Julia Pitters & Franz Seitz

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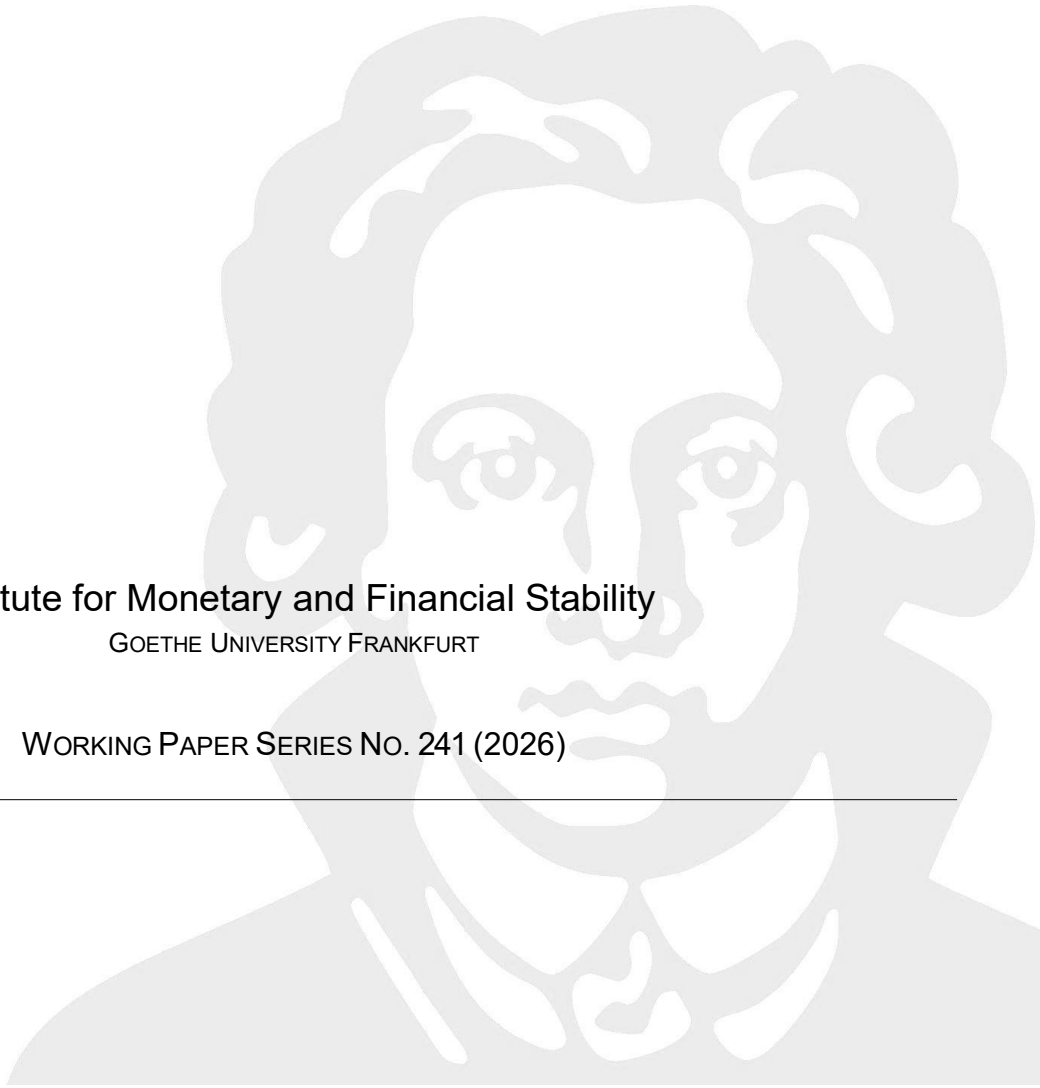

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Institute for Monetary and Financial Stability
Goethe University Frankfurt
House of Finance
Theodor-W.-Adorno-Platz 3
D-60629 Frankfurt am Main
www.imfs-frankfurt.de | info@imfs-frankfurt.de

Beyond the cost debate: A multidimensional approach to quantify the value of cash for society*

Julia Pitters[+] & Franz Seitz[#]

+) IU-Internationale Hochschule
Main Campus: Erfurt
Juri-Gagarin-Ring 152
D-99084 Erfurt
Germany
email: julia.pitters@iu.org

#) Technical University of Applied Sciences (OTH)
Amberg-Weiden
Hetzenrichter Weg 15
D-92637 Weiden
Germany
email: f.seitz@oth-aw.de

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Abstract

The decline of cash used for transaction purposes as well as the increase in total currency in circulation is usually discussed with respect to cost, efficiency and technological progress, i.e. digitalization. A large literature estimates the costs of cash production, distribution and handling. By contrast, the societal value of cash remains far less investigated and rarely quantified. This asymmetry matters because policy debates that monetize costs but leave benefits unconsidered may undervalue a payment instrument. The paper establishes a composite indicator capturing cash's value to society across five key dimensions: resilience, privacy, inclusion, cost control, and competition—supplemented by consumer surplus from seigniorage. We apply the methodology to Germany but the framework is designed to be replicable across countries and to support more balanced government and central-bank policy analysis. It combines a representative consumer survey, expert interviews, macro data and interdisciplinary workshops. In the base calibration, the aggregate value equals around 1.2 % of GDP. These results suggest that policy evaluations should incorporate cash's multifaceted benefits alongside costs. Recognizing cash's broader societal role can guide central banks and policymakers in fostering balanced payment ecosystems that preserve both innovation and public redundancy.

JEL: D12, E41, E42, E58

Keywords: cash value; public money; payment system; inclusion; privacy; resilience

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1 Introduction

Payment systems are undergoing a structural transformation. Over the past two decades, debit cards, credit cards, mobile wallets, e-commerce payments and platform-based payment solutions have expanded rapidly, bringing important benefits. Digital payments offer convenience, seamless integration into accounting systems, and suitability for remote transactions. For merchants, they can reduce queueing time and simplify reconciliation. For governments, they improve traceability and tax compliance. And for consumers, the possibility of paying without carrying cash has become a routine convenience.

Yet the expansion of digital payments has also changed the political economy of money. Cash is issued as public money and is supplied by central banks as part of the monetary infrastructure. Digital retail payments, by contrast, are largely intermediated by private providers - card schemes, banks, processors, wallet operators and technology platforms - and thus constitute private payment instruments based on private money. This does not make digital payments undesirable. It implies, however, that payment-system evolution is not a neutral technological process. It is shaped by commercial incentives and interests, network effects, data monetization, acceptance policies, pricing strategies and regulatory choices. The public debate frequently describes this transition as a movement from an inefficient legacy instrument to efficient digital alternatives.

The literature partly reflects this framing. Over the past two decades, a substantial body of research has quantified the private and social costs of retail payment instruments, including cash production, transportation, ATM infrastructure, merchant handling, bank processing and security costs. Comparative cost analyses by Humphrey, Kim & Vale (2001, 2003), Garcia-Swartz, Hahn & Layne-Farrar (2006a, b), Schmiedel, Kostova & Ruttenberg (2012), and subsequent national central-bank studies have established a mature empirical tradition in which payment instruments are evaluated primarily through resource efficiency and transaction costs. More recent studies by national central banks and payment authorities in countries such as Sweden (Segendorf & Jansson, 2012), Norway (Gresvik & Haare, 2009), Austria (Schautzer & Stix, 2019), Portugal (Banco de Portugal, 2019), and Germany (Krüger & Seitz, 2014; Knümann, Krüger & Seitz, 2025) have extended this approach, continuing to express payment-system costs as shares of GDP, retail turnover or per payment transaction. The methodological sophistication and policy visibility of this literature have made cost efficiency one of the dominant benchmarks in debates on the future of cash. Although it is difficult to draw unambiguous conclusions from these cost studies, a general pattern emerges: cash remains

the least expensive payment method per transaction, whereas debit cards are less expensive when assessed relative to turnover (see the overview in Krüger & Seitz, 2025). Further studies have adopted a comprehensive cost perspective by incorporating all relevant stakeholders into the cost assessment, including cash-in-transit providers, central banks, commercial banks, and private individuals (Kleine, Krautbauer & Weller, 2023; Schmiedel, Kostova & Ruttenberg, 2012). Ultimately, however, it is the consumer who bears these costs and should therefore be the primary focus of cost analysis (Rösl & Seitz, 2026; Knümann, Krüger & Seitz, 2025; South African Reserve Bank, 2025).

