How do households respond to income shocks?

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Workshop on Savings and Financial Underpinnings of Macro Models

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The questions

- How big is idiosyncratic risk that individuals face through working life?

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- No insurance (hands to mouth): consumption bears all the adjustment
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- Partial insurance

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The objective and relation to literature

- Use long panel on income, consumption and wealth/transfers to assess which model can better account for household level data and identify risk and insurance
- Substantial research on the topic, most focuses on consumption and income and it lacks explicit evidence on insurance mechanisms (i.e. wealth, transfers) (Altonji and Siow 1987,...,Jappelli and Pistaferri 2010) or focuses on a single shock (Johnson, Parker and Souleles, 2006)

Findings

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- For many households strong evidence of non-income risk
- For income risk evidence against HtM or CM, consistent with PIH with limited persistence of risk. Mixed evidence in favor of precautionary motive

Outline

- Describe data and characterize household responses to income shocks/changes
- Evaluate a simple self insurance model
- Research directions

The data

- Survey of household income and wealth (SHIW)
- About 8000 Italian households every 2 years. 1987-2008
- Detailed information on income, consumption and wealth
- Significant panel dimension

SHIW Panel sample size, 1987-2008

	Year of interview										
	1987	1989	1991	1993	1995	1998	2000	2002	2004	2006	2008
Total sample	8025	8274	8188	8088	8135	7147	8001	8011	8012	7768	7977
By entry year:											
1987	8025	1205	350	173	126	85	61	44	33	30	28
1989		7069	1837	877	701	459	343	263	197	159	146
1991			6001	2420	1752	1169	832	613	464	393	347
1993				4618	1065	582	398	269	198	156	140
1995					4491	374	246	178	118	102	85
1998						4478	1993	1224	845	636	538
2000							4128	1014	667	475	398
2002								4406	1082	672	525
2004									4408	1334	995
2006										3811	1143
2008											3632

Sample selection

- Households with head 25-55 not retired

An organizing budget constraint

$$c_{nt} + c_{dt} + a_{t+1} + e_{t+1} = y_t + p_t + a_t + e_t + T_t$$

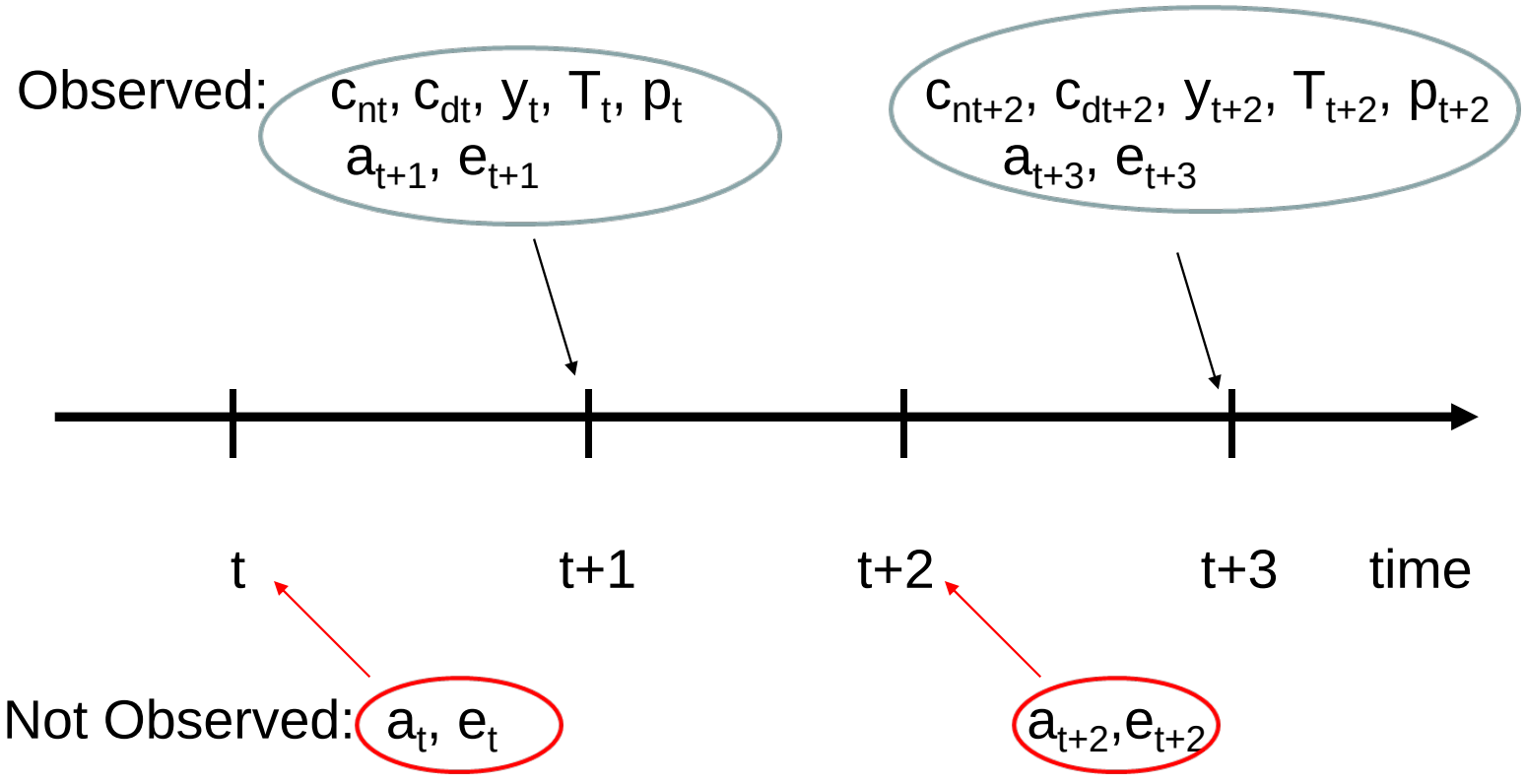
c_{nt}	$=$	Expenditures on nondurables
c_{dt}	$=$	Expenditures on durables
a_{t+1}	$=$	End of period financial assets
e_{t+1}	$=$	End of period real assets (real estate & businesses)
y_t	$=$	Labor and self employment income (after-tax)
p_t	$=$	After tax income from assets (real estate and financial)
T_t	$=$	Transfers (private and public)

SHIW Summary statistics

	Average Level			Annual Growth
	(1987)	(2006)	(2008)	(1987-2006)
Age of head	41.5	43.6	44.8	0.4%
Household size	3.8	3.2	3.18	-0.7%
Labor income	8156	11036	10441	1.4%
Asset income	1211	2613	2469	4.3%
Transfers	285	550	592	3.6%
ND consumption	5766	6691	6868	0.9%
D consumption	860	926	920	0.2%
Total Wealth	34939	94957	89179	5.5%
Financial Wealth	5124	9632	7606	3.4%

All vars except age and size, are per adult equiv. and in 2000 Euros

Timeline for the SHIW



Biannual differences

$$
\begin{aligned}
& \Delta^2 c_{nt} + \Delta^2 c_{dt} + \Delta^2 a_{t+1} + \Delta^2 e_{t+1} \\
= \quad & \Delta^2 y_t + \Delta^2 p_t + \Delta^2 T_t \\
& + \Delta^2 a_t + \Delta^2 e_t
\end{aligned}
$$

- How big are (annualized) income changes $\Delta^2 y_t$?
- How do the observable differences in the budget constraint co-move with $\Delta^2 y_t$?
- Note: $\Delta^2 a_t$ and $\Delta^2 e_t$ are not observed.

The empirical strategy

- Equivalize all variables and compute annualized changes

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- For each bin compute average change in observable components of the budget constraint ($\Delta^2 c_{nt}, \ldots$)

