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Alejandro Zamora-Pérez **Who owns crypto in the euro area?
Drivers of crypto adoption, payment
use, and its interaction with fiat cash**

No 3215

Disclaimer: This paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB.

Abstract

Using a survey of 39,507 adults in 17 euro-area countries, I find that crypto-asset owners and the niche subgroup of payers have distinct profiles. Owners – typically younger, male, and financially active – exhibit mixed preferences, valuing both cash-like privacy and card-like speed. Crypto payers display a cash-centric profile, seeking to replicate physical cash’s privacy and ease of use in digital form. While standard specifications show that holding cash reserves is positively associated with owning crypto – challenging the view that early adopters reject cash –, a multiple-instrument IV strategy exploiting pandemic-related payment shocks reveals a causal sign reversal: for compliers, building precautionary cash buffers reduces the probability of crypto ownership under uncertainty. These findings (1) explain the ownership-payment wedge as driven by user profiles beyond merchant-acceptance frictions, (2) show crypto and cash act as portfolio complements but substitutes under stress, and (3) may inform crypto regulation and CBDC design.

Keywords: Digital Assets, Money Demand, Store of Value, Payment Choice, Household Finance.

JEL Codes: E41, E42, E58, G11, O33.

Non-Technical Summary

The rapid growth of crypto-assets presents two central questions for policymakers and the public. First, there is a significant and puzzling gap between the rising number of people who own crypto-assets and the very small number who actually use them for everyday payments. While this ‘wedge’ is partially explained by low merchant acceptance, this study investigates whether it is also driven by fundamentally different motivations among users. Second, what is the relationship between these new private digital assets and traditional, central-bank-issued cash? Do they complement each other in a household’s portfolio, or do they compete as stores of value, especially during a crisis? This paper seeks to answer these questions by providing a detailed analysis of the behaviors and preferences of crypto-asset users in the euro area.

To do so, this study uses microdata from the European Central Bank’s 2022 payment survey, which covers around 40,000 adults across 17 euro area countries. The analysis employs a two-pronged econometric approach. First, to understand the gap between ownership and payment usage, it uses a two-stage model that distinguishes the decision to own crypto from the subsequent decision to use it for payments. Second, to establish a cause-and-effect relationship between holding cash and owning crypto, it uses the COVID-19 pandemic as a natural experiment. The pandemic created shocks to payment habits (such as a fear of handling cash or reduced access to ATMs) that were unrelated to people’s underlying views on crypto, allowing the analysis to isolate the causal impact of a change in cash holdings on crypto ownership (henceforth, the instrumental variable analysis).

The first major finding explains the wedge between high ownership and low payment use: crypto owners and crypto payers are two fundamentally different groups. The typical crypto owner fits an investor profile, exhibiting a mixed set of preferences. They are financially and technologically savvy, valuing the speed and convenience of digital cards, but at the same time they are more likely than the average person to hold precautionary cash reserves and to value the privacy of cash. In contrast, the much smaller group of individuals who use crypto for payments displays a cash-centric profile. They are not primarily motivated by the speed or convenience of digital payments. Instead, they are strongly driven by cash-like features, such as privacy and ease of use, suggesting they are seeking a digital instrument that replicates the core attributes of physical cash.

The second major finding clarifies the relationship between cash and crypto. Contrary to the

view that early adopters of digital technology reject traditional paper money, simple correlations suggest that the two assets are complementary in normal times. Crypto owners are actually more likely to hold cash reserves, suggesting that these assets coexist in a diversified portfolio. However, the picture changes completely during a crisis. The instrumental variable analysis shows that when an individual built their precautionary cash buffer due to the stress of the pandemic, it made them approximately 10 percentage points less likely to own crypto. This sign reversal reveals a substitution effect under uncertainty. The intuition is that in normal times, speculative crypto and safe-haven cash can coexist in a portfolio, but when uncertainty rises, households flee to the safety and immediate usability of central-bank-issued cash. This shows that individuals treat cash as a superior store of value and move away from volatile private digital assets. This finding is further corroborated by macroeconomic analysis showing that during the onset of the pandemic, demand for euro banknotes surged while crypto-asset markets fell.

These results carry significant policy implications for the euro area. First, they help to explain the “paradox of banknotes” – the persistent demand for physical currency even as its use in daily transactions declines – by highlighting the crucial role of cash as a safe haven in times of crisis even for tech-savvy individuals. Second, the findings suggest a dual approach to the regulation of crypto-assets. For the broad majority of crypto owners, who are effectively investors, policy should prioritize investor and consumer protection. For payment system policy and the design of a potential digital euro, the preferences of the niche group of crypto payers are more relevant. Their desire for a digital instrument that mimics the core properties of cash – notably privacy, simplicity, and robustness – suggests that a successful central bank digital currency for this specific group would need to benchmark itself against these features, rather than focusing solely on the speed and functionality offered by existing digital payment systems.

Finally, the findings cast further doubt on the classification of these assets as ‘currencies’ in the economic sense. With payment usage limited to less than 1.5% of the population (and a small fraction of their transactions) and their value failing to hold up during stress, they currently lack both the medium-of-exchange and store-of-value properties required of money.

1 Introduction

Background.- The evolution of money has been shaped by societies' need to innovate to meet the demands of trade. In sequential trade, where the sale of one good is separated from the purchase of another, money must both facilitate transactions and preserve value. What sets money apart from other stores of value is its liquidity, or the ability to be readily exchanged for goods. The efficacy of this liquidity is influenced by the underlying technology that different forms of money rely on. Financial innovation¹ has decreased reliance on paper currency for transactions. However, growing research shows that the older technology of cash remains unexpectedly resilient to substitution by more modern forms regarding precautionary demand, particularly in times of crisis. Its physical form allows for continued use when digital systems fail or access to broader financial networks is disrupted.

Crypto-assets were designed as an attempt to innovate on these technological foundations of money, promising decentralized control, privacy and resistance to confiscation in payments, potentially making them appealing for those seeking autonomy from traditional financial systems. However, issues such as liquidity constraints, volatility, and limited merchant acceptance have hindered their effectiveness as a genuine retail means of payment and a store of value in crises. These limitations lead to a low uptake of crypto-assets, but they have found a growing base of users, particularly among younger generations (see Figures 1 and 2). This generational divide suggests that crypto-asset technology may have increasing relevance in the coming years.

Motivation.- This paper aims to shed light on two central topics in the economics of crypto-assets. First, there exists a significant and growing wedge between crypto ownership and its use for payments. Despite many crypto-assets being designed as transactional media and ownership rates rising, their use in retail payments remains negligible. A key reason is that payment usage is constrained by the two-sided nature of the payment market, where transactionality depends on the readiness of counterparts to accept the asset. This paper acknowledges the frictions of low market acceptance as a baseline and uses microdata to identify the distinct behavioral profiles that persist within them. Second, there is a fundamental ambiguity in the relationship

¹Financial innovation encompasses a wide range of developments, from the expansion of bank branches and ATMs (Alvarez and Lippi, 2009), to advancements in contactless technologies (Brown et al., 2022).

between crypto-assets and traditional fiat cash. In other jurisdictions like Canada or Japan, the literature suggests that crypto owners are more likely to hold precautionary cash reserves, hinting at complementarity. Yet, in a crisis, these crypto markets crash while fiat cash (and other safe assets) surge. This paper is motivated by the need to re-examine this relationship: are cash and crypto complements or rivals, and under what conditions?² Specifically, the analysis focuses on the precautionary demand for cash as a hedge against uninsurable uncertainty and its interaction with volatile crypto-assets.

What I do.- I conduct a three-stage empirical analysis to investigate crypto-asset ownership and its relationship with fiat cash in the euro area. First, I establish a descriptive baseline of the preferences and socio-demographics of crypto owners. Using probit and Firth logit models to account for potential rare-event bias, I map the unique payment profile of these individuals. Second, I address the distinction between crypto-asset adoption and its subsequent reported use for payments. I employ a two-stage probit model with sample selection to formally test whether the decision to use crypto for payments is a distinct economic choice or is driven by unobserved factors that also determine ownership. This allows for a robust analysis of the observed wedge between high ownership rates and low transactional use. Finally, I assess the observed positive relationship between crypto ownership and cash holdings. To establish the causal relationship between holding cash reserves and owning crypto, I tackle the issue of endogeneity. I implement a multiple-instrumental-variable (IV) strategy, leveraging five exogenous pandemic-related shocks to payment behavior as instruments for cash holdings. The causal effect is estimated using a recursive bivariate probit model, which is appropriate for a binary endogenous regressor. Based on these empirical results, I then discuss their implications for understanding public-private currency competition, the enduring role of cash, and the design of digital currencies.

