Income Uncertainty and Consumption Dynamics

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Overview

What will this paper do?

1. Create a new method to estimate heterogeneity in consumption responses to permanent and transitory shocks to income
2. Show how well a standard consumption saving model, calibrated to Danish data, fits
3. Application: Redistribution Channel of Monetary Policy (Auclert (2015))

How Are Consumption Responses Typically 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				
Permanent Shocks	Nondurables	Total PCE	Horizon	Method	Event/Sample
Blundell, Pistaferri, and Preston (2008)*	0.65		∼	1	Estimation Sample: 1980–92
Gelman, Gorodnichenko, Kariv, Koustas, Shapiro, Silverman, and Tadelis (2016)		1.0	∼	3	Gasoline Price Shock
Transitory Shocks					
Agarwal and Qian (2014)		0.90	10m	1	Growth Dividend Program Singapore 2011
Blundell, Pistaferri, and Preston (2008)*	0.05			3	Estimation Sample: 1980–92
Browning and Collado (2001)		~ 0		1	Spanish ECPF Data, 1985–95
Coronado, Lupton, and Sheiner (2005)		0.36	1y	1	2003 Tax Cut
Fuster, Kaplan, and Zafar (2018)		0.08–0.31	3m	2	NY Fed Survey Cons. Expectations
Gelman (2016)		0.13	3m	1	Tax refunds 2013-2016
Hausman (2012)		0.6–0.75	1y	1	1936 Veterans' Bonus
Hsieh (2003)*	~ 0	0.6–0.75		1	CEX, 1980–2001
Jappelli and Pistaferri (2014)	0.48			2	Italy, 2010
Johnson, Parker, and Souleles (2009)	~ 0.25		3m	1	2003 Child Tax Credit
Lusardi (1996)*	0.2–0.5			3	Estimation Sample: 1980–87
Parker (1999)	0.2		3m	1	Estimation Sample: 1980–93
Parker, Souleles, Johnson, and McClelland (2013)	0.12–0.30	0.50–0.90	3m	1	2008 Economic Stimulus
Sahm, Shapiro, and Slemrod (2010)		$\sim 1/3$	1y	1	2008 Economic Stimulus
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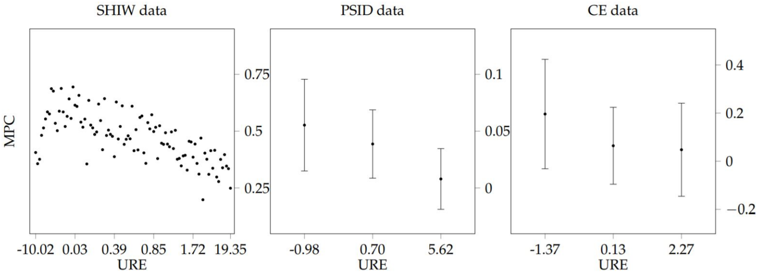
Souleles (1999)	0.045–0.09	0.34–0.64	3m	1	Estimation Sample: 1980–91
Souleles (2002)	0.6–0.9		1y	1	The Reagan Tax Cuts of the Early 1980s

* Elasticity. Methods: 1) Natural Experiment 2) Survey question 3) Covariance restrictions

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

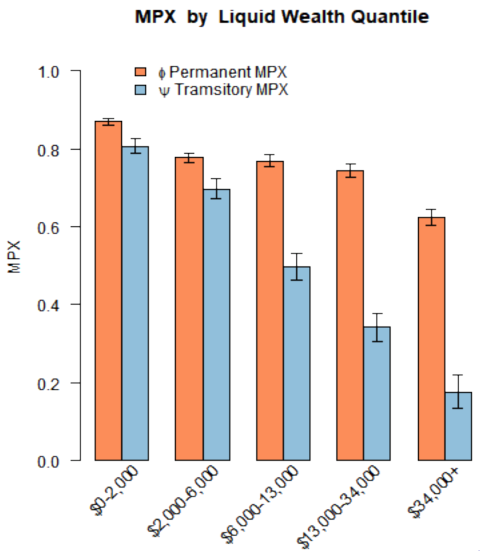
Evidence on Distribution of Consumption Response

