Income Uncertainty and Consumption Dynamics

Edmund Crawley & Andreas Kuchler

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Overview

1) How does household expenditure respond to income shocks?
   - To transitory shocks?
   - To permanent shocks?

2) How does this vary across the population?
   - Across (liquid) wealth
   - Across age
   - Across interest rate exposure

Empirical evidence on 1 weak, on 2 it is VERY weak

How Have Consumption Responses Been Measured?

Three methods:

1. (Natural) Experiments - stimulus checks, lotteries etc
   - Few true experiments, especially for permanent shocks
   - Data limitations
2. Ask people
   - Unclear how to interpret
3. Use covariance structure of income and consumption
   - Empirical methods (until now!) have been flawed

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Our contribution

- Develop a robust method based on 3
- Apply it to Danish registry data

The Danish data allows us to build a detailed picture of the distribution over different household characteristics

Evidence on Magnitude of Consumption Response

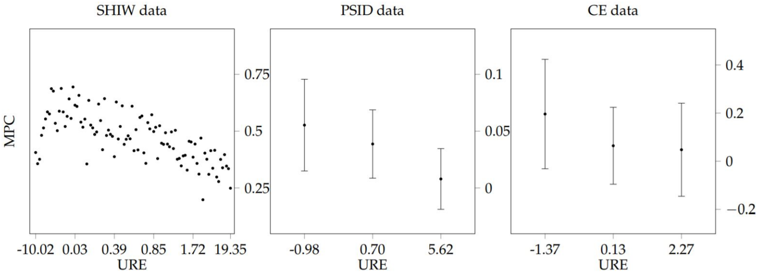
	Consumption Measure				
Authors	Nondurables	Durables	Total PCE	Horizon*	Event/Sample
Agarwal and Qian (2014)			0.90	10 Months	Growth Dividend Program Singapore 2011
Blundell, Pistaferri, and Preston (2008)‡	0.05				Estimation Sample: 1980–92
Browning and Collado (2001)			~ 0		Spanish ECPF Data, 1985–95
Coronado, Lupton, and Sheiner (2005)			0.36	1 Year	2003 Tax Cut
Hausman (2012)			0.6–0.75	1 Year	1936 Veterans' Bonus
Hsieh (2003)‡	~ 0		0.6–0.75		CEX, 1980–2001
Jappelli and Pistaferri (2014)	0.48				Italy, 2010
Johnson, Parker, and Souleles (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, Souleles, Johnson, and McClelland (2013)	0.12–0.30		0.50–0.90	3 Months	2008 Economic Stimulus
Sahm, Shapiro, and Slemrod (2010)			$\sim 1/3$	1 Year	2008 Economic Stimulus
Shapiro and Slemrod (2009)			$\sim 1/3$	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

Table from Carroll et al 2018

Rough consensus on (3 month) MPC $\sim 30\%$

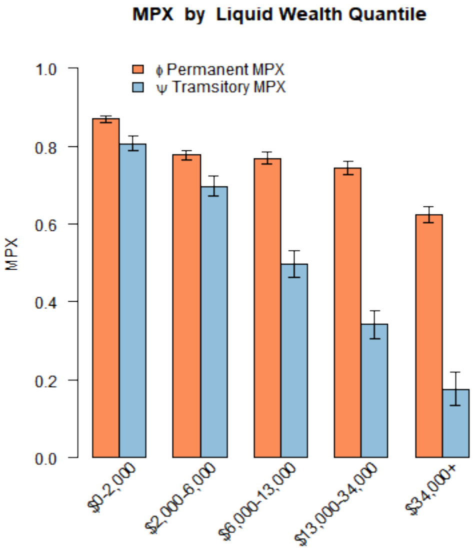
Evidence on Distribution of Consumption Response

Auclert (2018) uses the 3 different methods to identify the distribution of MPC by unhedged interest rate exposure



