ECB FORUM
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PAYMENTS AND CASH MANAGEMENT IN THE EURO AREA

EUROPEAN CENTRAL BANK

EUROSYSTEM

Motivation and research questions

Micro: novel evidence on payment choices

- How do people choose whether to pay using cash or cards?
- Some of the existing theoretical literature has focused on the **size of the transaction** s as the main driver
- Other papers have built inventory-theoretic models where cash/cashless choices depend on the **level of cash on hand** m
- Questionnaire data reveals that **both** the size of the incoming transaction **and** cash holdings influence people's choices. *Why?*

Macro: cross-country heterogeneity

- ECB Survey on the Use of Cash by Households (2017) reveals sizeable **differences** in cash management and payment choices across Euro Area
- In some countries (e.g. Finland, France, Netherlands) cashless means of payment widely used, and people withdraw rarely (and in small amounts)
- Other countries (e.g. Austria, Italy, Spain) are more cash-reliant
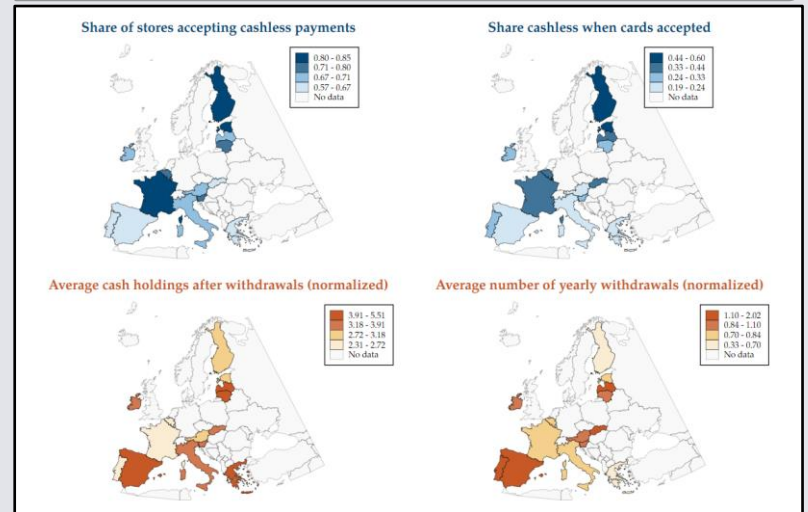- **Supply-side factors** (merchant acceptance) plays an important role, but don't seem to be the only one. *What else?*

> **Two research questions:**
> 1. What are the determinants of payment choices at the **individual level**?
> 2. What drives **cross-country variation** in payment choices and cash management across the Euro Area?
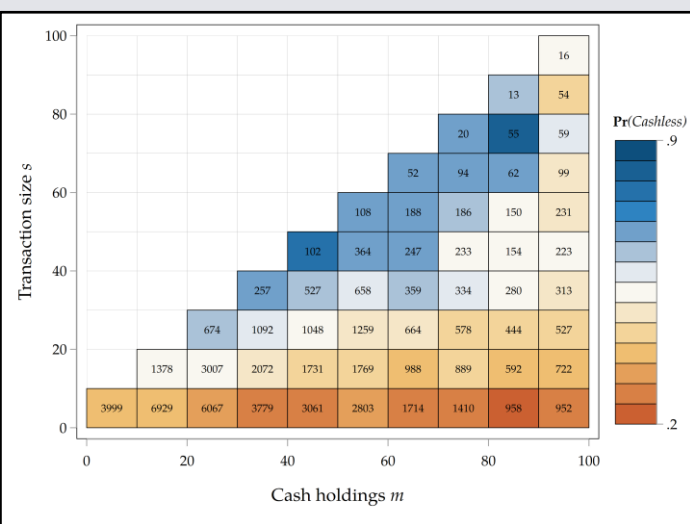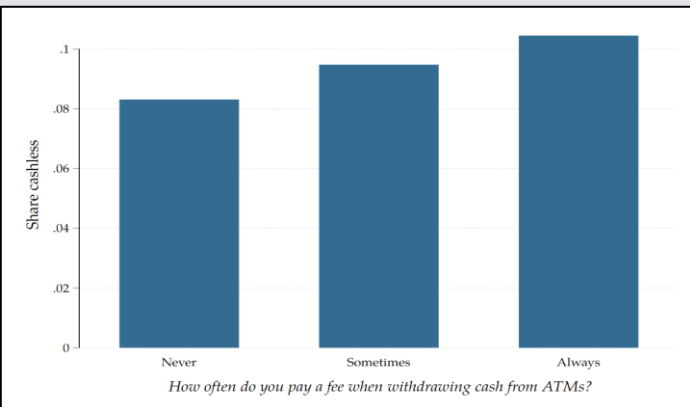