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



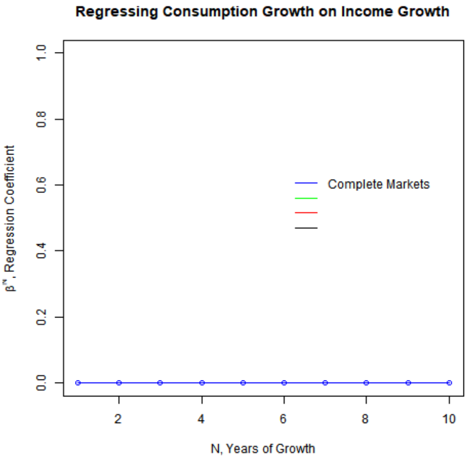
Recent evidence from Norwegian registry data using lottery winnings provides evidence of variation across liquid wealth

Results Preview



Methodology Intuition

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



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

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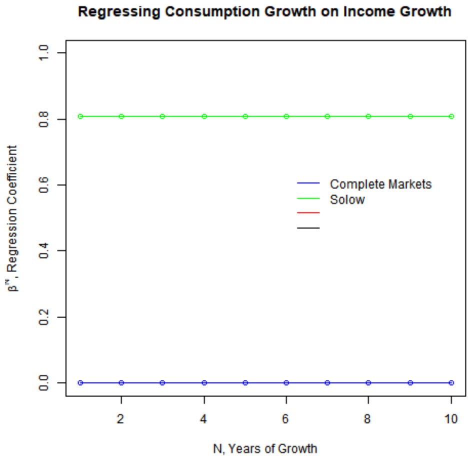

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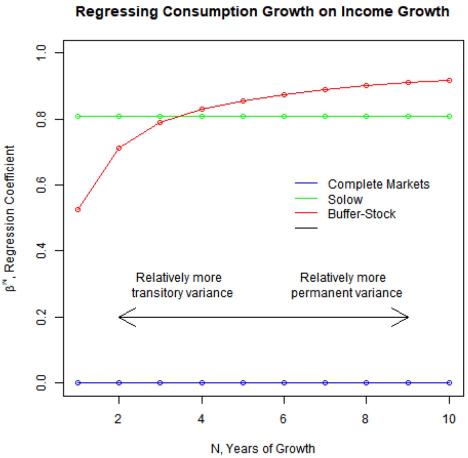

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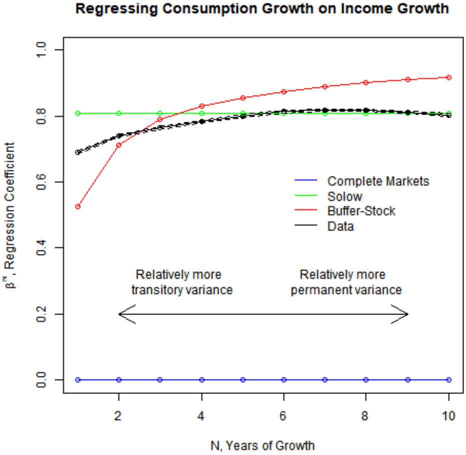

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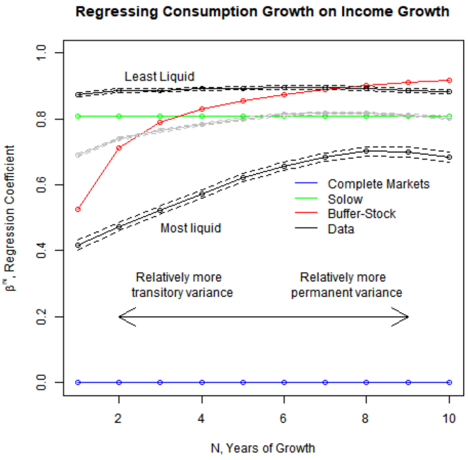

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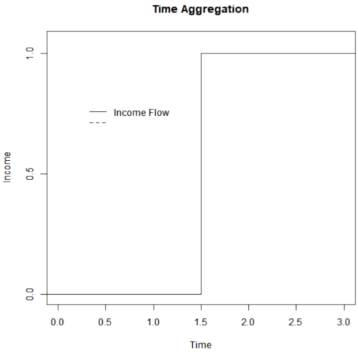
Aside: Why Not Blundell, Pistaferri and Preston 2008?