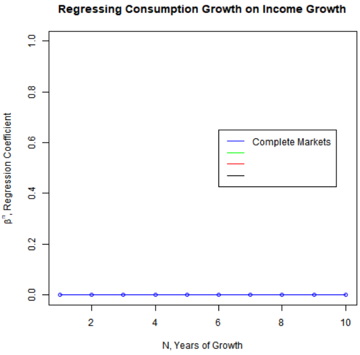
Recent evidence from Norwegian registry data using lottery winnings provides evidence of variation across liquid wealth

Results Preview



Methodology Intuition

Exploit increasing importance of permanent shocks as the time over which growth is measured increases



$$\Delta^N c = \beta \Delta^N y + \varepsilon$$

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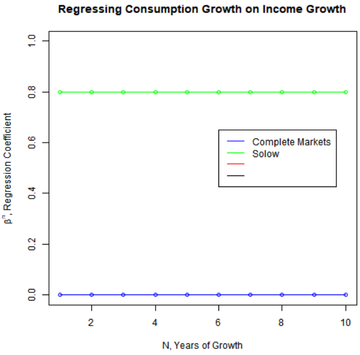

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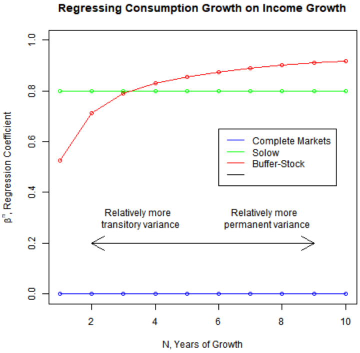

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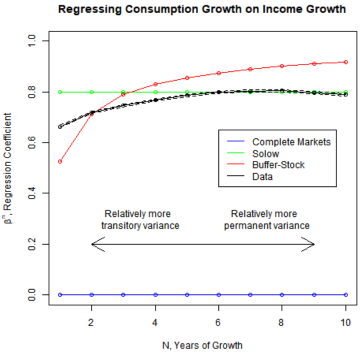

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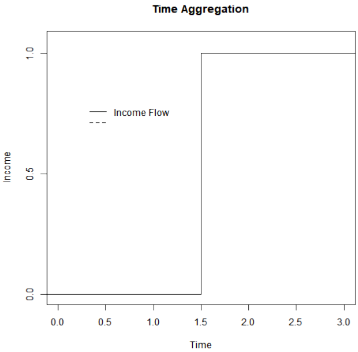
Aside: Why Not Blundell, Pistaferri and Preston 2008?

1) Time Aggregation Problem (Crawley 2018)



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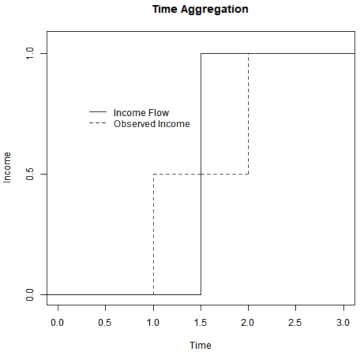

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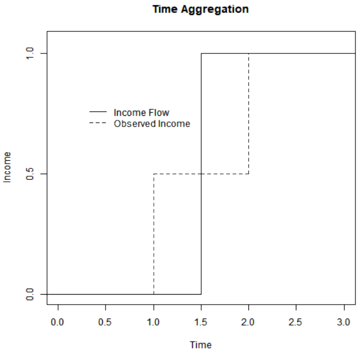

PIH Example:

- MPC out of Permanent Shocks $= 1$
- MPC out of Transitory Shocks $= 0$
- Variances approx. equal

BPP method estimates MPC out of transitory shocks to be -0.6

Aside: Why Not Blundell, Pistaferri and Preston 2008?