By contrast, the literature examining the value or benefits of cash remains comparatively fragmented and considerably smaller. Krüger & Seitz (2017) provide one of the most comprehensive early discussions of the benefits of cash, distinguishing microeconomic, macroeconomic, and societal dimensions in a qualitative way. More recent evidence strengthens these channels: the ECB (2024) SPACE survey reports that 62% of euro area consumers consider it important to retain cash as a payment option, 58% are concerned about privacy in digital payments, and the main perceived advantages of cash are anonymity/privacy, expenditure awareness and immediate settlement. Other existing studies mainly focus on individual dimensions of payment options in general or cash specifically rather than on an integrated welfare framework (see Shy, 2023). Research has examined the role of cash in preserving privacy and anonymity (Kahn, McAndrews & Roberds, 2005; Acquisti, Taylor & Wagman, 2016), supporting financial or payments inclusion (Demirgüç-Kunt, Klapper, Singer & Ansar, 2022), strengthening spending control (Prelec & Simester, 2001; Soman, 2003; Raghubir & Srivastava, 2008), or enhancing payment-system resilience during crises and infrastructure outages (Alvarez Argente & van Patten, 2026, Deutsche Bundesbank, 2024a, Rösl & Seitz, 2022a, b). The psychological benefits of cash to society are considered as well, though they are not quantified (Pitters, 2022).

A review of the literature from the last decade suggests that studies focusing on the costs of cash substantially outnumber those investigating its benefits, whether from a private or societal perspective (European Central Bank, 2022). While national cost studies routinely quantify payment-system effects and calculate different metrics (see the overview in Krüger & Seitz, 2025, as well as the multi-country study of Carbo-Valverde & Rodriguez-Fernandez, 2019), the societal-value literature generally emphasizes resilience, privacy, inclusion, autonomy and payment sovereignty in more qualitative or survey-based terms (Beermann, 2019; Deutsche Bundesbank, 2014; Krüger & Seitz,

2025). Consequently, policy debates may compare quantified cost estimates with benefits that remain vague and only partially monetized.

An additional, highly relevant and quantifiable aspect generating substantial economic value is seigniorage revenue. Seigniorage arises from the issuance of central bank money in the form of cash, constituting revenue for the central bank (and ultimately the government) and an opportunity cost for money holders, as cash bears no interest—these effects offset each other. Its net benefit for society can be measured by consumer surplus, a standard welfare-economic concept (see, e.g., and with respect to cash Rösl, Seitz & Tödter, 2019, Shy, 2023, ch. 2.3). In the case of a country within a monetary union, such as Germany in the euro area, the legal provisions in the Treaty on the Functioning of the Monetary Union (Art. 32) must be recognized.

This paper addresses the quantification gap between the costs and benefits of cash. It treats cash not only as a transaction technology but also as public payment infrastructure that contributes to resilience, privacy, inclusion, competition in payments markets and trust-related aspects.[1] The paper's key contribution is to quantify these dimensions. In doing so, it enables a cost-benefit-analysis and reduces the risk that policy evaluation disproportionately emphasizes measurable costs while implicitly assigning zero weight to non-quantified societal values of cash.

The paper is organized as follows. Section 2 reviews the literature on relevant cash topics, presents the conceptual framework used and describes the data and methodology. An application of this framework to the case of Germany is presented in Section 3. Section 4 summarizes the results of expert interviews and Section 5 discusses policy implications and limitations. Finally, Section 6 summarizes and concludes.

2 Relevant cash topics

2.1 Cash as resilience infrastructure

The resilience value of cash has become more salient as payment systems have become digitized and interconnected. Digital payments depend on electricity, telecommunications, authentication networks, bank systems, card schemes, cloud services and cybersecurity. Failures in any layer can

[1] The framework was first introduced at the Global Currency Forum in Antalya (Pitters, Seitz, Maroevic & von Loeper, 2026) and further discussed at the International Cash Conference of the Deutsche Bundesbank in Hanover (von Loeper, Maroevic, Pitters & Seitz, 2026).

interrupt payment capacity. Cash, by contrast, can settle transactions locally and immediately without network authorization. It is therefore an offline redundancy mechanism.

The International Monetary Fund (IMF) (2024) emphasizes that major cyber incidents affecting critical infrastructure or payment systems can generate macroeconomic spillovers through disruptions in credit provision, retail payments, and business operations. Consequently, cyberattacks on electricity grids or financial infrastructure may impair economic activity and undermine financial stability at a systemic level. Similarly, Lloyd's of London and the Cambridge Centre for Risk Studies estimate that a large-scale cyberattack targeting global payment systems could generate enormous global economic losses, highlighting the systemic vulnerability of digitally interconnected economies (Lloyd's, 2023).

Central banks increasingly frame payment resilience as part of critical infrastructure. The ECB (2024) SPACE report states that consumers should be able to make payments in efficient, safe and inclusive ways and links this to trust in the euro and to the Eurosystem retail payments and cash strategies (European Central Bank, 2024). The Bundesbank (2024a) similarly emphasizes that cash remains its core physical product and that it is working with the Eurosystem to keep cash available as a cost-effective and efficient means of payment. Several central banks even recommend to keep specific amounts of cash at home for redundancy reasons, e.g., Sveriges Riksbank (2025) or De Nederlandsche Bank (2025). The German government has even established a project on strengthening the resilience of the economic infrastructure cash in emergencies and crises which includes private and public stakeholders in the cash cycled (project BASIC, see https://bargeldversorgung.org/).

The large-scale power outage that affected Spain and Portugal in April 2025 caused substantial short-term economic disruption, particularly through its impact on household consumption and electronic payment systems. Initial concerns about a potential cyberattack intensified public and institutional attention to the vulnerability of critical infrastructure and digital financial networks during systemic crises. According to CaixaBank Research (Mestres Domènech & Vilató, 2025), household consumption expenditure in Spain declined by approximately 34% on the day of the blackout, mainly due to interruptions in card payments, cash withdrawals, and e-commerce transactions. Although part of this decline was recovered in subsequent days, the net effect still represented a reduction of around 15% in expected daily spending. CaixaBank further estimated that the blackout generated economic losses of approximately €400 million, corresponding to around 0.1 percentage points of quarterly GDP.

The resilience argument is not that cash can replace all digital payments in a prolonged systemic crisis. Rather, cash reduces the probability that a temporary digital failure becomes a social and economic breakdown. It allows households to purchase food, fuel, medicine and transport when terminals, apps or cards fail, and it also reduces panic because citizens know that a fallback exists. The value of this option is only realized during disruptions; if only normal times are considered, its importance may be overlooked.

2.2 Privacy, autonomy and the economics of payment data

Privacy is not merely a preference for secrecy. It is an economic and political attribute of exchange. Kahn, McAndrews & Roberds (2005) formalize the idea that money has privacy properties and that payment design affects information disclosure. Acquisti, Taylor & Wagman (2016) survey the economics of privacy and show that privacy has measurable welfare consequences, even when individuals have difficulty valuing it consistently. Payment data can reveal health conditions, political preferences, religious activities, travel patterns, intimate relationships and financial distress. Once recorded, these data can be stored, analyzed, sold, breached or requested by authorities. Payment data holds a particularly sensitive position among categories of personal information requiring protection. According to a representative study, respondents considered the protection of their payment data to be more important than the protection of health or address data. (Sieber & Pitters, 2025).

Digital payments can be designed with privacy safeguards (see, e.g., Summer, 2026), and regulation such as the General Data Protection Regulation limits some abuses. Nevertheless, digital payments generally create data trails. Cash is unique because it allows everyday transactions without generating a commercial record. The ECB 2024 SPACE study reports that a majority of euro area consumers are concerned about privacy when using digital payments or banking activities and identifies anonymity and privacy as the most important perceived advantage of cash (European Central Bank, 2024). This suggests that privacy is not a marginal concern held by a small minority, but a mainstream component of payment welfare.

The privacy value of cash is difficult to monetize. Willingness-to-pay measures may underestimate true value because individuals adapt to surveillance, lack information, or treat privacy as an abstract good until it is lost. Conversely, revealed preferences may overstate willingness to incur actual costs.