What drives payment behavior?
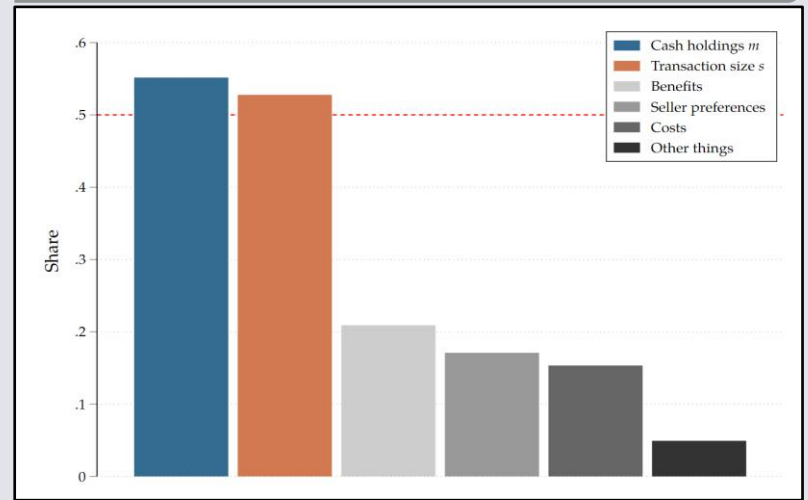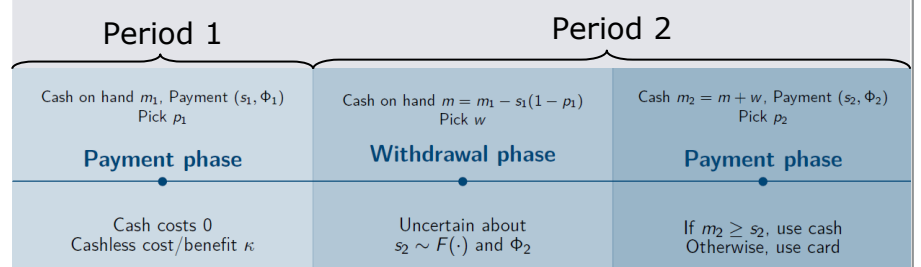

Euro Area heterogeneity

Empirical findings

	Dependent variable: $Cashless_{it}$			
	OLS	OLS	OLS	FE
	(1)	(2)	(3)	(4)
Expected acceptance rate	0.26***	0.13***	-0.0099	-0.049*
	(0.012)	(0.016)	(0.016)	(0.022)
Observations	33259	20510	20484	20484
Only vol. payments		✓	✓	✓
Controls			✓	✓

How often do you pay a fee when withdrawing cash from ATMs?

- Focus on transactions where **both options are possible**
- Card usage more likely as transaction size increases Klee (2008) ✓
- Cash usage more likely as cash holdings on hand at payment increase Wang and Wolman (2016) ✓
- **New finding:** when payment size **close to** cash holdings, card usage extremely frequent
- People do not want to deplete their cash holdings, they always want **minimum level of cash with them.**
- **Imperfect card acceptance:** when expected probability of acceptance in future transactions lower, higher prob. of card usage
- Prefer to avoid too frequent withdrawals by using their payment cards as **cash management devices**
- Cashless usage more frequent as ATM fees rise

Quantitative model

Why a quantitative model?
→ Embed relevant features of the problem

1. Infinite horizon and realistic payment frequencies (rate λ) and size distribution
2. Three types of shops: only cash, card+cash, only cards
3. Calibrated merchant acceptance probabilities as a function of transaction sizes; linear disutility from missed purchase $u(s) = \alpha \cdot s$
4. Agents receive a *transaction size signal* $\tilde{s}$ which is informative on the size of their next payment s. Signal accuracy $\bar{\sigma}_\varepsilon \in [0,1]$
5. Heterogeneity in tastes for cash/cashless κ, distributed $N(\mu_\kappa, \sigma_\kappa)$

Estimation
Structurally estimate $\Theta = \{\beta, R, b, \mu_\kappa, \sigma_\kappa, \bar{\sigma}_\varepsilon, \alpha, \lambda\}$

1. Target cash management statistics (including avg. cash holdings, cash at withdrawal, withdrawal sizes and frequency)
2. Target payment choice statistics (including avg. cashless payment, share cashless, number of payments)