1) Time Aggregation Problem (Crawley 2018)



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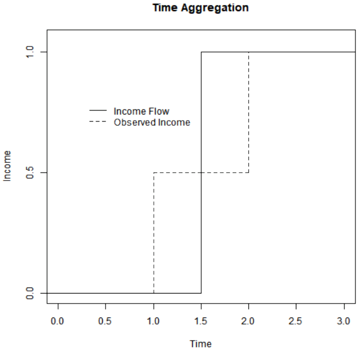

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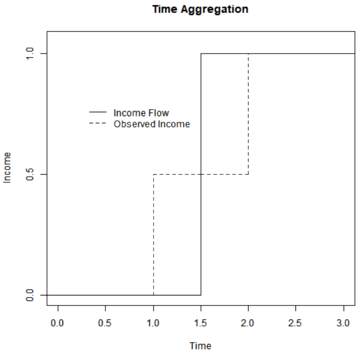

PIH Example:

- 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:

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

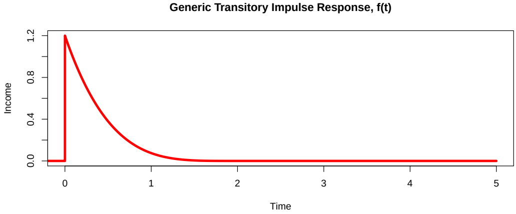
$$\implies \mathrm{Var}(\Delta^N \bar{y}_T) = (N - \frac{1}{3})\sigma_p + 2\sigma_q$$

Identification of the Income Process

Allow a generic persistence in transitory shock

- Following shock, transitory income flow decays as:

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



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

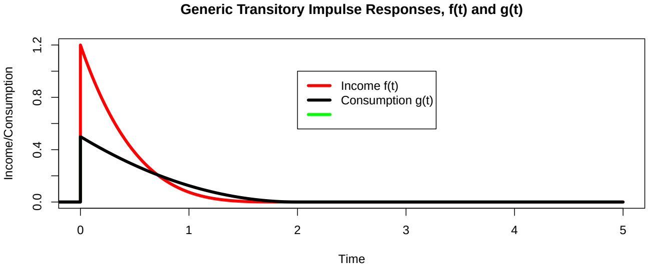
$$\implies \mathrm{Var}(\Delta^N \bar{y}_T) = (N - \frac{1}{3})\sigma_p^2 + 2\sigma_{\tilde{q}}^2 \text{ for } N \geq 3$$

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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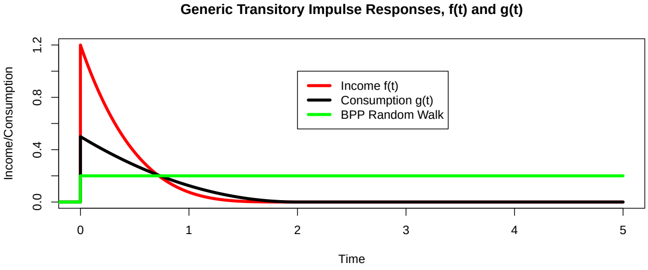

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Identification of the Consumption Response

