Income Uncertainty and Consumption Dynamics

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Overview

1) How well are households insured against shocks to their income?
   - MPC is a key statistic for many macro questions
2) How does this vary across the population?
   - Across wealth (Standard incomplete market model)
   - Across liquid wealth (Wealthy hand-to-mouth models)
   - Across interest rate exposure (monetary policy implications)
   - Across income uncertainty (precautionary saving)

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

How is MPC measured?

Three methods:

1. (Natural) Experiments - stimulus checks, tax rebates etc
2. Ask people
3. Use covariance structure of income and consumption

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Our contribution

- Show previous methods based on 3 are flawed
- Develop an alternative robust method
- Apply it to Danish registry data

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

Empirical Evidence on the MPC

	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
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Souleles (1999)	0.045–0.09	0.29–0.54	0.34–0.64	3 Months	Estimation Sample: 1980–91
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Table from Carroll et al 2018

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

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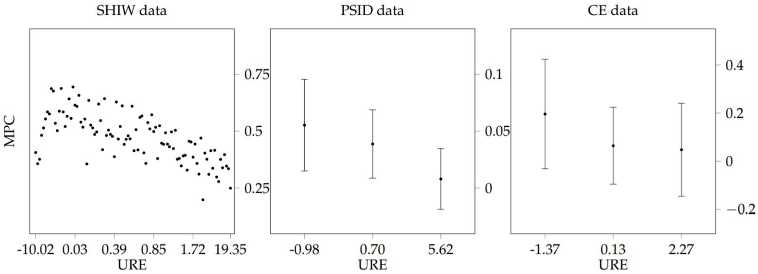
Empirical Evidence on the Distribution of MPC

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

Spending is VERY closely tied with transitory income

- Far more than standard models would suggest

High levels of liquid wealth reduce this relation

- As standard models suggest

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- As standard models suggest

\$1000 of extra transitory income in a year is associated with \$700 of extra spending that year

Possible Interpretation:

- Labor supply responds to transitory spending needs
- eg Car break down, work extra hours

Blundell Pistaferri and Preston 2008

Question:

How well insured are households against idiosyncratic income shocks?

Key idea:

1. Make a few core assumptions on the dynamics of income and consumption
2. Use the covariance matrix of income and consumption to identify key parameters
   - $\phi \approx 0.65$ Partial permanent shock insurance
   - $\psi \approx 0.05$ Almost complete transitory shock insurance

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Kaplan & Violante (2010) "The BPP insurance coefficients should become central in quantitative macroeconomics"

Blundell Pistaferri and Preston 2008

Assumptions on the log income process

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

Standard Friedman transitory/permanent decomposition (can easily extend to an MA(q) transitory process)

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Assumptions on the log consumption process

- $\Delta c_t = \phi \Delta p_t + \psi \varepsilon_t$

Hall random walk

BPP: Identification

Key identification moments for ϕ and ψ

$$\phi = \frac{\mathrm{Cov}(\Delta c_t, \zeta_t)}{\mathrm{Var}(\zeta_t)} = \frac{\mathrm{Cov}(\Delta c_t, \Delta y_{t+1} + \Delta y_t + \Delta y_{t-1}))}{\mathrm{Cov}(\Delta y_t, \Delta y_{t+1} + \Delta y_t + \Delta y_{t-1})}$$

$$\psi = \frac{\mathrm{Cov}(\Delta c_t, \varepsilon_t)}{\mathrm{Var}(\varepsilon_t)} = \frac{\mathrm{Cov}(\Delta c_t, \Delta y_{t+1})}{\mathrm{Cov}(\Delta y_t, \Delta y_{t+1})}$$

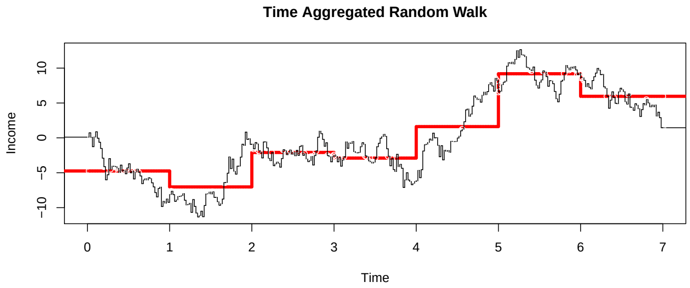
Kaplan & Violante (2010) show these work well for reasonable parameterizations of standard consumption models

