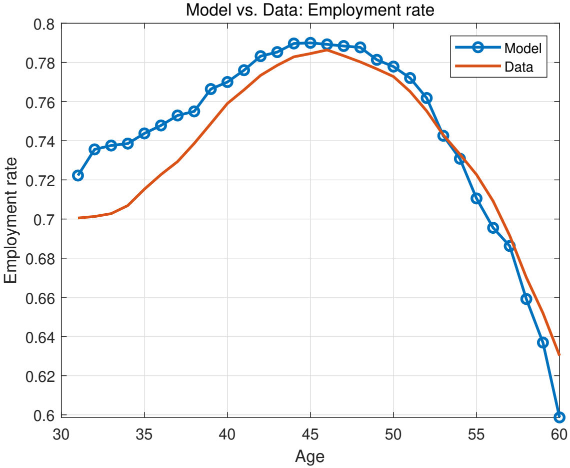

Figure: Data vs. Model: Emp rate

Model Fit: Earnings Mean & Variance over the life-cycle. Not Very Good

Figure: Data vs. Model: Mean

Figure: Data vs. Model: Variance

Quantitative Exercises: Role of each initial heterogeneity

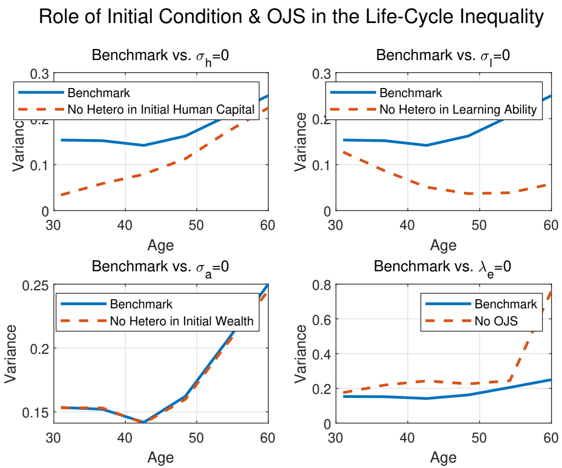

Figure: Hetero vs. Non-hetero on income variance

Quantitative Exercises: Impulse Responses

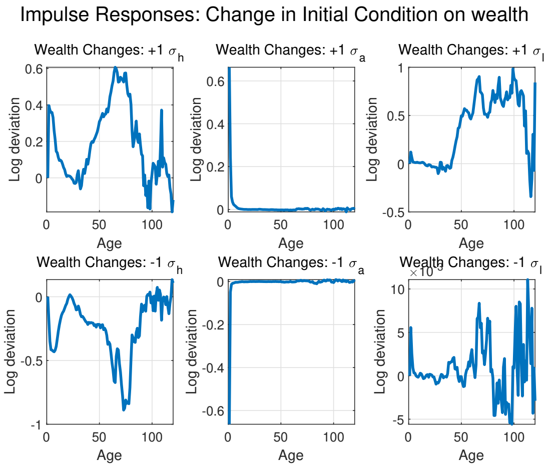

Figure: Effects of one-std.dev shock over the life-cycle

Quantitative Exercises: Change of Initial Condition on Life-time Wealth

	PV discounted value of life-time wealth	Average life-time wealth
$+1\sigma_h$	$+14.9579\%$	$+16.0733\%$
$+1\sigma_l$	$+14.1025\%$	$+19.4002\%$
$+1\sigma_a$	$+0.3755\%$	$+0.2740\%$

Policy Experiments

1. Higher replacement ratio: $60 \rightarrow 72\%$ ($\uparrow 20\%$)
2. Longer U.I benefit: $\gamma = 0.54 \rightarrow 0.27$
3. Lump-sum transfer: Equally divide increment of higher replacement ratio above
4. Higher lower bound of U.I. benefit: b_{min}+transfer

Policy Experiments on Consumption Inequalities

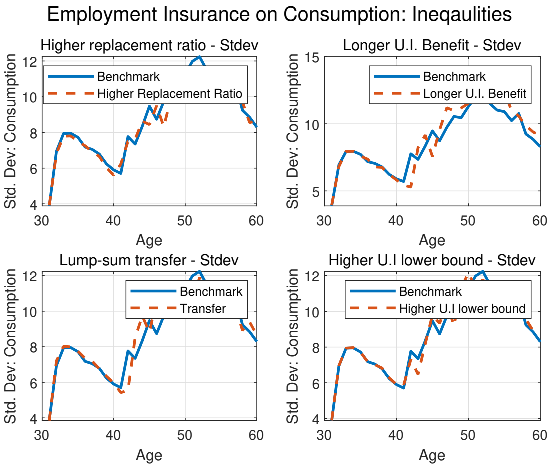

Figure: Policy Experiments on Consumption Inequalities

Policy Experiments on Consumption Level

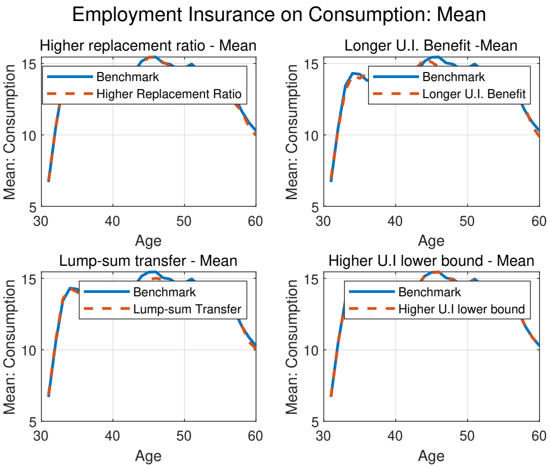

Figure: Policy Experiments on Consumption Average

Policy Experiments

Policy Experiments on Life-Cycle Consumption				
	Benchmark model: BP&LBD		Counter-factual model: BP only	
	PV consumption: Mean	PV consumption: Variance	PV consumption: Mean	PV consumption: Variance
Higher replacement ratio	-0.3798%	-2.7597%	-0.9743%	-5.4308%
Longer duration	-0.9157%	+2.3344%	+0.9713%	-1.1802%
Lump-sum transfer	-1.7648%	+0.4923%	+7.1746%	+2.4450%
Higher lower bound	+0.0335%	+0.3075%	-0.4762%	-1.4936%