



**SCHOOL OF
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**Cash against the current
A qualitative case study on cash persistence in Germany**

By

James-Filip Nyström - jamesfilipn@gmail.com
Isak Peurell - is2432pe-s@student.lu.se

ABSTRACT

Cash persists at a large scale in Germany despite having the necessary conditions to displace cash as has been observed in other high-income countries. This thesis examines why cash persists at the levels it has by applying network effects theory to the German payment market through a qualitative single case study. Two hypotheses are derived from the theory and are then tested through secondary data using pattern matching. Hypothesis one analyses the role of Germany's fragmented banking sector and its role in producing weak sponsorship incentives for digital payment adoption. Hypothesis two analyses German consumer preferences for cash's irreplaceable attributes and its implications on cash persistence. Evidence is found to be broadly consistent with both hypotheses. Germany's fragmented banking sector has failed to resolve the coordination problem of attracting enough merchants and consumers necessary for digital alternatives to displace cash. German consumers are found to display anomalously strong preferences for cash's unique attributes and that these preferences are demonstrated in economic behaviour which exceeds rational cost calculation. The two mechanisms reinforce one another, producing a situation where the conditions necessary for displacing cash with digital alternatives is prolonged by both weak incentives from banks and German preference for cash's attributes.

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List of Abbreviations

BIS - Bank for international settlements

DB - Deutsche Bundesbank

EA - Eurozone Average

ECB - European Central Bank

EU - European Union

FPEP - Foundation for the Promotion of Efficient Payments

GBIC - German Banking Industry Committee

GDP - Gross domestic product

GDPPC - Gross domestic product per capita

HHI - Herfindahl-Hirschman index

NET - Network effects theory

POS - Point of sale

P2P - Peer to Peer

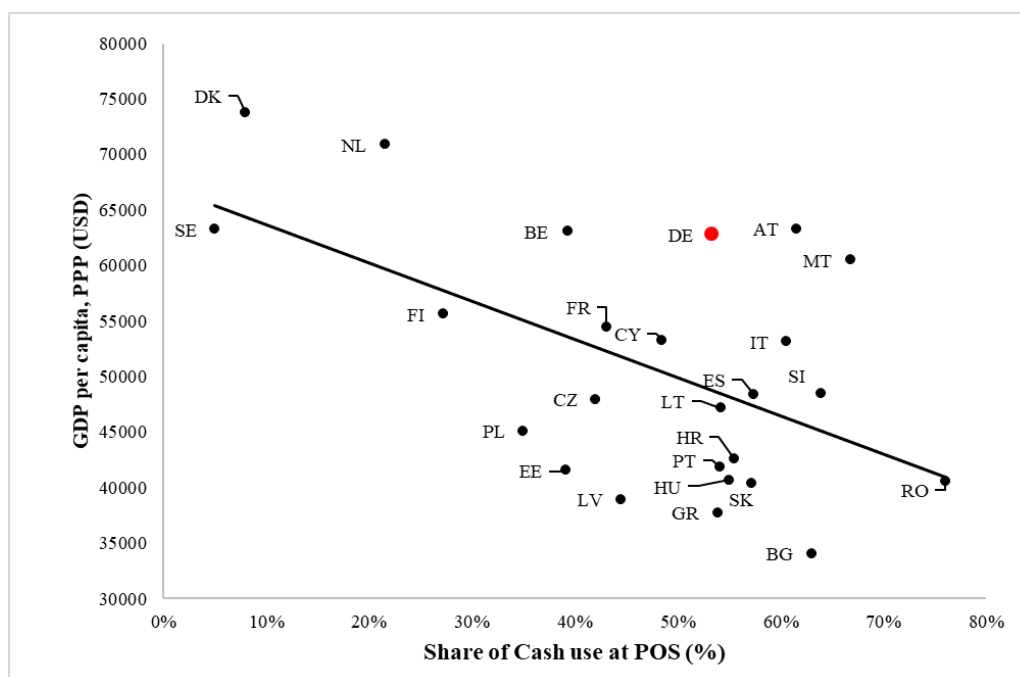
SME - Small and Medium-sized Enterprises

1. Introduction

1.1 Research Problem

Cash has been the dominant means of payment in Europe for centuries, with the introduction of digital payment systems, this hegemony has been challenged. Digital payment instruments such as debit cards, credit cards and mobile phone payments are rapidly displacing cash as the default tool for transactions in most high-income countries. In countries such as the Netherlands and Sweden, cash has ceased to be used by large parts of the population. This development impacts consumers, merchants, banks and policymakers alike, making studies related to this transition an object of both practical and academic interest.

Germany, however, has not undergone this transition. Despite levels of wealth, degree of digitalisation, demographic distribution and financial inclusion comparable to other high-income countries. Cash accounts for roughly half of point of sale (POS) transactions, marking Germany as an outlier when compared to its GDP per capita. Figure 1.1 below illustrates that the German level of cash use is quite unlike that of other high-income countries in the European Union. Understanding why Germany bucks the trend and resists the transition remains inadequately explained in current academic literature.



*Figure 1.1 Cash use at POS compared to GDP per capita**Source: ECB SPACE 2024; Eurostat tec00114, 2024.*

Several facets of academic literature are directly relevant to the question on cash persistence in Germany. Relevant literature is largely divided along lines of demand, focusing on consumer preferences and supply, focusing on banking structure and are rarely discussed together.

On the demand side, Murawski et al., (2021) observe through means of a Delphi study of experts that high cash acceptance is the primary driver of German cash use. Cultural background and behavioural entrenchment (inertia) around making smaller payments in cash is noted as secondary driving factors. Bagnall et al., (2014), document cash use across seven high income countries finding Germany maintains higher cash use even for larger transactions when compared. They also find lower merchant acceptance of digital payment instruments as a driver of cash use, with Germany having the highest rate of non-acceptance in the Eurozone.

On the supply side, Milne, (2006) argues that a link exists between the degree of fragmentation in a bank sector and its adoption of new payment methods. He argues that less fragmented banking sectors with fewer institutions sharing the payment network is conducive to stronger incentives to promote and price penetrate new methods of payment (sponsorship). Milne argues that the higher rates of digital adoption in Scandinavian countries is tied to the lesser degree of fragmentation in Scandinavian banks. Arango-Arango & Suárez-Ariza, (2019) finds that increased digital payment infrastructure and subsequent adoption significantly reduces the demand for cash. Rochet & Tirole, (2003) formalize the implications of fragmented incentives to sponsor new technology or products. They illustrate the so-called chicken and egg problem as a coordination problem of needing to attract both merchants and consumers simultaneously to a new product as a central problem for any new product to overcome. Milne, (2006) and Katz & Shapiro, (1994) observes a firm's (banks) willingness to provide sponsorship diminishing in relation to how many firms share the market, reducing the potential profit of an increased market size since more firms share the rewards.

Despite the depth of findings on both sides, studies on German consumer preferences do not connect findings to structural characteristics of the German banking sector and studies of the banking sector do not examine how those characteristics shape consumer behaviour. Only one located source makes the implication of both side's interaction affecting cash persistence. Bartelt & Wittig, (2023) argue that the interaction between Germany's fragmented banking sector and consumer preferences is reinforcing, but they fall short of developing a framework with the capacity to investigate this interaction's implication on cash persistence. By combining both demand side preferences and supply side constraints under a unified theoretical framework of network effects theory (NET), this study operates within this gap. The subsequent analysis is directed by the following research question.

Research Question

How may weak sponsorship of digital payment systems and consumer preferences explain the persistence of cash in Germany in the context of network effects?

1.2 Aim and Scope

The thesis aims to explain the persistence of cash in Germany and its resistance to displacement by applying mechanisms from NET on aspects of both the supply and demand side of the German payment market. In order to achieve this aim, the thesis is guided by three objectives.

- **(1)** A theoretical framework will be employed by applying NET to the German payment market, treating Cash as a product whose value is contingent on others using it (network good) and deriving hypotheses drawn from NET.
- **(2)** Data and findings from relevant secondary data will be collected, including cross-national surveys, Deutsche Bundesbank (DB) reports, commissioned research and peer reviewed academic literature.
- **(3)** The theoretical framework will be applied to the material through a structured analytical method, capable of assessing each hypothesis and evaluating interaction between both structural and behavioural explanations of cash persistence.

1.2.1 Contribution to discussion

The study contributes to existing literature in two regards. It provides, to the authors' knowledge, the first application of NET to cash specifically, rather than to other forms of fiat money or fiat money in general. It also incorporates potential explanations pertaining to both structural elements (supply side) as well as behavioural elements (demand side) under one theoretical framework. Thereby addressing the gap of both largely being treated separately. Beyond its academic contribution the study could be relevant to policymakers and other institutions or individuals seeking increased understanding of factors contributing to cash persistence and resistance to digital adoption in Germany.

1.2.2 Delimitations

This study uses Germany as the single case of study, focusing on depth rather than breadth. Cross-country comparisons are used as illustrative measures to contextualize Germany rather than as the focus of the study. The analysis is restricted to 1990 and onwards, as digital alternatives began to rise as meaningful challengers to cash during this period (Bartelt & Wittig, 2023). Developments prior to widespread availability of digital payment methods are not directly relevant to the research question. The theoretical framework is limited solely to NET for its capacity to capture both supply and demand side mechanisms within one singular framework. The study relies exclusively on secondary sources as the research question can, in the authors' opinion, be adequately addressed through existing survey data, reports and academic literature without the collection of primary data. Causality or generalisability beyond the specific case of Germany can not and will not be made.

1.3 Thesis outline

The subsequent sections of this thesis are structured as follows: Section 2 presents the literature review, covering the German banking sector, German consumer payment preferences and the broader German payment market. Section 3 then follows with the introduction of our theoretical framework and literature connected to NET. The section concludes with the theoretical approach

and presenting the two hypotheses that guide the analysis. Section 4 describes the data and source material, including a table of the most utilised sources and their potential limitations, before an assessment of reliability and validity concludes the section. Section 5 explains the methodology, covering the research design and the thesis's analytical strategy before methodological limitations conclude. The empirical analysis is conducted in Section 6, where pattern matching is applied against the evidence to assess each hypothesis' consistency. Section 6 concludes with a discussion on the findings. Section 7 concludes the thesis as a whole, in which key results are summarised and suggestions for directions in future research are offered.