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

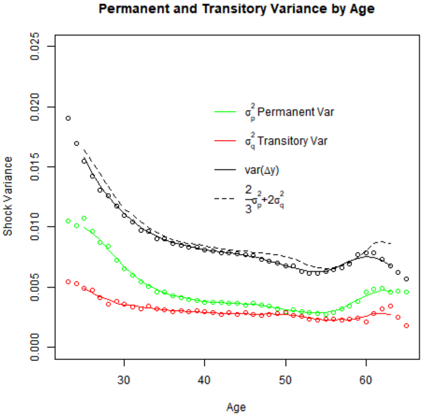
Imputing Expenditure

We use the identity

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

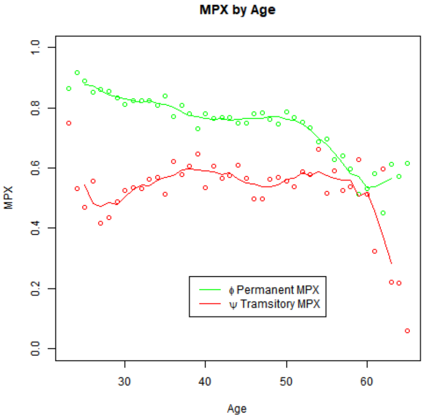
- Works well for households with simple financial lives
- Main issue: Capital gains and losses
  - Exclude households where methodology will not work well (eg Business owners)
  - Exclude housing wealth and years with housing transactions
  - Capital gains for stocks based on a diversified index
- Noisy, 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



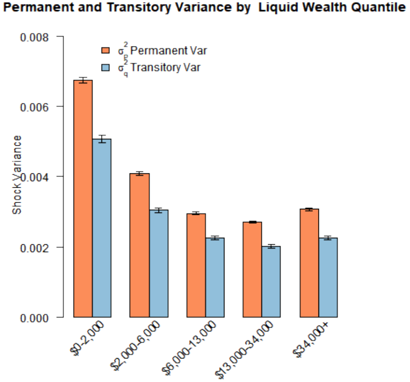
The assumption of constant variance works reasonably well from mid-30's to retirement

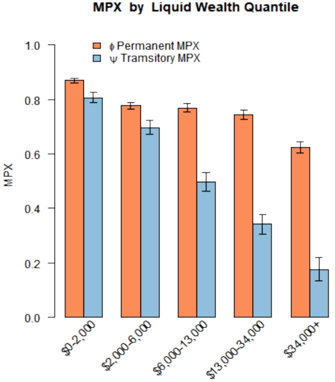
MPX by Age



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

MPX by Liquid Wealth





Durables

Our expenditure measure include ALL expenditure

- Household goods (electronics, kitchen equipment, etc)
- Cars
- Home improvements (roof repair, extensions)

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Durables make up about 10% of total expenditure

But theory suggests durable expenditures should not be proportional to permanent income changes

- This may bias our results

Durables

Suppose households *instantaneously* upgrade their durable goods and then pay a constant flow of depreciation:

$$dc_t = \phi p_t dt + \phi_d dp_t + \psi dq_t$$

- ϕ can be interpreted as the MPC to permanent shocks, where consumption includes non-durables and the service *flow* from durable goods
- ϕ_d is the proportion of the (annual) permanent shock that is spent instantaneously on durables
- ψ is the MPX out of transitory income, exactly as before

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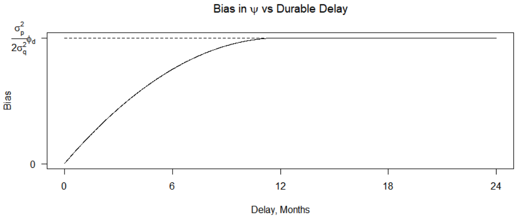
Then our estimates of ϕ and ψ are unbiased. We have no way of estimating ϕ_d

Durables

If households act with some delay things are different. Suppose they wait 1 year

$$dc_t = \phi p_t dt + \phi_d dp_{t-1} + \psi dq_t$$

- $\mathbb{E}(\hat{\phi}) = \phi$ Permanent MPC is unbiased
- $\mathbb{E}(\hat{\psi}) = \psi + \frac{\sigma_p^2}{2\sigma_q^2}\phi_d$ Transitory MPX is upward biased



Durables

We have data on value of household cars

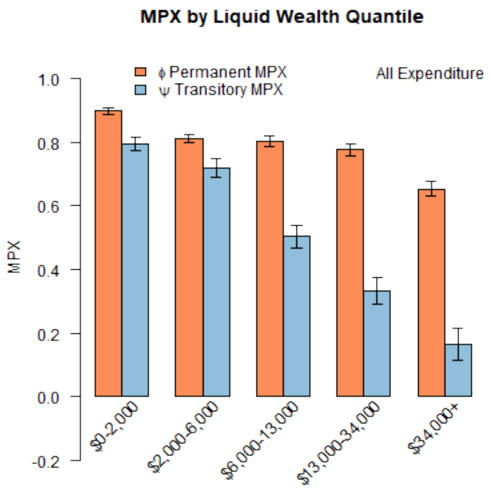
- Construct expenditure excluding car purchases and sales

