

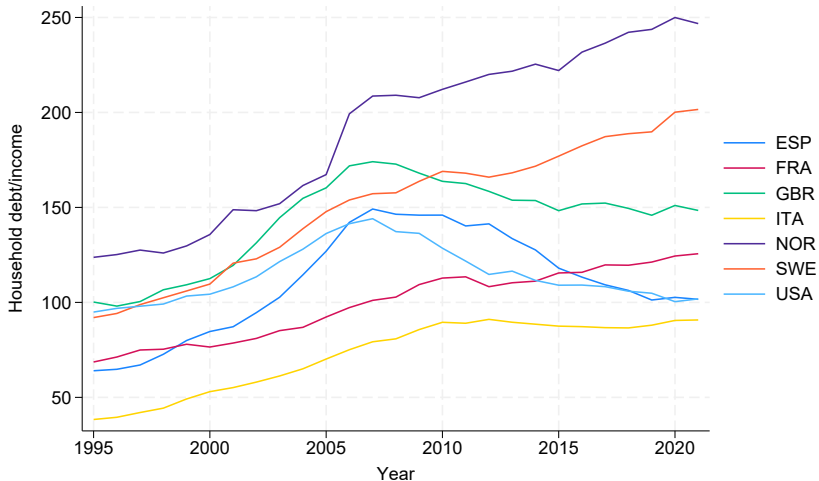
The Cash-Flow Channel of Monetary Policy - Evidence from Billions of Transactions

SeHyoun Ahn (Norges Bank), Sigurd Mølster Galaasen (Norges Bank) &
Mathis Mæhlum (Norges Bank)

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The views expressed are those of the authors and do not necessarily reflect those of Norges Bank

Households have become more indebted



Motivation and our contribution

How does monetary policy work?

- Representative agent NK models: mostly substitution effect
- Heterogeneous agent NK models (e.g. [Kaplan, Moll and Violante, 2018](#)): strong income effects, and household balance sheet positions key for transmission.

Motivation and our contribution

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Recent micro evidence on transmission through household balance sheets

- Liquid assets ([Holm et al., 2021](#))
- Debt ([Di Maggio et al., 2017](#), [Cloyne et al., 2020](#), [Flodén et al., 2021](#))

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We estimate the **cash-flow channel** of monetary policy by

- using a **direct, comprehensive** and **high-frequency** measure of household-level consumption, combined with extensive information on balance sheet positions for all households in Norway,
- allowing us to estimate the **size** and **timing** of the monetary policy response along the distribution of gross and net debt, as well as the **MPC** out of interest expenses

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 3. **Bank-specific interest rate shocks** \rightarrow estimate MPC

Preview of results

- MPC \approx 30: \$100 increase in interest payments \Rightarrow \$30 lower consumption after 1 year.
- Effects materialize rapidly within the first 3 – 6 months
- Effect driven by households with *gross* debt > 0
- Response increases \sim linearly in debt-to-income (DTI)

1. Describing the electronic transactions database and administrative data
2. Consumption response to interest rate changes
 - OLS with time FEs
 - Monetary policy shocks
 - Bank-specific shocks

Electronic transactions data

- Electronic transaction data 2006-2018 from Norwegian clearing institution (Nets Branch Norway) covering all Norwegian residents at the weekly frequency
 - Combines two sources of payments
 1. Universe of domestic in-store **debit card payments**
 2. 80 percent of **bank wire transfers** (e.g. bill payments) [▶ more](#)
- [▶ credit card](#)

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▶ card coverage
- Payments by cash not covered, but accounts for 3 – 5 percent of all payments in our sample period

Data and consumption measure

- Merged with Norwegian registry data on:
 - annual income, assets, debt from tax records (incl. identity of bank connection)
 - demographic and labor market information

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- Merged with Norwegian registry data on:
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 - demographic and labor market information
- Consumption measured as debit card transactions + bill payments, at household level
 - Remove “investment-like” transaction (single payments $> 100K$ NOK) and “mortgage-like” debt payments ▶ invest.
 - Use 3-month moving average of consumption.
 - weekly data noisy, no direct mapping to monthly frequency.