2. Literature review

This section discusses the previous research related to the persistence of cash in Germany. It begins with assessing the literature on the structural composition and nature of the financial sector in Germany. This is followed by a review of the previous research on German consumer payment preferences. To conclude, the section examines Bartelt and Wittig's (2023) work on payment markets in which the financial sector and consumer preferences are both presented as drivers of its distinctiveness.

2.1 The German Banking Structure

Bülbül et al., (2014) characterise the German banking sector as operating under a “three pillar system”, a system in which there are three groups of banks, different in their institutional structure and geographical scope. The privately owned and profit-oriented credit institutions make up the first pillar. The heterogeneous grouping includes everything from the ‘big banks’ to foreign banks operating in Germany, with big banks historically making up the largest share. The second pillar is made up by what is most commonly known as the savings bank group. The unifying element of all banks in the category is their lack of private ownership, as they are owned by public institutions. The third and final pillar is made up by the co-operative banks (co-op banks). Similar to the savings banks, the co-op banks are not profit oriented. Bülbül et al describes the competition between the three pillars as greatly limited by the two non-commercial pillars being limited in their scope of operations, limiting their ability to expand. The savings banks are geographically limited by law since their mandate disallows competition between

different regions. Co-op banks, while not limited in geographical scope by law, also typically refrain from competition between regions.

In a report by the German council of economic experts the German banking sector is described as one of the most fragmented and decentralised banking sectors in Europe. This can be observed through the average amount of assets held by any one German bank being very low in comparison to other banks in Europe, (German Council of Economic Experts, 2025).

The Herfindahl-Hirschman Index (HHI) can be used to illustrate this decentralisation.

HHI is an index of the average amount of assets held by a firm compared to the sector as a whole, the German banking sector stands out as being highly fragmented by this measure (figure 2.1).

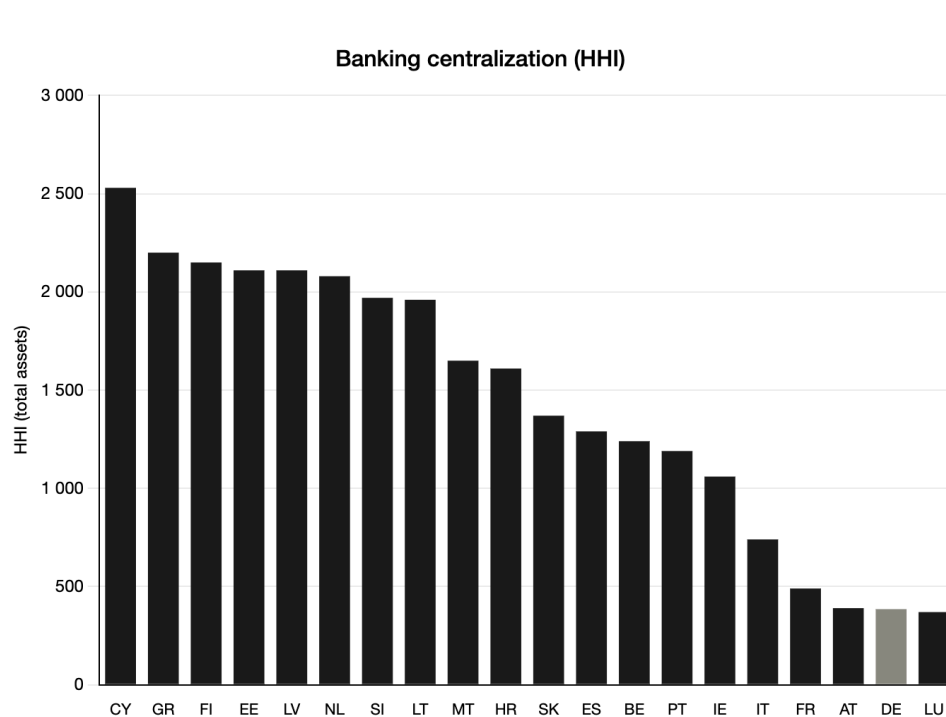


Figure 2.1 Bank sector centralisation by country in the Eurozone as measured by the Herfindahl-Hirschman index

Source: ECB data portal, 2024, own calculations

Burghof & Gischer, (2024) emphasise that this fragmentation plays a role in inhibiting the sector as a whole. The fragmentation is seen as an inhibitor of the sector achieving the size it could if it

was more centralised. The lack of size for individual institutions, inherent to a fragmented banking sector is emphasised by Milne, (2006) as something that could inhibit the ability of banks to afford to invest in innovation, especially in the payment system. This lack of innovation is tied to the demand for cash and its persistence by Arango-Arango and Suárez-Ariza, (2019). They assert that the adoption of payment system innovation results in increased digital infrastructure, significantly and negatively impacting the demand for cash.

2.2 German Consumer Payment Preferences

Murawski et al., (2021) investigate German payment preferences by means of a Delphi study of experts who were asked what the primary reason for holding cash was in Germany.

The consensus was that the primary driver is acceptance, with cash representing the only instrument one can rely on being accepted at all POS. The undefined cultural background response and behavioural patterns around small purchases was also highlighted. The experts found Germans having become accustomed to using cash for payments of lesser value

Bagnall et al., (2014) compare consumer payment behaviour across seven high income countries including Germany. Their main findings were that cash usage differs greatly across countries but remains widely available especially for smaller transactions. They find that cash use is strongly correlated with transaction size, consumer demographics, and merchant card acceptance and where the transaction takes place. Older respondents used cash to a greater extent than younger respondents.

Germany has the lowest rate of acceptance of cashless payment instruments with 16% of German respondents in ECB SPACE, (2024) on payment behaviour reporting cashless instruments not being accepted at POS at least once in the last month. Well above the 12% Eurozone average (EA). Cash use declines with transaction size across all surveyed countries, but Germany maintains higher cash use than average even at higher transaction values (ECB, 2024).

Meyer & Teppa, (2024) study payment preferences across the six largest euro area economies (Belgium, Germany, Italy, France, Spain, and the Netherlands) using ECB survey data from 2020 and 2022. They find that a majority of consumers prefer to use only one instrument with cash and contactless cards being the two dominant instruments. They further find that Germany stands out with the highest number of respondents who only pay with cash and the lowest number of

respondents paying only with cards. They find that those who perceive limited acceptance of an instrument in their local area are roughly 15% more likely to prefer cash as their only payment instrument. They use a variety of variables to test this finding which remains robust even after controlling for demographics and socioeconomic factors. A high degree of inertia is also observed as most consumers maintained their payment behaviour between 2020 and 2022. Perhaps most interesting is the fact that the COVID-19 pandemic coinciding with the surveys did not significantly alter results. They argue that inertia maintains the resistance to switching instruments despite exogenous shocks such as the pandemic. Although this contention is contested by the DB in the case of COVID-19 (Payment Behaviour in Germany 2023, 2023). They further find cash preference to be linked to factors such as older age and lower income with digital alternatives being favoured more by younger cohorts and those who earn more.

2.3 The German Payment Market

Bartelt and Wittig, (2023) Is a practitioner oriented report describing the German payment market with a structural overview synthesizing secondary data to compare Germany against EA. They describe that the fragmented three-pillar banking system drives both competitive intensity and structurally low fee levels. They argue that the reason for the low fees in the payment market is due to the three pillar's joint governance of the German Banking Industry Committee (GBIC). It is through the GBIC that all three pillars jointly own and manage the Girocard. The Girocard payment system is entirely domestic and exists primarily to provide German consumers with the ability to make low-fee debit card payments, as opposed to other profit-oriented payment systems. Bartelt and Wittig claim that the system prioritised these low transaction fees over innovation as the system had yet to gain online payment capabilities by the time they wrote the report, since then online payments are possible. Despite the subsequent introduction of online features, Bartelt and Wittig's argument for the non profit-oriented pillars of the GBIC inhibiting innovation seems to still stand within reason. They offer further insight into the fragmentation in the sector by illustrating that the three pillars not only hold different profit incentives but also different central institutions, IT providers and associations. They identify the unique setup of the sector as a principal source of market complexity. They further note that Germany, compared to the next five biggest Eurozone economies, has the smallest share of total assets held by its five largest credit institutions at 32%. They use this finding as an indicator of the German banking

system being unusually fragmented and decentralised. This fragmentation and decentralisation is explained by the authors as a result of three root causes. These causes are described as consumer preferences for control, the three pillar banking sector and standards unique to Germany which the authors describe as a result of consumer preferences and the banking structure.

Bartelt and Wittig, (2023) also draw on survey data from the DB to document preferences amongst German consumers. They document strong preferences for perceived spending control and avoiding accidental debt. Reporting that 63% of surveyed respondents expressed a preference for cards immediately charged to their bank account. They also document that 99% held a debit card while only 54% held a credit card of which only 15% had revolving credit. Using this finding to justify the observed debt aversion and desire for control which consumers perceive debit cards satisfy better. They also note that German consumers on average held around €100 in cash in 2021 and that this number had remained stable for over a decade. While they do not explicitly refer to this as inertia, the stability of German cash holdings could be construed as inertia.

Bartelt and Wittig, (2023) hint at the interaction between consumers and the banking sector. However, they fail to develop or use a theoretical framework capable of investigating the interactions between the banking structure and payment preferences further.

3 Theoretical Framework

3.1 Introducing Network Effects

Katz & Shapiro, (1985) developed *network effects theory* (NET). The core mechanism within NET is referred to as *network externalities*. Network externalities are conditions under which the value of certain products increase as more users adopt and use it. The products that increase in value as others also use them are considered *network goods* in NET. Products such as telephones, social media platforms or fax-machines can serve as examples of network goods as the value of the product is tied to the extent of its user base. The value of a telephone for example would be severely dampened if there were no other telephones to call and a fax-machine would not be of

much use if it has no other machines to fax (Jullien et al., 2021). The theory contends that as one agent joins, the network's value increases, which attracts more agents, further increasing its value. Katz & Shapiro, (1994) refer to this as *positive feedback effects*. This makes the market of goods operating under such conditions markedly different from ordinary markets. These markets are more dependent on dynamics such as coordination and expectations rather than pricing alone.

3.2 Payments instruments as Network Goods

Extensive research has been conducted on payment instruments as forms of network goods. Payment cards are given as an example of a network good in the foundational text on NET by Katz and Shapiro, (1985). Following this precedent, fiat money, cryptocurrency and electronic payment cards have also all been documented as network goods (Rochet and Tirole, 2003; Gowrisankaran & Stavins, 2002; Van Hove, 2004). These texts all mention cash in passing, mainly as the payment instrument that they compare digital payment instruments to.