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

- 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
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All Expenditure
MPX
1.0
0.8
0.6
0.4
0.2
0.0
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$0-2,000
$2,000-6,000
$6,000-13,000
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$34,000+

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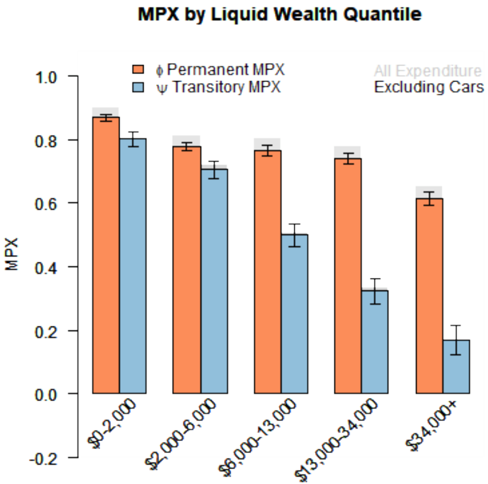
MPX by Liquid Wealth Quantile
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All Expenditure
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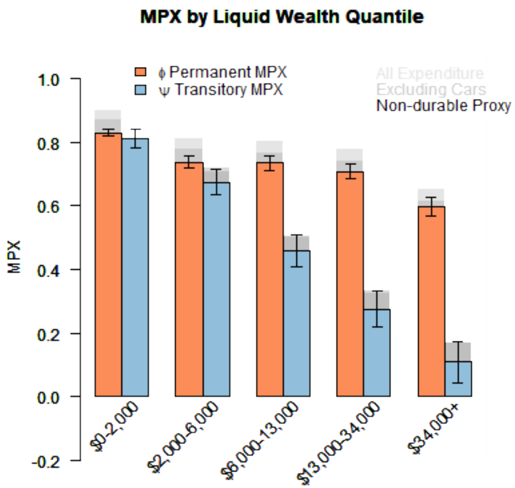
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All Expenditure
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$34,000+

Monetary Policy: Measuring Redistribution

We calculate the sufficient statistics from Auclert (2015)

Here we will focus on the *Interest Rate Exposure* channel:

If

1. Households that *owe* a lot of floating rate debt have *high* MPCs
2. Households that *own* a lot of floating rate debt have *low* MPCs

Then lowering interest rates will on average *increase* consumption through redistribution

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Do we know if 1 and 2 hold? How can we measure the size of this effect?

Monetary Policy: Measuring 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 channell on household i's expenditure is:

$$dc_i = MPC_i URE_i \frac{dR}{R} \tag{1}$$

Monetary Policy: Measuring Redistribution

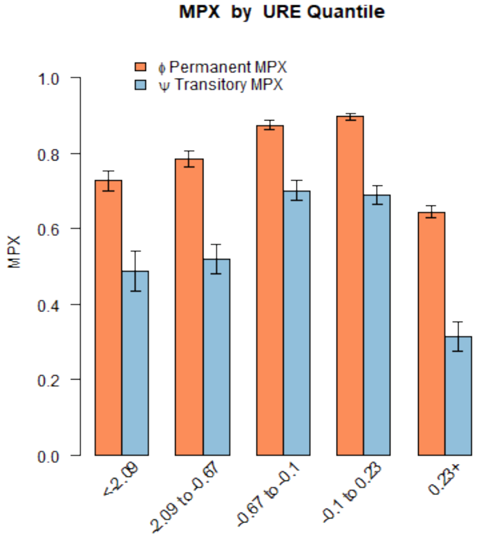
In aggregate, the size of this channel is given by:

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

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

We can do that!

Monetary Policy: Measuring Redistribution



Model

How does this compare with a standard buffer-stock saving model?