▶ national accounts

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Empirical specification (1): OLS with fixed effects

For HH i , month t and horizon $h = 0, \dots, 12$ we estimate the local projection:

$$\frac{c_{i,t+h} - c_{i,t-1}}{y_{i,\text{year}_t-1}} = \beta^h \Delta r_t \times \text{EXP}_{i,\text{year}_t-1} + \delta_i^h + \xi_t^h + \sum_{n=1}^N \gamma_{t,k}^{h,n} + X_{i,t} \alpha^h + \epsilon_{i,t}^h$$

- $c_{i,t}$ consumption and r_t 3-month MM rate
- y_{i,year_t-1} annual after-tax income and $\text{EXP}_{i,\text{year}_t-1}$ is the net *exposure* (debt net of deposits, relative to income), previous year
- Household-level control variables $X_{i,t-1}$, household FEs δ_i^h and **time-varying FEs for 9 household characteristics** $\gamma_{t,k}^{h,n}$ [▶ more](#)

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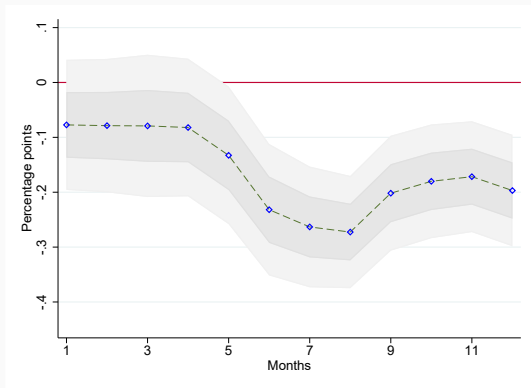
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$\beta^h \rightarrow$ how consumption response to 1 pp. higher rate varies with DTI

[▶ identification](#)

Estimate of β by month



- Consumption response increases by 0.15 – 0.25 pp. for each unit higher net debt/income
- i.e going from net debt/income = 0 \rightarrow 5 \Rightarrow 0.75 – 1.25 pp. lower consumption response

1. Describing the electronic transactions database and administrative data
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Empirical specification (2): high frequency instruments

For each *horizon* h , we estimate the response of consumption to interest rate change by *quantile* g of interest exposure,

$$\frac{C_{i,t+h} - C_{i,t-1}}{Y_{i,\text{year}(t)-1}} = \beta_g^h \Delta r_t + \delta_i^h + X_{i,t} \alpha_g^h + \epsilon_{i,t}^h \quad \forall i \in g,$$

Instrument Δr with

- high-frequency surprises in forward rates around CB policy announcements (Gürkaynak, Sack & Swanson, 2005),
- removing CB information component (Miranda-Agrippino & Ricco, 2021).

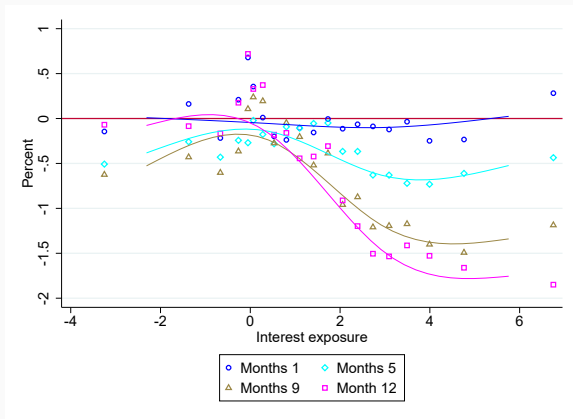
$\beta_g^h \rightarrow$ average consumption response (percent of disposable income) within quantile group g of 1 pp. exogenous increase in short-term MM rate

▶ Instrument Creation

▶ Controls

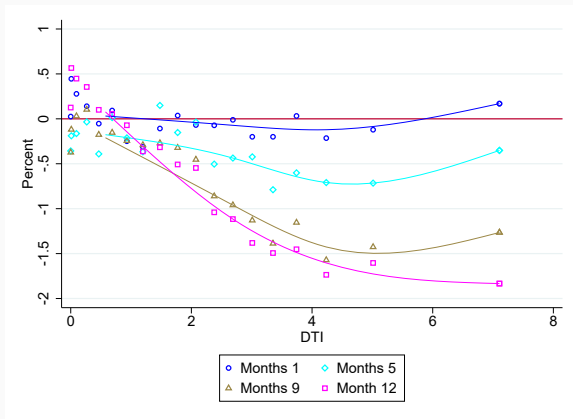
▶ First stage

Consumption response by *net* exposure



- e.g. household with debt-deposits = 4 times income drop consumption by ≈ 1.5 percent of income one year after 1 pp. monetary policy contraction
- fitted splines for legibility

Consumption response by *gross* exposure



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Marginal propensity to consume

- What is the MPC out of changes in net interest expenses?

