

# Shocked by Bank Funding Shocks: Evidence from 500 Million Consumer Credit Cards

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## Motivation

- What explains the sharp decline in consumption after the financial crisis?
  - Also, puzzling **slow recovery** post-crisis (esp. non-durables, services)?
- Household balance sheet effects (Mian, Rao, and Sufi, 2013):
  - Housing-wealth effect.
  - Debt overhang effect.
  - Borrowing constraints due to reduced collateral values.

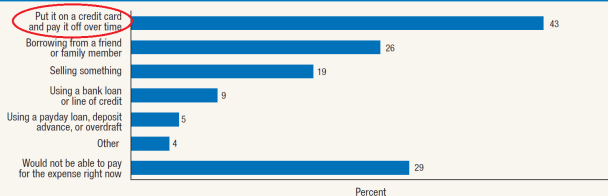
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- Financial intermediaries' balance sheet effects: Did **bank health** affect consumers' balance sheets?
  - **Bank health**: Fragile funding structures (reliance on uninsured short-term liabilities).
  - What is the **transmission mechanism**? **Who** gets affected? Are the effects **short-term** or **long-term**?
  - Effects on Durables vs. **Non-durables/services/staples**. Consumption financed by Secured (e.g., mortgage, auto) vs. **Unsecured** debt (e.g., credit cards).
  - **This paper**: *Did bank health affect consumption through credit cards?*

## Motivation

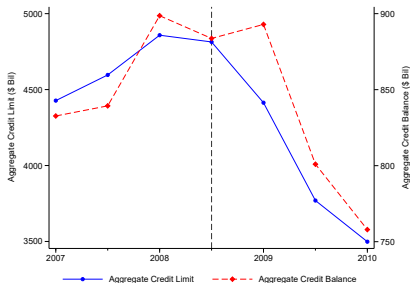
- Credit card spending accounts for 25% of personal consumption expenditure (PCE) (~ \$10 trillion in 2010, typically ~ 70% of GDP).
- Most households consume services and non-durable goods such as food, apparel, gasoline, transportation, and healthcare through credit cards.
- Important source of marginal borrowing:
  - Can you cover an emergency \$400 expense?
  - Answer is **NO** for **40%** of U.S. households.

Figure 12. Other ways that individuals would cover a \$400 emergency expense



Note: Among those who would not pay the expense in full using cash or its equivalent, respondents can select multiple answers.

## Preview of results



- Banks' balancesheets affect agg. consumption through the credit card channel.
- *Negative bank funding shock* → Dry-up of wholesale funding market.
- CC Balance-Limit Elasticities due to shock: **0.32**
- Banks transmit shocks **unequally** across consumers → greater transmission to consumers who have lower ability to cope with the transmitted shocks.
- Effects of transmitted shocks are **persistent** for some consumers.

## Identification challenges

- **Main challenge:** Isolate the changes in credit supply from the changes in credit demand.
- Implementation: **Within-individual comparison** (ala Khwaja & Mian, 2008)
  - **Same individual** exposed to high-shock and low-shock credit cards.
  - The **within** individual comparison controls for changes in **individual-specific demand factors** (e.g., income changes).
  - **Leave-out mean credit limit** to mitigate **individual-bank specific demand**.
- Unique data advantages:
  - Observe **CC limits** separately from **CC balances**.
  - Observe data on **ALL** credit cards for a given individual (advantage over previous papers).

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- Unique data advantages:
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- Identify shock's effect on consumption:
  - $$\frac{\partial CB}{\partial S} = \frac{\partial CL}{\partial S} \times \frac{\partial CB}{\partial CL}$$
  - Isolate  $\Delta$  (Credit Limits) due to the sudden bank liquidity shock.
  - Next, examine  $\Delta$  (Balances) resulting from  $\Delta$  (Credit Limits) induced by the bank liquidity shock.

## Transmission of bank shocks through credit cards

- **Hedged consumers?**: Ex-ante, the bank lending channel through credit cards is not obvious.
- Consumers have multiple credit cards and unutilized credit.
  - 59.8% of the households held two or more credit cards in 2007 (source: 2007 SCF).
  - Average utilization ratio is about 27%.
- **Substitutes**: Households have access to other sources of financing (personal loans, home equity lines of credit)
- Thus, **frictions that constrain consumers** in the credit market **are necessary** for a **real impact** of bank shocks transmitted through the credit card channel.
  - We highlight which credit market frictions are binding.



