Household Debt and Monetary Policy: Revealing the Cash-Flow Channel

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Mortgages – a relatively novel research domain in monetary economics

"[T]he structure of mortgage contracts may matter for consumption behavior. In countries like the United Kingdom, for example, where most **mortgages have adjustable rates**, changes in short-term interest rates (whether induced by monetary policy or some other factor) have an almost **immediate effect on household cash flows**. If household cash flows affect access to credit, then **consumer spending may react relatively quickly**. In an economy where most mortgages carry fixed rates, such as the United States, that channel of effect may be more muted. I do not think we know at this point whether, in the case of households, these effects are quantitatively significant in the aggregate. **Certainly, these issues seem worthy of further study**." — Ben S. Bernanke, Conference on The Credit Channel of Monetary Policy in the Twenty-first Century, 2007

The standard model

- Monetary policy affects household behavior through intertemporal substitution (Euler equation)
- The wealth effects of a temporary change in the short interest rate is small for almost all households (life-time budget constraint almost unaffected)
- This implies a homogenous response to consumption

Literature

Empirical

- Interest rate channel: Attanasio and Weber (2010), Jappelli and Pistaferri (2010), Boivin et al. (2011)
- Cash-flow channel and the mortgage market: Calza et al. (JEEA, 2013), Di Maggio et al. (AER, 2017), Cloyne, Ferreira, and Surico (ReStud, 2019)

Theory

- Rule-of-thumb consumers: Campbell and Mankiw (1990)
- Mortgage burden and monetary policy: Bernanke and Gertler (1995), Mishkin (2007)
- Distributional effects: Doepke and Schneider (JPE, 2006), Sterk och Tenreyro (JME, 2018)
- Recent models: Auclert (AER, 2019), Garriga, Kydland, and Sustek (RFS, 2017; 2019), Greenwald (2018), Wong (2019), Eichenbaum, Rebelo, and Wong (2019), Berger et al. (2020), Kinnerud (2020)

This paper investigates the cash-flow channel in a Swedish setting

- Half of Swedish mortgages have a very short interest fixation period (<3 months)
- Considerable variation in the policy rate during period of investigation (2002–2007)
- Registry-based panel data set on income, balance sheets, and spending
- Regression specification motivated by theory

Theory

1. A simple (simplest?) model of hand-to-mouth behavior

2. A simple quantitative model of the cash-flow channel

A simple model of hand-to-mouth behavior

- $u(c) = \frac{c^{1-1/\sigma}}{1-1/\sigma}$
- Intertemporal budget constraint: $c_{it} - d_{it+1} = y_{it} - d_{it}(1 + r_t)$
- HtM: $d_{it+1} = d_{it}$
- $c_{it} = y_{it} - d_{it} \cdot r_t$
- $\Delta \log c_{it} \approx \theta \cdot \Delta \log y_{it} - \theta \cdot \frac{d_i}{y_i} \cdot \Delta r_t$ where $\theta \approx 1$

HtM households: $\Delta \log c_{it} \approx \theta \cdot \Delta \log y_{it} - \theta \cdot \frac{d_i}{y_i} \cdot \Delta r_t$

Optimizing unconstrained households: $\Delta \log c_{it} = \sigma \cdot \Delta r_t$

A simple quantitative model (1)

Adopted from Garriga et al. (RFS, 2017)

$$\max_{D_1,\{c_t\}_1^T} \sum_{t=1}^{T} \beta^{t-1} u\left(c_t\right)$$

subject to A_0 given and:

$$P_1\left(c_1+h\right)+A_1 = P_1 w + D_1 + \left(1+i_1\right) A_0,$$

and for $2 \leq t \leq T-1$:

$$P_t c_t + A_{t+1} = P_t w + (1+i_t) A_t - i_t^D D_t - \gamma D_1$$

and in the last period:

$$P_T c_T = P_T w + \left(1+i_T\right) A_T - \left(1+i_T^D\right) D_T + \alpha P_T h.$$

A simple quantitative model (2)

- Price level, $\{P_t\}_1^T$ and nominal interest rate, $\{i_t\}_1^T$, are exogenous and known in advance
- The Fisher equation holds:

$$1 + i_t = (1 + r) \cdot \frac{P_t}{P_{t-1}},$$

where r is the real interest rate.