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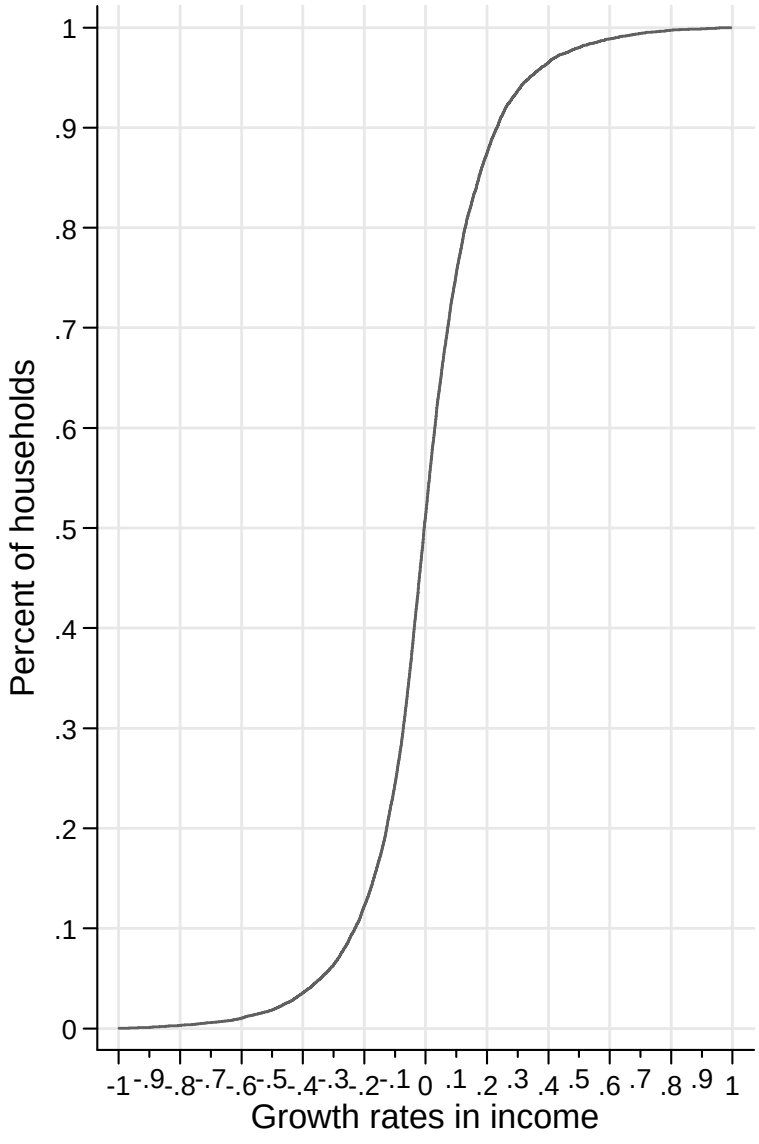
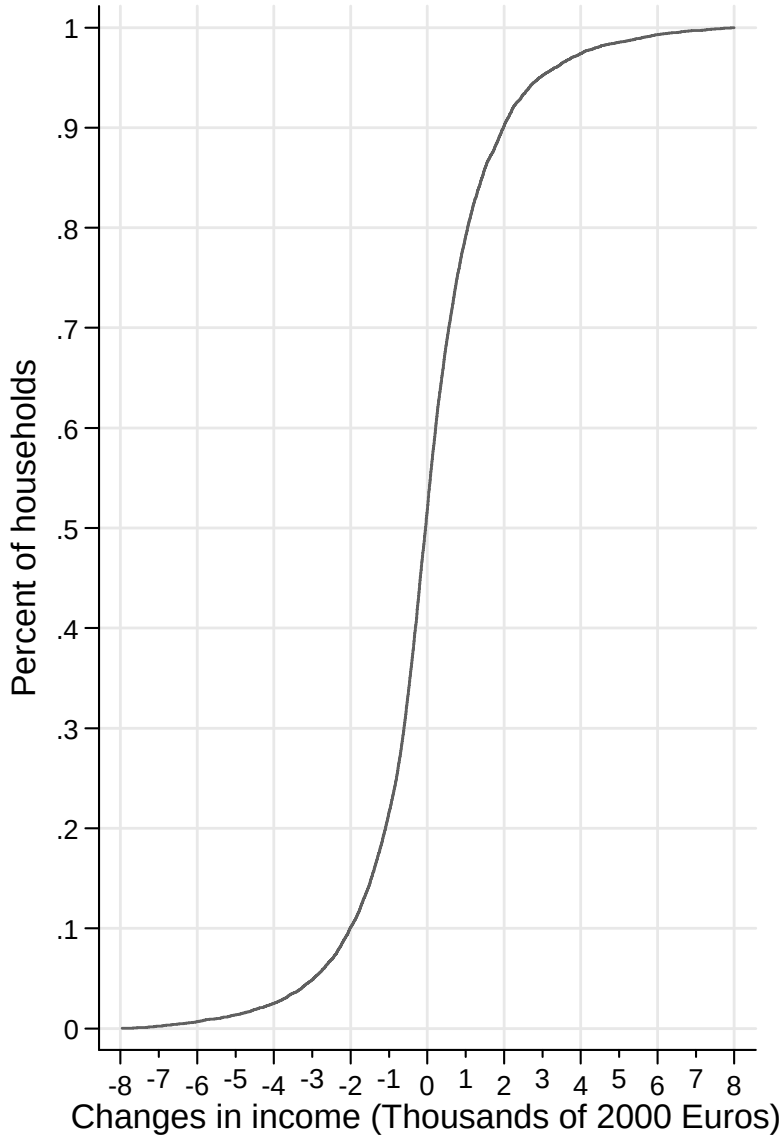
- For each bin compute average change in observable components of the budget constraint ($\Delta^2 c_{nt}, \ldots$)
- Plot against $\Delta^2 y_t$

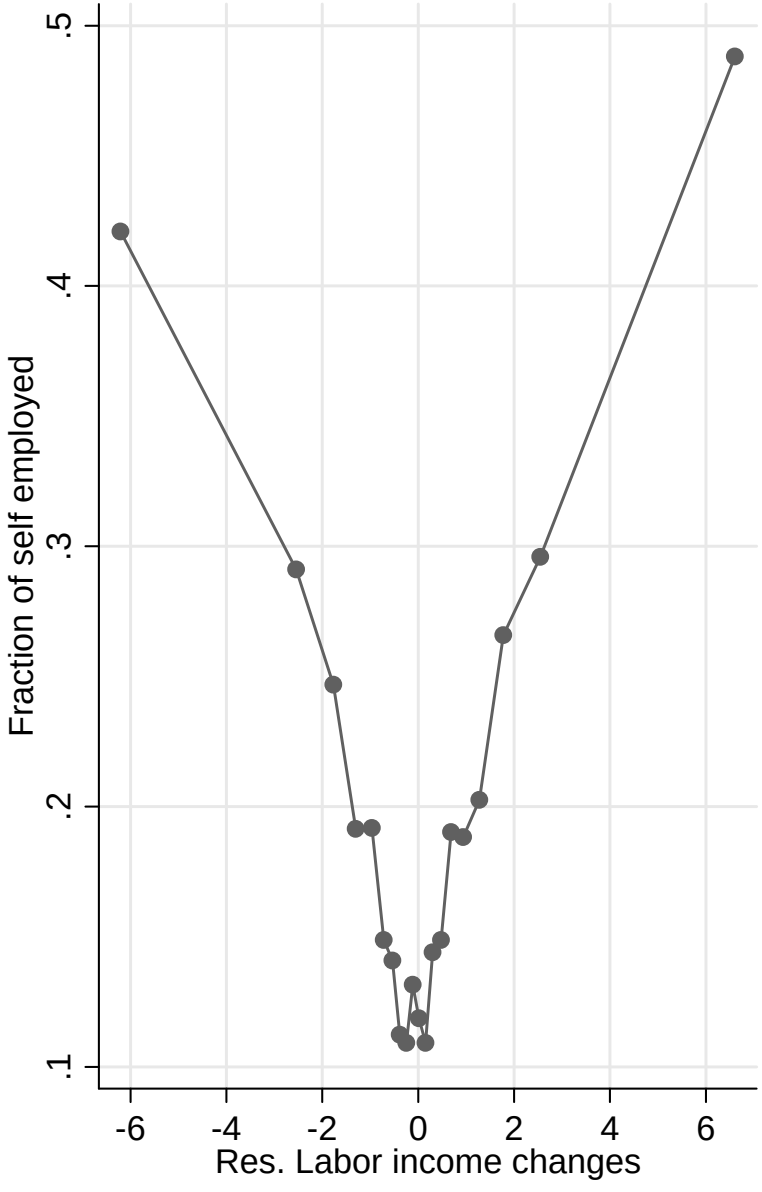
The size and distribution of income changes