Related literature.- This paper is related to the growing economic literature on crypto-assets ([Athey et al., 2016](#); [Schilling and Uhlig, 2019](#); [Liu and Tsyvinski, 2021](#); [Huberman et al., 2021](#); [Cong et al., 2021](#); [Biais et al., 2023](#); [Sockin and Xiong, 2023](#)). In particular, it contributes

²While crypto-assets and fiat cash do not currently share the same ‘currency’ status, they compete for the same portfolio allocation within a consumer’s budget or transactional constraint. In this framework, substitution or complementarity is driven by how similar underlying factors (e.g., preference for privacy or autonomy) affect the decision to hold both. If the total number of desired transactions or the precautionary buffer is fixed, any increase in one asset needs a reduction in the other, establishing a measurable relationship of substitution or complementarity in the household’s balance sheet.

to the scant but growing empirical research on the microeconomics of crypto-assets (see [Halaburda et al. \(2022\)](#) for a survey of the literature) and to the growing literature on crypto-asset ownership. This literature finds that younger, better-educated males are observed to be the main crypto adopters and that a sizable gender gap persists even after conditioning on income and education ([Balutel et al., 2024](#); [Fujiki, 2021](#); [Auer and Tercero-Lucas, 2022](#); [Bonaparte, 2022](#); [Stix, 2021](#)). Higher financial literacy is positively, though not uniformly, associated with crypto ownership ([Fujiki, 2021](#); [Bonaparte, 2022](#); [Stix, 2021](#)). Crypto owners appear to keep larger precautionary cash balances – especially those with prior financial-market experience ([Balutel et al., 2024](#); [Fujiki, 2021](#); [Bonaparte, 2022](#)). This paper also relates to the interaction of crypto with traditional fiat money (although particularly in the form of outside fiat money available to individuals, or cash). Previous works reject the common notion that distrust in fiat money drives adoption ([Auer and Tercero-Lucas, 2022](#); [Halaburda et al., 2022](#)). On the payment side, crypto users rely heavily on digital instruments ([Fujiki, 2021](#); [Balutel et al., 2024](#); [Auer and Tercero-Lucas, 2022](#); [Stix, 2021](#)).

More broadly, this study is linked to a growing literature that explains the enduring demand for physical currency.³ The persistence of cash, contrary to early predictions of a cashless society, is now understood to be driven by several complex factors. These include the distinct attributes of cash that make it an imperfect substitute for digital payments ([Alvarez et al., 2022](#); [Brown et al., 2022](#)), the inertia of established payment habits and the costs associated with adopting new technologies ([van der Cruijssen et al., 2016](#); [Nocciola and Zamora-Pérez, 2024](#)), and its continued utility across diverse demographic segments, from users with full access to digital options to financially vulnerable groups ([Bagnall et al., 2016](#); [Zamora-Pérez et al., 2024](#); [van der Cruijssen and Reijerink, 2024](#)). This enduring demand has prompted a re-evaluation of the social welfare implications of restricting cash. Recent scholarship has begun to formally quantify these previously underappreciated costs, highlighting the function of cash in mitigating the market power of financial intermediaries ([Lagos and Zhang, 2022](#)), the significant economic dislocations

³The phenomenon of a sustained demand for cash despite financial innovation affecting payment choices, a phenomenon coined as the “paradox of banknotes” ([Jiang and Shao, 2020](#); [Shy, 2023](#)) and also documented in the euro area ([Zamora-Pérez, 2021](#); [Lalouette et al., 2021](#); [Zamora-Pérez et al., 2024](#); [Clipal and Zamora-Pérez, 2025](#)). This phenomenon has been accentuated especially in times of crisis ([Rösl and Seitz, 2022](#); [Muñoz and Soons, 2024](#); [Bartzsch et al., 2025](#); [Faella and Zamora-Pérez, 2025](#)).

caused by demonetization policies (Chodorow-Reich et al., 2020), and the loss of consumer surplus when payment optionality is removed (Alvarez and Argente, 2022). This body of work suggests that policies aimed at heavily restricting cash (Rogoff, 2017) may impose social costs that outweigh their intended benefits (Alvarez et al., 2022).

Contribution.- This paper makes three primary contributions to the microeconomics of digital assets and the literature on currency competition. First, this paper provides a novel, micro-founded explanation for the well-documented wedge between crypto-asset ownership and its use for payments, which is not just explained by low merchant acceptance of crypto-assets in payments. Using a two-stage selection model, the analysis demonstrates that crypto owners and crypto payers are two economically distinct groups with fundamentally different profiles. The typical crypto owner exhibits a mixed profile, combining the characteristics of a financially sophisticated investor and cashless payer with store-of-value preferences that are complementary to cash (e.g., valuing privacy provided by cash). In contrast, the niche crypto payer displays a cash-centric profile, driven by a desire to replicate cash’s transactional features (like privacy and simplicity) in a digital form, while being indifferent or even averse to the typical conveniences of card payments. This core finding contributes to the puzzle of why ownership can rise while payment usage remains negligible.

Second, the paper provides what is, to my knowledge, the first causal evidence from the euro area on the relationship between fiat cash reserves and crypto ownership under stress. While simple correlations suggest a positive link between holding cash and owning crypto, this paper’s instrumental-variable strategy – exploiting pandemic-era payment shocks – reveals a causal sign reversal. The estimates show that for individuals whose behavior was shifted by the crisis, building a precautionary cash buffer crowded out crypto ownership. This establishes that cash and crypto act as substitutes during periods of heightened uncertainty, with households displaying a clear flight to the safety of central bank money.

These findings contribute to several discussions, including the abovementioned wedge between ownership of crypto-assets and its use in retail payments, the enduring role of fiat cash as a safe-haven in a crisis or, more generally, the coexistence of public and private money and the classification of crypto-assets as money or “currencies” (Baur et al., 2018; Alvarez et al.,

2023). It also has direct implications for financial regulation, suggesting the need to acknowledge that crypto owners and the smaller group of crypto payers are essentially different. Finally, the cash-centric profile of the crypto payer offers guidance for Central Bank Digital Currency (CBDC) design, indicating that to foster transactional adoption among this group of consumers, a CBDC should prioritize cash-like features such as privacy, simplicity, and resilience, rather than competing with existing digital payments solely on speed and functionality.

Structure of the paper.- The remainder of this study is structured as follows. Section 2 describes the data used for the analysis. Section 3 examines the determinants of crypto-asset ownership. Section 4 examines the two-stage decision to own crypto and use it for payment purposes. Section 5 addresses endogeneity concerns and presents instrumental variable (IV) estimates of the impact of cash as a store of value on crypto-asset ownership. Section 6 concludes.

2 Data

I use 2022 microdata from 17 euro area countries⁴ from the “Study on the Payment Attitudes of Consumers in the Euro area (SPACE)”. The SPACE survey is a comprehensive study conducted by the European Central Bank (ECB) to investigate the payment behaviors and preferences of consumers across the euro area and track evolving trends in payment methods. It captures detailed information on how consumers use different payment instruments, including at the point of sale (PoS), for person-to-person (P2P) transactions, online payments, and recurring payments. It also explores the reported use of cash as a store of value, as well as consumer preferences and perceptions regarding the use, access, and acceptance of cash and cashless payments.

The survey uses a sampling methodology that covers a broad cross-section of the population, ensuring representation across different countries, age groups, income levels, and urban/rural settings, which allows for detailed demographic analyses of consumer payment behaviors. The data is collected through structured questionnaires administered via online and telephone interviews, designed for comparability across countries and over time. Key variables in the dataset include the use of various payment instruments (such as cash, cards, mobile payment apps, and

⁴I include 17 euro area countries, excluding Germany, the Netherlands, and Croatia.

online systems), the context of transactions (distinguishing between in-store, online, and P2P payments), consumer preferences for different payment methods, access to payment methods, and demographic information. The dataset also includes questions on the reported ownership of crypto-assets and the main purpose for holding them, whether for payments, investment, or both. These questions are the focus of this study.