Glasner, (2020) and Stenkula, (2003) study if fiat money qualifies as a network good, both reach the conclusion that it does. They argue that because fiat money is not backed by any commodity and its value depends entirely on the amount of agents using it, it exhibits clear network externalities (Glasner, 2020; Stenkula, 2003). Essentially they echo the proverb, money is only good if you can spend it.

Cash may be qualified as a network good on two grounds. As perhaps the most well-known form of fiat money its value is derived from others also using it. Second, cash also competes alongside digital payment instruments in a two-sided market where its value to consumers depends on how many merchants accept it and vice versa. Both of these properties place cash within the definition of network goods by Katz and Shapiro.

3.3 The Two-Sided Market

Rochet and Tirole (2003) formalised the concept of *two-sided markets* using payment instruments as a central example throughout their paper. A two-sided market is described as

having two distinct groups who depend on each other for a shared system to hold value.

In payment markets these two groups are detailed by the authors as consumers and merchants.

A central problem for two-sided markets is described as the *chicken and egg problem* (Rochet and Tirole (2003) and Stavins, (2001). They use the example of payment cards to illustrate this problem, without consumers using and demanding its acceptance no merchant has reason to accept the card, and without merchant acceptance no consumer has reason to carry it. This echoes the arguments of Glasner, (2020) and Stenkula, (2003) as they find that payment instruments are only attractive to consumers to the extent that merchants accept it, and only in a merchant's interest if enough consumers carry and demand it. They thereby echo the sentiment of value deriving from other users and their acceptance of the product.

Rochet and Tirole describe the chicken and egg problem of attracting both merchants and consumers as the central coordination problem in two-sided markets. A potential challenger to any already established system (incumbent) must solve the problem of attracting both consumers and merchants before either group sees sufficient value to justify adoption. An incumbent system by contrast already has both sides coordinated around it. The problem of coordination any challenger faces therefore does not need to be resolved. This works in favour of the incumbent system and against any challenger seeking to displace it, regardless of the challenger's technical merits.

Gowrisankaran and Stavins, (2004) offer empirical confirmation of this coordination problem hampering the adoption of challenger payment instruments. Studying the adoption of electronic payments amongst US banks they observe significant interdependence between adoption decisions. Finding that any given bank is significantly more likely to adopt a system when surrounding banks already have. They further observe this pattern persisting twelve years after the alternative payment system was established, suggesting that NET can sustain an incumbent system over long periods of time even when a challenger is widely available.

This thesis applies the concept of two-sided markets by treating cash as the established incumbent and digital payment options as challengers, using NET to examine why the challengers have failed to displace the incumbent system.

3.4 Sponsorship of payment networks

Katz and Shapiro posit that to overcome the *chicken and egg problem* firms sometimes have to engage in sponsorship of network goods. Katz & Shapiro identify a sponsor as any one firm that is willing to sponsor a network, almost always due to them owning the network and standing to reap the rewards of its expansion. If solving the chicken and egg problem expands the network, a sponsor might invest in convincing both merchants and consumers to join the network, since its expansion would benefit the sponsor. A sponsored network good will have an advantage over an unsponsored one since the sponsor is able to engage in penetration pricing or other forms of investment to attract users to their network. This initial loss of revenue would then be recouped as market shares grow, at least in theory (Katz & Shapiro, 1994).

Katz & Shapiro make note of the fact that if a network is shared between multiple firms their ability to profit from the expansion of said network is diminished in accordance with the amount of firms they share it with. This is often conceptualized as *free-riding*, meaning firms on the network may reap the benefits of network expansion, even if they do not actively contribute. A network owned by a single firm, on the other hand, stands to extract all surplus value from the expansion of the network (Katz & Shapiro, 1994).

Milne, (2006) applies NET to payment systems shared by banks. He finds that some payment systems are shared between many banks while others are owned by very few or in some instances a single firm (Milne, 2006). Considering this, the concepts of shared networks and sponsorship are applied. Milne points out that smaller countries with more centralised banking sectors do not need to share payment systems between as many firms as more fragmented banking sectors in larger countries do. He goes on to argue that these factors lead to smaller and less fragmented banking sectors, being better able and more incentivized to invest in the adoption of innovation. Milne claims that this logic is a possible explanation for the high rate of digital payments made in the Scandinavian countries (Milne, 2006). However, Milne only examines five countries, the US, UK, Sweden, Norway and Finland to support this contention (Milne labours under the illusion that Finland is a Scandinavian country). Nevertheless, the reasoning follows the logic of NET and it maps onto the case of Germany, a large country with a

fragmented banking sector that exhibits relatively low levels of digital payments compared to other high income countries (ECB SPACE, 2024).

As explained in the previous research section the German banking sector is exceptionally fragmented and the domestic payment networks are shared by three pillars, all with varying levels of profit incentives. NET would suggest that the more fragmented nature of the German banking sector's payment network, should lead to poor sponsorship incentives and increased difficulties in coordination. This is because more banks would need to coordinate and share the potential rewards leading to lower incentives to engage in sponsorship. This in turn might help explain why the German banks have been unable to solve the chicken and egg problem to the extent that other less fragmented countries' banking sectors have.

3.5 Network effects demand

Another question elaborated upon by Katz and Shapiro, (1994) is whether products can resist being replaced even when newer alternatives are better or more heavily promoted. They find that even products with smaller user bases often can, for two main reasons.

The first of these is what Katz and Shapiro, (1994) label *excess inertia*. This describes a situation where users continue using an established product even when switching to a new one would, in total, produce greater benefits. In essence excess inertia describes a preference for sticking to what one knows. A reason for this is that the person who switches bears both the financial and time costs of doing so personally, while most of the gains from the network growing goes to future users of the network. This asymmetry creates weaker incentives to switch and the established product can persist, not because it is better, but because switching is individually costly while the rewards fall on later users.

The second reason concerns the certain attributes of products. Katz and Shapiro observe that if products have irreplaceable attributes and if those attributes are valued, then consumers will not switch even if the rival product has a larger user base. As long as attributes of a certain product cannot be replaced or bettered by competitors, the products with such attributes can persist alongside products with a larger user base (Katz and Shapiro, 1994).

Together, these mechanisms offer an explanation for how products can persist even amongst fierce competition. It shows that the future of an instrument is not necessarily determined from the size of the network alone. If that product can not replace valued attributes of incumbent products then those products may persist as long as those attributes are valued. Products may also benefit from excess inertia rendering users less willing to switch even when challengers offer benefits. Users tend to stick with what they know and perceived benefits are often skewed by the financial or time cost of said switch.

3.6 Theoretical Approach

This thesis applies NET in order to explain the persistence of cash in Germany. Having established in the theoretical framework that cash qualifies as a network good, we develop two hypotheses from the mechanisms described earlier in the framework.

The first mechanism is that of sponsorship. As Katz and Shapiro, (1985) argues, the incentives for firms to sponsor payment networks is related to how many firms share that network. Milne, (2006) extends this to banks and their sharing of payment systems. Germany's severely fragmented banking sector means that the payment system is shared across a large number of institutions, all with varying profit incentives. NET would predict that the sector's fragmentation and large share of non-commercial actors would lead to weak incentives and coordination abilities. For the prediction of the theory to be valid we would expect to find German banks displaying less ability to solve the chicken and egg problem. This would be validated by German banks being less capable of attracting both merchants and consumers to digital payment alternatives, thereby contributing to cash persistence. This reasoning is expressed in our first hypothesis:

H1: The structure of the German banking sector and the weak sponsorship incentives it produces contributes to the persistence of cash.

The second mechanism concerns the role of consumer demand. Katz and Shapiro, (1994) find that products can resist displacement when they possess certain attributes which competitors can

not replace, regardless of the size of their network. The resistance to displacement is contingent on these certain attributes being valued by a sufficient number of users to persist. If this was the case in Germany we would expect to observe stronger preferences for the unique attributes of cash in comparison to other populations. The inclusion of an independent demand-side mechanism is further reinforced by excess inertia, stipulating perceived switching costs reduce the individual incentive to move away from an established product. If excess inertia can be observed it would need to be coupled with preferences and the attachment to those preferences would need to exceed rational cost calculation. The attachment to certain attributes will be the focus with excess inertia being analysed on a smaller scale. This is expressed in our second hypothesis:

H2: The particular preferences of consumers in regards to product attributes of payment instruments contributes to cash persistence.

4 Data

4.1 Source Material, Limitations and Validity

The sources utilised throughout the thesis consist primarily of cross-national surveys, payment diary surveys, commissioned research reports and academic literature. While primary data was not collected we have selected a wide array of different sources in order to facilitate triangulation. The different types of secondary sources carry distinctive strengths and weaknesses that warrants acknowledgement. Information on the most utilised sources of information is therefore provided regarding reliability, representativity and validity in the form of the table found below.

Table 4.1. List of Source Material

Source	Usage	Nature and origin	Composition	Relevance	Limitations & Potential Bias
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Table 4.1. List of Source Material

Bartelt and Wittig (2023) Country report	H1	Peer reviewed country report published in a specialised practitioner-academic journal by two industry insiders.	Coverage: Germany with systematic comparisons with EA and selected Euro countries.	Main relevance Comprehensive structural overview of the German payment market.	Reliability: Both authors active industry participants - Industry bias Reliability: Does not collect primary data, limiting reliability
De Nederlandsche bank 2017 Research report	H1	Report on the Dutch banking sector's sponsorship and promotion of digital innovation.	Coverage: The Dutch financial sector, consumers and merchants. Sample: Transaction data, 57 nationwide campaigns and five regional campaigns. Data collection: 2005-2013	Main relevance Comparing the German financial sectors sponsorship to another country's sector	Validity: The comparison to the Netherlands can not be generalised beyond the scope of the case of Germany and the Netherlands.
European commission 2015 & 2024 Survey reports	H1	Survey on merchant costs for processing cash and card payments. Documentation of payment schemes.	Coverage: Interchange fee levels for merchants by country in the EU 2015 & 2024. Sample: Interchange scheme information from card providers. Data collection: Payment card providers 2015 & 2024.	Main relevance Empirical data on costs incurred by merchants at transactions.	Representativity: Only compares Germany to 9 other countries, limiting the scope of the comparison. Representativity: Does not show acquiring fees for payment systems incurred by merchants by country, limiting comparison.
Ego, Knümann and Korella (2026) Research report	H1	Research report published by three DB researchers based on primary empirical data collection, direct time measurements of POS transactions and a merchant survey.	Coverage: German retail stores, restaurants, hairdressers and other retail sectors. Sample: 13,000 transactions at 15 POS in 3 German cities. Data collection:	Main relevance Empirical data on cost of different payment methods, merchant acceptance rates, concrete cost figures and	Reliability: DB can be argued to have institutional incentive to prove cash's cost competitiveness, potentially creating framing bias Representativity: Narrow time window for transaction data may limit generalisation