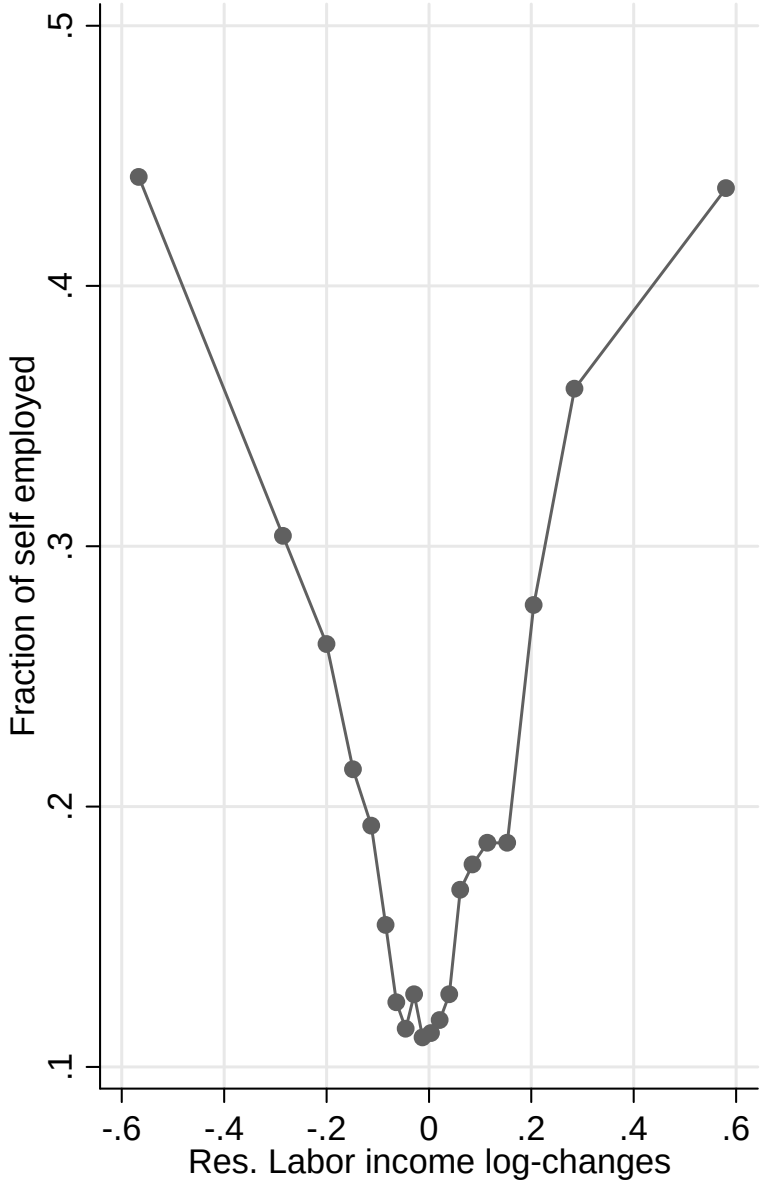




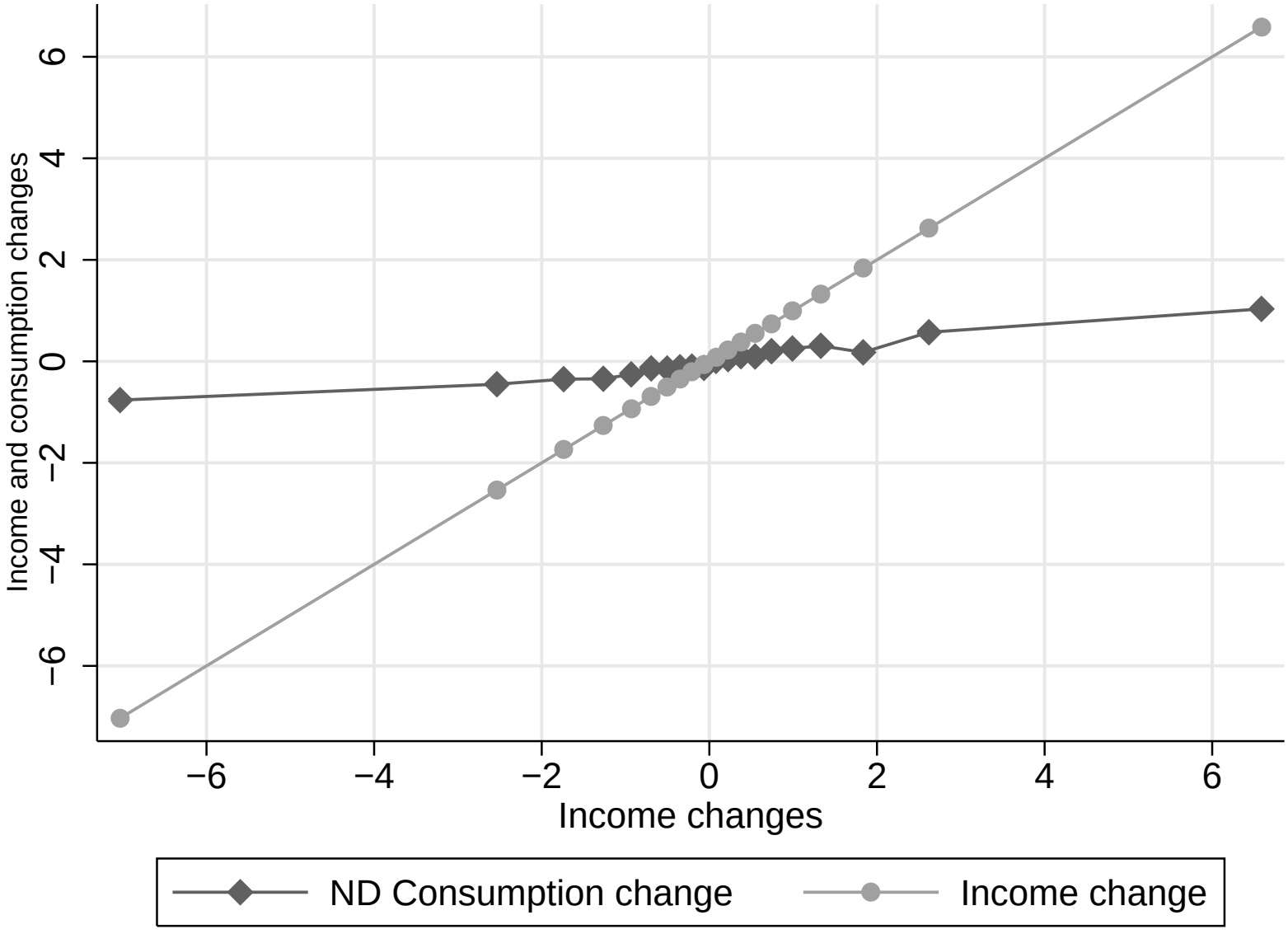
Note: Income is real after tax labor + business per adult equivalent. Growth rates and changes are annualized

