Consumption Heterogeneity: Micro Drivers and Macro Implications

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What Do We Do?

We estimate the **sensitivity of consumption**

to permanent and transitory **shocks to income**

for **different groups** of households

Hasn't This Been Done Before?

Yes, but...

Our **method** addresses bias in previous results

Our **data** allows sharp focus on household heterogeneity

Hasn't This Been Done Before?

Time Aggregation Problem

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Our **data** allows sharp focus on household heterogeneity

Sample size in millions
Detailed balance sheet

What do we find? (Redistribution in Monetary Policy)

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Medium MPX
≈ 0.5

High MPX
≈ 0.8

Low MPX
≈ 0.25

MPX: Marginal Propensity to eXpend (includes durables)

What do we find? (Redistribution in Monetary Policy)

Medium MPX
≈ 0.5

High MPX
≈ 0.8

Low MPX
≈ 0.25

spending
a *little*

What do we find? (Redistribution in Monetary Policy)

1yr rate $\uparrow$ 1%

Aggregate Spending $\downarrow$ 26 basis points

Through this redistribution channel *alone*

Reduced Form Approach

Identifying Restrictions on

Income

and

Consumption

In **Continuous** Time

Reduced Form Approach

Identifying Restrictions on

Income $\longrightarrow$ Permanent (random walk) shocks
Transitory (<2 years) shocks

and

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In **Continuous** Time

Reduced Form Approach

Identifying Restrictions on

Income $\longrightarrow$ Permanent (random walk) shocks; Transitory (<2 years) shocks

and

Consumption $\longrightarrow$ Permanent (random walk) response; Transitory (<2 years) response

In **Continuous** Time

Reduced Form Approach

Identifying Restrictions on

Income $\longrightarrow$ Permanent (random walk) shocks; Transitory (<2 years) shocks

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Consumption $\longrightarrow$ Permanent (random walk) response; Transitory (<2 years) response

In **Continuous** Time $\longrightarrow$ Time Aggregation Problem

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 $N = 3, 4, 5$ (and $T = 2007, .., 2015$) to identify:

- 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

where ψ is the regression coefficient of 'transitory' consumption on transitory income Why not BPP

Data

What we need:

- Panel Data on **Income** and **Expenditure**
- Household **Balance Sheets**

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What we have: Registry data for all Danish households

- **Income**

  Third party reported
  After-tax, restrict to heads aged 30-55

- **Balance Sheet**

  Wealth on 31 Dec
  Asset category, mortgage tenure

- **Expenditure**

  No *direct* measure of spending

Data: Expenditure

Intertemporal budget constraint

$$\text{Expenditure} = \text{Income} - \text{Saving}$$

Data: Expenditure

Intertemporal budget constraint

$$\text{Expenditure} = \text{Income} - \text{Saving}$$

$$= \text{Change in Net Worth}$$

(adj. for capital gains)

Data: Expenditure

Intertemporal budget constraint

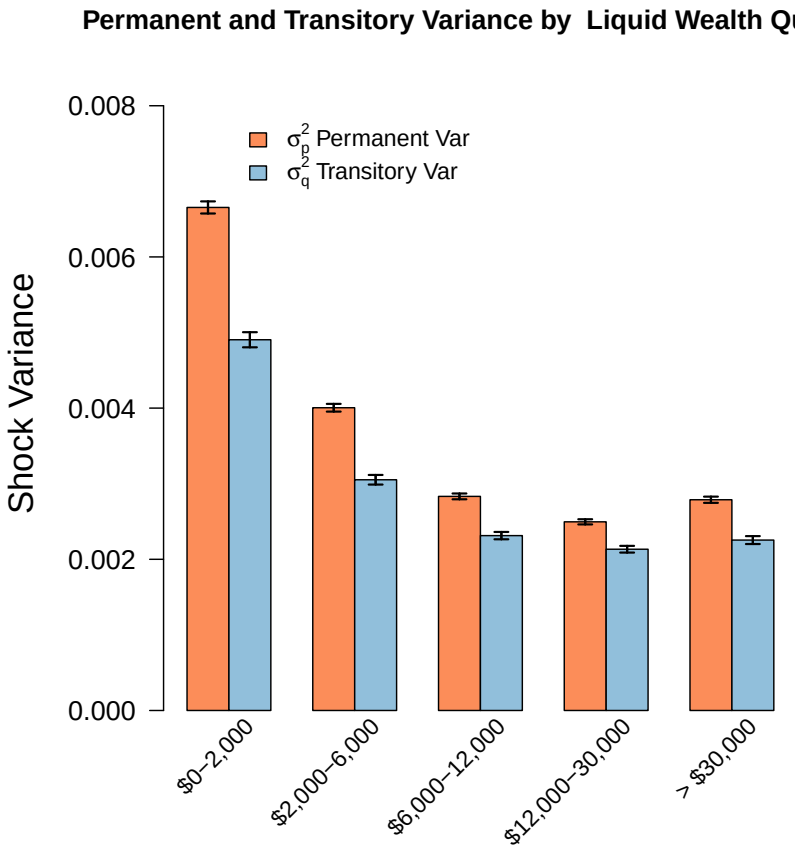
$$\text{Expenditure} = \text{Income} - \text{Saving}$$

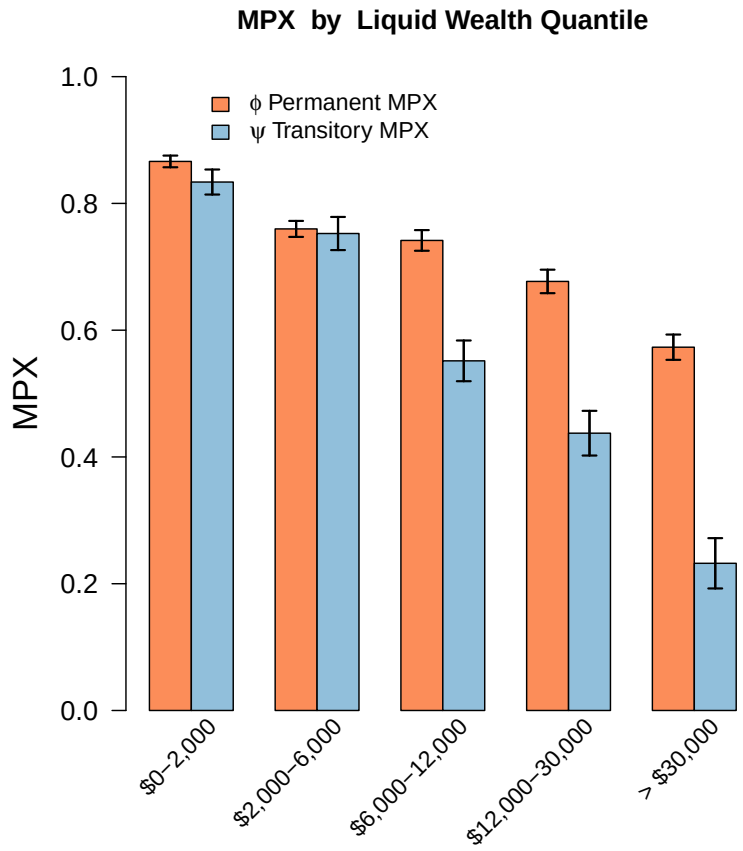
$$= \text{Change in Net Worth (adj. for capital gains)}$$

