Consumer Cash Usage: A Cross-Country Comparison with Payment Diary Survey Data*

John Bagnall,[a] David Bounie,[b] Kim P. Huynh,[c]
Anneke Kosse,[d] Tobias Schmidt,[e] Scott Schuh,[f]
and Helmut Stix[g]

[a]Reserve Bank of Australia
[b]Telecom ParisTech
[c]Bank of Canada
[d]De Nederlandsche Bank
[e]Deutsche Bundesbank
[f]Federal Reserve Bank of Boston
[g]Oesterreichische Nationalbank

We measure consumers' use of cash by harmonizing payment diary surveys from seven countries. The seven diary surveys were conducted in 2009 (Canada), 2010 (Australia), 2011 (Austria, France, Germany, and the Netherlands), and 2012 (the United States). Our paper finds cross-country differences—for example, the level of cash usage differs across countries. Cash has not disappeared as a payment instrument, especially for low-value transactions. We also find that the use of cash is strongly correlated with transaction size, demographics, and point-of-sale characteristics such as merchant card acceptance and venue.

JEL Codes: E41, D12, E58.

*The figures and tables are derived from payment diary survey data and may differ from previous published work from each respective country. We thank the Editor, Loretta Mester, and two anonymous referees for their constructive comments and suggestions. Special thanks to Angelika Welte for constructing the programs and routines to create many of the tables and figures in this paper. We thank Tamás Briglevics, Sean Connolly, Chris Henry, Lola Hernández, Vikram Jambulapati, William Murdock III, and David Zhang for providing excellent research assistance. We thank Nicole Jonker for her input in the early stages of the project; David Emery and Clare Noone for providing assistance with the Australia results; Claire Greene and Glen Keenleyside for editorial assistance; and participants of various conferences and seminars for their comments and

1. Introduction

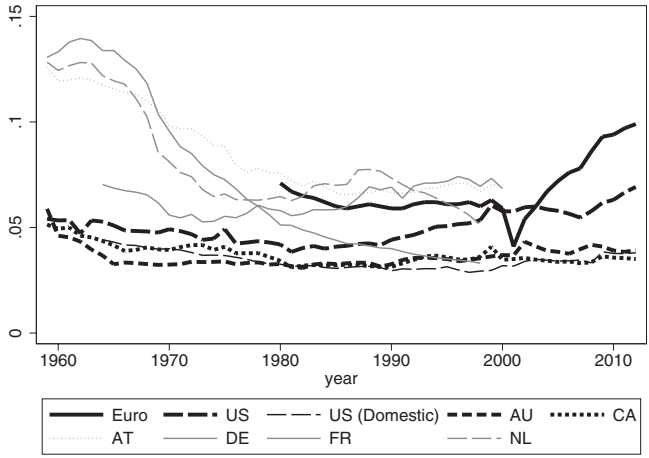
During the past several decades, payment systems worldwide have become increasingly electronic, transformed by innovations in financial markets and information technology—even in less-developed countries that rely heavily on mobile phones; see Jack, Suri, and Townsend (2010) for a discussion of Kenya. Now, these electronic innovations have spread to private virtual currencies, such as Bitcoin; see European Central Bank (2012) and Velde (2013). During this breathtaking transformation, relatively little research has been done comparing payment systems in different countries since the seminal work of Humphrey, Pulley, and Vesala (1996). In the rare instances where comprehensive data are available for comparison, usually cash is excluded; see the studies by Bolt, Humphrey, and Uittenbogaard (2008) and the Federal Reserve System (2013). However, new research is revealing an emerging consensus that during the transformation of payments from paper to electronics, cash holding and use have not disappeared.[1]

Figure 1 depicts the surprising resilience of cash in the twenty-first century for a select group of industrial countries. In most of

suggestions. Finally, we thank Eugenie Foster of the International Association of Currency Affairs (IACA) for arranging the 2010 IACA meetings in Buenos Aires, Argentina. This venue facilitated early discussions of an international cash comparison. The views expressed are solely those of the authors and not those of the Bank of Canada, De Nederlandsche Bank, the Deutsche Bundesbank, the Federal Reserve Bank of Boston or the Federal Reserve System, the Groupement des Cartes Bancaires, the Oesterreichische Nationalbank, Reserve Bank of Australia, or the Eurosystem. Author contact: Bagnall: Reserve Bank of Australia, 65 Martin Place, Sydney NSW 2000, Australia; Tel.: +61 2 9551 8794; E-mail: BagnallJ@rba.gov.au. Bounie: Telecom ParisTech. 46, rue Barrault Paris Cedex 13, F-75634, France; Tel.: +33 1 45 81 73 32; E-mail: david.bounie@telecom-paristech.fr. Huynh: Bank of Canada, 234 Wellington St., Ottawa, ON K1A 0G9, Canada; Tel.: +1 (613) 782 8698; E-mail: khuynh@bankofcanada.ca. Kosse: De Nederlandsche Bank, P.O. Box 98 1000, AB Amsterdam, The Netherlands; Tel.: +31-(0)20-5242827; E-mail: j.c.m.kosse@dnb.nl. Schmidt: Deutsche Bundesbank, Wilhelm-Epstein-Str. 14, 60431 Frankfurt am Main, Germany; Tel.: +49 (0) 69 9566 3730; E-mail: tobias.schmidt@bundesbank.de. Schuh: Federal Reserve Bank of Boston, 600 Atlantic Avenue, Boston, MA 02210-2204, USA; Tel.: +1 617-973-3941; E-mail: Scott.Schuh@bos.frb.org. Stix: Oesterreichische Nationalbank, POB 61, 1011 Vienna, Austria; Tel.: +43 (0)1 40420 7211; E-mail: helmut.stix@oenb.at.

[1]Examples include Amromin and Chakravorti (2009), Lippi and Secchi (2009), and Evans et al. (2013).

Figure 1. Ratios of Currency in Circulation to Nominal GDP



Sources: Haver Analytics, International Financial Statistics, and authors' calculations.

these countries, the ratios of currency in circulation (CIC) relative to nominal GDP generally declined at least through the 1980s or even early 1990s. Since then, however, these ratios have stayed flat or even increased. Likely, the CIC ratios for the United States (US) and the euro area (euro) have increased considerably because of strong foreign demand for the dollar and the euro; see Fischer, Köhler, and Seitz (2004) and Judson (2012). However, even the estimated domestic U.S. currency ratio has increased since 2000 and its behavior is similar to that of the ratios in the other non-euro countries.[2] The econometric evidence in Briglevics and Schuh (2013b) suggests that some of the recent U.S. increase may be the result of a decline in short-term interest rates to nearly zero. Nevertheless, persistent holding and use of cash in these industrial countries during the spread of electronic alternatives highlights a dire need for

[2]The domestic currency ratio could still be driven by domestic hoarding. One indicator of transaction demand is given by the ratio of medium-denomination bank notes to nominal GDP. Judson (2012) shows that the respective ratio for $20 decreased by half for the United States and Canada since the 1970s but has remained fairly stable over the past ten years.

an updated comparative study of payments that includes the use of cash. Furthermore, evidence on *consumer* holding and use of cash is even rarer.[3]

This paper attempts to fill this gap in the literature by comparing the payment choices of consumers in the seven industrial countries portrayed in figure 1 using a unique and growing data source.[4] The data are collected from large-scale payment diary surveys conducted in Australia (AU), Austria (AT), Canada (CA), France (FR), Germany (DE), the Netherlands (NL), and the United States (US).[5] Consumer payment diaries, which trace back at least to Boeschoten and Fase (1989) and Boeschoten (1992), feature rich information on individual payments collected over a fixed number of days paired with information on the detailed characteristics of individual consumers.[6] Payment diaries require consumers to record their transactions, so they should provide more accurate data than surveys, which rely on consumer recall.

The current paper offers two contributions relative to previous work: (i) a careful, thorough harmonization and analysis of these international diary data; and (ii) an econometric analysis of consumers' use of cash versus non-cash payment instruments that employs the microeconomic data from the payment diaries.

As with most international data, harmonization is essential to be able to make valid and useful cross-country comparisons.[7] Although the diary surveys are similar across countries, direct comparisons of their respective statistics cannot be made without meticulous

[3]An early U.S. example is the Survey of Currency and Transactions Account Usage described in Avery et al. (1986).

[4]Jonker, Kosse, and Hernández (2012) and Arango et al. (2013) provide complementary comparisons of subsets of these seven countries.

[5]The payment diaries from these seven countries do not form an exhaustive list of international sources of consumer payments data. Other sources include Takács (2011), Danish National Bank (2013), and UK Payments Council (2013).

[6]The Austrian National Bank has the longest history of successive diaries in 1995, 2000, 2005, and 2011 starting with Mooslechner and Wehinger (1997).

[7]The efforts to harmonize consumer payment diaries were inspired by international initiatives such as the Penn World Tables (Summers and Heston 1991), International Trade and Foreign Direct Investment (Feenstra et al. 2010), and the European Central Bank's wealth survey project (Eurosystem Household Finance and Consumption Network 2009).

analysis and adjustment of the technical details of the diary survey design and concept definitions. Seemingly minor details, such as the inclusion (or exclusion) of recurring bill payments, can have substantial effects on the resulting statistics. Therefore, we have harmonized the underlying data sources and results from the seven individual country diaries so that the reported figures are comparable. In addition, we have harmonized the definition of sociodemographic variables, perceptions, and point-of-sale (POS) characteristics (e.g., card acceptance and the spending location), which permits a disaggregated view of payment behavior. As a result, the statistics reported in this paper may not coincide exactly with analogous data from national statistics. One factor that cannot be harmonized, however, is the supply of services and providers across the national payment systems. For example, paper checks still are relatively common in France and the United States but not in the other countries. Primarily for this reason, we do not attempt to model specific non-cash payment instruments in each country.

Using the harmonized data, we shed light on two empirical issues. First, we demonstrate the extent of consumer cash holding and use in each of the seven economies. Second, the micro data allow us to discover who uses cash, for which purchases, at which locations, and for what value of payment. These data may help us determine why cash is used and whether or not it is likely to continue to be used in the future.

