The rise of Yape and Plin in Peru: what drives the adoption of payment instruments?

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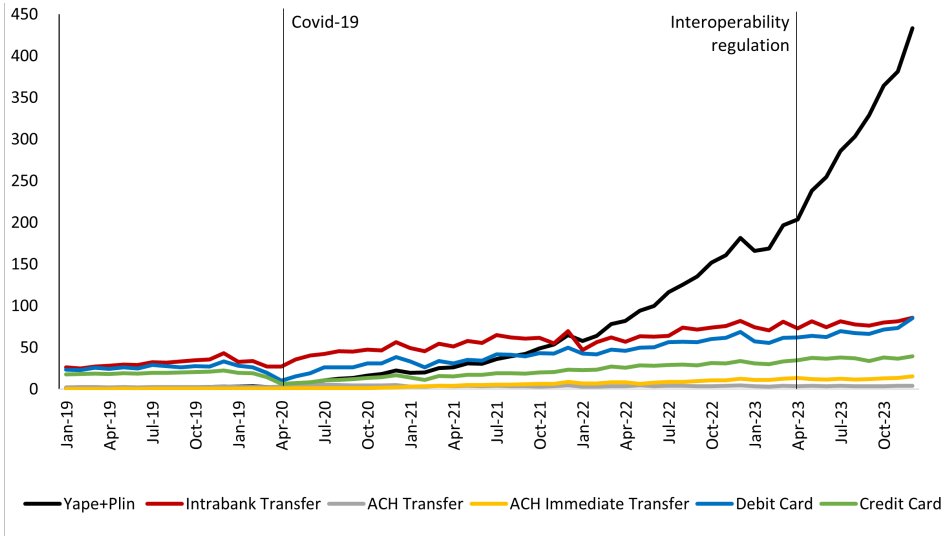
Outline

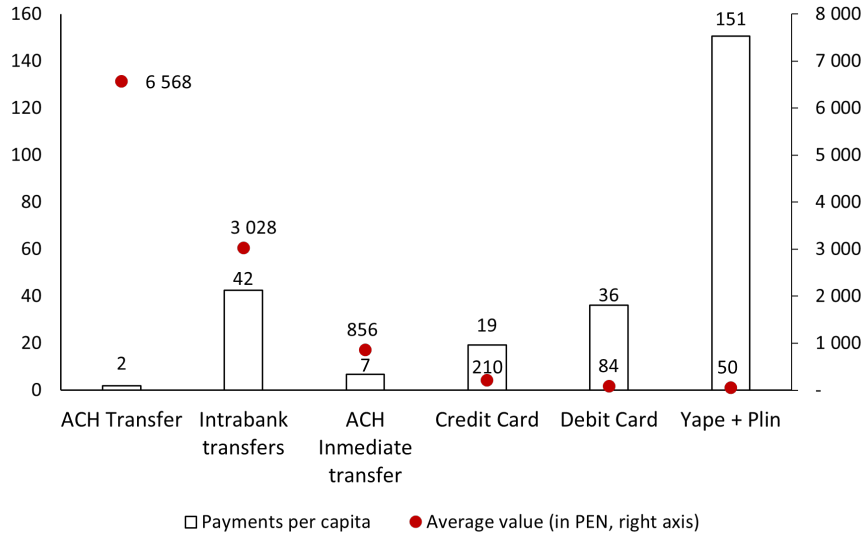
Overview of the paper

- Yape and Plin are two digital wallets that have changed the way Peruvians make payments (slang terms: "yapear" and "plinear")
- Research questions: why are Yape and Plin so successful? what drives the adoption of payment instruments?
- We estimate the demand for payment instruments using aggregate-level data on market shares of six available payment instruments in the Peruvian market (on transaction value)
- Findings:
  - (Payer) fees reduce the demand
  - Immediate availability of funds on a 24x7 basis increases the demand
  - Other features such as paying with a QR code and at a card POS also increase the demand