- Works well for households with simple financial lives
- Problem: Capital gains
  - Houses off balance sheet (exclude transaction years)
  - Exclude business owners
  - Capital gains based on a diversified index
- Noisy, but perhaps better than surveys (Browning & Leth-Petersen, 2003; Abildgren et al. 2018)
- Huge sample size advantage: sample covers 7.6 million observations over 2004-2015

Summary Statistics | On measurement error

Results by Liquid Wealth





MPX by Net Wealth

Monetary Policy: Auclert's Decomposition

How does Monetary Policy Effect Aggregate Consumption?

- Intertemporal Substitution
- Aggregate Income

} Representative Agent Channels

Monetary Policy: Auclert's Decomposition

→ Dominates in Rep. Agent NK models

How does Monetary Policy Effect Aggregate Consumption?

- Intertemporal Substitution
- Aggregate Income

} Representative Agent Channels

→ Large in Spender-Saver, or TANK models

Monetary Policy: Auclert's Decomposition

How does Monetary Policy Effect Aggregate Consumption?

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} Representative Agent Channels

- Fisher (Inflationary debt relief)
- Earnings Heterogeneity
- Interest Rate Exposure

} Redistribution Channels

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} Redistribution Channels

How can we *empirically* measure the size of the redistribution channels?

Need to know the distribution of MPCs along the relevant dimension of redistribution

Interest Rate Exposure: Auclert's Experiment

Key assumption:
Households treat redistribution like an income shock

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Experiment

Short term real interest rate $\uparrow$ 1% for 1 year

Hold constant income and inflation

How does subsequent **redistribution** impact **aggregate consumption**?

Dimension of Redistribution: **Unhedged Interest Rate Exposure**

Interest Rate Exposure: Dimension of Redistribution

Define **Unhedged Interest Rate Exposure** for household i as the total savings the household will invest at this year's interest rate:

$$URE_i = Y_i - C_i + A_i - L_i$$

Where

- Y_i = Total after tax income
- C_i = Total Expenditure, including interest payments
- A_i = Maturing assets
- L_i = Maturing liabilities

Following a change in the interest rate dR, the size of the Interest Rate Exposure channel on household i's expenditure is:

$$dc_i = MPC_i URE_i \frac{dR}{R}$$

Interest Rate Exposure: Aggregation

Aggregate to find size of channel:

$$dc_i = MPC_i URE_i \frac{dR}{R}$$

$$\implies \frac{dC}{C} = \mathbb{E}_I\left(MPC_i \frac{URE_i}{\mathbb{E}_I(c_i)}\right)\frac{dR}{R}$$

Define sufficient statistic:

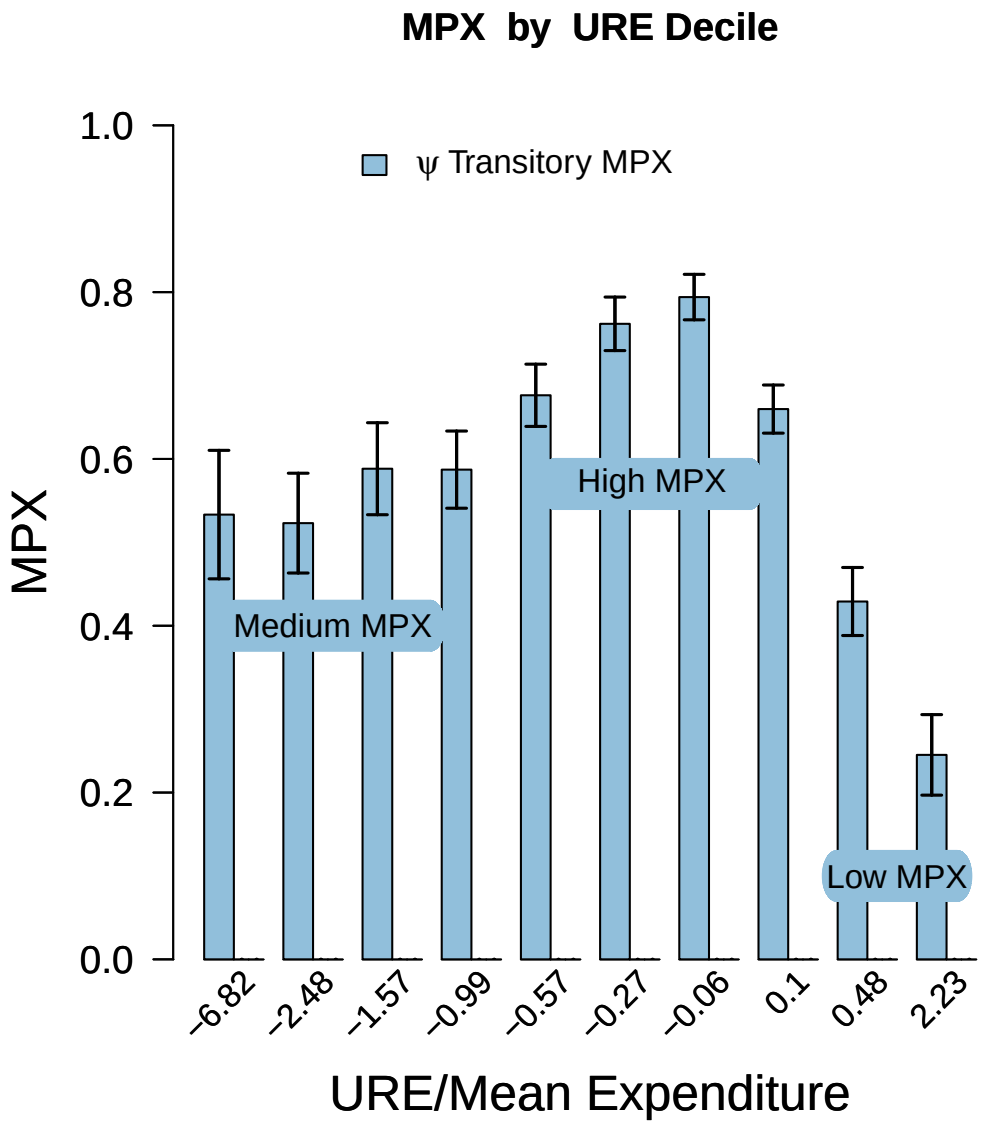
$$\mathcal{E}_R = \mathbb{E}_I\left(MPC_i \frac{URE_i}{\mathbb{E}_I(c_i)}\right)$$

$\implies$ Need to know the distribution of MPC_i with URE_i

We can do that!