The survey’s mixed-mode design, combining online and telephone interviews, is particularly well-suited for studying crypto-asset ownership. For topics concerning tech-savvy populations or involving privacy-sensitive behaviors, survey methodology research indicates that self-administered components (e.g., web surveys) can enhance data quality. Specifically, they tend to reduce interviewer-induced social desirability bias in responses and can achieve better coverage of early technology adopters (Tourangeau and Yan, 2007; Kreuter et al., 2008; Pew Research Center, 2015). By pairing probability-based sampling with appropriate weighting, sequential mixed-mode designs achieve population-consistent estimates that are robust to selection effects (de Leeuw, 2005, 2018; Dillman et al., 2014; Bethlehem, 2010).⁵

This study is based exclusively on the questionnaire components of the survey. All measures of crypto-asset ownership and the intention to use them for payments are derived from self-reports collected in the core survey module. The separate online diary module, in which a subsample of respondents reports specific online transactions, is not used in this study. Therefore, the term “crypto payer” denotes an individual’s self-declared purpose for holding crypto-assets, not an observed payment recorded in the diary. A potential limitation of the self-reported question on payment motives is that the survey does not explicitly disaggregate “payments” into retail goods and services and financial assets (e.g., using crypto-assets in inter-crypto swaps). However, this potential problem is mitigated since SPACE is structurally designed as a payment attitude study focusing on the purchase of goods and services, the survey context likely guides respondents toward reporting retail-oriented usage.

⁵While it could be argued that face-to-face methodologies are superior to ensure representative results (Fessler and Weber, 2024), the balance of evidence in survey methodology suggests that for sensitive and technology-related domains, mixed-mode designs with a strong self-administered component are often preferable to face-to-face interviews alone, due to improved candor in reporting and better coverage of the target population (see, e.g., Duffy et al., 2005; Bianchi et al., 2017; Cornesse et al., 2022).

2.1 Summary statistics

Table 1 compares the summary statistics for the whole sample (39,507 observations) with the sub-samples of crypto owners (1,753 observations) and crypto payers (537 observations). The data reveals that crypto owners and payers generally have higher income and are more likely to hold a university degree or higher compared to the overall sample. Additionally, they are slightly more likely to live in urban areas and are more frequently employed.

Table 1: Descriptive statistics of crypto-asset ownership and usage

	All Sample (I)	Crypto Owners (II)	Crypto Payers (III)
Socio-demographics			
<i>Household income</i> (in EUR)			
Between 500 and 1000	11.41	12.31	16.15
Between 1001 and 2500	41.00	35.03	33.80
More than EUR 2501	47.59	52.66	50.05
<i>Education</i>			
Primary and lower secondary	25.92	15.47	21.60
Upper secondary and post-secondary	41.62	42.04	39.29
University graduate or postgraduate	32.46	42.48	39.11
<i>Other socio-demographics</i>			
Age	48.78	38.97	38.51
Male	48.53	67.52	63.31
Urban dweller	69.69	73.74	73.24
Is employed	54.83	70.31	68.02
Internet and digital payment access			
Uses internet daily	85.04	91.77	85.78
Has card	91.42	91.98	87.52
Has online banking	59.94	76.37	72.85
Investment profile			
Has financial investment	24.84	50.14	43.89
Store of value profile			
Holds cash reserves	38.62	50.79	51.44
Transactional profile			
Does not use cards	2.63	0.78	0.32
Strictly prefers cash	69.61	61.53	57.28
Strictly prefers cashless	9.05	21.81	22.94
Values cash privacy	35.11	43.25	44.01
Values convenience of cards	36.68	43.17	42.46
Number of observations	39,507	1,753	537

Note: The table displays weighted averages using sample weights, which are representative of the general population. Source: authors' own elaboration from SPACE 2022 data.

They also tend to be younger, with an average age approximately 10 years lower than the general population and are predominantly male. Figure 1 shows 2022 survey data that younger

cohorts exhibit higher levels of crypto-asset ownership and payments in 17 euro area countries. Despite the overall low adoption rates, individuals born after 1980 show a marked increase in participation, with substantial variability across different countries. Figure 2 further corroborates this trend, showing that younger generations, particularly Millennials and Gen Z, are driving crypto-asset adoption in most countries.

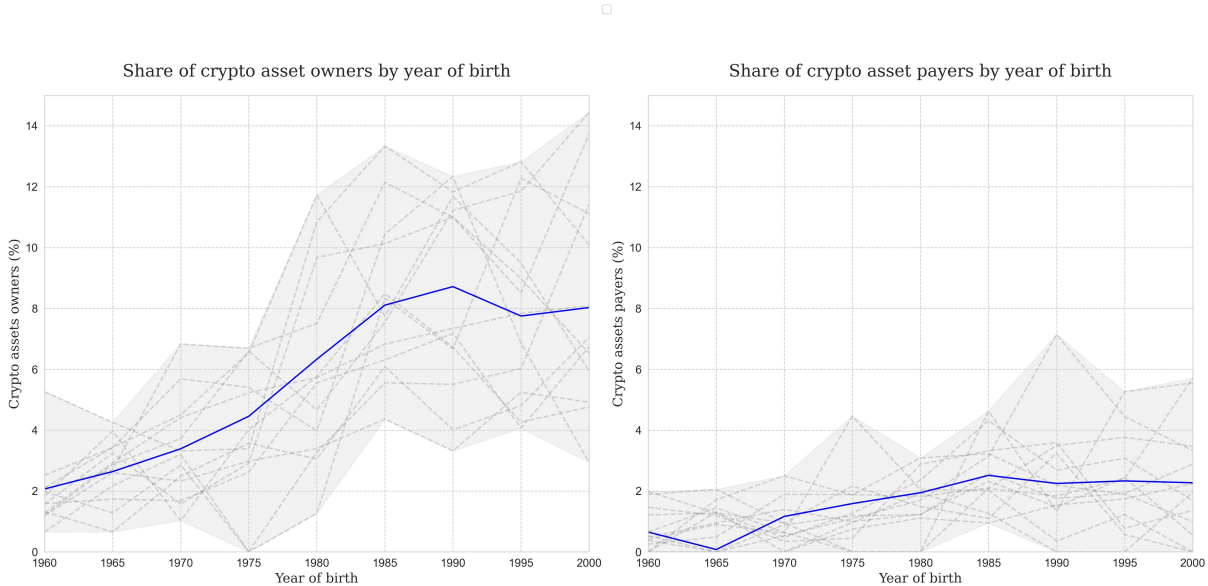


Figure 1: Younger cohorts hold more crypto, with high country variability. Source: SPACE survey

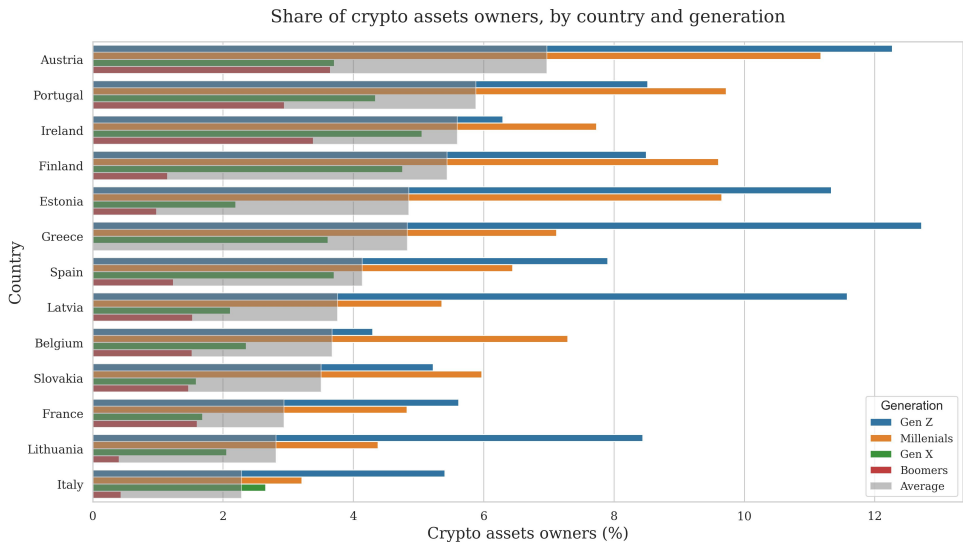


Figure 2: Younger generations lead crypto-asset holdings. Source: SPACE survey

In terms of internet use, crypto owners exhibit higher daily internet usage compared to the general population, while crypto payers' internet habits align more closely with the overall sample. The ownership of payment cards is nearly identical between the whole sample and crypto owners, though it is marginally lower among crypto payers.

A notable difference is observed in the investment profiles: around 25% of the entire sample owns financial instruments, whereas this figure doubles among crypto owners. Although crypto payers have slightly lower ownership of financial instruments compared to crypto owners, their ownership rate remains considerably higher than that of the general population.

Another salient difference is in the storage of cash reserves, with crypto owners and payers being more likely to keep cash at home than the general sample. In their transactional behavior, crypto owners and payers rarely lack a payment card and tend to prefer cashless payments at the point of sale (PoS) more often than the rest of the population, who generally favor cash. Moreover, crypto users place a higher value on privacy and anonymity in their transactions and find payment cards more convenient compared to the broader population.