Mortgage types

- ARM: $i^D = i$ (amortization rate γ in the first period)
- FRM: i^D fixed for 5 years and then reset

Household types and shocks to the interest rate

Household types

- Optimizing households
- HtM households: $A_t = 0$ for $t \geq 1$

Ex post "MIT" shocks

- i changes unexpectedly to $r + \delta$, temporarily or with some persistence
  - $\mathrm{i}_{\tau+j} = r + \delta\rho^j$
- Optimizing households adjust optimally (adjust $\{c_t\}, \{A_t\}$)
- HTM household's response: $c_t = w - i_t^D \frac{D_t}{P_t} - \gamma \frac{D_1}{P_t}$

Calibration

Consumption responses of four household types to a 1 p.p. interest rate shock

Regression estimates based on simulation

Variation in h and τ, observations from time period when shock hits

$$\Delta \log c_{i,\tau} = \alpha_i + \beta DTI_{i,\tau-1} \times \Delta i_\tau + \gamma X_{i,\tau-1} + \varepsilon_{i,\tau}$$

	(1)	(2)	(3)	(4)	(5)
$\text{DTI}_i \times \Delta i$	−0.081	-0.337	−1.282	−0.434	−0.210
	(0.004)	(0.010)	(0.008)	(0.027)	(0.029)
Constant	−0.000	-0.029	0.002	−0.015	−0.001
	(0.001)	(0.002)	(0.001)	(0.005)	(0.005)
Observations	423	423	423	1692	1692
R-squared	0.690	0.812	0.993	0.210	0.057
Persistent shock	No	Yes	Yes	Yes	Yes
Fisher effect	No	No	No	No	Yes
Share ARM	1.0	1.0	1.0	0.5	0.5
Share HtM	0.0	0.0	1.0	0.5	0.5

Regression estimates based on simulation

Variation in h and τ, observations from time period when shock hits

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Share HtM	0.0	0.0	1.0	0.5	0.5

Summary

- HtM households' responses
  - are approximately proportional to their DTI ratio
  - do not depend much on the relationship between the nominal interest rate and inflation (short-term)
- Optimizing households' responses
  - are smaller than HtM households', unless the shock is very persistent, and independent of their DTI ratio
  - to an immediate positive shock to interest expenses (i.e., ARM) require access to a buffer of liquid assets or credit

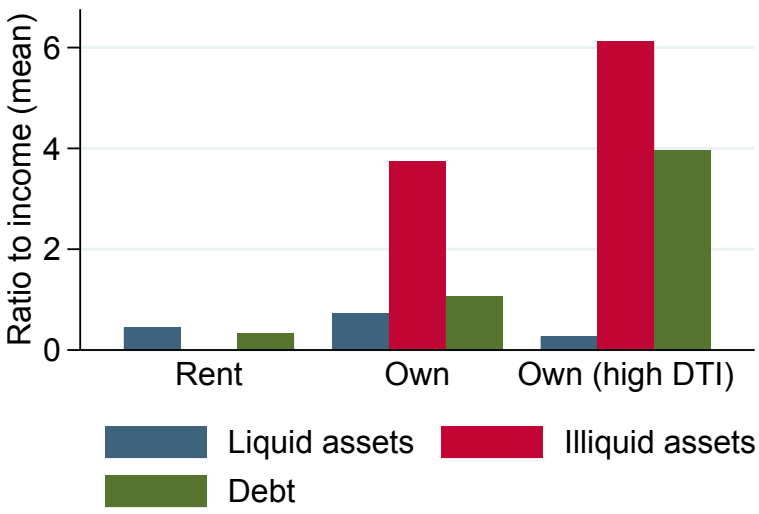
Data

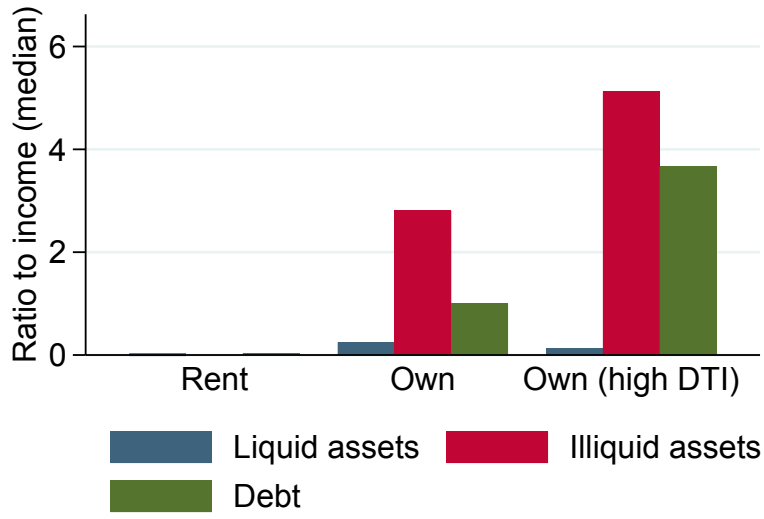
Registry-based panel data from Statistics Sweden 2000–2007