## Data

- Data from one of the three major credit bureaus in the United States – observe credit limits and balances on **all** credit cards of an individual (~ 500 million CCs.)
- Sample: **18 BHCs** with non-zero wholesale funding dependence that are CC issuers; account for **65%** of market; cover **7** of **top 10** CC issuers which account for 50% of market share.
  - Dropped 4 foreign issuers, 1 specializing in retail store cards, 1 targeting a particular segment of U.S. population (veterans), 1 with insufficient data.
- Omit cards closed in the post-shock period → so that we don't pick up changes in credit limits and balances due to personal bankruptcies or CC cancellations.
- Two main samples: Within-individual sample (**158 million** CCs, **54 million** individuals), Aggregate sample (**500 million** CCs, **134 million** individuals).
- Bank data from BHC Y-9C filings.

## Bank liquidity shock

- Bank exposure to liquidity shock: ratio of bank's short-term wholesale funding to deposits.
- *Exposure measure*: bank's **runnable funding** (short-term wholesale funding) as a proportion of its **stable funding** (deposits).
- Exposure measure: Relatively stable in the pre-crisis period, and declines sharply in the post-crisis period.



## Bank liquidity shock

- Banks vary in the extent to which they depend on short-term wholesale funding → liquidity shock should vary across banks.
- **Short-term wholesale funding:** non-deposit financing (e.g., repos, commercial paper, interbank borrowing) with maturity **less than one year**.
  - Mainly provided by institutional investors such as, money market funds (MMFs) and other banks.
  - Advantages: Alternative to deposits when they need to quickly cover any funding gap (supply of deposits is highly inelastic with respect to the interest rates offered (Amel & Hannan, 1999))
  - Disadvantages: Expensive and prone to runs when compared to deposit financing
  - Ex-ante, less risky/strong banks should have a comparative advantage in accessing the wholesale funding market (Choi & Choi, 2017)

## Validity of liquidity shock

<i>Depvar:</i>	$\Delta$ ST Wholesale (1)	$\Delta$ Wholesale (2)	$\Delta$ Tot Liabilities (3)	$\Delta$ Tot Equity (4)
Exposure	-0.425*** (-4.03)	-0.324*** (-2.95)	-0.272*** (-3.34)	-0.151 (-1.75)
N	18	18	18	18
Adj. $R^2$	0.469	0.334	0.412	0.181
Controls	Assets	Assets	Assets	Assets
Orthog-Exposure $R^2$	<b>0.531</b>	0.412	<b>0.481</b>	0.278

- Banks with high exposure experienced larger decline in short-term wholesale funding
- High exposure banks also experienced declines in total liabilities
- Equities/deposits unaffected
- The exposure measure explains  $\sim 53\%$  of the decline in short-term wholesale funding, and  $\sim 48\%$  of decline in total liabilities in banks.

## Empirical setup: Collapsed cross-sectional analysis

- Collapse the time-series credit card account-level data to obtain a **single credit card-level cross-section** separately in the pre-shock and post-shock period by averaging across time.
- Estimate credit card-level regression:

$$\Delta CreditLimit_{i,c,b} = \alpha + \beta Exposure_b + f(\mathbf{X}_{i,c,b}) + \eta_i + \varepsilon_{i,c,b}$$

- Sample period:
  - *Pre-shock* – Jan-2007, Jul-2007, and Jan-2008 semi-annual archives.
  - *Post-shock* – Jan-2009, July-2009, and Jan-2010 archives.
- Analysis is similar to including *Individual*  $\times$  *Archive* FE which absorbs all time-varying individual-level factors.