BPP: Two Improvements

- Time Aggregation
- Short term dynamics

BPP: Time Aggregation

Working (1960) showed that the a time aggregated random walk is autocorrelated



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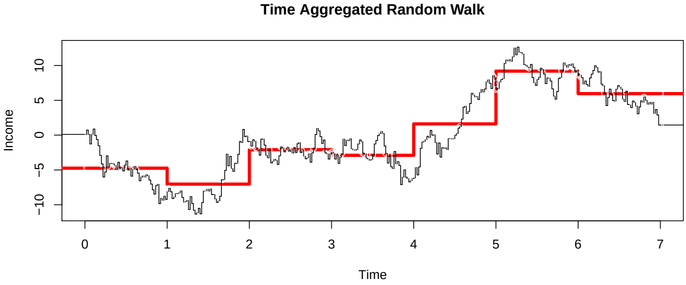

Macroeconomics has (mostly) absorbed this point

The household finance literature has not - this is particularly problematic for BPP

BPP: Time Aggregation

BPP use the (non time-aggregated) moment

$$\frac{\mathrm{Cov}(\Delta c_t, \Delta y_{t+1})}{\mathrm{Cov}(\Delta y_t, \Delta y_{t+1})} = \frac{-\psi \mathrm{Var}(\varepsilon)}{-\mathrm{Var}(\varepsilon)} = \psi$$

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But if the underlying processes are continuous

$$\frac{\mathrm{Cov}(\Delta \bar{c}_t, \Delta \bar{y}_{t+1})}{\mathrm{Cov}(\Delta \bar{y}_t, \Delta \bar{y}_{t+1})} = \frac{\frac{1}{6}\phi \mathrm{Var}(\zeta) - \frac{1}{2}\psi \mathrm{Var}(\varepsilon)}{\frac{1}{6}\mathrm{Var}(\zeta) - \mathrm{Var}(\varepsilon)}$$

So the moment used for identification of ψ is messed up

BPP Time Aggregation Problem

Problem: BPP estimates (from PSID data) are wildly out of sync with the rest of the literature

MPC out of transitory estimate: $\sim 5\%$
MPC out of permanent estimate: $\sim 65\%$

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Fixing time aggregation we get

MPC out of transitory estimate: $\sim 25\%$
MPC out of permanent estimate: $\sim 30-100\%$

Results become VERY sensitive to exact nature of short term income dynamics

BPP Short Term Dynamics

Identification in BPP comes primarily from covariances from one period to the next

Carroll & Samwick (1997) use a similar technique to identify shock variances, but use a longer time frame

$$\mathrm{Var}(\Delta^n y_t) = n\mathrm{Var}(\zeta) + 2\mathrm{Var}(\varepsilon)$$

Using $n = 3, 4, 5$ the identification is robust to MA(2) transitory shocks

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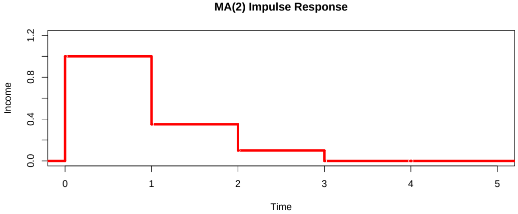
1. What might the equivalent of “robust to MA(2) transitory shocks” be in continuous time?
2. Can we extend this more robust method to consumption?

BPP Short Term Dynamics

Carroll & Samwick in Discrete Time



$$y_t = p_t + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2}$$

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

$$\implies \mathrm{Var}(\Delta^n y_t) = n\mathrm{Var}(\zeta) + 2 \underbrace{(1 + \theta_1^2 + \theta_2^2)\mathrm{Var}(\varepsilon)}_{\text{“Total” transitory variance}} \qquad \text{for } n \geq 3$$

