Financial Innovation, Payment Choice and Cash Demand – Causal Evidence from the Staggered Introduction of Contactless Debit Cards

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Coronavirus accelerates shift away from cash

Pandemic encourages more businesses to move to contactless payments

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Daniel Thomas and **Nicholas Megaw** MAY 27 2020

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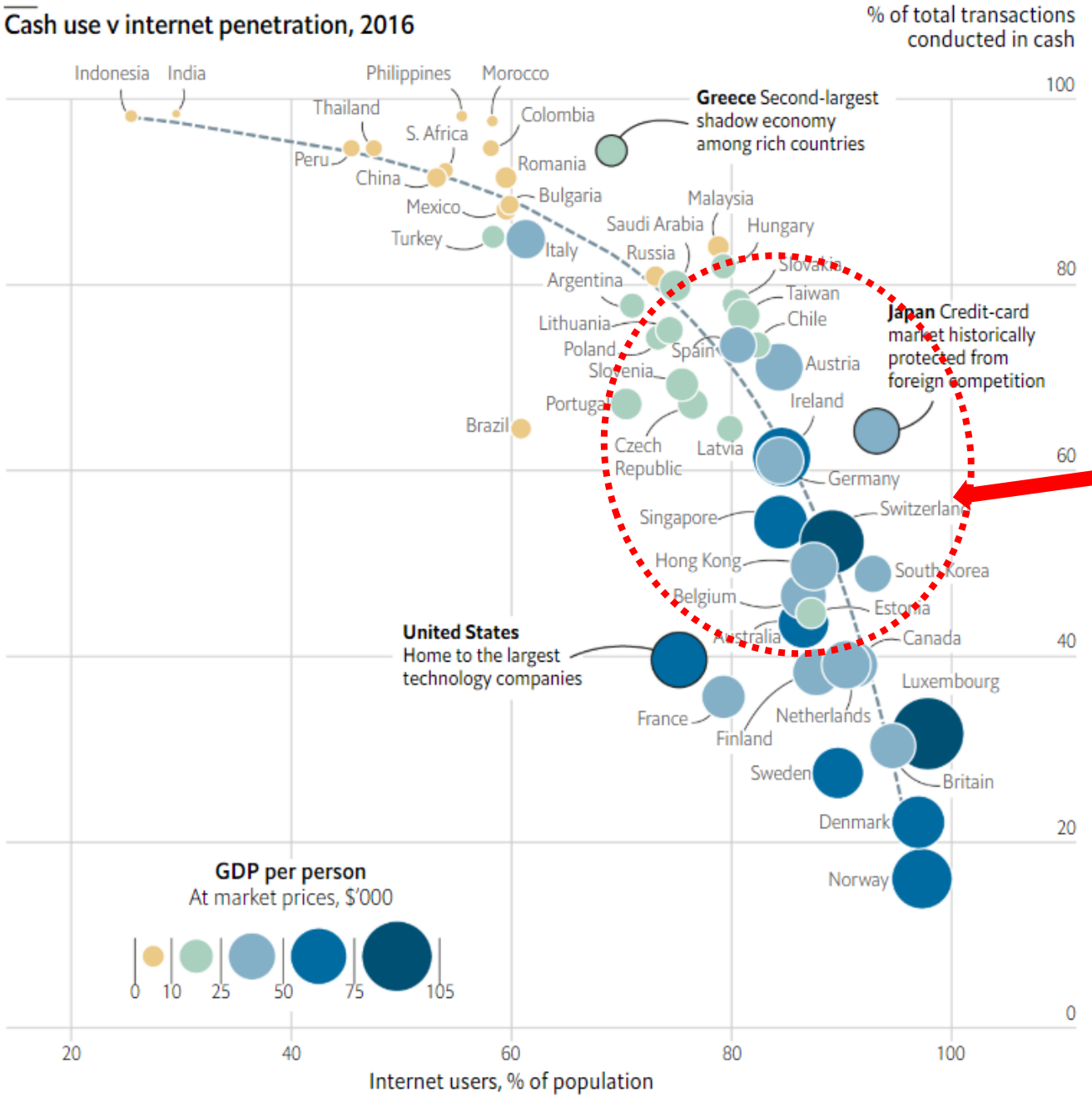

The Economist

August 3, 2019

many advanced economies are cash intensive ..

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Rise of contactless payment means cash is no longer king