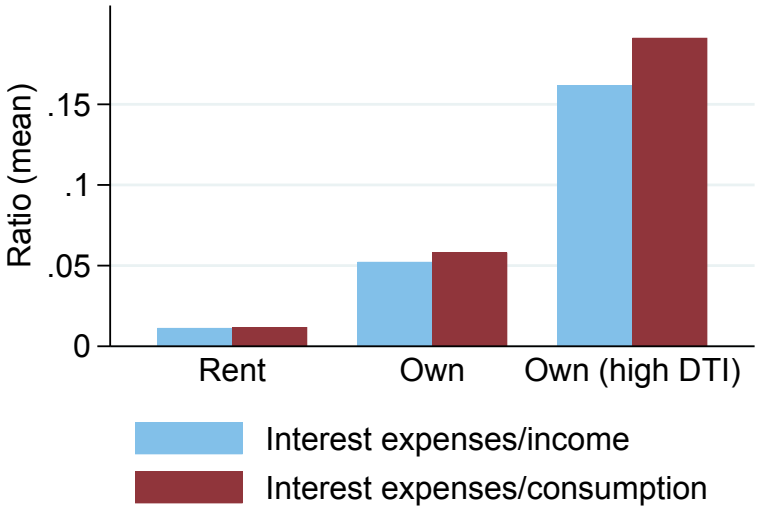
- Start from representative sample of Swedish households (LINDA)
- Demographic variables
- Incomes from labor and capital
- Balance sheets (financial and real assets, debt, interest expenses)
- Match on returns on specific stocks and mutual funds
- Imputation of spending:
  - c_{it} the only unknown in the intertemporal budget constraint
  - $c_{it} + a_{it} - d_{it} = y_{it} + (1 + r^a_{it})a_{it-1} - (1 + r^d_{it})d_{it-1}$
  - We follow Koijen, Van Nieuwerburgh, and Vestman (2015)

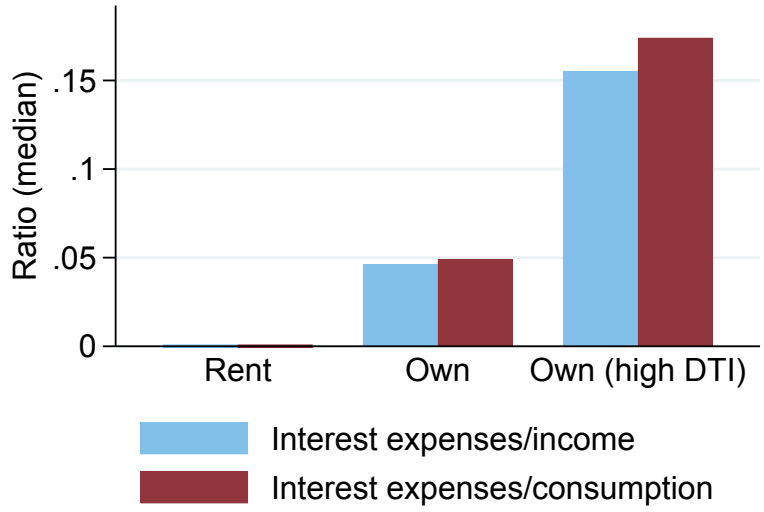
▸ Sample restrictions

Households with high DTI have little liquid assets and a high interest expense share