The first exemplary experiments of quantifying "privacy" can be found in Garcia-Swartz et al. (2006a, b), who estimate the marginal benefit (in monetary units) of "privacy" for consumers on the basis of

the food and electronics retail trade. The benefit of anonymity of cash payments and the protection of privacy is measured by the discounts granted under loyalty card programs ("loyalty card discounts"). According to the authors, these represent the implicit benefit of disclosing private information. Knümann, Krüger & Seitz (2025, section 3.2.4) go one step further to quantify this effect. They follow two approaches: in the first, they asked consumers an iterative survey question whether they would be willing to pay suggested amounts per digital payment transaction for immediately deleting their data. In the second approach, they examined a German loyalty program, whereby, in return for disclosing their data to the provider, consumers are granted discounts, rewards and/or cash payments. Using the average of the two approaches, the willingness to pay for data protection (or the cost of data disclosure) would be €0.43 per card transaction or 0.86% of card turnover.

2.3 Inclusion, access and distribution

Financial inclusion is often discussed with respect to access to bank accounts and digital finance. However, access to a bank account does not guarantee the ability to use digital payments independently. Older consumers, persons with disabilities, low-income households, migrants, tourists, minors, people with limited digital literacy and those without reliable connectivity may face barriers. The World Bank Global Findex work shows that financial access remains uneven globally, and even in advanced economies, account ownership does not eliminate payment exclusion (Demirgüç-Kunt, Klapper, Singer & Ansar, 2022).

The ECB 2024 SPACE survey reports that for almost one in ten euros respondents needed assistance when making digital payments and that access to cash had slightly deteriorated in perceived terms (European Central Bank, 2024). Deutsche Bundesbank (2024a) finds that 15% of German respondents considered it fairly difficult or very difficult to get to an ATM or bank counter, compared with 6% in 2021. These numbers show that access is not a binary variable. A payment system can be technically available while being practically burdensome for some citizens.

Cash supports financial, and especially payments inclusion because it is simple, tangible and independent of bank-account status at the point of transaction. In the MIT study on Central Bank Digital Currency (CBDC) and financial inclusion (see Narula, Swartz & Frizzo-Barker, 2023), for example, cash was the benchmark case that the CBDC needed to match to have an impact on the payments market. Cash is also important for people managing debt or tight budgets, as it makes spending visible and finite. Excluding cash can impose costs on precisely those groups with least bargaining power. Such distributional costs are often cushioned in aggregate efficiency metrics. With

respect to this distributional aspect, Felt, Hayashi, Stavins & Welte (2021) find that credit card transactions are effectively cross-subsidized by lower-cost payment instruments such as debit cards and cash, while the largest cost component for consumers stems from the non-transparent pass-through of payment-instrument costs into retail prices. Finally, the pricing structures of payment instruments lead to regressive distributional effects (see also Shabgard & Asensio, 2023).

2.4 Behavioral economics: budgeting, salience and the pain of paying

The behavioral literature provides a mechanism for the cost-control function of cash. According to Thaler's concept of mental accounting, individuals mentally categorize and evaluate financial transactions in separate cognitive accounts rather than treating money as fully interchangeable. Because cashless payments, particularly credit card transactions, delay and abstract the actual outflow of money, they reduce the immediate "pain of paying." As a result, consumers perceive purchases as less financially salient and are more likely to spend more compared to cash payments. This buffering effect helps explain why credit card use is often associated with higher expenditures (Thaler, 1985; Pitters & Kastlunger, 2020; Pitters, 2022).[2]

In a comprehensive meta-analysis Schomburgk, Belli, & Hoffmann (2024) show that consumers tend to spend more when using cashless payment methods, although this effect appears to be diminishing over time as consumers increasingly adapt to such payment technologies. Prelec & Simester (2001) find that consumers were willing to pay more when using credit cards than when paying cash, consistent with the notion that card payments reduce the immediate salience of spending. Soman (2003) similarly argues that payment mechanisms affect consumption through memory, coupling and spending pain. Raghubir & Srivastava (2008) present evidence that less transparent payment forms can increase spending by weakening the perceived outflow of money.

This literature does not imply that cash is always superior. Digital budgeting tools can help consumers track expenses, and some consumers manage money effectively without cash. However, the evidence suggests that payment form changes behavior. For households facing liquidity constraints, debt risk or impulse-control problems, cash can function as a self-control technology. Moreover, for financially vulnerable groups in particular, the increasing ease of online payments—especially through "buy now, pay later" services—may contribute to higher levels of over-indebtedness, thereby exacerbating existing social inequalities (Brandl, Hengsbach & Moreno, 2024).

[2] Sometimes even the type of goods purchased differs; see Eschelbach (2017).

On the other hand, cash may play an important role in facilitating spontaneous and socially embedded economic interactions such as charitable giving, tipping, neighbourhood assistance, and transactions at communal and regional markets. Unlike digital payments, cash enables immediate, tangible, and low-friction transfers of small amounts, which are often driven by social norms, habits and situational impulses rather than planned consumption. Research on prosocial spending shows that physical money can strengthen the salience and emotional visibility of donations in face-to-face settings, particularly in contexts such as street fundraising, tipping jars, church collections, or local community events (Soetevent, 2011; Danieli, 2026). In addition, studies on the transition toward cashless societies indicate that the decline of cash reduces opportunities for spontaneous micro-donations and informal reciprocal exchange because digital payments require greater technological effort, formalization, or prior registration (Ansvar Insurance, 2021; Global Banking & Finance Review, 2020)

Empirical evidence also suggests that certain forms of charitable and communal giving decline when physical cash disappears from public spaces. For example, the removal of cash donations at the Roman Baths in the United Kingdom led to a dramatic fall in visitor contributions despite the availability of contactless alternatives, indicating that the symbolic and behavioral functions of physical cash are not fully replicated digitally (New York Post, 2024). Similarly, tipping (see, e.g., Stadelmann & Trütsch, 2026) and local market transactions often rely on small-denomination cash payments and social immediacy, both of which may weaken in fully digital payment environments. Consequently, a cashless society could reduce participation in informal and community-oriented local economic practices that depend on spontaneous, low-barrier monetary exchange.

2.5 Competition, market power and the public outside option

Several studies suggest that cash plays an important competitive and disciplinary role in payment markets by constraining the pricing power of digital payment providers. In two-sided payment markets, cash constitutes an outside option that limits the ability of card networks and payment intermediaries to increase interchange and merchant fees excessively (Hung, Serfes & Zhang, 2025; Bolt & Chakravorti, 2008; Rochet & Tirole, 2006). Empirical and regulatory research further indicates that where cash usage declines and card networks become more dominant, payment providers may gain greater market power, potentially resulting in higher merchant and consumer fees and reduced competitive pressure (European Commission, 2020; Leinonen, 2011).

Moreover, several studies argue that interchange fees can create cross-subsidization effects and increase merchants' dependence on dominant card schemes. Leinonen (2011) shows that high card fees may indirectly subsidize cash infrastructure while simultaneously limiting merchants' bargaining power. Similarly, market concentration in digital payment systems has been associated with increasing fee structures and lock-in effects, especially in markets characterized by strong network externalities (Hunt, Serfes & Zhang, 2024). Consequently, if cash were to disappear entirely, the absence of a universally accepted public payment alternative could weaken competitive constraints on private payment providers and potentially lead to higher transaction fees for merchants and consumers over time.[3]

2.6 Conceptual framework

Based on the discussed five topics in section 2 this paper defines the societal value (benefit) of cash as the sum of five functional value dimensions, normalized by GDP. In addition, consumer surplus will be added.