3 Drivers of crypto ownership

For a first approximation of the determinants of crypto ownership and the use of crypto for payment purposes, I estimate both linear probability models (LPM) and probit models. Table 2 presents the results. Both the LPM and probit results highlight key socio-demographic and behavioral variables that are associated with crypto-asset ownership. The probit marginal effects in column (II) provide more precise estimates of how incremental changes in covariates affect the probability of owning crypto-assets.

Consistent with the descriptive baseline and related literature, the results confirm that crypto-asset owners are typically younger, male, more educated, and financially sophisticated individuals. Notably, using cash as a store of value is positively associated with ownership, whereas a lack of card usage significantly reduces the propensity to adopt crypto.

The transactional preference profile also reveals significant insights into crypto-asset ownership. Individuals who do not use cards for transactions are significantly less likely to own crypto-assets, indicating a potential overlap between reliance on cash for payments and a lower

Table 2: Determinants of Crypto Ownership

Model	Crypto owner	
	LPM (I)	Probit (II)
Use of cash as store of value	0.009*** (0.002)	0.010*** (0.002)
Does not use cards	-0.021*** (0.005)	-0.038*** (0.010)
Socio-demographic profile		
Income	0.001 (0.001)	0.001 (0.001)
Education	0.006*** (0.001)	0.006*** (0.002)
Is employed	0.005** (0.002)	0.011*** (0.002)
Age	-0.008*** (0.000)	-0.008*** (0.000)
Lives in urban area	0.000 (0.000)	0.000* (0.000)
Is male	0.028*** (0.002)	0.027*** (0.002)
Internet and digital payment usage profile		
Does not own cards	0.001 (0.004)	-0.001 (0.004)
Has bank account	0.013*** (0.003)	0.014 (0.004)
Uses internet daily	0.000 (0.003)	0.004 (0.004)
Has online banking	0.008*** (0.002)	0.010*** (0.003)
Receives some income in cash	0.014*** (0.003)	0.014*** (0.003)
Investing profile		
Has financial instruments	0.055*** (0.003)	0.044*** (0.002)
Has pension fund	0.000 (0.002)	0.001 (0.002)
Transaction preference profile		
Weakly prefer cash	-0.003 (0.002)	-0.003 (0.002)
Thinks cash is important	-0.003 (0.002)	-0.004* (0.002)
Values wide acceptance of cash	0.004 (0.002)	0.004 (0.002)
Values speed of cash	0.002 (0.003)	0.002 (0.003)
Values privacy/anonymity of cash	0.006** (0.002)	0.006** (0.002)
Values ease of use of cash	-0.001 (0.003)	0.000 (0.003)
Values safety of cash	0.003 (0.003)	0.003 (0.003)
Values immediate settlement of cash	-0.001 (0.002)	0.000 (0.002)
Values budgeting usefulness of cash	-0.006** (0.002)	-0.006** (0.002)
Values wide acceptance of cards	-0.002 (0.003)	-0.002 (0.003)
Values speed of cards	0.009*** (0.002)	0.008*** (0.002)
Values ease of use of cards	0.004* (0.002)	0.003 (0.002)
Values safety of cards	-0.002 (0.002)	-0.001 (0.002)
Values the need to not carry cash or cards	0.001 (0.002)	0.001 (0.002)
Values budgeting usefulness of cards	0.004 (0.003)	0.003 (0.003)
Country fixed effects	Yes	Yes
Number of observations	37,909	37,909

Note: *, ** and *** are for statistically significant coefficients or marginal effects at the 10%, 5% and 1% level, respectively. Robust standard errors are reported in parenthesis.

propensity to adopt crypto-assets. Notably, individuals who value the privacy and anonymity of cash are more likely to hold crypto, with a positive and statistically significant effect (p-value = 0.012). This suggests that the perceived anonymity of crypto-assets, often touted as one of its key features, resonates with individuals who prioritise similar attributes in cash transactions. On the other hand, individuals who value the budgeting usefulness of cash – using cash as a tool to be more aware of their expenses – are significantly less likely to own crypto-assets. This negative relationship possibly stems from the volatility of cryptocurrencies, which makes them unsuitable for individuals who prefer stability and predictability in their payments. Additionally, people who value the speed of card transactions are more likely to own crypto-assets. This highlights an important characteristic of crypto-assets that aligns with the preferences of these individuals.

These findings provide an interesting picture of who is more likely to hold crypto. Individuals that prioritise both privacy associated with cash and transactional speed associated with cards are more likely to be crypto-asset owners. This combination of preferences points to a segment of the population that values both the privacy offered by crypto and the transactional speed of cashless payments.⁶ Additionally, while preferences related to the wide acceptance and speed of cash do not significantly influence crypto-asset ownership, those valuing the speed of cards are more likely to own crypto. These results highlight that individuals who favor certain qualities in traditional cash, particularly related to privacy, may find crypto-assets appealing as a digital alternative for securing transactions without third-party oversight.

3.1 Addressing rare event bias

To address potential rare event bias, I estimated the main specification with standard logit and Firth logit (Firth, 1993) as is common practice in the crypto-asset ownership literature (Henry et al., 2018; Stix, 2021; Balutel et al., 2024). As shown in Figure 3, the coefficients of the probit, logit, and Firth logit models have the same sign, and particularly the logit and the Firth logit are almost identical, which confirms that rare-event bias is negligible thanks to a large sample

⁶The data includes preferences for the transactional speed of both cards and cash, as well as preferences for the immediate settlement of cash transactions. In the models, preferences for both the transactional speed and settlement immediacy of cash are not statistically significant.

($N > 40,000$). For parsimony I therefore report only the LPM and probit results in the text.

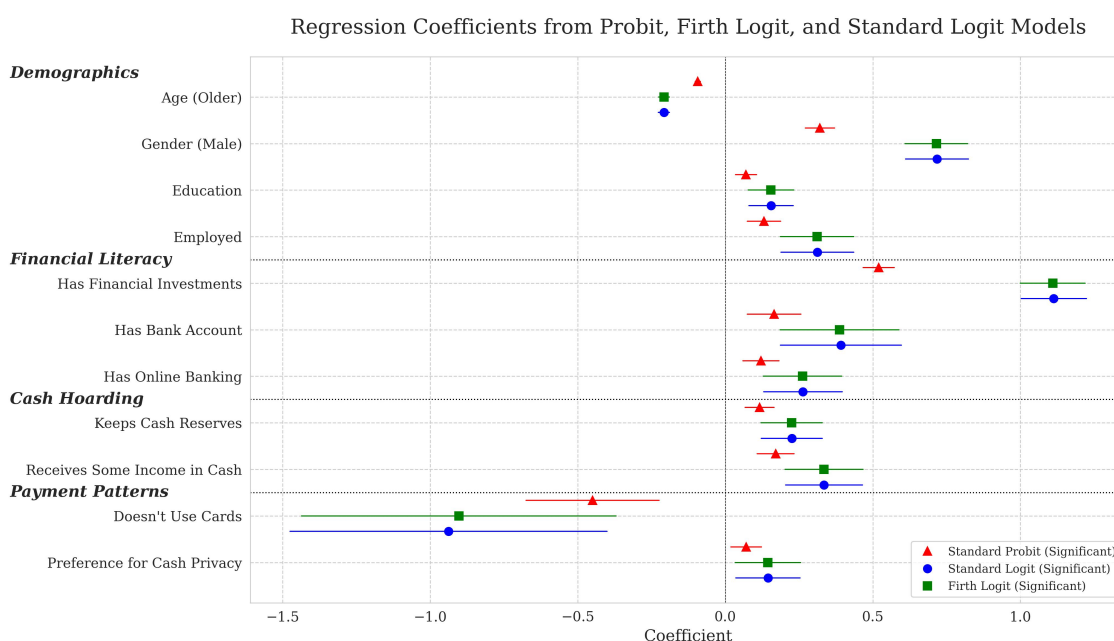


Figure 3: Coefficients from probit, standard logit, and Firth logit. Similar coefficients of logit and Firth logit indicate that bias-reduced estimation adds no material correction in the used large sample from the SPACE survey.

4 Payment usage of crypto-assets

The previous section established the profile of the marginal crypto adopter in the euro area, treating crypto ownership as a single decision. A significant question remains regarding the subset of these owners who report using their holdings for payments, a core function for which many of these assets were originally designed. To assess this two-stage decision process (ownership and payment use), this section moves from the general question of ownership to the specific question of payment usage.