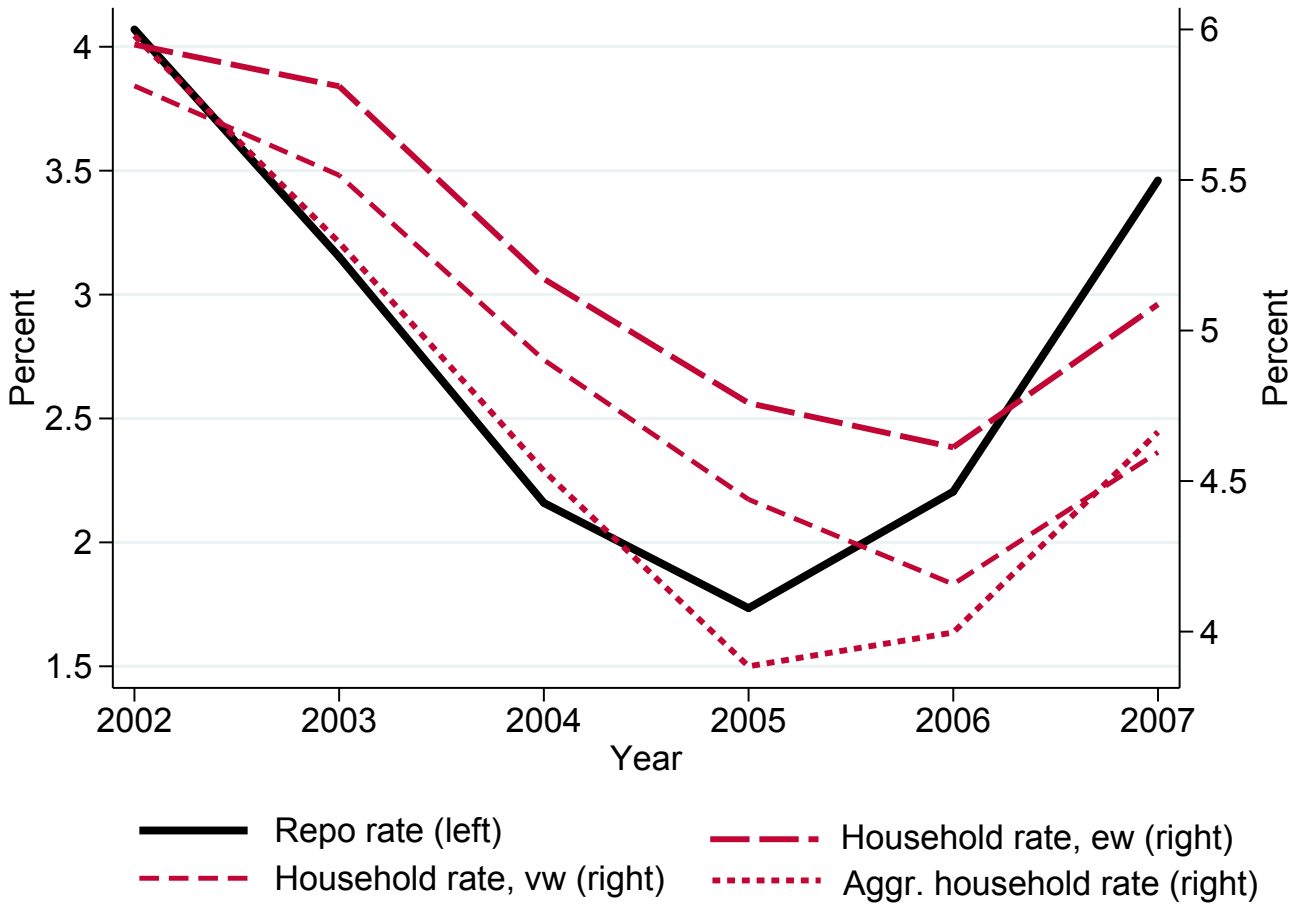




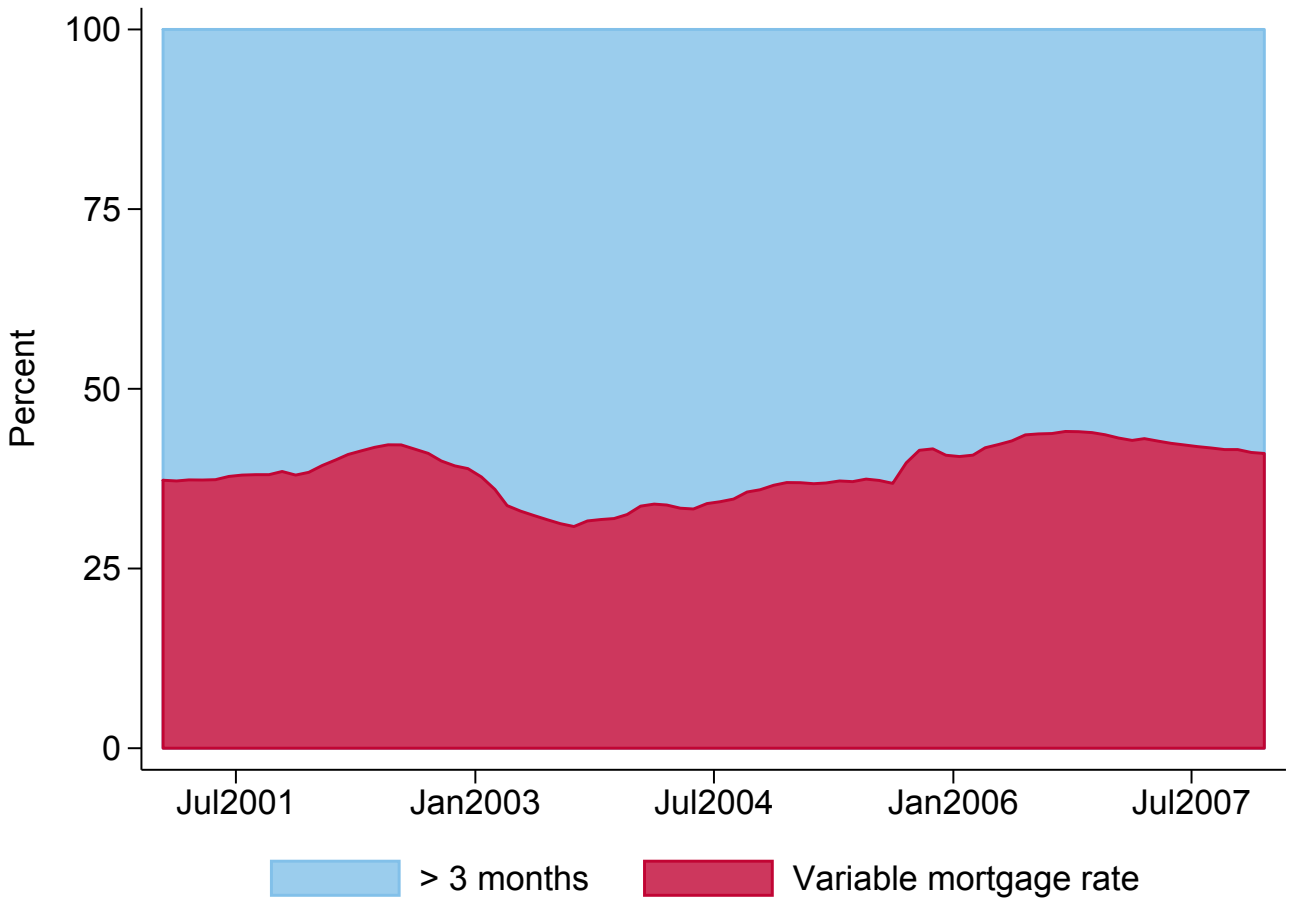




Interest rates in our data set vs. aggregate rates



ARMs vs. FRMs in the aggregate



Empirical strategy

$$\Delta \log c_{i,t} = \alpha_i + \delta_t + \beta \Delta r_t \times \mathrm{DTI}_{i,t-2} + \mathbf{X}'_{i,t}\gamma + \varepsilon_{i,t}, \tag{1}$$

- Δr_t: policy rate or aggregate household rate
- δ_t: Year FEs
- α_i: Household FEs to capture selection into mortgage contracts and unobs char.
- $\mathbf{X}_{i,t}$: basic controls
- β captures consumption responses due to cross-sectional variation in interest-rate sensitivity, less aggregate effect
- Standard model $\beta \approx 0$ (response to Δr_t soaked up by δ_t)
- HtM $\beta \approx 1$

IV ESTIMATION

- Reverse causality: monetary policy responds to households' economic conditions
- Monetary policy shocks: separation between anticipated and unanticipated changes of Δr_t
- Change of 1-month T-bill at the day of a monetary policy announcement to isolate the shock (e.g., Kuttner (2001), Cochrane and Piazessi (2002), Gurkaynak et al. 2005; Gertler and Karadi (2015))