Income changes and self employment



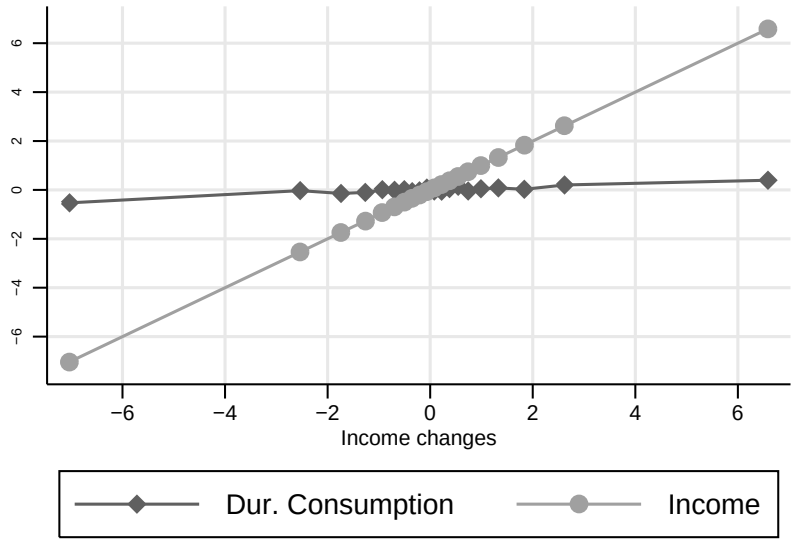


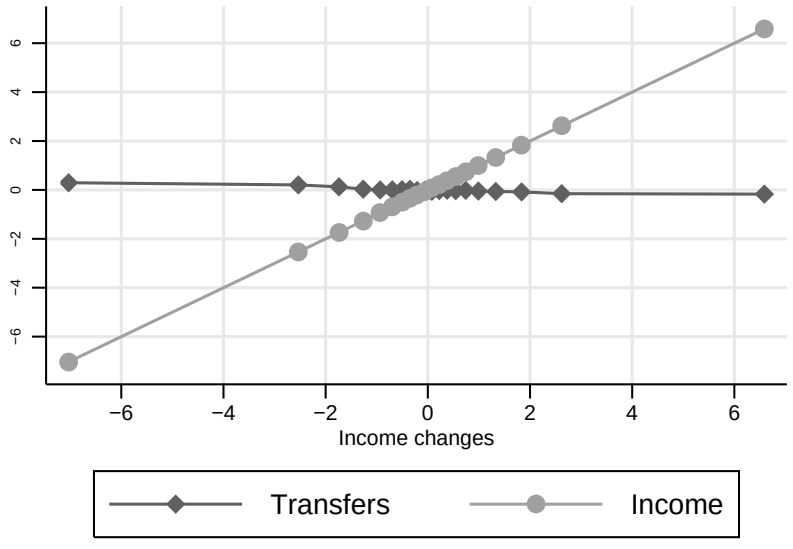
Income and consumption changes

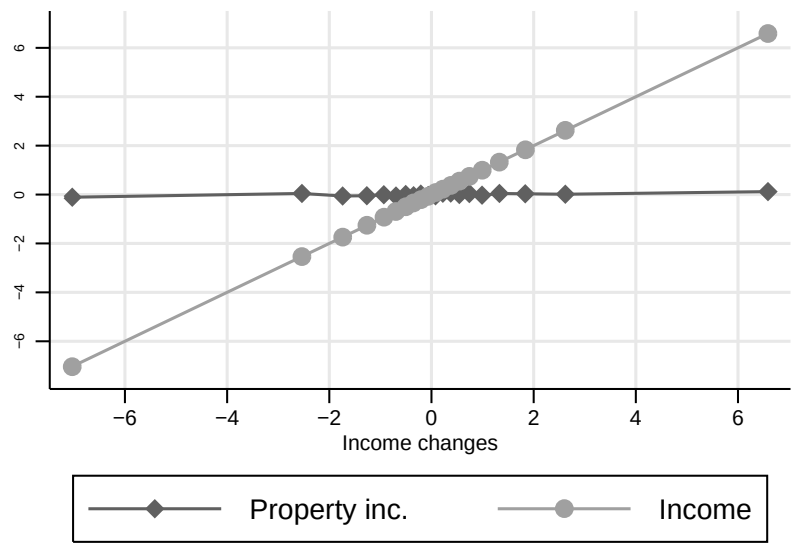


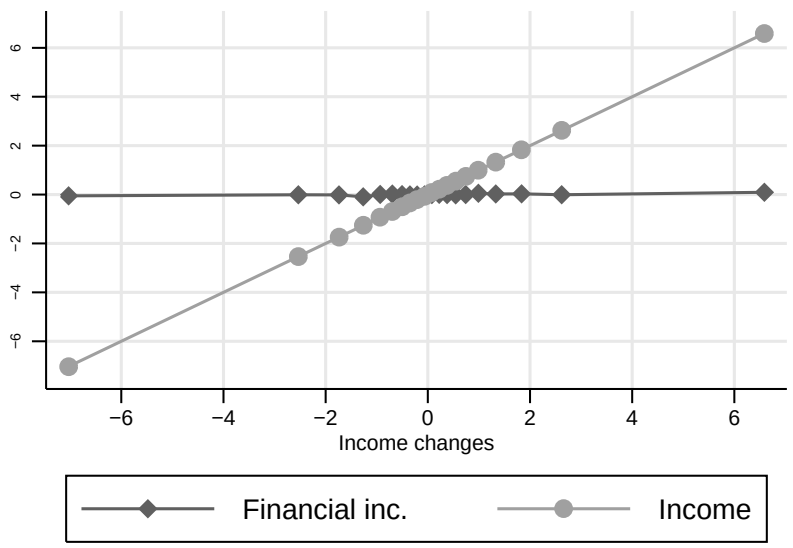
Changes are annualized and in thousands of 2000 Euros. Each dot averages approx. 700 households

Budget items with small response









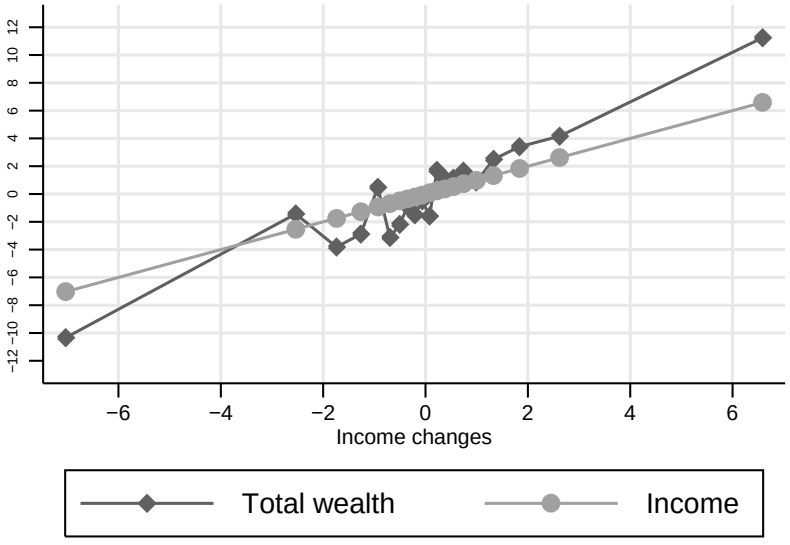
Households are sorted by residual labor income changes. Each dot averages approx 700 households
Changes are annualized and in thousands of 2000 Euros

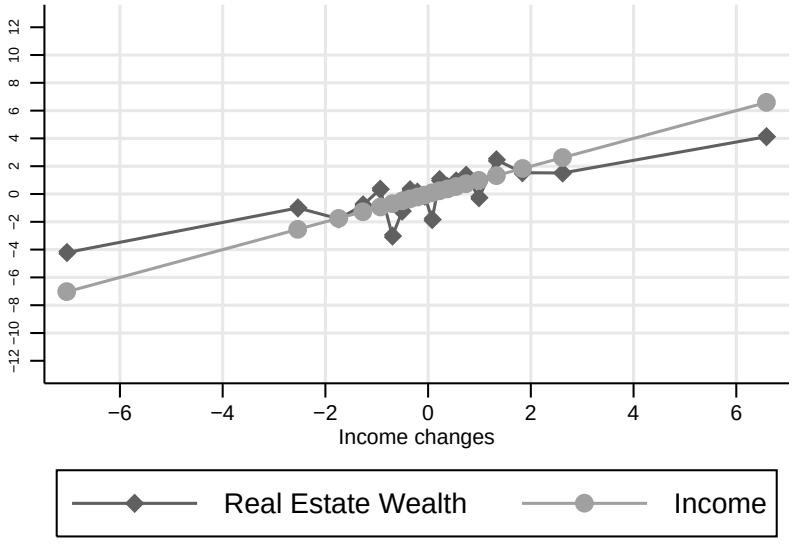
Regressing Components on Income Changes, I

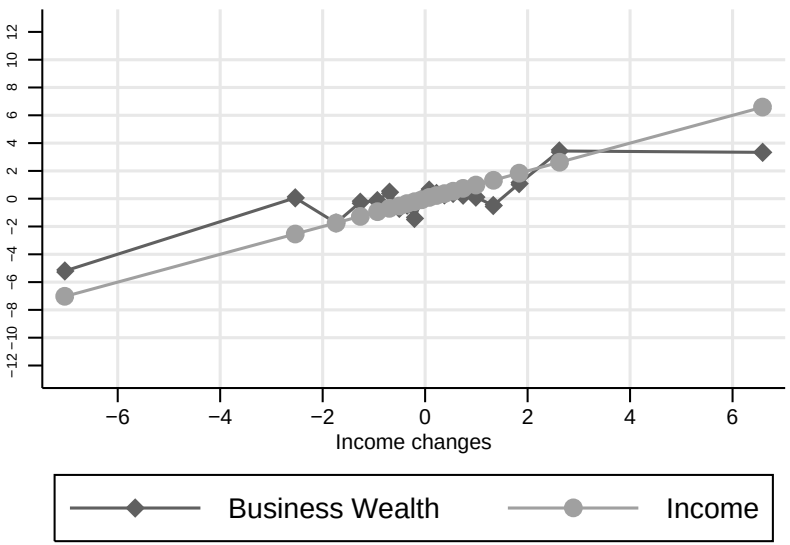
	Δc_n	Δc_d	ΔT	ΔT_P	ΔT_O	Δp
β_{OLS}	6.0	2.8	-0.9	-3.1	2.4	0.6
	(1.33)	(1.98)	(0.40)	(0.75)	(0.85)	(0.37)
R^2	0.03	0.01	0.00	0.01	0.00	0.00
β_{MR}	10.5	0.4	-0.07	-0.6	-0.4	0.7
	(0.20)	(0.04)	(0.02)	(0.01)	(0.04)	(0.05)
R^2	0.02	0.00	0.00	0.00	0.00	0.00
Obs.	14272	14272	14272	7852	7852	14272

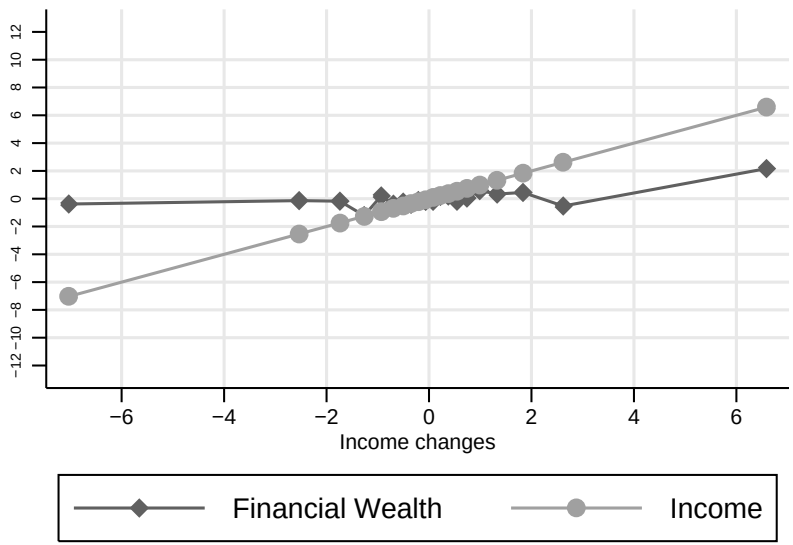
Note: SE clustered at household level (for OLS) are in parenthesis

Budget items with large response









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Regressing Components on Income Changes, II