Our econometric analysis of consumer cash use follows in the tradition of the recent literature that seeks to understand the determinants of consumer payment behavior more broadly. This literature extends back at least to Stavins (2002), who estimated the effects of consumer characteristics such as age, education, and income on consumer use of payment instruments and certain banking practices. More recent papers on this subject, such as Borzekowski, Kiser, and Shaista (2008), Ching and Hayashi (2010), Schuh and Stavins (2010), von Kalckreuth, Schmidt, and Stix (2014b), or Arango, Huynh, and Sabetti (2015), inter alia, add a variety of other explanatory variables to such regressions. Unlike most studies, which use data usually from one country or only a few countries, this harmonized diary database makes it possible to assess the extent to which the determinants

of payment choice are specific to a particular country or are more general in nature.[8]

Our econometric analysis is a first step toward what ultimately can be done with the diary data and generates a few notable results. In the logit estimation of cash versus non-cash use, we find a surprising degree of similarity in the significant marginal effects of determinants of payment use across countries, both qualitatively and quantitatively. Not surprisingly, the similarity is stronger for consumer payments made at grocery stores, which presumably are relatively homogeneous payment opportunities across countries in terms of goods, transaction sizes, and merchant acceptance of payments. Much more econometric modeling could be done with this harmonized diary database.

Using comprehensive, cross-country information on cash usage to develop a more refined understanding of consumer payment choices is important for policymakers and academics alike. In recent years, regulation of credit card and debit card interchange fees has come to the forefront in a number of countries. Better insight into consumer behavior is essential for the determination and evaluation of these regulations. The study of cash demand and management also is important for evaluation of the cost of payments,[9] seigniorage revenue, central bank management of currency stocks, and the welfare costs of inflation. The use of payment instruments to access bank accounts is important for understanding bank supervision and regulation, and may provide insights into consumer welfare associated with liquid asset management. The breadth and importance of all of these topics underscore the puzzling deficiency of statistical evidence on cash use by consumers, and the importance of payment diaries as a resource for future research.

[8]We do not attempt to estimate models of consumer demand for cash, which is the subject of another closely related branch of the literature including Daniels and Murphy (1994), Mulligan and Sala-i-Martin (2000), Attanasio, Guiso, and Jappelli (2002), Bounie and Francois (2008), Lippi and Secchi (2009), and Briglevics and Schuh (2013b). These studies rely on consumer surveys, rather than diaries, to collect cash-related data on consumers, and generally do not attempt to estimate consumer demand for other payment instruments.

[9]Schmiedel, Kostova, and Ruttenberg (2013) provide a summary of the ECB cost study.

The paper is organized as follows. Section 2 presents salient aggregate results regarding the payment behavior in the seven countries, which provide a foundation for the subsequent analysis. Section 3 describes the payment diaries and steps taken to harmonize the database. Section 4 presents the consumer expenditure patterns across countries. Section 5 discusses the various factors that may affect the levels of cash usage across countries. Section 6 presents the estimation results for the econometric models of consumer choice between the use of cash versus non-cash payment instruments and provides robustness analyses. Section 7 provides a discussion on cross-country differences, and section 8 concludes.

2. Salient Results

Table 1 distills our findings concerning the payment structure in each of the seven countries. Although the harmonization of the data sources will be discussed in more detail in section 3, at this point we note that the presented figures include basically all personal payments of respondents made either at a POS, for remote purchases, or in person to other persons. Recurrent transactions (e.g., rent, utility bills) are excluded. Our main findings follow:

- Between 46 percent and 82 percent of the number of all payment transactions are conducted by cash.
- In value terms, differences across countries are stark. AT and DE are cash-intensive countries with a value share of more than 50 percent; in CA, FR, and US, cash payments account for only about one-fourth of the value of transactions.
- The composition of non-cash payments varies substantially across countries. Credit cards are used more frequently in AU, CA, and US than in European countries. Across all countries considered, debit cards are used more frequently than credit cards, with particularly high use in NL. FR and US have a large share in the *other* category. Checks constitute a non-trivial portion in both countries, while prepaid cards are a factor in the US.
- The overwhelming fraction of payments is conducted with only a few payment instruments: the accumulated cash, debit, and

Table 1. Salient Results

	AU	AT	CA	FR	DE	NL	US
Payment Share by Volume							
Cash	0.65	0.82	0.53	0.56	0.82	0.52	0.46
Debit	0.22	0.14	0.25	0.31	0.13	0.41	0.26
Credit	0.09	0.02	0.19	0.01	0.02	0.01	0.19
Total	0.96	0.98	0.97	0.88	0.97	0.95	0.91
Other Most Important Payment Instrument (Share > 5%)	—	—	—	0.09[a]	—	—	—
Payment Share by Value							
Cash	0.32	0.65	0.23	0.15	0.53	0.34	0.23
Debit	0.32	0.25	0.30	0.43	0.28	0.60	0.27
Credit	0.18	0.05	0.41	0.03	0.07	0.04	0.28
Total	0.82	0.95	0.94	0.60	0.89	0.97	0.78
Other Most Important Payment Instrument (Share > 5%)	0.12[b]	—	—	0.30[a]	—	—	0.14[a]
Ownership of Payment Cards							
Debit Share	0.93	0.85	0.97	0.83	0.94	0.99	0.76
Credit Share	0.47	0.24	0.81	0.36	0.33	0.62	0.67
Average Transaction Values							
Cash	15.2	24.7	12.9	10.9	25.0	17.4	17.8
Debit	43.3	55.6	37.6	56.6	75.7	39.1	37.3
Credit	60.0	85.9	64.7	92.5	160.5	95.6	56.4
Acceptance of Alternatives to Cash[c]							
Share	—	0.63	0.73	—	0.57	—	—
Average Cash Balances in Wallet							
Mean	59	148	64	70	123	51	74
Median	32	114	38	30	94	28	37

Notes: Authors' calculations based on questionnaire and diary surveys. Nominal values are expressed in PPP-adjusted USD. PPP exchange rates are taken from the OECD: http://www.oecd.org/std/prices-ppp/.
[a]Checks.
[b]Internet/telephone banking.
[c]Acceptance as perceived by consumers.

credit share is greater than 95 percent for AU, AT, CA, DE, and NL, and greater than 88 percent for FR and US.

The major question that emerges from these findings is how the levels of cash use in the various countries can be explained. As a first attempt, table 1 summarizes information on three indicators about market structure. The results show the following:

- Payment card ownership (especially debit card ownership) is high in all countries. However, there are large cross-country differences with respect to the dissemination of credit cards. This suggests that the use of cash may be correlated with the level of card ownership.
- Another indication about market structure can be obtained from average transaction values. In all seven countries, the average value of cash transactions is lower than the average value of card transactions. This result is consistent with prevalent transaction-size models (i.e., Whitesell 1989; Bouhdaoui and Bounie 2012). Notably, in countries where cash is used relatively more frequently, the average card transaction value is higher than it is in countries where there is more intensive use of cards.
- The acceptance of payment cards by merchants differs across countries. There is limited evidence from the surveys, but available evidence for AT, CA, and DE indicates there is a correlation with cash usage.
- Survey responses suggest that cash balances are substantially higher for AT and DE than for the other countries. This result corresponds with the importance of cash for payments in these countries. This correlation may not be causal and there may be a simultaneity in cash management and payment behavior. For example, the level of cash balances might affect consumers' use of cash, but similarly, the use of cash may also be a determinant of the amount of cash consumers carry.

We will use the above findings to delve deeper into the levels in cash use across countries. To get a better grasp, we will also analyze cash use by looking at (i) the expenditure structure in the various

countries, (ii) whether cash usage differs across transaction types and POS characteristics (transaction value, type of expenditure, acceptance), and (iii) whether the use of cash varies across sociodemographic factors. Similarly, we further assess the interrelation between cash holdings and payment behavior by delving deeper into cash management practices of consumers. As a case in point, table 1 highlights that all "non-cash-intensive" countries have a rather similar median cash balance of about 30 purchasing power parity (PPP)-USD. This suggests that consumers behave rather similarly in different countries. We will further exemplify and analyze this issue by looking at withdrawals and other aspects of cash management behavior.

3. Consumer Payment Diaries—Validity and Harmonization

This section provides a short overview of the methodological features and key survey outcomes of the payment diaries included in the cross-country comparison. We will start with a more general discussion about the value of payment diary data, by contrasting diary studies with classical ways of collecting information, such as questionnaire surveys or macro data analyses. The section concludes with a few remarks on the harmonization steps necessary to create comparable data sets.

3.1 Consumer Payment Diaries

Several types of data can be used to assess consumers' use of payment instruments. First, official transaction records of banks, card processors, or retailers can be employed. The advantage of these data is that they are based on observed behavior and they provide a good basis for examining aggregate changes in payment use over time. However, often such data do not allow for an in-depth analysis of behavior at the consumer level. Some data are proprietary, so individual behavior cannot be tracked. Scanner data do not usually provide information about the consumer and are focused on only a certain portion of consumer behavior (e.g., grocery purchases); see Cohen and Rysman (2013).

Therefore, payment studies often have recourse to consumer survey data. Here a distinction can be made between data collected through consumer questionnaires versus data collected through consumer payment diaries. The advantage of questionnaires is that the burden on the respondent is limited to the time needed for completing the questionnaire at one moment in time; diaries, in contrast, require respondents to report information over a number of days. While the consumer questionnaire generates data that allow for thorough analyses of general behavioral patterns as well as the underlying drivers, it is less suitable for analyzing the specificities of individual payments. For example, surveys may serve as a valuable tool for measuring the adoption of payment instruments by consumers, while diaries are better for assessing their actual use.[10]

Collecting payment data through diaries has thus become popular in recent years.[11] The main benefits of using diary data—in particular, in combination with questionnaire data—are obvious. Foremost, as consumers are stimulated to record with a minimum of delay after each particular transaction, the probability of transactions being omitted or erroneously reported is lower than for questionnaire surveys. Payment diaries also allow for the collection of many details of individual transactions, such as the payment amount, the payment location, the acceptance of non-cash payments, and surcharging, which enable better understanding of the factors that drive consumer heterogeneity in payment behavior.