Out of Sample Assumptions

Interest Rate Exposure: MPX Distribution



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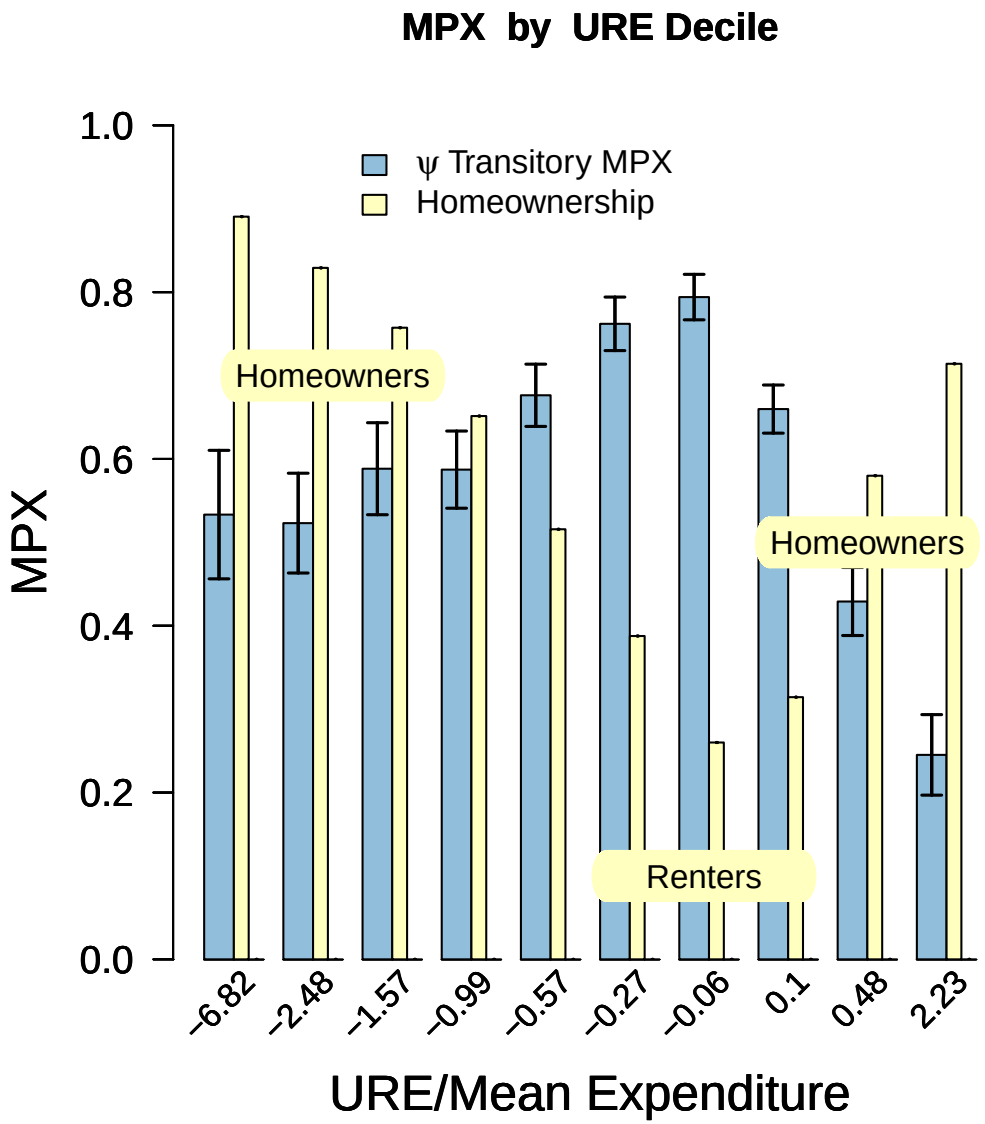