$$\mathrm{CV} = \frac{\sum_{i=1}^{6} v_i}{Y},$$

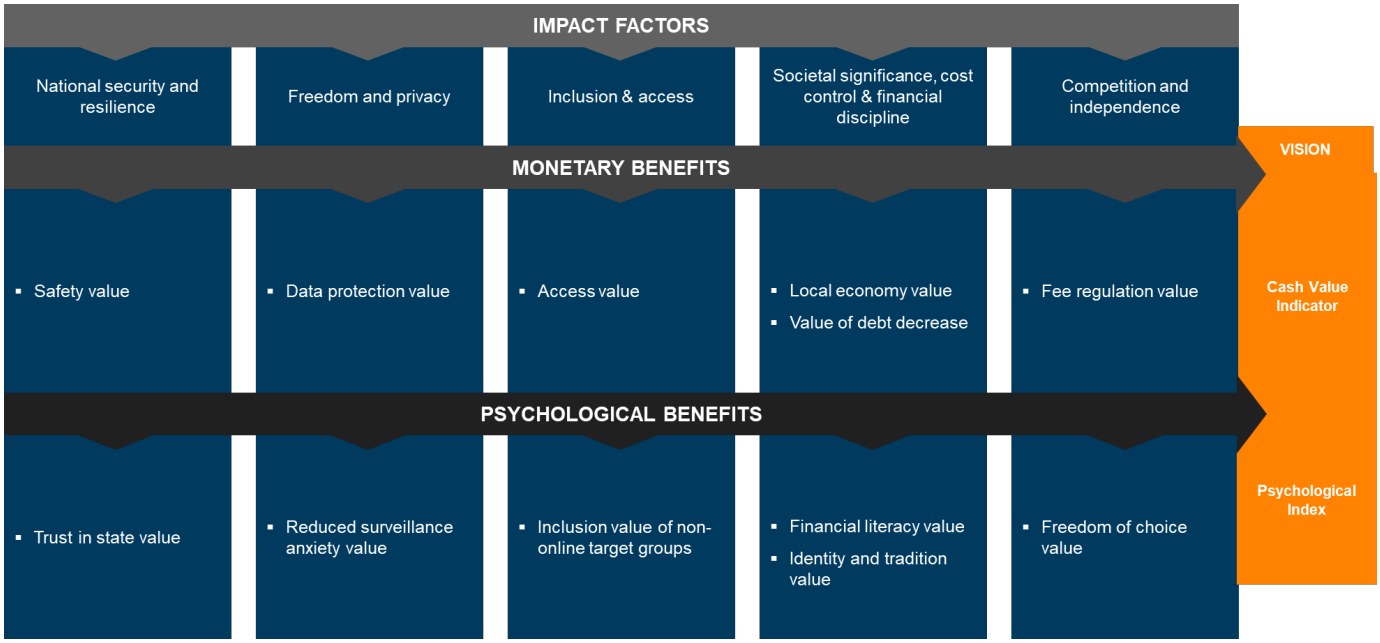
where cv denotes the cash value indicator, Y is nominal GDP and v_i are the five (i=1,…,5) different individual benefits of cash supplemented by consumer surplus (i_6), all combined in an additive way. The formula represents a quantitative indicator model translating behavioral data, system-level metrics and economic scaling factors into macroeconomic value, both in absolute terms and relative to GDP. The five dimensions correspond to the discussed impact factors national security and resilience (i_1); freedom and privacy (i_2); inclusion and access (i_3); societal significance, cost control and financial discipline (i_4); and competition and independence (i_5).

The framework separates monetary (economic) benefits from psychological benefits. Resilience, for instance, increases trust. If trust in a functioning payment system is lost, this psychological impact factor might affect the motivation to invest in or to support the state (Kirchler, Hölzl & Wahl, 2008). With regard to privacy, the psychological impact factor of reducing surveillance anxiety may be important for individuals, but on a macro level may decrease health costs for society. The inclusion value of elderly people into settings that they would not frequent when being forced to pay digital

[3] One of the reasons put forward by the ECB to consider launching a digital Euro is exactly its function to reduce fees (see Cipollone, 2026). If the digital Euro would be introduced and widely used, it could, in principle, also exert this disciplinary function.

may also decrease loneliness. Additionally, the traditional value of cash and the impact on financial literacy are primarily psychological but become monetary when children`s understanding of handling money is decreasing. Finally, the pure option of having the choice between online and offline payment opportunities may reduce reactance and thus prevent people from revolting against the system. These factors are also depicted in table 1 but will be addressed in more detail in a forthcoming paper.

Table 1: Framework to quantify the value of cash for society



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3 Data and methodology

3.1 Research design

The empirical design is triangulated. It combines three sources: a representative consumer survey in Germany; eleven expert interviews across relevant sectors; and secondary data together with literature analysis. The structure is designed to bridge micro, meso and macro levels.

The consumer survey forms the basis of behavioral inputs: willingness to pay for privacy, perceived crisis readiness, preference for cash as a budgeting tool, expected spending under a cashless counterfactual, and expectations regarding digital-payment fees. Expert interviews supply system-level validation from sectors such as retail, banking, cash-in-transit, public administration, cybersecurity, consumer protection, social services and payment technology. Literature review and macro data supply external benchmarks.

3.2 German macroeconomic anchors and survey method

Germany is a suitable pilot country because cash usage remains significant while digital payments are growing. The German Retail Institute EHI reports that in 2025, around one half of point-of-sale transactions in Germany were paid in cash, down from about 60% in 2022, while payment cards (including mobile payments) accounted for 48% of transactions (EHI, 2026). In value terms, cash accounted for around one third of expenditures and cards for 65% (see also Deutsche Bundesbank, 2024a).

3.2.1 Methodology

This section presents the calculation of the societal value of cash in Germany based on a representative online survey conducted in October 2025 among the German population aged 16 years and older (N = 2,006).[4] The average length of answering the questionnaire was 13 minutes and comprised more topics than presented in the following section. Only those results that are relevant to the calculation of the cash value indicator are discussed in this paper. The analysis combines descriptive survey evidence with macroeconomic calculations in order to quantify a multidimensional cash value. It combines five survey-based societal dimensions of cash plus one macroeconomic dimension (consumer surplus). Depending on the construct measured, the questionnaire employed different response formats, including nominal categories (e.g., cash vs. cashless), Likert-type scales (e.g., 1 = very likely to 5 = not at all likely), ranking tasks, predefined value ranges (e.g., €0–100; €101–500), and slider-based inputs for precise numerical assessments (e.g., 0–100%, lower or higher). For slider items, respondents were required to actively move the slider before proceeding to the next question. Unless otherwise stated, all analyses reported are based on the unweighted dataset. Counterfactual scenarios were introduced selectively rather than throughout the questionnaire. They were used only for items that required respondents to evaluate situations in which cash was unavailable as a payment method. Given that cash remains a well-established and familiar means of payment, imagining its absence in specific situations is considered a straightforward cognitive task.

[4] The empirical analyses are based on a cross-sectional survey conducted via computer-assisted web interviewing (CAWI). Data were collected by the professional online panel provider Horizoom in October 2025. The target population comprised individuals aged 16 years and older residing in Germany. A quota sample (N = 2,006) was drawn to be representative of the German population with respect to age, gender, and federal state (Bundesland). Online quota sampling represents a pragmatic approach to obtaining a population-like sample by aligning key demographic characteristics with those of the target population. While acknowledging that certain groups, such as individuals with limited internet access or very old people, may be underrepresented, this approach provides a reasonable approximation of population characteristics and is widely accepted for survey research where probability sampling is not feasible. The complete questionnaire is available from the authors upon request.

Restricting counterfactual framing to these items therefore minimizes unnecessary complexity while enabling the measurement of responses to a clearly defined hypothetical condition. The core anchors are 83.5 million inhabitants, 71.5 million adults above 16 years, and nominal GDP of €4.5 trillion (Destatis, 2025).

3.3 Empirical results and cash value estimates

As mentioned, each value component is calculated relative to GDP. For survey items with categorical responses, midpoint coding is applied. For open-ended upper categories, conservative caps are used. For example, the emergency-cash category "more than €5,000" is coded as €5,000. For skewed distributions, especially privacy willingness to pay, the median is preferred for the baseline compared to the mean. This follows a conservative approach and avoids allowing a small number of high stated valuations to dominate the estimate.

3.3.1 Resilience and National Security "safety value"

Resilience is measured by questions concerning blackout preparedness, precautionary cash reserves, and banking-crisis scenarios. Respondents were asked: "How much cash would you recommend others to keep at home for emergencies (e.g., in case of a blackout)?" and "How much cash do you keep at home or in a safe for emergencies?" As we expected substantial variation in cash reserves, response categories with unequal intervals were used.

A total of 73% considered a cash reserve either very or somewhat important in case of a blackout, while 87% regarded cash as helpful during payment disruptions. Respondents report holding emergency cash at home or in a safe. The self-reported emergency cash holdings have a mean of €764 (SD = 1,259) and a median of €300, 17% of the respondents answered to keep nothing, while only 4% recommended others to keep no cash reserve at home. Respondents state that this reserve would cover on average 8.4 days. To avoid overstating the stock value of all cash held at home, the calculation normalises each respondent's reserve to a three-day crisis horizon as suggested by de Nederlandsche Bank (2025a, b). This produces a mean three-day reserve of €272.86 per adult. Scaled to 71.5 million adults, the resilience value therefore is €19.51 billion or 0.44% of GDP.[5] This is more conservative than using the full reported cash stock, which would exceed 1% of GDP, and more survey-grounded than relying only on external emergency-kit recommendations. It captures the

[5] Calculating with the Median of €300 would yield 0.47% of GDP.

macroeconomic value of maintaining sufficient offline liquidity to feel safe and avoid transaction breakdown during short disruptions.