Insofar as payment diaries record cash balances over time, they also allow for an examination of the interaction between payment choice and cash management. When conducted for several days, a temporal sequence of actual payments and cash withdrawals can be created, which is useful for understanding within-consumer heterogeneities in payment instruments usage.

[10] In particular, when asking about individual payments, questionnaires may suffer from "recall bias" or under-reporting of payments due to incomplete recall. Frequent and low-value payments are especially sensitive to being omitted; see Jonker and Kosse (2013).

[11] Collecting data using diaries has a long history in official statistics on expenditure; see McWhinney and Champion (1974). Earlier general surveys about payments were conducted by Avery et al. (1986) and Boeschoten (1992). Mooslechner and Wehinger (1997) conducted a payment diary in Austria in 1996.

3.2 Validity of Seven Payment Diaries

Our study uses payment diaries that were conducted independently in each country and hence were not harmonized. Differences pertain to the number of recorded days (from one to eight days), the mode of data collection (paper versus online), the scope of transactions covered (e.g., recurrent and remote transactions), and the level of detail regarding transaction characteristics (table 2).[12] To account for these differences, we put a lot of effort into the harmonization of the variables and concepts, and we are confident that the level of comparability is high enough to conduct our cross-country analysis. The next subsections discuss similarities and differences as well as the harmonization steps undertaken.

Despite the advantages of diary surveys described above, the question arises as to the representativeness of recorded transactions. Under-reporting is one issue, as illegal transactions and transactions in the realm of the shadow economy will likely not be covered. But even for everyday expenditures, we do not know how well respondents record their transactions.

To ensure the efficacy of the seven payment diaries, we compare the diary outcomes to aggregate expenditure data from national accounts statistics. For this reason, we extrapolate the survey outcomes by multiplying the average daily diary expenditure by 365 to obtain an annual figure. This value is compared with the average annual value of expenses as reported by the Organisation for Economic Co-operation and Development (OECD), deducting expenses for housing, water, electricity, and gas.[13]

The results of this exercise are reported in the last row of the top panel of table 2. For all diaries, the ratio of the extrapolated diary outcomes to the aggregate OECD POS consumption figures ranges from 0.72 to 1.16. Note that certain deviations are to be expected, as both the diary data and the data provided by the OECD are

[12]The literature has shown that the specific design of a diary may affect the quality of the collected data; e.g., Sudman and Ferber (1971), Crossley and Winter (2012), and Jonker and Kosse (2013).

[13]We focus on the average annual expenses by the adult population only, since the samples used in the diary surveys also only targeted residents aged between eighteen and seventy-five years.

Table 2. Survey Design Summary

	AU	AT	CA	FR	DE	NL	US
Year	2010	2011	2009	2011	2011	2011	2012
Month(s)	Oct–Nov	Oct–Nov	Nov	Oct–Nov	Sep–Nov	Sep	Oct
Data Collection	Paper	Paper	Online Paper	Paper	Paper	Online Phone	Online Paper
Sampling Frame	18+	15+	18–75	18+	18+	18+	18+
Diary Length (Days)	7	7	3	8	7	1	3
Respondents	1,240	1,165	3,283	1,106	2,098	7,175	2,468
Total Transactions	18,110	12,970	15,832	10,759	19,601	11,877	13,942
Diary-to-Aggregate-Expenditure Ratio	1.11	0.92	0.99	0.88	0.97	1.16	0.72
Macroeconomic Aggregates							
Short-Term Nominal Interest Rate	5.0	1.5	0.4	1.5	1.5	1.6	0.2
Core Inflation	2.5	2.4	1.1	1.2	1.0	1.9	1.9
Real GDP Growth	2.5	1.3	–1.4	1.5	2.5	1.1	2.0
Output Gap	–1.1	–0.6	–3.0	–0.8	0.3	–0.5	–3.4
Unemployment Gap	–0.1	–0.1	1.0	0.2	–0.9	0.6	2.0

Notes: For these diary-to-aggregate-expenditure ratios, we calculate the total annual per-person expenditure in local currency, by multiplying the average per-person per-day expenditure figure from each diary with 365 days. We compare this estimated annual consumption figure with national accounts data from the OECD website. We start with the time series labeled "P31NC: Final consumption expend. of res. households on the territory and abroad" and subtract "P33: Final consumption expenditure of resident households abroad." We also subtract "P31CP040: Housing, water, electricity, gas and other fuels" to arrive at a concept of consumption expenditure more comparable to what we have in the diaries. The diaries do not cover recurrent payments, and most of the payments for housing and utilities are recurring. Finally, we divide the calculated consumption expenditure by the total adult population, implying that we assume that the responses to our diaries do not include consumption expenditure for minors. To harmonize the transaction values in this study, we use PPP-adjusted USD. PPP exchange rates are taken from the OECD: http://www.oecd.org/std/prices-ppp/. Macroeconomic aggregates are taken from the following OECD Stat Extracts: Short-term interest rate: http://www.oecd.org/std/. Core inflation: http://stats.oecd.org/index.aspx?queryid=26661. Output gap: *OECD Economic Outlook*, Volume 2014, Issue 1, Annex Table 10. Latest versions available at http://www.oecd.org/eco/outlook/economic-outlook-annex-tables.htm. GDP growth: http://stats.oecd.org/index.aspx?queryid=26674. Unemployment: http://stats.oecd.org/index.aspx?queryid=36324. NAIRU: http://stats.oecd.org/Index.aspx?DataSetCode=EO95_INTERNET.

based on sampling-based survey estimates, and, hence, are subject to a certain degree of error. Also, due to differences in classifications, the diaries and national account figures are likely to differ regarding the sectors and types of payment included.

Therefore, we interpret the ratios, which all vary around 1.00, as evidence that all individual surveys perform rather well in capturing the actual expenses made in these countries. Moreover, all countries undertook a number of plausibility checks. These comprised either comparison with population figures (if available; e.g., the average number and value of debit card payments or automated teller machine (ATM) withdrawals) or with other sources (such as other market research reports). Some countries could refer to earlier payment diary or questionnaire studies and check their stability over time.

One factor that may adversely affect our efforts to harmonize the diaries is cross-country variation in the state of business-cycle conditions.[14] The lower panel of table 2 summarizes these conditions by reporting standard macroeconomic aggregates for each country at the time its diary was fielded (between 2009 and 2012). Short-term nominal interest rates were relatively low, in the range of 0.2 percent (US) to 1.6 percent (NL) with the exception of AU, which was 5.0 percent. All of the countries had reasonably low core inflation, ranging from 1.0 percent (DE) to 2.5 percent (AU). Most countries were growing in terms of real GDP except for Canada, which declined 1.4 percent and had a –3.0 percent output gap. The United States, though expanding (2.0 percent real GDP growth), also had a large negative output gap (3.4 percent). Not much is known yet about the cyclical properties of consumer payment choice because of a general lack of time-series data. Following the financial crisis, U.S. consumers significantly increased their use of cash and decreased their use of credit cards (Schuh and Stavins 2014), suggesting there may be some cyclical variation, but we do not have enough data or business cycles to formally adjust the diary responses. The reader may wish to bear in mind that the results for each country may be influenced by the macroeconomic conditions

[14]We thank an anonymous referee for pointing out this observation to us.

prevailing at the time of the survey—for example, the output gaps in CA and US.

3.3 Similarities

The seven diary surveys share a number of similarities (see table 2). First, all seven diaries collect data on POS transactions. Each diary attempts to record non-business-related personal expenditures of the respondent (whether for the respondent or for other people). Second, the information collected for each transaction is similar. All respondents were asked to record (i) the date (and sometimes even the time), (ii) the transaction value, (iii) the payment instrument used, and (iv) the merchant's sector where the purchase occurred. AT, CA, DE, and NL respondents were asked to assess whether the purchase could have been paid using payment instruments other than the one actually used. For cash withdrawals, all diaries collected information on the location (and in some cases the timing) as well as on the amount of the withdrawal. Each diary furthermore contained questions on consumers' cash balances either before the first recorded transaction or for their typical average cash holdings.

Third, the seven diary studies are similar in that they were all conducted at the end of the year, i.e., between September and November. The fieldwork was conducted in 2009 (CA), 2010 (AU), 2011 (AT, FR, DE, and NL), and 2012 (US).

Fourth, the seven diaries are similar with respect to the population being surveyed. Most targeted residents were between the ages of eighteen and seventy-five years, although some diaries were also distributed among children and people over seventy-five years of age. However, as discussed above in the expenditure ratio, all the analyses presented in this paper focus only on the payments made by adults. Finally, all diary surveys yielded data sets containing more than 10,000 transactions.

3.4 Differences

Several differences among the diaries should be kept in mind when interpreting the results. First, some diaries asked respondents to fill out the diary using paper and pencil (AU, AT, DE, and FR). US

and CA relied on a mix of paper and online questionnaires. For NL, information was collected via an online tool or by phone, if desired. Also, a difference relates to the selection of respondents. Most countries used random stratified or clustered sampling techniques, but they differed with respect to the frame from which the respondents were selected. For CA, NL, and US, for instance, respondents were randomly selected from an existing panel of consumers who regularly participate in surveys.

Online data-collection methods and online panels may be sensitive to biases when particular population groups are excluded from participation because of not having access to the Internet, and when the persons who do participate behave differently than those who do not; see Bethlehem (2008). Yet, given the high Internet penetration for CA, NL, and US, the potential biases caused by the use of online methods and online panels can be expected to be limited. Jonker and Kosse (2013) demonstrate for NL that drawing respondents from an online panel does not introduce pro-electronic biases reflected in an over-estimation of card usage. Moreover, in order to prevent any such biases, all panelists for US were provided with a computer or with Internet access.