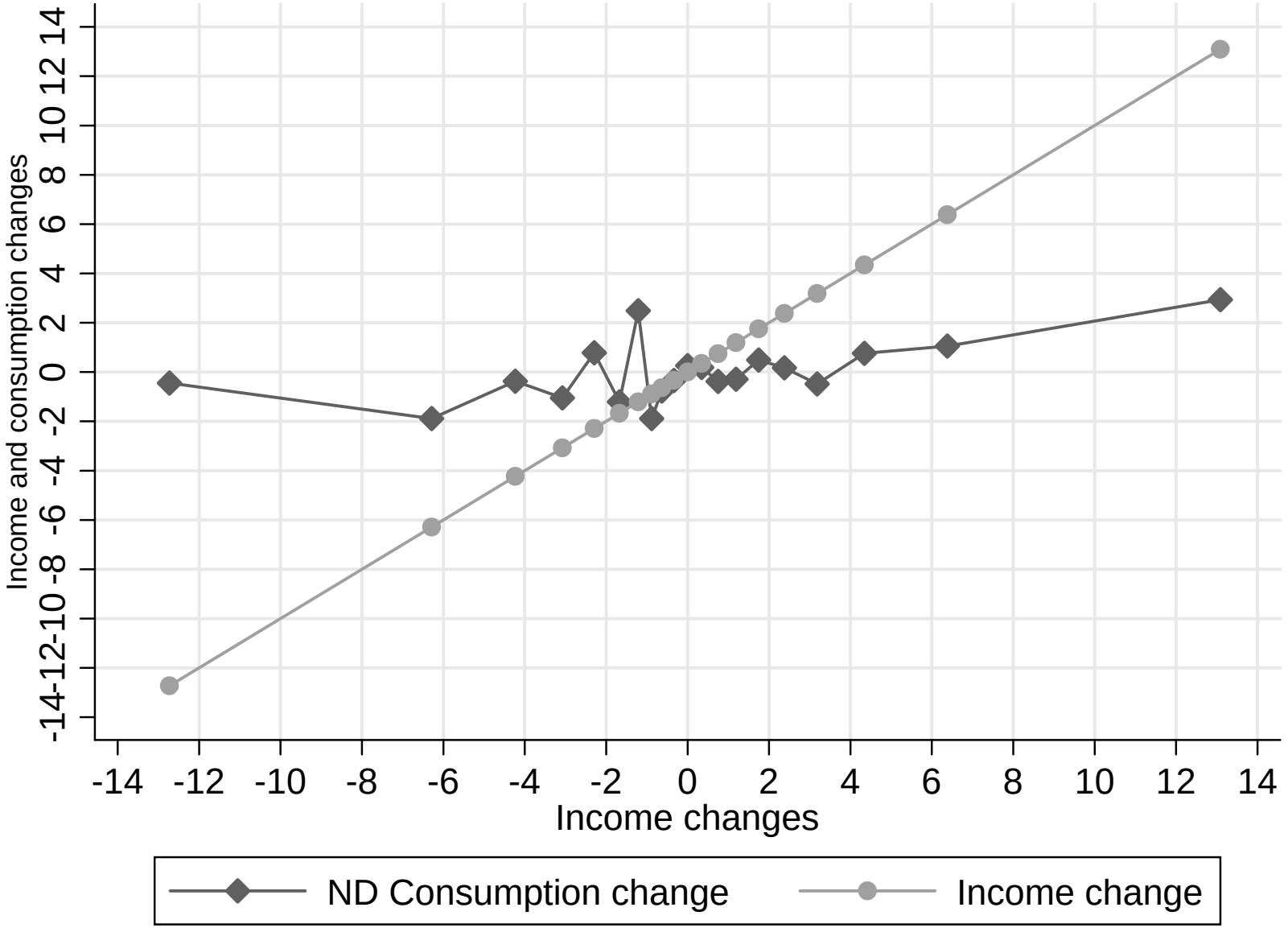
	Δa	Δa^f	Δa^{re}	Δa^{bw}	Δa^v
β_{OLS}	283.9	13.4	85.5	183.7	1.9
	(70.4)	(10.2)	(41.7)	(34.9)	(1.6)
R^2	0.04	0.00	0.01	0.03	0.00
β_{MR}	132.0	15.7	31.8	29.3	1.3
	(2.32)	(0.44)	(1.62)	(0.86)	(0.08)
R^2	0.01	0.00	0.00	0.00	0.00
$Obs.$	14272	14272	14272	14272	14272

Note: SE clustered at household level (for OLS) are in parenthesis

Summary for the entire sample

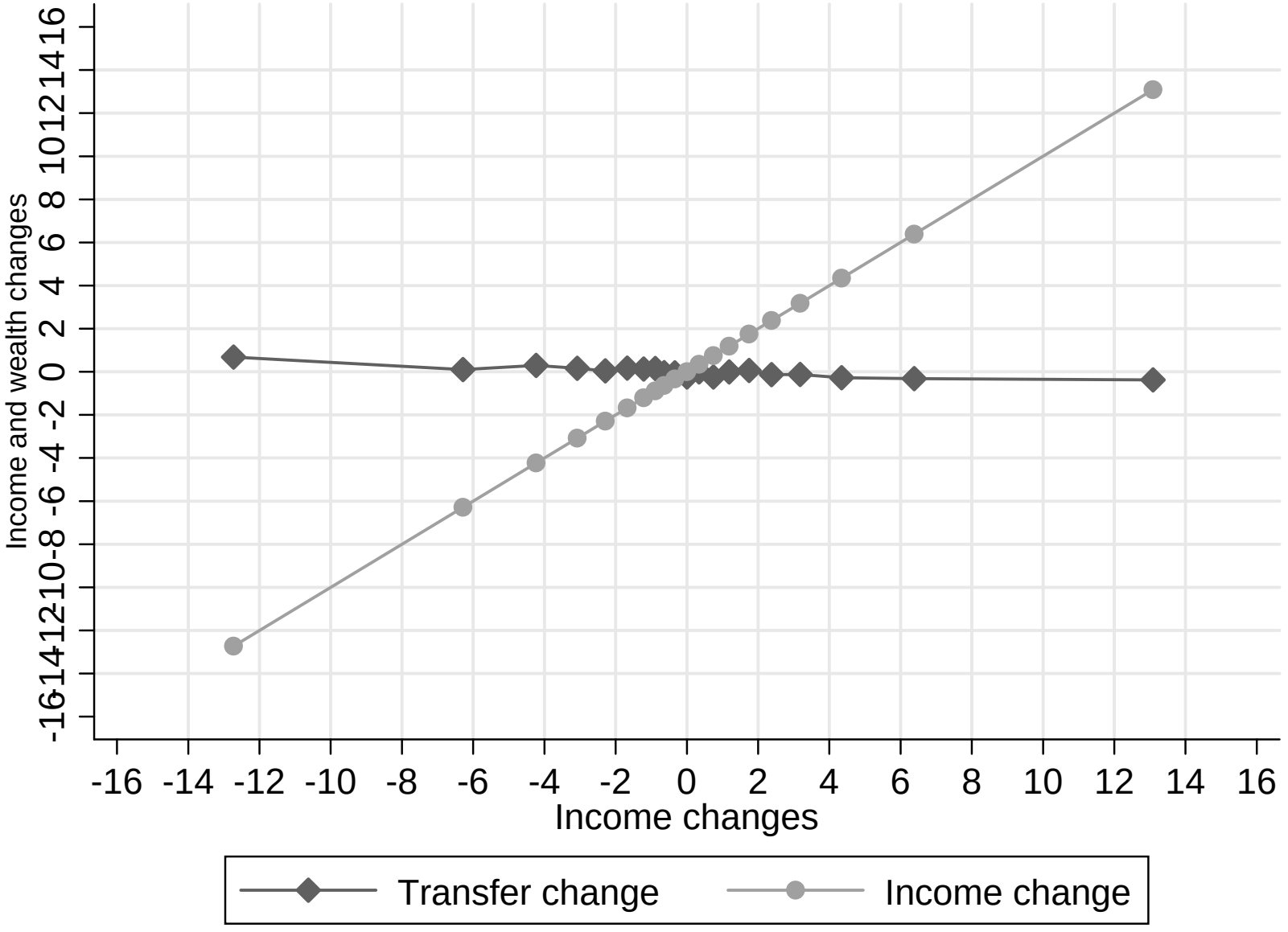
- Small consumption response (Less than 10c to the Euro)
- Small response from transfers or asset income
- Large wealth response (exceeding 130c to the Euro) suggesting simple 1 shock model cannot explain wealth dynamics