We conduct several robustness checks to validate our calculations:

First, there are some central banks which recommend specific amounts of cash to be held for emergency reasons (see De Nederlandsche Bank, 2025a, b; Sveriges Riksbank, 2025). The Dutch central bank recommends €70 per adult and €30 per child, both for 3 days, whereas the respective amounts are 1,000 Swedish kronor per private household (about 95 €) for a week. Using these figures for Germany would yield 0.12% of GDP (Dutch benchmark) or 0.09% of GDP (Swedish benchmark). Second, instead of using the actual cash holding for emergency, we could also work with the recommended amounts which we also asked in the survey and which are significantly higher than the actual amounts.[6] With a mean of around €1,000, we get a safety value of 1.54% of GDP.

Consequently, our estimate of just over 0.4% of GDP is obviously a very conservative one. On top of that, since we're focusing on a 3-day period.

3.3.2 Privacy and data protection

Privacy preferences are measured through the item: “How important is privacy, protection of personal data, and anonymity when paying?” using a five-point Likert scale. 77% regarded payment privacy as important, and 71% feared that cashless systems could lead to government or commercial surveillance.

The direct monetary valuation of privacy was elicited through the slider question: “How much would you be willing to pay per transaction so that your data is not stored or immediately deleted?” The slider ranged from €0 to €10 in Euro cent increments. The privacy component uses respondents’ willingness to pay per digital transaction so that transaction data are not stored or are immediately deleted (see also Knümann, Krüger & Seitz, 2025, ch. 3.2.4). The distribution is strongly right-skewed: mean = €1.35 (SD = 2.41); median = €0.20. Knümann, Krüger & Seitz (2025) estimate of €0.60 generated by a survey with given amount categories is three times higher than our median estimate. This suggests using the median in the baseline specification to correct for extreme outliers.

[6] The exact question reads as: "How much cash would you recommend others to keep at home for emergencies (e.g., in case of a blackout)?

Based on (latest available) Deutsche Bundesbank (2024) calculations, annual cash transactions are estimated at 16.2 billion, based on 235 cash transactions per adult and 71.5 million adults. Therefore, the privacy value is equal to €3.36bn or 0.075% of GDP.[7]

For two reasons, this is a lower-bound estimate. First, stated willingness to pay may understate the true value of privacy because individuals often find it difficult to evaluate future data misuse, profiling or surveillance risks ex ante. Second, our estimates are lower than in Knümann, Krüger & Seitz (2025). Their figure would yield a privacy value of 0.22% of GDP.

3.3.3 Inclusion and access

The inclusion dimension captures the accessibility of payment systems independent of digital infrastructure and bank account ownership. Our operational concept for that is deliberately narrow. It quantifies only the account-fee burden that unbanked adults avoid by being able to use cash. In the survey, 1.15% of respondents report having no bank account.[8] The mean annual account fee among valid responses is around €64.[9]

Given the 71.5 million adults and the low number of unbanked in Germany, this implies an inclusion value of €0.053bn or 0.001% of GDP.

Again, this seems to be a very conservative estimate. It excludes identification costs, onboarding costs, device and connectivity costs, digital-skills costs, dependence on third parties, and the broader welfare value of autonomous access to money.

3.3.4 Cost control: debt-prevention value

The survey includes a counterfactual question asking respondents how much more or less they would spend if all expenses had to be paid digitally. Participants again used a slider from -100% to +100%. The mean response across all respondents is +5.64%, significantly different from zero, $p < .001$. However, the effect is concentrated among younger respondents as the following table shows. Only the "younger" population, aged below 50, exhibit a significant increase

[7] Due to a different definition of the retail sector (compared to the Deutsche Bundesbank), the German Retail Institute (2026) estimates a total number of retail transactions (cash and cashless) in 2025 of 20 bn. With a cash share of 50.5%, cash transactions amount to 10.1 bn. Thus, the privacy value would be (given our median estimate of €0.20) €2 bn = 0.045% of GDP.

[8] According to the World Bank (see Ventura, 2021), the unbanked share in Germany in 2021 was 1%.

[9] Based on their own Bundesbank survey, Knümann, Krüger & Seitz (2025) get an average account fee of €60, close to our figure. The "Stiftung Warentest" analyzes 175 banks and calculates a higher value of around €120 for 2024, see https://www.tagesschau.de/wirtschaft/verbraucher/girokonten-gebuehren-kontowechsel-100.html.

Table 2: Over-spending, age and cash

Age group	N	Mean expected spending change	Test
Under 50	962	+11.31%	t = 10.39, p < .001
50+	1,044	+0.42%	n.s., p>0.1
Difference		10.90%	Welch t = 7.55, p < .001

Source: own table based on survey results.

To include this channel in the aggregate value calculation, a deliberately narrow external debt anchor is used. Destatis (Statistisches Bundesamt, 2025) reports that in 2024, 29% of approximately 577,400 persons seeking debt counselling in Germany had debts to online and mail-order retailers. The average outstanding amount owed to these retailers was €644. Thus, total online-retail debt of debt-counselling clients amounts to €107.8 million.

Since the survey effect is concentrated among respondents below 50, and Destatis reports that younger people are particularly affected by online-retail debt, we allocate 75% of this observed online-retail debt exposure to the under-50 population. This is a conservative modelling assumption rather than a directly reported Destatis statistic. Applying the survey-based under-50 spending effect of +11.31% (see table 2) implies a debt increase of €9.46 million or 0.00021% of GDP which we use as the debt-prevention value of cash.

This figure captures only debt-counselling cases and only the subset of debts owed to online and mail-order retailers. It excludes credit-card debt, overdrafts, buy-now-pay-later balances not yet in counselling statistics, informal arrears, and broader welfare losses from financial stress. The estimate should therefore be interpreted not as the full value of cash for household financial discipline, but as a lower-bound monetisation of one observable debt channel.[10]

3.3.5 Local economy value

Participants were initially presented with 12 payment categories that were expected to involve relatively high levels of cash usage (e.g., tips, cleaning services, and public transportation). For each category, they have to indicate whether they predominantly use cash or cashless payment methods. In a second step, only those categories in which a majority of respondents reported primarily paying with cash were retained for further analysis. Within these selected categories, only respondents who

[10] Our survey also reveals that younger people predominantly use "Buy Now, Pay Later" and would therefore probably spend more without cash.

themselves predominantly used cash were presented with a counterfactual scenario and asked to imagine a situation in which cash was no longer accepted as a payment method.

The local-economy component thus estimates the spending that would be lost in cash-intensive sectors if cash were no longer accepted. Its value uses as ingredients the sector turnover, the respective cash share and the expected spending reduction.

The local-economy dimension captures the extent to which cash supports socially embedded, informal, and community-oriented economic activities that may decline in a fully cashless environment. For each category, the estimated reduction in spending in a hypothetical cashless environment is multiplied by the respective share of respondents preferring cash payments. The resulting percentages are then applied to sector-specific expenditure baselines derived from official statistics, industry reports, and available surveys.

Table 3: Local economy values across different sectors

Sector	**Cash share**	**Mean spending reduction if cash unavailable**	**Macro proxy**	**Value, €bn**
Bar visits	48.0%	21.27%	€12.22bn	**1.23**
Tips	81.0%	25.08%	€2.89bn	**0.59**
Neighbour/acquaintance services	66.0%	20.20%	€112bn	**14.8**
Monetary gifts	82.0%	19.03%	€2.31bn	**0.36**
Donations	35.0%	28.84%	€12.4bn	**1.26**
Entrance fees	50.0%	17.21%	€0.92bn	**0.08**
Body/beauty care	50.0%	13.64%	€23.35bn	**1.63**
Total	—	—	—	**19.95**

Source: own table based on survey.

The calculation includes seven sectors (see table 3): monetary gifts, tips, paid services from neighbours or acquaintances, body and beauty care, entrance fees, bar visits, and donations. The methodological rationale is that cash facilitates spontaneous, low-threshold, and socially embedded transactions that may not be fully replicated by digital payment systems (Seyfang & Longhurst, 2013; Schneider & Enste, 2000).

For monetary gifts, the baseline was reconstructed from German Christmas gift expenditures (NielsenIQ/GfK, 2024; YouGov Deutschland, 2024). Given total gift spending of €18.1 billion and the share of consumers giving monetary gifts (51%) as well as the estimated average number of recipients (four persons), we get a baseline of approximately €2.31 billion. Applying the survey-based cash preference (82%) and the expected spending decline in a cashless environment (19%) yields a cash-dependent value of approximately €0.36 billion.