UK spending on debit cards overtook hard currency for the first time in 2017

Contactless payments have almost doubled over the past year © Bloomberg

Nicholas Megaw, Retail Banking Correspondent JUNE 18 2018

Source: Financial Times

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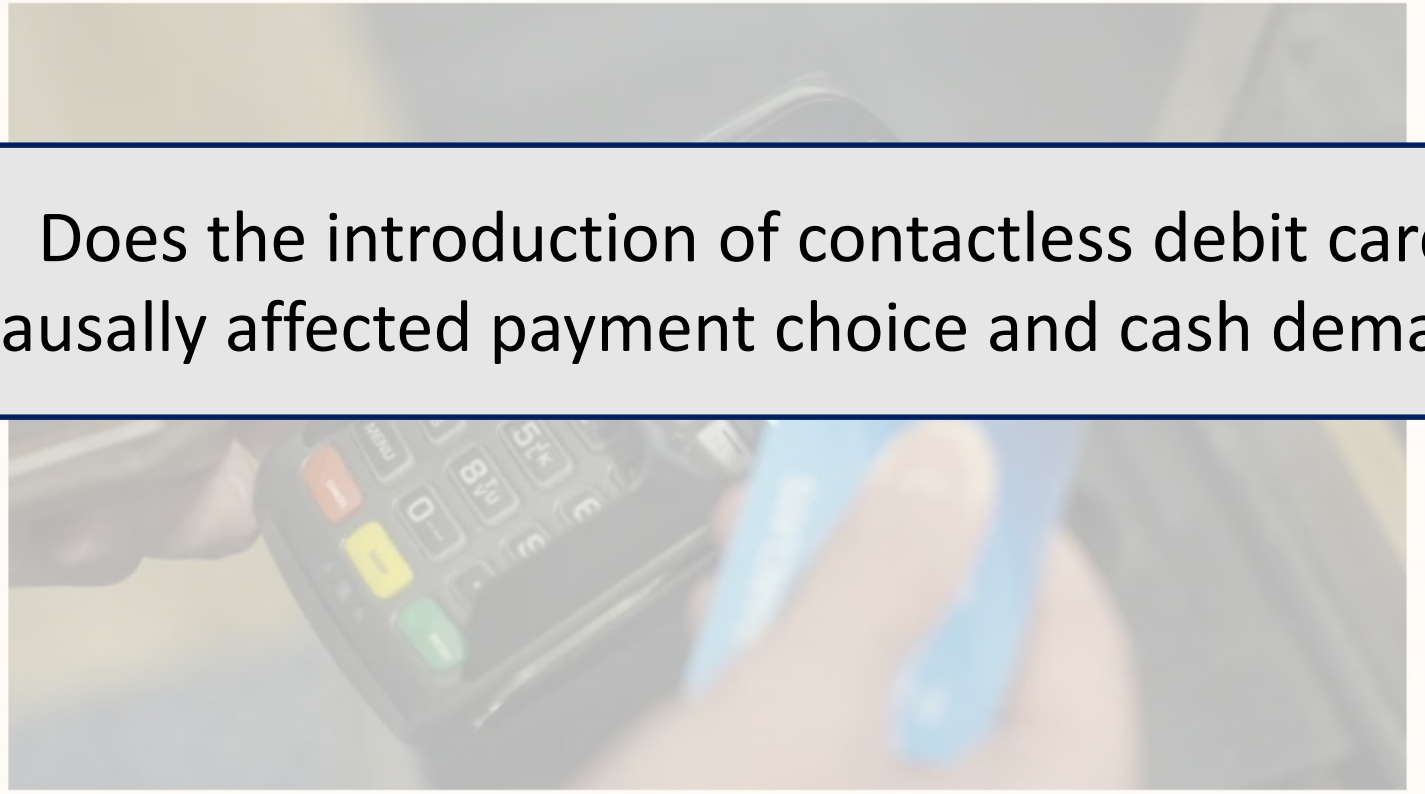

Contactless payments have almost doubled over the past year © Bloomberg

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Does the introduction of contactless debit cards causally affected payment choice and cash demand?

Source: Financial Times

What we do and find

- Study the staggered introduction of contactless debit cards by a Swiss retail bank between 2016-2018

- Use account-level data on card payments and cash withdrawals by 21’122 retail clients between 2015-2018