Consumption response in 2004-2006 PSID



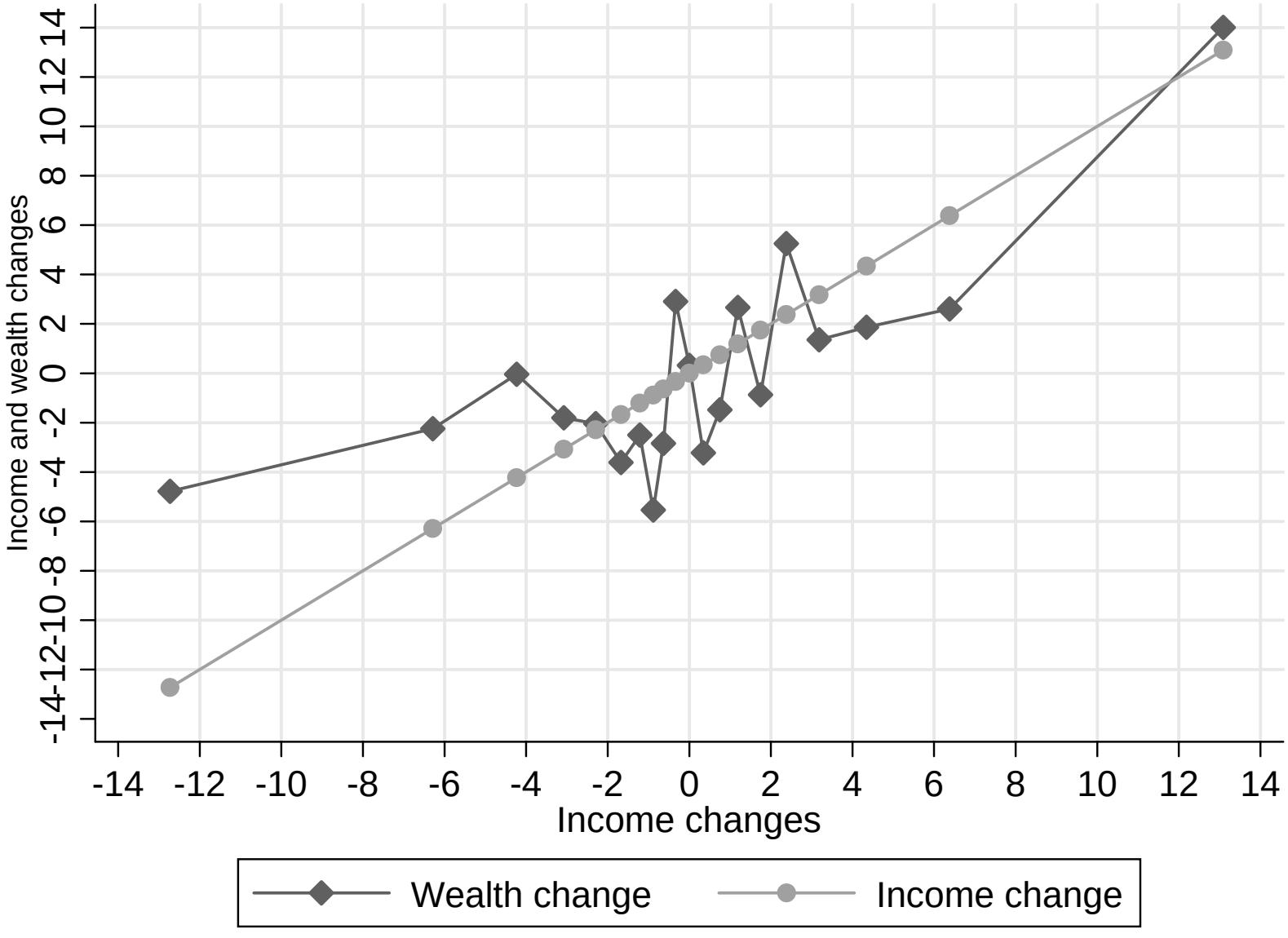
Changes are annualized and in thousands Dollars. Each dot averages approx. 200 households

Transfer response in 2004-2006 PSID



Changes are annualized and in thousands Dollars. Each dot averages approx. 200 households

Wealth response in PSID



Changes are annualized and in thousands dollars. Each dot averages approx. 200 households

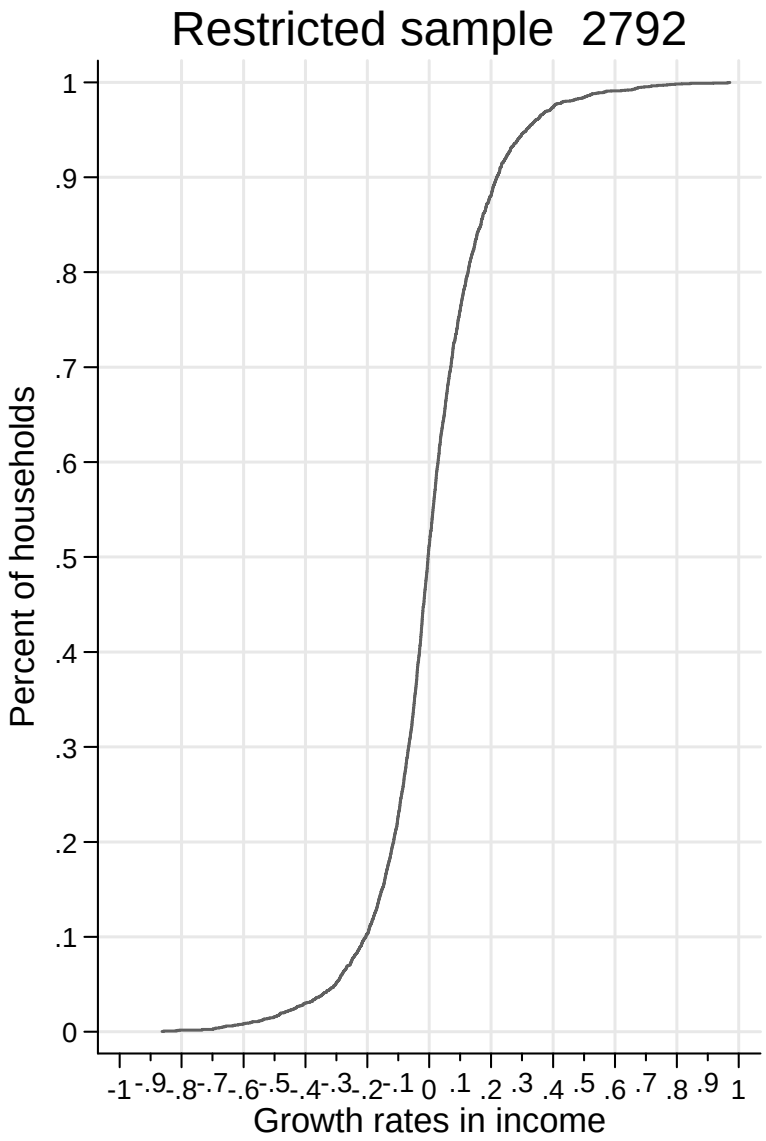
Regression results from PSID

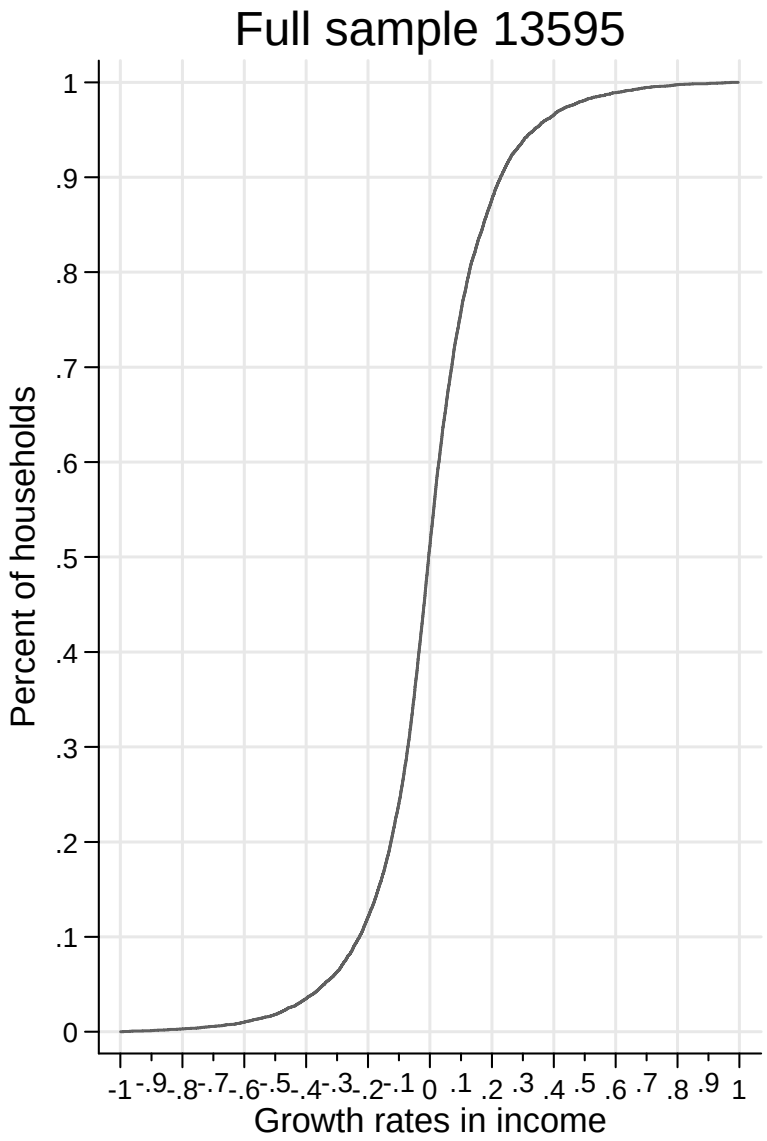
	Δc_n	Δa
β_{OLS}	11.7	76
	(4.8)	(11)
R^2	0.00	0.01
β_{MR}	14.1	34.2
	(0.9)	(2.9)
R^2	0.01	0.00
$Obs.$	4467	4467

Note: SE are in parenthesis

A more focused exercise

Employees w/out real estate





Note: Income is real after tax labor + business per adult equivalent. Growth rates and changes are annualized

Employees w/out real estate

	Δc_n	Δc_d	ΔT	Δa
β_{OLS}	26	8.7	-7.5	35
	(2.7)	(2.9)	(1.1)	(12)
R^2	0.02	0.01	0.04	0.01
β_{MR}	22	1.5	-0.3	43.6
	(1.1)	(0.3)	(0.1)	(8.3)
R^2	0.01	0.00	0.00	0.01
Obs.	2932	2932	2932	2932

Note: SE clustered at household level (for OLS) are in parenthesis

A different way of identifying shocks

- Look only at households whose head is unemployed either in the beginning or in the final year

	Δy	Δc_n	Δc_d
Job Losers (292)	-1535	-271	-11
Job Gainers (225)	1705	343	103

Lessons from data from employees

- Clearly reject hands to mouth
- Transfers and asset income response small so not much support for complete mkts
- Best candidate seems a simple self insurance model

