Heterogeneous Agent Macroeconomics: An Example and an Agenda

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1. Economics
   - The Marginal Propensity to Consume
     - Out of Transitory Shocks (MPCT)
     - Out of Permanent Shocks (MPCP)
   - The Paradox of Thrift
   - The Paradox of Toil
2. Finance
   - In Representative Agent Models:
     - Who Is the Agent Lending To?
     - Who Is the Agent Borrowing From?
     - Why?
3. Politics of Heterogeneity and Inequality
   - Can Affect Economic Policies!

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Our Claim: Heterogeneity Is Key To Modeling the MPCT

Overview of Carroll, Slacalek, Tokuoka, and White (2014)

The Question: How Large Is the MPCT ($\equiv \kappa$)?

If households receive a surprise extra \$1 in income,
how much will be in aggregate spent over the next year?

Need to Consider:

- Households are heterogeneous
- Wealth is unevenly distributed
- C function is highly concave
- $\Rightarrow$ Distributional issues matter for aggregate C
  Giving \$ 1 to the poor $\neq$ giving \$ 1 to the rich

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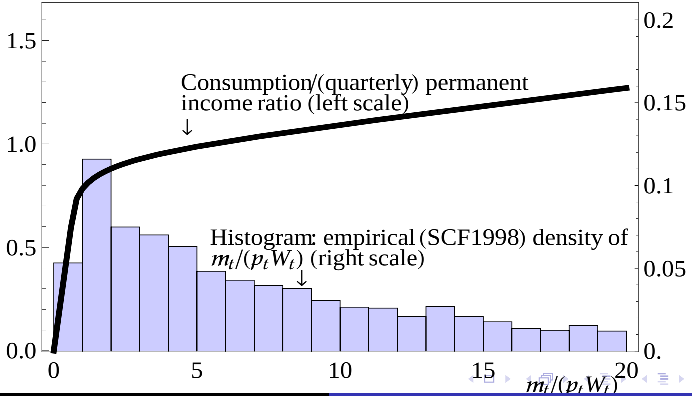
Consumption Concavity and Wealth Heterogeneity



Why Worry About the MPCT ($\equiv \kappa$)?

Nobody trying to make a forecast in 2008–2010 would ask:

- Big 'stimulus' tax cuts
- Keynesian multipliers should be big in liquidity trap
- Crude Keynesianism: Transitory tax cut multiplier is $1/(1-\kappa)-1$
  - If $\kappa = 0.75$ then multiplier is $4 - 1 = 3$
  - If $\kappa = 0.05$ then multiplier is only ≈ 0.05

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What We Do

1. Calibrate income process to match macro *and micro* data
2. Calibrate other params to match empirical wealth distribution
3. Compute C and MPCT out of transitory income

Our Claim

A model that matches micro facts about income dynamics and wealth distribution gives very different answers and ones that are *much more plausible and consistent with micro evidence* than RA models to macroeconomic questions (say, about the response of consumption to fiscal 'stimulus')

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Model Without Aggr Uncertainty: Decision Problem

$$
\begin{aligned}
\mathrm{v}(m_t) &= \max_{\{c_t\}} \ \mathrm{u}(c_t) + \beta \not{D} \mathbb{E}_t \left[\psi_{t+1}^{1-\rho} \mathrm{v}(m_{t+1}) \right] \\
&\text{s.t.} \\
a_t &= m_t - c_t \\
a_t &\geq 0 \\
k_{t+1} &= a_t / (\not{D} \psi_{t+1}) \\
m_{t+1} &= (\daleth + r) k_{t+1} + \xi_{t+1} \\
r &= \alpha Z(\boldsymbol{K} / \bar{\ell} \boldsymbol{L})^{\alpha - 1}
\end{aligned}
$$

Variables normalized by $p_t \mathrm{W}$

Parameter Values

- β, ρ, α, δ, $\bar{\ell}$, μ , and u taken from from Den Haan, Judd, and Juillard (2010)

Estimation of β-Point and β-Dist

'β-Point' model

- 'Estimate' single $\grave{\beta}$ by matching the capital–output ratio

'β-Dist' model—Heterogenous Impatience

- Assume uniformly distributed β across households
- Estimate the band $[\grave{\beta} - \nabla, \grave{\beta} + \nabla]$ by minimizing distance between model (w) and data (ω) net worth held by the top 20, 40, 60, 80%

$$\min_{\{\grave{\beta}, \nabla\}} \sum_{i=20,40,60,80} (w_i - \omega_i)^2,$$

s.t. aggregate net worth–output ratio matches the steady-state value from the perfect foresight model