Table 4.1. List of Source Material

			POS transaction data: 8—13 Aug 2022. Merchant survey: 14 Aug — 15 Dec 2023.	differences between retail sectors.	
German Council of Economic Experts 2025 Research report	H1	Report on digital innovation in the financial sector and its policy implications.	Coverage: The German financial sector	Main relevance Structural account of the nature and effects of digital innovation in the financial sector	Reliability: Potential bias due to positions on the council being appointed by the German government.
DB Payment behaviour Germany 2008-2024 Longitudinal survey, payment diary 2009 and 2023 Waves used	H1 & H2	Survey report produced in waves by DB since 2008, with subsequent waves in 2009, 2011, 2014, 2017, 2020, 2021 and 2023. Authored by 6 DB researchers.	Coverage: Germany. Sample: 5,698 German-speaking +18 respondents using random sampling, with 4,036 also conducting a payment diary over 3 days. Data collection: 4 Sep — 30 Nov 2023.	Main relevance Primary dataset for German payment behaviour. Combines questionnaire and payment diaries. Wave structure makes cash use and patterns observable over time.	Reliability: DB has operational involvement in cash infrastructure - potential reporting bias and framing bias Reliability: Results are self-reported - recall bias Representativity: Includes only German speakers - May exclude relevant findings Representativity: Post-Covid data may skew patterns
ECB SPACE 2024 Cross-national survey	H1 & H2		Coverage: 18 Eurozone countries	Main relevance	Reliability: Self-reported data - potential recall bias

Table 4.1. List of Source Material

		Study commissioned by the European Central Bank, starting in 2019.	Sample: 50,000 respondents. 5,598 German respondents collected by DB. Data collection: September 2023 — June 2024.	Allows Germany to be compared to EA.	Representativity: Online panel may exclude part of population Representativity: German respondents included in displayed EA, potentially reducing true divergence gap when comparing to Germany Representativity: Post-Covid data may skew patterns
Knümann, Krüger and Seitz (2024) Research report	H2	Research report commissioned by DB on the costs and benefits of cash and cashless payment instruments. Written by two academics and one DB researcher.	Coverage: Germany. Sample: 2,001 respondents, all respondents +18 years old, holding bank accounts. Data collection: 3 Jan — 27 Jan 2023.	Main relevance Rational insights into drivers of cash use and strong findings from willingness-to-pay experiments.	Reliability: Commissioned by the DB - Institutional bias Reliability: Sample restricted to current account holders, limitation mitigated by 99% of Germans holding accounts. Reliability: Willingness to pay experiments - Not necessarily conducive to actual economic behaviour

Reliability:

As can be seen in table 4.1 we rely heavily on empirical sources connected to the DB. The German payment behaviour surveys, Knümann et al., (2024) and Ego et al., (2026), are either produced by researchers working at the DB or commissioned by it. While the DB does not actively promote either cash or cards, they are operationally involved in cash infrastructure and could be argued to have an interest in presenting cash as a relevant and cost competitive instrument. This does not disqualify their use as they constitute the most comprehensive record

of German payment behaviour available and is widely cited. ECB SPACE, (2024) is administered independently by the European central bank (ECB) across eighteen eurozone countries and is used as a cross reference where possible. Self-reporting presents a further limitation across the survey-based sources as the gap between reported and actual behaviour is well documented in payment research. Bartelt and Wittig, (2023) constitute a separate concern as both authors actively work in the industry they report on, potentially creating an industry bias. The source is treated primarily as a structural overview rather than a basis for any causal inference. The German Council of Economic Experts, (2025) stands as comparatively strong, as a government advisory body mandated to impartially advise on economic development, its findings on fragmentation and innovation capacity are drawn on with greater reliability.

Representativity:

The sources used are broadly representative and reliable for the purposes of this study. The biggest limiting factor on representativity would be the impact of the Covid-19 pandemic. The changes in payment behaviour can not be observed in waves or surveys conducted before the pandemic. Results from surveys conducted following the pandemic are also likely skewed by impact of the pandemic. Whether changes observed during or after the pandemic can be tied to the pandemic alone or to other structural or behavioural changes will remain very difficult to ascertain even long in the future. As an example 20% of respondents in Payment Behaviour in Germany in 2020, (2021) reported trying out the contactless function of their cards for the first time during the pandemic. The pandemic's effect on payment markets therefore can not be understated. Any study on payment markets and payment behaviour alike will need to acknowledge the impact of the pandemic and the fact that causes of diverging results from this period will be very hard to label accurately. A limitation of the ECB SPACE, (2024) survey's representativity is that German respondents are not removed from the displayed EA. This marginally pulls the baseline toward German figures, meaning observed divergence between Germany and the EA likely understates the true gap. The German payment behaviour surveys exhibit some issues in regards to representativity as it excludes non-german speakers living in Germany. This potentially limits representativity and potentially excludes interesting findings.

Validity:

The inclusion of payment behaviour data, merchant cost data and expert reports on the case we contend to be broadly valid. That which may be called into question is the inclusion of the Nederlandsche Bank report. This report does not deal with the issue of the persistence of cash in Germany. However, it does serve as a point of comparison for the German case and is therefore deemed as valid for the analysis.

5. Methodology

5.1 Research design

The design of this thesis is that of a theory-driven qualitative single case study, the choice of which is contingent on passing a set of conditions by Yin, (2003) for which a case study is particularly motivated. Yin first established that research questions best suited for case studies begins with *why* or *how*. Further conditions of single case studies are that the researcher exercises little or no control over events and that the thesis wishes to investigate contemporary phenomena in a real life context. We find these three criteria to be met, our research question is a how question and we also cannot control cash persistence on our lonesome. Finally our question requires a wide range of aspects of real life to be considered such as behavioural, structural and institutional context to reach a nuanced answer. The choice of doing a case study stems specifically from our desire to tackle the question in depth rather than broadly, an explicitly stated quality of case studies, (Yin, 2003).

Case studies can further be divided into more types depending on the thesis's purpose. As our thesis derives hypotheses from an established theoretical framework and then assesses if Germany is consistent with those hypotheses our thesis is *theory-driven*. It is also characterised as *explanatory* as we mean to explain findings not merely identify them.

The selection of a single case study such as ours can according to Yin, (2003) be appropriate under several circumstances. Although only one is necessary, Yin identifies five of these circumstances of which two apply to our thesis. First being the *critical case*, where a single case is sufficient to test a well-formulated theory. The second being the *extreme* or *unique* case, where the deviation from expectations is extreme enough to warrant investigation. Germany is not

extreme in its cash use compared to countries in general. However if historical and contemporary cash use patterns are included combined with a near unique banking sector structure, Germany stands as a clear outlier compared to other high-income countries. This warrants the extreme case although the critical case is enough to justify the single case study.

5.2 Analytical Strategy

In accordance with Yin's recommendations we make use of evidence and findings from a variety of independent sources of various types to allow for triangulation. These include findings from a Delphi study of experts, peer reviewed academic literature, cross-national surveys, German specific surveys, DB commissioned studies on consumer preferences and merchant acceptance rates and conference papers.

Yin highlights relying on theoretical propositions as his preferred strategy for analysis for case studies. This thesis's analysis uses *pattern matching* (Yin, 2003) to test our hypotheses by describing a pattern that NET would predict and then assessing if the evidence matches predicted outcomes. Eventual contradictory findings are also established in advance in accordance with the suggestions of Yin where we derive what the theory would predict and what could make its explanations inconsistent or incompatible. If conclusions rely on only partially consistent evidence or if rival explanations can explain observed patterns more consistently, then that will be addressed upfront.

5.3 Methodological limitations

The method of single case study also comes with limitations. Single case studies are limited in their generalisation as acknowledged by Yin. This stems from eventual findings not extending beyond the case being studied. In the case of our study this limitation is somewhat mitigated by the degree to which certain conditions we investigate are unique to Germany. These include for example the fragmented banking sector, as well as the non-commercial mandates and regional restrictions of certain segments of the sector. As this combination of conditions is not found anywhere else the generalisability is limited regardless of the selected method. The scope for

which findings could be generalised to other contexts is therefore limited by the specificity of the conditions that are found in Germany.

6. Empirical analysis

Our empirical analysis chapter analyses cash's persistence in Germany through the lens of NET. The hypotheses are drawn from the theory and applied to the context of payment networks with cash as the network good. Our analysis follows the model of pattern matching, the model according to Yin is one of the most desirable techniques for case study analysis. Below we elicit the conditions of pattern matching we will engage in, the core conditions being engaging with contradictory evidence and rival explanations openly (Yin, 2003).

Predicted pattern, The theory's prediction for our hypotheses and expected evidence/patterns if valid.

Pattern matching, A comparison of evidence against said prediction, focusing on consistency towards the predicted pattern.

Rival explanation, Acknowledging and entertaining potential rival explanations of our evidence

Overall assessment, Brief summary where evidence is evaluated on consistency towards the predictions.

We employ the following format to display our analysis in a consistent and easily understood format.

- Background and theoretical justification
- The theory's prediction for our hypotheses and expected patterns if valid.
- Comparison of evidence against said prediction, focusing on consistency towards the predicted pattern.
- Review and entertainment of potentially contradictory evidence
- Acknowledging and entertaining potential rival explanations of our evidence
- We then make a brief summary of findings before further discussing their implications in our discussion.

6.1 Hypothesis 1

The structure of the German banking sector and the weak sponsorship incentives it produces contributes to the persistence of cash.

6.1.1 Background and theoretical justification

As discussed in the theoretical framework, Milne, (2006) when writing about NET asserts that shared ownership of a payment system leads to weak incentives for adoption of innovation and digital investment for the firms that share said system. The German bank sector is among the most fragmented in Europe and has also had some of the lowest levels of active investment in and adoption of developments in payment system technology.

Less profit oriented German actors, such as the savings banks and co-op banks, would in NET be less willing to engage in sponsorship. Milne argues that since the incentives to expand a network through sponsorship are determined by private interests, only institutions oriented around profit should be expected to engage in sponsorship (Milne, 2006).