2) BPP assume consumption is a random walk

- High transitory MPCs are incompatible with consumption following a random walk

Identification of the Income Process

We follow the spirit of Carroll & Samwick (1997):

- Permanent income follows a random walk

$$p_t = p_{t-1} + \zeta_t$$

- Total income includes a transitory component

$$y_t = p_t + \varepsilon_t$$

Growth over N years is:

$$\Delta^N y_T = (\zeta_{T-N+1} + \ldots + \zeta_T) + \varepsilon_T - \varepsilon_{T-N}$$
$$\mathrm{Var}(\Delta^N y_T) = N\mathrm{Var}(\zeta) + 2\mathrm{Var}(\varepsilon)$$

Identification of the Income Process

We follow the spirit of Carroll & Samwick (1997):

- If transitory income follows an MA(2) process:

$$y_t = p_t + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2}$$
$$\implies \mathrm{Var}(\Delta^N y_T) = N \underbrace{\mathrm{Var}(\zeta)}_{\text{Perm var}} + 2 \underbrace{(1 + \theta_1^2 + \theta_2^2)\mathrm{Var}(\varepsilon)}_{\text{“Total” trans var}} \text{ if } N \geq 3$$

Carroll & Samwick use $N = 3, 4, 5$ to identify permanent shock variance and "total" transitory shock variance

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1. How does time aggregation affect this identification?
2. What might the equivalent of "robust to MA(2) transitory shocks" be in continuous time?

Identification of the Income Process

Carroll & Samwick in Continuous Time with Aggregation

- To begin assume no persistence in the transitory shock
- p_t and q_t are independent martingale processes with independent increments

$$\mathrm{Var}(p_t - p_{t-1}) = \sigma_p^2$$
$$\mathrm{Var}(q_t - q_{t-1}) = \sigma_q^2$$

- Instantaneous income is equal to the flow of permanent income plus the transitory income component

$$dy_t = p_t dt + dq_t$$

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We observe $\bar{y}_T$, total income over year T:

$$\bar{y}_T = \int_{T-1}^{T} p_t dt + q_T - q_{T-1}$$

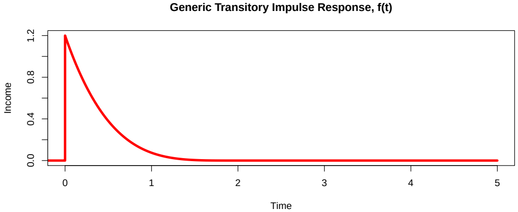
$$\implies \mathrm{Var}(\Delta^N \bar{y}_T) = (N - \frac{1}{3})\sigma_p + 2\sigma_q$$

Identification of the Income Process

Allow a generic persistence in transitory shock

- Following shock, transitory income flow decays as:

$$f(t) \text{ where } f(t) = 0 \text{ if } t > 2$$



$$y_t = p_t + \int_{t-2}^{t} f(t-s)dq_s$$

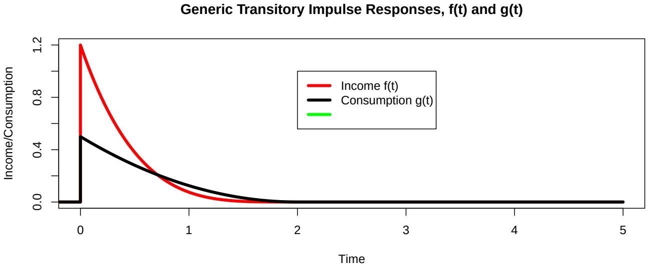
$$\implies \mathrm{Var}(\Delta^n \bar{y}_T) = (n - \frac{1}{3})\sigma_p^2 + 2\sigma_{\tilde{q}}^2 \text{ for } n \geq 3$$

where $\tilde{q_T} = \int_{T-1}^{T} \int_{t-2}^{t} f(t-s)dq_s dt$ is the time aggregated transitory component of income

Identification of the Consumption Response

Assumptions on Consumption

- Permanent: Consumption permanently moves by fraction ϕ of the income shock
- Transitory: Allow for generic impulse response $g(t)$ where $g(t) = 0$ for $t > 2$



