UNIVERSITÄT TRIER

Arina Wischnewsky

Nearly Cashless: Digital Transformation or Cultural Transmission?

Research Papers in Economics
No. 4/24

Nearly Cashless: Digital Transformation or Cultural Transmission? *

Arina Wischnewsky†

Trier University

Preliminary version: 13 April, 2024

Abstract

As economies transition towards digitalization, the shift from cash to non-cash alternatives becomes increasingly relevant. While this trend is rapidly advancing in some countries, others continue to rely heavily on cash, underlining the need for central banks to measure and understand cash usage accurately. Numerous studies have attempted to explain the dynamics behind the declining—or, in some instances, paradoxically increasing—utilization of cash in conjunction with the rise of digital payment systems. Yet, the question of what fundamental factors influence cash use and how one might accurately formulate policies for a Central Bank Digital Currency (CBDC), particularly in a diverse European context, remains unanswered. This paper enriches the discourse on digital payment systems and cash usage by exploring the underlying influences on these phenomena. Notably, it provides new cross-country evidence on cultural and behavioral factors being pivotal in shaping these trends. This study is the first to reveal that (social) trust plays a crucial role in the global shift from cash reliance to digital economy integration, outlining a distinctive non-linear relationship between trust and cash usage.

JEL classifications: E41, O33, E42, C33, Z1, E7

Keywords: cash use, digital transformation, culture, national mobile payment system, cashless societies, trust, monetary systems

*Great appreciation to Robin Hjelte, Dennis Norup, Victoria Baudisch, Baard Slaattelid, Mario Aparicio, Alina Lapina, Raynor de Best, Niklas Scheuer, Hanna Armelius, Carl Claussen, André Reslow, David Humphrey, Mei Wang, Diane Pierret and Martina Fraschini for substantial input.

†Corresponding author. Email: wischnewsky@uni-trier.de.

1 Introduction

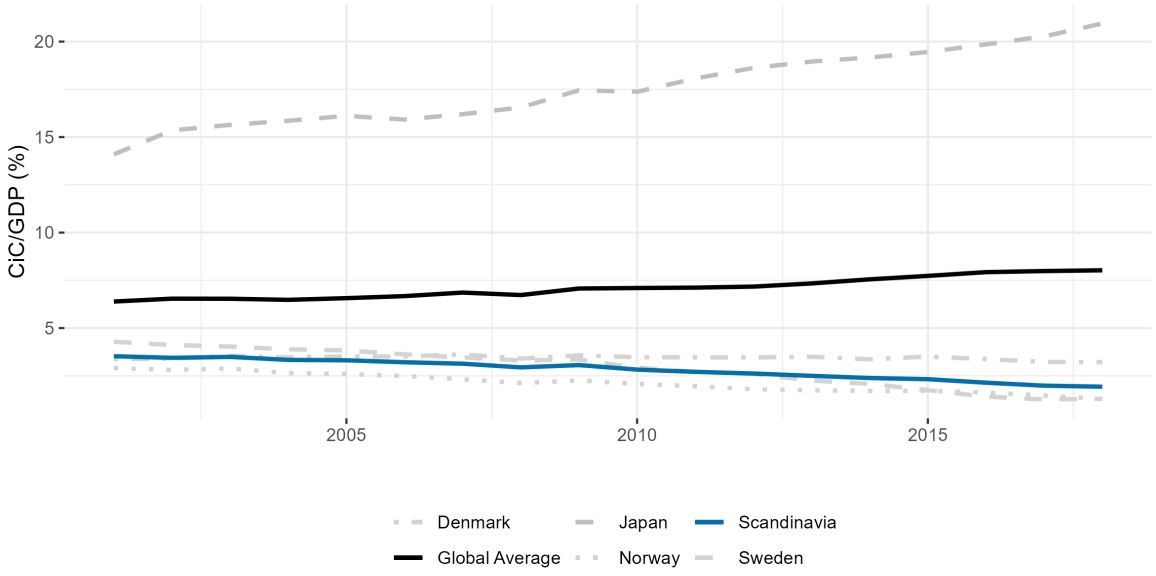
Digitalization of payment systems is what happens when, notably, the retail payments shift from cash to non-cash equivalents. While it is rapidly occurring in some economies (e.g., Sweden, China, New Zealand, South Korea), other countries continue to heavily rely on cash (e.g., Japan, India, Germany, Thailand). Paradoxically, in a world with increasing usage of alternative means of payment, such as cards and mobile payments, on average, cash demand is still rising. In fact, Scandinavia (Denmark, Norway and Sweden) is the only region that experienced a negative change in the use of cash since year 2000. Figure 1 shows a change of -45% in currency in circulation as a ratio of nominal GDP (CiC/GDP) in Scandinavian region, as opposed to the global average of 26%. To comprehend the potential adoption of digital currencies and the volume of (cash) money circulating in an economy, central banks need to, first, accurately measure (cash) money usage and, then, identify its determining factors. Yet, what is currently presented in the literature on both aspects, exhibits significant limitations.

One prevalent method of quantifying cash usage is the CiC/GDP ratio, despite its limitations in accurately reflecting the actual use of cash in payment transactions. This ratio, while offering a broad measure of cash availability within an economy, may fail to account for hoarding behavior and the presence of cash in the shadow economy. Consequently, it does not necessarily indicate the true share of cash payments in retail transactions entirely accurately (Evans et al., 2013; Khiaonarong and Humphrey, 2019). ATM cash withdrawals is another measure of cash demand which accounts for velocity. Nevertheless, neither measure is perfect and the readily available data associated with CiC measure (as opposed to the ATM measure which is highly scarce as can be seen in Figure 2) provides a useful starting point for further investigation.

Even as this ratio continues to increase in most economies – with the notable exception of Scandinavian countries – the demand for cash is decreasing as non-cash

payment instruments are adopted more widely. Furthermore, the body of literature examining the utilization of cash and non-cash payment instruments and their influencing factors is disjointed. Recent studies advance the field (e.g., Armelius et al., 2022) albeit without fully incorporating the insights from some existing foundational works (e.g., Humphrey et al., 1996). Furthermore, when they do, the studies often rely on quite limited datasets (Cabezas and Jara, 2021). The special case of Scandinavian countries of being highly digitized (i.a., equipped with *national* payment systems such as Swish in Sweden, MobilePay in Denmark and Vipps in Norway, as visualized in Figures A1 and A3) and being nearly cashless is little studied (Beaumont et al., 2019; Engert et al., 2019).

Figure 1: Currency in Circulation over GDP in Scandinavia vs. RoW



Source: International Monetary Fund, World Bank.
Note: Percentage change in the CiC-to-GDP ratio over the period 2001–2019 for 129 countries. Global average excludes Scandinavia. The all-time high is observed for Guinea Bissau in the year 2016, with a ratio of approximately 32%. On the other end, the lowest in the world is observed for Iceland before the crash, in the year 2007, with a ratio of around 1%.

This study investigates the link between one of the most important indicator underlying central bank policies–the use of cash–and culture. The present analysis reveals that one of the mechanisms through which culture impacts the adoption of

cashless payment methods is by the prevailing level of trust, which is sometimes referred to as social capital (or, at least, the central part of it). The nonlinear, hump-shaped relationship between trust and the reliance on cash relative to the size of an economy suggests a complex dynamic where increasing levels of trust initially correlate with an increase in cash circulation, albeit at decreasing rates, before this relationship becomes inverse. This pattern underscores the predominance of trust-based cashless payment systems in high-trust societies.

The inception of national mobile payment systems in Scandinavia–such as Swish, MobilePay, and Vipps[1]–likely manifests not from the supply-side aspirations of fintech or major payment companies seeking extensive consumer data and funds, but rather from a robust demand-side driven by the diminishing use of banknotes and coins (as can be seen in Figures A1, A3 and A2) and the existing and rising trust among economic agents. These demonstrate a readiness to share personal information necessary for facilitating digital transactions, indicating that the shift away from cash towards digital payment solutions is in this case likely consumer-driven. Finally, the transition toward cashless economies remains arguable, particularly when considering the enduring advantages of cash. Notably, in regions like Scandinavia–where the dominance of major bigtechs is limited and national mobile payment systems operate on minimal profit margins, if at all,–the preference for cash among consumers should persist. This trend suggests that the perceived obsolescence of cash is not inevitable. As Scott (2022) eloquently frames it, cash should be viewed as the "bicycle" of payment methods, rather than an antiquated "horse carriage." This metaphor underscores the enduring value and utility of physical money in facilitating direct and straightforward transactions.