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- If certain conditions are met, above estimates can be re-interpreted as measuring the \$ consumption response to \$ changes in interest payments. We need

$$\Delta \text{Cash Flow}_{t+h} = \Delta r_t \times (b - d)_{i, \text{year}(t)-1}$$

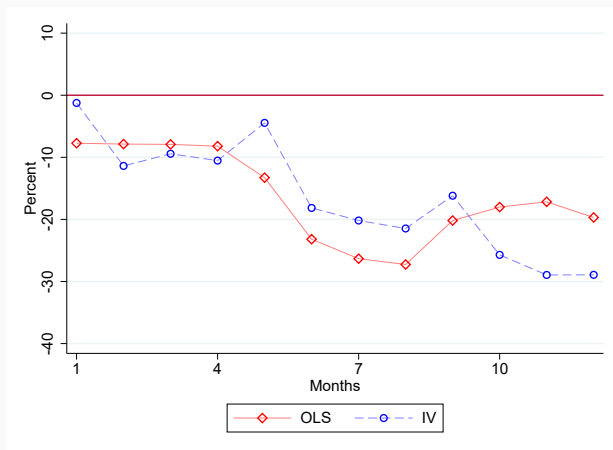
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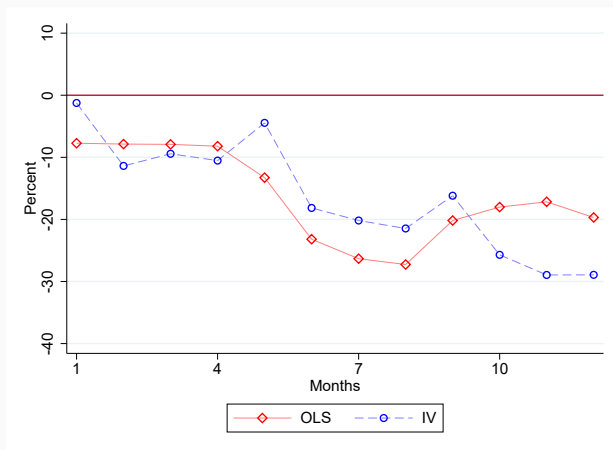
$$\Delta \text{Cash Flow}_{t+h} = \Delta r_t \times (b - d)_{i, \text{year}(t)-1}$$

1. Full and uniform pass-through of Δr
 - $\text{corr}(\text{MM-rate}, \text{lending rate})=0.97$, and 90% of borrowers have ARMs [▶ more](#)
2. Initial interest rate shock representative for contemporaneous rate
 - Interest rates elevated for up to one year after the shock [▶ more](#)
3. Other transmission channels either uniform across households or not present at relevant horizons
 - Indirect channels appears 2 – 3 years later (Holm et al., 2021)
4. Lagged financial assets capture contemporaneous positions

MPC from OLS and IV methods



MPC from OLS and IV methods



Ideally we want exogenous and directly measured variation in interest expenses across households

1. Describing the electronic transactions database and administrative data
2. Consumption response to interest rate changes
 - OLS with time FEs
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Empirical specification (3): Household-specific interest rates

Institutional background:

- Bank serving *only* public sector (“state”) workers
 - mortgage rate = 3-month T-Bill rate + markup set by government
- All other (private) banks:
 - mortgage rate = 3-month MM rate + markup determined by market conditions

Empirical specification (3): Household-specific interest rates

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 - mortgage rate = 3-month MM rate + markup determined by market conditions

Sudden policy change in 2014:

- Govt. markup historically at 0.5, but raised to 1.25 in March 2014, and 1.65 in March 2015
 - Communicated reason: gap to other banks had grown too large after the Financial Crisis
 - Suddenly and unexpectedly announced October 14, 2013

Policy change reduced interest spread to pre-GFC level



- Difference in loan-weighted interest rates between conventional banks and public sector bank.
- Gap ↓ 1.16 pp. during 2014-2015, but remained $\gg 0$

Empirical specification

We compare outcomes of treated and non-treated households:

$$Y_{i,2013+t} - Y_{i,2013} = \alpha^t + \beta^t T_{i,2013} + X_{i,2013} \gamma^t + \epsilon_i$$

- Treated ($T_{i,2013} = 1$) if having debt in the public sector bank Dec. 2013
- Outcome Y : consumption or interest expenses
- Sample:
 - households with pre-existing debt as of Dec. 2013
 - who do not take up more debt or pay down large share of debt during 2013-2014
- Include household controls $X_{i,2013}$ to account for non-random treatment.