Graph of MP shocks

Spending responses to changes in the policy rate

	(1)	(2)	(3)	(4)
	OLS			
	All Households		Homeowners	
$\Delta r \times$ DTI	-0.260***	-0.266***	-0.199***	-0.211***
	(0.058)	(0.058)	(0.075)	(0.075)
Liquid assets-to-income	No	Yes	No	Yes
Mean DTI	0.88	0.88	1.27	1.27
Observations	265,642	265,642	153,964	153,964
Clusters (households)	64,125	64,125	37,514	37,514

Spending responses to changes in the policy rate

	(1)	(2)	(3)	(4)
	IV			
	All Households		Homeowners	
$\Delta r \times$ DTI	-0.400***	-0.400***	-0.413***	-0.415***
	(0.078)	(0.078)	(0.103)	(0.103)
Liquid assets-to-income	No	Yes	No	Yes
Mean DTI	0.88	0.88	1.27	1.27
Observations	265,642	265,642	153,964	153,964
Clusters (households)	64,125	64,125	37,514	37,514

MPC: 0.19 – 0.34

Spending responses to changes in the aggregate household interest rate

	(1)	(2)	(3)	(4)
	OLS			
	All Households		Homeowners	
$\Delta r \times$ DTI	-0.622***	-0.631***	-0.594***	-0.616***
	(0.087)	(0.087)	(0.114)	(0.114)
Liquid assets-to-income	No	Yes	No	Yes
Mean DTI	0.88	0.88	1.27	1.27
Observations	265,642	265,642	153,964	153,964
Clusters (households)	64,125	64,125	37,514	37,514