Second, differences exist with respect to the length of the diaries, as follows: one day (NL), three days (CA, US), seven days (AT, AU, and DE), and eight days (FR). Research by McWhinney and Champion (1974), Ahmed, Brzozowski, and Crossley (2006), Jonker and Kosse (2013), and Schmidt (2014) investigate the possibility that longer diaries may lead to survey fatigue (i.e., under-reporting of expenditures), especially for small-value transactions. Despite these differences and their potential consequences, we believe that, due to their richness, the seven data sets are well suited for answering the main questions of this paper. Moreover, as will be discussed below, we conducted some robustness checks that confirmed that the differences in diary length do not sizably affect our overall findings and conclusions.

3.5 Harmonization

We undertook the following harmonization steps to create seven data sets that are mutually comparable. In particular:

- We distilled all payments from persons aged eighteen years and older.
- We only consider the payments made at the POS; payments for remote purchases via mail order, the telephone, or the Internet; and in-person person-to-person payments. Recurrent transactions (e.g., rents, utility bills) are excluded.

Also, we conducted a number of harmonization steps with respect to the reported results on card acceptance at the POS, consumer preferences, and type of purchases made. The results with respect to the type of purchases, however, should only be taken as a rough indicator, due to the large national differences in the number and size of categories used.[15] Finally, we harmonized the definitions and categories of the various sociodemographic characteristics (e.g., income, education).

4. Expenditure Patterns

Table 3 reports summary statistics of the total structure of recorded payments and thereby of expenditures of consumers.[16] It shows that the structure of payments is very similar across countries with respect to the day of the week, time of day, and payment channel. As expected, Sunday is the day with the lowest share of transactions, although some cross-country differences are discernible. For example, the Sunday share is slightly higher for AU and US, which is reasonable given cultural differences in store opening hours. About one-third of transactions are conducted before noon, and two-thirds

[15] Harmonization difficulties arose mainly because of (i) national differences in how the information was collected (from only a few broad categories of sectors in some countries to very detailed lists in other countries); (ii) differences in the categorization of expenditures (e.g., some countries recorded expenditures in restaurants and hotels in one category; other countries recorded hotel expenditures with other services), and (iii) differences in the structure of retail shops (e.g., in some countries newspapers and tobacco can be bought in grocery shops; other countries have small special shops for these expenditures).

[16] Note that these are consumer expenditures and not consumption.

Table 3. Structure of Consumer Payments

	AU	AT	CA	FR	DE	NL	US
Transactions Volume PPD							
Mean	2.1	1.6	1.7	1.5	1.4	1.8	1.6
Median	1.9	1.4	1.3	1.3	1.3	1.0	1.3
Expenditures PPD							
Mean	63	50	50	43	48	52	62
Median	41	34	28	27	35	20	31
Distribution of Transaction Values							
25th Percentile	5.1	7.1	4.4	2.9	7.0	5.1	12.3
Median	12.0	16.7	11.9	12.5	17.8	11.3	22.7
75th Percentile	25.3	37.3	30.3	35.0	42.6	28.4	39.8
Transactions Volume Shares							
Days of the Week:							
Monday	0.14	0.15	0.11	0.12	0.14	0.12	0.16
Tuesday	0.13	0.14	0.15	0.15	0.15	0.13	0.16
Wednesday	0.14	0.14	0.17	0.15	0.15	0.13	0.16
Thursday	0.16	0.15	0.19	0.16	0.15	0.19	0.13
Friday	0.16	0.16	0.14	0.16	0.17	0.18	0.13
Saturday	0.16	0.16	0.15	0.17	0.17	0.17	0.14
Sunday	0.11	0.09	0.09	0.08	0.08	0.07	0.12
Time of Day:							
AM	—	0.38	0.33	—	—	—	0.31
PM	—	0.62	0.67	—	—	—	0.69
Payment Channel:							
In Person	0.952	0.985	1.000	0.954	0.977	1.000	0.936
Internet/Mobile	0.044	0.011	—	0.015	0.015	—	0.051
Mail-Order/Phone	0.003	0.004	—	0.017	0.009	—	0.013
Sectoral Composition:							
Groceries	0.31	0.42	0.33	0.46	0.46	0.44	0.20
Gasoline	0.07	0.06	0.08	0.03	0.08	0.09	0.08
Semi-durables	0.18	0.13	0.15	0.12	0.06	0.18	0.12
Services	0.15	0.09	0.04	0.14	0.07	0.09	0.30
Restaurants/Drinks	0.21	0.17	0.22	0.09	0.16	0.13	0.27
Other	0.07	0.14	0.19	0.15	0.16	0.08	0.03

Notes: Authors' calculations based on diary surveys. PPD refers to per person per day. Nominal values are expressed in PPP-adjusted USD. To harmonize the transaction values in this study, we use PPP-adjusted USD. PPP exchange rates are taken from the OECD: http://www.oecd.org/std/prices-ppp/.

after. Finally, in-person transactions make up the vast majority of payments.[17]

With respect to the type of purchase or the sectoral composition, keeping the harmonization difficulties in mind, we find that groceries account for the majority of transactions in all countries (except for US). The share of grocery expenditures is quite similar for AT, FR, DE, and NL. Also, the gas station expenditure share, which arguably constitutes the most homogeneous type of expenditure, is similar across countries. These results provide evidence that some aggregate shopping patterns are similar across the seven countries examined.

More importantly, the diaries are also informative regarding other payment characteristics about which relatively little is known, at least in a comparative perspective. This brings us to our first fact:

Fact 1. *The structure of consumer payments is generally similar across most of the countries with respect to the number and the value of transactions: (i) Consumers conduct only a few payment transactions per day and (ii) most consumer expenditures are relatively small in value.*

The mean number of transactions per person per day (PPD) varies from 1.4 to 2.1 transactions across countries. The median person, who arguably is more robust to outliers, conducts only 1.3 transactions for CA, FR, DE, and US, and 1.4 transactions for AT. The median amount spent PPD varies across countries, ranging from 20 to 41 PPP-USD.

Analyzing individual transactions provides another angle from which to view the data. Table 3 reports the quartiles of transaction values. This analysis shows that the median transaction amount is around 12 PPP-USD for AU, CA, FR, and NL. For AT, DE, and US, the value is higher, at 17 to 22 PPP-USD. We also find that 75 percent of all recorded transactions are lower than 25 to 40 PPP-USD.

[17]For AU and US, Internet/mobile payments at the POS account for a volume share that is higher than 4 percent, while in all other countries it is almost negligible.

5. Cash Usage: Descriptive Evidence

Table 1 documented the outstanding importance of cash in all countries. In this section, we focus on the use of cash in terms of transaction size, cash balances, sociodemographics (income, education, age, and consumer preferences), cash card ownership, and POS characteristics (acceptance of payment cards and type of economic activity). The selection of these factors rests on previous literature that has mostly been confined to the analysis of single countries.[18] Note that the descriptive statistics presented in this section provide only a first indication of the potential correlation with cash usage, disregarding all other factors. A final answer on the role of each of the selected factors in explaining consumers' cash usage can only be provided after controlling for the other variables using multivariate econometric estimations. These estimates are completed in section 6.

5.1 Transaction Size

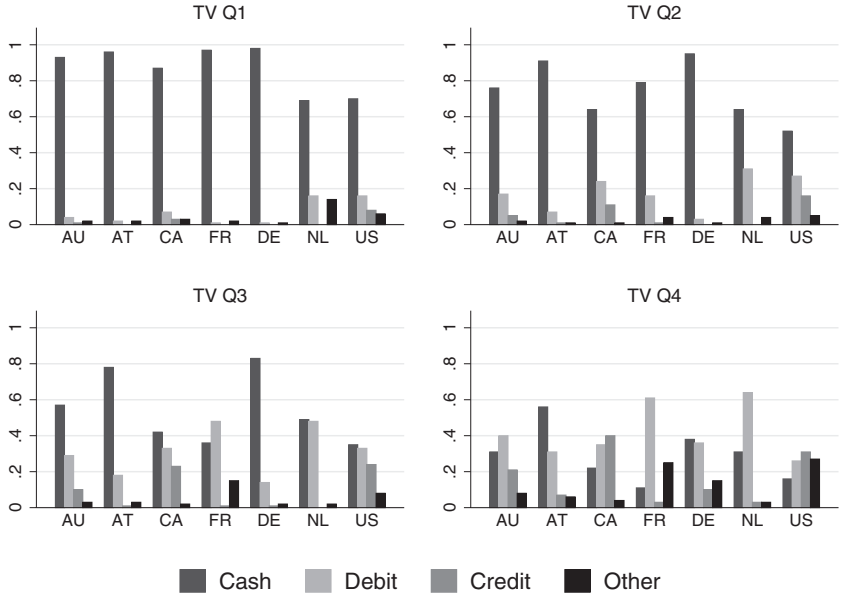
Numerous previous papers have shown that transaction size is highly correlated with the choice of payment instruments (e.g., Klee 2008; Bouhdaoui and Bounie 2012; von Kalckreuth, Schmidt, and Stix 2014a; Arango, Huynh, and Sabetti 2015). Our analysis substantiates these findings.

Fact 2. *The use of cash decreases with transaction size. In all countries, cash is predominant for the smallest 50 percent of transactions. For the largest 25 percent of transactions, the use of payment instruments is very heterogeneous across countries.*

Figure 2 depicts the payment instrument shares for cash, debit, credit, and other payment instruments for each transaction value quartile. This figure confirms the dominance of cash for low transaction values in all countries. In the first transaction value quartile, debit plays only a minor role for CA, NL, and US, while credit is

[18] One shortcoming of our analysis is that our data cannot establish the causal link between payment choice and card pricing (e.g., Borzekowski, Kiser, and Shaista 2008; Simon, Smith, and West 2010). Moreover, whenever we analyze POS characteristics, we assume that these are fixed.