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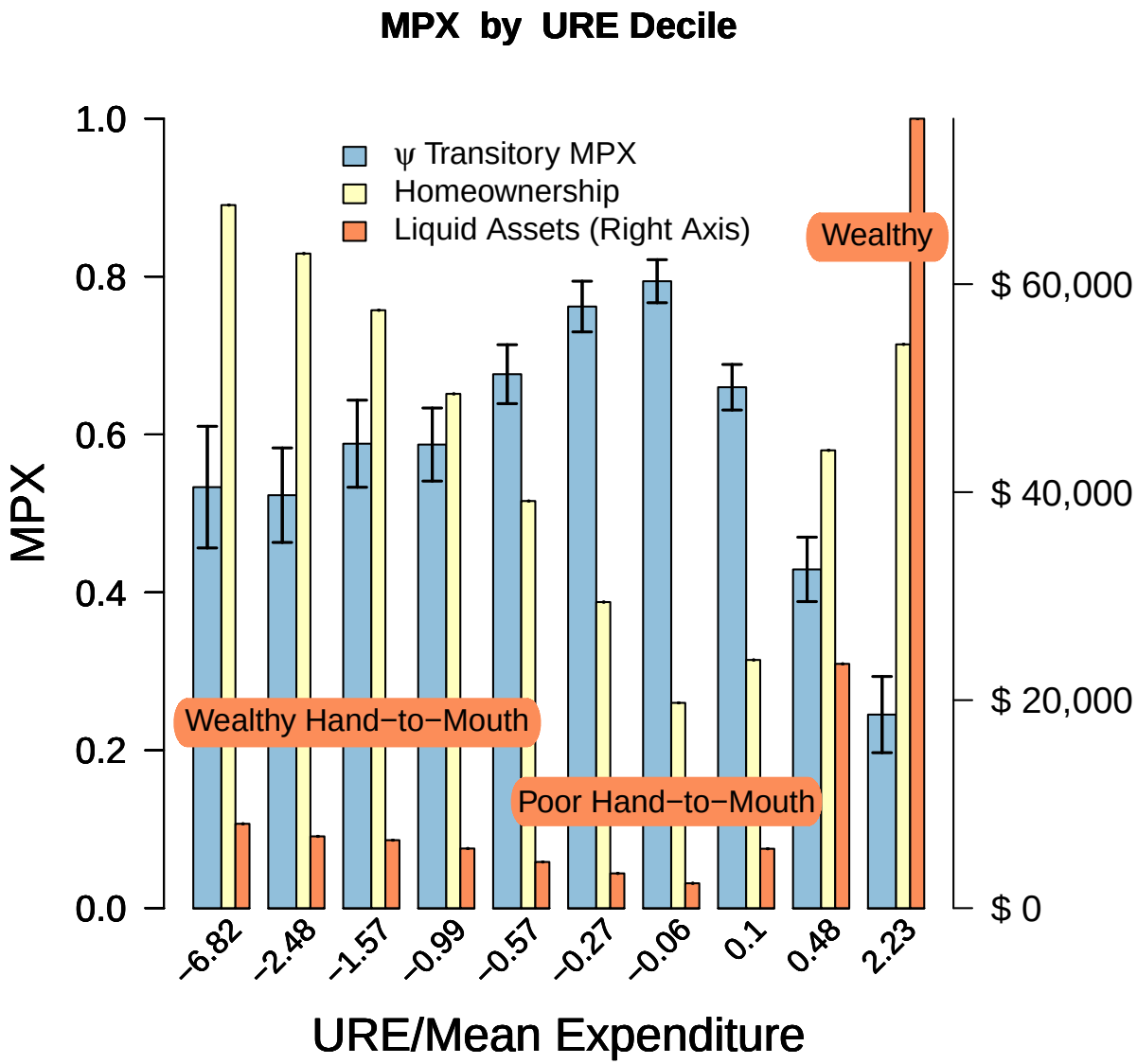

Interest Rate Exposure: Out of Sample

Total URE sums to zero - this is not true for our household sample

- -61bn USD

	MPX	URE	$\mathcal{E}_R$ component
Estimation Sample	**See Distribution**	**-61**	**-0.29**
Young	0.5	-15	-0.06
Old	0.5	6	0.02
Pension Funds	0.1	37	0.03
Government	0.0	-23	0.00
Non-financial Corp.	0.1	-13	-0.01
Financial Sector	0.1	61	0.05
Rest of World	0.0	9	0.00
Total		**0**	**-0.26**

Notes: URE numbers are in billions of 2015 USD.

All Five Transmission Channels

$$\frac{dC}{C} = \overbrace{\mathcal{M}\frac{dY}{Y}}^{\text{Aggregate Income Channel}} \overbrace{+\gamma\mathcal{E}_Y\frac{dY}{Y}}^{\text{Earnings Heterogeity Channel}} \overbrace{-\mathcal{E}_P\frac{dP}{P}}^{\text{Fisher Channel}} \underbrace{+\mathcal{E}_R\frac{dR}{R}}_{\text{Interest Rate Exposure Channel}} \underbrace{-\sigma\mathcal{S}\frac{dR}{R}}_{\text{Intertemporal Substitution Channel}}$$

$\mathcal{M}$	0.52
$\mathcal{E}_Y$	-0.03
$\mathcal{E}_P$	-0.75
$\mathcal{E}_R$	-0.26
$\mathcal{S}$	0.49

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Compare $\mathcal{E}_R$ to σS:

$\sigma \approx 0.1$ Best, Cloyne, Ilzetzki, and Kleven (2018)

$\sigma S \approx 0.05$

Conclusion

- We have designed a new method to estimate consumption responses to income shocks
- It appears to work well, both in theory and practice
- We can use it to show that heterogeneity plays a key role in monetary policy transmission

Thank you!

Durables

We have data on value of household cars

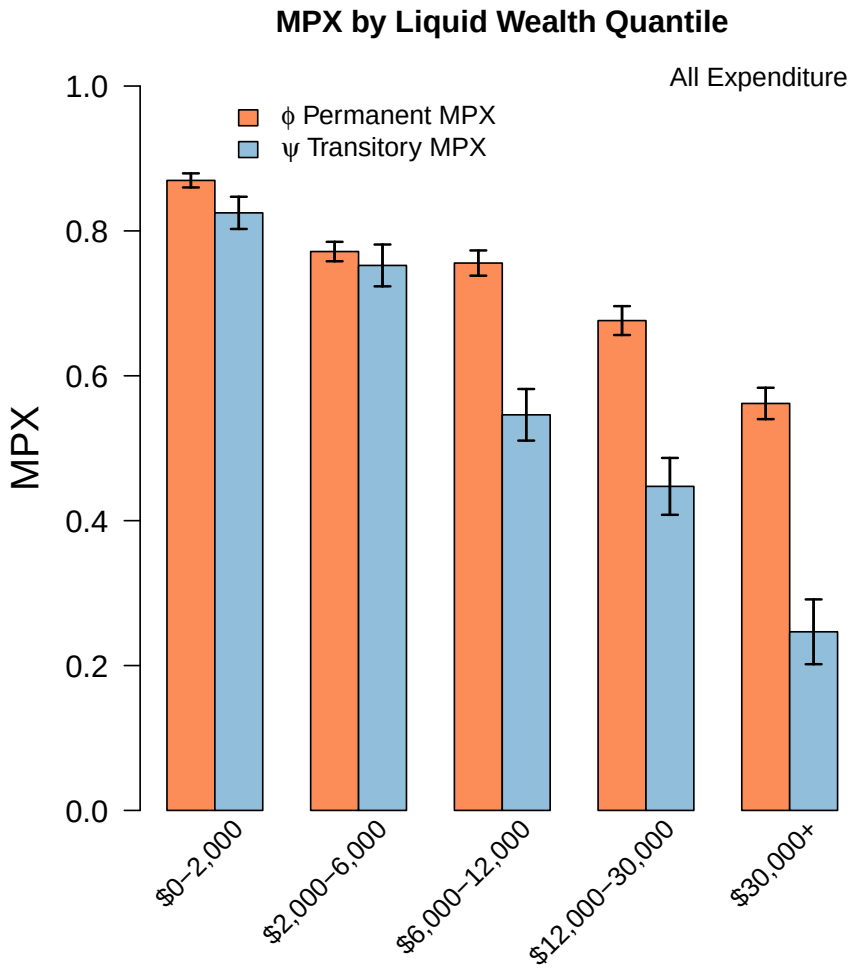
- Construct expenditure excluding car purchases and sales