6.1.2 Predicted pattern

If H1 is valid we expect to observe two patterns. First, we should expect to see similar results to what Milne predicts in regards to bank sector fragmentation and its effect on digital payment adoption on a larger scale. We already know that Germany's bank sector is fragmented and that digital payment adoption has been low in relation to other high-income countries. However, to confirm if the two are related, we expect to see the pattern in other countries as well.

Second we expect to see low merchant acceptance of digital payment instruments being related to lack of sponsorship from German banks. Milne specifically points out that to solve the chicken and egg problem the provider of a digital payment system must be able to make it worth the merchants while. Milne makes particular note of interchange fees (a processing fee paid by the merchant's bank to the consumers bank, often passed onto the merchant) as one kind of cost that tends to be offset by sponsorship. Thus, we should expect to see the cost of acceptance of a

payment system being lower in countries with stronger sponsorship incentives, i.e less fragmentation.

6.1.3 Pattern matching

The German Council of Economic Experts, (2025) and Bartelt and Wittig, (2023) support Milne's notion of fragmented banking sectors leading to a smaller share of digital payments. Asserting that Germany has been particularly slow to encourage digital innovation using HHI-index to display Germany as a particularly fragmented case. As can be seen in figure 6.1 there is some correlation between the fragmentation of a country's banking sector and their share of cash use when accounting for GDP per capita.

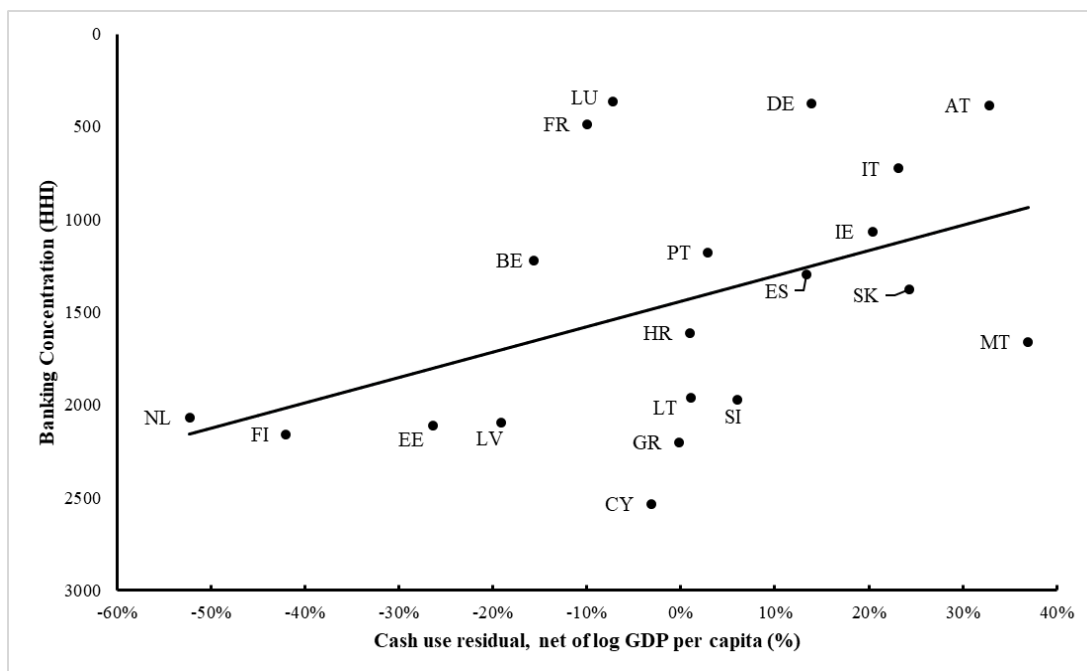


Figure 6.1 Banking Concentration and Cash Use, Controlling for GDP per capita
 Data: ECB SPACE 2024; GDP per Capita PPP: Trading economics 2024; Herfindahl
 Hirschman-index: European Central Bank, 2024

The scatterplot displays the relationship between banking sector concentration and cash use for Eurozone countries participating in the ECB SPACE, (2024) survey, after controlling for differences in GDP per capita. Each country's position on the x-axis reflects how much higher or lower its cash transaction share is than would be predicted by its GDP per capita alone. This shows us that Milne's prediction not only tracks for the case of Germany but also seems to hold

some relevance for other Eurozone countries as well. Germany is found in the upper right quadrant, along countries with similarly fragmented banking sectors and shares of transactions at the POS made in cash. In the lower left quadrant a cluster of countries with highly concentrated banking sectors also show much lower cash use than their GDP per capita would predict. This correlation does not confirm any manner of causal link between bank sector concentration and levels of cash use. However, it is consistent with Milne's predicted pattern of more concentrated banking sectors having lower levels of cash use.

To test the second predicted pattern we examine if there has been any sponsorship efforts in Germany attempting to reduce the costs for merchants to accept digital payments. We also examine if sponsorship of reducing costs has been implemented elsewhere.

The European Commission, (2015) report on merchants' costs of accepting digital payments showcase the interchange fees of ten EU countries (European Commission. Directorate General for Competition., 2015). As can be seen in Table 6.1 Germany has the highest percentage based interchange fee for its domestic debit card, a slightly above average interchange fee for international debit cards and the highest interchange fee for international credit cards. It should be noted that all countries do not have a domestic debit card. It should be further noted that when taking the fixed interchange fees of other countries' domestic and international debit cards the German rates are by no means extreme. However, countries that exhibit lower interchange fee levels, such as Belgium, Sweden, the UK and the Netherlands, have significantly lower levels of cash use today. This matches the pattern as predicted by Milne.

Table 6.1 2012 estimated weighted average interchange fee levels by country

Country	Domestic debit		International debit		International credit	
	EUR	%	EUR	%	EUR	%
Austria			0.050	0.24%		1.00%
Belgium	0.056		0.050	0.15%		0.69%
France	0.047	0.18%	0.080	0.34%	0.070	0.36%
Germany		0.20%	0.050	0.26%		1.58%
Italy	0.120	0.16%	0.070	0.34%		0.63%
Netherlands	0.020	0.00%	0.030	0.00%		0.75%
Poland			0.010	1.56%		1.47%
Spain			0.190		0.030	0.50%
Sweden			0.040	0.12%		0.76%
UK			0.100			0.80%

Source: European commission 2015

Notably, the Netherlands has an extremely low interchange fee in relation to the other nine countries. If we compare Germany to the Netherlands specifically we can find differences in sponsorship behaviour that aligns with the predicted pattern. Jonker et al.,(2017) states that this, along with other initiatives, was part of a concerted effort to increase merchant adoption of digital payment systems. Besides the sponsored low interchange fees the banks created an institution responsible for the promotion of digital payments called the Foundation for Promotion of Efficiency of Payments (FPEP) in 2005. The foundation engaged in promotional campaigns including both informing the public about benefits of digital payment systems as well as direct subsidies of their use. This included a 100 euro subsidy for merchants to purchase digital payment terminals, specifically targeting Small and medium sized businesses (SMEs) (Jonker et al., 2017). A subsidy is a form of price penetration and as Jonker et al show in their findings this had measured results.

Ego et al's,. (2026) report on the costs of payments in Germany confirms that digital payment options remain the more expensive alternative for merchants.

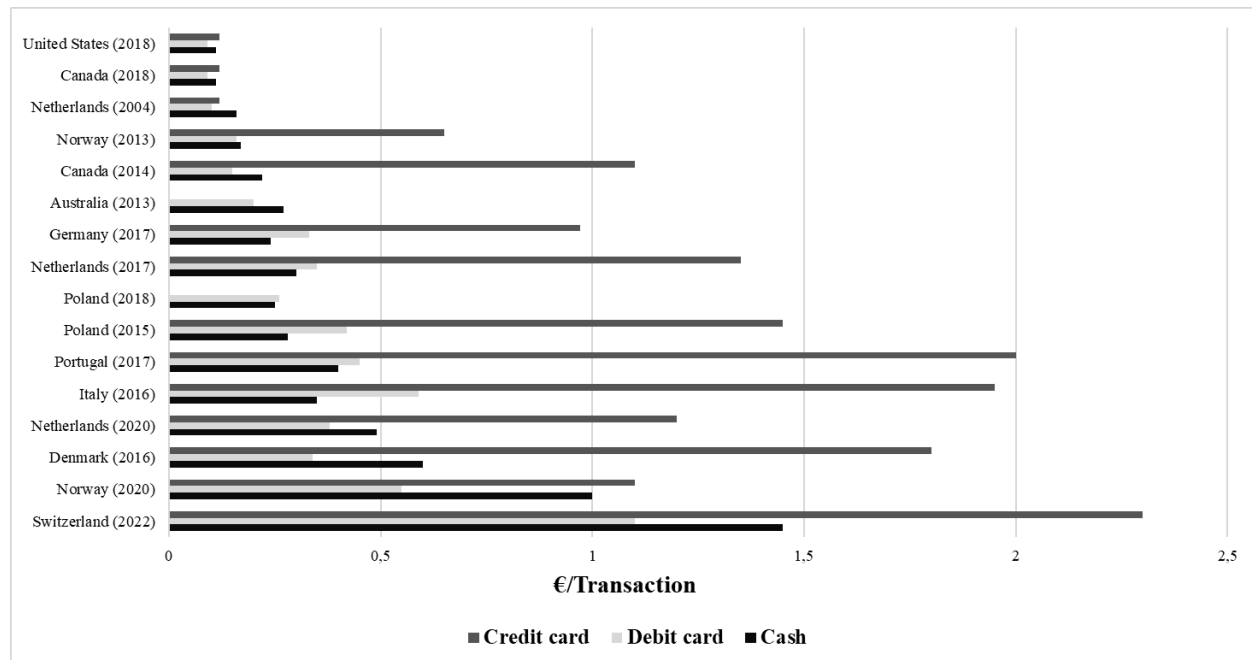


Figure 6.2 Cost of Transactions for Merchants by Payment Instrument

Source: adapted from Ego et al., 2026

Notably, Germany is one of the few high-income countries included in which cash is still the cheaper alternative. This matches the second pattern predicted by Milne as the chicken and egg problem can be seen to not have been solved in the case of German merchants, especially SMEs (Ego et al., 2026). As can be seen in figure 6.3 the cost of handling the Girocard is the more costly alternative for firms with one to nine employees while it is the cheaper alternative to larger firms.