## Summary stats

- High-exposure banks significantly **larger** than low-exposure banks
- Insignificant differences in equity capital, liquid assets, business mix, performance between high- and low-exposure banks.
- **Greater decline in credit card limits for high-exposure banks:**
  - Mean  $\Delta\text{CCLimit}_{\text{High-exposure}} = -3.96\%$
  - Mean  $\Delta\text{CCLimit}_{\text{Low-exposure}} = -0.30\%$
- **Greater decline in credit card balances for high-exposure banks:**
  - Mean  $\Delta\text{CCBalance}_{\text{High-exposure}} = -49.07\%$
  - Mean  $\Delta\text{CCBalance}_{\text{Low-exposure}} = -19.13\%$
- **High-exposure banks lend to relatively higher quality borrowers**
  - Better credit scores, higher monthly income, lower delinquency rates, lower subprime share.
  - Consumers of high-exposure banks have **higher** credit card balance, mortgage balance, differences in debt composition (auto, mortgage, credit card etc.), but similar DTI.

## Bank exposure and $\Delta$ CC limits: Credit card-level analysis

<i>Depvar: <math>\Delta</math>CC Limit</i>	<i>Individual FE</i>			<i>OLS</i>
	(1)	(2)	(3)	(4)
Exposure	-3.811*** (-9.85)	-5.050*** (-13.32)	-4.750*** (-12.89)	-4.035*** (-8.66)
Bank characteristics	✓	✓	✓	✓
Bank quality		✓	✓	✓
Credit card controls			✓	✓
N	158,432,533	158,432,533	158,432,533	158,432,533
Adj. $R^2$	0.072	0.084	0.090	0.036
Clustering	Bank $\times$ State			

- FE estimate implies 1 SD (16%) greater bank exposure leads to a reduction of \$434 in credit limit (Avg. pre-shock credit limit  $9131.60 \times 4.750\%$ ).
- FE and OLS estimates are similar  $\rightarrow$  demand factors that drive increases in credit limits seem uncorrelated with liquidity shock exposure in the cross-section.
- Robust after controlling for bank quality (size, size<sup>2</sup>, capital ratio, CC business, ROE, non-perf loans etc.) and credit card controls (CC utilization, CC age, bank-individual relationship).
- Robust to alternate measures of bank exposure (exposure defined w.r.t assets, exposure orthogonalized to bank size) and different levels of clustering (bank-level).

## Bank exposure and $\Delta$ CC balances

- Why should changes in credit limits affect credit card balances?
  - **Permanent income hypothesis:**  $\text{Corr}(\Delta\text{CCLimits}, \Delta\text{CCBalances})=0$  if  $\Delta(\text{Permanent income})=0$ .
  - **Liquidity constraints:**  $\text{Corr}(\Delta\text{CCLimits}, \Delta\text{CCBalances})>0$  only if binding liquidity constraints (e.g.: high CC utilization individuals.)
  - **Buffer stock models:**  $\text{Corr}(\Delta\text{CCLimits}, \Delta\text{CCBalances})>0$  if liquidity constraints expected to be binding in future affects currently unconstrained individuals too.
- $\text{Corr}(\Delta\text{CCLimits}, \Delta\text{CCBalances})\neq 0$  because of demand factors.
  - Consumers apply for credit limit increase.
  - Lenders can anticipate future demand changes.
  - Important to control for **Individual FE!**



## Bank exposure and $\Delta$ CC balances: Card-level analysis

<i>Depvar: <math>\Delta</math>CC Balance</i>	OLS (1)	FE (2)	OLS (3)	FE (4)	2SLS (5)
$\Delta$ CC limit	0.744*** (46.40)	0.854*** (25.05)			
Exposure			-3.080 (-1.02)	-9.805*** (-4.57)	
$\Delta$ CC limit (instrumented)					2.064*** (4.52)
<i>Individual FE</i>		✓		✓	✓
Bank characteristics	✓	✓	✓	✓	✓
Bank quality	✓	✓	✓	✓	✓
Credit card controls	✓	✓	✓	✓	✓
N	158,432,533	158,432,533	158,432,533	158,432,533	158,432,533
Adj. $R^2$	0.04	0.16	0.02	0.15	0.13
F-stat (Excl. Instru)					97.1

- OLS and FE estimates suggest that individual demand factors **bias against** finding results  $\rightarrow$  *high exposure* banks were lending to *better borrowers*.
- IV estimate captures LATE  $\rightarrow$  **2.06%** card-level consumption **foregone** due to 1% reduction in credit limits from short-term wholesale funding shock (Assumption: Shock affects balances only through limits.)
- Results robust to using a “leave-out” mean credit supply measure instead of credit limits  $\rightarrow$  *mitigates bank-specific individual demand concerns*.