$$C_T^{\text{nocar}} = C_T - \Delta\text{CarValue}$$

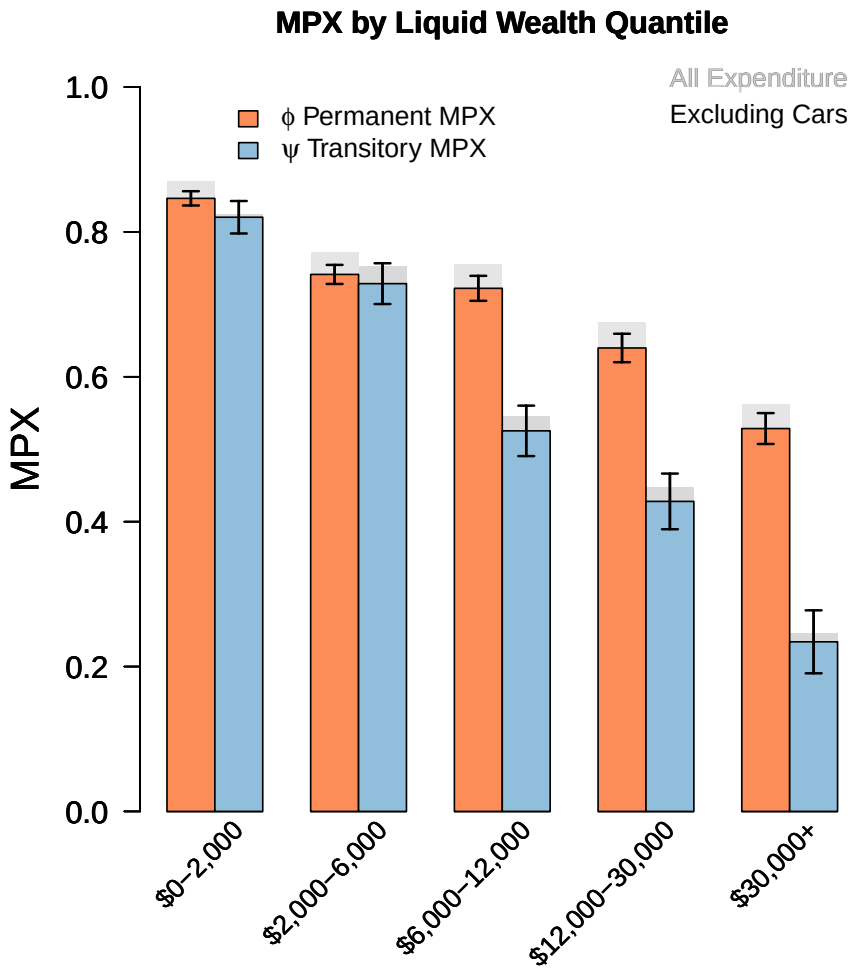
- Construct proxy for non durable consumption (Cars $\approx 42.1\%$ durable expenditure)

$$C_T^{\text{nondurable}} = C_T - \frac{1}{0.421}\Delta\text{CarValue}$$

Durables


MPX by Liquid Wealth Quantile
All Expenditure
ϕ Permanent MPX
ψ Transitory MPX
MPX
1.0
0.8
0.6
0.4
0.2
0.0
$0–2,000
$2,000–6,000
$6,000–12,000
$12,000–30,000
$30,000+

Durables


MPX by Liquid Wealth Quantile
All Expenditure
Excluding Cars
ϕ Permanent MPX
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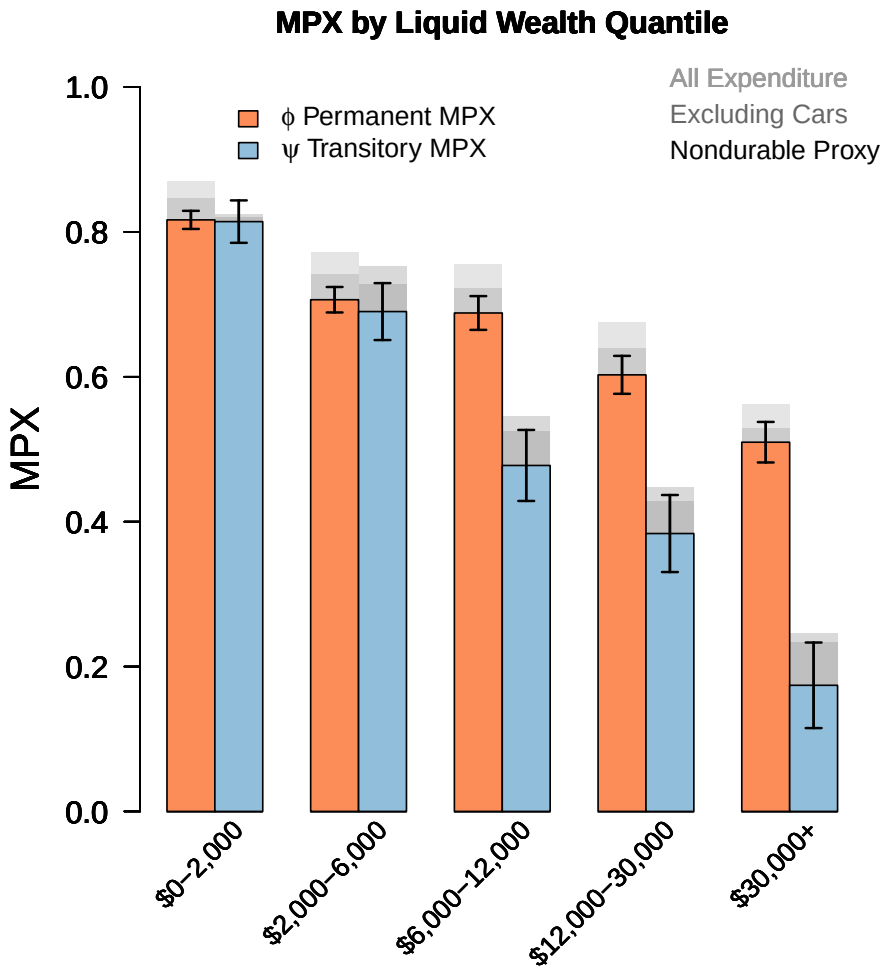
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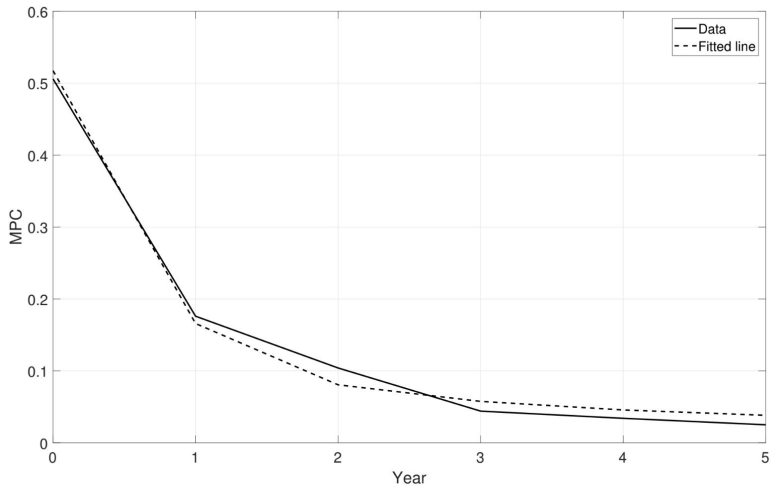
Evidence of Consumption Decay Within 2 Years