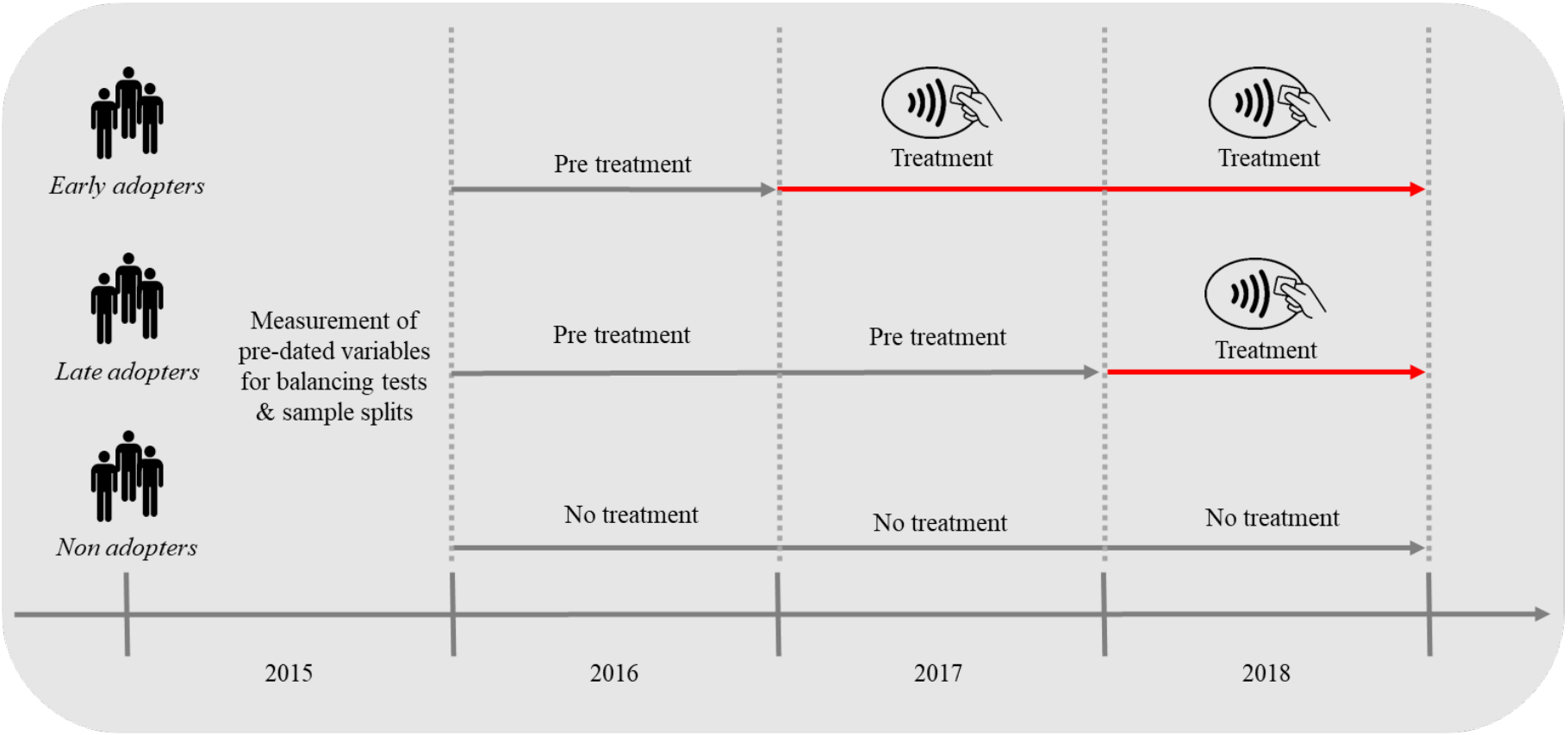
➢ Strong effect on (small value) debit card payments
➢ Weak effect on the cash share of payments
➢ Negligible effect on cash withdrawals

Research Design (I)

- Debit cards are regularly replaced every 3rd year in Q4
- Contactless cards rolled out to existing clients in 2016:Q4 / 2017:Q4 / 2018:Q4
- Timing of receipt of contactless debit card depends only on expiry date of existing card

disclaimer: not card of the «Bank»

Research Design (II)



Panel data with staggered adoption (Athey & Imbens, 2018)

$$Y_{i,t} = \beta_i + \beta_t + \tau \cdot Contactless_{i,t} + \varepsilon_{i,t}$$

Theory & Hypotheses

- Inventory model of cash demand with payment instrument choice
  - contactless technology reduces relative costs of card payments
    (Alvarez & Lippi, JME 2017)

- Average effect
  - Reduce the share of payments made by cash
  - Reduce the frequency & average size of cash withdrawals

- Mechanism
  - Increase the frequency of (small value) debit card PoS payments

- Heterogenous effects
  - Effects are stronger for those who initially use debit cards at PoS

Data

- Anonymized, random sample of retail clients from 1 bank

- Transaction data: 2015 – 2018
  - Cash withdrawals (ATM, branch) – number and amount
  - Amount spent with debit card, credit card
  - Number of PoS debit card transactions by transaction size

- Socioeconomic / account information as per 2015:12
  - Age, Location, Gender, Nationality
  - Other bank services (savings, custody, retirement, mortgage)
  - Account balance & monthly turnover

Outcome variables

Summary statistics (Pre-treatment = 2015)

	mean	min	p25	p50	p75	max	n
Main Outcome Variables							
Cash ratio (%)	71.6	0	52	78	96	100	21'122
Cash withdrawal frequency	47.4	0	20	39	64	594	21'122
Cash withdrawal amount	625	20	189	344	677	25'000	20'992
Auxillary Outcome Variables							
Debit PoS transactions	64.8	0	6	36	95	909	21'122

$$Cash\ ratio\ (\%) = \frac{Cash\ Withdrawals}{Cash\ withdrawals + Debit\ PoS\ payments + Credit\ card\ payments} \cdot 100$$