The paper is organized as follows. Section 2 provides theoretical considerations and conceptual background dealing with the use of cash vs. digital payment in-

[1]The end of 2022 is marked by the merger between Vipps and MobilePay which allows the creation of a new corporate group named Vipps MobilePay, aiming to become a leading digital wallet in the Nordics and Europe. By early 2024, the fintech has garnered a user base exceeding 11.5 million across Denmark, Finland, and Norway. With plans underway, Sweden is identified as the next market for expansion.

struments and presents the main hypothesis tested. Section 3 discusses the data and the empirical methodology and Section 4 presents the results. The article concludes with a discussion in Section 5.

2 Conceptual Background

The debate about cashless society started not with the introduction of bank cards in the 1960s, but rather earlier, with the wide acceptance of checks in the US in the 19th century (Bátiz-Lazo et al., 2014; Bátiz-Lazo et al. 2016; James and Weiman, 2010; Quinn and Roberds, 2008). It became more vivid in 2013, though, with reports and news stories about homeless beggars not accepting cash any longer in Sweden and preferring cards (Gustafsson and Magnusson, 2013). Later in 2018 it became known that the biggest church in Sweden where over 60% of Swedes belong to (despite the widely accepted belief of the region's high secularization) became an absolutely cash-free organization (Arvidsson, 2019). Around that time, between years 2012 and 2015, as a result of a collaboration among six major Swedish banks to facilitate easy and instant mobile payments, Swish was introduced, primarily as a peer-to-peer transfers solution for splitting bills in the restaurants in the absence of enough cash. Independently, equivalent solutions were developed in Denmark the same year and in Norway two years later, in 2015 - all of which rapidly obtained the status of national mobile payment systems due to their total-population market penetration rates.

There has been a coevolution of financial and technological innovations, which eventually evolved into a standalone fintech discipline. Yet, there is a wide range of non-technological factors that play a role in the adoption of digital payment systems and the growth or slow decline of cash use (e.g., see Table A2). A good example would be Japan that is known for being one of the most technologically advanced countries, where the first launch of a fast payment system (FPS) took place way before the rest of the world, in 1973, where the QR-code was invented, where m-

commerce, i.e., mobile banking, originated and so forth (BIS, 2021; Mullan et al., 2016). Nevertheless, Japan is among the top five cash-loving countries, measured by the average for around the last two decades CiC/GDP ratio (after Guinea Bissau, Morocco, Algeria and Albania). Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) are in the top twenty in the descending order.[2]

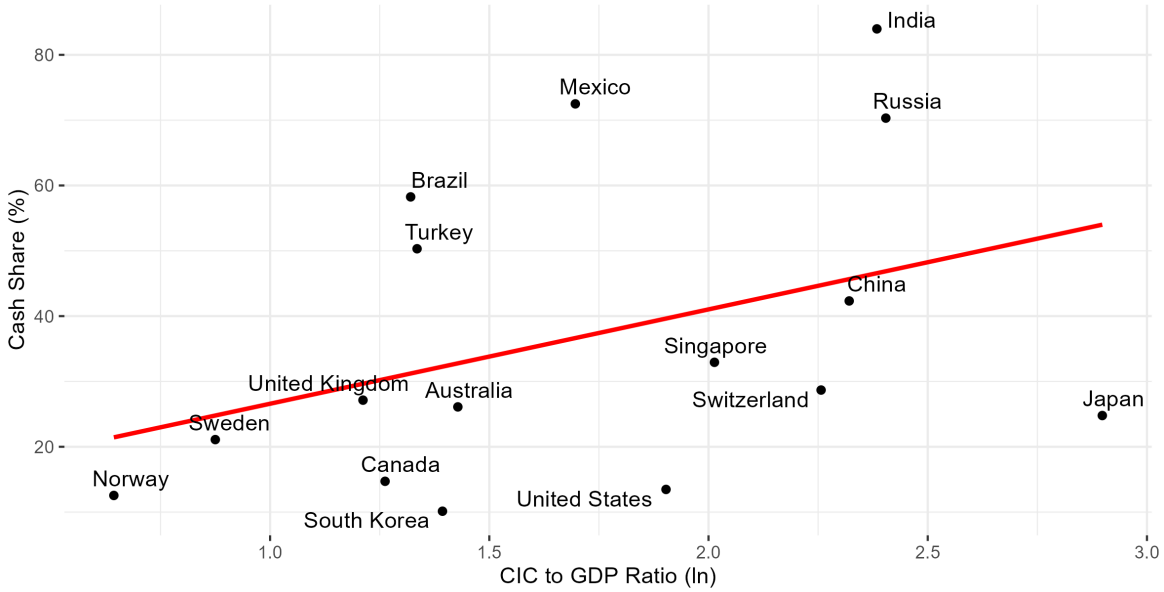
Still, according to another measure reflecting the use of cash in a country, cash share (monetary value of cash transactions over the sum of cash, card and e-payments transaction values), first proposed by Evans et al. (2013) and adjusted by Khiaonarong and Humphrey (2019), Japan is, rather, somewhere on the other half of the list, on average, as visualized in Figure 2. Whereas, the latter has a downward-sloping dynamics for almost all the jurisdictions available at the BIS Committee on Payments and Market Infrastructures (CPMI), it is, again, only the Scandinavian countries in case of the former. Despite the fact that there is no perfect cash use measure and that the precise country-level measurement is not straightforward, on average, there is a strong positive association between the two indicators.

Multiple studies attempted to investigate, what drives the use of cash as opposed to the use of a digital payment instrument from the macroeconomic perspective (e.g., Armelius et al., 2022; Cabezas and Jara, 2021; Titova et al., 2021). While many find some determinants, a large unexplained variation still remains. Cabezas and Jara (2021) are first to point to the existence of idiosyncratic or cultural factors that must be the missing puzzle. Although cultural factors have been empirically linked to economic and financial outcomes (Alesina and Giuliano, 2015), e.g., economic development (Gorodnichenko and Roland, 2011), financial development and financial decision-making (Guiso et al., 2004; 2006), little is known on the exact channels and implications for monetary and payment systems. What we know,

[2]Although the terms "Nordic" and "Scandinavian" are often used interchangeably to describe the cultural and societal characteristics of this region, it is important to distinguish between them. Scandinavia specifically refers to Denmark, Norway, and Sweden, forming a subset within the broader Nordic region that also includes Finland and Iceland. Despite the shared cultural attributes across these five Nordic countries, this distinction underscores the nuanced differences within the collective identity of the region. Economically, each of the Scandinavian countries have its own distinction: Sweden, Norway and Denmark represent industrial, oil and trade nations, respectively.

though, is that (country-of-birth) culture, particularly as it pertains to payment behavior, i.e., cash vs. cashless, exhibits a strong persistence across individuals and is not inherited by the second generation of movers (Kosse and Jansen, 2013). In addition, a central cultural variable, social capital (or trust), is associated with a higher use of cashless payment instruments such as checks, lower investments in cash and higher in stocks (Guiso et al., 2004).

Figure 2: Cash Share vs. Currency in Circulation over GDP



Source: International Monetary Fund, Bank for International Settlements, Norges Bank, Engert et al. (2019) for additional data on cash and OTC withdrawals in Canada.
Note: Country averages over the period 2005–2019 ($\rho = 0.39$). Cash share is calculated as the monetary value of cash over the sum on cash and non-cash transactions (card- and e-payments). CiC is a stock and cash share is a flow variable, accounting for velocity.