## Bank exposure and *total consumer-level* $\Delta$ CC balances

Depvar:	$\Delta$ Agg. CC Limit	$\Delta$ Agg. CC Balance		
	(1)	(2)	(3)	(4)
Weighted exposure	-3.827*** (-9.56)	-1.216** (-2.55)		
$\Delta$ Agg. CC limit			0.859*** (43.56)	
$\Delta$ Agg. CC limit (instrumented)				0.318*** (2.87)
Zip-code FE	✓	✓	✓	✓
Consumer quality	✓	✓	✓	✓
N	133,501,009	133,501,009	133,501,009	133,501,009
Adj. $R^2$	0.027	0.032	0.141	0.098
F-stat (excl. instru)				91.386

- For each individual, compute weighted exposure using **All** their credit cards.
- Note: Individual-level regression (Zip-code FE).
- 1 SD increase in bank exposure reduces aggregate credit card balances by **1.216%** (effect is  $1/8^{th}$  compared to card-level balance results  $\rightarrow$  consumers are able to **partially hedge away** the shock.)
- IV estimate captures LATE  $\rightarrow$  **0.32%** aggregate CC consumption **foregone** due to 1% reduction in credit limits from short-term wholesale funding shock.

## Dollar Regressions

Depvar: \$ Changes:	$\Delta$ CC Limit FE	$\Delta$ CC Balance 2SLS	$\Delta$ Agg. CC Balance 2SLS
	(1)	(2)	(3)
Exposure	-475.35*** (-13.31)		
$\Delta$ CC limit (instrumented)		0.235*** (7.30)	
$\Delta$ Agg. CC limit (instrumented)			0.071*** (13.03)
N	158,432,533	158,432,533	133,501,009
F-stat (excl. instru)		177.15	104.48

- 1 SD increase in bank exposure reduces credit card balance by **\$475.35**.
- Funding-shock induced credit limit cuts:
  - Credit card level:  $\downarrow$  \$1 Credit Limit  $\implies$  Balance **23.5 cents**  $\downarrow$
  - Individual level:  $\downarrow$  \$1 Credit Limit  $\implies$  Balance **7.1 cents**  $\downarrow$
- Other Studies:
  - Gross and Souleles (2002):  $\uparrow$  \$1 Credit Limit  $\implies$  Balance 10 – 14 cents  $\uparrow$
  - Mian, Rao, and Sufi (2013):  $\downarrow$  \$1 House Price  $\implies$  Spending 5 – 7 cents  $\downarrow$

## Heterogeneity: Credit card level analysis

Panel A: CC-level Util		Panel B: Ind-level Util		Panel C: Credit Score	
Depvar: $\Delta CC$ Limit	(1)	Depvar: $\Delta CC$ Limit	(2)	Depvar: $\Delta CC$ Limit	(3)
Exposure	-4.052*** (-10.61)	Exposure	-4.232*** (-10.87)	Exposure	-4.038*** (-10.26)
Exposure $\times$ CC util (50–90%)	-4.298*** (-10.61)	Exposure $\times$ Agg. util (50–90%)	-4.994*** (-11.68)	Exposure $\times$ Near-prime	-4.145*** (-9.92)
Exposure $\times$ CC util (>90%)	-6.587*** (-15.16)	Exposure $\times$ Agg. util (>90%)	-8.185*** (-15.37)	Exposure $\times$ Subprime	-7.887*** (-14.88)
N	158,432,533		151,449,029		158,423,518
Adj. $R^2$	0.089		0.089		0.089

- *Banks transmit shocks differentially across consumers!* → Banks cut credit limits more for higher utilization and lower credit score consumers.
- Evidence consistent with greater costs of lending to consumers with greater information frictions (e.g., moral hazard for high utilization ratio consumers).