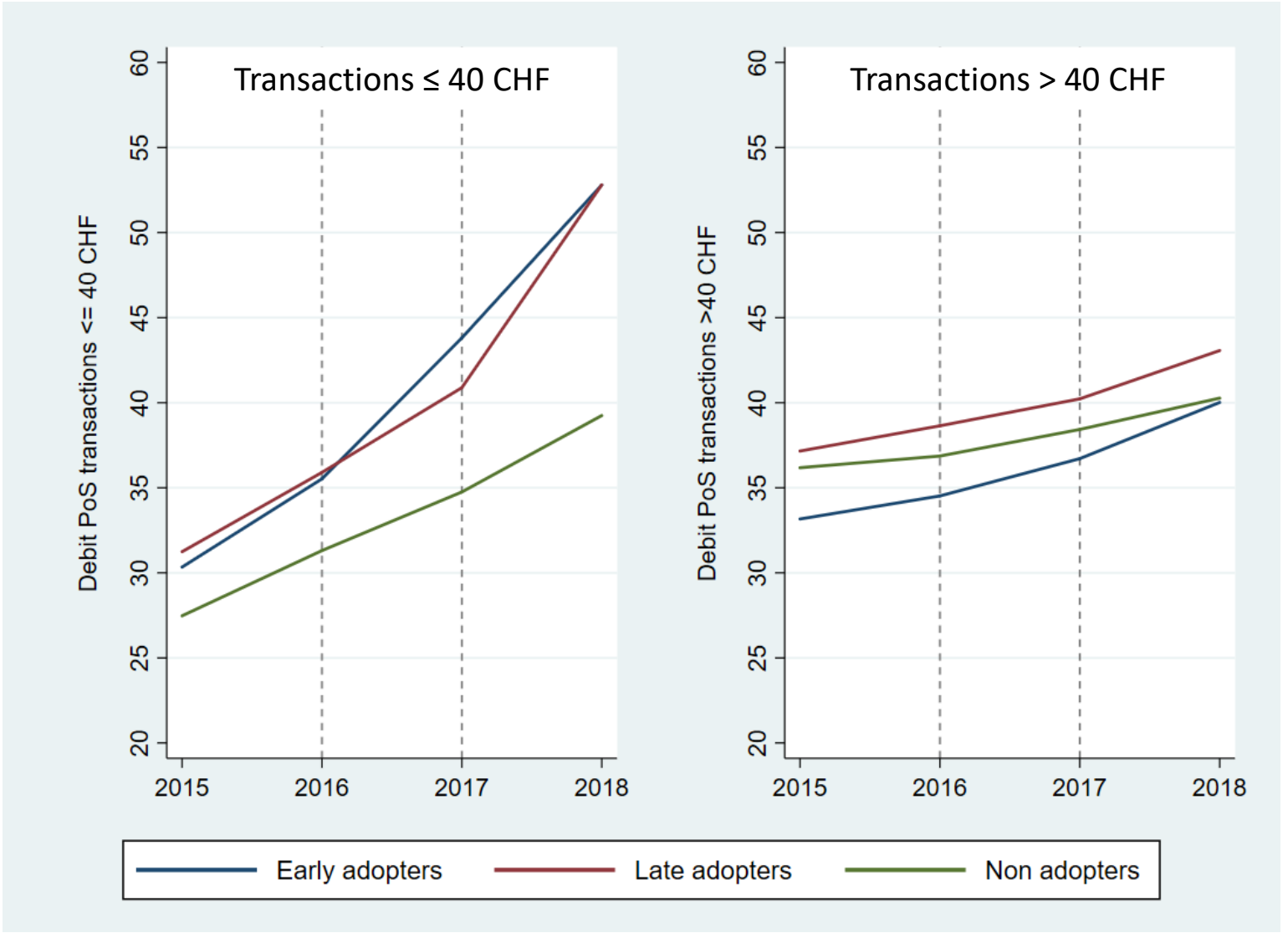
$Cash\ withdrawal\ frequency$: $Number\ of\ withdrawals\ per\ year\ \ (ATM\ and\ branch)$

$Cash\ withdrawal\ amount$: $Average\ withdrawal\ size\ in\ CHF$

$Debit\ PoS\ transactions$: $Number\ of\ transactions\ per\ year$

Pre-registered analysis plan

Debit card PoS transactions



Debit card PoS transactions

- ATE of contactless card: +6.8*** transactions per year
- Trend change 2016-2018: +6.6*** transactions per year
- Average 2016-2018: 79 transactions per year

- The bulk of the effect is due to transactions below 40 CHF
  (threshold for contactless payment without PIN)

Results: Cash ratio (%)

- ATE of contactless card: -0.6*** pp per year
- Trend change: -1.8*** pp per year
- Average 2016-2018: 68 %

Results: Cash Demand

- Cash withdrawals (#)
  - ATE of contactless card: -0.36* withdrawals per year
  - Trend change 2016-2018: -1.9*** withdrawals per year
  - Average for 2016-2018: 44 withdrawals per year

- Average withdrawal amount
  - ATE of contactless card: - 1 CHF per year
  - Trend change 2016-2018: - 2 CHF per year
  - Average for 2016-2018: 614 CHF

Further tests

- Dynamic treatment effect (pre-registered)
  - Effect stronger in 2018 than in 2017
- Placebo test (pre-registered)
  - No effect of new card in 2016 (no contactless function)
- Sample matched by client-age (unregistered)
  - Results are confirmed, magnitude somewhat weaker

Heterogenous treatment effects

- By pre-treatment cash-use (pre-registered)
  - Strongest effect for clients with intermediate cash-use
  - No effect for cash-only clients

- By age*location (unregistered)
  - Strongest effect for young*urban clients … their trend behavior is also strong…
  - No effect for young*rural clients ……. although they also exhibit strong trend behavior..