Figure 2. Value Share of Cash by Transaction Value Quartiles



Source: Authors' calculations based on diary surveys.

used only materially for CA (share of 3 percent) and US (share of 6 percent). Other payment instruments have a notable share for low-value transactions only for NL (14) and US (6 percent). For all countries, we find that the cash share is higher than 50 percent up to the median transaction value. In the third quartile, the dominance of cash fades. In this transaction value range, however, cash has a materially higher share than debit or credit in three countries and a share that is about equal to the share of debit for CA, FR, NL, and US. In the fourth quartile, the full heterogeneity across countries becomes evident: (i) the importance of credit card payments for AU, CA, and US relative to other countries, (ii) the importance of checks for FR and US, and (iii) the relative importance of debit versus credit in all European countries.

5.2 Cash Balances

Withdrawal innovations such as ATM terminals have affected the demand for cash. For instance, Alvarez and Lippi (2013) show that free and random withdrawal opportunities can give rise to a precautionary motive for holding cash, meaning that agents withdraw cash even if they have some cash on hand. Several empirical studies suggest that higher cash holdings are correlated with higher use of cash in payments; see Bouhdaoui and Bounie (2012), Arango et al. (2013), Eschelbach and Schmidt (2013), and Arango, Huynh, and Sabetti (2015). Our findings provide support for a relationship between cash usage and cash balances.

Fact 3. *Austria and Germany, relative to other countries, are cash intensive, with large cash balances and large average withdrawal amounts.*

Table 4 reports statistics on individuals' cash management patterns. The average cash balances (M) for AT (148 PPD-USD) and DE (123 PPD-USD) are two times greater than those in other countries (from 51 for NL to 74 PPD-USD for US). These statistics are in line with the greater use of cash in payments for AT and DE, where the share of cash by volume exceeds 80 percent. It reaches a maximum of just 65 percent in other countries. As a consequence, the mean of the ratio M/e, where e denotes daily expenditure, varies from 1.5 for AU to 4.8 for AT. The gaps between countries persist even if we abstract from extreme values: the median equals 0.6 for US, while it reaches 3.4 for AT. The extent to which the suggested relationship between cash balances and cash usage is causal remains unclear. That is, the level of cash balances might affect consumers' use of cash, but, similarly, the use of cash may determine the amount of cash that consumers carry. Hence, it is not clear whether cash management causes cash usage or vice versa.

Cash is obtained from ATMs, bank tellers, and other sources (family, retail stores' cashback, etc.). Except for US, the main source of cash is the ATM; the share of people withdrawing at least once a month from ATMs exceeds 70 percent in all countries. However, the mean number of monthly ATM withdrawals greatly varies across

Table 4. Cash Management

	AU	AT	CA	FR	DE	NL	US
Cash Balances							
In the Wallet (M)	59[a]	148	64	70	123	51[a]	74
Mean M/e	*1.48*	*4.78*	*4.38*	*4.13*	*4.15*	*2.87*	*2.44*
Median M/e	*0.69*	*3.36*	*1.01*	*1.30*	*2.61*	*1.00*	*0.62*
Withdrawals (Number per Month)							
ATM	—	3.48	4.98	3.70	3.08	2.45	1.31
Teller	—	1.07	1.83	2.21	0.99	0.02	0.65
Other Sources	—	1.31	4.05	2.09	0.70	0.40	3.29
Share of Respondents Withdrawing							
ATM (at Least once a Month)	—	0.79	0.73	0.95	0.85	—	0.69
Teller (at Least Once a Month)	—	0.28	0.41	0.70	0.22	—	0.41
Other Source (at Least Once a Month)	—	0.11	0.56	0.71	0.03	—	0.92
Average Withdrawal Amount							
ATM (W)	138	224	86	89	256	102	103
Teller	668	511	225	224	539	75	219
Other Sources	51	559	52	122	125	53	95
W/M	*5.80*	*3.86*	*3.77*	*6.25*	*15.96*	*8.71*	*14.05*
Median W/M	*2.33*	*1.42*	*1.67*	*1.72*	*2.11*	*2.50*	*2.31*
Precautionary Balances							
Cash Balance before Withdrawal ($\underline{M}$)	—	58	22	—	43	—	67
Mean $\underline{M}/M$	—	*0.84*	*0.46*	—	*1.66*	—	*2.29*
Median $\underline{M}/M$	—	*0.25*	*0.20*	—	*0.32*	—	*0.73*

Notes: Authors' calculations are based on questionnaire and diary surveys. M/e is the ratio of cash balances to daily expenditures from the diary. All values represent means, unless otherwise indicated. Nominal values are expressed in PPP-adjusted USD. To harmonize the transaction values in this study, we use PPP-adjusted USD. PPP exchange rates are taken from the OECD: http://www.oecd.org/std/prices-ppp/.

[a]Values for AU and NL are from the questionnaire ("typical" average cash balance); all others are from the diary.

countries, from 1.3 for US to 5 for CA. These withdrawal patterns seem to be directly correlated with the typical cash withdrawal amounts at ATMs.[19]

5.2.1 Implications for Inventory Models of Money Demand

The overall picture that emerges from these figures is that respondents in cash-intensive economies do not economize on cash balances by withdrawing more often. Instead, it seems that they prefer to hold higher cash balances. There are several possible reasons for this behavior. One is that AT and DE respondents hold larger cash balances because of the risk that lumpy purchases can only be conducted in cash (Alvarez and Lippi 2013). This would imply that precautionary balances are higher in these two countries than in other countries. However, the evidence is not conclusive. Cash balances at withdrawals are larger for AT and DE than for CA but not larger than for US.

These descriptive statistics can be further exploited to examine the empirical performance of the deterministic inventory theoretical model proposed by Baumol (1952) and Tobin (1956). We focus our discussion on two statistics. The first is the ratio between cash holdings at the time of a withdrawal ($\underline{M}$) and average/median currency holdings (M). This statistic provides a measure of precautionary balances: the higher $\underline{M}/M$, the more precautionary the consumers are. This ratio is zero in the Baumol-Tobin model, as consumers withdraw only when they have depleted their stock of cash. We notice in table 4 that the median of this ratio ranges from 0.20 for CA to 0.73 for US. The data are thus more in line with the dynamic model of cash management suggested by Alvarez and Lippi (2009), who extend the Baumol-Tobin model to a dynamic environment in which consumers face not only costly ATM withdrawals but also random and free ATM cash withdrawal opportunities. More precisely, the model predicts that consumers withdraw cash when

[19]As previously outlined, US stands out in this respect: the share of people obtaining cash from other sources at least once a month (90 percent) is above that of ATMs and tellers (70 percent and 40 percent, respectively), and the withdrawal frequency at these other sources is far above that for ATMs and tellers (3.3 compared with 1.3 for ATMs and 0.7 for tellers).

facing free withdrawal opportunities even if they have some cash on hand, resulting in a positive ratio of $\underline{M}/M$ (with values between zero and one).

The second interesting statistic (W/M) is the ratio between the average withdrawal amount at the ATM (W) and the average currency holdings (M), which is also related to the precautionary motive ($\underline{M}/M$). Since withdrawals only happen when cash balances reach zero, in the Baumol-Tobin model W/M is equal to 2. With random free withdrawals, Alvarez and Lippi (2009) show that this ratio will be below 2. The higher the number of free cash withdrawals relative to the overall number of withdrawals, the higher $\underline{M}/M$ and the lower W/M—consumers take advantage of the free random withdrawals regardless of their cash balances, which decreases the level of cash withdrawals. As free withdrawal opportunities relative to the overall number of withdrawals increase, $\underline{M}/M$ becomes greater than 0 (and lower than 1) while W/M tends from 2 to 0, implying a negative correlation between these ratios.

In the data, we find that the median of this ratio lies between 1.42 for AT and 2.31 for US. The data are in line with the prediction of Alvarez and Lippi (2009) regarding the level of W/M in three countries where W/M is found to be lower than 2 (AT, CA, FR). However, the finding of ratios above 2 for four countries is neither compatible with Baumol-Tobin nor with Alvarez and Lippi (2009). Also, if we analyze the values across countries, no negative correlation between these two ratios is discernible. Overall, these findings, if taken at face value, would question deterministic and dynamic models of demand for cash.

However, we treat the results merely as indicative because work which goes beyond the scope of this paper would be necessary to obtain a valid structural comparison across countries. First, consumers have several withdrawal sources, and it is neither obvious how an average withdrawal amount should be computed if several withdrawal sources are used nor how much we can rely on survey information on withdrawal sources that are only rarely used on average, i.e., cashback in Germany or via teller in Netherlands. In the face of this difficulty, we have opted for a pragmatic approach and have used the average withdrawal amount at the ATM as our measure of W. Second, the model of Alvarez and Lippi (2009) makes

predictions about the cross-sectional variation across households, while we extend this to a comparison across countries. Institutional, regulatory, and market differences (e.g., density of ATMs, pricing, daily withdrawal limits, etc.) might confound our results. Finally, the dynamic model of cash demand abstracts from precautionary strategies related to consumers' long-term cash management that could induce a ratio W/M greater than 2. One needs to make sure that these considerations do not play a role.

5.3 Sociodemographic Characteristics

This section presents evidence on cash usage along sociodemographics characteristics, and we inquire into consumers' preferences by analyzing survey evidence on perceptions of cash.