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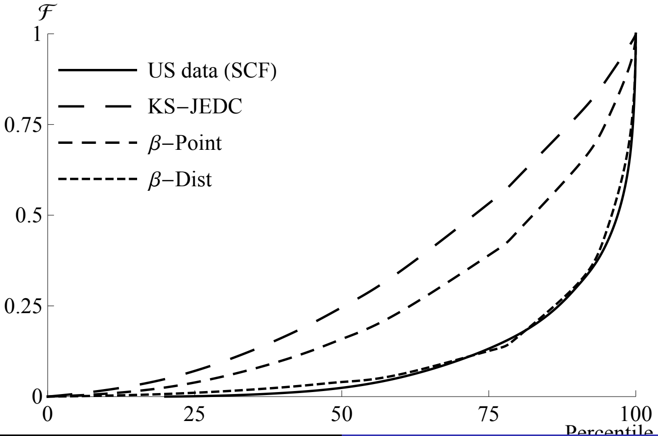
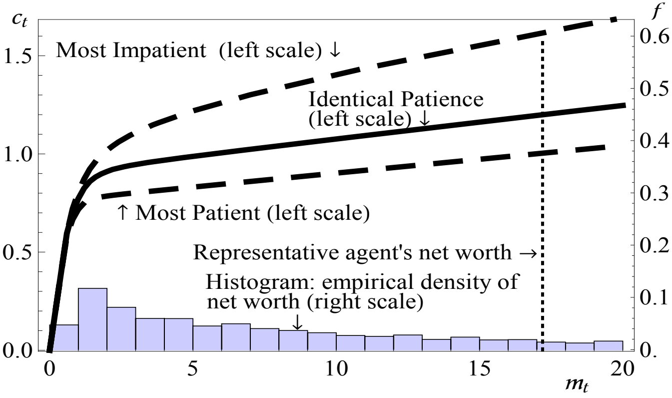
Results: Wealth Distribution



Results: Wealth Distribution

	Micro Income Process					
	Friedman/Buffer Stock		KS-JEDC	KS-Orig◇		
	Point Discount Factor‡	Uniformly Distributed Discount Factors⋆	Our solution		Hetero	U.S.
	β-Point	β-Dist				Data*
Top 1%	8.6	28.4	3.	3.0	24.0	29.6
Top 20%	54.3	83.4	39.5	35.0	88.0	79.5
Top 40%	76.6	93.8	65.4			92.9
Top 60%	90.	97.4	83.6			98.7
Top 80%	97.5	99.3	95.1			100.4

Marginal Propensity to Consume & Net Worth



Results: MPCT (in Annual Terms)

	Micro Income Process		
	Friedman/Buffer Stock		KS-JEDC
	β-Point	β-Dist	Our solution
Overall average	0.1	0.23	0.05
By wealth/permanent income ratio			
Top 1%	0.06	0.05	0.04
Top 20%	0.06	0.06	0.04
Top 40%	0.06	0.08	0.04
Top 60%	0.07	0.12	0.04
Bottom 1/2	0.13	0.35	0.05
By employment status			
Employed	0.09	0.2	0.05
Unemployed	0.23	0.54	0.06

Notes: Annual MPCT is calculated by $1-(1-\text{quarterly MPCT})^4$.

Estimates of MPCT in the Data: ∼0.2–0.6

	Consumption Measure				
Authors	Nondurables	Durables	Total PCE	Horizon	Event/Sample
Blundell et al. (2008b)‡	0.05				Estimation Sample: 1980–92
Coronado et al. (2005)			0.36	1 Year	2003 Tax Cut
Hausman (2012)			0.6–0.75	1 Year	1936 Veterans' Bonus
Johnson et al. (2009)	∼ 0.25			3 Months	2003 Child Tax Credit
Lusardi (1996)‡	0.2–0.5				Estimation Sample: 1980–87
Parker (1999)	0.2			3 Months	Estimation Sample: 1980–93
Parker et al. (2011)	0.12–0.30		0.50–0.90	3 Months	2008 Economic Stimulus
Sahm et al. (2009)			∼ 1/3	1 Year	2008 Economic Stimulus
Shapiro and Slemrod (2009)			∼ 1/3	1 Year	2008 Economic Stimulus
Souleles (1999)	0.045–0.09	0.29–0.54	0.34–0.64	3 Months	Estimation Sample: 1980–91
Souleles (2002)	0.6–0.9			1 Year	The Reagan Tax Cuts of the Early 1980s

Notes: ‡: elasticity.