Estimate Θ using minimum distance procedure at the **country level**

Results

Country	β	R	b	μ_κ	σ_κ	$\bar{\sigma}_\varepsilon$	α	λ
Finland	0.998	0.000621	8.26	-0.49	6.09	0.847	0.293	0.0926
Greece	0.998	0.000914	8.61	4.07	5.53	0.714	0.349	0.107
Ireland	0.998	0.000825	6.24	2.54	3.72	0.596	0.174	0.11
Italy	0.998	0.000951	8.56	4.21	5.64	0.83	0.379	0.103
Portugal	0.994	0.000964	3.61	4.57	6.77	0.182	0.201	0.107
Spain	0.995	0.000956	6.14	4.49	8.44	0.259	0.276	0.0974

→ Supply-side constraints alone **cannot explain cross-country differences**

→ Sizeable heterogeneity in i) preferences; ii) enviroment (opportunity cost of cash R, withdrawal costs b)

→ **Next steps:** use the model to estimate welfare cost from imperfect acceptance and decrease in ATMs across the Euro Area.

Analytical model

Period 1 / Period 2

- Model of cash management + payment choices combining Whitesell (1989) and Alvarez and Lippi (2017)
- Households endowed with a debit card face two successive payments, with the chance to withdraw cash in between
- Expenditure sizes s random, drawn from $F(s)$
- Only a fraction ϕ of merchants accept cards
- Minimize discounted expected cost, sum of:
  1) Proportional cash holding costs Rm
  2) Withdrawal cost b
  3) Fixed cost of using card κ
  4) Cost of missed purchases u

Key equations
Payment method choice
$$V_1(m,s) = \begin{cases} \kappa + \beta V(m), & m < s \\ \min\{\kappa + \beta V(m), \beta V(m-s)\}, & m \geq s \end{cases}$$
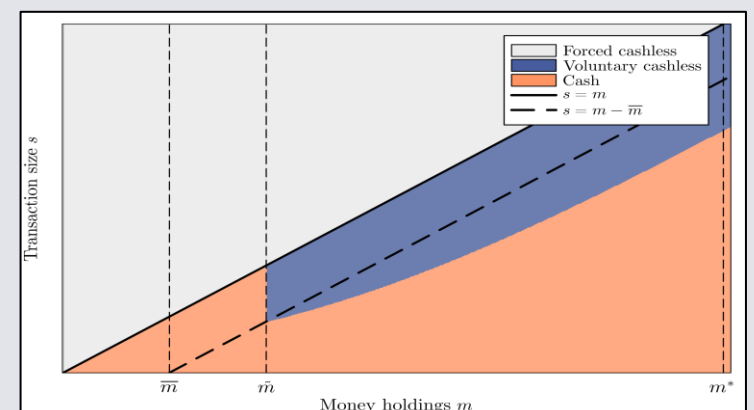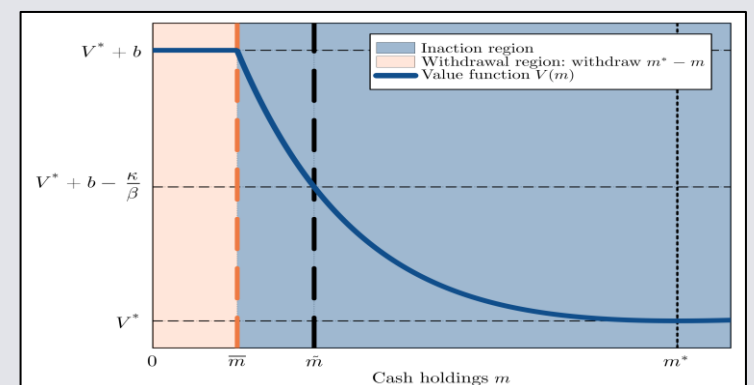
Withdrawal choice
$$V(m) = \min\{\min_{\hat{m}} EV_2(\hat{m}) + b, EV_2(m)\}$$

Terminal value
$$EV_2(m) = Rm + (1 - F(m))(\phi\kappa + (1-\phi)u)$$

Results

- Optimal to withdraw up to m^* whenever cash holdings fall below threshold value $\bar{m}$

✓ **Consistent with data**
1) Withdrawal when cash on hand positive ✓
2) Nondegenerate distribution of withdrawal sizes ✓

- Optimal to use cards when $s \simeq m$

✓ **Consistent with data**
1) Card payments unlikely for small transactions ✓
2) Card usage more likely when i) merchant acceptance rates ϕ low; ii) ATM fees b high ✓

Selected references

1. Alvarez, Fernando and Lippi, Francesco (2013). "The Demand of Liquid Assets with Uncertain Lumpy Expenditures". In: *Journal of Monetary Economics*
2. Whitesell, William C. (1989). "The Demand for Currency versus Debitable Accounts: Note". In: *Journal of Money, Credit and Banking*