BPP Short Term Dynamics

Carroll & Samwick in Continuous Time with Aggregation

To begin assume no persistence in the transitory shock

$$y_t dt = p_t dt + dq_t$$

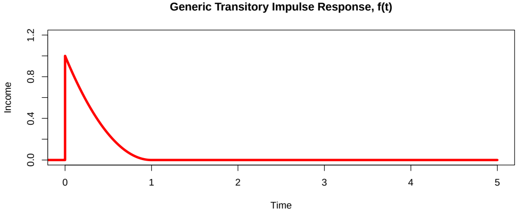
where p_t and q_t are independent stationary martingale processes with variances σ_p^2 and σ_q^2

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

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

BPP Short Term Dynamics

Allow a generic transitory shock, $f(t)$ where $f(t) = 0$ if $t > 2$



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

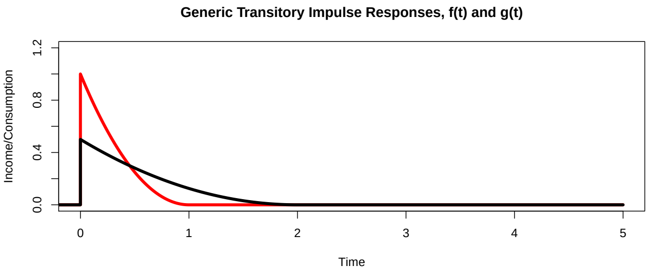
$$\implies \mathrm{Var}(\Delta^n \bar{y}_T) = (n - \frac{1}{3})\sigma_p^2 + 2\mathrm{Var}(\tilde{y}) \text{ for } n \geq 3$$

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

BPP Short Term Dynamics

Assumptions on Consumption

- Permanent: Same as BPP $c_t = \phi y_t$ (+constant)
- 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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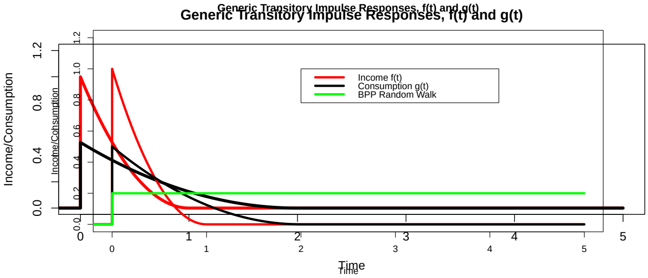

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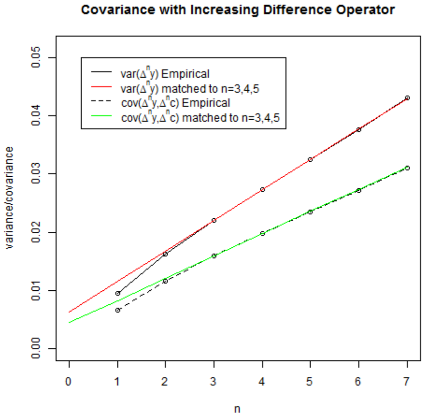
BPP Short Term Dynamics

$$c_t dt = \phi y_t dt + \int_{t-2}^{t} g(s-(t-2))dq_s dt$$
$$\implies \mathrm{Cov}(\Delta^n \bar{c_T}, \Delta^n \bar{y_T}) = \phi(n - \frac{1}{3})\sigma_p^2 + 2\mathrm{Cov}(\tilde{c}, \tilde{y})$$

where $\tilde{c}$ and $\tilde{y}$ are the time aggregated *transitory* components of consumption and income

BPP Short Term Dynamics

Is 2 years long enough?



Should be linear in n:

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

$$\mathrm{Cov}(\Delta^n \bar{y}_T, \Delta^n \bar{c}_T) = \phi(n - \frac{1}{3})\sigma_p + 2\mathrm{Cov}(\tilde{c}, \tilde{y})$$

BPP Short Term Dynamics

We can now identify:

- σ_p^2 Variance of permanent shocks
- $\mathrm{Var}(\tilde{y})$ Variance of transitory income received in a year
- ϕ Elasticity of consumption w.r.t permanent income
- $\psi = \frac{\mathrm{Cov}(\tilde{c},\tilde{y})}{\mathrm{Var}(\tilde{y})}$ Elasticity of transitory consumption w.r.t transitory income over a year

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$\psi = 0.7$ means *"If income this year is 1% higher than it would have been with no transitory shocks this year or in the last 2 years, then consumption is on average 0.7% higher than it would have been"*

or equivalently ψ is *the regression coefficient of transitory consumption on transitory income over a one year period*