Conclusion

- Concurrent introduction of contactless cards and decline of cash use reflects more correlation than causation

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Rise of contactless payment means cash is no longer king

UK spending on debit cards overtook hard currency for the first time in 2017

Contactless payments have almost doubled over the past year © Bloomberg

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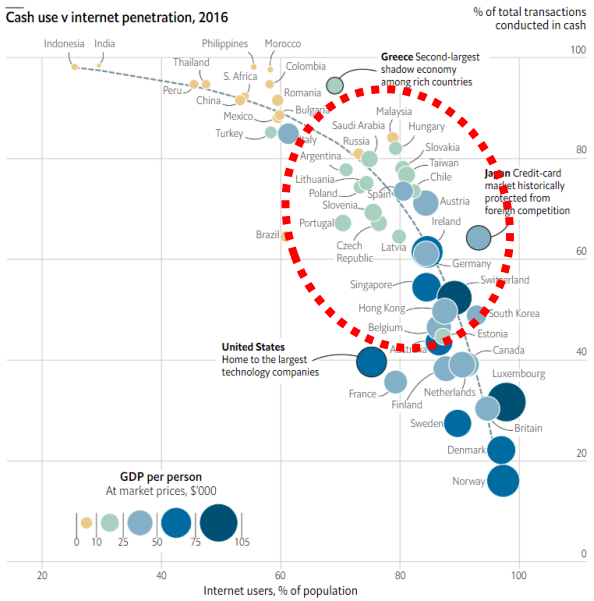
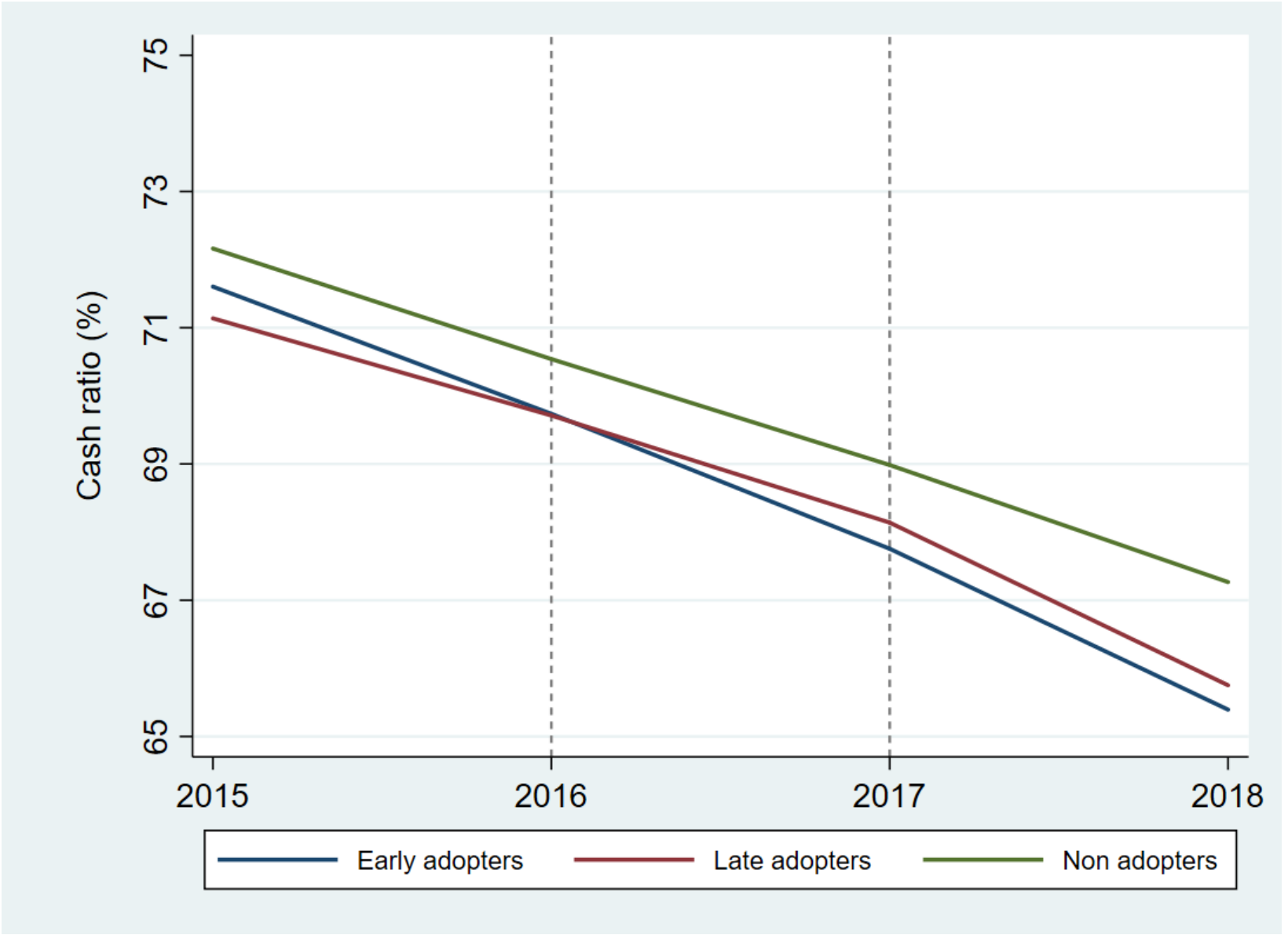
.. but recent payment innovations are accelerating the divergence in payment behavior across social groups in cash-intensive countries…