In addition, trust as a reflection of privacy considerations may play a crucial role in the adoption of (personal) data-intensive systems like mobile payments, where one typically needs to provide not only bank account data but also a mobile phone number, personal ID, etc. In the Nordic region it is common to be able to find personal and/or sensitive data of people online, e.g., income and tax statements of neighbors, which would be impossible in other parts of Europe, especially, in Germany. Indeed, there have been found fundamental differences between Norwegian

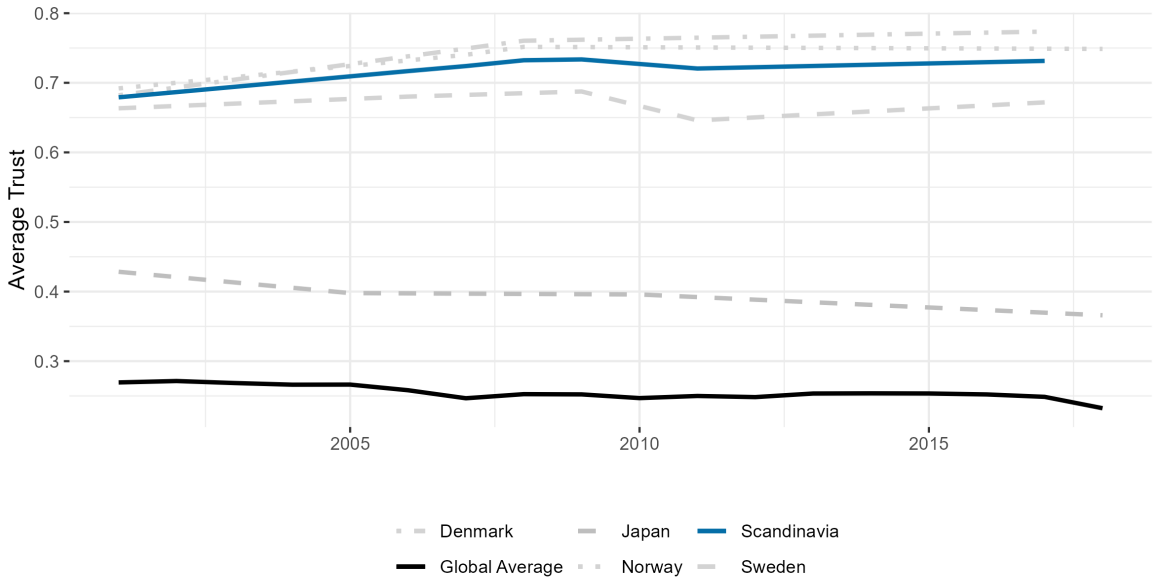
(significantly less privacy-sensitive and more disclosing) and German (significantly more privacy-sensitive and less disclosing) social media users in terms of privacy concerns and attitudes as well as intention to self-disclose (Oghazi et al., 2020).

One of the most extensive and enduring research initiatives on cultural values, the World Values Survey (WVS), with its over four decades of data collection, emerges as a pivotal resource. This survey uncovers that cultural diversity primarily varies along two axes: (i) traditional versus secular-rational values and (ii) survival versus self-expression values. Traditional values highlight the importance of religion, family, and respect for authority, emphasizing national pride and conservative stances on social issues like divorce and abortion. Secular-rational values, in contrast, downplay religious and traditional family roles, favoring rationality and tolerance of individual choices. Survival values focus on economic and physical security, leading to ethnocentrism and lower trust, while self-expression values environmental protection, tolerance, gender equality, and active civic participation. These dimensions reflect a society's orientation towards tradition, modernization, and the balance between communal security and individual autonomy, illustrating a global shift from traditional and survival values to more secular-rational and self-expressive priorities as societies develop economically and socially. The influential work of Putnam et al. (1993) emphasized that the gateway for integrating cultural aspects into economic discourse has been the idea of trust, in particular.

Scandinavia has, indeed, enjoyed high levels of trust since the end of the World War II (Algan and Cahuc, 2010). Generalized trust levels have been increasingly high since then. One of the explanations in the literature boils down to the fact that Scandinavian countries are often highlighted for their "cuddly" capitalism, characterized by greater social insurance and less inequality, contrasting with "cutthroat" capitalism, which is more inequality-driven and innovation-focused (Acemoglu et al., 2017). In addition to more free time, the fact that Scandinavians have "nothing to lose" in such a setting makes them, i.a., more open to innovations and their adoption (like digital payment systems) than the societies that create them, e.g., the

US. These causes seem institutional at first glance, however, they are also rooted in culture that, in turn, lead to the construction of institutions.

Figure 3: (Generalized) Trust in Scandinavia vs. RoW



Source: World Values Survey.
Note: Dynamics over the period 2001–2019 for 129 countries. Global average excludes Scandinavia.

Interestingly, trust used to be somewhat similarly high in Germany but dropped after the second World War. In 1910, Germany had even higher levels of inherited trust compared to Sweden (Algan and Cahuc, 2010). This supports the findings that, although trust is embedded in culture, it itself can be affected by cultural variables like shared religion and historical experiences, such as political regimes, conflicts or wars (Guiso et al., 2006). Consequently, while technological infrastructure and economic factors might set the stage for the transition towards cashless societies, the underlying cultural fabric, mainly characterized by trust and societal norms, may ultimately determine the pace and extent of this evolution.

3 Data and Empirical Methodology

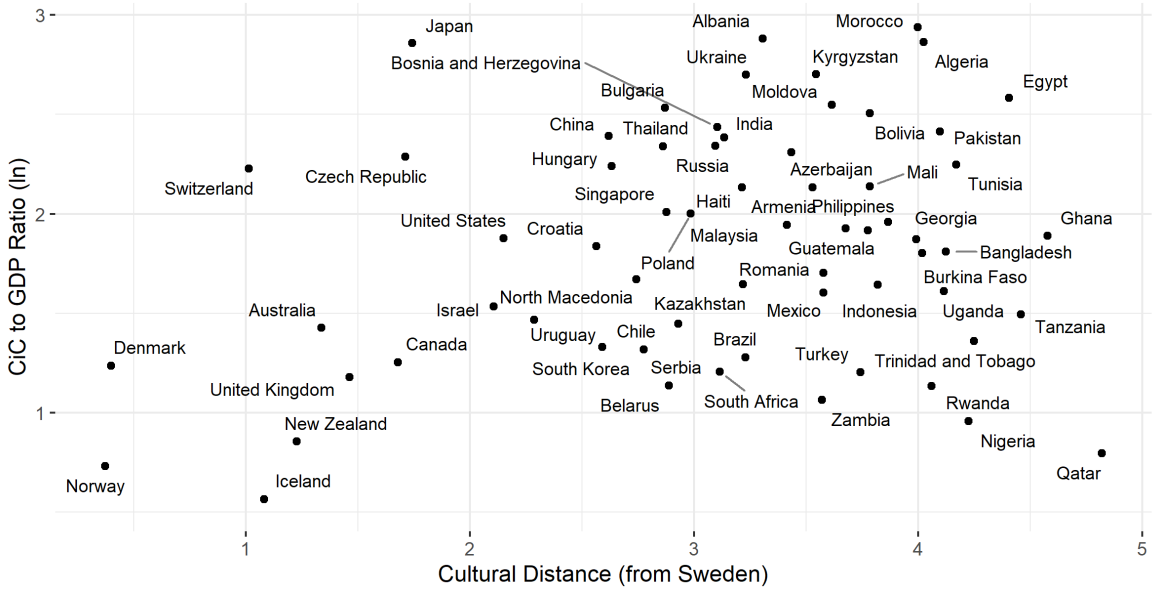
3.1 Data

The dataset for this study comprises an array of variables pivotal for analyzing cash usage (and, consequently, digital payment adoption) across different countries. The main data spans from 2001 to 2019 (it deliberately stops right before the Corona crisis to due to the necessity to exlude the COVID years from the analysis), covering total of 63 countries (yet, potentially 129 countries for some specifications), with 19 being OECD members and 10 being often referred to as WEIRD (Western, Educated, Industrialized, Rich, and Democratic) societies in the behavior-, psychology- or culture-related literature.[3] The selection is based on the availability of CiC data in the International Monetary Fund (IMF) database, excluding countries without key data and those in the Eurozone. Data sources and the overview of the variables are presented in Table A1, and the descriptive statistics is shown in Table 1.

