

# Informational Synergies in Consumer Credit

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# Motivation

- Financial intermediaries are special because they **produce private information** to screen and monitor borrower risk
- Lenders can consider multiple sources of private information to assess consumer credit risk
- However, little is known about potential **synergies between different sources** of private hard information
- Synergies in our context
  - Private information from different sources is similar to **pieces of a puzzle** that, only when it is fully assembled, shows the **whole picture**
  - “The whole is greater than the sum of its parts”

# Motivation

- Our question: Are there informational synergies between different sources of private information that lenders can exploit to manage credit risk and customer relationships?
  - Consumers default because of **negative income shocks** or **positive expenditure shocks** (Gross & Souleles 2002; Chatterjee et al. 2007; Livshits et al. 2016)
  - Data from **different credit accounts** of the same individual that might provide the lender with a real-time view on cash in-/outflows
    - Checking accounts (with lines of credit): in-/outflows, regular payments
    - Credit card accounts: outflows, irregular payments
- Why relevant?
  - Informational synergies might affect **the supply** and **the allocation of consumer credit** in the economy

## Related literature

- Account activity and **private information** production
  - Norden and Weber (2010, RFS): Information from checking accounts is useful for monitoring consumers and SMEs (Germany)
- Individual **consumption patterns and credit risk**
  - Vissing-Jorgensen (2012): Consumer choice and credit risk (Mexico)
  - Stango and Zinman (2016, RFS): Shopping intensity and credit risk (U.S.)
  - Liberman (2016, JFE): Consumers are willing to “buy” good credit reputation (Chile)
- Information and **cross-selling**
  - Kamakura et al. (1991, JRM), Akçura and Srinivasan (2005, MS), Li et al. (2011, JMR): Lowering marketing costs, cross-product pricing and increasing customer loyalty
  - Learning about spending and consumption behavior, preferences and risk

# Contribution

- Source of information
  - Related studies: **Private versus public** information
  - Here: Multiple sources of **private information**
- Type of information
  - Related studies: Private **hard versus soft** information
  - Here: Different **private hard** information
- Type of consumer credit
  - Related studies: Vast majority of studies is on mortgage lending (default is risky; **exposure quasi fixed**)
  - Here: Credit cards and checking accounts with lines of credit (**default and exposure at default are risky**)

# Data

- Retail portfolio of a privately-owned European bank
- Information about consumers' checking accounts and credit card accounts from 12/2007 to 01/2014
- Default at the account level
- 3.6 million account-month observations from 46,925 clients
  - Account activity measures
  - Client characteristics
  - Characteristics of the bank relationships (duration, etc.)

## Dependent variables

### Probability of Default (PD)

Estimation of the probability of default within one year

$$(Default_{i,t+12} = 1)$$

### Also: Credit Line Usage (CLU and CLUAD)

Estimation of the credit line used at default

$$CLUAD_{i,t+12} = \frac{neg. Balance_{i,t+12} | Default_{i,t+12} = 1}{Limit_{i,t}}$$

# Explanatory variables

## **Default Risk**

Rating: PD of the bank internal rating system

## **Account Activity**

Net CF/limit: Monthly in- minus outflows (in percent of Limit)

Amplitude: Max. minus min. Balance (in percent of Limit)

Bounced:  $\emptyset$  No. of bounced credits in the prev. year (per month)

Days Usage: Percentage of days with pos. credit line usage in prev. year (in %)

Days Overdraft: Percentage of days with overdrafts in the prev. year (in %)

Limit: External limit (in Euro)

## **Relationship**

Duration: Time since account opening (in months)

Prev. Def: Previous default of the borrower (yes/no)

## **Account Type**

Full payments: Full payment (or instalments)

## **Client Controls**

Age, gender, job, marital status, number of children, nationality, online vs. offline banking, academic titles



# Summary statistics

## Panel A: Number of account month observations and default events

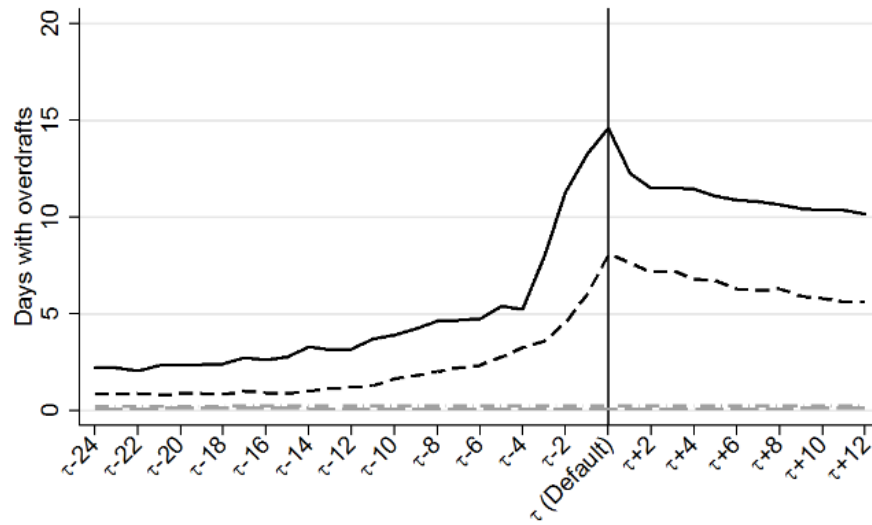
Statistic	Checking account	Credit Card
Number of account-month observations	1,779,356	1,781,408
Number of account-months with default in the subsequent 12 months	19,149	22,964
Number of defaults	1,418	1,893