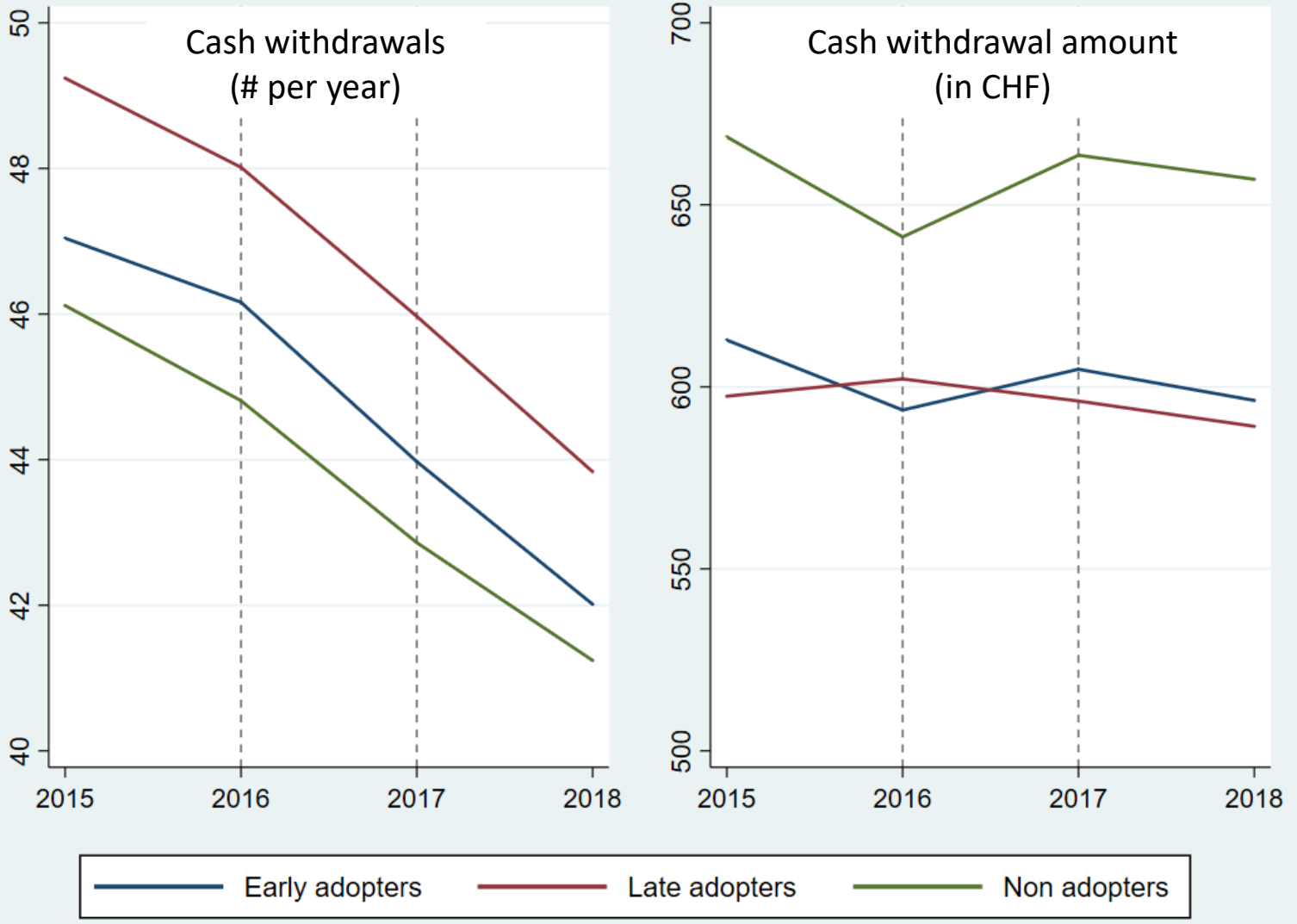


XTRA slides

Payment Choice: Cash ratio (%)



Cash Demand


Cash withdrawals
(# per year)
50
48
46
44
42
40
2015
2016
2017
2018
Cash withdrawal amount
(in CHF)
700
650
600
550
500
2015
2016
2017
2018
Early adopters
Late adopters
Non adopters

Further tests

- Dynamic treatment effect (pre-registered)
  - Effect stronger in 2018 than in 2017
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Theory

(Alvarez & Lippi, JME 2017)

- Inventory model of cash demand with payment instrument choice
  - Consumers are either “cash burners” or “cash-only”

- Contactless technology reduces relative costs of card payments (time, effort)
  - ➢ Cash-burners use cards more often and reduce cash withdrawals
  - ➢ Cash-only consumers may start using cards

Our contribution

- Financial innovation and money demand
  - Attanasio et al. (JPE 2002), Alvarez & Lippi (Ectra 2009)

- Financial innovation and consumer behavior
  - Jack & Suri (AER 2016), Bachas et al. (JF 2020)

- Consumer behavior & payment instrument choice
  - Wang & Wolman (JME 2016), von Kalckreuth et al. (JMCB 2014)