Exploring the simplest bond model (PIH)

- Quadratic utility
- Borrowing constraints never binding
- $\beta(1+r)=1$

Exploring the simplest bond model (PIH)

- Budget constraint

$$c_t + a_{t+1} = y_t + ra_t + a_t$$

- Observed income process

$$\begin{aligned}
y_t &= z_t + \varepsilon_t + \gamma_t \\
z_t &= z_{t-1} + \eta_t \\
\varepsilon_t &\sim N(0, \sigma_\varepsilon^2), \text{ Transitory Shock} \\
\eta_t &\sim N(0, \sigma_\eta^2), \text{ Permanent Shock} \\
\gamma_t &\sim N(0, \sigma_\gamma^2), \text{ Measurement Error}
\end{aligned}$$

PIH solution, 1

$$\begin{aligned}
\Delta c_t &= \frac{r}{1+r}\varepsilon_t + \eta_t \\
\Delta a_{t+1} &= \frac{\varepsilon_t}{1+r} \\
\Delta y_t &= \eta_t + \Delta\varepsilon_t + \Delta\gamma_t
\end{aligned}$$

Define

$$\begin{aligned}
\Delta^N x_t &= x_t - x_{t-N} \\
&= \Delta x_t + \Delta x_{t-1} + \ldots + \Delta x_{t-N+1}
\end{aligned}$$

PIH solution, 2

$$\begin{aligned}
\Delta^N c_t &= \sum_{\tau=t-N+1}^{t} \left(\frac{r\varepsilon_\tau}{1+r} + \eta_\tau \right) \\
\Delta^N a_{t+1} &= \sum_{\tau=t-N+1}^{t} \frac{\varepsilon_\tau}{1+r} \\
\Delta^N y_t &= \sum_{\tau=t-N+1}^{t} \eta_\tau + \Delta^N \varepsilon_t + \Delta^N \gamma_t
\end{aligned}$$

Regression coefficients in the model, 1

$$
\begin{aligned}
\beta_c^N &= \frac{Cov\left(\Delta^N c_t, \Delta^N y_t\right)}{Var\left(\Delta^N y_t\right)} \\
&= \frac{N\sigma_\eta^2 + r\sigma_\varepsilon^2/(1+r)}{N\sigma_\eta^2 + 2\left(\sigma_\varepsilon^2 + \sigma_\gamma^2\right)} \\
\beta_a^N &= \frac{Cov\left(\Delta^N a_{t+1}, \Delta^N y_t\right)}{Var\left(\Delta^N y_t\right)} \\
&= \frac{\sigma_\varepsilon^2}{(1+r)\left[N\sigma_\eta^2 + 2\left(\sigma_\varepsilon^2 + \sigma_\gamma^2\right)\right]}
\end{aligned}
$$

Regression coefficients in the model, 2

- Define $Q = \frac{\sigma_\eta^2}{\sigma_\varepsilon^2+\sigma_\gamma^2}$ and $M = \frac{\sigma_\gamma^2}{\sigma_\varepsilon^2+\sigma_\gamma^2}$
- Then

$$\begin{aligned} \beta_c^N &= \frac{NQ + (1-M)\frac{r}{1+r}}{NQ+2} \\ \beta_a^N &= \frac{(1-M)\frac{1}{1+r}}{NQ+2} \end{aligned}$$

- β_c^N increasing in Q and N, insensitive to M
- β_a^N decreasing in Q, N and M
- Note that $\beta_c^N + \beta_a^N = \frac{NQ+(1-M)}{NQ+2} < 1$

Recursive identification

- Assume that $r = 2\%$ (exact value does not matter much for the analysis).
- For $N = 2$, what values for (M, Q) are consistent with empirical estimates for $\beta_c^2 \approx 0.26, \beta_w^2 \approx 0.35$?
- $Q = 0.29$ (identified by consumption response), $M = 0.05$ (identified by Q and wealth response)

How reasonable are $M = 0.05$ and $Q = 0.29$?

- Measurement error a bit on the small side (no self employed)
- Q can be estimated directly on income data

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Simply note that

$$\begin{aligned} y_t &= z_t + \varepsilon_t \\ z_t &= z_{t-1} + \eta_t \end{aligned}$$

$$\begin{aligned} cov(y_{t+1} - y_t, y_t - y_{t-1}) &= cov(\eta_t + \varepsilon_{t+1} - \varepsilon_t, \eta_t + \varepsilon_t - \varepsilon_{t-1}) = -\sigma_\varepsilon^2 \\ var(y_{t+1} - y_t) &= \sigma_\eta^2 + 2\sigma_\varepsilon^2 \end{aligned}$$

Checking $Q = 0.29$

- Jappelli and Pistaferri estimate (1987-2000, all sample) $Q = 0.33$
- Our own estimate (1987-2006, employees) $Q = 0.25$

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- Jappelli and Pistaferri estimate (1987-2000, all sample) $Q = 0.33$
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- This all suggests idiosyncratic income risk contains large temporary component (Guvenen and Smith, 2010)

Additional test: Exploiting the Panel Structure

- Conditional on r, Q, M the model restricts how β_c^N, β_a^N depend on N (changing the persistence of the income process).
- Panel dimension of the data allows to estimate β_c^N, β_a^N for various N.

Regression Coefficients as Function of N

- Set $Q = 0.29$ and $M = 0.05$ Then PIH fits data for $N = 2$

	β_c^N		β_w^N (MR)	
N	Model	Data	Model	Data
2	0.23	0.23	0.34	0.34
4	0.37	0.25	0.14	0.07
6	0.47	0.27	0.12	0.09

- PIH qualitatively consistent with facts, for plausible values of M, Q, for the group of employee/renters.
- PIH consumption response rises too fast with N

Precautionary saving?

- PIH ignores precautionary saving motives
- Precautionary saving reduces consumption response to permanent shocks below 1 (Carroll, 2001, Blundell et al. 2008, Kaplan and Violante, 2008). Thus lower consumption response for given $Q = \frac{\sigma_\eta^2}{\sigma_\varepsilon^2}$.
- How about β_w^N as N increases? The larger the N, the larger is persistence of shocks, but also the larger their variance

More Sophisticated Self-Insurance Models

- CRRA utility $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$
- Tight borrowing constraint $a_{t+1} \geq 0$
- Initial conditions $a_0 = z_{-1} = 0$

More Sophisticated Self-Insurance Models

- Income process $y_t = \bar{y}_t \tilde{y}_t$

$$
\begin{aligned}
\log(\tilde{y}_t) &= z_t + \varepsilon_t \\
z_t &= z_{t-1} + \eta_t \\
\varepsilon_t &\sim N(-\frac{\sigma_\varepsilon^2}{2}, \sigma_\varepsilon^2), \text{ Transitory Shock} \\
\eta_t &\sim N(-\frac{\sigma_\varepsilon^2}{2}, \sigma_\eta^2), \text{ Permanent Shock}
\end{aligned}
$$

- $\sigma_\varepsilon^2 = 0.04, \sigma_\eta^2 = 0.02$ (implied $Q = 0.5$). $\rho = r = 2\%$. $\sigma = 2$. Mean life cycle income profile $\bar{y}_t$ from data.

Results

Consumption

N	Data	PIH	CRRA $(T = \infty)$	CRRA $(T < \infty)$
2	0.23	0.34	0.19	0.27
4	0.25	0.50	0.28	0.39
6	0.27	0.6	0.35	0.46

Wealth

N	Data	PIH	CRRA $(T = \infty)$	CRRA $(T < \infty)$
2	0.34	0.33	0.57	0.50
4	0.07	0.25	0.82	0.66
6	0.09	0.20	1.15	0.85

PIH v/s Precautionary Saving

- PIH: Consistent with short run data if income shocks are mostly transitory, harder to match long run responses
- Precautionary savings: better consumption response if shocks are more permanent and matches better long run responses. But: wealth dynamics as N increases at odds with data
- Remaining puzzles: large short run response of wealth for owners and entrepreneurs

Speculations on housing

	Δc_n	$\Delta(a+e)$	Δe^{re}	Δa	Δm
β_{MR}^{NonAdj} [4761]	18.2	78.2	11.5	15.8	0.5
	(0.7)	(5.8)	(2.7)	(1.5)	(0.1)
$\beta_{MR}^{NonAdjPR}$[1619]	17.1	104	52.1	20.7	0.5
	(1.2)	(12.5)	(10.4)	(2.8)	(0.2)
β_{MR}^{Adj}[7875]	11.9	191	75.7	17.9	0.2
	(0.3)	(4.2)	(4.4)	(0.8)	(0.01)

- Large co-movement between income and housing wealth for non-adjusters with positive real estate wealth. Positive regional correlation between income and house prices? For the U.S., see Davidoff (2005) and Davis and Ortalo-Magne (2008)

Speculations on entrepreneurs

	Δc_n	$\Delta(a+e)$	Δe^{re}	Δe^{bw}	Δa
β_{MR}^{self} [2613]	5.7	148.2	20.9	17.8	15.8
	(0.4)	(6.1)	(3.5)	(1.0)	(0.8)
β_{MR}^{emp} [10023]	20.5	117.2	44.8	9.3	18.5
	(0.4)	(5.9)	(3.2)	(1.3)	(1.2)

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- Self employed: stronger wealth response due to business wealth and weaker consumption response
- Different persistence? Not supported if estimate income process for entrepreneurs
- Selection? Not likely
- Precautionary saving? maybe
- Different model of income (endowment v/s production)? Likely

Conclusion

- Evidence on how consumption, wealth and transfers co-move with income at the household level
- Evidence not consistent with simple CM and hands-to-mouth models but with self insurance of not very persistent shocks. Idiosyncratic income risk can be insured fairly well..
- Next steps: explicit models of self employment (entrepreneurship) and housing to better understand wealth dynamics and the role of additional shocks

Additional slides

Why Italian micro data?