This is a key difference between what we assume and BPP

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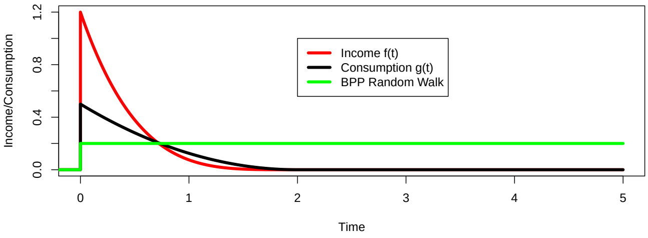
Generic Transitory Impulse Responses, f(t) and g(t)



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Identification of the Consumption Response

Consumption flow is given by:

$$c_t = \phi p_t + \int_{t-2}^{t} g(t-s)dq_s$$

$$\implies \mathrm{Cov}(\Delta^N \bar{c_T}, \Delta^n \bar{y_T}) = \phi(N - \frac{1}{3})\sigma_p^2 + 2\psi\sigma_{\tilde{q}}^2$$

where $\psi = \frac{\mathrm{Cov}(\tilde{c},\tilde{q})}{\mathrm{Var}(\tilde{q})}$, the regression coefficient of 'transitory' consumption on transitory income

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- ϕ: MPX out of permanent income shocks
- ψ: MPX out of transitory income shocks

Full Identification

We use GMM on the equations:

$$\mathrm{Var}(\Delta^n \bar{y_T}) = (N - \frac{1}{3})\sigma_p^2 + 2\sigma_{\tilde{q}}^2$$
$$\mathrm{Cov}(\Delta^N \bar{c_T}, \Delta^n \bar{y_T}) = \phi(N - \frac{1}{3})\sigma_p^2 + 2\psi\sigma_{\tilde{q}}^2$$

with $N = 3, 4, 5$ (total of six equations) to identify the four unknowns:

- σ_p^2: Permanent shock variance
- $\sigma_{\tilde{q}}^2$: (Time aggregated) transitory shock variance
- ϕ: MPX out of permanent income shocks
- ψ: MPX out of transitory income shocks

Data

- Starting point: Register based micro data for all Danish households made available by Statistics Denmark
- Really good income data
  - We use after-tax income for the household head, based on third-party reported tax data
- We divide through by permanent income (mean income over all observed years) and take the residual after controlling for age, education, marital status etc. (along with interactions of these)
- Expenditure data imputed from income and wealth
  - Deposit and brokerage accounts all third party reported
  - Less accurate than income data

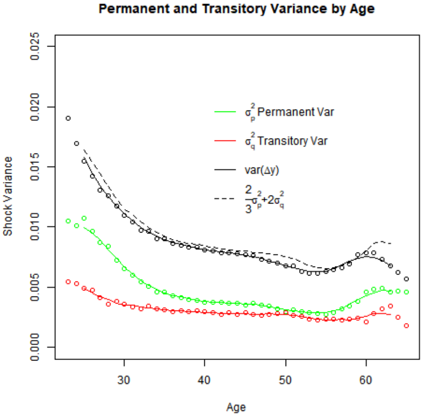
Imputing Expenditure

We use the identity

$$C_t \equiv Y_t - S_t = Y_t - \Delta NW$$

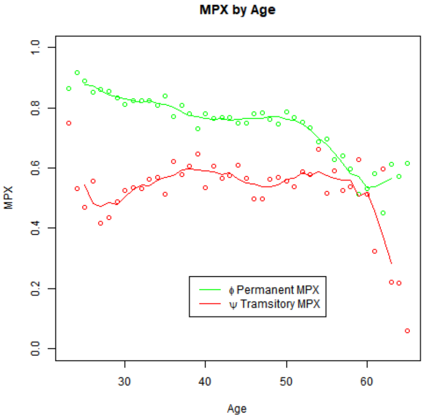
- Works well for households with simple financial lives
- Main issue: Capital gains and losses
  - Exclude households where methodology will not work well (eg Business owners)
  - Exclude housing wealth and years with housing transactions
  - Capital gains for stocks based on a diversified index
- Noisy, but perhaps better than surveys (Browning and Leth-Petersen, 2003; Eika et al., 2017; Fagereng and Halvorsen, 2017; Koijen et al., 2015; Kolsrod et al., 2017; Kreiner et al., 2015)
- Huge sample size advantage: sample covers 23.3 million observations over 2004-2015 (approx 1.9 million per year)