5.3.1 Age, Income, and Education

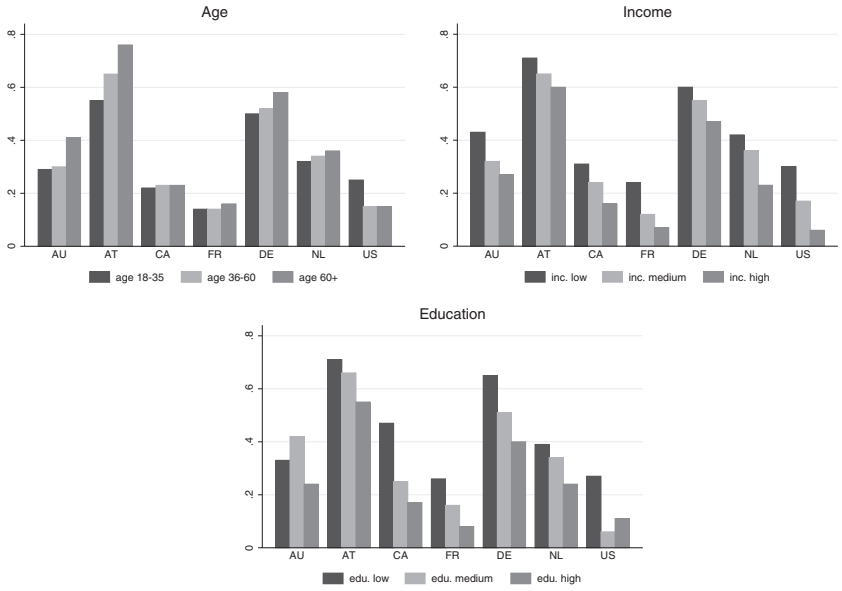
Fact 4. *Cash usage decreases with education and income, but varies across age categories.*

The role of age is of interest because one could argue that the enduring importance of cash could be due to habit persistence. Indeed, previous literature indicates that older people hold and use more cash, while young consumers are more likely to use new payment technologies (e.g., Daniels and Murphy 1994; Boeschoten 1998; Carow and Staten 1999; Stavins 2002; Hayashi and Klee 2003).

Our results in figure 3 reveal that older people use significantly more cash than younger people except for US, where younger individuals use more cash than older individuals. These figures regarding age do not control for differences in expenditure patterns or other personal characteristics; for example, younger consumers may buy different products and/or services and at different venues than older individuals. Therefore, a final answer on the role of age can only be given with estimations that control for these other variables, which will be the focus of the next section.[20]

[20]Von Kalckreuth, Schmidt, and Stix (2014a) find no evidence in favor of strong habit persistence. Instead, they attribute higher cash usage of older people to their differential characteristics (e.g., lower opportunity costs of time or lower income).

Figure 3. Value Share of Cash by Age, Income, and Education



Notes: The graphs depict the shares of cash (in value terms) in percentage for the respective subgroup. Authors' calculations are based on harmonized diary surveys.

Income and education have been cited in the literature as important factors, with cash usage declining with higher income and education (e.g., Arango, Huynh, and Sabetti 2015 for CA; von Kalckreuth, Schmidt, and Stix 2014b for DE; and Schuh and Stavins 2010 and Cohen and Rysman 2013 for US). Figure 3 confirms differences along income terciles, with less cash usage by higher-income respondents. Even stronger differences are found along education. Notably, these differences pertain to all analyzed countries: for DE and CA, the difference in the value share of cash between low education and high education is more than 26 percentage points, while in the remaining countries this difference ranges from 9 to 18 percentage points.[21]

[21]In many respects, these findings mirror the pattern observed for card ownership, which tends to vary along the same sociodemographic lines

Recent work by von Kalckreuth, Schmidt, and Stix (2014a) finds that cash is used to monitor expenditures. In particular, their prediction is that cash will be used for this purpose by individuals who face financial constraints and who have difficulties with other monitoring techniques (such as online accounts). The pattern of results obtained for income and education is in line with this proposition.[22]

5.3.2 Consumer Preferences

One could argue that consumers are using cash because they have no choice; e.g., because payment cards are not accepted or for reasons of costs, safety, or convenience. We can analyze this issue by looking at consumers' ratings of certain payment instrument attributes, which can be viewed as broad proxies for consumer preferences and which have been found to affect payment choice (e.g., Borzekowski, Kiser, and Shaista 2008; Ching and Hayashi 2010; Schuh and Stavins 2010; Arango, Huynh, and Sabetti 2015).

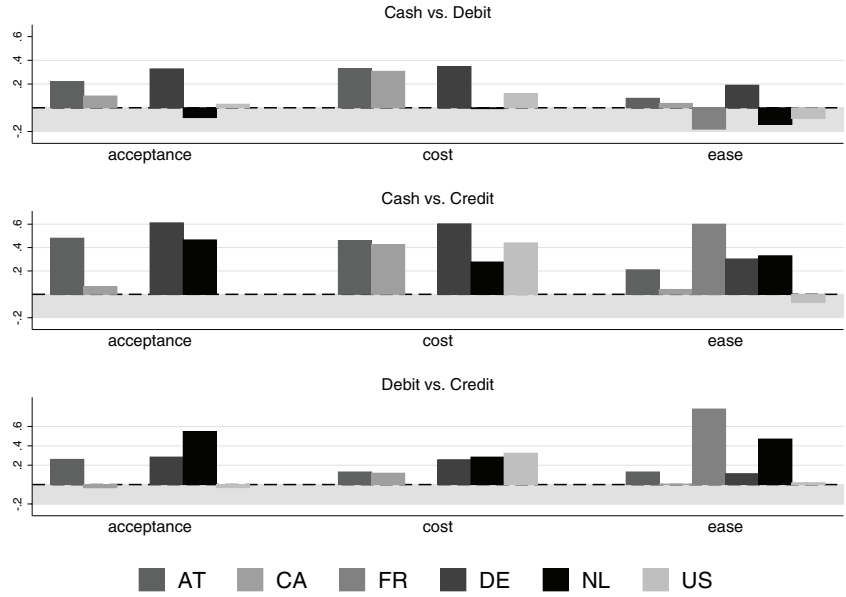
To a varying degree, the seven diaries contain information on preferences that we have attempted to harmonize. The harmonization was difficult because the different diary surveys described and asked about preferences in different ways. Moreover, responses were measured in different ways, with some countries using Likert scales and others binary responses. In the face of these obstacles, we were able to successfully harmonize only responses concerning the relative perceived acceptance, cost, and ease of use of cash. Figure 4 shows a normalized comparison of consumers' ratings of cash versus debit.[23] The depicted measures are scale free, with a positive (negative) value implying that cash is rated better (worse) than debit (a value of zero means that cash is rated the same as debit). Similarly, we show results of a comparison of cash with credit and of debit with credit.

(table 6). However, the case of NL, where debit card ownership does not vary across income or education while the cash shares do, suggests that income and education exert an autonomous effect on cash usage that is independent of card ownership.

[22]The role of debit cards for spending restraint has been recently analyzed by Fusaro (2013).

[23]See Jonker (2007) and Arango, Huynh, and Sabetti (2015) for a description of the normalization. Variables are defined in table 13 in the appendix.

Figure 4. Perceptions of Cash



Notes: The figure shows normalized perceptions of cash relative to debit and credit. A positive (negative) value indicates that cash is perceived better (worse) than the respective payment card. Due to differences in the wording of survey questions, the harmonization is only approximate. Values for acdeptance and costs are not available for FR. For DE, values are taken from the 2008 payment diary. Authors' calculations are based on questionnaire and diary surveys.

Fact 5. *Cash is generally valued highly by consumers for its perceived acceptance, costs, and ease of use.*

Concerning consumer perceptions of acceptance, we can compare results from five countries. For AT, CA, and DE, cash is rated higher than debit. For US, cash is rated the same as debit, and for NL, cash is rated worse than debit. For CA and US, we find that results concerning cash versus debit and cash versus credit are very similar, mirroring that both cards are perceived to have a similar acceptance. In the other countries, credit cards are seen as worse than debit cards, corresponding with the authors' perception of the acceptance of credit cards in countries such as AT, DE, and NL.

With respect to perceived cost, we find that cash is rated better than debit for AT, CA, DE, and US, and for NL it is rated similarly. Again, the difference is more pronounced in favor of cash when it comes to a comparison of cash to credit. Finally, regarding the ease of use, debit is rated higher for AT, CA, and DE, while it is rated lower than cash for FR, NL, and US.

Overall, this evidence suggests that cash usage by consumers is not the sole result of a lack of alternatives. To the contrary, cash is valued by consumers because it is perceived more positively than, or as positively as, credit and debit cards with respect to cost. Also, the assessment shows that in particular in countries with relatively high cash use, ease of use may be an important driver.

5.4 Card Ownership

Cash usage may be influenced by differences in the dissemination and use of payment cards.

Fact 6. *Whereas the levels of card ownership differ across countries, overall card ownership is rather high. Consumers only use a few payment instruments alongside cash.*

Table 5 shows that in each country the vast majority of consumers hold payment cards: For AT, with its high cash share, we observe the lowest card dissemination share of 86 percent. For NL, virtually all consumers are in possession of a payment card.

The most striking difference in card ownership can be seen in the dissemination of credit cards. Table 6 presents disaggregated evidence on card ownership by sociodemographics, showing that differences in credit card ownership prevail along all age, income, and educational groups. These differences suggest that there are factors related to the market structure that affect credit card dissemination.

There are significant differences in the number of cards owned or used (multi-homing).[24] CA and US consumers possess, on average,

[24]Rysman (2007) discusses the issue of multi-homing (that is, respondents' practice of holding or using more than one payment card). In our analysis, we focus on card use on the extensive margin (number of cards), not the intensive margin (how much the card is used).

Table 5. Card Ownership and Multi-homing

	AU	AT	CA	FR	DE	NL	US
Share of Respondents With:							
Payment Card	0.95	0.86	0.99	0.92	0.94	1.00	0.88
Debit Card	0.93	0.85	0.97	0.90	0.94	0.99	0.76
Credit Card	0.47	0.24	0.81	0.31	0.33	0.62	0.67
Number of Payment Cards in Possession							
Mean	1.93	1.77	3.51	1.61	1.85	1.63	4.23
Median	2.00	1.00	3.00	1.00	1.00	2.00	3.00
Number of Payment Instruments Used in Diary							
Mean	2.23	1.75	1.79	2.37	1.88	1.56	2.28
Median	2.00	2.00	2.00	2.00	2.00	1.00	2.00
Share of Respondents Who Revolve or Overdraft							
Revolvers	0.29	—	0.26	—	—	—	0.33
Overdraft	—	0.33	—	—	—	—	0.28

Notes: "Payment Card" is defined as those persons with either a debit or a credit card. Authors' calculations are based on questionnaire and diary surveys. "Revolvers" are those who do not pay off their total credit card balances each month and incur interest/finance charges. "Overdraft" refers to persons who at least sometimes overdraw their checking account.