From Fagereng, Holm, and Natvik (2016)



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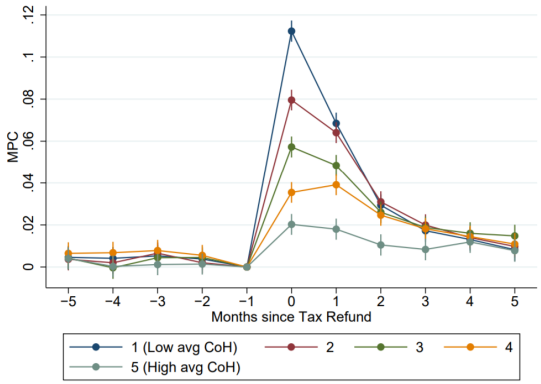
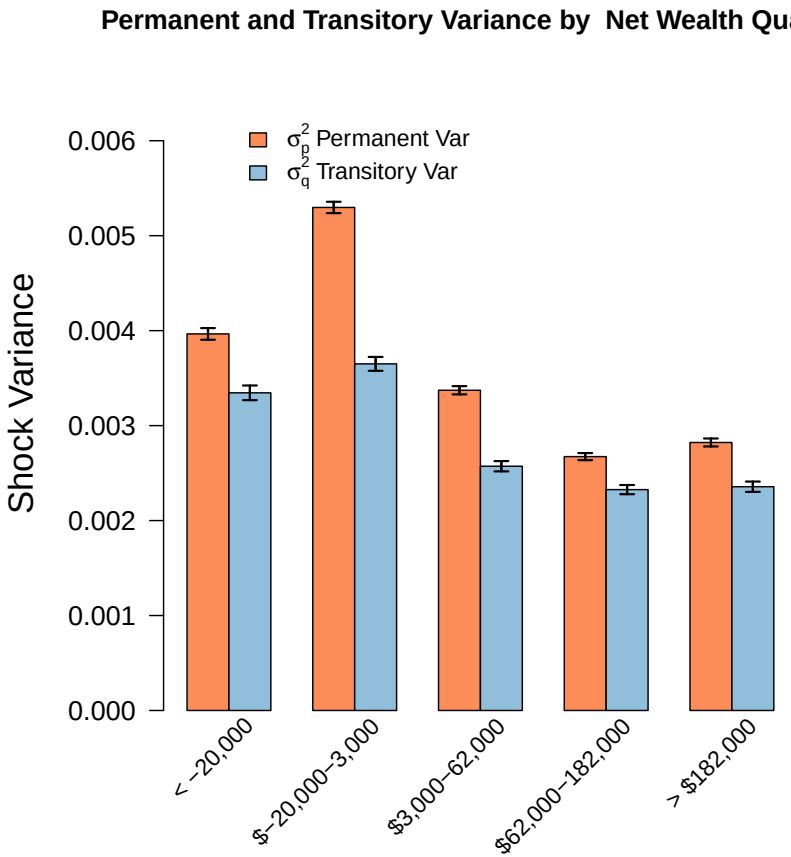
From Gelman (2016)

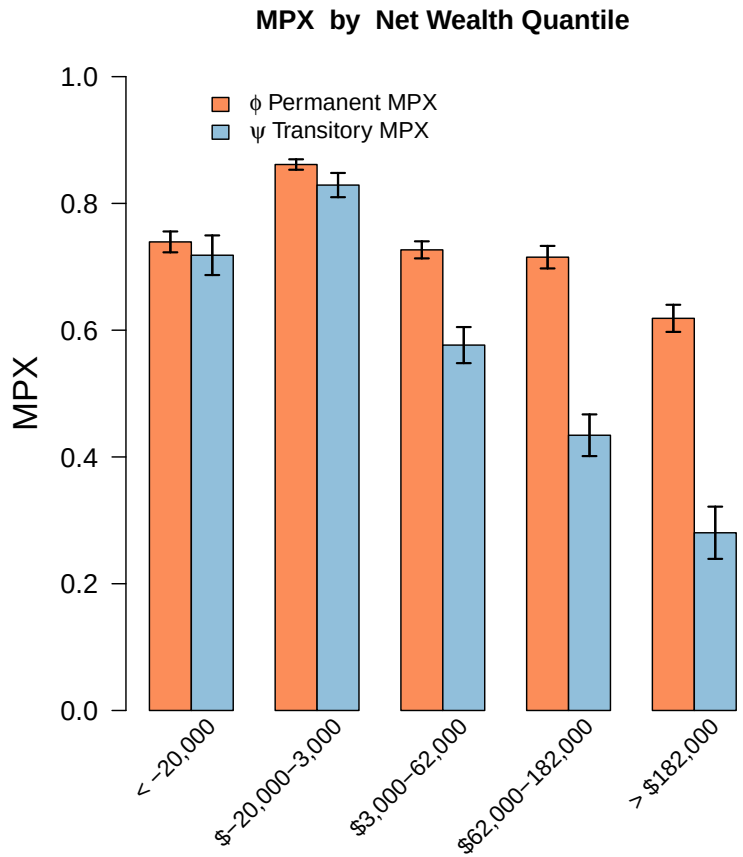
Figure 10: Tax refund impulse response function



Notes: 1,445,560 observations from 48,059 individuals. The vertical bars on each coefficient represent 95% confidence intervals using heteroskedasticity robust errors clustered at the individual level.

MPX by Net Wealth





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Notes: URE numbers are in billions of 2015 USD.