Results: MPCT Over the Business Cycle

Model: β-Dist	Krusell–Smith (KS)			Friedman/Buffer S	
Scenario	Base	Recssn	Expnsn	Base	Large Bad Perm Shock
Overall average	0.23	0.25	0.21	0.20	0.20
By wealth/permanent income ratio					
Top 1%	0.05	0.05	0.05	0.05	0.05
Top 10%	0.06	0.06	0.06	0.06	0.06
Top 20%	0.06	0.06	0.06	0.06	0.06
Top 40%	0.08	0.08	0.08	0.06	0.06
Top 50%	0.09	0.10	0.09	0.06	0.06

Overlapping Generations

Realistic Life-Cycle Model

- Three education levels: $e \in \{D, HS, C\}$
- Age/education-specific income profiles

$$
\begin{aligned}
\boldsymbol{y}_t &= \xi_t \boldsymbol{p}_t = (1-\tau)\theta_t \boldsymbol{p}_t, \\
\boldsymbol{p}_t &= \psi_t \overline{\psi}_{es} \boldsymbol{p}_{t-1}
\end{aligned}
$$

  - Age-specific variances of income shocks
  - Transitory unemployment shock with prob u
- Household-specific mortality D_{es}

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Household Decision Problem

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a_t &\geq 0
\end{aligned}
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Macro Dynamics

- Population growth N, technological progress Γ
- Tax rate to finance social security and unemployment benefits: $\tau = \tau_{SS} + \tau_U$
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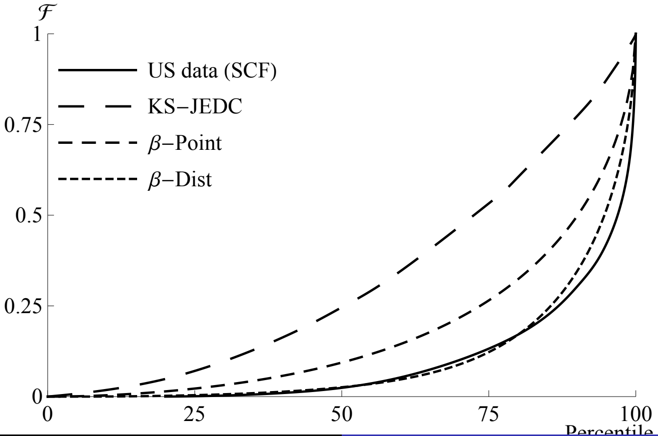
Calibration

Description	Parameter	Value
Coefficient of relative risk aversion	ρ	1
Effective interest rate	$(r-\delta)$	0.01
Population growth rate	N	0.0025
Technological growth rate	Γ	0.0037
Rate of high school dropouts	θ_D	0.11
Rate of high school graduates	θ_{HS}	0.55
Rate of college graduates	θ_C	0.34
Average initial permanent income, dropout	$\bar{\boldsymbol{p}}_{D0}$	5000
Average initial permanent income, high school	$\bar{\boldsymbol{p}}_{HS0}$	7500
Average initial permanent income, college	$\bar{\boldsymbol{p}}_{C0}$	12000
Unemployment insurance payment	μ	0.15
Unemployment rate	u	0.07
Labor income tax rate	τ	0.0942

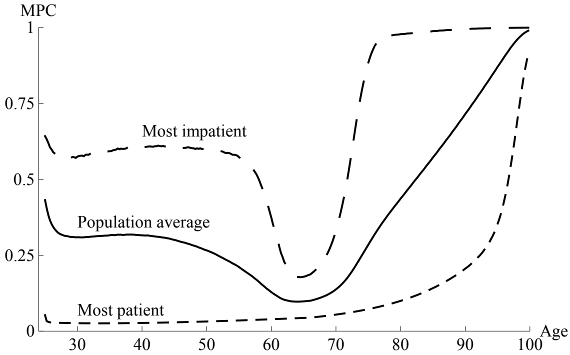
Results: Wealth Distribution



Results: MPCT (in Annual Terms)

	Micro Income Process		Life-Cycle Model		
	KS-JEDC	FBS			
	Our solution	β-Dist	β-Point	β-Dist	β-Dist
Wealth Measure	NW	NW	NW	NW	Liquid
Overall average	0.05	0.23	0.11	0.29	0.42
By wealth/permanent income ratio					
Top 1%	0.04	0.05	0.08	0.07	0.07
Top 20%	0.04	0.06	0.09	0.07	0.07
Top 40%	0.04	0.08	0.08	0.07	0.11
Top 60%	0.04	0.12	0.08	0.10	0.20

Results: MPCT by Age



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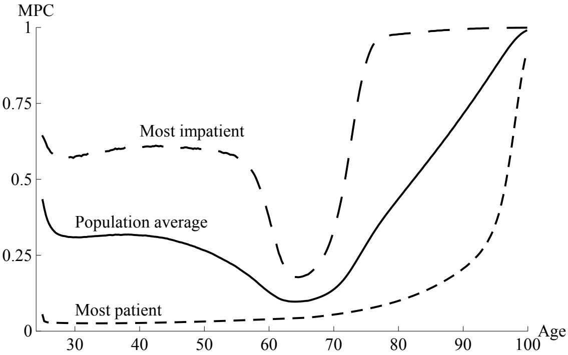

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Conclusions

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Example:

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2. Simulate Pop Behavior Under Those Beliefs (Hard)
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    - Failure to Reinvent the Wheel: Even More Time Wasted
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