In addition to the economic and institutional variables like *ln* GDP per capita, monetary policy key rate, the ratio of self-employed population, a demographic metrics like the age dependency ratio is utilized to capture the age structure of the population. Technological advancement is proxied by the share of people using internet in the country. Governance metrics incorporate regulatory quality and control of corruption, from the Worldwide Governance Indicators (WGI); public trust in politicians – from the Global Competitiveness Index (GCI), and human rights scores are based on Fariss (2019).

[3]The term first coined by Henrich et al. (2010) referred to the WEIRD bias found in the behavioral studies, where, as estimated by the authors, 96% of all existing psychological samples had come from countries with only 12% of the world's population.

Figure 4: Cultural Distance and Cash Use



Source: International Monetary Fund, World Bank, World Values Survey.
Note: Country averages over the period 2001–2019. The cultural distance metric is derived following the methodology of Konara and Mohr (2019), using the two main cultural dimensions from the WVS (Survival vs. Self-Expression and Traditional vs. Secular), with Sweden as the baseline. This measure, aimed at correcting the inaccuracies of the Kogut and Singh (1988) index, adheres to the principles of Euclidean distance.

Cultural dimensions (Traditional vs. Secular and Survival vs. Self-Expression) and generalized trust, which represent the cultural variables in this analysis, are extracted from the WVS. The generalized trust variable is measured using a specific question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"[4] This question aiming to capture an individual's inclination to trust others, is a general reflection of a soci-

[4]The notably low generalized trust in Iceland, particularly compared to other Nordic countries, is perplexing, given its relative homogeneity, small population, and strong community ties. Analysis reveals a strong correlation between the European Value Study's yes/no questions and the European Social Survey's 11-point scale across Europe—except in Iceland and Ireland (Vilhelmsdóttir, 2020). This anomaly may stem from the Icelandic translation of the survey question, which uses the term "strangers" instead of "people," as in the English version. Assuming that trust levels in Iceland were at least as high as in the rest of the Nordic region, with institutional trust sometimes even higher, the data would indicate a very high trust level also in 2008, when the GFC occurred. It is arguable that excessively high trust levels could have exacerbated the severity of the crash. Furthermore, the fact that Iceland is the first European country to introduce a fast payment system in 2003 supports the idea of high trust in the economy (BIS, 2021).

ety. Additionally, the responses are rescaled: "need to be very careful" as 0, "don't know" as 0.5 and "most people can be trusted" as 1, which simplifies the analysis by reducing the categories to three essential ones and assigning them a straightforward numeric scale (omitted responses: "missing: other", "not asked" and "no answer"). To address data gaps, interpolation and extrapolation techniques are employed to complete some missing observations.

Figure 5: (Simplified) Cultural Distance and Cash Use

Source: International Monetary Fund, World Bank, World Values Survey.
Note: Country averages over the period 2001–2019.

Cultural Distance is a function of differences in values, norms, preferences, behavioral characteristics, beliefs, communication styles and the like that are rooted in culture. Following the methodology of suggested by Konara and Mohr (2019), based on the Euclidean distance principle, the cultural distance (CD) metric is derived as follows:[5]

[5]This formula corrects the original Kogut and Singh (1988) index of cultural distance by taking the square root of the sum of squared differences, each standardized by the variance of the respective cultural dimension.

Table 1: Descriptive Statistics

Variable	**N**	**Mean**	**St. Dev.**	**Min**	**Max**
CiC/GDP (%)	799	7.67	4.67	1.12	21.97
ln (CiC/GDP)	799	1.85	0.63	0.12	3.09
GDP per capita	799	16,235	20,540	239	102,913
ln GDP per capita	799	13.49	1.35	10.08	16.15
Interest	799	6.36	6.43	-0.78	83.87
Age Dependency Ratio	799	15.86	7.44	0.83	45.13
Self Employment	799	32.85	20.88	0.62	93.03
Internet Use	799	43.27	29.26	0.09	98.26
Human Rights	799	0.43	1.64	-2.38	4.94
Quality of Regulation	799	61.80	24.90	3.92	100.00
Corruption Control	799	55.09	29.32	0.53	100.00
Public Trust in Politicians	524	3.13	1.26	1.32	6.48
(Generalized) Trust	799	0.28	0.17	0.03	0.77
Traditional vs. Secular	799	-0.23	0.83	-2.17	1.86
Survival vs. Self-Expression	799	0.01	1.21	-2.14	2.99
Cultural Average	799	2.22	0.84	0.15	3.63
Cultural Distance	799	2.90	1.06	0.06	4.82

Note: Generalized Trust, Traditional vs. Secular, Survival vs. Self-Expression, Cultural Average, and Cultural Distance capture the behavioral-cultural dimensions and are derived from the WVS.

$$CD_{ij} = \sqrt{\sum_{k=1}^{n} \left(\frac{(I_{ki} - I_{kj})^2}{V_k} \right)} \tag{1}$$

where CD_{ij} represents the cultural distance between country i and country j, n denotes the number of dimensions considered (in this case, n=2), I_{ki} is the index score of country i on dimension k, I_{kj} is the index score of country j on dimension k, and V_k is the variance of dimension k across all countries. This allows for a quantifiable assessment of the cultural differences between economies, taking into account multiple aspects of culture and normalizing for the distribution of each cultural dimension. Cultural Average (or the simplified cultural distance) is calculated as an expectation of the two main cultural dimensions subtracted from the respective Swedish average. As visualized in Figures 4 and 5, these are two indicators of culture, constructed in different ways out of identical inputs.

3.2 Empirical Methodology

The panel data model employs the following functional specification for estimating cash usage, denoted by y_{it}:

$$y_{it} = \alpha + \delta_t + \beta X_{it} + u_{it}, \tag{2}$$

where α is the common constant across all observations, δ_t represents the time fixed effects to capture any time-specific influences that are common to all countries, βX_{it} is the vector of coefficients for the explanatory variables, and u_{it} is the error term.

Building on the existing evidence on the drivers behind the use of cash (Table 2, column (1)), an enhanced panel dataset surpassing the standard benchmark is assembled to investigate the missing puzzle explaining a substantial part of the variation in the dependent variable. Although cultural variables are not entirely time-invariant, they are slow-moving and the within-variation is rather limited. Thus,

country fixed effects are not considered as an appropriate model specification and the estimations are based on the pooled Ordinary Least Squares (OLS).[6]

To account for the possibility of correlated errors within countries, standard errors are clustered at the country level. This adjustment allows for the relaxation of the assumption that observations are independent across time within the same country, ensuring more robust inference by correcting the standard errors to account for this within-group correlation. This approach is particularly important in the context where the assumption of independent errors may not hold due to country-specific shocks or policies that affect cash usage patterns uniformly within countries but vary across countries.

4 Results

The estimation results show that non-economic and non-institutional determinants have the strongest impact on the use of cash. The most robust relationships across all model specifications, as it can be inferred from Tables 2 and 3, are interest rate and the age dependency ratio. Control of corruption turns significant and negative in most specifications, except for the ones involving the Survival vs. Self-Expression cultural dimension. Monetary policy rate and per capita income are negatively associated, whereas the demographic structure, i.e., how old a society is, has a positive association with the use of cash. The rest of the non-cultural variables does not seem to matter, including the technological factor, which is in line with other studies documenting that internet or mobile usage either do not significantly affect the use of cash or impacts it in an unexpected direction (Armelius et al., 2022; Titova et al., 2021).

The harmonized results presented in Table 2 reveal that culture matters the more, the more granular elements it can be decomposed into (from the biggest pic-

[6]The model specification estimated with covariates lagged by one period in order to mitigate the endogeniety problem yield very similar results as shown in Table A3.