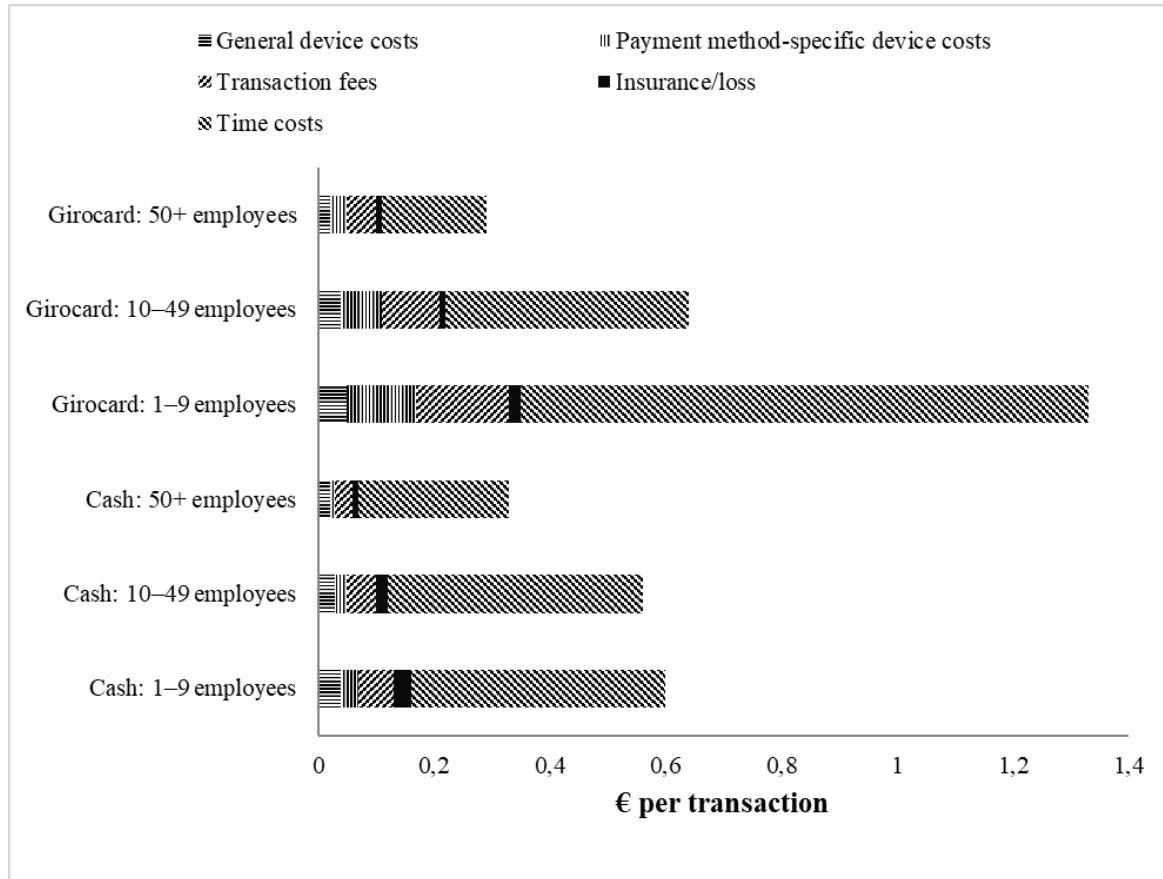


Figure 6.3 The Merchant Cost of Cash and Girocard by Firm Size

Source: Adapted from Ego et al 2026.

To test if higher costs of transactions may lead to diverging acceptance rates for digital payment between firms, Ego et al., (2026) also look at merchant acceptance by firm size.

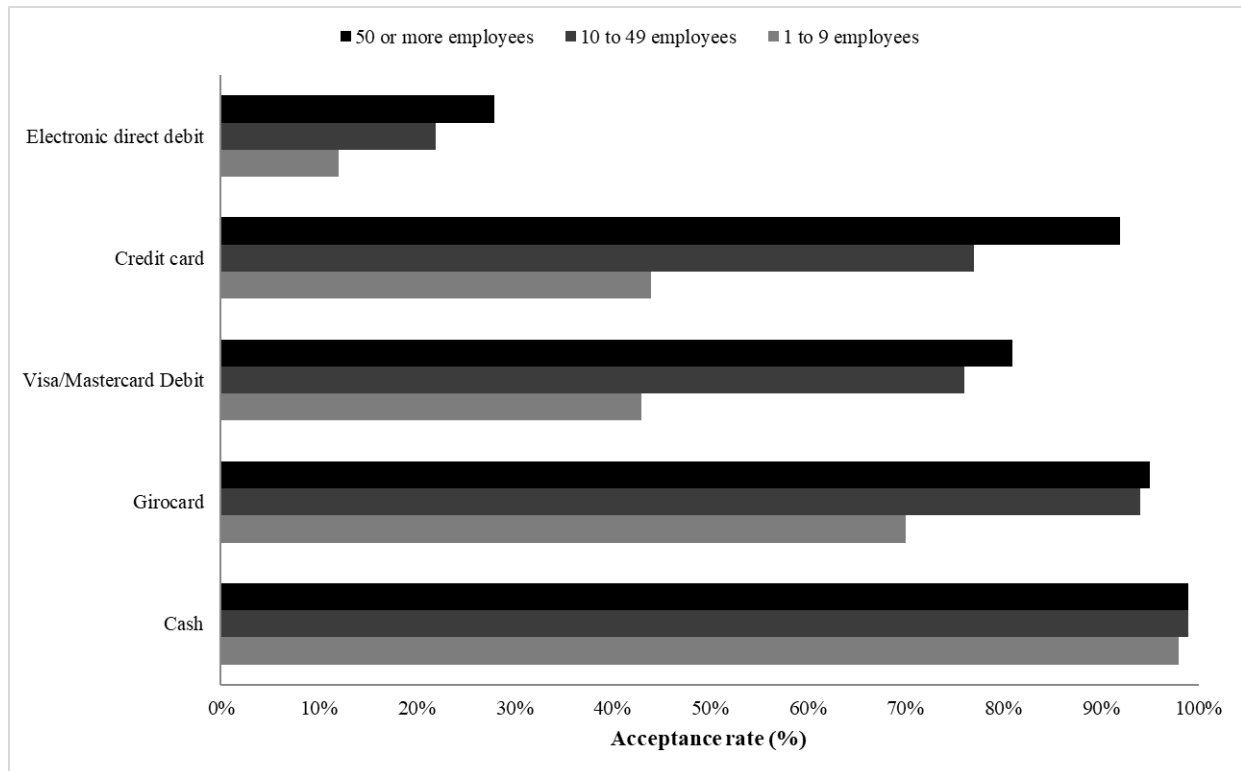


Figure 6.4 Acceptance rates of payment methods by firms size
Adapted from Ego et al., 2026

As can be observed, acceptance rates in smaller firms are roughly 20-25% lower for the Girocard than it is for larger firms. This matches the pattern predicted by Milne, (2006) showing a link between higher interchange fees and lower acceptance. Bigger firms with larger revenue are more able to bear the costs of digital infrastructure and therefore acceptance of digital payments. Notably, the transaction fees as well as the device costs differ substantially between larger and smaller firms. Ego et al., (2026) assert that this is due to larger firms having more leverage to negotiate favourable rates for fees with the payment system provider. The smaller firms' inability to bear the costs or negotiate more favourable fees was partly overcome in the Netherlands, through active subsidisation. What is interesting however is that the Nederlandsche bank report found informational campaigns to be more efficient than subsidies in increasing digital adoption.

6.1.4 Potentially contradictory evidence

One piece of potentially contradictory evidence to the second predicted pattern concerning sponsorship is the cost of the Girocard. When compared to other European domestic debit card schemes it actually exhibits among the lower levels of costs. This would run counter to the expected pattern of German banks being unable to sponsor low costs of digital payments in an attempt to have merchants join the network. However, Ego et al., (2026) show that despite the relatively low transaction cost of the Girocard, cash still remains cheaper for most merchants. Most importantly cash remains cheaper still for merchants with businesses only employing one to nine employees, the group that is in the greatest need of subsidizing.

6.1.5 Rival explanation:

Some of the experts in the Murawski et al., (2021) study suggested that these mandates, as well as German sensibilities more generally, reflect a cultural preference for stability, found especially in institutions. However, we find no evidence that any elements of culturally derived preferences for stability in institutions would differ to the degree necessary for it to determine sponsorship. This is not to say that culture plays no part whatsoever, institutions do not operate in a void. The question then becomes why Germany is more decentralised than other European countries, a question far outside the scope of this study.

6.1.6 Findings summary

This analysis' findings broadly match the patterns predicted through the theoretical framework. We review the correlation between fragmentation of the bank sector and levels of digital adoption predicted by Milne, (2006) and find that the trend is in line with what he suggests. Secondly, the predicted pattern of merchant adoption of digital payment systems being related to how strong the sponsorship of the system is. Our findings display the pattern matching in a series of cases, including Germany, the Netherlands, as well as a series of high-income countries.

6.2 Hypothesis 2

The particular preferences of consumers in regards to product attributes of payment instruments contributes to cash persistence.

6.2.1 Background and theoretical justification

Katz and Shapiro, (1994) established in NET that different systems may co-exist within the same market and that even smaller systems can remain competitive if they offer certain product attributes the competition can not replace. Cash does hold certain attributes and these are widely discussed as irreplaceable from both researchers and institutions alike (Ego et al, 2026; Knümann et al. 2024; Murakawski, 2021; (Bartelt & Wittig, 2023); Payment Behaviour in Germany 2023, 2023). First of these attributes for which cards do not possess an answer for is that of anonymity. Cash offers near total anonymity for its users, is untrackable and the risk of fraudulent data exposure is non-existent. Also as stipulated in our theoretical framework, excess inertia may be a contributing factor to cash maintaining its widespread use in Germany. This could be a result of habitual use or because the cost of switching is overinflated in the minds of consumers.

6.2.2 Predicted pattern:

NET would thereby predict that cash may prove more resilient to displacement due to its unique attributes. For H2 to be validated, a pattern where Germans exhibit stronger preferences for those attributes than comparable populations would need to be observable. If the preferences are found to be anomalously high, we further expect this to display itself in actual behavioural inertia. One way this could exhibit itself is if German consumers' resistance towards switching to cards exceeds rational cost calculations.

6.2.3 Pattern matching:

In order to pattern match we use ECB SPACE, (2024) to attain EA for the perceived main advantages of cash to test if German preference for cash's attributes is anomalous. Respondents in both surveys were asked about the perceived advantages of cash. Results can be found in table 6.2 below.