4.1 A two-stage model for crypto adoption and payment use

Modeling the decision to use crypto for payments is complicated by a classic sample selection problem, as the choice is only observed for the non-random subsample of individuals who already own crypto. To address this, I employ a probit model with sample selection (Van de Ven and Van Praag, 1981). This model jointly estimates a selection equation (the probability of owning

crypto) and an outcome equation (the probability of using it for payments), explicitly modeling the correlation (ρ) between the error terms.

Formally, the model is specified as follows. The outcome equation (crypto-asset payment usage) is given by the latent variable model:

$$y_i^* = x_i\beta + u_{1i}$$

where y_i^* is the latent propensity to use crypto for payments, x_i is the vector of covariates, β is the vector of parameters, and $u_{1i} \sim N(0,1)$ is the error term. The selection equation (crypto-asset ownership) is:

$$z_i^* = z_i\gamma + u_{2i}$$

where z_i^* is the latent propensity to hold crypto, z_i is the vector of covariates (which includes x_i and the exclusion restrictions), γ is the vector of parameters, and $u_{2i} \sim N(0,1)$. The observed variables are defined as follows. We observe the ownership decision d_i :

$$d_i = \begin{cases} 1 & \text{if } z_i^* > 0 \\ 0 & \text{if } z_i^* \leq 0 \end{cases}$$

The payment usage outcome y_i is observed **only if** $d_i = 1$:

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \text{ and } d_i = 1 \\ 0 & \text{if } y_i^* \leq 0 \text{ and } d_i = 1 \\ \text{unobserved} & \text{if } d_i = 0 \end{cases}$$

The error terms u_{1i} and u_{2i} are assumed to be drawn from a bivariate normal distribution with correlation ρ . The model is estimated via maximum likelihood. The log-likelihood function sums the contributions of the selected (observed) and non-selected (unobserved outcome) observations:

$$\ln L = \sum_{d_i=1} \ln \Phi_2(w_i, v_i, \rho^*) + \sum_{d_i=0} \ln(1 - \Phi(z_i\gamma))$$

where Φ_2 is the cumulative bivariate normal distribution function. For selected observations ($d_i = 1$), the arguments w_i and v_i correspond to the standardized bounds for y_i and d_i , specifically $q_{y_i}x_i\beta$ and $z_i\gamma$, where $q_{y_i} = 2y_i - 1$, and $\rho^* = q_{y_i}\rho$. The correlation coefficient ρ captures the extent to which unobserved factors driving ownership are correlated with those driving payment usage.

4.2 Identification strategy

The primary econometric challenge of this model is the identification of the outcome equation's parameters. As surveyed in the extensive review by [Lewbel \(2019\)](#), credible identification in such models requires more than the assumption of bivariate normality in the error terms. The standard for identification is a valid exclusion restriction: at least one variable that influences the selection (ownership) decision but has no direct, separate effect on the outcome (payment usage) decision ([Heckman, 1979](#)). In the absence of a perfect instrument, an alternative strategy is to achieve identification through non-linearities in the model's functional form, a method advanced by [Dong \(2010\)](#) and [Escanciano et al. \(2016\)](#).

I adopt a multi-pronged identification strategy consistent with recent best practices in the payments literature, which often combine these approaches ([Balutel et al., 2022](#); [Felt et al., 2024](#)). I employ two distinct sets of exclusion restrictions. First, I use variables capturing financial sophistication (having financial investments and having a pension fund), based on the economic rationale that the decision to adopt a speculative asset is primarily an investment choice, whereas the subsequent decision to use it for payments is transactional. Second, I leverage the non-linearity in age by including an age-squared term in the selection equation only. The economic justification for this is that the barriers to technology adoption (e.g., learning costs) are often higher for older individuals ([Berenguer et al., 2016](#)), creating a non-linear adoption pattern that is less relevant for usage decisions conditional on having already adopted. By combining these theoretically grounded identification strategies, I ensure the model's robustness.

The multi-pronged identification strategy consists of a four-step robustness check. [Table 3](#) presents the results of this check. The baseline model (M1), which lacks a credible exclusion restriction, fails to reject the null hypothesis that ($\rho = 0$). However, this result is an artifact of

weak identification. Once the model is identified using the financial sophistication instruments (M2), the non-linearity of age (M3), or both (M4), the result reverses. In the properly identified specifications, the Wald test consistently rejects the null hypothesis, revealing a statistically significant correlation between the unobserved determinants of ownership and payment usage. This uncovers the presence of selection bias that was previously obscured. The stability of the coefficients of interest across the robustly identified models (M2 and M4) provides confidence in the final specification.

Table 3: Robustness of Sample Selection Model to Identification Strategy

Variable	(M1) Baseline	(M2) Financial Inst.	(M3) Age-Squared Inst.	(M4) Combined
<i>Outcome Equation: Use Crypto for Payments</i>				
Preference: Privacy of Cash	0.132 (0.059)	0.130 (0.066)	0.127** (0.045)	0.131** (0.066)
Preference: Speed of Cards	-0.039 (0.146)	-0.066 (0.069)	0.004 (0.051)	-0.064 (0.069)
<i>Selection Parameter</i>				
Correlation (ρ) ^a	0.740 (1.691)	0.420** (0.173)	1.469* (0.772)	0.438** (0.178)
Wald test ($\rho = 0$) [p-value]	[0.662]	[0.015]	[0.057]	[0.014]
Observations	37,909	37,909	37,909	37,909
Log-likelihood	-7293.99	-7122.45	-7293.22	-7122.07

Notes: The table presents coefficient estimates from four different specifications of a probit model with sample selection. Standard errors are reported in parentheses.

^a The coefficient reported is for ρ , the inverse hyperbolic tangent of ρ . Significance stars are based on the Wald test of the null hypothesis that $\rho = 0$.

* $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$.

4.3 Results from the two-stage model

The selection equation in the more complex models largely replicates the findings from the simpler probit analysis in Section 3.1. As shown in Column (1) of Table 4, the determinants of crypto ownership remain consistent, which provides a check and builds confidence in the model's structure. The results from the fully identified model (M4 in table 3) also allow for a clear distinction between the drivers of crypto ownership and the drivers of its use for payments.

The selection equation reveals that the typical crypto owner has a mixed payment profile.

Table 4: Determinants of Crypto Ownership and Payment Usage

Variable	(1) Holding Crypto (Selection Eq.)	(2) Paying with Crypto (Outcome Eq.)
<i>Socio-Demographics</i>		
Male	0.317*** (0.025)	0.072 (0.084)
Age	-0.108*** (0.019)	-0.015 (0.017)
Education	0.080*** (0.018)	-0.071 (0.052)
<i>Financial Profile</i>		
Has Financial Investments	0.479*** (0.026)	-
Has Bank Account	0.145*** (0.045)	-0.247* (0.136)
Holds Cash Reserves	0.111*** (0.025)	0.054 (0.066)
<i>Cash and digital Payment Preferences</i>		
Preference: Privacy of Cash	0.088*** (0.025)	0.131** (0.066)
Preference: Ease of Use of Cash	-0.003 (0.034)	0.177** (0.086)
Preference: Speed of Cards	0.090*** (0.026)	-0.064 (0.069)
Preference: Ease of Use of Cards	0.055** (0.026)	0.006 (0.068)
Preference: No Cash to Carry	0.019 (0.027)	-0.152** (0.070)
<i>Model Diagnostics</i>		
Correlation (ρ)		0.412** (0.147)
Observations		37,909

Notes: The table presents coefficient estimates from the fully identified Heckman-type probit model with sample selection (M4). Robust standard errors are in parentheses. All models include a full set of control variables and country fixed effects.

^a ‘Has Financial Investments’, ‘Has Pension Fund’, and ‘age’-squared serve as exclusion restrictions and are omitted from the outcome equation by design.

* $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$.

Their behavior is complementary to cash’s store-of-value function as they are significantly more likely to hold precautionary cash reserves and to value the privacy of cash. They are also driven by the transactional advantages of digital payments, as shown by the positive and significant

coefficient on the preference for the speed of cards, but value the privacy offered by cash. This paints a picture of a technologically adept investor who values both the safety-haven properties and privacy feature of physical cash and the efficiency of modern digital payments.

In contrast, the outcome equation in Column (2) of Table 4 shows that the crypto payer is a transactional user whose profile is strongly aligned with the payment function of cash, not digital convenience. The store-of-value motive disappears entirely as holding cash reserves is no longer a significant predictor. Instead, payment usage is positively and significantly driven by preferences for cash-like features, such as privacy and ease of use. Most strikingly, the typical reasons for preferring digital payments are either insignificant (speed and ease of cards) or have a significant negative effect. The coefficient on preferring cards for the logistical convenience of not carrying cash is negative and significant, implying that individuals motivated by this classic digital benefit are less likely to be crypto payers. Thus, crypto payers appear to be a distinct group seeking to replicate the features of physical cash in a digital form.