Table 2: Harmonized Estimation Results: 63 Countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln GDP per capita	-0.212	-0.159	-0.167	-0.093	-0.095	-0.190	-0.185
	(0.140)	(0.148)	(0.147)	(0.143)	(0.139)	(0.151)	(0.147)
Interest Rate	-0.037***	-0.038***	-0.038***	-0.039***	-0.038***	-0.037***	-0.036***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)
Age Dep. Ratio	0.036***	0.042***	0.043***	0.035***	0.027**	0.037***	0.034***
	(0.014)	(0.013)	(0.013)	(0.012)	(0.013)	(0.014)	(0.013)
Self-Employed	-0.003	-0.003	-0.003	-0.001	-0.000	-0.003	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Internet Use	-0.001	0.001	0.001	0.000	-0.002	-0.000	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Human Rights	-0.089	-0.057	-0.066	-0.053	-0.066	-0.082	-0.074
	(0.056)	(0.058)	(0.058)	(0.052)	(0.050)	(0.056)	(0.055)
Quality of Regulation	0.005	0.004	0.004	0.003	0.004	0.003	0.004
	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
Corruption Control	-0.009*	-0.009*	-0.009*	-0.006	-0.005	-0.009*	-0.008*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Cultural Distance		0.185*					
		(0.111)					
Cultural Average			0.204				
			(0.142)				
Surv. vs. Self-Exp.				-0.239**	-0.219**		
				(0.081)	(0.080)		
Tradit. vs. Secular					0.132		
					(0.095)		
Trust						-0.303	1.712*
						(0.391)	(0.917)
(Trust)^2							-2.744**
							(1.110)
Observations	799	799	799	799	799	799	799
R^2	0.47	0.49	0.48	0.53	0.54	0.47	0.49
Adj. R^2	0.45	0.47	0.46	0.51	0.52	0.45	0.47
BIC	1196	1172	1181	1103	1092	1197	1171
Year FE	✓	✓	✓	✓	✓	✓	✓

Note: Yearly data for the period 2001–2019. Pooled OLS estimations. Standard errors are clustered at the country level and displayed in parentheses. The symbols (***, **, *) denote significance levels, with *** indicating p<0.01, ** indicating p<0.05, and * indicating p<0.1.

Table 3: Alternative Model Specification: 56 Countries

	(1)	(2)	(3)	(4)
ln GDP per capita	-0.200	-0.177	-0.136	-0.224*
	(0.131)	(0.126)	(0.119)	(0.134)
Interest Rate	-0.066***	-0.067***	-0.063***	-0.066***
	(0.013)	(0.013)	(0.012)	(0.015)
Age Dependency Ratio	0.054***	0.053***	0.035***	0.043***
	(0.010)	(0.011)	(0.013)	(0.011)
Internet Use	0.005	0.007	0.003	0.005
	(0.004)	(0.004)	(0.004)	(0.005)
Human Rights	-0.067	-0.061	-0.056	-0.081
	(0.052)	(0.054)	(0.051)	(0.051)
Quality of Regulation	-0.003	-0.004	-0.002	-0.005
	(0.007)	(0.006)	(0.006)	(0.007)
Corruption Control	-0.009*	-0.009*	-0.006	-0.010**
	(0.005)	(0.005)	(0.005)	(0.005)
Public Trust in Politicians	0.114*	0.085	0.063	0.114
	(0.063)	(0.062)	(0.059)	(0.074)
Cultural Distance	0.270**			
	(0.108)			
Cultural Average		0.406***		
		(0.144)		
Survival vs. Self-Expression			-0.291***	
			(0.074)	
Traditional vs. Secular			0.051	
			(0.104)	
Trust				-0.948**
				(0.428)
Observations	524	535	535	540
R^2	0.56	0.55	0.60	0.51
Adj. R^2	0.54	0.53	0.58	0.50
Year FE	✓	✓	✓	✓

Note: Yearly data for the period 2001–2019. Pooled OLS estimations. Cultural Average can be interpreted as the average distance from Sweden on the major cultural dimensions (Traditional vs. Secular and Survival vs. Self-Expression obtained from the WVS). Standard errors are clustered at the country level and displayed in parentheses. The symbols (***, **, *) denote significance levels, with *** indicating p<0.01, ** indicating p<0.05, and * indicating p<0.1.

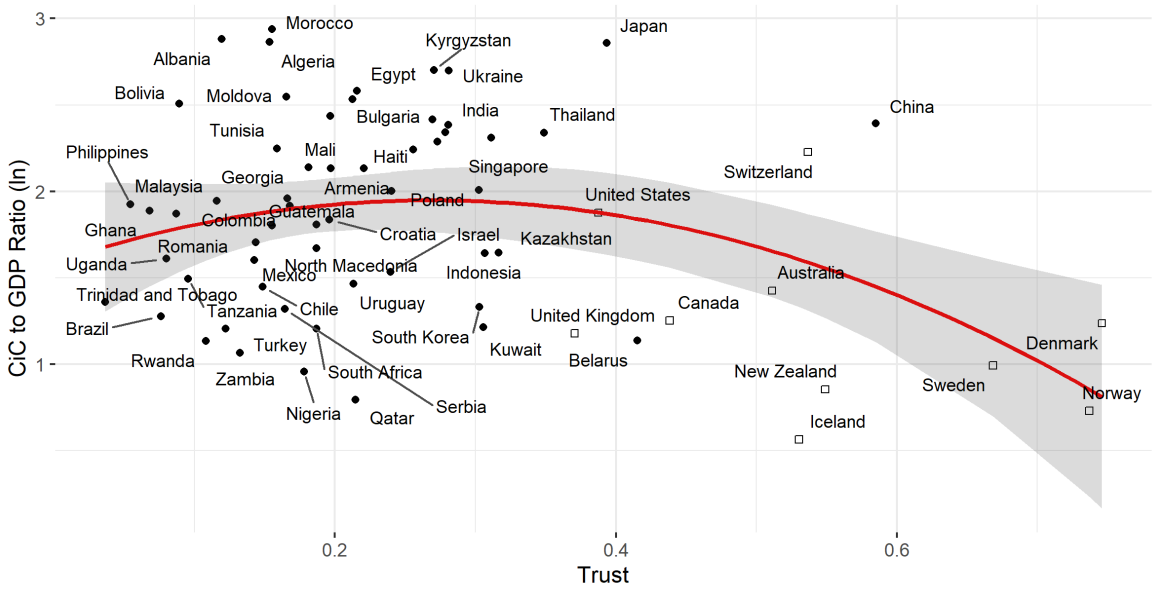
ture, i.e., cultural distance, to the zoomed-in element of trust, which is also a part of the broader Survival vs. Self-Expression dimension). The closer a society moves from survival to self-expression values, the less cash-intensive it appears.

More precisely, on average, a one percentage point increase in the key monetary policy rate is accompanied with 3.6%–6.7% decrease in cash use. Correspondingly, a one-standard-deviation shock in interest rates is associated with a 23%–43% drop in cash demand. A one-unit increase in corruption control implies a 0.8 to 1 percent lower cash-to-GDP ratio. Respectively, one standard deviation raise in corruption control translates into 23%–29% decrease in the ratio. Next, economies with a 1 percentage point higher age dependency ratio are on average expected to rely on cash 2.4 to 4.3 percent more. Put another way, a one standard deviation increase in the share of old to the working-age population, is linked to approximately 20%–40% more cash use.

Moreover, the farther away a country is culturally from Sweden (that has the highest scores on both cultural dimensions, on average), the more cash-intensive it appears: one step away may imply up to 27% (when proxied by the cultural distance index) to 41% (when measured by a simple expectation of the two main cultural dimensions) increase in cash use. Put differently, a one standard deviation increase in Cultural Distance is associated with an approximate 19%–29% increase in the CiC/GDP ratio. Similarly, a one standard deviation increase in Cultural Average corresponds to an increase in cash demand of around 34%, when public trust in politicians is controlled for. Societies that score higher on self-expression are more likely to embrace cashless transactions, reflective of their openness to innovation and change in the financial domain. One unit rise in the society's cultural orientation score (if a society moves from being survival-centered one unit closer to being self-expression-centered) implies a 22 to 29 percent drop in the CiC/GDP ratio. In other words, one standard deviation towards self-expression would mean a lower cash use around 25–35 percent. Nevertheless, trust substantially exceeds the economic significance of the rest of the cultural variables, when interpreted in terms

of units of measure: a one-unit shock in trust is associated with almost a twofold fall in cash demand, when controlling for public trust in politicians. On the other hand, a one standard deviation increase in trust would correspond to a 16% decrease in the use of cash.