	Year		
	2014	2015	2016
interest exp.	912*** (8.9)	1985*** (16.1)	2154*** (20.6)
consumption	-278** (86.9)	-825*** (118)	-835*** (137)
MPC	30.5** (11.1)	41.5*** (6.62)	38.8*** (7.48)
Observations	289,182	289,168	273,786

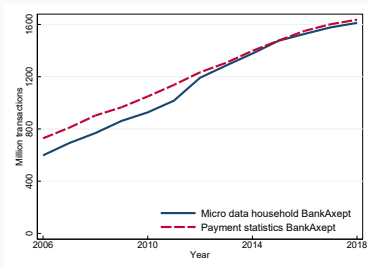
Effect of treatment. Interest expenses and consumption in USD, MPC in percent.

Summary

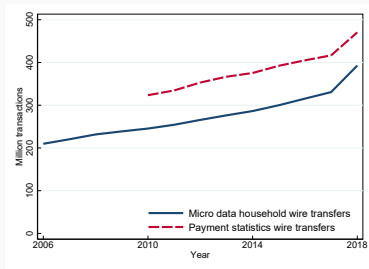
- We study fast-moving cash flow effects of monetary policy on consumption when households have debt
 - Using novel high-frequency expenditure data on the universe of Norwegian households
- HH's with a 100 pp. higher DTI have a 0.3-0.4 percentage points larger drop in consumption relative to income, in the months after interest rate change
- Yearly MPC out of interest expenses of 30 – 40 percent
- Suggests that transmission of monetary policy to private spending will be substantially higher in countries where ARMs are common
 - Consistent with cross-country evidence ([Calza et al., 2013](#); [Pica, 2022](#); [Corsetti et al., 2022](#))

Appendix

Transaction coverage



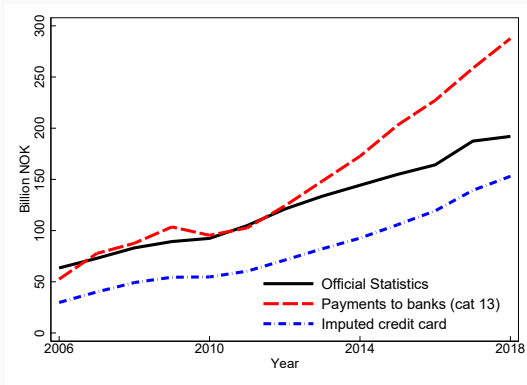
Debit Card



Wire Transfers

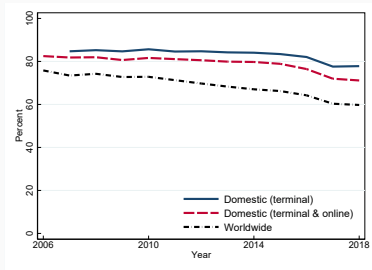
◀ back

Credit card coverage

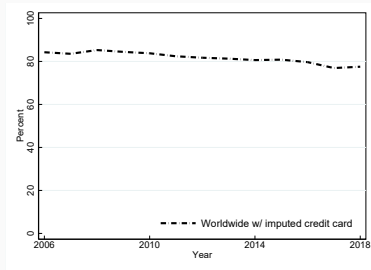


- Individual invoice payment to banks labeled as non-credit card debt if stable over time or large (above NOK100K).
- Residual is labeled as consumption related credit card payments
- Observe only payments to banks if it goes through NICS. Likely not the case for internal transfers.