Table 6.2, Response rates to survey on payment behaviour

EA	Germany
<i>Exact formulation of available answer</i>	<i>Exact formulation of available answer</i>
Anonymity/protects my privacy 41%	Anonymous/ protects my privacy better 63%
Makes me more aware of my spending 35%	Good overview on spending 47%
Immediately settled 30%	Instant- no need to check later 41%
Accepted in more situations 28%	More frequently accepted 26%

Source: ECB SPACE 2024, Deutsche Bundesbank payment behaviour in Germany 2023.

Authors note: more than one answer was permitted, answers available varied in exact formulation. German respondents not excluded from ECB SPACE 2024.

The results presented in Table 6.2 show German respondents reporting stronger preferences for cash's specific attributes than the EA across nearly all categories. The largest gap is observed for anonymity and privacy protection, where 63% of German respondents identified this as an advantage of cash compared to an EA of 41%, a gap of 54%. The single category where Germany did not exceed the respondents of EA was acceptance, where German responses stood at 26% against a EA of 28%, the implication of this finding is relevant to both hypotheses and will be returned to in the discussion. Payment behaviour in Germany, (2009) found 57% of respondents indicating anonymity and the maintenance of privacy to be indispensable when selecting a payment instrument. This coupled with 85% of respondents indicating that only cash can guarantee anonymity and a majority of respondents seeing it as indispensable could logically

be construed to impact the levels of cash use. This can also be seen in the higher response rates for German respondents when asked about the importance of being able to pay with cash.

ECB SPACE, (2024) shows the response for “very important” stood at 31% for the EA and 43% for German respondents.

Knümann et al., (2024) in their study on consumer transaction costs used factors such as fees, financial loss, time spent and data disclosure to calculate the costs per option. They found that cost per transaction for cash was 0.38€ and 0.74€ for debit cards with credit cards at above 1€ per transaction. The cost related to the risk of data erasure increased the cost only for digital options, since cash because of its untraceable nature excludes this cost factor. When cost per transaction was weighted against the transaction amount, debit proved cheaper at 1.49% against 1.74 % for cash. This was explained by the authors by card payments being more frequently used for larger transactions. This could indicate that the cost of alternatives is of less value to consumers than their attributes.

To test if preference is displayed in actual behaviour we examine academic literature containing willingness to pay experiments to test if attribute preferences exceed rational cost calculations. In these experiments, consumers were asked if they would replace their current product or used payment option with an alternative. Knümann et al., (2024), asked respondents about their willingness to switch to a bank account that did not offer cash withdrawals. 72% of respondents refused even when offered 20€ monthly, (240€ per annum). In another experiment 26% refused to switch from cash to card when conducting a payment at a POS terminal even for a 6% transaction discount on a 50€ payment, the authors attributing this to preference for privacy over cost. In the final experiment, respondents were asked how much money they would be willing to pay for immediate data erasure when using cards to pay at a POS. 42% were willing to pay with an average of 1.43€ per transaction among those willing to pay. Whilst these experimental findings may not be conducive to actual economic behaviour, the experiments show that preference for cash exceeds rational cost calculation as excess inertia would stipulate.

6.2.4 Potentially contradictory evidence: Contradictory evidence for the finding of Germans indicating anomalous weight on the advantages of cash would be if they put similarly disproportionate weight on the advantages of cards.

To test this, we use the payment behaviour survey and ECB SPACE, (2024) to compare responses. When asked about the main advantage of cards, 77% of German respondents selected the option “No concerns of whether sufficient cash at hand” Payment behaviour in Germany, (2023). The option is differently formulated in ECB SPACE, (2024) - “I don’t have to carry a lot of cash” indicated by 61% of respondents. Rather than reflecting advantages such as convenience or speed, respondents in both groups cited not needing cash as the biggest advantage. Cash retains users for its irreplaceable attributes such as anonymity and finality and those attributes are valued. We can also observe that the unique attributes of cards such as being usable online is not valued to the extent the certain attributes of cash are. This can help to explain why cash resists displacement, it can further be used as evidence that the certain attributes of cards are weaker in the eyes of the public leaving potential sponsors of cards at a disadvantage against cash. This is consistent with Katz and Shapiro, (1994) and its mechanism on certain attributes. Had the main advantage for cards been cited as easier, faster or usable online the discrepancy would be mitigated since those are attributes of payment cards. Alas the results do not indicate this.

To further test if this potential disadvantage has real life implications, we investigate German online payment data in comparison to EA using ECB SPACE, (2024). No country in the survey had more than 2% of respondents indicating that they do not make online payments. The German response stood at 7%. Online payments, a unique attribute to non-cash options, are not utilised by a substantially larger portion of the German population than other Eurozone countries. To control the validity of this finding we controlled the reported rates of technical difficulties when making online payments as this could potentially explain the diverging German results. Only 1% of German respondents reported difficulties when making online payments compared to an EA of 20%. This substantial discrepancy goes far in ruling out technical difficulties as an explanation for 7% of Germans avoiding online payments. Despite online payments seemingly working well, a minority are still not using it which could be an indicator of inertia. We also tested if difficulties with card payments could explain the lower share of card payments. When asked about technical difficulties at POS when using digital instruments, only 8% of German respondents indicated issues, the lowest of all countries surveyed. This stands against an EA of 13%. Together these findings suggest that German avoidance of digital payment instruments can not be attributed to poor user experience or technical unreliability. These findings point towards

excess inertia as described in NET, it also points to cash being used for its attributes rather than consumers being dissatisfied with digital alternatives.

6.2.5 Rival explanation:

A rival explanation to 72% refusing a cashless account even for 240€ annual compensation in the experiment may reflect rational adaptation to the German payment environment since cash is more widely accepted (ECB SPACE, 2024). Refusing a cashless account is therefore rational regardless of weight placed on cash's attributes. Another rival explanation may also lift lack of access as a potential explanation. 97% of German respondents in Payment behaviour in Germany, (2023) held a bank account compared to 93% EA. Lack of access to digital payments can therefore not explain this discrepancy alone.

Weak merchant acceptance driven by poor sponsorship incentives as discussed in H1, may also offer a more consistent explanation for cash use than attribute preferences. To test the consistency of this rival explanation we make use of peer to peer transactions (P2P). We do this because in P2P there are no merchants, no POS terminal or structural constraints involved. The choice of which method to conduct in such transactions is therefore not contingent on any structural constraints as identified in H1. P2P transaction data from ECB SPACE, (2024) show 74% of German P2P payments being conducted in cash. This stands in stark contrast to the EA of 41%. This indicates that rival explanations of structural constraints driving cash use can not explain this finding. It can also be argued to be strong independent evidence that German cash use in P2P transactions is driven by preference rather than necessity.

Something that must also be addressed is the fact that certain attributes of cash such as being analogue may cause decision makers to abstain from actively prompting alternatives that may displace it. It is the only means of payment that can fulfil vital societal functions of non-dependence on intermediaries and technical infrastructure (Ehrenberg-Silies et al., 2024). Its independence from third-parties provides a crucial fallback option in scenarios of infrastructure breakdowns, crisis or coordinated online attacks. Due to its ability to operate independently outside of technical infrastructure, cash provides a form of guarantee which cards and mobile payments can not fully replace. Ehrenberg-Silies et al., (2024) was a commissioned study made by the DB. It is of note that the DB themselves considers cash's role in a crisis is irreplaceable, a

rival explanation that does hold weight is the fact that this acknowledgment of the need for cash in such situations may lead to its resistance to displacement. If the DB themselves ascertain its need in a crisis it would be counterproductive to expedite its replacement. This contention does weaken the argument of preferences for cash attributes in one sense. Since it could lead to institutional support for its maintained role. However, it can also be seen as an institutional preference for its certain attributes namely its independence from technical infrastructure. This rival explanation is therefore twofold, part in favour and part against.

6.2.6 Findings summary:

The analysed evidence is found to be broadly consistent with H2 and the predictions of NET. German respondents display anomalously strong preferences for cash's irreplaceable attributes, with anonymity being most favoured alongside finality. These preferences manifest themselves in primary behavioural experiments, where respondents showed resistance to switching to digital alternatives which exceeds rational cost calculations. Rival explanations such as rational adoption and structural constraints were entertained throughout the analysis. The P2P findings and data erasure experiment proved most difficult to reconcile with rival explanations. Cash being regarded as a vital fallback in times of technological failure due to its independence from technological infrastructure may complicate the findings' consistency. Due to cash being recognised as irreplaceable even by institutions it may also receive favourable treatment to avoid displacement. No active promotion of this has been found however. Rather cash's analogue nature can be viewed as yet another valued attribute and its use in crisis would be as vital to individuals as institutions. We thereby find consumer preferences for cash's specific attributes to complement and extend beyond what structural constraints and weak sponsorship alone can explain.

6.3 Discussion

In our analysis we have used pattern matching to examine the validity of two hypotheses. The presented findings related to H1 illustrate the nature of German banks' sponsorship of innovation in payment systems, as well as the cost for merchants to adopt these innovations. Our findings related to H2 cover the preferences of German consumers and how they relate to the unique product attributes of cash in comparison to digital payments.

6.3.1 Sponsorship and the Chicken and Egg Problem

NET, and especially the work of Milne, (2006) within that theory, outlines what mechanisms to expect shared payment systems to exhibit explicitly. We were able to make use of reports that corroborate his contention and market data from DB to generalize his findings on the “Scandinavian countries” having lower rates of cash use due to their concentrated banking sectors.

The second investigated pattern of H1 pertained to how merchant acceptance of a payment instrument was influenced by the cost of accepting said instrument. This is something that Milne relates to the chicken and egg problem, and from what is found in the analysis it seems that the merchant side of the problem remains to be solved. The findings show us that cash remains the cheapest option for German merchants to accept, especially small scale enterprises. It was exactly this category of merchants that the Dutch FPEP targeted with information campaigns and subsidies to increase payment terminal acquisitions. In the analysis we also show levels of interchange fees in different countries, while the data is from 2012, the level of the fees seem to correspond with levels of cash use today, especially for the Dutch (Table 6.1). As we have noted previously the Dutch banking sector is one of the more centralised in Europe. Taken together with its lower levels of interchange fees and efforts of sponsorship we find a case that follows Milne’s predictions closely. Germany seems to reflect the opposite of the Dutch case, not having engaged in any sponsorship through penetration pricing by means of low interchange fees or any other initiatives to solve the chicken and egg problem. Thus, it can be considered as following closely to Milne’s prediction as well.