## Panel B: Summary statistics and comparisons of checking accounts and credit cards

Variable	Checking account		Credit Card		Checking account minus credit card	
	Mean	Median	Mean	Median	Pairwise difference	<i>t</i> -stat.
<i>Default Risk</i>						
Rating <sub><i>t</i></sub>	1.79	0.88	3.79	1.94	-1.939***	-428.25
<i>Account Activity</i>						
Net Inflow/Lim <sub><i>t</i></sub>	0.02	0.00	0.00	0.00	0.0195***	19.18
Amplitude <sub><i>t</i></sub>	1.80	1.03	0.39	0.24	1.407***	727.72
Limit <sub><i>t</i></sub>	2437	2000	2581	2000	-143.7***	-163.29
Bounced <sub><i>t</i></sub>	0.00	0.00	0.05	0.00	-0.0500***	-182.49
Days Usage <sub><i>t</i></sub>	0.18	0.03	0.55	0.67	-0.367***	-1269.96
Days Overdraft <sub><i>t</i></sub>	0.01	0.00	0.00	0.00	0.0070***	201.34
<i>Relationship</i>						
Duration <sub><i>t</i></sub>	46.38	41.00	34.99	34.00	11.46***	616.02
<i>Account Type</i>						
Full Payment <sub><i>t</i></sub>			0.93	1.00		

# Consumer defaults and overdrafts

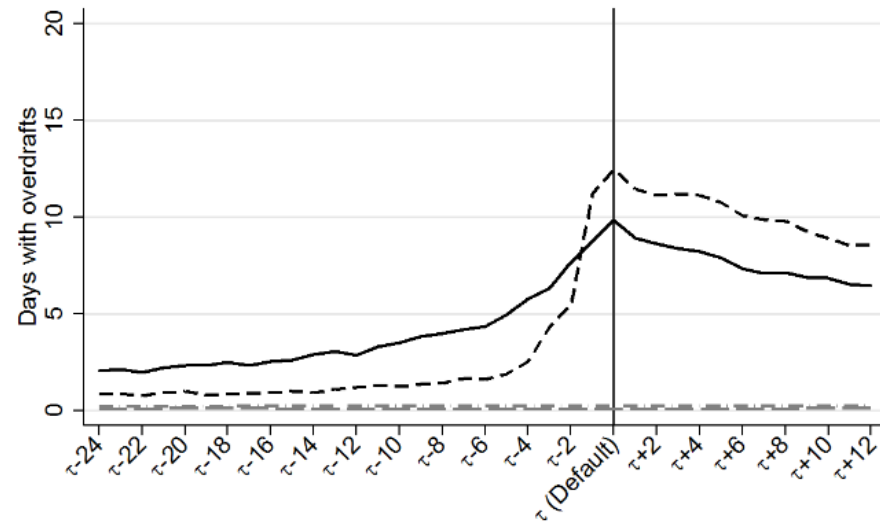
Default of checking accounts



Event time (months)

— Checking account def.      - - - - Credit card def.  
 - · - · - Checking account non def.      - - - - - Credit card non def.

Default of credit cards



Event time (months)

— Checking account def.      - - - - Credit card def.  
 - · - · - Checking account non def.      - - - - - Credit card non def.

# Probability of default: Cross-product information

	Default <sub>t+12</sub> : Checking Account				Default <sub>t+12</sub> : Credit Card		
CHECKING ACCOUNT VARIABLES							
<i>Default Risk</i>							
Rating <sub>t</sub>	0.4626***		0.2215***	0.1703***			0.1314***
<i>Account Activity</i>							
Net Inflow/Lim <sub>t</sub>		-0.0479***	-0.0561***	-0.0616***			-0.0475***
Amplitude <sub>t</sub>		-0.0687***	-0.0645***	-0.0614***			-0.0360***
Limit <sub>t</sub>		-0.1289***	-0.1322***	-0.0842***			-0.0750***
Bounced <sub>t</sub>		0.2471*	0.2288*	0.1853†			0.1649
Days Usage <sub>t</sub>		1.2349***	0.8366***	0.9115***			0.7657***
Days Overdraft <sub>t</sub>		2.1567***	1.8995***	1.4664***			1.1692***
<i>Relationship</i>							

➤ **Result 1:** Banks obtain useful *private hard information* from account activity