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Detailed panel info on income, consumption and wealth is not available for other countries

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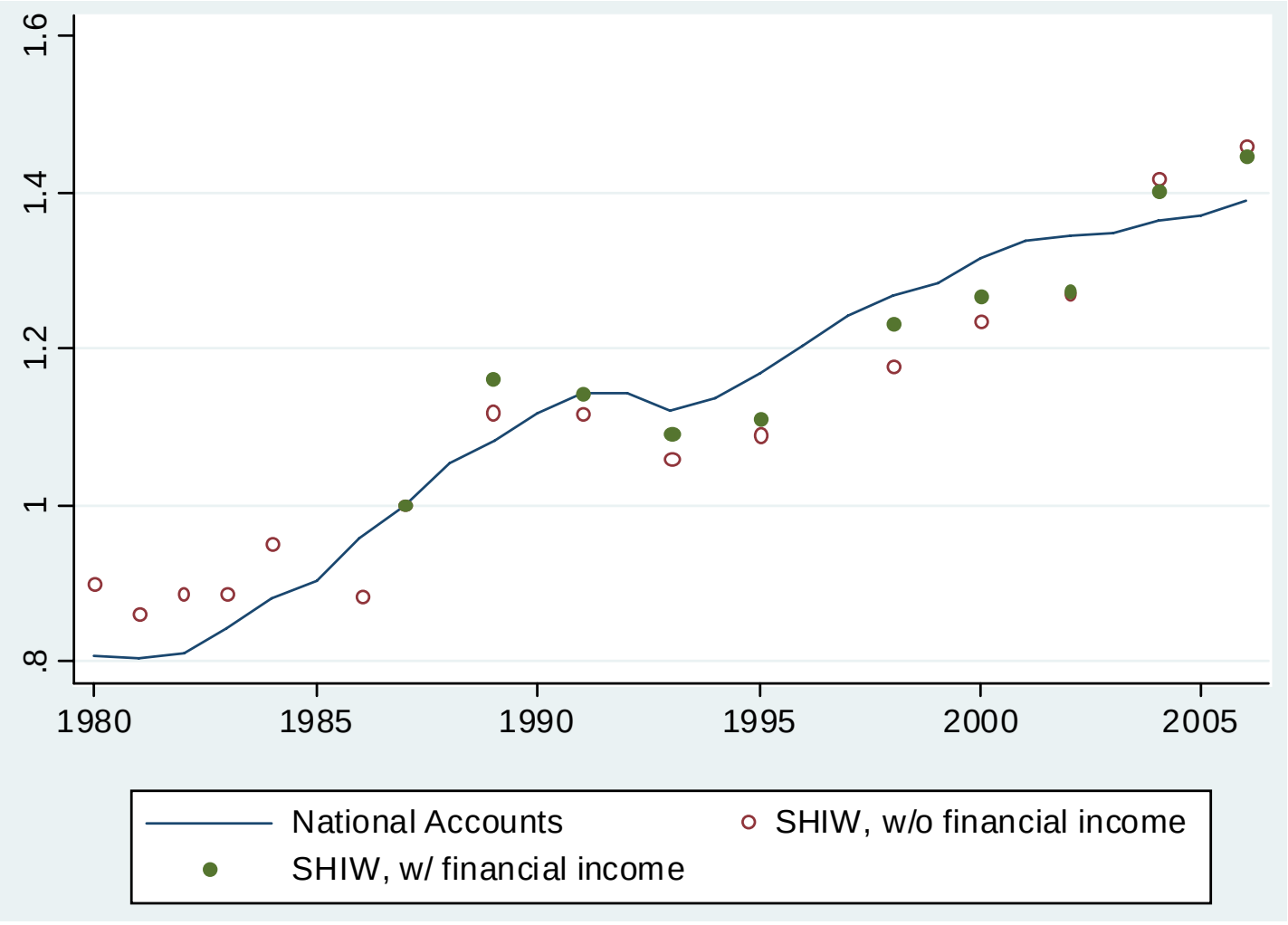
Detailed panel info on income, consumption and wealth is not available for other countries (2007 PSID is the only exception)

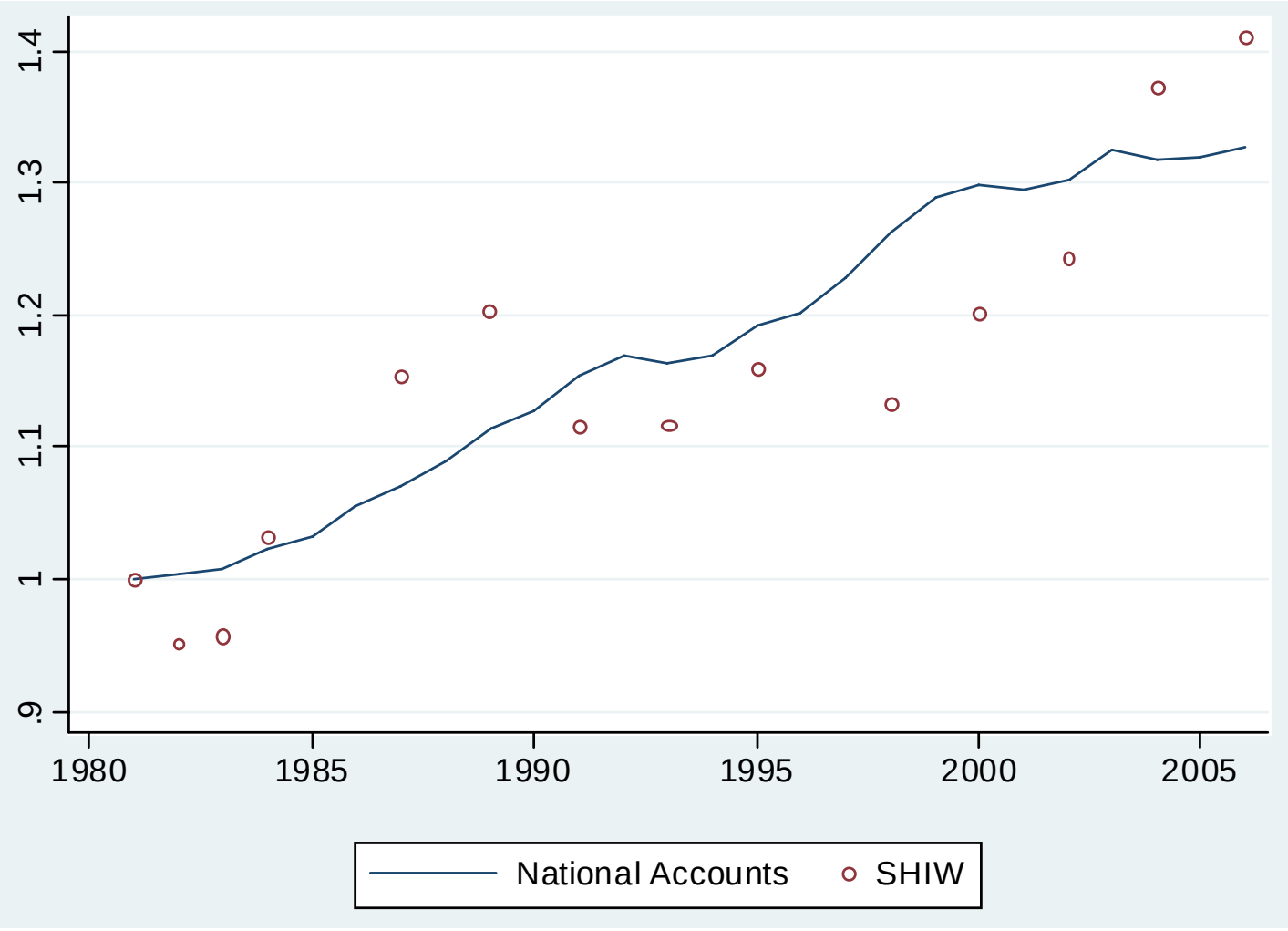
Why Italian micro data?

SHIW and NIPA: Disposable income



Why Italian micro data?

SHIW and NIPA: Consumption



Why Italian micro data?

Aggregated micro data close to macro data (not true, for example, for US or UK consumption)

How about the 2004-2006 PSID?

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	Average Level		Annualized Growth
	(2004)	(2006)	(2004-2006)
Age of head	39.7	40.1	0.5%
Household size	3.0	3.0	0%
Labor income	22480	22513	0.3%
Asset income	661	680	1.4%
Transfers	1599	1400	-7%
Non Durable consumption	15927	17187	3.9%
Total wealth	79915	89125	5.5%

All variables except age and size, per adult equiv. and in 2004 Dollars

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- Higher income, lower wealth