Yape and Plin have become the most widely used digital payment instruments



(a) Volume of transactions, by payment instrument

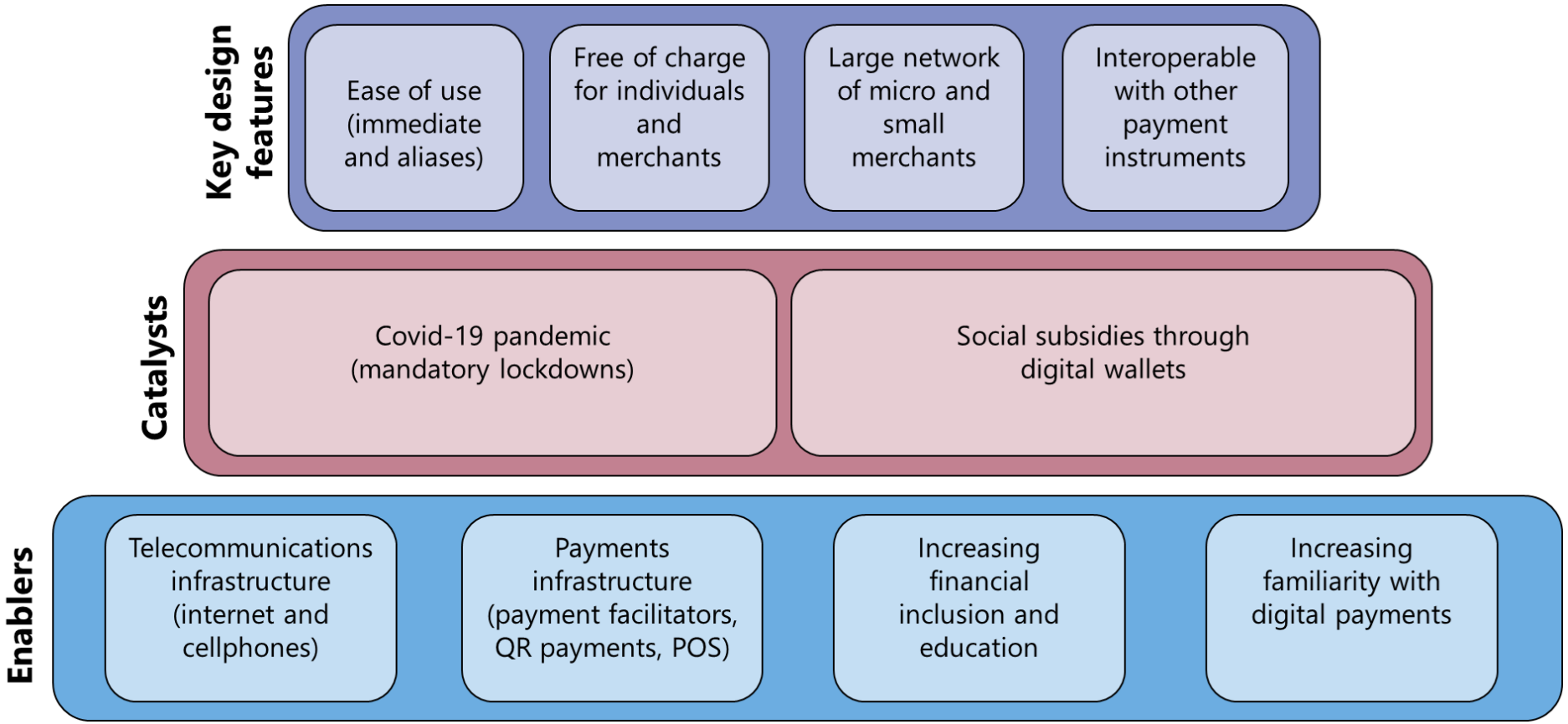


(b) Per capita transactions and average value, 2023

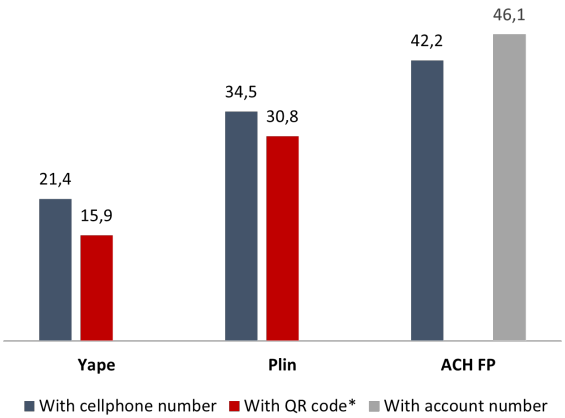
What are Yape and Plin?