Share of card payments covered, domestic and worldwide



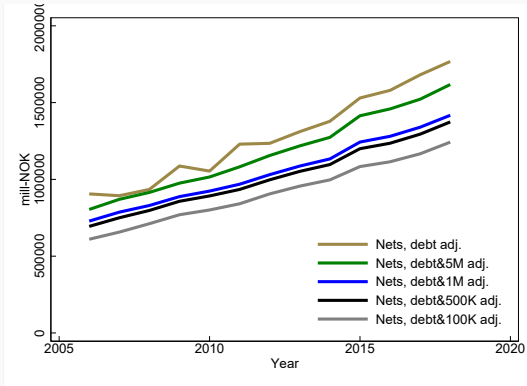
(a) Debit Card



(b) Debit card + imputed credit card

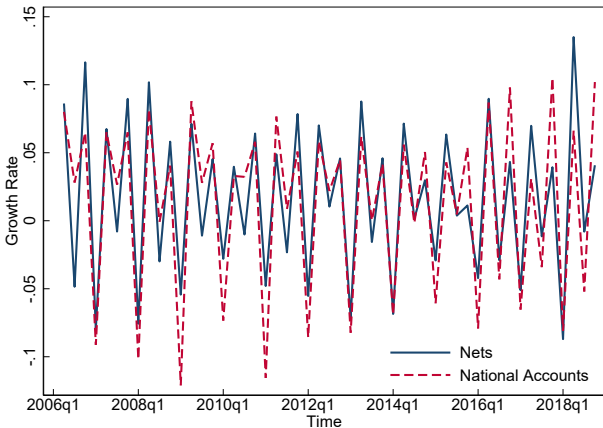
- Domestic: debit card \approx 80% of total card usage by Norwegians
- Worldwide: between 60-70%. Up to 80% with imputed credit card

Invoice includes some very large transactions



- Transactions above 100K accounts for more than 50 percent of total spending.
- Our baseline: 100K cutoff.

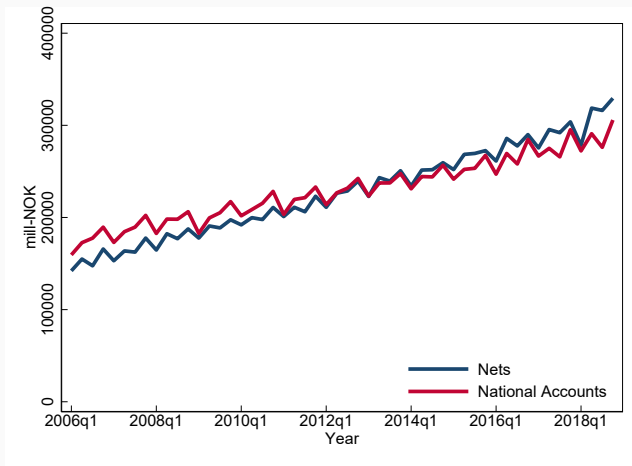
Comparison to National Accounts: quarterly growth rates



Correlation: 0.83

▶ back

Comparison to National Accounts, level



▶ back

Control Variables

Time varying group fixed effects based on pre-determined household characteristics

- County of residence
- Age of household head
- Employment dummies for head and partner
- Industry of employment head and partner
- Size of household
- Homeowner dummy
- Deciles of income, wealth/income and liquid wealth/income

Time varying pre-determined household observables

- debt-to-income ratio
- lagged dependent variable

Empirical specification (1): Identification threats

$$\frac{c_{i,t+h} - c_{i,t-1}}{y_{i,\text{year}(t)-1}} = \beta_g^h \Delta r_t + \delta_i^h + X_{i,t} \alpha_g^h + \epsilon_{i,t}^h \quad \forall i \in g,$$

Threats to causal interpretation:

1. Δr endogenous to other factors driving Δc
 - Classical: CB increase rate in a boom
 - Here: business cycle sensitivity of consumption varies with factors correlating with debt burden
2. Even if Δr exogenous, variation in response to Δr due to other factors correlating with debt burden
 - indirect effects on e.g. wages
 - elasticity of substitution

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Our identification rests on:

- Household fixed effects \Rightarrow
 - relative, not absolute, debt burden that matters
- FE Time \times HH group characteristics
 - debt burden changes relative to the average within the group that matters
location, age, employment, industry, size, homeowner, income, wealth, liquid asset
- Other (lagged) observables (including debt-to-income).