Shock Variance by Age



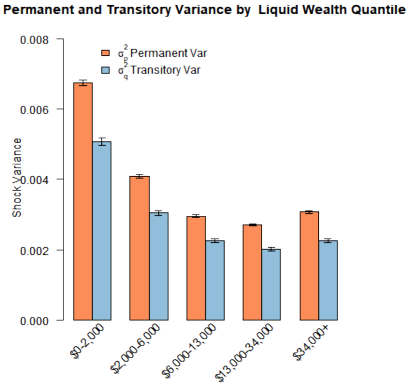
The assumption of constant variance works reasonably well from mid-30's to retirement

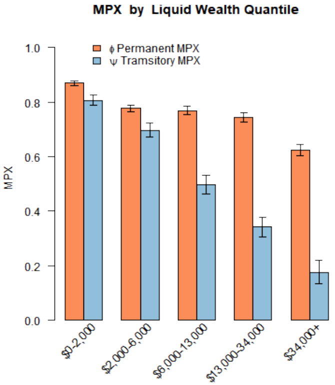
MPX by Age



- $\phi \approx 0.8$, declines towards retirement
- $\psi \approx 0.5$, constant

MPX by Liquid Wealth





Durables

Sensitivity to Misspecification

Given the MPX out of transitory and permanent income are both similar, results are not very sensitive to exact modeling assumptions

- AR(1) in permanent shock
- Correlation between permanent and transitory shocks

Why is Transitory MPX so large?

Explantion 1: It just is

In line with some other estimates e.g.

- Agarwal & Quin (2014) find 90% 10 month MPX from the 2011 Singapore Growth Dividend Program (excellent data)
- Parker et al. (2013) find 50-90% 3 month MPX out of 2008 stimulus
- Souleles (2002) finds 60-90% 12 month MPX out of Reagan tax cuts

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However, Fagereng et al (2017) find an MPX of 35% using lottery winnings and similar expenditure data in Norway

Why is Transitory MPX so large?

Explantion 2: Income is Endogenous

Potential model would need

- Permanent and transitory income uncertainty
- Transitory taste shocks
- Endogenous labor supply

Is a quantitatively reasonable model feasible?

- How big (or small) will labor elasticity need to be?
- Seems unlikely the high wealthy MPX can be matched

Why is Transitory MPX so large?

Explantion 3: Measurement Error

- Method is robust to *classical* measurement error in expenditure
- Method is (mostly) robust to *classical* measurement error in income
- The imputation method potentially introduces correlation between measurement error in income and expenditure (a problem)

Unobserved income uncorrelated with observed income is OK
Problem if income is observed with error

Why is Transitory MPX so large?

How can we dig into this?

- Break down sources of income
  - MPX from secondary earner is much higher than primary earner
  - Look only at households who have little choice over work hours
  - Look at wages and hours worked rather than income
- Use income data from an independent source (employer payment data)

Model

How will a model in which labor decisions are driven by spending needs behave over the business cycle?

- In a recession households have much less ability to insure themselves through their labor supply
- May increase saving to compensate

Model

GHH preferences with a taste shifter

$$u(c, l, \varphi) = U(\varphi c - G(l))$$

First order condition w.r.t l

$$\implies l = G'^{-1}(\varphi w)$$

where w is the wage

Note - even the wealthy adjust their labor