- Build model to match Danish income process
- Allow *heterogeneous discount factors* in order to match the distribution of *liquid* assets in Denmark
- See how the distribution of transitory MPX varies with liquid asset holdings

Model

Given market resources ($\mathbf{m}_t$), households in this model maximize expected utility:

$$\mathbb{E}_t \sum_{i=t}^{\infty} \beta^i (1-D)^i u(\mathbf{c}_i)$$

subject to the constraints:

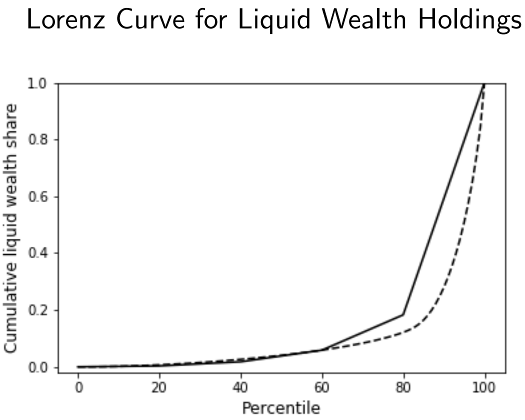
$$\begin{aligned} \mathbf{a}_t &= \mathbf{m}_t - \mathbf{c}_t \\ \mathbf{b}_t &= R\mathbf{a}_t \\ \mathbf{y}_t &= \theta_t \mathbf{p}_t \\ \mathbf{p}_t &= \Psi_t \mathbf{p}_{t-1} \\ \mathbf{m}_t &= \mathbf{b}_t + \mathbf{y}_t \end{aligned}$$

Calibration

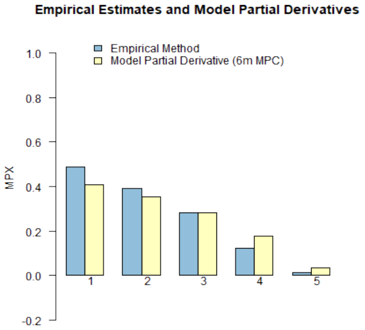
Table: Calibration

		Calibrated Parameters
σ^2_θ	0.012	Variance Tran Shocks (=4× 0.003 Annual)
σ^2_ψ	0.001	Variance Perm Shocks (=0.25× 0.005 Annual)
$\wp$	0.070	Probability of Unemployment Spell
θ^u	0.600	Income in Unemployment Spell
D	0.006	Probability of Mortality
ρ	1.	Coefficient of Relative Risk Aversion
R	1.016	Quarterly Interest Rate
		Estimated Parameters
β^c	0.977	Mean discount factor
∇	0.020	Discount factor spread

Lorenz Curve



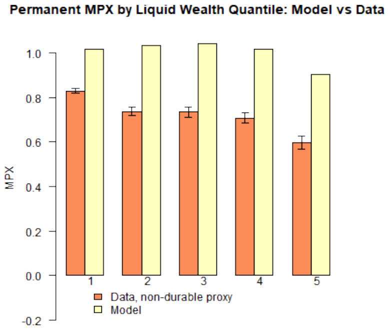
Does our Methodology Work?

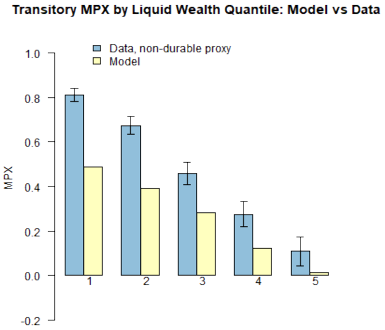


- Estimate is larger than 6m MPX for low liquid wealth
  - Income jumps can be large
- Estimate is smaller than 6m MPX for high levels of wealth
  - Consumption response lasts more than 2 years

Model vs Data

How does the model compare with the data?





Threats to Identification

	Direction of Bias	
	Perm MPX	Tran MPX
Endogenous Income Shocks	Neutral	+ve
Persistent Consumption Response	+ve	-ve
Income Measurement Error	Neutral	+ve
Permanent Shocks are AR(1)	Neutral	+ve
Non-linear MPX	?	?