➢ we study effect of innovation on payment choice & cash demand

➢ we exploit a «natural experiment» to estimate causal effects

  ➢ we measure consumer choice using detailed administrative data

  ➢ we adhere to a pre-registered analysis plan

Balancing tests

- Covariates are in general well balanced across the three groups

  … but client age is not

	Early adopters n=8'487	Late adopters n=6'150	Non adopters n=6'485
Age group			
14-35	0.34	0.31	0.25

- Not visible from “blind” data quality check

- Robustness check (unregistered): we match the age-structure of each group to that of the full sample

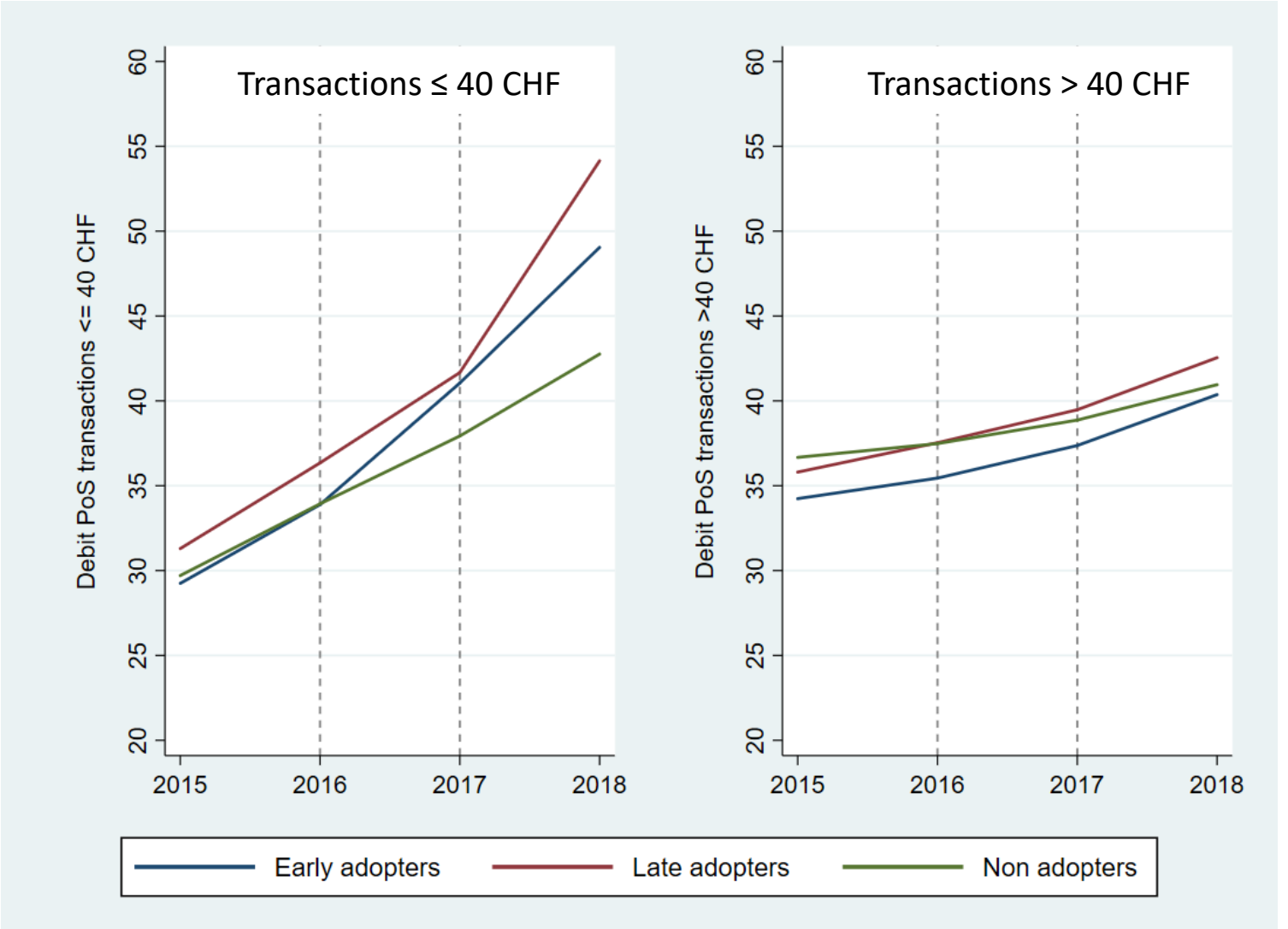
Exploratory: Role of Age & Location

	(1)	(2)	-3	(4)	-5	(6)
Outcome variable	Cash ratio (%)					
Location	Urban			Rural		
Client age (years)	below 35	35-55	above 55	below 35	35-55	above 55
Contactless	-1.246***	-0.717*	0.092	-0.390	-0.333	0.365
	[0.411]	[0.303]	[0.348]	[0.396]	[0.307]	[0.364]
Year = 2017	-3.085***	-0.858***	-0.643**	-3.244***	-1.308***	-0.549*
	[0.301]	[0.217]	[0.259]	[0.300]	[0.217]	[0.265]
Year = 2018	-7.139***	-2.720***	-1.198***	-7.137***	-2.961***	-1.164***
	[0.428]	[0.294]	[0.346]	[0.411]	[0.305]	[0.347]
Client fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year*Location fixed effects	No	No	No	No	No	No
Clients	3'041	4'033	3'262	3'323	4'417	3'036
Client * Year observations	9'105	12'085	9'738	9'958	13'214	9'069
Mean of dependent variable	58.4	66.2	77.7	61.9	67.0	78.5
Method	OLS	OLS	OLS	OLS	OLS	OLS