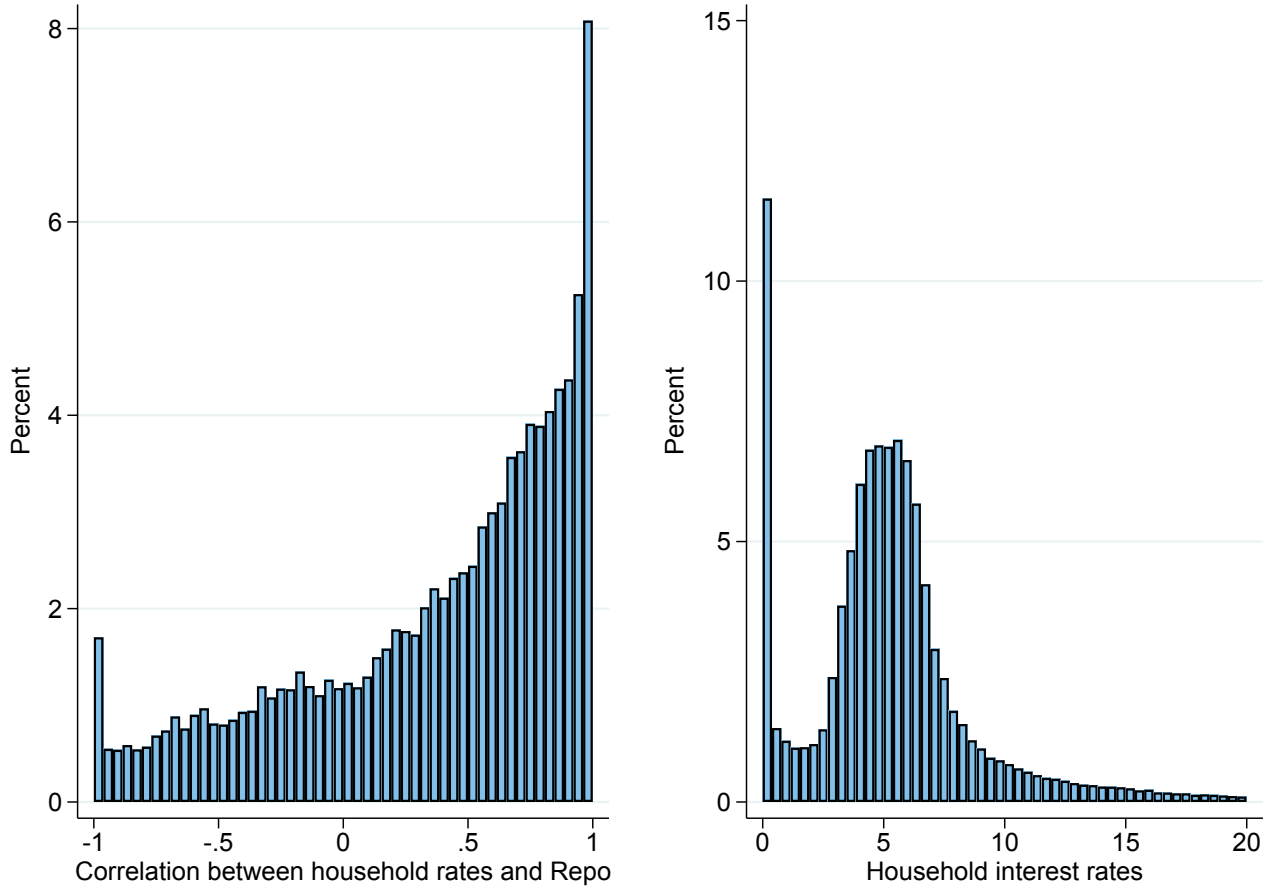
Spending responses to changes in the aggregate household interest rate

	(1)	(2)	(3)	(4)
	IV			
	All Households		Homeowners	
$\Delta r \times$ DTI	-0.529***	-0.528***	-0.538***	-0.539***
	(0.111)	(0.111)	(0.146)	(0.146)
Liquid assets-to-income	No	Yes	No	Yes
Mean DTI	0.88	0.88	1.27	1.27
Observations	265,642	265,642	153,964	153,964
Clusters (households)	64,125	64,125	37,514	37,514

MPC: 0.40 – 0.50

ARMs vs. FRMs

Households' implied interest rates and the policy rate



Extended specification

$$\Delta \log c_{i,t} = \alpha_i + \delta_t + \sum_{q=1}^{5} \lambda_q \text{ Interest fixation}_{i,q} \times \Delta r_t \times \text{DTI}_{i,t-2}$$

$$+ \sum_{q=1}^{5} \eta_g \text{ Interest fixation}_{i,q} \times \Delta r_t + \mathbf{X}'_{i,t}\gamma + \varepsilon_{i,t}$$