Figure 6: Trust and Cash Use



Source: International Monetary Fund, World Bank, World Values Survey.
Note: Country averages over the period 2001–2019. On average, the *ln* (CiC/GDP) ratio increases with trust up to a level of around 0.27, corresponding approximately to Pakistan, and then begins to decrease with higher levels of generalized/social trust. WEIRD (Western, Educated, Industrialized, Rich, and Democratic) societies are represented by square markers, whereas other countries are depicted with round markers.

The significance and the signs of the trust variable and its square in Table 2 suggest a hump-shaped type of non-linear relationship between trust and the amount of cash being utilized, which is demonstrated in Figure 6. The effect of trust on cash use increases at a decreasing rate, and after a certain point, additional increases in trust have a diminishing or negative effect on the currency in circulation outstanding relative to GDP. In an inverted U-shaped pattern, initially, as generalized trust increases, with a corresponding increase in the use of cash. Similarly, more distrust

may urge people to substitute for banknotes and coins with cashless alternatives like cryptocurrencies or e-payments.

Beyond a certain level of trust, the relationship reverses, and further increases in trust lead to a decrease in the use of cash. As trust increases, there may be an initial increase in cash usage due to also increased economic activities. Yet, as trust continues to grow, a transitioning to such a trust-based system like digital payments or non-cash transactions takes place. The fitted regression line's intersection with the US suggests that the it likely exemplifies the observed global trend between trust and cash use as it often serves as a benchmark for economic and social indicators. This implies the model's validity and relevance to diverse economic contexts.

The interplay between demographic shifts and payment system preferences is profoundly illustrated in Japan's experience, a nation distinguished by the world's highest average age dependency ratio for the elderly (proportion of the elderly population aged 65 and older relative to the working-age population, aged 15-64). Over the last two decades, this ratio has on average ascended to as much as 40%, starkly contrasting with the twenty-years global average of approximately 10%. The period witnessed a surge in the ratio from about 26% to over 50%, denoting an almost twofold increase. This marked escalation signifies the growing proportion of the elderly demographic relative to the working-age public, illuminating the challenges confronting Japan. Among these challenges is the lag in embracing digital technologies, particularly in the realm of payment methods such as mobile transactions.

The reasons underpinning Japan's pronounced inclination towards cash, despite its status as a technologically advanced society, are multifaceted. Japan's cultural scene, apart from the relatively low generalized trust, characterized by a longstanding respect for physical currency, further compounds this phenomenon. Money, especially when traditionally presented in envelopes to children during special occasions, go beyond a mere economic utility, embodying significant social value. Privacy and anonymity are highly valued, rendering cash an island of privacy within the restrictions of a densely populated environment. Moreover, the nation's suscep-

tibility to natural disasters—while not empirically shown to impact currency circulation significantly within the dataset at hand (proxied by the Uncertanty Index[7])—requires a robust emergency preparedness culture. This often includes maintaining a reserve of cash, given the potential for infrastructure disruptions that could compromise digital payment systems. Finally, Japan's cash-based infrastructure includes sophisticated cash handling machines and a widespread network of ATMs that support cash payments for a variety of services, including e-commerce.

5 Conclusion

This study enhances the understanding of the trends and factors influencing the shift from cash-based payments towards electronic payment methods. The determinants of cash use (as opposed to digital payment instruments) are analyzed. In particular, the present paper highlights the so-called cultural channel of transformation of societies towards (or against) digital payments. As a matter of fact, such advancements of digital technologies like internet spread does not impact the currency in circulation. By providing a nuanced analysis, the research paves the way for a better comprehension of the perspectives of digital forms of payments and future inquiries into this critical aspect of digitalization when it comes to different societies. Apart from the cultural or behavioral drivers, the robust associations with cash use exhibit demographic characteristics, corruption and monetary policy rates.

Given an enhanced dataset of roughly 50 to 130 countries over two decades, the study suggests that idiosyncratic factors associated with cultural differences across countries do explain some of the heterogeniety in the use of cash across countries, which may be a fundamental insight in desining CBDCs in culturally diverse regions like, e.g., the euro area. Apart from different aggregated trust levels across countries, another challenge is the tendency of less likely trusting or trustworthy behavior between economic agents with national and racial differences (Glaeser

[7]The results are omitted for the sake of conserving space but are available on demand.

et al., 2000). Investigating how cultural factors should influence the design and implementation of CBDCs to ensure broad acceptance and utilization should be a promising research avenue.

As Nobel Prize laureate in Economics, Kenneth Arrow (1972) writes, "Virtually every commercial transaction has within itself an element of trust, certainly any transaction conducted over a period of time. It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence." In general, in low-trust societies, people appear to hold more currency outside of the formal banking system. Indeed, trust substantially exceeds the economic significance of the rest of the variables, at the same time reflecting a complex, non-linear relationship between trust and financial behavior. Cultural orientation and social trust turn out to be the key determinants in the transition from cash-intensive to digital-payment-based economies.

References

Acemoglu, D., Robinson, J. A. and T. Verdier (2017): "Asymmetric Growth and Institutions in an Interdependent World," *Journal of Political Economy*, 125(5), 1245–1305.

Algan, Y. and P. Cahuc (2010): "Inherited Trust and Growth," *American Economic Review*, 100(5), 2060–2092.

Alesina, A. and P. Giuliano (2015): "Culture and Institutions," *Journal of Economic Literature*, 53(4), 898–944.

Armelius, H., C.A. Claussen and A. Reslow (2022): "Withering Cash: Is Sweden Ahead of the Curve or Just Special?" *International Journal of Central Banking*, 18(4), 91–123.

Arrow, K. J. (1972): "Gifts and Exchanges," *Philosophy and Public Affairs*, 1(4), 343–362.

Arvidsson, N. (2019): "Building a Cashless Society: The Swedish Route to the Future of Cash Payments," Springer Briefs in Economics. *Springer*.

Bank for International Settlements (2021): "Developments in retail fast payments and implications for RTGS systems," *Bank for International Settlements*. URL: https://www.bis.org/cpmi/publ/d201.pdf.

Bank for International Settlements (2023): "Statistics on Payment, Clearing and Settlement Systems in the CPMI Countries: 2023 Red Book," *Bank for International Settlements*. URL: https://stats.bis.org/statx/toc/CPMI.html.

Bátiz-Lazo, B., Haigh, T., and D. L. Stearns (2016): "Origins of the Modern Concept of a Cashless Society, 1950s–1970s," in Bátiz-Lazo, B. and Efthymiou, L. (Eds.), *The Book of Payments: Historical and Contemporary Views on the Cashless Society*. Palgrave Macmillan UK.

Bátiz-Lazo, B., Karlsson, T., and B. Thodenius (2014): "The Origins of the Cashless Society: Cash Dispensers, Direct To Account Payments And The Development Of On-Line Real-Time Networks, C.1965-1985," *Essays in Economic and Business History*, 32(1), 100–137.

Beaumont, C., Mancini-Griffoli, T., Martinez Peria, M. S., Misch, F. and B. Segendorf (2019): "The Diffusion of Payment Innovations: Insights from the Stellar Rise of Swish" (unpublished manuscript).

Cabezas, L. and A. Jara (2021): "The demand for cash: stylized facts and substitution by electronic means of payment," *CEPAL Review*, 135, 119–145.

Engert, W., B. Fung, and B. Segendorff (2019): "A Tale of Two Countries: Cash Demand in Canada and Sweden," Sveriges Riksbank Working Paper Series No. 376.

European Central Bank (2022, July): "ECB Payment statistics," Retrieved from URL: https://data.ecb.europa.eu/sites/default/files/2023-06/Payment%20Statistics%20%28full%20report%29.pdf

Evans, D. S., Webster, K., Colgan, G. K., and S. R. Murray (2013). "Paying with Cash: A Multi-Country Analysis of the Past and Future of the Use of Cash for Payments by Consumers." URL: `http://ssrn.com/abstract=2273192`.

Fariss, C. J. (2019): "Yes, Human Rights Practices Are Improving Over Time." *American Political Science Review*, 113(3), 868–881.