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Not addressed here: Business cycle sensitivity of consumption varies directly with debt? Δr in response to c-driven boom fueled by debt? Need exogenous Δr

Construction of monetary policy instruments

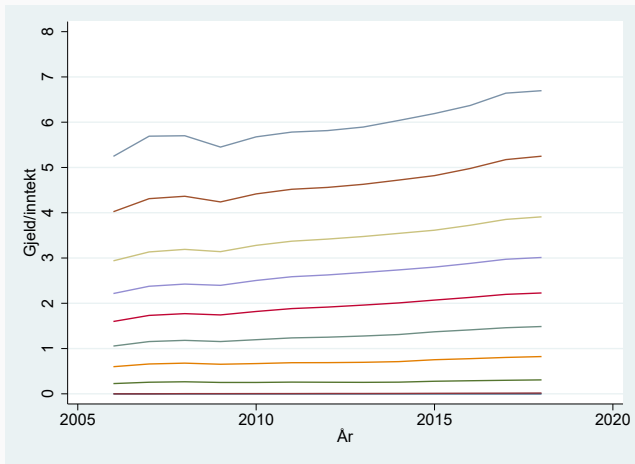
- Changes in forward rate agreements for money market rate (3 month NIBOR) around each monetary policy meeting.
 - 20 minutes after vs. 10 minutes before results from meeting are made public.
 - Four horizons of FRA contracts \Rightarrow four market surprises, $FF_{i,m}$ for $i = 1 - 4$ at meeting frequency.
- Project these surprises on Norges Bank's forecasts and forecast revisions of GDP growth and inflation at quarterly frequency (vector x):

$$FF_{i,m} = \alpha_{i,0} + \sum_{j=0}^3 \theta_{i,j} F_m^{NB} x_{q+j} + \sum_{j=0}^2 \nu_{i,j} \left[F_m^{NB} x_{q+j} - F_{m-1}^{NB} x_{q+j} \right] + \text{MPI}_{i,m}$$

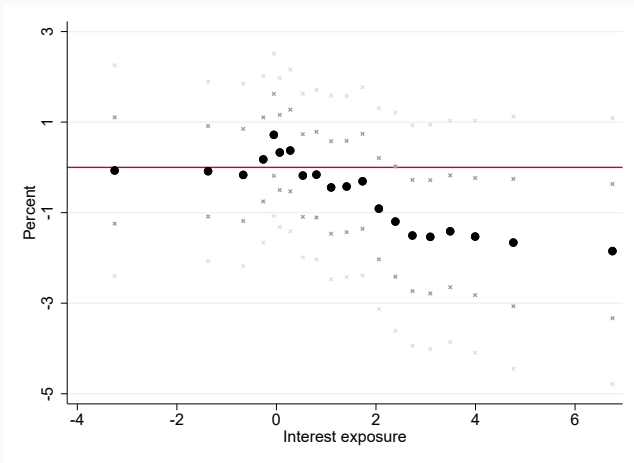
- Project residuals, averaged at monthly frequency, on their own lags:

$$\overline{\text{MPI}}_{i,t} = \phi_{i,0} + \sum_{j=1}^{12} \phi_{i,j} \overline{\text{MPI}}_{i,t-1} + \text{MPI}_{i,t}$$

Deciles of DTI over time

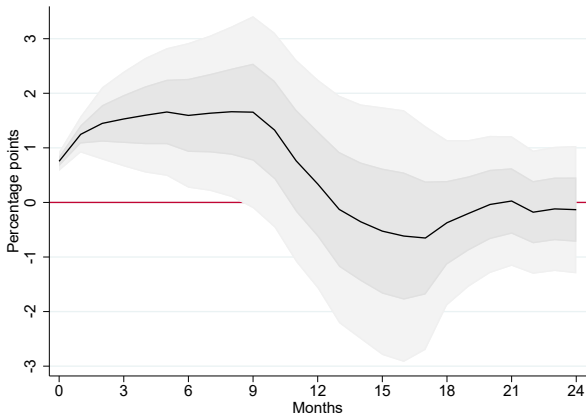


Consumption response by *net* exposure: Months 11-13



MP surprise raises 3-month NIBOR temporarily

Interest rate after initial change.



◀ Empirical spec.

◀ MPC

Empirical specification (2): controls

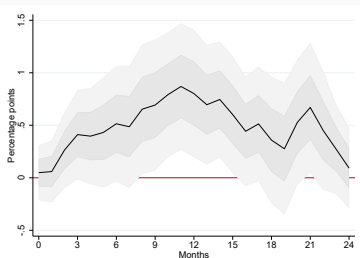
We include in the vector $X_{i,t}$

- lagged consumption growth
- household income in the previous year,
- total wealth divided by income
- liquid wealth divided by income.
- month dummies
- second order time polynomial.