4.4 Discussion of results

The results from the selection and outcome equations deliver three important findings. First, the selection equation largely reproduces the simpler probit results from Section 3.1, which reassures that the determinants of crypto ownership are robust to explicitly modeling the non-random split between owners and non-owners. Crypto owners retain a mixed profile. They are more likely to value card-based speed and convenience, yet they also hold larger precautionary cash reserves and attach a high value to the privacy of cash. This places crypto ownership at the intersection of speculative finance and precautionary money demand, rather than at the purely digital end of the payment spectrum.

Second, the outcome equation shows that, conditional on ownership, the decision to use crypto for payments is not simply a scaled-down version of the ownership decision. Crypto payers are behaviorally distinct. Preferences that proxy for cash-like, offline attributes – such as valuing privacy and the ease of cash in day-to-day transactions – are strong positive predictors of using crypto at the point of sale. By contrast, the canonical motives for using cards (speed and the convenience of not carrying cash) are insignificant or even negatively associated with paying

in crypto. In other words, crypto is bought by a relatively broad group with mixed motives, but actually used in payments only by a much narrower, cash-oriented subset of owners.

Third, the contrast between the selection and outcome equations provides a micro-foundation for the well-documented wedge between widespread crypto ownership and its very limited use as a means of payment. Our results imply that the aggregate “crypto market” combines two analytically distinct behavioral types: an investment-oriented owner, and a niche transactional user who seeks to replicate cash-like properties in digital form. This segmentation is consistent with recent work emphasizing the dual role of crypto-assets as both speculative investments and money-like instruments (e.g. [Baur et al., 2018](#); [Bank for International Settlements, 2018](#); [Hayashi and Routh, 2025](#)).

5 Revisiting the relationship between holding fiat cash reserves and crypto ownership

In the previous sections, I have assumed that using cash as a store of value (or keeping cash reserves at home) is exogenous to the decision to hold crypto-assets. However, it is plausible that this assumption may not hold, and the use of cash as a store of value could be endogenous. Endogeneity could arise due to reverse causality or omitted variables – individuals who prefer to hold cash reserves may do so as part of a broader financial strategy that also influences their decision to adopt crypto-assets, or unobserved factors could simultaneously drive both behaviors. This potential endogeneity introduces bias into the previous estimates, leading to inconsistent results ([Wooldridge, 2010](#)).

5.1 Multiple instruments IV approach

To account for this, I adopt an instrumental variables (IV) approach, where I identify five exogenous instruments that can help us isolate the causal effect of holding cash on the likelihood of holding crypto-assets. These instruments are derived from behavioral changes triggered by the COVID-19 pandemic, which provided a unique exogenous shock that influenced individuals’ payment habits. This shock operated through multiple channels, exogenously limiting the use of traditional payment instruments like cash and PIN-based cards across the euro area ([Tamele](#)

et al., 2021), while also spurring the adoption of alternative digital payment methods (Nocciola and Zamora-Pérez, 2024) and finance applications (Fu and Mishra, 2022). Figure 4 depicts the strategy to instrument cash holdings.

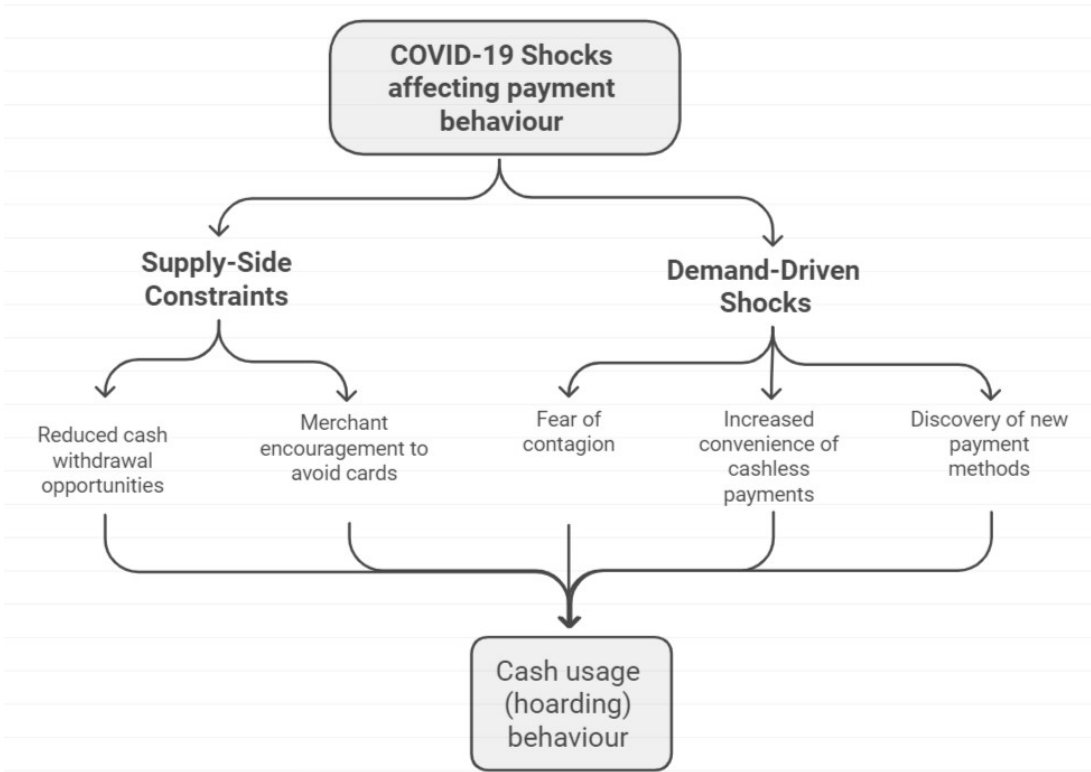


Figure 4: COVID-19 shocks used as instruments for cash-holding behavior. Supply-side constraints: reduced ATM access and merchant advice to avoid cash. Demand-driven shocks: fear of contagion, increased convenience of cashless payments, and discovery of new payment methods.

The pandemic induced two types of behavioral changes: supply-side constraints and demand-driven shifts in payment behavior. For the supply side, I use two instruments related to (1) the perception of reduced opportunities for cash withdrawals and (2) the influence of merchants who encouraged consumers to avoid using cash. These instruments capture the supply constraints that affected cash usage during the pandemic.

On the demand side, I use three additional instruments: (1) individuals’ fear of SARS-CoV-2 contagion, which led to reduced cash usage; (2) perceived increased convenience of cashless payments due to pandemic-driven policy changes (such as raising the contactless payment limit, allowing more transactions without needing to enter a PIN); and (3) the discovery of new

payment methods during the pandemic that would likely not have been considered without the exogenous shock. These instruments are exogenous because they stem from an unexpected external shock that affected individuals uniformly, and thus they provide valid variation in cash usage behavior that is unrelated to crypto ownership preferences.

All five instruments meet the requirements for valid instruments: most of them are relevant in explaining variation in cash usage, and they satisfy the exclusion restriction, as they are unrelated to the decision to hold crypto-assets except through their influence on holding cash, as all of them are connected to a change of behavior connected to physical payments induced by an exogenous shock. By employing these instruments in an IV framework, I aim to obtain consistent estimates of the causal impact of holding cash on holding crypto-assets, addressing the potential endogeneity of using cash as a store of value.

In case there is any concern regarding the validity of a specific instrument, I employ all five instruments in the IV estimation. This approach provides important advantages. First, it increases the identification strength by explaining more variation in the endogenous variable, reducing the risk of weak instruments and improving the overall reliability of the IV estimates (Staiger and Stock, 1997). Second, it provides greater robustness against potential misspecification or invalidity of individual instruments. By using multiple instruments, one can leverage over-identification tests to provide evidence about the collective validity of the multiple instruments, and hence that the exclusion restriction is likely satisfied (Hansen and Singleton, 1982). Third, using more instruments can lead to improved precision in the estimates by lowering standard errors, which enhances the efficiency of the IV estimation. Finally, the approach of employing instruments that capture both supply-side and demand-driven factors provides flexibility in accounting for different channels through which the exogenous shock – the COVID-19 pandemic – affected cash usage.

5.2 Addressing the binary endogenous variable problem

In the context of a binary endogenous variable (keeping cash reserves or not), traditional IV methods such as 2SLS face several limitations. When the endogenous explanatory variable is binary, applying IV directly in a linear probability model can result in inconsistent and biased

estimates. Specifically, if the fitted values of a binary variable are used in a non-linear model like probit or logit, the non-linearity prevents us from passing expectations through the indicator function correctly. This leads to biased estimates because the fitted values do not adequately capture the variation in the binary endogenous variable.