Limit <sub>t</sub>				-0.0241†		-0.1057	-0.0667	0.0053
Bounced <sub>t</sub>				0.0343*		0.1628***	0.1402***	0.0554***
Days Usage <sub>t</sub>				-0.5843***		0.1516***	-0.3906***	-0.4539***
Days Overdraft <sub>t</sub>				0.8898***		4.7102***	4.1120***	2.2709***
<i>Relationship</i>								
Duration <sub>t</sub>				-0.0068***		-0.0120***	-0.0104***	-0.0080***
Prev. Def <sub>t</sub>				-0.1909†				
<i>Account Type</i>								
Full Payment <sub>t</sub>				-0.1120***		-0.5604***	-0.2670***	-0.0398
Constant	-2.2031***	-1.9650***	-1.9854***	-1.9658***	-2.5644***	-1.2397***	-1.9346***	-2.1022***
Client controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year-month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,779,356	1,779,356	1,779,356	1,779,356	1,781,408	1,781,408	1,781,408	1,781,408
McFadden adj. R <sup>2</sup>	0.185	0.259	0.277	0.296	0.101	0.185	0.204	0.278

# Probability of Default: Cross-product information

	Default <sub>t+12</sub> : Checking Account			Default <sub>t+12</sub> : Credit Card		
CHECKING ACCOUNT VARIABLES						
<i>Default Risk</i>						
Rating <sub>t</sub>	0.4626***	0.2215***	0.1703***			0.1314***
<i>Account Activity</i>						
Net Inflow/Lim <sub>t</sub>	-0.0479***	-0.0561***	-0.0616***			-0.0475***
Amplitude <sub>t</sub>	-0.0687***	-0.0645***	-0.0614***			-0.0360***
Limit <sub>t</sub>	-0.1289***	-0.1322***	-0.0842***			-0.0750***
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## Relationship

➤ **Result 2:** *Cross-product activity* adds significant information about *default risk*

Limit <sub>t</sub>				-0.0241†		-0.1057	-0.0667	0.0053
Bounced <sub>t</sub>				0.0343*		0.1628***	0.1402***	0.0554***
Days Usage <sub>t</sub>				-0.5843***		0.1516***	-0.3906***	-0.4539***
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Client controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year-month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,779,356	1,779,356	1,779,356	1,779,356	1,781,408	1,781,408	1,781,408	1,781,408
McFadden adj. R <sup>2</sup>	0.185	0.259	0.277	0.296	0.101	0.185	0.204	0.278

## Screening with cross-product information

Dependent variable	Default <sub>t+12</sub> of checking account	Default <sub>t+12</sub> of credit card account
Independent variables	Credit card account	Checking account
<i>Default Risk</i>		
Rating <sub>t</sub>	0.2715***	0.1718***
<i>Account Activity</i>		
Net Inflow/Lim <sub>t</sub>	-0.1144***	-0.0426***
Amplitude	0.0387***	0.0153**

➤ **Result 3:** Cross-product information is valuable for *monitoring & screening*

Prev. Def <sub>t</sub>	0.1383	0.1251 <sup>†</sup>
<i>Account Type</i>		
Full Payments <sub>t</sub>	-0.3769***	-0.1618***
Constant	-1.8416***	-1.6782***
<b>Lambda: Default</b>		
Client Controls	Yes	Yes
Year-month FE	Yes	Yes
N	1,779,356	1,781,408
Adj. R <sup>2</sup>	0.185	0.250

## How large are the effects?

Dependent Variable	Measure	Information Source		
		(1) Checking Account	(2) Credit Card Account	(3) Both Accounts
<i>Default<sub>t+12</sub> of checking account</i>	Adj. McFadden R <sup>2</sup>	0.277	0.185	0.296
	ROC	0.906	0.843	0.913
	Type I error	13.99	23.81	13.69
	Type II error	18.03	23.63	17.38
<i>Default<sub>t+12</sub> of credit card account</i>	Adj. McFadden R <sup>2</sup>	0.250	0.204	0.278
	ROC	0.882	0.845	0.892
	Type I error	16.36	23.76	15.89
	Type II error	19.55	22.24	18.48

without cross-product  
information

both sources of  
private information

- **Result 4:** Cross-product information significantly *improves* default prediction
- Large improvement when information from checking account is added to credit card account (Type I error: **-33%**)
  - Small improvement when information from credit card account is added to checking account (Type I error: **-2%**)

# Further empirical checks and robustness tests

- **Credit Line Usage at Default (CLUAD)**  
Estimation of additional dependent variables
- **Alternative definition of credit line usage**  
Restriction of credit line usage to positive values (potential losses for the bank)
- **Defaults at the client level**  
Defining defaults on client instead of account level
- **Alternative time horizons**

➤ **Results are robust to different specifications**

- **Impact of the financial crisis**  
Estimation of PD and CLUAD in good (2011-2014) and bad state of economy (2009-2010)
- **Aggregate information from multiple credit products per client**  
Considering only clients with exactly one checking account and one credit card
- **Alternative functional forms for account activity variables**  
Estimation with highly non-linear functional forms
- **Interaction effects of cross-product account activity measures**  
Estimation of PD and CLUAD with interaction terms

## Conclusion

- Financial institutions can realize **significant informational synergies** by tapping into different sources of private hard information
  - Cross-product activity adds significant information about default risk and credit line usage
  - Information is valuable for monitoring and screening
  - Checking accounts display early warning indications earlier and more accurately than credit card accounts
- Significant potential for **economies of scope** in credit risk management and customer relationship management