Glaeser, E. L., Laibson, D. I., Scheinkman, J. A. and C. L. Soutter (2000): "Measuring trust," *The Quarterly Journal of Economics*, 115(3), 811–846.

Gorodnichenko, Y. and G. Roland (2011): "Which dimensions of culture matter for long-run growth?" *American Economic Review*, 101(3), 492–498.

Guiso, L., Sapienza, P., and L. Zingales (2004): "The Role of Social Capital in Financial Development," *The American Economic Review*, 94(3), 526–556.

Guiso, L., Sapienza, P. and L. Zingales (2006): "Does Culture Affect Economic Outcomes?" *Journal of Economic Perspectives*, 20(2), 23–48.

Gustafsson, K. and N. Magnusson (2013): "Stockholm Homeless Accept Credit Cards as Cash Is King No More," *The Independent*, October 28.

URL: https://www.independent.co.uk/news/world/europe/stockholm-homeless-accept-credit-cards-as-cash-king-no-more-8910867.html

Henrich, J., Heine, S. J. and A. Norenzayan (2010): "The weirdest people in the world?" *Behavioral and Brain Sciences*, 33(2–3), 61–83.

Humphrey, D., L. Pulley and J. Vesala (1996): "Cash, paper, and electronic payments: A cross-country analysis", *Journal of Money, Credit, and Banking*, 28(4) 914–939.

Inglehart, R. and Welzel, C. (2005): "Modernization, Cultural Change, and Democracy: The Human Development Sequence," *Cambridge University Press*.

James, J.A. and D.F. Weiman (2010): "From Drafts to Checks: The Evolution of Correspondent Banking Networks and the Formation of the Modern U.S. Payments System, 1850–1914," *Journal of Money, Credit and Banking*, 42, 237–265.

Khiaonarong, T., and D. B. Humphrey (2019): "Cash Use Across Countries and the Demand for Central Bank Digital Currency." *International Monetary Fund*. URL: https://www.imf.org/en/Publications/WP/Issues/2019/03/01/Cash-Use-Across-Countries-and-the-Demand-for-Central-Bank-Digital-Currency-46617

Kogut, B. and H. Singh (1988): "The Effect of National Culture on the Choice of Entry Mode," *Journal of International Business Studies*, 19(3), 411–432.

Konara, P. and A. Mohr (2019): "Why We Should Stop Using the Kogut and Singh Index," *Management International Review*, 59(3), 335–354.

Kosse, A. and D.-J. Jansen (2013): "Choosing how to pay: The influence of foreign backgrounds," *Journal of Banking & Finance*, 37(3), 989–998.

Mullan, J., Bradley, L. and S. Loane (2016): "Barriers and Drivers to Future Bank Adoption of Mobile Banking: A Stakeholder Perspective," in Bátiz-Lazo, B., and Efthymiou, L. (Eds.), *The Book of Payments: Historical and Contemporary Views on the Cashless Society*. Palgrave Macmillan UK.

Oghazi, P., Schultheiss, R., Chirumalla, K., Kalmer, N. P. and F. F. Rad (2020): "User self-disclosure on social network sites: A cross-cultural study on Facebook's privacy concepts," *Journal of Business Research*, 112, 531–540.

Putnam, R. D., Leonardi, R. and R. Y. Nonetti (1993): "Making Democracy Work: Civic Traditions in Modern Italy," *Princeton University Press*.

Scott, B. (2022): "Cloudmoney: Cash, Cards, Crypto, and the War for Our Wallets," *Bodley Head*.

Titova, Y., Cornea, D., and S. Lemeunier (2021): "What Factors Keep Cash Alive in the European Union?," *De Economist*, 169(3), 291–317.

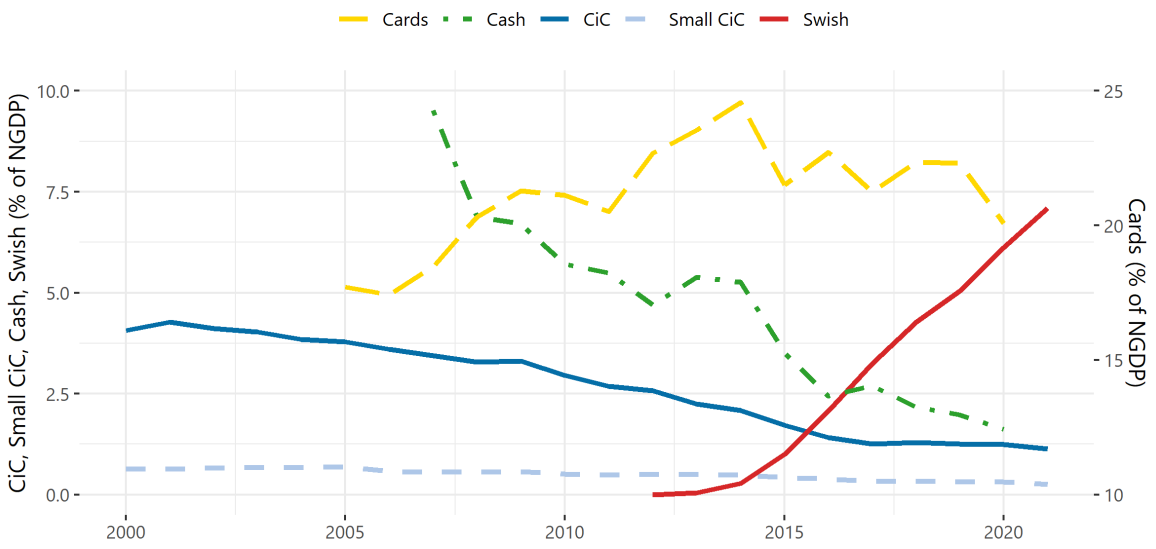
Quinn, S. F. and W. Roberds (2008): "The Evolution of the Check as a Means of Payment: A Historical Survey," *Economic Review (Atlanta, Ga.)*, 93(4), 1-28.

Vilhelmsdóttir, S. (2020). "Political Trust in Iceland: Determinants and trends, 1983 to 2018," Doctoral dissertation, University of Iceland. DOI: 10.13140/RG.2.2.10734.77124

World Values Survey (2020): "Findings and Insights," *World Values Survey*. URL: `http://www.worldvaluessurvey.org`.

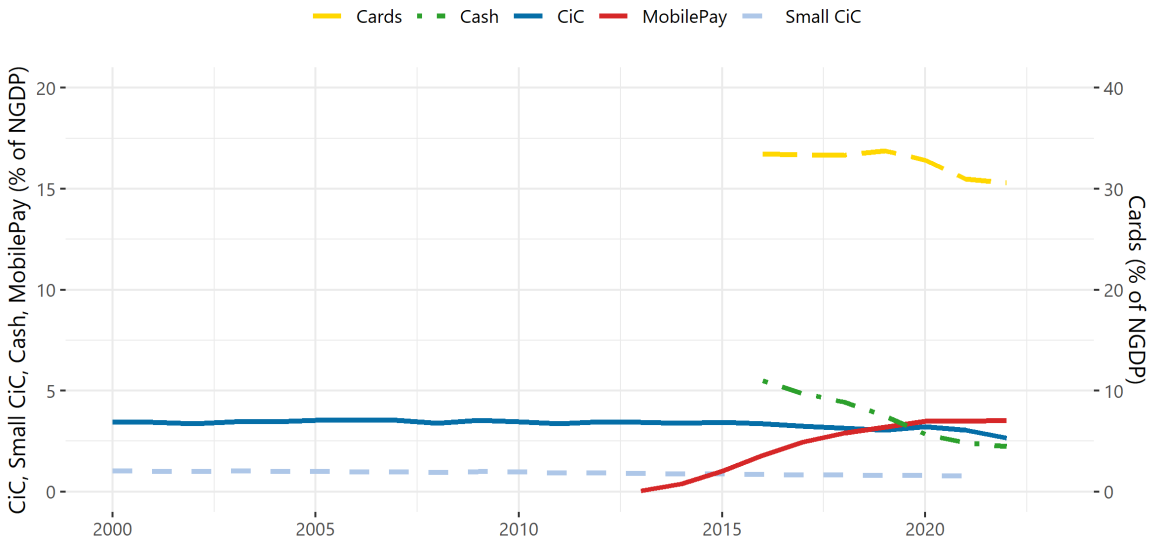
A Appendix

Figure A1: Swedish Fast Payment System (Swish)



Source: Bank for International Settlements, Swish, International Monetary Fund, World Bank. All figures as a percentage of nominal GDP. Small CiC conventionally represents banknotes and coins under 35 USD.