	Yape	Plin
Launch date	February 2017	May 2020
Access technology	Stand-alone mobile app	Embedded in mobile banking apps
Participants	BCP, Mibanco, Caja Cusco, Caja Trujillo, Caja Tacna, Caja Sullana, Caja Huancayo, Caja Piura	Interbank, BBVA, Scotiabank, Banbif, Caja Sullana, Caja Arequipa, Caja Ica
Administrator	BCP	Interbank, BBVA, Scotiabank
Owner of the directory	BCP	Yellow Pepper
Payment infrastructure	Visa Direct	
Registered users	16 MM	10 MM
Payment functionalities	QR codes, cell phone numbers, POS payments	
Supported on	Bank account transfers	
Fees	No fees for P2P and P2B 2.95% for large merchants	No fees for P2P and P2B
Per-transaction limits	PEN 500 (USD 230)	
Daily limits	PEN 2,000 (USD 520)	PEN 1,500 (USD 390)
Receiving limts	PEN 25,750 (USD 6,700)	PEN 20,000 (USD 5,200)

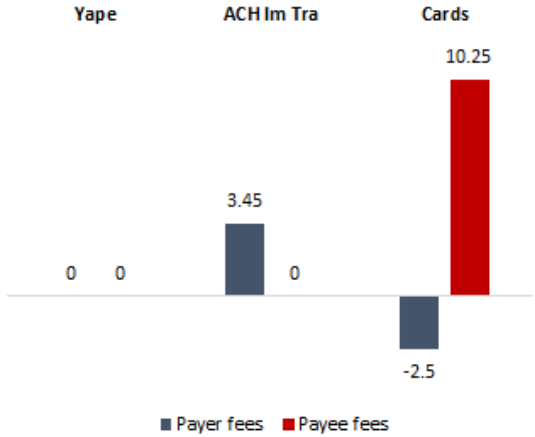
Why are Yape and Plin successful?



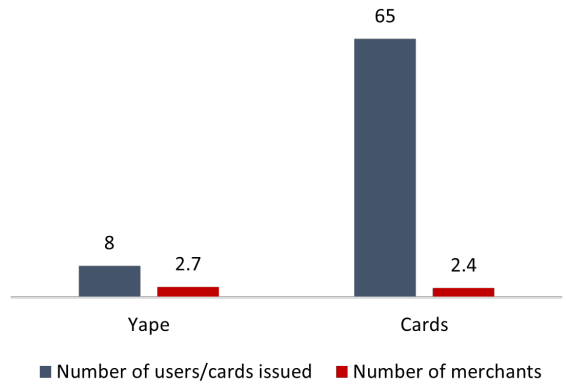
Yape and Plin are faster, cheaper and have a larger network



(a) Transaction time (in seconds)



(b) Fees (in PEN)



(c) Users and merchants (in millions)

Estimation of the demand for payment instruments

- We now seek to provide a more formal analysis: estimation of the demand for payment instruments
- We use aggregate-level data on market shares of six available payment instruments (i.e., digital wallets (Yape and Plin), intra-bank transfer, ACH transfer, ACH immediate transfer, debit card and credit card) (Jan 19-Dec 23)
- The outside good chosen is cash, which could be measured in two ways: either as currency in circulation or through cash withdrawals at ATMs within a country. For our context, we choose withdrawals.
- Context: On the basis of a monthly budget (in monetary units), a banked person decides which payment instrument to use: six alternatives and cash.
- Explanatory variables: fees and product characteristics (eg immediate availability of funds, qr, pos, cell phone number)

Database

Variable	Obs	Mean	Std Dev	Min	Max
s_j	360	11.91	13.36	0.36	46.89
s_0	360	28.55	6.18	19.01	40.38
payer-fee (in PEN)	360	0.84	1.76	-1.99	4.97
fps	360	0.44	0.50	0	1
qr	360	0.35	0.48	0	1
cell phone	360	0.18	0.38	0	1
pos	360	0.43	0.50	0	1