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Summary Statistics

	Estimation Sample			Population (Age 30-55)		
	Mean	Median	Std Dev	Mean	Median	Std Dev
After Tax Income	59,261	57,804	28,819	58,312	53,304	68,799
Consumption	52,680	48,344	28,581	54,022	46,373	38,126
Liquid Assets	18,438	6,856	33,016	23,331	6,578	81,473
Net Worth	74,937	19,115	157,295	85,799	12,952	564,404
Homeowner	0.57	1.00	0.50	0.50	1.00	0.50
Car Owner	0.66	1.00	0.47	0.55	1.00	0.50
Higher Education	0.31	0.00	0.46	0.33	0.00	0.47
Age	43.5	44.0	7.1	42.5	42.0	7.3
URE	-28,052	-12,627	108,382	-47,589	-19,374	243,604
NNP	-109,685	-65,810	156,523	-158,321	-85,207	542,498
No. Household-year obs		7,664,360			18,050,340	

Notes: Values are 2015 USD. Age refers to the age in 2008 of the main income earner in the household. For the purposes of calculation of consumption in the population, top and bottom 1% in terms of consumption have been excluded. URE and NNP can only be calculated in the period 2009-2015 due to mortgage information being insufficiently detailed in the previous years.

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Aside: Why Not Blundell, Pistaferri and Preston 2008?

Key to BPP Identification

Transitory shock year t

$\Delta y_{t+1} = \Delta p_{t+1} + \Delta \varepsilon_{t+1}$ is a *valid instrument* for ε_t

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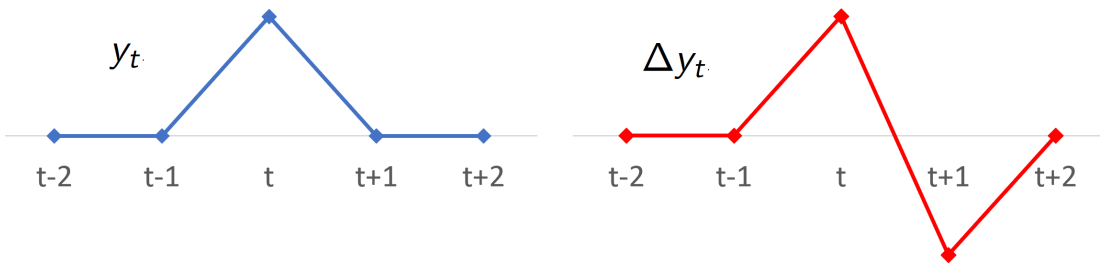

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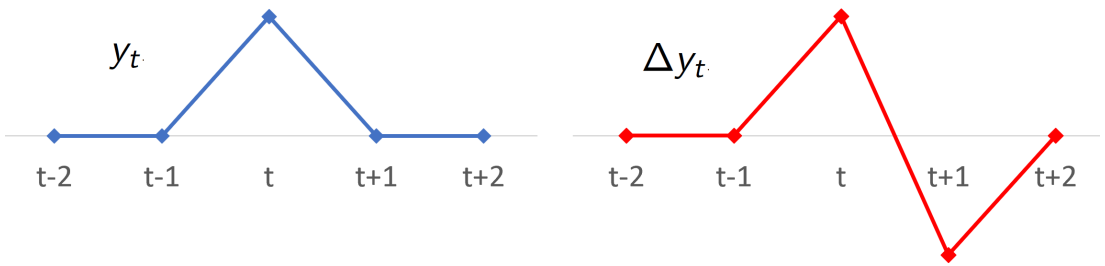
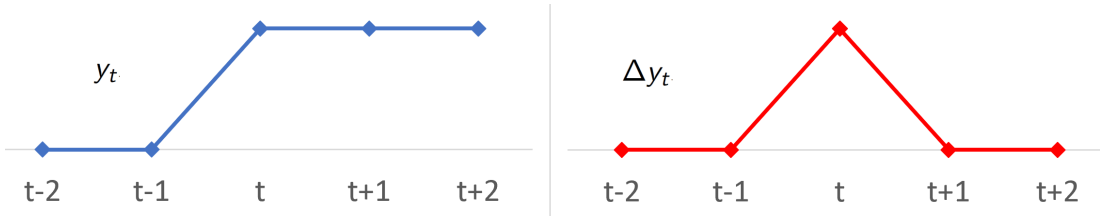


- Uncorrelated with permanent shocks in year t



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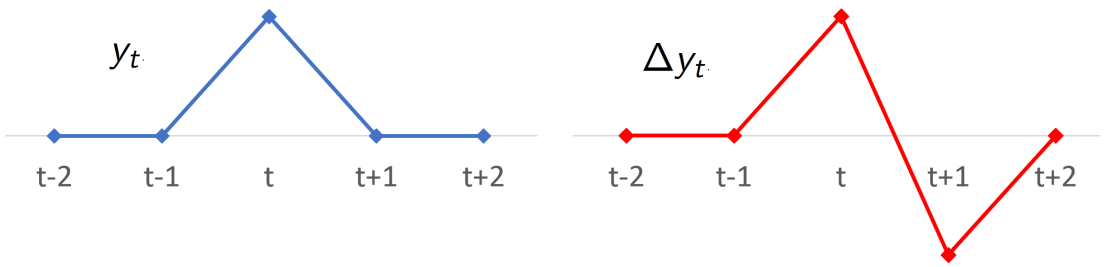

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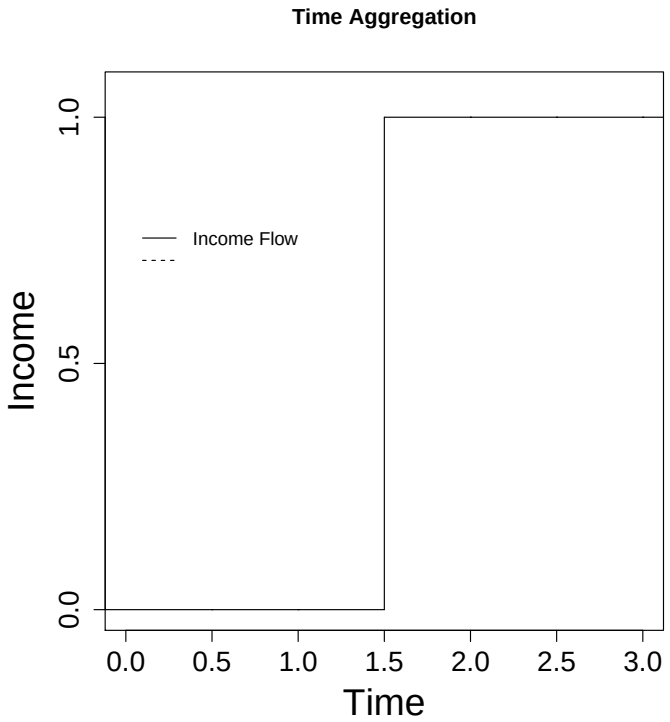
Fails due to the **Time Aggregation Problem**