$\text{Interest fixation}_{i,q}$: quantile q in c-s distribution of correlations

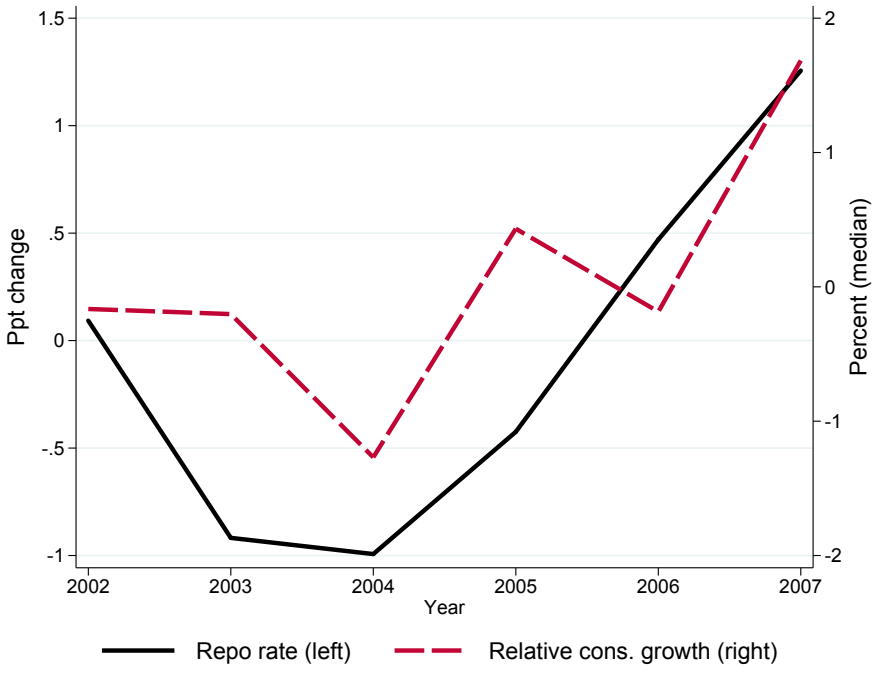
ARMs vs. FRMs: Spending responses

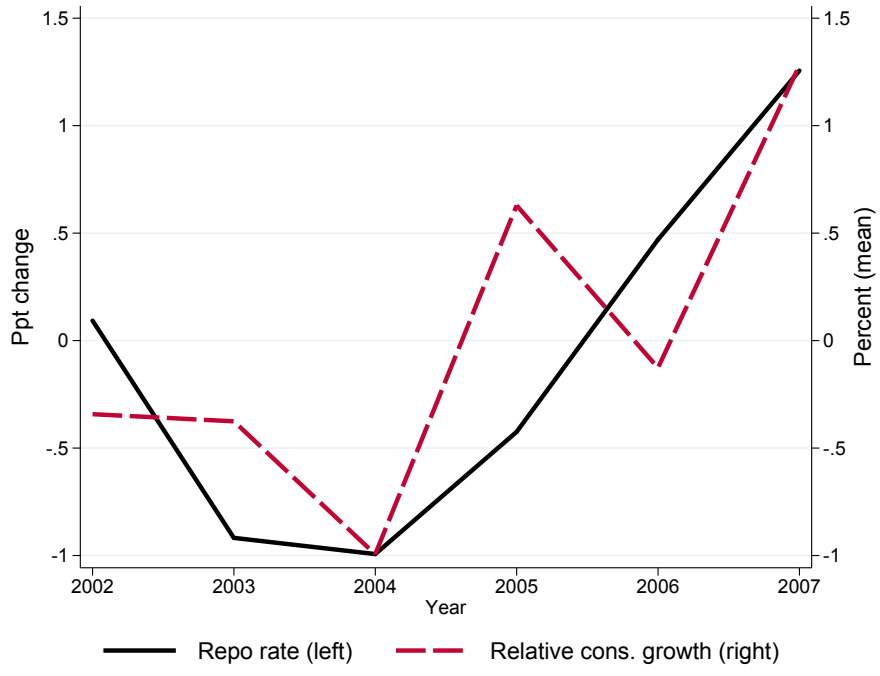
	(1)	(2)	(3)	(4)
	OLS		IV	
Interest fixation$_1$ $\times$ Δr $\times$ DTI	-0.102	-0.107	0.000	-0.004
Interest fixation$_2$ $\times$ Δr $\times$ DTI	-0.072	-0.074	-0.447***	-0.448***
Interest fixation$_3$ $\times$ Δr $\times$ DTI	-0.381***	-0.384***	-0.492***	-0.495***
Interest fixation$_4$ $\times$ Δr $\times$ DTI	-0.438***	-0.439***	-0.383**	-0.385**
Interest fixation$_5$ $\times$ Δr $\times$ DTI	-0.440***	-0.448***	-0.395*	-0.406*
Interest fixation$_1$ $\times$ Δr	0.626***	0.608***	-0.322	-0.312
Interest fixation$_2$ $\times$ Δr	0.626***	0.611***	0.391	0.405
Interest fixation$_3$ $\times$ Δr	0.520**	0.507**	-0.024	-0.009
Interest fixation$_4$ $\times$ Δr	0.272	0.262	-0.532	-0.508
Interest fixation$_5$ $\times$ Δr	0.421*	0.421*	-0.215	-0.189
Liquid assets-to-income	No	Yes	No	Yes
Observations	265,642	265,642	265,642	265,642
Clusters (households)	64,125	64,125	64,125	64,125