Table: Descriptive statistics

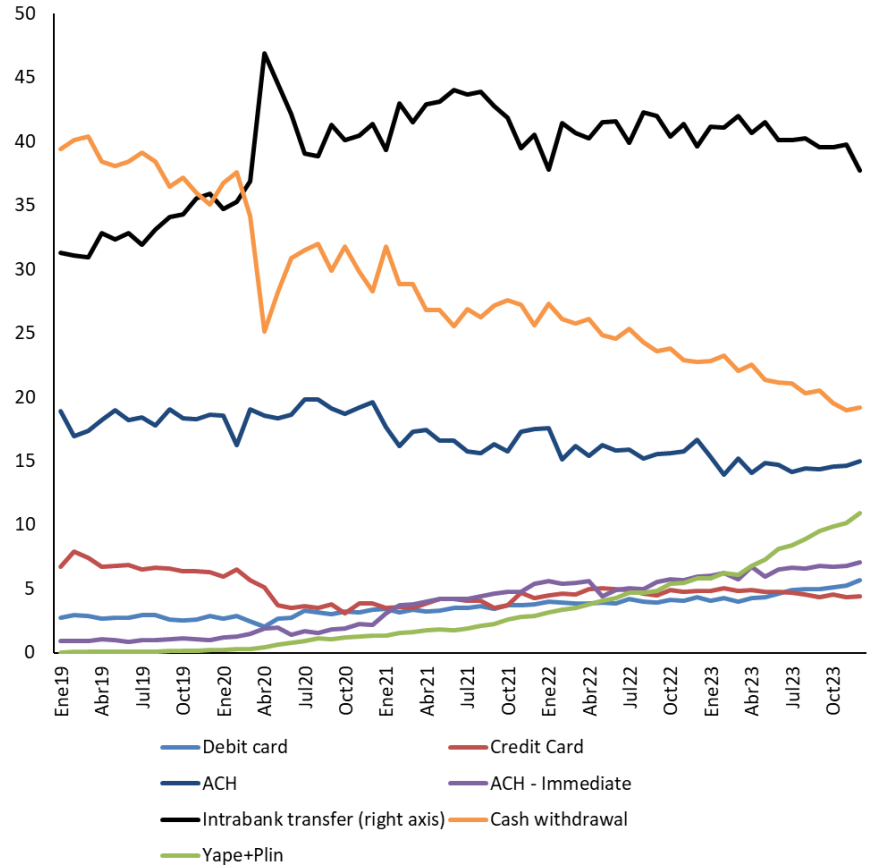
Product features have changed over time

Instrument	immediate and 24x7	QR code	POS	cell phone number
Digital wallets	✓	✓	✓ (April 2021)	✓
Intra-bank transfer	✓	-	-	-
ACH transfer	-	-	-	-
ACH immediate transfer	✓ (November 2020)	-	-	✓ (September 2023)
Debit card	-	✓ (April 2021)	✓	-
Credit card	-	✓ (April 2021)	✓	-

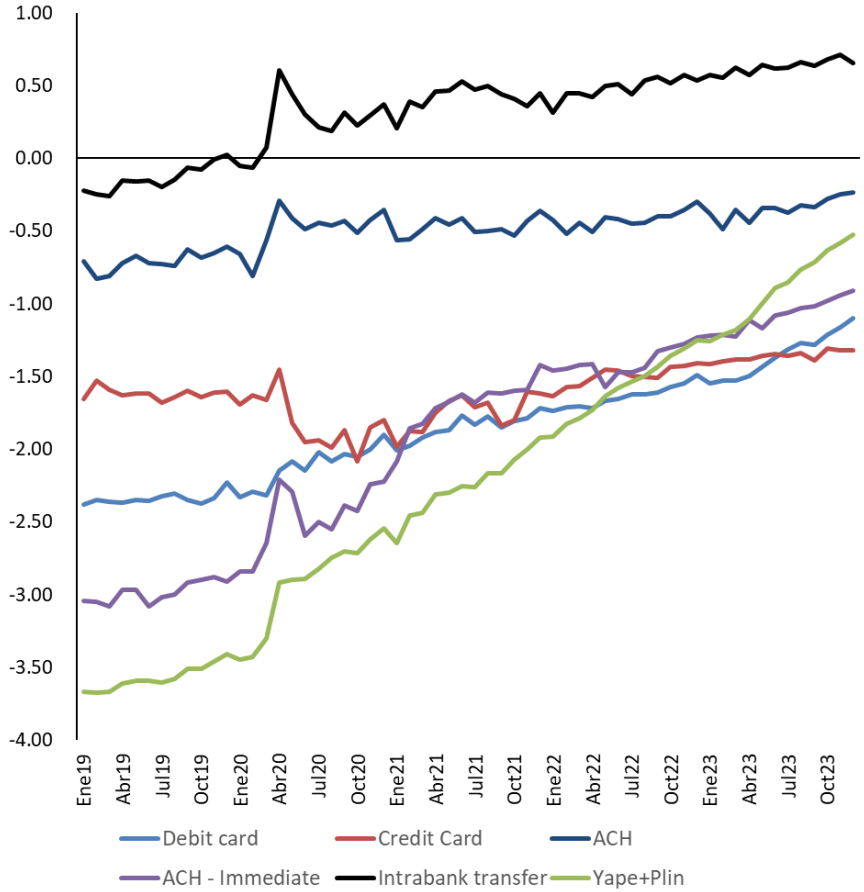
Note: Date in parentheses indicates date of change.