For tips in gastronomy, the baseline was estimated using total gastronomy turnover of €64.3 billion and an effective average tipping rate of 4.5%, resulting in total annual tips of approximately €2.89 billion (Lightspeed Commerce Inc., 2025). This amount by the share preferring cash payments for tips (81%) and the expected reduction in tipping without cash (25%) yields €0.59 billion.

The largest component originates from paid services from neighbours and acquaintances, representing informal and local service activities. The baseline was derived from the estimated German shadow economy of about €450 billion in 2025 (Schneider, 2026), assuming conservatively that 25% reflects household-related and local service activities.[11] This results in a baseline of €112 billion. Applying the corresponding survey values — 66% cash preference and 20% expected reduction in spending without cash — yields €14.8 bn.

For body and beauty care, the baseline uses German household consumption expenditure (€2,300 billion) and the corresponding CPI expenditure weight of 10.15%, resulting in sector expenditures of approximately €23.35 billion (Destatis, Deutsche Bundesbank, 2026). Applying the survey-based coefficients of cash use (50%) and expenditure reduction (14%) yields €1.63 billion.

Entrance fees were approximated by German cinema box-office revenues of €0.924 billion because no comprehensive national aggregate for all entrance-fee categories exists (Filmförderungsanstalt, 2026). With cash use of 50% and expenditure reduction of 17%, we get a value of €0.08 bn.

[11] The measure of the shadow economy used by Schneider (2026) refers to the hidden economy, i.e., activities that clearly fall in the production boundary of the System of National Accounts and are legal, but are deliberately concealed from public authorities to avoid the payment of social security contributions, to avoid having to meet certain legal standards such as minimum wages, maximum hours, safety or health standards or to avoid complying with certain administrative procedures. This is clearly the kind of household and neighbourhood activities we are focusing on. Nevertheless, the shadow economy estimates are more comprehensive and a complete separation from undeclared economic activity is not possible given the available data.

For bar visits, our estimates are based on total gastronomy turnover (see above) and the estimated share of drink-oriented gastronomy (19%),[12] resulting in expenditures of €12.22 billion. Applying the corresponding survey coefficients (cash use: 48%; expenditure reduction: 21%) yields €1.23 billion.

Finally, the donations category is based on annual charitable donations in Germany amounting to €12.4 billion according to the German Central Institute for Social Issues (DZI, 2026). Multiplying this amount by the survey-based cash preference (35%) and the expected reduction in donations in a cashless environment (29%) results in a value of €1.26 billion.

Aggregating all seven dimensions results in a total local-economy value of cash of approximately €19.95 billion or 0.45% of GDP. The results suggest that cash continues to support forms of economic interaction characterized by spontaneity, social proximity, low formalization, and community embeddedness. At the same time, several limitations must be acknowledged. First, the assumed 25% share of household and local services within the shadow economy is not directly observable and therefore represents a scenario-based assumption. Second, categories such as monetary gifts and tips are not systematically included in national accounts and consequently require indirect survey-based inference. The estimates should therefore be interpreted with caution and as indicative valuation corridors rather than precise point estimates. Third, the results represent a snapshot in time, as potential adaptation and substitution effects are neglected. They should therefore be interpreted as turnover at risk rather than as realized losses.

3.3.6 Independence and fee-control value

The independence component measures cash as a public outside option that disciplines digital payment providers. The survey asks respondents how fees of digital payment providers would change if cash were abolished, using again a slider tool. Responses show a clearly positive significant and relatively large expected fee effect (see table 4).

The preferred calculation uses the median expected fee increase of 20% and applies it to a conservative baseline merchant fee of 1% of card-payment turnover.[13] Deutsche Bundesbank payment statistics report that the total German card-payment market in 2024 was €577 billion in annual turnover. Therefore, the fee-control value is €1.154bn which equals 0.026% of GDP.

[12] According to Destatis, the share of expenditures for drinks in total expenditures for drinks and food is around 19%, see https://www.destatis.de/EN/Themes/Society-Environment/Income-Consumption-Living-Conditions/Consumption-Expenditure/current-food-ngt.html.

[13] Ego, Knümann & Korella (2026) find that the girocard costs merchants in Germany around 1%, international debit cards 2.2% and credit card2 2.5% of turnover.

Table 4: Cash and card fees

Statistic	Value
Mean expected fee change	+23.31% (SD = 34,30)
Median expected fee change	+20.00%
One-sample test	$t(2005) = 30.44$, $p < .001$
Effect size	Cohen's d = 0.68

Source: own table based on survey.

An alternative to the baseline calculations would be to use the fees the respondents mentioned in our survey. Participants spend on average €59.73 for their credit card fees and €47.81 for debit card fees. However: 97 % of the German population have a debit card but only 52% a credit card (Knümann, Krüger & Seitz, 2025). Consequently, the average sum of card fees is €77.44. A 20% expected fee increase (€15.49) would mean a new level of €92.93. In total (adult population), the increase is equal to €1.108 billion or 0.025% of GDP.

Knümann et al. (2025) find that in 2023 debit card fees were €9.75 (€0.07 per transaction), whereas credit card fees were much higher, €26.87 (€0.65 per transaction). With 138 debit card transactions and 41 credit card transactions in 2024 (Deutsche Bundesbank, 2024b) and given debit and credit card ownership (see above), this yields a "value of cash as market corrective" of only €325 million per year or 0.007% GDP, i.e. a much lower value than our estimate.

Taken the average of the three approaches gives an estimate of around 0.019% of GDP.

3.3.7 Consumer surplus based on seigniorage

The seigniorage-based value of cash is treated separately from the survey-based dimensions because due to the complexity of the topic it cannot be meaningfully derived from individual attitudes or behavioral responses. Seigniorage represents a revenue for the central bank from the issuance of central bank money in the form of cash but also a cost for cash holders in the form of foregone interest (opportunity costs). Therefore, economic analyses usually do not take gross seigniorage into account when looking at the economy as a whole, but concentrate on consumer surplus. Consumer surplus is the difference between the money services cash delivers and the amount, cash holders have to pay,

i.e. their opportunity costs (or, equivalently, the seigniorage revenues). Technically speaking, it is the area under the cash demand curve less seigniorage revenue.[14]

For 2025, the seigniorage value attributable to Germany has to be estimated on the basis of the institutional framework of the Eurosystem and the Treaty on the Functioning of the European Union (TFEU). Unlike the other dimensions of the cash value, seigniorage is calculated exclusively using macroeconomic and central bank data rather than survey responses.

The basis of the calculations are the total cumulative net issues of euro banknotes by the Eurosystem at the end of 2025, amounting to approximately €1.62 trillion (see https://data.ecb.europa.eu/). Germany's capital share in the ECB's capital was 26.6% in 2025 (https://www.ecb.europa.eu/ecb/orga/capital/html/index.en.html), i.e. around €430 bn are allocated to Germany which is the correct basis for seigniorage calculation of an individual euro area country according to the regulations in the TFEU. The annual average long-term interest rate in Germany, measured by the yield on 10-year German government bonds, amounted to 2.61% (see https://statistiken.bundesbank.de/statistiken-de). Applying the standard opportunity-cost approach to seigniorage yields an estimate of approximately €11.25 billion in 2025, corresponding to roughly 0.25% of German GDP.

To estimate consumer surplus, a cash demand function is needed (see, e.g., Rösl, Seitz & Tödter, 2019; Shy, 2023, ch. 2.3). This function quite naturally is non-linear. We base our calculations on a money-in-the utility-function approach as in Rösl, Seitz & Tödter (2019).[15] Given the assumptions about interest rates and the banknote base (see above), we derive a consumer surplus of €11.17 bn or around 0.25% of GDP. An estimate with the 3-month Euribor (average of 2025 of 2.18%) which is close to the ECB policy rate (i. e. the deposit rate) would yield €9.34 bn or 0.21% of GDP. As we do not know how much of the monetary services are already captured by our five dimensions considered, our final results (see Table 5) differentiate between those with and without consumer surplus.

[14] Nevertheless, one might argue that the costs for consumers due to money production are there anyway as they have to pay with cash or cashless alternatives. The latter, however, imply that seigniorage revenues accrue to private, and sometimes (see Visa and Mastercard) foreign, firms. In the case of cash, they accrue to a domestic public entity. Moreover, the costs of cash production for the central bank are low compared to seigniorage so that a net profit for the central bank and thus for the country remains.

[15] The cash demand function used is quite standard. Cash demand increases with private consumption and decreases with opportunity costs proxied by an interest rate, see Rösl, Seitz & Tödter (2019, 7).