Aside: Time Aggregation Problem in BPP (Crawley 2018)



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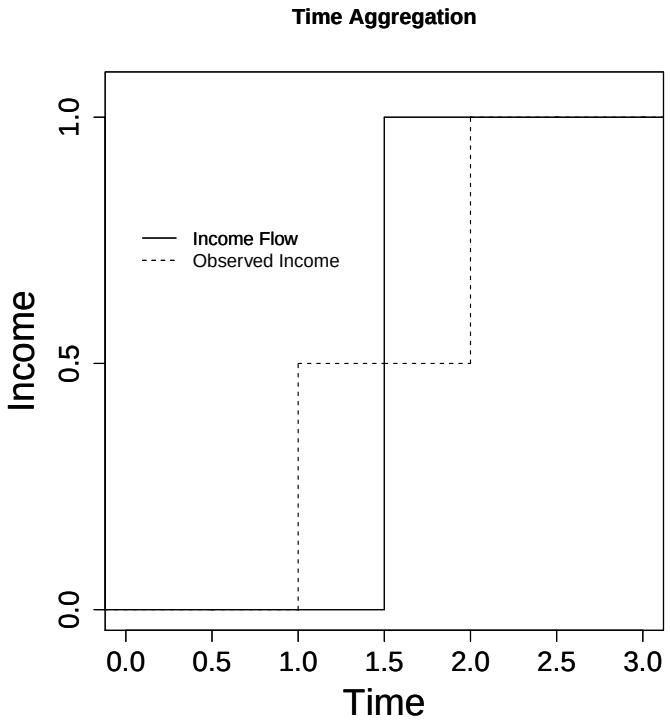

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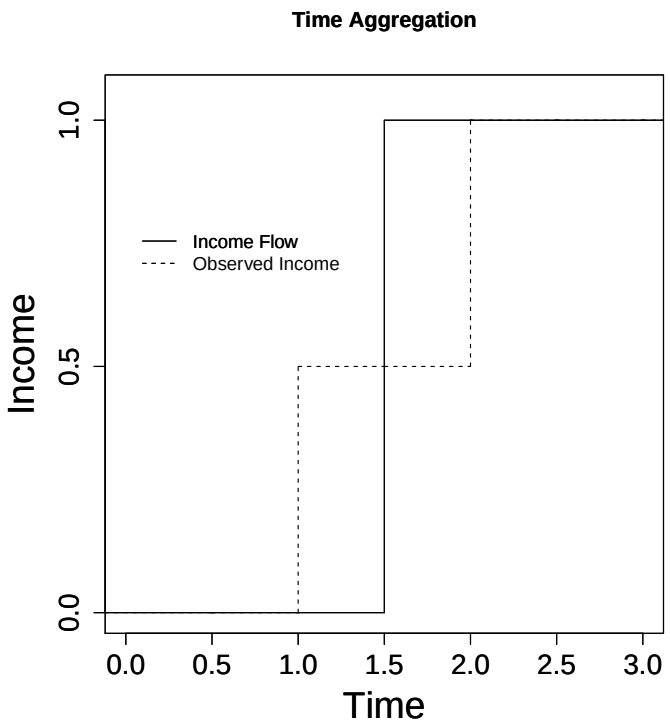
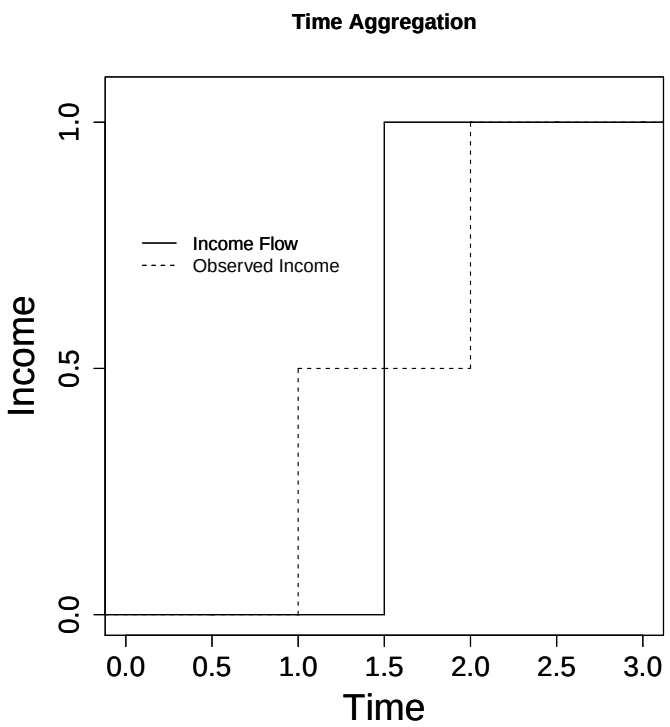


Observed permanent income growth is *positively* autocorrelated

BPP misinterprets *positive* permanent income shocks as *negative* transitory shocks

$\Longrightarrow$ Thinks negative transitory shocks result in consumption *increasing*

Aside: Time Aggregation Problem in BPP (Crawley 2018)



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BPP misinterprets *positive* permanent income shocks as *negative* transitory shocks

$\Longrightarrow$ Thinks negative transitory shocks result in consumption *increasing*

If the Permanent Income Hypothesis holds, BPP will estimate the MPC to be -0.6

Data: When is Measurement Error a Problem?

We have the same issues as the regression:

$$\Delta c_i = \alpha + \beta \Delta y_i + \varepsilon_i$$

That is measurement error in:

- Δy_i leads to attenuation bias
- Δc_i should be uncorrelated with Δy_i

Data: When is Measurement Error a Problem?

We have the same issues as the regression:

$$\Delta c_i = \alpha + \beta \Delta y_i + \varepsilon_i$$

That is measurement error in:

- Δy_i leads to attenuation bias ↗ High quality income data
- Δc_i should be uncorrelated with Δy_i ↙

When might this fail?

- Off balance sheet saving
- Returns correlated with *changes* in income (e.g. stock compensation)
- When insurance is provided by friends and family