Table: Product features (as of December 2023), by instrument

Yape and Plin have gained market share since the pandemic



(a) Market share (%), by payment instrument



(b) Market share in logs (relative to cash withdrawals), by payment instrument

Logit demand models (I)

- Berry (1994): Aggregate market shares reflect consumer preferences
- Let's consider a consumer's utility function as:

$$U_{ij} = X_j\beta - \alpha p_j + \xi_j + \epsilon_{ij} \tag{1}$$

Where i indexes consumer and j indexes product. X_j is a set of observable characteristics of product j and p_j is the price of product j. The term ξ_j measures unobserved product characteristics and ϵ_{ij} is an error term distributed i.i.d extreme value

- Given the assumption of the error, we can write the choice probabilities as a conditional logit probability:

$$Pr(y_{ij} = j) = \frac{exp(\delta_j)}{\sum_{k=0}^{J} exp(\delta_k)} = \frac{exp(\delta_j)}{1 + \sum_{k=1}^{J} exp(\delta_k)} \tag{2}$$

where $\delta_j = X_j\beta - \alpha p_j + \xi_j$ is the mean utility of product j.

Logit demand models (II)

- This probability can be transformed into a predicted market share. The market share of product j is:

$$\tilde{s}_j = Pr(y_{ij} = j) = \frac{exp(\delta_j)}{1 + \sum_{k=1}^{J} exp(\delta_k)} \tag{3}$$

- The predicted market share for the outside good (ie cash) is:

$$\tilde{s}_0 = Pr(y_{ij} = 0) = \frac{1}{1 + \sum_{k=1}^{J} exp(\delta_k)} \tag{4}$$

- We can then use these predicted shares to make a linear equation by taking logs as:

$$log(s_j) - log(s_0) = X_j\beta - \alpha p_j + \xi_j \tag{5}$$

Logit demand models (III)

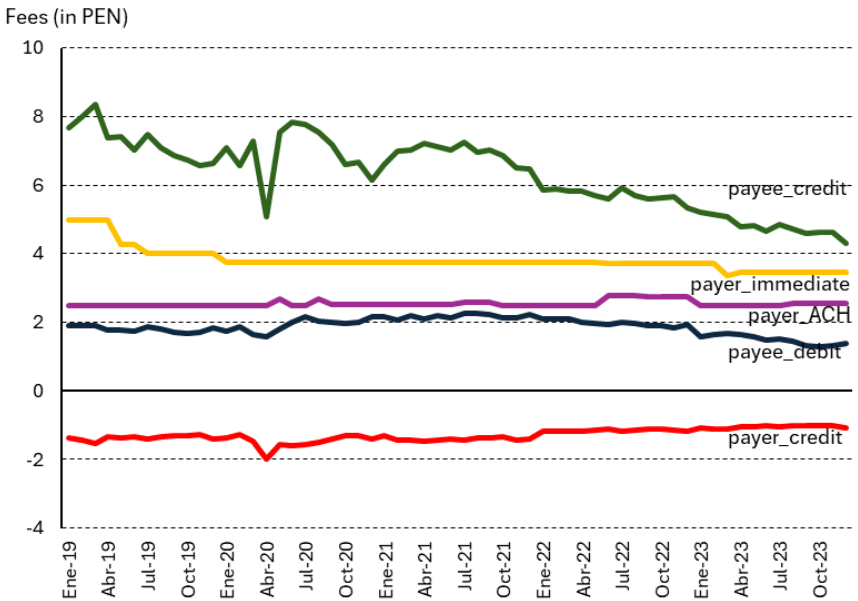
- In our paper, there are six payment instruments (ie digital wallets, intra-bank transfers, ACH transfers, ACH immediate transfers, debit cards and credit cards) and the outside good is cash which gives zero utility to the consumer.
- As our data have time dimension, we then specify the following regression to estimate the demand for payment instruments:

$$log\left(\frac{s_{j,t}}{s_{0,t}}\right) = \alpha_1 + \alpha_2 fee_{j,t} + \beta' x_{j,t} + \gamma_j + \phi_t + \xi_{j,t} \tag{6}$$