3.5 and 4.2 payment cards. For all other countries, the respective value is below 2. The median number of payment cards is 3 for CA and US, 2 for AU and NL and only 1 for AT, DE, and FR.

Table 5 also presents evidence on the number of payment instruments used in the diary period. Our findings indicate that the median consumer uses two payment instruments (including cash) over the diary recording period.[25] Although these results are influenced by the length of the diary period, it suggests that the median consumer uses only a few payment instruments alongside cash, which

[25]For NL the median is one payment instrument, which is explained by the fact that respondents only recorded their payments for one day.

Table 6. Card Ownership by Sociodemographics

	AU	AT	CA	FR	DE	NL	US
Debit Card Ownership by Sociodemographics							
Age:							
18–35	0.96	0.95	0.97	0.91	0.96	1.00	0.77
36–60	0.94	0.89	0.98	0.91	0.95	0.99	0.79
60+	0.88	0.69	0.94	0.86	0.91	0.99	0.69
Education:							
Low	0.94	0.79	0.89	0.81	0.86	0.99	0.71
Medium	0.86	0.91	0.98	0.90	0.98	0.99	0.86
High	0.91	0.96	0.97	0.96	0.99	0.99	0.80
Income:							
Low	0.88	0.78	0.96	0.83	0.89	0.98	0.62
Medium	0.95	0.90	0.97	0.93	0.96	0.99	0.82
High	0.94	0.93	0.97	0.96	0.97	0.99	0.82
Credit Card Ownership by Sociodemographics							
Age:							
18–35	0.33	0.21	0.76	0.25	0.31	0.60	0.52
36–60	0.57	0.28	0.84	0.36	0.43	0.62	0.69
60+	0.46	0.20	0.83	0.29	0.24	0.62	0.84
Education:							
Low	0.48	0.13	0.62	0.22	0.16	0.44	0.56
Medium	0.41	0.31	0.77	0.31	0.39	0.55	0.81
High	0.45	0.42	0.91	0.36	0.68	0.75	0.92
Income:							
Low	0.27	0.11	0.64	0.23	0.20	0.36	0.36
Medium	0.53	0.20	0.84	0.32	0.27	0.60	0.75
High	0.54	0.42	0.95	0.52	0.54	0.86	0.91

Notes: Payment card is defined as either a debit or credit card. Authors' calculations are based on diary and questionnaire surveys.

is in line with the results of Cohen and Rysman (2013) using a data set that follows consumers over a much longer period of time.[26]

[26]Table 5 provides evidence on how certain consumers use their cards, i.e., it compares the share of revolvers in US, AU, and CA with the share of persons with overdrafts on their checking accounts for US and AT. Interestingly, all shares are

Table 7. Perceived Acceptance by Transaction Value

	AT	CA	DE
Quartile 1	0.48	0.53	0.28
Quartile 2	0.63	0.71	0.48
Quartile 3	0.68	0.80	0.69
Quartile 4	0.75	0.89	0.87
Overall	0.63	0.73	0.57

Note: The table shows the share of transactions in a given transaction value quartile for which respondents answered that cards were accepted.

5.5 POS Characteristics

Finally, we discuss two types of POS characteristics: (i) card acceptance at the POS, and (ii) the type of economic activity in which transactions occur.

5.5.1 Card Acceptance

FACT 7. *Higher usage of cash is associated with lower levels of card acceptance at the POS.*

The role of card acceptance at the POS can be approached by using direct survey evidence for AT, CA, and DE. In particular, the respective payment diaries recorded whether a transaction could have been made in cashless form. On the basis of this information, we can analyze whether high cash usage is attributable to insufficient payment card acceptance. When interpreting results, however, it should be kept in mind that they are based on the subjective assessment of respondents.

Table 7, which tabulates the consumer's self-stated acceptance of cards at the POS by transaction values, confirms that the acceptance

roughly around 30 percent, even in AT with little credit card use (disregarding measurement difficulties). This result implies that AT consumers use the overdraft facility on their checking account to obtain credit, whereas consumers in the English-speaking countries use their credit cards. Short-term credit could also be obtained with deferred debit cards. However, we do not have comparable information on these types of cards.

of payment cards is much lower for small-value amounts than for large-value amounts. For transaction values in the first quartile, DE stands out with low acceptance. Furthermore, a comparison across countries indicates that (i) CA has the highest acceptance values in each quartile, and (ii) the difference, interestingly, is not strong for higher transaction amounts relative to AT and DE. This evidence is roughly consistent with cash usage. Note again that these descriptive statistics assume all other factors to be fixed. Therefore, to analyze the real effect of card acceptance, econometric analyses will be used in section 6 to account for all other potential factors.

5.5.2 Type of Purchase

FACT 8. *Cash usage varies across types of purchases and venues.*

The diaries allow the analysis of cash usage in different sectors/for different types of expenditures. We have calculated payment instrument shares for cash, debit, and credit for all sectors, summarized in table 8. Given country-specific differences in industry sector definitions, we stress that harmonization is incomplete, particularly for services and "other sectors," so results should be taken with caution.

Cross-country differences in payment patterns across different sectors could be driven by differences in transaction values, card acceptance, or behavioral patterns, or by cultural differences. Accordingly, figure 5 depicts three sectors that we consider interesting with regard to these factors.[27]

First, we suspect that card acceptance at gas stations is almost universal, or at least high in all countries. At the same time, the typical expenditure value is roughly equal in size across countries. This implies that an analysis of cash usage at gas stations should give an indication of the role of acceptance and transaction sizes in explaining the levels of cash usage. That is, if acceptance and transaction sizes were the only factors driving payment behavior, we would expect to find fairly equal levels of cash usage in gas stations

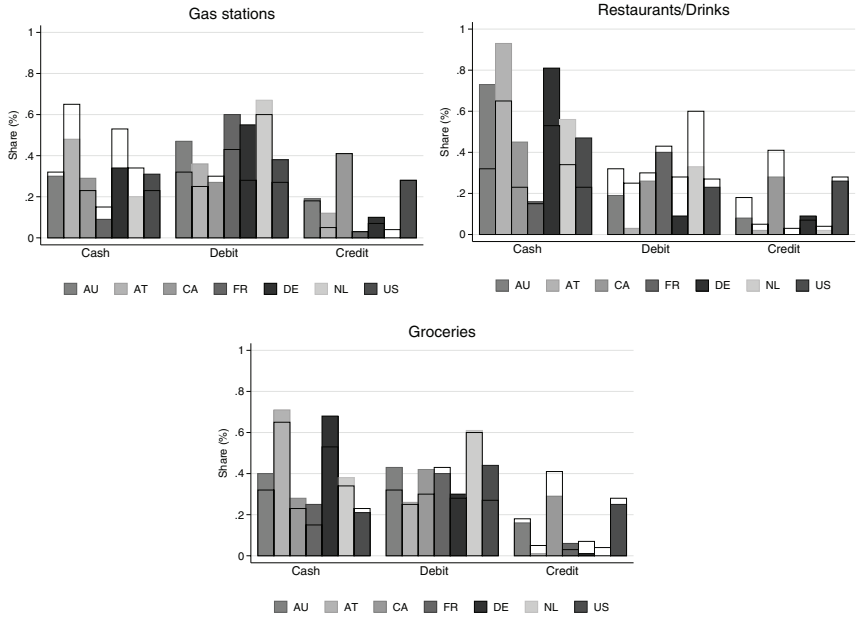
[27]Note that the FR share does not add up to 1 since checks have a non-trivial share.

Table 8. Payment Instrument Value Shares by Type of Purchase

	Groceries	Gasoline	Semi-Durables	Service	Restaurant/ Drinks	Other
Cash						
AU	0.40	0.30	0.21	0.29	0.73	0.21
AT	0.71	0.48	0.43	0.69	0.93	0.78
CA	0.28	0.29	0.12	0.11	0.45	0.24
FR	0.25	0.09	0.09	0.12	0.16	0.12
DE	0.68	0.34	0.26	0.56	0.81	0.42
NL	0.38	0.20	0.27	0.36	0.56	0.39
US	0.21	0.31	0.12	0.16	0.47	0.40
Debit						
AU	0.43	0.47	0.43	0.25	0.19	0.14
AT	0.26	0.36	0.41	0.14	0.03	0.12
CA	0.42	0.27	0.29	0.21	0.26	0.35
FR	0.40	0.60	0.41	0.25	0.40	0.09
DE	0.30	0.55	0.51	0.14	0.09	0.06
NL	0.61	0.67	0.65	0.50	0.33	0.53
US	0.44	0.38	0.32	0.14	0.23	0.08
Credit						
AU	0.16	0.19	0.25	0.24	0.08	0.07
AT	0.01	0.12	0.11	0.04	0.02	0.01
CA	0.29	0.41	0.56	0.54	0.28	0.26
FR	0.06	0.03	0.06	0.01	0.00	0.00
DE	0.01	0.10	0.12	0.13	0.09	0.10
NL	0.00	0.00	0.00	0.01	0.02	0.02
US	0.25	0.28	0.43	0.25	0.26	0.06
Other Payment Instrument (if share > 0.1)						
AU	—	—	0.11	0.21	—	0.58
AT	—	—	—	0.13	—	—
CA	—	—	—	0.14	—	0.15
FR	0.29	0.28	0.44	0.62	0.44	0.79
DE	—	—	0.10	0.17	—	0.43
NL	—	0.12	—	0.13	—	—
US	0.10	—	0.13	0.44	—	0.46

Notes: Authors' calculations are based on diary surveys. Shares are in percent. Sectoral harmonizaton across countries is only approximate.

Figure 5. Value Share of Cash by Location/Activity



Notes: Sectoral harmonization across countries is only approximate. The shaded area shows the shares for the respective location/activity. The transparent bar depicts the shares for all consumer expenditures.

across all countries. Indeed, our results suggest that cross-country differences in cash usage are significantly smaller at gas stations than for all expenditures. In particular, we find that the cash share at gas stations for AT and DE drops significantly relative to the overall cash share.[28] This provides a strong indication of the effects of acceptance and transaction sizes. Despite this finding, we note that sizable differences across countries still prevail, showing that acceptance and sizes are not the only factors driving cash usage.