Endogenous Income Shocks

- Household's consumption preference highly variable
- Hours worked is endogenous

The household maximizes:

$$\mathbb{E}_t \sum_{n=t}^{\infty} \beta^n \left(\mathcal{X}_n \frac{\mathbf{c}_n^{1-\rho}}{1-\rho} - \frac{\boldsymbol{\ell}_n^{1+\frac{1}{\xi}}}{1+\frac{1}{\xi}} \right)$$

- Frisch elasticity ξ
- Preference shock $\mathcal{X}$

Endogenous Income Shocks

	MPC	Frisch Elasticity				
		0.00	0.13	0.25	0.38	0.50
	0.00	0.17	0.13	0.11	0.09	0.08
Preference shock	0.10	0.19	0.15	0.13	0.11	0.09
	0.20	0.25	0.20	0.16	0.13	0.11
	0.30	0.32	0.26	0.21	0.17	0.14
	0.40	0.38	0.31	0.25	0.20	0.16

	ψ	Frisch Elasticity				
		0.00	0.13	0.25	0.38	0.50
	0.00	0.07	0.05	0.04	0.04	0.03
Preference shock	0.10	0.09	0.07	0.06	0.05	0.05
	0.20	0.14	0.12	0.11	0.12	0.13
	0.30	0.20	0.20	0.23	0.28	0.32
	0.40	0.27	0.33	0.43	0.54	0.64

Persistent Consumption Response

We assume the transitory consumption response lasts less than 2 years

High MPC Model

n_1 \ n_2	1	2	3	4	5	6	7	8	9	10
1		0.62	0.64	0.66	0.66	0.67	0.67	0.67	0.67	0.67
2			0.76	0.77	0.77	0.77	0.77	0.77	0.77	0.77
3				0.78	0.78	0.78	0.78	0.78	0.78	0.78
4					0.78	0.78	0.78	0.78	0.78	0.78
5						0.79	0.78	0.78	0.79	0.79
6							0.78	0.78	0.79	0.79
7								0.79	0.79	0.79
8									0.79	0.79
9										0.78
10										

Low MPC Model

n_1 \ n_2	1	2	3	4	5	6	7	8	9	10
1		0.21	0.23	0.23	0.24	0.24	0.25	0.25	0.25	0.25
2			0.29	0.30	0.31	0.31	0.32	0.32	0.32	0.32
3				0.33	0.34	0.34	0.34	0.35	0.35	0.35
4					0.35	0.35	0.36	0.36	0.36	0.36
5						0.36	0.36	0.36	0.36	0.37
6							0.37	0.37	0.37	0.37
7								0.37	0.37	0.37
8									0.37	0.38
9										0.38
10										

When MPCs are low, this assumption does not hold in the model, leading to downward bias

Income Measurement Error

Imputation method means measurement error in income shows up in consumption too

Example:

- Actual transitory MPX is zero
- 25% of transitory income variance is due to measurement error
- Methodology would result in MPX estimate of 25%

Income Measurement Error

Imputation method means measurement error in income shows up in consumption too

Example:

- Actual transitory MPX is zero
- 25% of transitory income variance is due to measurement error
- Methodology would result in MPX estimate of 25%

But:

- Income is well measured (administrative data)
- Bias is much larger for households with small MPCs
  - MPX for high liquid wealth households is close to zero

Permanent Shocks are AR(1)

How does our methodology do if permanent income follows an AR(1) process?

$$p_t = \rho p_{t-1} + \varepsilon_t$$
$$y_t = p_t + q_t$$
$$c_t = \phi y_t + \psi q_t$$

	ψ	n_1 1	2	3	4	5	6	7	8
	1.0	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
ρ	0.98	0.41	0.42	0.43	0.44	0.46	0.47	0.49	0.51
	0.96	0.41	0.43	0.45	0.47	0.50	0.52	0.54	0.56
	0.94	0.42	0.44	0.47	0.50	0.52	0.55	0.57	0.59
	0.92	0.42	0.45	0.49	0.52	0.55	0.57	0.59	0.61
	0.9	0.43	0.46	0.50	0.53	0.56	0.59	0.61	0.62

References I

AGARWAL, SUMIT, AND WENLAN QIAN (2014): "Consumption and Debt Response to Unanticipated Income Shocks: Evidence from a Natural Experiment in Singapore," *American Economic Review*, 104(12), 4205–4230.