## Heterogeneity: Individual level analysis

### Change in Credit Card Balances Across All Cards

	Utilization			Credit score		
	0-50% (1)	50-90% (2)	90%+ (3)	Sub-prime (4)	Near-prime (5)	Prime (6)
$\Delta$ Agg. CC Limit (instru)	0.232 (1.14)	1.078*** (21.11)	1.325*** (44.16)	1.475*** (36.59)	0.639*** (12.50)	0.120 (0.66)

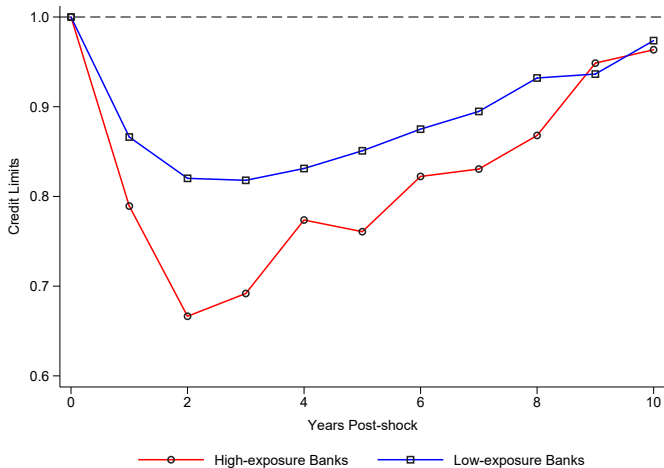
### Change in Total Debt Balances Across All Debt-related Accounts

	Utilization			Credit score		
	0-50% (1)	50-90% (2)	90%+ (3)	Sub-prime (4)	Near-prime (5)	Prime (6)
$\Delta$ Agg. CC limit (instru)	-0.890*** (-4.91)	-0.001 (-0.03)	0.199*** (6.48)	0.596*** (10.23)	0.123** (2.13)	-0.723*** (-5.43)

- Aggregate consumption elasticity is **decreasing** in an individual's ability to hedge.
- Individuals with lower credit score, higher utilization **reduce** consumption on their credit cards at the aggregate level.
- Elasticities for total debt balances are smaller compared to total credit card balances. → Individuals able to substitute to other credit sources.
- Overall, suggests credit constrained individuals were **not able to hedge away** the funding shock to their bank at the aggregate level.

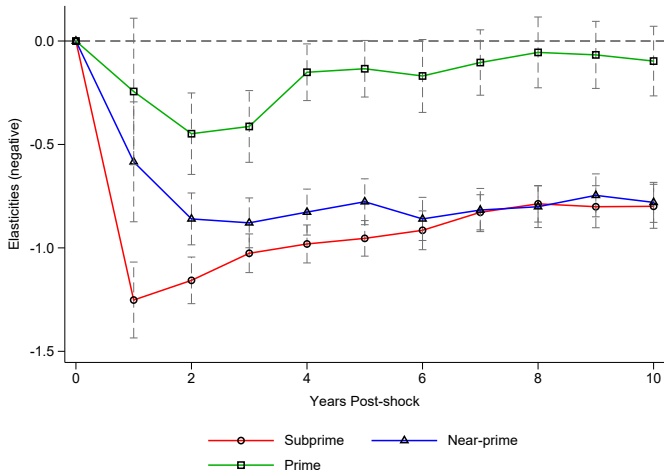
## Long-run effects of the funding shock

- Total inflation-adjusted real credit extended by banks on credit cards recovered to pre-crisis levels over time.



## Long-run effects of the funding shock

- Persistent effects of funding shock for the near-prime and subprime consumers in the long-run.



# Conclusion

- **Results:**

- Funding structure of banks affects aggregate consumption through the credit cards channel.
- **Heterogeneity in bank response:** Banks transmit shocks more to the credit constrained consumers.
- **Heterogeneity in consumption elasticities:** Consumption sensitivity to funding shock is higher for credit constrained consumers.
- Overall, when faced with liquidity shocks, banks pass them on to consumers who are least able to cope with them.
- *Ours + prior studies shed light on the winners and losers in a credit boom-bust cycle:*  
**Credit constrained** consumers enjoy less gains in boom and suffer more costs in bust.

- **Contribution:**

- Banks' balance sheets can affect aggregate consumption through the **credit card channel** with significant **distributional** consequences over the **long-term**.
- **Post-crisis regulatory reform** focused on addressing the vulnerabilities of a bank's funding structure, especially the reliance on wholesale funding (Tarullo, 2014).