Choosing and Using Payment Instruments: Evidence from German Microdata

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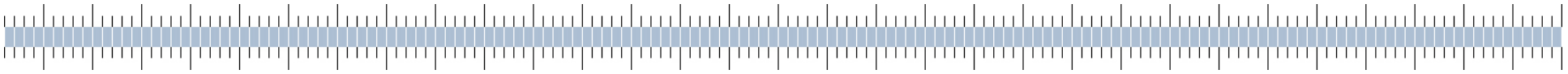

Introduction I

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- Advancements in payment technologies have implications for the use of cash, the demand for currency and the involved interest-rate sensitivities --- and hence for monetary policy.

- Card network coverage high, cashless payments possible at low costs for most transactions $\Rightarrow$ Significant decline of cash use to be expected.

- Stylized facts:
  - Cash usage is still quite significant
  - Very often despite cashless alternative
  - Cash shares from survey data for Germany (2008):
    - 82% of all transactions (excl. regular payments)
    - 57% of total value (excl. regular payments)

Introduction II

- This raises several questions:
  - Do individuals behave rationally? Can (high) cash intensity be explained structurally or is it a consequence of irrationality / habit persistence?
  - Future of cash use? Interesting both theoretically (monetary transmission) and from a practical perspective (seigniorage, cost of payment system)
  - Will cash share decline as the current population ages?

How do individuals decide on their means of payment?

Our contributions I

- **Survey data on payment behaviour of German individuals**
- **Estimate a model of payment behaviour, which embraces both:**
  - decision on payment infrastructure
  - share of cash payments
- **Variants of the model are estimated for:**
  - observed transaction data (short-term)
  - self-assessment of payment habits (long-term)
- **In depth analysis of differences between young and old individuals**

Our contributions II

- **Comprehensive empirical framework**
  - Overall share of cash payments of individuals taking into account ownership of cards
  - Separate share of cash payments for different transaction types and spending locations
  - Comprehensive list of explanatory variables, incl. relative cost of cash usage, preferences, transaction characteristics and personal characteristics
- **Focus on payments with the option to pay cash or non-cash**

A survey on payment behaviour

- Collaboration of several Bundesbank departments and the OeNB
- Representative for German population 18 or older
- Data collection by IPSOS between April and June 2008
- Random-route sample of 3,612 individuals
- CAPI interviews and diary for payments during one week
- Valid responses from 2,292 individuals (response rate: 63.5 %)
- About 25,000 transactions recorded in payment diary

Theoretical framework

- **Choice of payment instrument has three aspects:**
  - Acceptance by seller ← controlled for
  - Availability on the side of buyers ← explicitly modeled
  - Choice among available alternatives ← explicitly modeled

- **Individuals choose methods of payment to minimise total transactions costs c_i such that**
  - the sum of payments add up to an individual's total transaction value $\overline{T_i}$.
  - the amount paid (p^j) with each m.o.p *j* is larger than zero (= m.o.p. is used) or equal to zero (m.o.p. not used).

- **Transaction costs are a function of the payment structure $\mathbf{p}_i$ and household characteristics $\mathbf{x}_i$:**

$$c_i = c\left(\mathbf{x}_i, \mathbf{p}_i\right) = p_i^0 + \sum_{j=1}^{K} p_i^j \left(\mathbf{x}_i' \boldsymbol{\beta}^j + \gamma^j p_i^j\right)$$

Adoption (decision on payment infrastructure)

There may also be fixed costs for the use of certain means of payments, such as credit card fees, paperwork, learning costs or credit constraints. Furthermore, unobserved variables may influence the decision on the payment infrastructure and the intensity decision in a correlated way.

$\Rightarrow$ We need to model the decision on the payment infrastructure separately.

We limit ourselves to modelling credit cards, since 91% of German households have debit cards and almost all households with credit card also have debit card.

Adoption decision (probit): $cc_i = \mathrm{I}(\mathbf{r}_i' \rho + \eta_i > 0)$

Intensity (share of cash payments)

1. Short-term transaction measure (one week) from payment diary
   - Share of cash payments (value and volume) – with options
   - Instrumental variable estimation

2. Long-term self-assessment from survey questionnaire for different transaction types: “What means of payment do you typically use for the following type of transactions”
   - Retail daily,
   - Gas stations,
   - etc.