While the LPM 2SLS is a simple and good approximation (Wooldridge, 2010), it leads to inconsistent estimates of the parameters. To address these limitations, the main specification is a recursive bivariate probit model with an endogenous binary regressor, estimated via Maximum Likelihood (MLE), which can properly handle binary endogenous explanatory variables. This model jointly estimates the probability of holding crypto-assets and the probability of holding cash reserves, allowing for potential correlation between the error terms of the two equations. This approach yields consistent estimates even when the endogenous explanatory variable is binary, and avoids the above challenges.

Formally, the model consists of a two-equation system. The first is the structural equation for the outcome of interest (crypto-asset ownership, y_{1i}):

$$y_{1i}^* = \mathbf{x}_i\boldsymbol{\beta}_1 + \delta y_{2i} + \varepsilon_{1i}$$

where y_{1i}^* is the latent propensity to own crypto, \mathbf{x}_i is a vector of exogenous control variables, and y_{2i} is the observed binary endogenous variable (holding cash reserves). The parameter δ captures the causal effect of holding cash reserves on the probability of owning crypto-assets.

The second is the reduced-form equation for the endogenous decision to hold cash reserves (y_{2i}):

$$y_{2i}^* = \mathbf{x}_i\boldsymbol{\beta}_2 + \mathbf{z}_i\boldsymbol{\gamma} + \varepsilon_{2i}$$

where \mathbf{z}_i represents the vector of instrumental variables (the pandemic-related payment shocks) that satisfy the exclusion restriction.

The observed binary outcomes are determined by the latent variables:

$$y_{1i} = \mathbb{I}(y_{1i}^* > 0), \quad y_{2i} = \mathbb{I}(y_{2i}^* > 0)$$

where $\mathbb{I}(\cdot)$ is the indicator function. The error terms $(\varepsilon_{1i}, \varepsilon_{2i})$ are assumed to be distributed as

bivariate normal with correlation ρ :

$$\begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} \sim \mathcal{N} \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right)$$

The model is identified by the exclusion restrictions in \mathbf{z}_i . The correlation coefficient ρ tests for endogeneity. If $\rho \neq 0$, unobserved factors influence both decisions, and estimating the structural equation in isolation (e.g., via a standard probit) would yield biased estimates of the causal parameter δ .

5.3 Results

The results from the IV models are reported in Table 5, presenting estimates from both the LPM 2SLS and the Bivariate Probit MLE specifications. Interestingly, while the marginal effects in Table 2 – assuming exogeneity of use of cash as a store of value – suggested a positive relationship between holding cash and owning crypto-assets, the IV results point in the opposite direction. All models indicate a negative relationship between holding cash reserves and the likelihood of holding crypto-assets. Particularly, in the Bivariate Probit MLE model, the coefficients on using cash as a store of value are consistently negative and highly significant across all specifications (columns IV to VI), with values around -1.02. The corresponding marginal effects are also negative and significant, approximately -0.103 across the models. This suggests that individuals who increase their cash reserves during the pandemic are less likely to hold crypto-assets. These results are consistent, robust across specifications, and unaffected by the staggered inclusion of instruments, providing evidence about the validity of the chosen instruments.

Table 5: IV models results: Effect of use of cash as store of value on selected instruments

Model	LPM 2SLS			Bivariate Probit MLE		
	(I)	(II)	(III)	(IV)	(V)	(VI)
Use of cash as store of value						
Coefficient	-0.187*	-0.210**	-0.223***	-1.025***	-1.016***	-1.021***
	(0.106)	(0.102)	(0.103)	(0.140)	(0.142)	(0.138)
Marginal effects				-0.104***	-0.102***	-0.103***
				(0.028)	(0.028)	(0.027)
Instrument (First stage coefficients)						
Supply-side change						
Fewer cash withdrawal opportunities	0.032**	0.032**	0.032**	0.072*	0.073*	0.073*
	(0.015)	(0.015)	(0.015)	(0.041)	(0.041)	(0.041)
Did not follow merchants' advice	-0.031***	-0.024***	-0.023***	-0.093***	-0.072***	-0.069***
	(0.007)	(0.008)	(0.008)	(0.017)	(0.021)	(0.021)
Demand-driven change						
Had fear of SARS-CoV-2 contagion	0.016*	0.017*	0.017*	0.051**	0.053**	0.053**
	(0.009)	(0.009)	(0.009)	(0.025)	(0.025)	(0.025)
Perceived increase in cashless convenience		-0.015*	-0.014*		-0.042*	-0.041*
		(0.008)	(0.008)		(0.021)	(0.021)
Discovered new means of payment			-0.007			-0.037
			(0.013)			(0.037)
Controls						
Socio-demographic profile	Yes	Yes	Yes	Yes	Yes	Yes
Internet and digital payment usage profile	Yes	Yes	Yes	Yes	Yes	Yes
Investing profile	Yes	Yes	Yes	Yes	Yes	Yes
Transaction preference profile	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects						
	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	37,909	37,909	37,909	37,909	37,909	37,909
Hansen J test (p-value)	[0.304]	[0.445]	[0.605]			

Note: *,** and *** are for statistically significant coefficients/marginal effects at the 10%, 5% and 1% level, respectively. Robust standard errors are reported in parenthesis.

The instruments themselves behave as expected. On the supply side, individuals who experienced fewer cash withdrawal opportunities during the pandemic show a weakly significant increase in holding cash reserves. This is consistent with the literature on cash management, which demonstrates that cash balances increase when the costs of accessing cash rise (Alvarez and Lippi, 2017; Lippi and Moracci, 2025). However, those who changed behavior toward more cashless payments without being influenced by merchants' advice to stop using cash are significantly less likely to hold cash reserves. This aligns with the fact that fewer opportunities to use cash are associated with a reduced need to maintain cash balances.

On the demand side, changing transactional behavior toward cashless payments due to fears of SARS-CoV-2 contagion is positively associated with holding more cash reserves. This could be explained by the stylized fact observed in previous analyses that while the transactional

demand for euro cash decreased during the pandemic, the precautionary demand increased (Faella and Zamora-Pérez, 2025). Perceived increases in cashless convenience, on the other hand, decrease the likelihood of holding cash as a store of value, albeit only at the 10% level. However, discovering new means of payment has an insignificant effect in both models.

5.4 Discussion of results

The instrumental-variable estimates provide a robust causal interpretation of the crypto-cash relationship, revealing a substitution effect during periods of stress. This section discusses these findings in the context of broader macroeconomic data, clarifies the scope and limitations of the analysis, and outlines implications for policy and future research.

As a consistency check, the microeconomic estimates can be triangulated with aggregate market dynamics. Time-series analysis confirms that euro currency in circulation, Bitcoin market capitalization, and financial market volatility (VIX) are cointegrated. Impulse response functions from a Vector Error Correction (VEC) model show that a positive shock to volatility correlates with a significant increase in currency demand and a simultaneous decrease in crypto market cap. While the global nature of crypto-asset markets precludes a purely domestic causal interpretation, these patterns provide a high-level external validity check for the substitution effect identified at the household level in the euro area.

Figure 5 visualizes this inverse relationship, which is particularly stark during the onset of the COVID-19 pandemic in March 2020. While this time-series evidence supplements and strengthens the paper's conclusions by providing a continuous observation of market behavior during times of uncertainty, it is important to reiterate that the paper's causal claims rest entirely on the micro-IV results presented in the previous section.