Dispersion in elasticities ~ 0.90

Dispersion in MPCs ~ 0.73

ARMs vs. FRMs: Relative spending growth





Relative spending growth $= \Delta \log c$ of high DTI

$- \Delta \log c$ of high DTI and corr$>$ median

The role of liquid assets

- 8 groups: high/low DTI, Corr, liquid assets to income
- Extended specification:

$$\Delta \log c_{i,t} = \alpha_i + \delta_t + \sum_{k=1}^{8} \omega_k \text{Group}_{i,k} \times \Delta r + \mathbf{X}'_{i,t}\gamma + \varepsilon_{i,t}, \qquad (2)$$

The role of liquid assets

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
DTI	High	High	High	High	Low	Low	Low	Low
Mortgage	ARM	ARM	FRM	FRM	ARM	ARM	FRM	FRM
Liquid ATI	Low	High	Low	High	Low	High	Low	High
				A. Summary statistics				
Disp. income	308	359	278	344	211	260	207	257
Age	47	50	46	49	50	56	49	56
Household size	2.84	3.01	2.68	2.92	2.12	2.02	2.27	2.03
Consumption	290	331	265	314	210	255	208	253
Debt	573	604	470	563	49	49	45	42
DTI	1.77	1.66	1.61	1.60	0.22	0.18	0.21	0.16
Interest rate	5.26	4.71	4.98	4.87	6.90	5.51	6.72	5.62
Interest share	8.58	7.56	7.43	7.60	1.37	0.95	1.24	0.79
Illiquid assets	873	1,390	623	1,254	114	579	83	517
Liquid assets	23	196	20	189	12	241	10	227
Liquid ATI	0.07	0.57	0.06	0.57	0.05	0.92	0.04	0.87
Loan-to-value	0.74	0.52	0.72	0.52	0.27	0.13	0.23	0.12
Observations	34,054	36,247	33,387	26,778	14,714	11,103	22,548	13,411
Households	11,158	11,827	10,829	9,075	4,891	3,959	7,158	4,702
				B. Consumption responses (OLS)				
Group$_k$ $\times$ Δr	-0.689***	-0.234	0.325*	-0.065	0.202	0.942***	0.667***	0.969***
	(0.201)	(0.207)	(0.195)	(0.226)	(0.223)	(0.305)	(0.192)	(0.283)
F-test	0.060		0.125		0.040		0.340	
				C. Consumption responses (IV)				
Group$_k$ $\times$ Δr	-1.786***	-0.550*	-0.789***	-0.566*	-0.890***	0.744*	-0.306	1.120***
	(0.280)	(0.287)	(0.267)	(0.307)	(0.303)	(0.409)	(0.254)	(0.368)
F-test	0.001		0.504		0.001		0.001	

Conclusions

- We use a regression specification motivated by theory to test for the presence of the cash-flow channel on Swedish micro data
- On average, indebted households reduce spending by an additional 19–50 cents for every $ increase in interest expenses
- The large dispersion in responses are driven by mortgage type (ARM vs. FRM) and the amount of liquid assets to income, consistent with theory

Calibration

BACK

- $u(c) = \log c$
- $T = 50$
- $\beta = 0.98$
- $i_t = i_t^D = 1/\beta - 1 = r$
- $\alpha = 0.5$
- $\gamma = 0.01$
- w=1
- $P_1 h = 4$
- $A_0 = 0$
- Baseline: $P_t = 1$ for all t
- $\delta = 0.01$
- If persistent shock: $\rho = 0.8145$ (0.95 at quarterly freq.)

Sample restrictions

BACK

- Age > 18
- Stable households that don't buy/sell their home
- Households in panel for $\geq$3 years
- Outliers:
  - Negative spending
  - Income distribution
  - Spending growth
  - Interest expense
- As a result, our sample is somewhat older and poorer than the population

Monetary policy shocks and changes to the policy rate

BACK