   For each transaction type one binary variable:
   - 1 cash exclusively
   - 0 non-cash (partly or exclusively)

   Multivariate probit with endogenous credit card adoption decision for the two transaction types with the highest total expenditures recorded in the diary, i.e. retail daily and gas stations

Groups of explanatory variables

- **Demographics**
  - age, gender, education, employment status, hh income
- **Relative costs of cash and card usage**
  - freq. ATM user, distance to next ATM / bank, subjective risk of theft, POS density
- **Expenditure structure (types of transactions)**
  - share of recorded transactions at point X
- **Size distribution of transaction value recorded in the diary**
- **Preference for certain m.o.p characteristics**
  - convenience and speed of use, anonymity, internet, abroad, familiarity and experience

Summary of results

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- All variable groups relevant, both for adoption and intensity
- Coefficient signs consistent with rational economic behaviour
- Preferences and expenditure structure increase predictive power
- Differences in payment behaviour between young and old individuals due to differential characteristics and not age per se
- Credit cards and debit cards close substitutes in Germany

Summary of results II

- High predictive power of choice equations
- No direct effect of habit persistence measure
- Diffusion of credit cards completed

$\Rightarrow$ payment behaviour probably not driven by habit persistence

- People pay the way they do because they want to pay that way

Estimation results – credit cards

	SHARE OF CASH PAYMENTS (volume)	SHARE OF CASH PAYMENTS (volume)	DAILY RETAIL EXCL: CASH	GAS STATION EXCL: CASH	CREDIT CARD (dummy)
	OLS	IV-REGRESSION	MULTIVARIATE PROBIT		
CREDIT_CARD	-0.091***	-0.051	0.109	-0.252	
	[0.020]	[0.121]	[0.425]	[0.428]	

Instruments for credit card decision:

- ACCOUNT_INC: hh-income if joint account, personal income if own account
- JOINT_ACCOUNT: 1, if person does not have a bank account himself
- DIRECTBANK: 1, if the main bank account of individual is with a direct bank

Estimation results – age

	OLS Estimations					Multivariate Probit Estimation					
	Share of Cash Payments - Volume			Share of Cash Payments - Value		Retail daily (dummy - exclusively cash=1)		Gas stations (dummy - exclusively cash=1)		Credit Card	
	Observations	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Full sample	1,599	0.65	0.16	0.54	0.21	0.60	0.21	0.42	0.25	0.30	0.24
Only persons 58 and older	439	0.76	0.17	0.67	0.23	0.76	0.20	0.59	0.26	0.25	0.23
Only persons 57 and younger	1,160	0.61	0.14	0.49	0.18	0.54	0.19	0.35	0.21	0.32	0.24
Counterfactual: Only persons 58 and older. but with coefficients of persons 57 and younger	439	0.69	0.13	0.60	0.17	0.73	0.17	0.55	0.21	0.22	0.23
Percentage of difference between old and young explained by different characteristics		58%		60%		84%		83%		139%	

Interaction terms with age for variables from the following groups:

- Income
- Employment status
- Relative costs of cash and card usage
- Preferences
- Instruments

Estimation results – preferences

	CREDIT CARD (dummy)	SHARE OF CASH PAYMENTS (volume)	SHARE OF CASH PAYMENTS (volume)	DAILY RETAIL EXCL: CASH	GAS STATION EXCL: CASH	CREDIT CARD (dummy)
	PROBIT	OLS	IV-REGRESSION	MULTIVARIATE PROBIT		
Preferences						
P_EXPCONTR	-0.100	-0.007	-0.005	0.082	0.011	-0.101
P_TIME	0.149*	-0.017	-0.017	-0.117	-0.154*	0.170*
P_ANONYM	-0.150	0.036*	0.032	0.325***	0.180*	-0.158
P_INTERNET	0.525***	-0.057***	-0.064**	-0.397***	-0.268**	0.495***
P_ABROAD	0.783***	-0.021	-0.023	-0.507***	-0.529***	0.798***
P_HABIT	0.244***	-0.008	-0.012	-0.042	0.049	0.264***

important determinants

learning, technical inclination

Estimation results – relative costs

high costs of holding cash / fam. with payment tech.

	CREDIT CARD (dummy)	SHARE OF CASH PAYMENTS (volume)	SHARE OF CASH PAYMENTS (volume)	DAILY RETAIL EXCL: CASH	GAS STATION EXCL: CASH	CREDIT CARD (dummy)
	PROBIT	OLS	IV-REGRESSION	MULTIVARIATE PROBIT		
Relative Costs of Cash						
HH_INC	0.463***	-0.030*	-0.034	-0.234**	-0.377***	0.497***
ATM_USER	-0.140	-0.053***	-0.053***	-0.153*	-0.238***	-0.163*
DIST_WITHDR	-0.222***	0.008	0.007	0.036	-0.003	-0.211***
RISK_THEFT	-0.133	-0.036	-0.034	0.354***	-0.020	-0.078
POS_DENSITY	-1.001***	0.040	0.060	-0.598	-0.441	-0.903**

important factors for adoption and intensity decision

Conclusions and future research

- Payment behaviour is consistent with rational economic behaviour

  => Given current technology, sellers behaviour and relative costs, cash usage is unlikely to erode much further

- Missing effect of credit card on cash share

  => Variation of costs between cash and group of non-cash dominates variation within group of non-cash

  => The end of "credit or debit?"