Data

- Starting point: Register based micro data for all Danish households made available by Statistics Denmark
- Really good income data
  - We use total income (i.e. labor income, transfers, and capital income) after tax, based on third-party reported tax data
- Work with the residual of log income 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)

Results Overview

- Elasticity of consumption with transitory income is VERY high
- Lots of heterogeneity in transitory and permanent variance
- Surprisingly little heterogeneity in either transitory or permanent consumption responses
- Low liquid wealth associated with high ϕ and ψ

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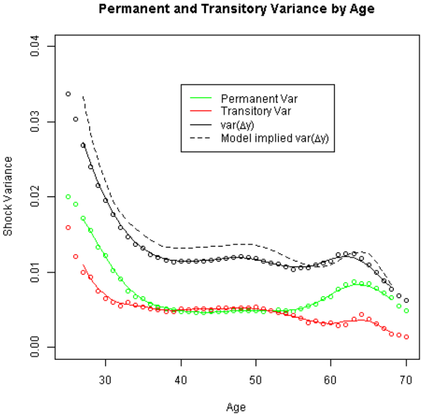
Possible explanations

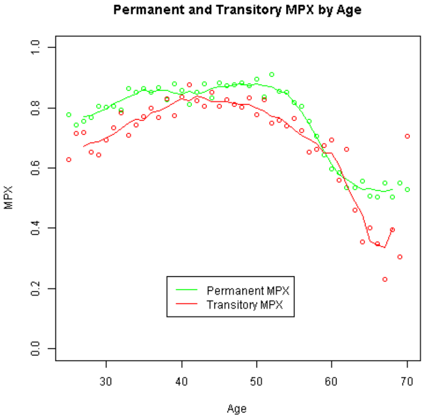
- MPC is much higher than we think
- Income variance reflects choices, not exogenous risk
- Measurement error

Shock Variance by Age



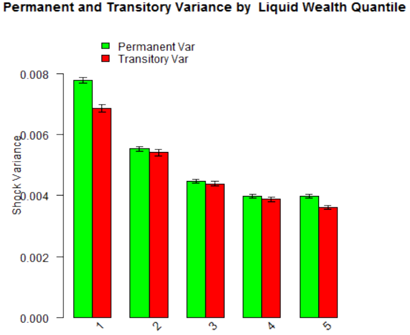
The assumption of constant variance works well from mid-30's to retirement

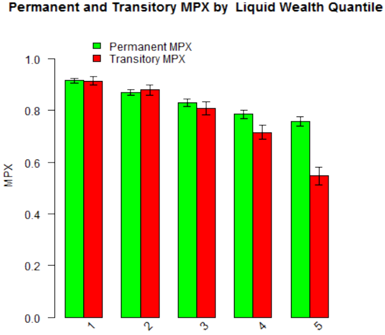
MPX by Age



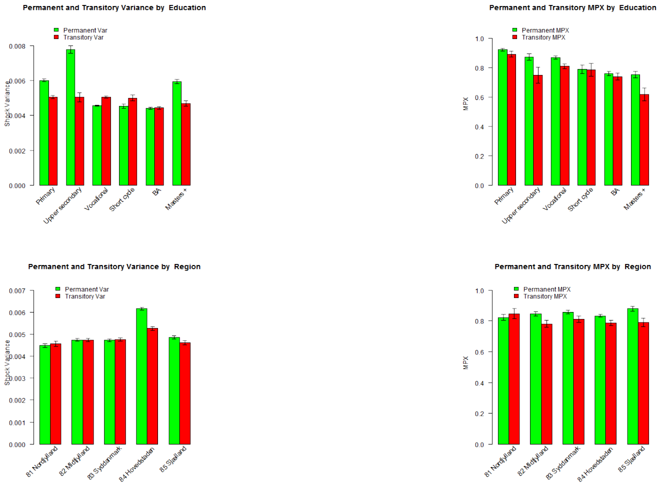
- MPX is very high
- No large difference between permanent and transitory MPX
- Both decline towards retirement

MPX by Liquid Wealth





Little Relation between Shock Variance and MPX



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
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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