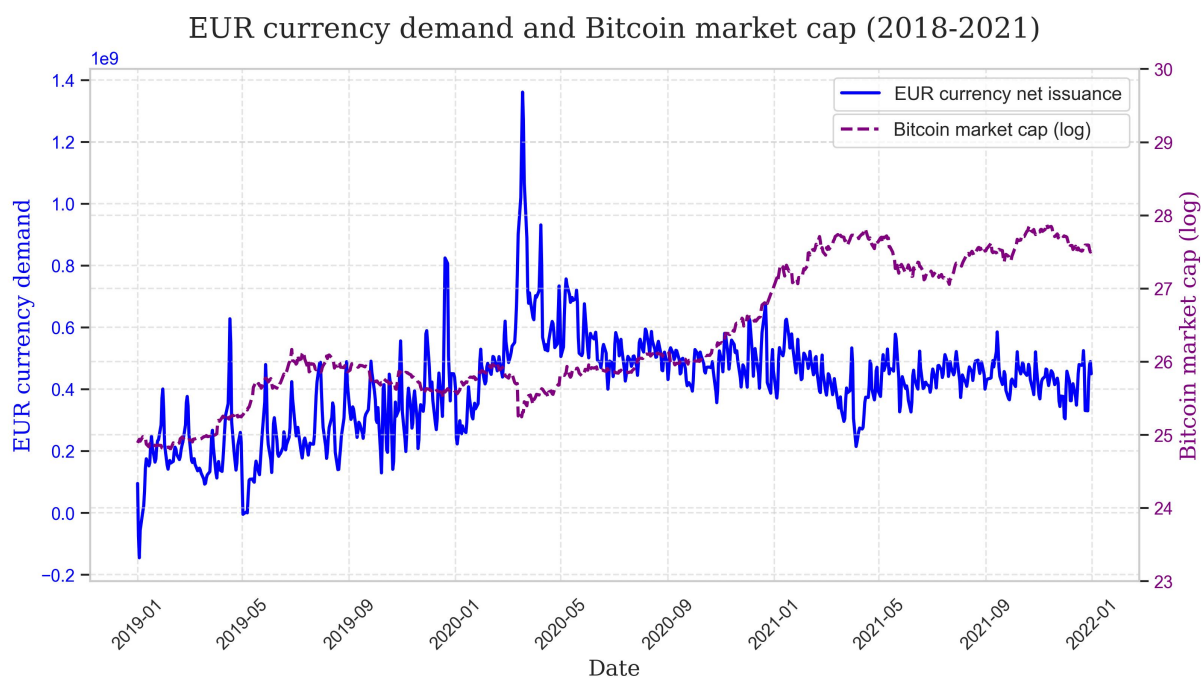


Figure 5: Aggregate EUR currency demand and Bitcoin market cap (2018–2021). The inverse relationship during the March 2020 shock mirrors the flight-to-safety dynamics observed in the micro-IV estimates.

To contextualize the findings, several qualifications are important. First, the measure for the “use for payments” is self-reported in the questionnaire and may mismeasure actual behavior at the margin. Second, the IV strategy identifies a local average treatment effect (LATE). This effect applies specifically to compliers – individuals whose cash-reserve decisions were influenced by the pandemic-era payment shocks – and should not be interpreted as a population-average effect. General-equilibrium channels and direct pandemic effects operating outside the cash-behavior channel are not identified by this approach. Furthermore, the analysis pools 17 countries with country fixed effects; cross-country heterogeneity in the treatment effect is not modeled structurally. Finally, the analysis focuses on the extensive margin (the decision to own versus not own) rather than the intensive margin (portfolio shares).

These limitations naturally point toward avenues for future research. To speak directly to the ownership-usage wedge, a promising extension would be to link the questionnaire data with the survey’s online payment diary module. This would enable a structural two-stage adoption-usage framework (such as in [Koulayev et al. \(2016\)](#) and [Nocciola and Zamora-Pérez \(2024\)](#)),

in which (i) the adoption or ownership decision is modeled using the full set of questionnaire covariates, and (ii) conditional on ownership, the choice of online payment instrument in the diary can be used to separate availability frictions from choice disutility (e.g., a crypto-specific taste parameter). Such an approach could accurately quantify how much of the observed wedge is attributable to adoption frictions versus inherent usage preferences.

The micro-causal IV evidence, contextualized by these broader market trends, informs several policy considerations. First, the baseline positive correlation challenges the view that early adopters of financial technology reject traditional paper money; in normal times, stable cash and volatile crypto appear to coexist in the portfolios of tech-savvy individuals. Second, however, the precautionary role of cash becomes first-order during periods of stress. Notably, this helps partly explain the persistent demand for euro area cash, even amid widespread financial innovation (Faella and Zamora-Pérez, 2025). This phenomenon has been coined as the ‘paradox of banknotes’ (Jiang and Shao, 2020; Shy, 2023), and has also been documented in the euro area (Zamora-Pérez, 2021; Lalouette et al., 2021). Furthermore, it points to specific features for a potential central bank digital currency (CBDC) – such as robust privacy and offline resilience – that could target and encourage actual usage for payments, rather than mere speculative ownership.

6 Conclusion

Using a 2022 euro area payment survey covering more than 40,000 adults in 17 countries, this paper provides new cross-country microeconomic evidence on how crypto-assets and cash interact in households’ portfolios and payment choices. To the best of my knowledge, this is the first study to jointly analyse crypto-asset ownership and payment usage across a large set of euro area countries. I use a selection-corrected two-stage model to assess the crypto ownership–payment wedge and an instrumental-variable strategy to revisit the relationship between owning crypto-assets and holding fiat cash reserves.

The two-stage (Heckman-type) model produces several findings. The selection equation confirms the usual demographic profile of crypto owners (younger, male, more educated, financially active) and shows that crypto owners are more likely to hold fiat cash reserves and to value

the privacy of cash, while at the same time appreciating the speed and convenience of cards. This finding implies a complementarity between cash and crypto for owners in the euro area, challenging the common view that crypto ownership belongs at a purely cashless or fully digital extreme and that early adopters reject traditional paper money. However, the outcome equation or the decision to use crypto for payments (conditional on ownership and once selection is accounted for) is driven by a different profile. Crypto payers form a smaller, cash-oriented subset of owners, for whom preferences that resemble cash (reported reference for cash and its privacy and ease of use) are strong positive correlates of usage, whereas the standard motives for favoring cards (speed, not carrying cash) are insignificant or even negatively related to paying in crypto.

These results provide an explanation for the wedge between high reported ownership and very limited payment use. While this gap is partially attributable to the two-sided nature of the payment market and limited merchant readiness, our findings reveal a deeper behavioral driver. The aggregate crypto market in the euro area is best viewed as a mixture of an investor-type owner and a niche transactional user who tries to replicate the most valued attributes of cash in digital form, so that crypto and cash are complementary for owners but not for payers.

The instrumental-variable analysis puts this complementarity into a crisis context. While the non-IV models consistently show a positive link between precautionary cash reserves and crypto ownership, the IV estimates reveal a different pattern for those whose cash behavior responds to stress. The local average treatment effect is about -0.10 , meaning that, among compliers, adopting a precautionary cash buffer reduces the probability of owning crypto by roughly ten percentage points. This sign reversal points to substitution under conditions of heightened uncertainty and indicates that the previous correlations are biased by unobserved traits such as risk attitudes or crisis expectations. A complementary analysis of macroeconomic time-series data shows a similar crisis pattern at the aggregate level: around episodes of elevated financial volatility, such as the onset of the COVID-19 pandemic, cash in circulation tends to rise while the market value of major crypto-assets falls. The time-series results are not used for identification, but they corroborate the micro evidence that, although cash and crypto can coexist in normal times, households tend to tilt towards central-bank-issued cash and away from

volatile crypto-assets when uncertainty spikes.

From a broader monetary-policy perspective, the evidence from both the selection-corrected model and the IV estimates supports the following message. In non-crisis periods, cash and crypto can coexist in household balance sheets, with crypto playing a predominantly speculative role and cash covering both transactional and precautionary functions. In periods of stress, however, the role of cash as a reliable backstop becomes important. When uncertainty rises, households appear to treat cash and crypto as substitutes and to favor the safety and immediate usability of central-bank money over privately issued, high-volatility digital assets. This helps explain the persistent demand for banknotes in the euro area despite rapid digitalisation and ongoing financial innovation, and contributes to previous discussions of the apparent “paradox” of cash, whereby the use of cash in everyday payments declines even as demand for banknotes remains strong. Furthermore, the findings suggest that crypto-assets currently fail to fulfill the classic functions of money: their role as a medium of exchange is restricted to a tiny niche (a small share of transactions of 1.4% of consumers), and their function as a store of value collapses precisely when it is needed most.

The results have implications for the regulation of crypto-assets and for the design of publicly backed digital currencies. The profile of the typical crypto owner suggests that most regulatory attention should focus on investor and consumer protection, in line with the treatment of other high-risk assets that are mainly held for speculative purposes. By contrast, the much smaller group of crypto payers is more relevant for payment-system policy: these users are not primarily seeking even faster or more convenient alternatives to existing cards and mobile payments, but rather a digital instrument that replicates core properties of cash, notably privacy, simplicity and robustness under adverse conditions. For this group of niche users, a central bank digital currency that aims at payment usage is therefore likely to be more successful if it benchmarks itself against cash along these dimensions, rather than competing only on speed or functionality.

By moving beyond a one-dimensional view of the crypto user and distinguishing between owners and payers, and accounting for precautionary cash behaviour under stress, this paper offers a perspective for understanding how crypto and cash coexist, why payment usage remains limited, and which cash-like properties matter most for the future architecture of digital money.

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