3.4 Final monetary cash value calculation

Total cash-related (private) costs of consumers, the banking system (together with the Deutsche Bundesbank) and retailers amount to approximately 0.45% of GDP (see Knümann, Krüger & Seitz, 2025; Krüger & Seitz, 2014; Ego, Knümann & Korella, 2026; Kleine, Krautbauer & Weller, 2013).[16] As there is uncertainty in calculating the value of cash, we compare this figure with a conservative guess of the benefits of cash in Table 5 by assuming a low value in almost all cases. Against this, the estimated consumer surplus value attributable to Germany amounts 0.21% of GDP. It therefore offsets more than 45% of total cash costs, reducing the net societal cost of cash to around 0.25% of GDP. When compared with the estimated total societal value of cash of approximately 1.20% of GDP, the resulting gross value-cost ratio exceeds 2:1, while the net value-cost ratio including seigniorage rises to approximately 2.5:1. This indicates that, even when the full infrastructure costs of cash are factored in, the estimated societal benefits of cash exceed its estimated costs.

Table 5: Cash value quantification, Germany 2025

Domain	Impact factor	% GDP
Resilience	Safety value	0.44
Privacy	Privacy value	0.07
Inclusion	Access value	0.001
Cost control/societal significance	a) Debt decrease value	0.0002
	b) Local economy value	0.45
Independence	Fee control value	0.02
Total gross value excluding consumer surplus		**0.98**
Consumer surplus	Consumer surplus value	0.21
Total gross value including consumer surplus		**1.19**
Costs	Society's total cost	0.45
Total net value including consumer surplus and costs		**0.74**

Source: own table.

[16] This calculation assumes that the figures derived for different years are still true for 2025, i.e. it over-estimates the costs in 2025.

4. Expert Interviews on the Societal Value of Cash

4.1 Methodological Approach

To complement the representative survey and the macroeconomic calculations, semi-structured expert interviews were conducted to analyze institutional, systemic and critical perspectives on the societal value of cash. The interviews explored the dimensions of resilience, privacy, financial inclusion, spending control, competition, seigniorage, and local economy effects (see appendix) and thus also acted as a kind of robustness check to the survey results. Based on a semi-structured guideline, experts were contacted via e-mail invitation and personal teams-interviews were conducted in March 2025. They lasted between 30 and 45 minutes. Key representatives of the following sectors were included[17]:

Table 6: Participating institutions

Institution	**Perspective**
Deutsche Bundesbank	Central bank / cash research
EU Commission	Regulation / European perspective
German Banking Association	Commercial bank perspective
EHI Retail Institute	Retailers perspective / Payment acceptance
GS1	Standardization / Trading systems
Central Association of Bakeries	SME / firm's perspective
Prosegur	Cash logistics
Security League	Cybersecurity
Consumer Protection Association	Consumer perspective
Denaria	Cash initiative / Spain/EU
Bargeld zählt ("Cash Counts")	Civil society perspective

Source: own table.

The interview material is analyzed using qualitative content analysis following Mayring (2015). Within this framework, we establish a deductive category system based on the dimensions of the derived cash value system. The coding process focuses on identifying recurring themes, areas of broad expert consensus, conflict lines, and plausible valuation ranges.

[17] While the sample covers the important stakeholder groups relevant to the research question, additional perspectives from sectors like insurance companies or private payment service providers are not included because participation could not be secured within the project timeframe.

4.2 Main findings

4.2.1 Resilience

The strongest consensus emerged regarding the resilience function of cash. All experts described cash as the only immediately functioning payment method during blackouts, cyberattacks, or payment-system failures. Typical statements of the experts were:

"There are many situations where cash is the only possibility."

"When the blackout happens, terminals no longer work."

Several experts referred to regional crises such as floods, local power outages, and terminal failures rather than nationwide collapse scenarios. The interviews therefore strongly support the interpretation of cash as a public resilience infrastructure independent of everyday payment preferences.

4.2.2 Privacy and Data Protection

Privacy and anonymity represented the second strongest consensus category. Experts emphasized that digital payments inevitably create transaction traces, platform dependencies, and profiling opportunities. ("Digital payments generate data traces.")

At the same time, many interviewees emphasized the difficulties in trying to exactly quantify the value of privacy. ("The value of anonymity is difficult to monetize.") Suggested values ranged from approximately €0.20 per transaction to €2–3 for more sensitive contexts, while isolated experts mentioned situational values of up to €10 for highly privacy-sensitive transactions. The interviews therefore support the use of valuation corridors rather than single point estimates.

4.2.3 Financial Inclusion

Financial inclusion was primarily discussed in terms of practical barriers to digital participation. Experts stressed that digital payments require not only bank accounts, but also devices, internet access, electricity, digital literacy, and social support. ("You need a device – but under the bridge there is no power outlet.")

Interviewees repeatedly identified older persons, financially vulnerable groups, and individuals with low digital skills as particularly exposed to exclusion risks in a fully cashless environment. Most expert estimates regarding unbanked populations in Germany ranged between 1% and 4%.

4.2.4 Spending Control and Financial Discipline

A similarly high degree of consensus emerged regarding expenditure control. Experts repeatedly referred to the behavioral-economic "pain of paying" effect and argued that physical cash increases spending salience and budget discipline. ("If you have to put the banknotes on the table, you think twice." "It hurts more to spend cash.")

Several interviewees emphasized that these effects are particularly relevant for financially vulnerable consumers and for the financial education of children and adolescents.

4.2.5 Competition and Independence

Most experts argued that cash acts as a competitive outside option in payment markets. According to several interviewees, the disappearance of cash would likely strengthen the market power of digital payment providers and increase transaction fees. ("As long as cash exists, it acts as a corrective." "The more payment options exist, the lower the prices.")

Some experts explicitly mentioned fee increases of around 20% as a plausible scenario in the absence of cash, although a minority argued that existing regulation and the girocard system (i.e., the existence of a national card system) could partly constrain such developments.

4.2.6 Local Economy and Seigniorage

The local economy aspect was treated cautiously by several interviewees. Although most experts acknowledged the role of cash in small informal transactions and neighbourhood services, others warned to use arguments that are associated with the shadow economy as a central normative justification for cash. That might be related to the potential illegal component of such activities.

Seigniorage, by contrast, was regarded as highly relevant but analytically difficult to estimate within qualitative interviews. Most experts did not provide precise quantitative estimates, supporting the methodological decision to calculate seigniorage exclusively using central-bank, financial and macroeconomic data.

4.2.7 Consensus and Value Corridors

Across interviews, the strongest consensus emerged for resilience, privacy, and expenditure control. Experts repeatedly emphasized that the societal value of cash lies primarily in its systemic functions rather than in transaction efficiency alone.

When interviewees were asked to estimate the overall societal value of cash relative to GDP, most plausible estimates clustered within a corridor between approximately 0.5% and 1.5% of GDP. Our calculations in chapter 3 estimates are at the upper end of these estimates, even though we adopted a conservative approach. Figures significantly higher than this, of up to 5% appeared only as isolated upper-bound scenarios and were generally interpreted as speculative outliers rather than realistic central estimates.

The interviews also revealed indicative willingness-to-pay ranges for maintaining cash infrastructure. Suggested amounts ranged from approximately €10 per month to around €100 annually, while isolated responses mentioned values between €300 and €500 per year as upper-bound estimates.

Overall, the expert interviews strongly support the multidimensional interpretation of cash as a public infrastructure that contributes to resilience, privacy, financial inclusion, expenditure control, and competitive balance within payment systems.

5 Discussion

5.1 What the German results mean

The German pilot estimates a base cash value of around 1.2 % of GDP including consumer surplus. This is not a claim that cash increases GDP mechanically by that amount. Rather, it is an annualized welfare-equivalent valuation of public functions delivered by cash. The result is comparable to the way cost studies express resource or private costs as a share of GDP.

The largest dimensions are resilience and the local-economy value. This finding is plausible because both are system-level properties. Even infrequent crises can justify substantial precautionary value if the avoided harm is large. An analogy might be the existence of a fire brigade. Supporting and maintaining local economic activities is a value in itself for human coexistence. The final numbers we assumed are estimated on a very conservative level given the lack of precise spending numbers for each payment situation. The next dimensions – privacy, inclusion and competition - are smaller individually but collectively important. They represent ongoing social functions that operate in normal times, not only during crises.

Consumer surplus is the net benefit accruing to money holders from seigniorage, i.e. central bank money creation. Therefore, it should be included in the calculations of the value of cash even it is nearly impossible to include questions on this issue in surveys. However, the calculation of consumer

surplus for a country within the euro area with a common currency is complicated by the fact that the exact circulation of cash in an individual country is difficult to capture. We relied on the legal rules in the TFEU.