  => Probably hierarchical decision: 1st cash share, 2nd choice among non-cash m.o.p.

- Future research:
  - Analysis of non-monetary cost factors influencing payment behaviour
  - Analysis of individual transactions

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Thank you for your attention !

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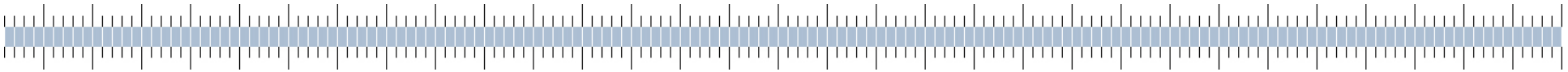
Additional Slides



Comparison with Austrian survey (sample)

	OeNB 2005	Bbk 2008
Transactions		
Total number of transactions	14,075	25,056
Average number of transactions per person per week	11.7	11.3
Median number of transactions per person	11	10
=median transactions per day	1.6	1.4
Value		
Total value of transactions	375,559	695,596
Total value of transactions per person per week	311.9	313.5
Median value per week	226	212
=median value per day	32.3	30.3

Estimation results – demographics

as expected

	CREDIT CARD (dummy)	SHARE OF CASH PAYMENTS (volume)	SHARE OF CASH PAYMENTS (volume)	DAILY RETAIL EXCL: CASH	GAS STATION EXCL: CASH	CREDIT CARD (dummy)
	PROBIT	OLS	IV-REGRESSION	MULTIVARIATE PROBIT		
Sociodemographic Var.						
MALE	0.100	0.012	0.011	0.257***	0.026	0.073
EDU_MEDIUM	0.177*	-0.023	-0.026	-0.319***	-0.238***	0.201**
EDU_HIGH	0.454***	-0.031	-0.036	-0.391***	-0.508***	0.487***
EDU_UNI	0.664***	-0.042	-0.052	-0.419**	-0.398**	0.700***
EMPLOYED	0.242**	0.008	0.001	-0.343***	-0.397***	0.218*

no influence or result of aggregating over all spending types?

Estimation results – frequencies

	SHARE OF CASH PAYMENTS (volume) OLS	SHARE OF CASH PAYMENTS (volume) IV-REGRESSION
Structure of payments		
AVG_VAL_TRANS	-0.085***	-0.088***
FRQ RETAIL (LONG)	-0.229**	-0.249**
FRQ GAS	-0.429***	-0.415***
FRQ RESTAURANT /HOTEL/CAFE	-0.130**	-0.149***
FRQ INTERNET / MAIL-ORDER	-1.373***	-1.380***
FRQ SERVICES (AWAY)	-0.048	-0.061
FRQ SERVICES (AT HOME) / POCKETM. / PRIVATE PERS	-0.187*	-0.198*
FRQ DRUGSTORES / VENDING MACHINES / LEISURE	-0.270***	-0.284***
FRQ OTHER	0.174	0.176

Larger trans. value – less cash

Expenditures other than for daily consumption goods (ref. group) non-cash

Estimation results – quality of regression

	CREDIT CARD (dummy)	SHARE OF CASH PAYMENTS (volume)	SHARE OF CASH PAYMENTS (volume)	DAILY RETAIL EXCL: CASH	GAS STATION EXCL: CASH	CREDIT CARD (dummy)
	PROBIT	OLS	IV-REGRESSION	MULTIVARIATE PROBIT		
Altroh (2/1)					1.032***	
					[0.077]	
Altroh (3/2)					-0.228	
					[0.254]	
Altroh (3/1)					-0.338	
					[0.274]	
Sargan-p-value			0.5931			
Observations	1,721	1,599	1,583		1,552	
logl	-770.9				-2,233	
Chi2	420.6		482.8		739.2	
Pseudo R2	0.251					
R-squared		0.240	0.242			
Count R2	79%			70%	74%	78%

Further regressions and robustness checks

- Results for volume and value very similar

- Predictive power of probits and multivariate probits good:
  - PROBIT credit cards: 78 % correctly classified
  - MVPROBIT Retail daily: 70 % correctly classified
  - MVPROBIT Gas stations: 74 % correctly classified

- Main results qualitatively not different for different specifications of the simulation methods used for the multivariate probit estimations

- Insignificance of credit card variable for cash share also shows up in biprobits with only one transaction type and credit card as independent variables.