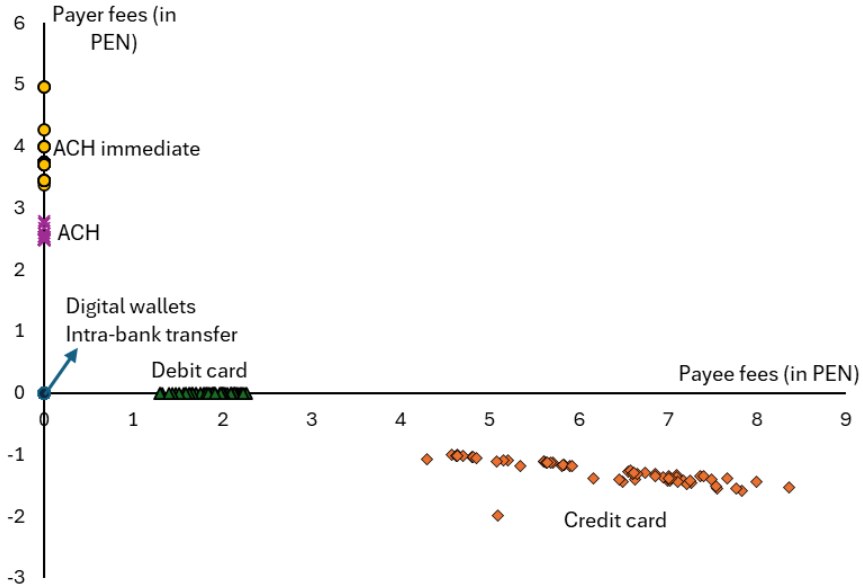
Price endogeneity

- Price is correlated with the error term which makes its estimate biased towards zero. For instance, the price could be correlated with quality (e.g., security) which is unobserved
- Good instruments for solving this problem include: cost shifters, characteristics of products of close competitors, and the price of the same product in other markets
- We use payee fees (i.e., how much the receiving side pays) as an instrument for payer fees
- Exogenous: payee fees are not considered in the demand for payment instrument of the payer, she only takes into account her price.
- Relevant: both payer and payee fees are taken into consideration when the pricing scheme is designed. These both fees should cover costs but also are interconnected due to indirect (and direct) network effects.

Price endogeneity



(a) Payer and payee fees over time



(b) Payer versus payee fees, by payment instrument

Results

	Dep. var.: ln (s_j/s_0)					
	OLS					IV
	(1)	(2)	(3)	(4)	(5)	(6)
payer-fee	-0.74***	-0.43***	-0.28***	-0.29***	-0.29***	-1.07***
	(0.09)	(0.10)	(0.07)	(0.07)	(0.07)	(0.26)
fps		0.51***	0.80***	0.82***	0.82***	0.48***
		(0.07)	(0.06)	(0.07)	(0.05)	(0.13)
pos			1.26***	1.29***	1.29***	1.27***
			(0.10)	(0.10)	(0.10)	(0.07)
qr				0.07	0.07	0.15**
				(0.05)	(0.05)	(0.07)
cell phone					0.05	-0.15
					(0.09)	(0.15)
Instrument FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
N	360	360	360	360	360	360
R^2	0.897	0.902	0.960	0.960	0.960	0.571

Robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Econometric results

Discussion

- Our results suggest that the uptake of a payment instrument is higher when the fees are lower. Immediate availability of funds on a 24x7 basis, the ability to pay with QR codes and at card POS increase the demand for payment instruments
- To test the weakness of our instrument, we use the critical values proposed by Stock and Yogo (2005) and the Cragg-Donald (CD) Wald F statistics. The CD is 49.82 which is much higher than the 10% maximal IV size value of 16.38. This means that the null hypothesis of weak instruments is rejected.
- Although this model allows us to estimate own- and cross-price elasticities, we do not go into detail because most payment instruments have zero fees, which means that estimating price elasticities becomes impractical.

Discussion

- The features found significant may be important to consider when designing the introduction of new payment instruments (e.g. a retail CBDC)
- While we have tried to cover several design features and attributes, others may be relevant (e.g. security and quality)
- The BCRP plays a key role:
  - Interoperability
  - Quality standards
  - Retail CBDC
  - FPS

Thank you!