Thus, including consumer surplus can reduce comparability across countries within and outside the Monetary Union. The paper recommends dual reporting. The headline should present both cash value including and excluding consumer surplus. Costs can then be compared to both estimates. If the objective is broad welfare accounting, consumer surplus necessarily is part of it. If the objective is payment-system functionality, the non-seigniorage measure is perhaps the more preferable concept.

5.2 Policy implications for central banks

For central banks, the paper suggests three policy implications. First, cash strategies should include the value or benefits of cash, not only access monitoring and cost containment. Central banks already collect data on payment behavior while a systematic analysis of measurable factor for estimating the value of cash is missing. However, this has to be the basis for a systematic cost-benefit-analysis of cash.

Second, central banks should communicate the public-good functions of cash more actively. Institutional neutrality does not require silence about the benefits of public money, i.e. cash. If private payment providers market digital convenience aggressively while central banks only provide technical assurances, public understanding may become distorted and a lever-playing field is lacking. A factual, evidence-based communication strategy can defend cash without opposing digital innovation.

Third, policy should protect both access and acceptance. Access without acceptance is insufficient; acceptance without access is also insufficient. The Deutsche Bundesbank (2024a, 2026) reports that cash remains accepted for a high share of physical payments, but access has become more difficult for a growing share of respondents. The ECB similarly emphasizes the importance of ensuring continued access to public money (European Central Bank, 2024). A cash policy must therefore monitor closely ATM density, withdrawal fees, merchant acceptance and public-sector acceptance.

5.3 Limitations

Like any analytical framework, our framework also has limitations. First, several parameters require stated-preference survey data. Such data are vulnerable to hypothetical bias. Second, quantifying public-good functions requires assumptions about counterfactuals. Third, some dimensions may

overlap. Fourth, the Germany pilot uses calibrated parameters where raw microdata are not included in the uploaded materials. The estimates should therefore be interpreted as a structured pilot, not as a final official statistic.

Yet, these limitations do not invalidate the approach. All cost-benefit analysis requires counterfactual assumptions. The advantage of the present framework is transparency: each assumption is visible, replaceable and testable. Future research can improve the framework with better microdata, administrative data on outages, merchant fee data, natural experiments and cross-country variation.

6 Summary, Conclusion, Outlook

The debate about cash has been shaped by an asymmetry. Costs are counted; values are mentioned and described, but not quantified. This paper provides a framework for measuring the value side of the ledger. It conceptualizes cash as public payment infrastructure and quantifies its contribution to resilience, privacy, inclusion, societal significance/cost control, competition, and consumer surplus generated by seigniorage. We find that the estimated benefits of cash for society outweigh the estimated costs.

The policy implication is not that cash should dominate the payment system. Rather, based on welfare-theoretical considerations as well as empirical and practical facts, the paper advocates for a payment mix consisting of digital payment methods and, necessarily, cash as well. A welfare-maximizing payment system should preserve both innovation and public redundancy. Cash is more than a transaction instrument. It is a privacy technology, an inclusion device, a competition constraint, a trust anchor and an emergency infrastructure. If these functions are allowed to erode because they are hard to quantify, society may discover their value, and finally the value of cash, only after they have vanished.

The development of the present framework for quantifying the value of cash for society is guided by the principle commonly attributed to Albert Einstein: “Everything should be made as simple as possible, but not simpler.” The objective of this paper was not to construct an overly complex theoretical model with limited practical applicability, nor to reduce the phenomenon to simplistic transaction-cost calculations that ignore the broader societal functions of cash. Instead, the German pilot study aimed to identify a common denominator that is sufficiently robust to capture the multidimensional value of cash while remaining simple enough to be applied consistently across countries and institutional contexts.

The framework presented therefore constitutes the first step toward a global and standardized approach to measuring the value of cash from a country's or society's perspective. The current study focused primarily on the development of a monetary cash value expressed as a percentage of GDP. It integrates resilience, privacy, financial inclusion, expenditure control, local economy, competition effects, and consumer surplus into a single macro-social valuation framework. However, the long-term vision extends beyond purely monetary calculations. Our idea was to develop a framework that can easily be adapted by any country, be it in the developed, transformation or developing world.

Future research will complement the monetary value with a second pillar: a standardized psychological cash perception index designed to measure the perceived societal importance of cash across the five core impact dimensions. While the monetary value indicator captures measurable economic effects, the psychological index aims to quantify collective attitudes, trust, perceived vulnerability, and behavioural dependence on cash within society. Together, these two building blocks are intended to provide a comprehensive barometer of the societal importance of cash.

The broader objective is that central banks and public institutions worldwide apply these two approaches by harmonized representative survey methodologies combined with country-specific macroeconomic data. Over time, this would enable the creation of a global dashboard through which participating institutions could compare their value estimates internationally, identify drivers and vulnerable dimensions within their payment ecosystems, and monitor changes over time. For example, countries experiencing cyberattacks, blackouts, banking crises, inflation shocks, or rapid digitalization may observe significant shifts in specific dimensions such as resilience, privacy concerns, or expenditure control.

Importantly, both pillars are designed as compound and modular frameworks. This means that additional dimensions can be integrated in future research without undermining comparability. The framework therefore remains adaptable to technological, social, and geopolitical developments that may alter the societal role of cash in the future.

The German pilot study should consequently be understood as the starting point of a broader international research agenda. While the present paper establishes the conceptual and empirical foundation of quantifying economically the value of cash, future studies will focus on refining the psychological part, improving international comparability, testing stability over time and between countries, and expanding the framework across different monetary systems and cultural contexts.

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Appendix

Expert interview guideline *(questions are selected according to the specific knowledge of the expert)*

National security and resilience

1. In your view, how likely is it that your country will experience a natural disaster in the near future?

2. How likely do you believe a nationwide blackout could occur due to technical failures?

3. How likely do you believe a blackout could occur due to political actions or geopolitical tensions?

4. How important do you consider cash to be as a backup payment method in the event of a blackout or natural disaster?

5. How much cash do you think households should keep on hand to be prepared for such situations?

6. Are you aware of any estimates of the economic cost of a blackout if cash were not available as a payment alternative?

Seigniorage

7. Do you have information or estimates on the contribution of seigniorage (from issuing cash) to your country`s GDP?

Freedom and privacy

8. How important is privacy and data protection to you when choosing between cash and digital payment methods?

9. What would you estimate people are willing to pay per transaction for additional data protection or privacy features?

10. Do you know of any figures on the amount of fraud associated with digital payment methods?

11. Do you know of any figures on the amount of fraud associated specifically with cash transactions?

Financial Inclusion & Digital Exclusion

12. What is your estimate of how many people in your country do not have a bank account?

13. What do you think are the average costs (devices, software, service fees, consultation) for accessing and using online banking?

14. What percentage of the population do you think feels excluded from digital-only environments (e.g., restaurants, mobility services, online travel bookings) where cash is not accepted?

15. What economic effects do you believe this exclusion could have on overall consumption levels?

Over indebtedness & Spending Behavior

16. How significant do you consider the impact of “Buy Now, Pay Later” (BNPL) offers on consumer over indebtedness?

17. In your opinion, does the availability of cash reduce or increase the likelihood that people spend beyond their financial means?

18. Do you have insights into how cash usage influences over indebtedness levels? Are there any relevant data points, for example from the COVID-19 period?

Competition and independence

Approximately how much money/cash do you estimate is used in your country for the following types of expenditures? Do have any reliable numbers?

19. Supermarket shopping

20. Visits to bars

21. Restaurant visits

22. Tips

23. Paid services from neighbors or acquaintances

24. Monetary gifts

25. Tradespeople, gardening, or repair services

26. Cleaning or household services

27. Public transportation

28. Donations (e.g., churches, charities)

29. Entrance fees (events, museums, etc.)

30. Body and beauty care (hairdressers, cosmetics, wellness, etc.)

31. Other: Are there any other fields of relevance?

Card Payments & Fees

32. What are the average fees charged for card payments in your country?

33. How do you think these fees would change if cash was no longer available as a payment option?

Shadow Economy

34. What percentage of your country`s GDP do you estimate is generated in the shadow economy?

35. How much of this activity, in your opinion, relies on cash payments?

Open comments

Anything else to consider?

36. In your view, what is the societal value of cash when all factors are considered? Accounting for both costs and benefits, what percentage of your country`s GDP would you attribute to it?

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