We also note that the Jonker report, (2017) notes that information campaigns actually proved more impactful in regards to merchant acceptance of digital payment systems than direct subsidies. This would mean that a non-subsidy alternative to sponsorship exists at least in theory. Since two pillars of the German banking sector are mandated to represent their customers best interests it seems odd that more information campaigns have not been undertaken. This could be due to the weakened state of the two non-commercial leaving them without the resources to engage even in cost efficient campaigns.

However, we also found that there is some information that indicates that weak incentives might not be the sole reason for weak sponsorship. The German stability culture favouring stable institutions, which maintains the three pillar system, may also have had a part to play in inhibiting sponsorship initiatives from the German banks as Murawski et al., (2021) contends.

6.3.2 The Preferences of the German Consumer and the Unique Attributes of Cash

In our analysis of H2 we expected to see Germans valuing the unique product attributes of cash at higher rates than other European populations. We further expected excess inertia which would be ascertained if Germans showed resistance to switching to digital instruments which exceeded rational cost calculations.

The data erasure findings from the willingness to pay experiment show primary data of German consumers being willing to pay a premium for maintaining privacy. Since the privacy attribute is isolated from merchant acceptance infrastructure it can be considered directly consistent with German consumer resistance to switching, exceeding rational cost calculation. Cost differences between cash and debit cards stood at a near parity (Knümann et al., 2024) and can not explain the finding. With the finding on anonymity receiving most responses in the survey it points to the attributes of cash being valued at a premium. Finality is also considered an advantage of cash and German acknowledgment of that fact was noted at higher rates than EA. The findings that 57% of Germans in 2009 considered anonymity indispensable coupled with 85% considering cash the sole method capable of this is consistent with what the theory would predict. It may also explain why Cash has been so hard to displace, an attribute that can not and may never be replaced by digital alternatives is both indispensable and irreplaceable to users of cash. This preference for anonymity has also been maintained over time and it seems clear in the minds of Germans that cash best satisfies this preference. German respondents also show anomalously strong preference for cash's attributes even in later DB payment behaviour in Germany surveys. This is consistent with NET predicting that even smaller systems can maintain relevance if it offers irreplaceable attributes and those continue to be valued. As digital alternatives are not poised to become untrackable, NET would predict cash to maintain its relevance even in the medium to long term.

We also entertained rival explanations throughout, such as rational adaptation due to cash's widespread acceptance which cannot be completely ruled out for elements of our evidence. Rational adoption is however incapable of explaining the data erasure finding as cards were accepted at the POS in the experiment. Somewhat paradoxically, Germans have the least degree of technical issues when making online payments, yet 7% make no use of this unique attribute of cards. Similarly, issues with digital instruments at POS terminals are lower than any other eurozone population. Digital alternatives in Germany clearly work in a good capacity but a minority seems unwilling to adapt. This would be consistent with excess inertia as stipulated by the theory. Where either the financial cost of switching or the perceived cost of learning to use new systems make the switch seem unjustified. However it must be noted that the habit of paying with cash particularly with smaller transactions can contribute to the unwillingness to switch. Habitual inertia is yet another form of inertia but the root cause of the unwillingness of a minority of Germans to choose digital means was not an objective of this thesis. These patterns are however broadly consistent with H2, suggesting both excess inertia towards switching to a system with benefits such as online payments and with certain attributes of cash maintaining its use and relevance. One finding that may potentially weaken the argument that cash's attributes lead to its persistence is the acknowledgment by the DB of its role in crisis or technological breakdowns. Cash's unique status as independent of technical infrastructure may lead to less active support for its rival instruments as displacing cash would eliminate a fallback option in a crisis. It can however also be argued to be yet another appreciated attribute of cash, helping to maintain its use in society at large, however preferential treatment from institutions as a safeguard in crisis can not be ruled out. These findings when coupled with the fact that cash is more widely accepted than cards in Germany the role of cash seems secured for now. If digital alternatives can produce a product incapable of being tracked however, then that future seems less secure unless cash receives active institutional support.

6.3.3 Considering Both Hypotheses

To conclude our discussion we look at how the pattern matching of each hypothesis relates to the findings of the other.

The findings of H1 and H2 complement one another and together they offer a more complete explanation than either would do on their lonesome. H1 establishes that weak sponsorship incentives have left merchants without incentives to accept digital payments. This dynamic can be construed as keeping digital payment acceptance anomalously low. H2 shows that German consumers hold strong preferences for cash's irreplaceable attributes. H2 also show these preferences can persist independently of structural constraints as demonstrated by the P2P findings.

An interaction between the two can be observed and can best be explained through the context of the chicken and egg problem. Any alternative instrument seeking to increase market shares at the behest of cash must attract both merchants and consumers simultaneously. H1 shows that German banks have lacked both the incentive and capacity to solve this problem on the merchant side. H2 would suggest that even if a coordinated sponsorship was undertaken, the preferences on the consumer side presents an obstacle. German consumers do not merely use cash because it is nearly universally accepted, they actively value its attributes in ways that exceed rational cost calculation. Even well sponsored digital payment alternatives would need to convince a consumer base with deeply rooted preferences for anonymity, privacy protection and finality. While cash use may continue to decline, it is very hard to see a scenario where it is rendered obsolete since cards cannot replicate these highly valued attributes.

As long as consumers continue to demand cash, merchants have little incentive to invest in card infrastructure. As long as the incentive to adopt digital infrastructure is weak, the threshold of what is needed to convince merchants to adopt digital infrastructure is higher. The near universal card ownership among German consumers combined with persistently low card use at POS terminals suggests the barrier is not access but preference and acceptance. Consumers have the means to pay digitally but choose not to and merchants have little reason to push them toward it. The findings in H1 and H2 not only coexist but can be observed to influence one another, further reinforcing the conditions that have established the observed patterns. The influence of both sides on one another makes cash particularly resistant to displacement, prolonging its persistence.

7. Conclusion

The aim of this paper has been to conduct an in-depth investigation of why cash persists in Germany. By conducting a qualitative case study guided by the previous work on why cash persists and NET. Through employing a process of pattern matching we developed hypotheses from the literature on NET and tested whether or not the expected patterns could be observed in the German context. Our study contributes to the discussion by allowing room for the expected explanations as well as other possible explanations, furthering the in-depth investigative advantage of a qualitative case study.

We find that cash persistence in Germany can not be explained by any one factor. We find that a combination of different mechanisms in both the German payment systems market and German society at large contribute to the persistence of cash. Initially there appeared to be two chief components to the puzzle, namely, the banks and the German consumer. However, through pattern testing we found the situation to be somewhat more complex.

The complexity stems from the interplay between consumer, merchant and the banks in a chicken and egg problem. The fragmented banking sector has been unable to coordinate sponsorship capable of convincing merchants to adopt digital payment systems. At the same time the German consumers' preference for cash's unique attributes maintains the demand for cash. As long as consumers demand cash and no bank is willing to sponsor the adoption of digital payment systems, merchants have little reason to steer away from cash.

The practical implications of the findings are manyfold. The nature of cash persistence in Germany is of interest to any actor promoting digital payment adoption, be they policymaker or payment system provider. The thesis provides a more in-depth insight into the dynamics that drive cash persistence in Germany, something that could become all the more relevant with the roll-out of the pan-European digital payment system 'Wero' on the German market. The study also provides a frame of reference for discussion on the adoption of new payment instruments in general, something of use when seeking a greater understanding of cryptocurrencies or Central Bank Digital Currencies.

There is much room for future research, one woefully unexplored aspect of cash persistence in Germany is its connection to German interwar period history. Both the severe inflation and banking crises could have had a lasting impact on the German populace's preferences as well as on the structure of the banking sector. There is also much room for the exploration of Milne's ideas on digital adoption outside of Europe and North America. A study of the role of cryptocurrencies as the challengers to cash in some parts of the global South could serve to further the understanding of NET in relation to payment instruments. Potential discrepancies between risk aversion in former East and West German states diverging could be another future research topic. The implications of risk aversion on financial decision making is widely studied but a connection of diverging risk aversion stemming from historically different forms of government has not been made. The case of authoritarian rule in the East and democratic rule in the West is understudied to this day in the context of its implication on diverging risk aversion. Higher risk aversion in Eastern states and its potential implication for financial convergence with the West, remains underdeveloped as well.

AI use

The AI tool Claude developed by Anthropic was used in several capacities in this thesis's production. It was used for data visualisation, conversion of quantitative data and for structural feedback of the organisational aspects of the thesis, namely scheduling and division of labour. It was also used to find peer reviewed sources but in a limited capacity and only during the early onset of the writing process. Claude was also utilised in a therapeutic capacity and during the darkest days of writing this thesis the tool was invaluable in terms of mental support. In terms of actual context however the text is solely written by the authors. All analysis, argumentation, conclusions and review is solely written by human hands.

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Appendix

For figure 6.1 on page 28 we regressed cash use at POS from ECB SPACE 2024 against the log of GDP per capita in Euro of each country in the survey. Below we display that regression and how much they differ from the expected y value in percentages. The country codes are those developed by the international organization for standardization. For the sake of clarity we will list what country each code corresponds to.

AT - Austria
BE - Belgium
CY - Cyprus
DE - Germany
EE - Estonia
ES - Spain
FI - Finland
FR - France
GR - Greece

HR - Croatia
 IE - Ireland
 IT - Italy
 LT - Lithuania
 LU - Luxembourg
 LV - Latvia
 MT - Malta
 NL - The Netherlands
 PT - Portugal
 SK - Slovakia
 SI - Slovenia

Residual Output

Observation	Predicted Y	Residuals	Difference from predicted Y in percent
AT	0,464195	0,152289	32,81%
BE	0,465565	-0,0727	-15,62%
CY	0,50053	-0,01576	-3,15%
DE	0,468228	0,065213	13,93%
EE	0,531012	-0,14022	-26,41%
ES	0,506677	0,067677	13,36%
FI	0,468228	-0,19663	-41,99%
FR	0,479032	-0,04791	-10,00%

GR	0,539941	-0,00099	-0,18%
HR	0,549472	0,00508	0,92%
IE	0,405094	0,082506	20,37%
IT	0,491916	0,113665	23,11%
LT	0,536907	0,005511	1,03%
LU	0,393614	-0,02844	-7,22%
LV	0,550246	-0,10494	-19,07%
MT	0,487805	0,180138	36,93%
NL	0,453705	-0,23722	-52,28%
PT	0,525723	0,015218	2,89%
SK	0,539527	0,032694	6,06%
SI	0,514315	0,12481	24,27%