AUCLERT, ADRIEN (2015): "Monetary policy and the redistribution channel," *Unpublished manuscript*.

BLUNDELL, RICHARD, LUIGI PISTAFERRI, AND IAN PRESTON (2008): "Consumption Inequality and Partial Insurance," *American Economic Review*, 98(5), 1887–1921.

BROWNING, MARTIN, AND M. DOLORES COLLADO (2001): "The Response of Expenditures to Anticipated Income Changes: Panel Data Estimates," *American Economic Review*, 91(3), 681–692.

CORONADO, JULIA LYNN, JOSEPH P. LUPTON, AND LOUISE M. SHEINER (2005): "The Household Spending Response to the 2003 Tax Cut: Evidence from Survey Data," FEDS discussion paper 32, Federal Reserve Board.

FUSTER, ANDREAS, GREG KAPLAN, AND BASIT ZAFAR (2018): "What Would You Do With $500? Spending Responses to Gains, Losses, News and Loans," Working Paper 24386, National Bureau of Economic Research.

GELMAN, MICHAEL (2016): "What Drives Heterogeneity in the Marginal Propensity to Consume? Temporary Shocks vs Persistent Characteristics," .

GELMAN, MICHAEL, YURIY GORODNICHENKO, SHACHAR KARIV, DMITRI KOUSTAS, MATTHEW D. SHAPIRO, DAN SILVERMAN, AND STEVEN TADELIS (2016): "The Response of Consumer Spending to Changes in Gasoline Prices," Working Paper 22969, National Bureau of Economic Research.

HAUSMAN, JOSHUA K. (2012): "Fiscal Policy and Economic Recovery: The Case of the 1936 Veterans' Bonus," mimeo, University of California, Berkeley.

HSIEH, CHANG-TAI (2003): "Do Consumers React to Anticipated Income Changes? Evidence from the Alaska Permanent Fund," *American Economic Review*, 99, 397–405.

JAPPELLI, TULLIO, AND LUIGI PISTAFERRI (2014): "Fiscal Policy and MPC Heterogeneity," *American Economic Journal: Macroeconomics*, 6(4), 107–136.

References II

JOHNSON, DAVID S., JONATHAN A. PARKER, AND NICHOLAS S. SOULELES (2009): "The Response of Consumer Spending to Rebates During an Expansion: Evidence from the 2003 Child Tax Credit," working paper, The Wharton School.

LUSARDI, ANNAMARIA (1996): "Permanent Income, Current Income, and Consumption: Evidence from Two Panel Data Sets," *Journal of Business and Economic Statistics*, 14(1), 81–90.

PARKER, JONATHAN A. (1999): "The Reaction of Household Consumption to Predictable Changes in Social Security Taxes," *American Economic Review*, 89(4), 959–973.

PARKER, JONATHAN A, NICHOLAS S SOULELES, DAVID S JOHNSON, AND ROBERT MCCLELLAND (2013): "Consumer spending and the economic stimulus payments of 2008," *The American Economic Review*, 103(6), 2530–2553.

SAHM, CLAUDIA R., MATTHEW D. SHAPIRO, AND JOEL B. SLEMROD (2010): "Household Response to the 2008 Tax Rebate: Survey Evidence and Aggregate Implications," *Tax Policy and the Economy*, 24, 69–110.

SHAPIRO, MATTHEW D., AND JOEL SLEMROD (2009): "Did the 2008 Tax Rebates Stimulate Spending?," *American Economic Review*, 99(2), 374–79.

SOULELES, NICHOLAS S. (1999): "The Response of Household Consumption to Income Tax Refunds," *American Economic Review*, 89(4), 947–958.

——— (2002): "Consumer Response to the Reagan Tax Cuts," *Journal of Public Economics*, 85, 99–120.