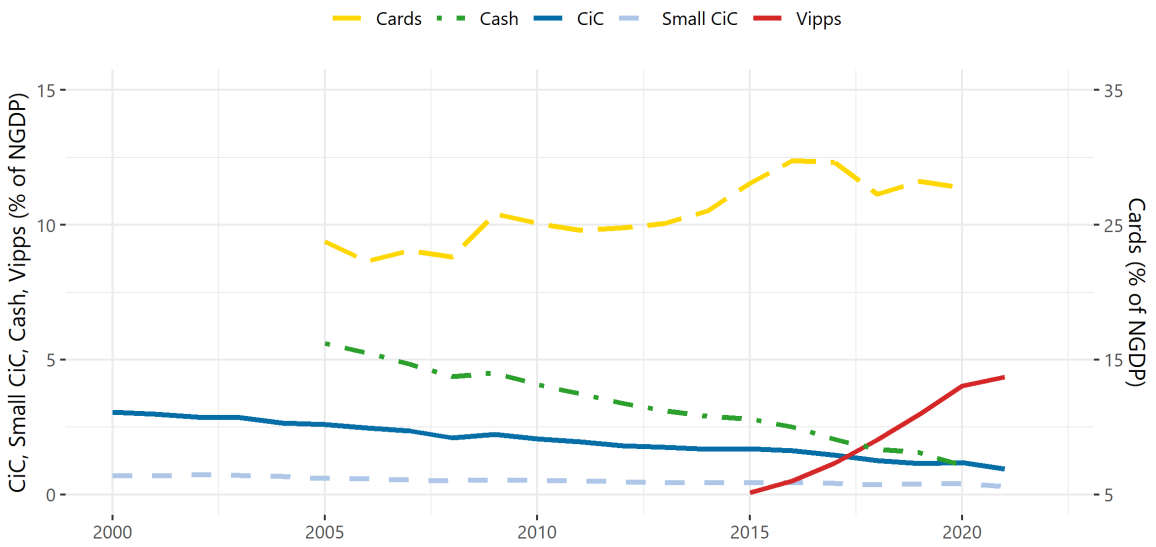
Figure A2: Danish Fast Payment System (MobilePay)



Source: Danmarks Nationalbank, International Monetary Fund, European Central Bank, MobilePay, World Bank. All figures as a percentage of nominal GDP. Small CiC conventionally represents banknotes and coins under 35 USD.

Note: ATM and OTC cash withdrawals in Denmark are only reported starting from 2016 since data available earlier included withdrawals using national debit cards at ATMs not operated by the card issuer (ECB, 2022).

Figure A3: Norwegian Fast Payment System (Vipps)



Source: Norges Bank, International Monetary Fund, Vipps, World Bank. All figures as a percentage of nominal GDP. Small CiC conventionally represents banknotes and coins under 35 USD.

Table A1: Data Sources

Variable	**Source**	**Notes**
CiC	IMF (IFS) and the respective central banks	Currency in Circulation, in local currency
GDP	World Bank, IMF	Gross Domestic Product, in local currency
Interest Rate	OECD, IMF (IFS)	Opportunity cost of holding cash, in percentage
ln GDP per capita	World Bank	Natural logarithm of GDP per capita in USD
Self-Employed	World Bank	Assesses the informal sector's role in cash demand, in percentage of total employment
Age Dependency Ratio	World Bank	Old age dependency ratio as a percentage of the working-age population
Internet Use	World Bank	Measures technology adoption, in percentage of the population
Human Rights	Fariss (2019)	Understands governance, freedom, and cash demand relationship, index
Regulatory Quality	WGI	Percentile rank
Control of Corruption	WGI	Percentile rank
Public Trust in Politicians	GCI	Score (1–7)
(Generalized) Trust	WVS	Reflects trust to each other and social capital, score (0–1)
Traditional vs. Secular	WVS	Highlights the importance of religion, family, and respect for authority, score (-2.5–2)
Survival vs. Self-Expression	WVS	Reflects the trade-off between economic, physical security and self-expression, score (-2.5–3.5)
Cultural Average	WVS	Average cultural distance from Sweden (simple average of the two key cultural dimensions)
Cultural Distance	WVS	Cultural distance from Sweden (calculated according to Konara and Mohr (2019)

Table A2: Determinants of Cash vs. Digital Payments Use Summarized

Category	**Factors**
Economic	welfare, economic uncertainty, financial markets development
Fiscal	tax evasion, tax system complexity, tax system equality
Monetary	interest rate, inflation, degree of the involvement of the central bank, efficiency of the banking sector; cooperation between central banks, banks and payment providers; competitiveness of the payment market
Spatial-Geographical	population density, frequency and/or scale of natural disasters
Cultural-Behavioral	trust, self-expression vs. survival, openness, transparency as social norm, traditional vs. secular, share of secular population (main religion)
Institutional-Political	conflicts, bureaucracy, sustainability orientation, perceived corruption
Demographic	age structure, share of population with a migration background
Social	egalitarian socio-economic structure, equality
Technological	availability of technology and infrastructure, willingness to adopt innovation
Cost	costs to merchants and users, fixed or variable payment transaction fees
Governance	regulator or government support, central vs. decentralized governance
Efficiency	speed of transactions, convenience or ease of use, e-commerce
Data	privacy sensitivity, transparency and traceability

Note: Although literature identifies up to forty various drivers, the non-exhaustive list summarizes relatively broadly defined determinants.

Table A3: Harmonized Estimation Results with Lagged Controls: 60 Countries

	(1)	(2)	(3)	(4)	(5)	(6)
lag(Interest)	-0.038***	-0.038***	-0.038***	-0.038***	-0.037***	-0.036***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
lag(*ln* GDP per capita)	-0.229	-0.180	-0.186	-0.115	-0.115	-0.200
	(0.146)	(0.151)	(0.150)	(0.147)	(0.143)	(0.151)
lag(Age Dep. Ratio)	0.036***	0.043***	0.043***	0.036***	0.027**	0.035***
	(0.014)	(0.013)	(0.014)	(0.012)	(0.013)	(0.013)
lag(Self-Employed)	-0.003	-0.003	-0.003	-0.001	-0.0004	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
lag(Internet Use)	-0.0005	0.001	0.001	0.001	-0.001	-0.0001
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
lag(Human Rights)	-0.094*	-0.062	-0.071	-0.058	-0.070	-0.079
	(0.055)	(0.057)	(0.058)	(0.051)	(0.049)	(0.053)
lag(Quality of Regulation)	0.006	0.005	0.005**	0.005	0.005	0.005
	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
lag(Corruption Control)	-0.009*	-0.009*	-0.009*	-0.006*	-0.005	-0.009*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Cultural Distance		0.194*				
		(0.109)				
Cultural Average			0.214			
			(0.140)			
Surv. vs. Self-Exp.				-0.243***	-0.223***	
				(0.025)	(0.079)	
Tradit. vs. Secular					0.133	
					(0.094)	
Trust						1.613*
						(0.936)
(Trust)^2						-2.639**
						(1.140)
Observations	757	757	757	757	757	757
R^2	0.47	0.49	0.49	0.53	0.55	0.49
Adj. R^2	0.45	0.47	0.47	0.52	0.53	0.48
BIC	1128	1101	1111	1035	1024	1105
Year FE	✓	✓	✓	✓	✓	✓

Note: Yearly data for the period 2001–2019. Pooled OLS estimations. Standard errors are clustered at the country level and displayed in parentheses. The symbols (***, **, *) denote significance levels, with *** indicating p<0.01, ** indicating p<0.05, and * indicating p<0.1.