*,**,***: 5%, 1.7%, 1% level

$$Cash\ ratio_{i,t} = \beta_i + \beta_t + \tau \cdot Contactless_{i,t} + \varepsilon_{i,t}$$

Matched sample: Debit card PoS transactions



Background: Introduction of Contactless Cards

	Debit Cards		Credit cards	
	(#)	Contactless (%)	(#)	Contactless (%)
2015	10’061’863	9,9%	6’192’051	83,3%
2016	10’487’999	27,9%	6’345’971	89,9%
2017	10’506’033	50,7%	6’578’735	93,6%
2018	10’641’767	70,7%	6’914’273	95,3%
2019	10’799’002	79,5%	7’218’251	96,8%

Source: SNB Dataportal

.... by treatment group …

	Early adopters [1]	Late Adopters [2]	Non adopters [3]
Main Outcome Variables			
Cash ratio (%)	71.6	71.1	72.2
Cash withdrawal frequency	47.0	49.2	46.1
Cash withdrawal amount	613	597	669
Auxillary Outcome Variables			
Debit PoS transactions	63.2	68.2	63.5
Debit PoS transactions (0-20 CHF)	16.4	16.1	13.1
Debit PoS transactions (20-40 CHF)	13.9	15.1	14.4
Debit PoS transactions (40-60 CHF)	10.1	11.3	10.9
Debit PoS transactions (60-100 CHF)	11.5	13.0	12.7
Debit PoS transactions (>100 CHF)	11.3	12.8	12.5

Covariate balancing tests:

Panel B. Sample Means by Treatment Group (Pre-treatment = 2015)

* (**) indicate significance levels of T-tests at the 5%-level (1%-level), respectively.

	Early adopters	Late Adopters	Non adopters	T-tests		
	[1]	[2]	[3]	[1 vs. 2]	[1 vs. 3]	[2 vs. 3]
Client-level Variables						
Age	3.41	3.49	3.68	**	**	**
Male	0.51	0.53	0.50			**
Nationality Swiss	0.72	0.70	0.71	**	*	
Size municipality	2.64	2.64	2.61			
Income	2.53	2.71	2.64	**	**	*
Wealth	2.03	1.98	2.05	*		**
Retirement account	0.54	0.53	0.52		*	
Savings account	0.21	0.23	0.23	**	**	
Custody account	0.19	0.18	0.21		**	**
Mortgage	0.07	0.07	0.08			
Ebanking	0.54	0.55	0.52		**	**
Account-level Variables						
Account opening year	1998	1999	1997	**	**	**
Direct debiting	0.54	0.56	0.55	**		
Standing order Ebanking	0.15	0.17	0.15	**		**
Standing order paper	0.35	0.36	0.38		**	
Ebanking payments	18'493	20'428	19'401	**		
Transfers	3'632	4'293	4'000	**		
Incoming payments	56'351	60'366	60'073	**	**	
Outgoing payments	61'858	66'614	65'842	**	**	
Account balance	3.42	3.34	3.42	*		*

Heterogenous effects: Initial payment behavior

	(1)	(2)	(3)	(4)
Outcome variable		Cash ratio (%)		
Cash ratio (%) in 2015 (subsample):	[0-52%]	(52%-78%]	(78%-96%]	(96%-100%]
Contactless	-0.172	-1.292***	-0.347	-0.343
	[0.333]	[0.326]	[0.276]	[0.191]
Year = 2017	-0.620**	-1.973***	-2.296***	-1.144***
	[0.244]	[0.240]	[0.202]	[0.129]
Year = 2018	-2.226***	-4.775***	-5.061***	-2.102***
	[0.329]	[0.325]	[0.289]	[0.183]
Client fixed effects	Yes	Yes	Yes	Yes
Year*Location fixed effects	No	No	No	No
Clients	5'278	5'278	5'280	5'276
Client * Year observations	15'801	15'805	15'820	15'743
Mean of dependent variable	35.6	59.6	81.1	96.2
Method	OLS	OLS	OLS	OLS

*,**,***: 5%, 1.7%, 1% level

$$Cash\ ratio_{i,t} = \beta_i + \beta_t + \tau \cdot Contactless_{i,t} + \varepsilon_{i,t}$$

Treatment depends on expiry date of old card

acc_year_cat	Treatment			
	Early adopters	Late adopters	Never adopters	Total
1972-1989	2,066	1,264	1,571	4,901
1990-1998	1,878	1,364	1,756	4,998
1999-2004	1,285	1,193	1,096	3,574
2005-2010	1,897	1,292	1,234	4,423
2011-2013	856	788	808	2,452
2014	505	249	20	774
Total	8,487	6,150	6,485	21,122

- Cards are valid for 3 years
  (505 accounts opened in 2014 have cards expiring in 2016)
- Overrepresentation of «Early adopters» due to historic changes in card technology