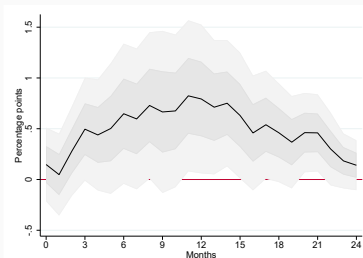
Regressions by horizon $h \rightarrow$ effects controls on the outcome variable vary flexibly by horizon. [◀ back](#)

Pass-through of money market rate to lending and deposit rates.

Lending rate

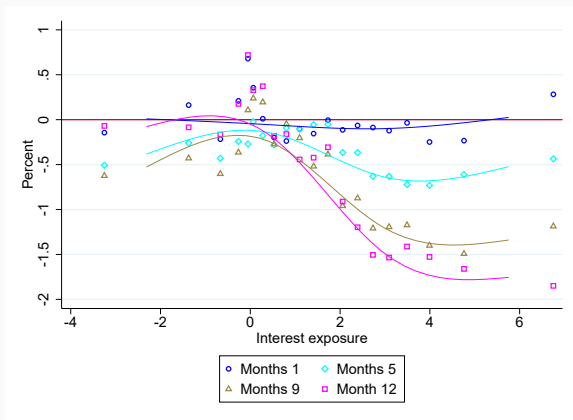


Deposit rate



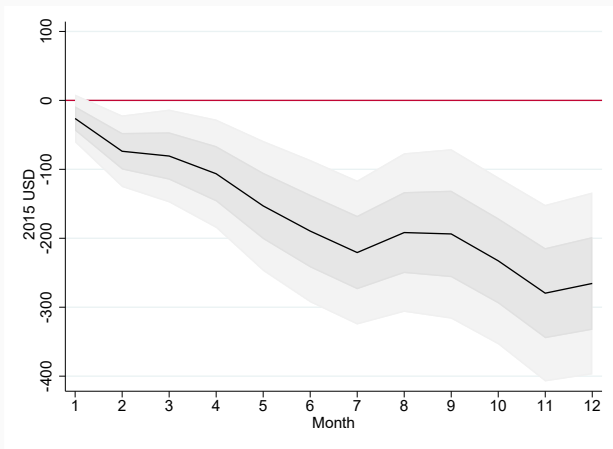
Notes. The figure shows the pass-through of an initial change in the 3 month money market rate to the lending and deposit rates, respectively, for the period December 2013 to December 2018

Consumption response to interest rate increases



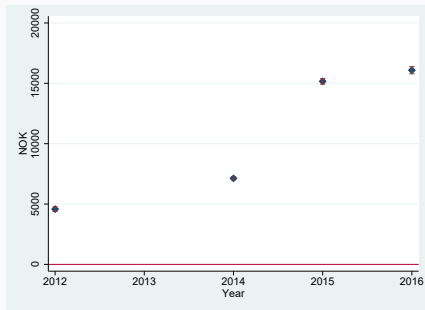
Notes. Impact on consumption by horizon and 20 quantiles of net DTI.

Spending adjusts smoothly throughout 2014

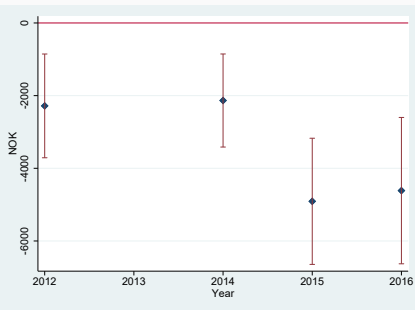


▶ Back

Results



Interest expenses



Consumption

▶ Back

Consumption categories

- 26 categories based on COICOP classification.
- BankAxept classified by payment terminal's MCC code.
- Bill payments based on NACE code of firm.

01 Food and non-alcoholic beverages

02 Alcoholic beverages, tobacco and narcotics

03 Clothing and footwear

04 Housing, water, electricity, gas and other fuels

05 Furnishings, household equipment and routine household maintenance

06 Health

07 Transport (sub. cat. 71-73)

08 Communications

09 Recreation and culture (sub. cat. 91-95)

10 Education

11 Restaurants and Hotels (sub. cat. 111-112)

12 Miscellaneous goods and services (sub. cat. 121-127)

—

13 Payment to banks

14 Payments to public institutions