Second, expenditures at bars and fast food restaurants could be cash intensive due to convenience. Indeed, the descriptive results

[28]Huynh, Schmidt-Dengler, and Stix (2014) find that higher acceptance is correlated with a lower cash share for AT and CA, especially in venues such as gas stations.

show that the cash share for these transactions is substantially higher than the overall cash share for all countries except FR, where checks account for more than 40 percent of the expenditure value share in this sector. It is notable that this can also be observed in countries that have a high card acceptance rate. Again, this result is an indication that consumers differ in their payment behavior depending on the spending location, which is not only to be explained by levels of card acceptance and transaction sizes.

Third, for the grocery sector the cash expenditure share is higher than the average for all countries except US. Interestingly, the debit share is higher for all countries except FR, which has a slight increase in credit cards. We conjecture that this fact is associated with convenience and/or the market structure of the grocery sector. Regarding the first issue, cash could be considered a convenient and fast way to pay for purchases at (small) grocery stores. It might also be correlated with the size of the location and card acceptance. In most European countries, grocery stores are smaller than they are in AU, CA, and US. The grocery sector, often having low margins, might focus on the cost of payments, which could explain the higher usage of debit.

6. Choosing Cash vs. Non-Cash

Ideally, we would like to use the diary data to estimate econometric models to test at least the traditional theoretical models of money demand discussed in section 5, such as the Baumol-Tobin model. In particular, merging the diary micro data would provide an international database that could allow us to quantify international differences in consumer behavior. However, institutional and data limitations prevent us from doing so. Perhaps the most important limitation is the lack of individual-level data on basic core variables, such as interest rates on bank account balances or other liquid assets to proxy for the opportunity cost of cash, which none of the diaries include.[29]

[29] Briglevics and Schuh (2013a) provide an example of the difficulties with obtaining and constructing individual-specific interest rates for use in an econometric Baumol-Tobin model. Huynh, Schmidt-Dengler, and Stix (2014) also

Therefore, this section investigates the choice of using cash versus non-cash in a multivariate setting. We estimate the probability of choosing cash versus non-cash alternatives (either debit or credit) at the POS using the following logit model:

$$U_j^* = X_j\beta + \epsilon_j, \text{ where } j = \text{ Cash, Non-Cash,} \tag{1}$$

where U_j^* is the utility of choice j as a function of observables X_j and a logit error ϵ_j. The variables, X_j, used in the regression are (i) transaction size, (ii) cash balances, (iii) sociodemographic characteristics (age, income, education), (iv) consumer perceptions of ease of use, acceptance, and cost, and (v) POS transaction characteristics (card acceptance and type of purchase). We attempt to harmonize variables for all countries, but there are some differences. Please refer to table 13 in the appendix for the exact list. The sample contains all individuals (also those without payment cards) and all transactions that are conducted using cash, debit, or credit.

The goal of these estimations is twofold. First, we would like to quantify which factors exert an impact on consumers' choice of whether or not to pay in cash, even when controlling for other potential factors. Second, we would like to study whether the use of cross-country data reveals patterns that are common to all countries.

6.1 Results of Logit Regressions

Table 9 reports the marginal effects on the probability of using cash. Our baseline demographic profile is a person aged thirty-five or less that is married, with low education and low income. Overall, the findings are fairly consistent and highlight that demographics play a major role across countries. Even when controlling for transaction size and other characteristics, we find that higher income and higher education are associated with lower cash use.

Regarding age, we find that persons older than thirty-six use significantly more cash than persons younger than thirty-five. Also, the

estimate a Baumol-Tobin model that exploits perceived acceptance of cards at the POS and uses imperfect proxies such as risk of theft and whether respondents revolve on credit card debt.

Table 9. Cash versus Non-Cash Payment Choice (marginal effects)

	AU	AT	CA	FR	DE	NL	US
Medium Income	−0.031	−0.068**	0.021	−0.046**	−0.005	0.006	−0.119***
	(0.017)	(0.024)	(0.021)	(0.017)	(0.011)	(0.016)	(0.02)
High Income	−0.035	−0.067**	0.014	−0.071*	−0.013	−0.009	−0.119***
	(0.019)	(0.025)	(0.027)	(0.031)	(0.012)	(0.016)	(0.025)
Aged 36 to 59	0.071***	0.022	0.041*	0.051**	0.024*	0.043**	0.091***
	(0.017)	(0.018)	(0.019)	(0.017)	(0.01)	(0.016)	(0.023)
Aged Over 60	0.112***	0.057*	0.026	0.042	0.047**	0.061**	0.073*
	(0.027)	(0.024)	(0.031)	(0.028)	(0.018)	(0.02)	(0.029)
Medium Education	−0.04*	0.047	−0.106**	−0.045*	−0.034***	0.005	−0.126**
	(0.02)	(0.029)	(0.039)	(0.022)	(0.01)	(0.016)	(0.047)
High Education	−0.08***	0.011	−0.134***	−0.097***	−0.085***	−0.037**	−0.194***
	(0.015)	(0.022)	(0.04)	(0.027)	(0.014)	(0.014)	(0.046)
Not Homeowner	0.012		0.027				0.01
	(0.014)		(0.022)				(0.021)
Perceptions of:							
Ease	0.123***		0.17***				0.212***
	(0.037)		(0.045)				(0.035)
Cost	−0.046		0.082				0.037
	(0.025)		(0.043)				(0.045)
Security	0.082***		−0.054**				0.064***
	(0.016)		(0.020)				(0.014)
Acceptance	−0.023		−0.08				0.054
	(0.042)		(0.045)				(0.045)
Card Acceptance	−0.104***		−0.48***		−0.105***	−0.546***	
Share at the POS	(0.025)		(0.033)		(0.016)	(0.041	

(*continued*)

Table 9. (Continued)

	AU	AT	CA	FR	DE	NL	US
Cash on Hand	0.002	0.038***	0.005***	0.001***	0.002***	0.006***	0.003***
	(0.001)	(0.01)	(0.001)	(0)	(0.001)	(0.001)	(0.001)
Gasoline	−0.071***	−0.056***	−0.008	−0.161***	−0.098***	−0.046*	0.02
	(0.014)	(0.015)	(0.028)	(0.027)	(0.007)	(0.022)	(0.019)
Semi-durables	−0.047***	−0.039**	−0.036*	−0.098***	−0.082***	0.06***	−0.06**
	(0.012)	(0.012)	(0.017)	(0.016)	(0.008)	(0.014)	(0.019)
Services	0.08**	0.053***	0.031	−0.029*	0.048***	0.054*	0.138***
	(0.025)	(0.012)	(0.029)	(0.014)	(0.011)	(0.027)	(0.019)
Entertainment	0.167***	0.156***	0.109***	−0.098***	0.081***	0.269***	0.09***
	(0.021)	(0.012)	(0.017)	(0.018)	(0.012)	(0.017)	(0.016)
Other (Not Groceries)	0.075***	0.122***	0.084***	0.04**	0.061***	0.161***	0.409***
	(0.017)	(0.023)	(0.018)	(0.015)	(0.01)	(0.022)	(0.04)
TV Q2	−0.168***	−0.248***	−0.254***	−0.241***	−0.117***	−0.11***	−0.178***
	(0.022)	(0.015)	(0.016)	(0.035)	(0.021)	(0.016)	(0.016)
TV Q3	−0.263***	−0.372***	−0.397***	−0.454***	−0.243***	−0.264***	−0.305***
	(0.023)	(0.015)	(0.015)	(0.033)	(0.02)	(0.015)	(0.015)
TV Q4	−0.364***	−0.541***	−0.549***	−0.629***	−0.373***	−0.417***	−0.462***
	(0.023)	(0.013)	(0.015)	(0.028)	(0.02)	(0.016)	(0.017)
Observations	7,841	17,303	12,652	7,549	18,676	8,233	10,671

Notes: The dependent variable takes a value of 1 if a payment is made by cash and 0 if it is made by debit or credit. Results for location (urban/rural), marital status, gender, employment status, and family size are not shown. Variables are defined in table 13 in the appendix. TV Q2, TV Q3, and TV Q4 denote the second to fourth quartile of transaction values. We cluster standard errors at the person level. Standard errors are in parentheses and the 1, 5, and 10 percent levels of significance are denoted by ***, **, and *, respectively.

results provide support for a certain habit persistence in some countries (AT, AU, DE, NL), where cash use increases homogeneously with age: people aged sixty and older are more likely to use cash than people between the ages of thirty-six and fifty-nine.

For three countries that collected data on consumer perceptions regarding payment instruments (AT, CA, and US), the perceived ease of using cash was highly significant and positive. This shows that consumers who rate cash high with regard to ease of use conduct more cash transactions. The perceptions regarding security were different, positive versus negative, between AT and CA. The other perceptions with respect to cost and overall acceptance were not significant. These results are in line with previous research; see Schuh and Stavins (2010), von Kalckreuth, Schmidt, and Stix (2014b), and Arango, Huynh, and Sabetti (2015).

The strongest effect on consumers' choice between cash and non-cash was obtained for transaction values, where the estimation results confirm that the probability of using cash decreases homogeneously with the transaction value quartile. These results hold across all countries. In the fourth transaction value quartile, the probability of using cash is lower by 42 (NL) to 63 percentage points (FR) relative to the first transaction value quartile.

The results also confirm an independent effect of purchase location/type of purchase. The baseline category is a durable purchase in the lowest transaction value category. For expenditures at gas stations and for purchases of semi-durables, the marginal effects were universally negative (with the exception of NL), while for services, entertainment, and groceries they were positive. These results confirm previous results that were based on data from single countries (e.g., Klee 2008; Cohen and Rysman 2013).

Another finding of the logit model is that people who hold higher cash balances on average use cash more often than people with lower cash balances. Note, however, that we treat this as indicative only because of the likely presence of reverse causality.[30] Although we

[30] Applying an instrumental-variable approach that is common to all countries was impossible, because the survey questionnaires differed too much across countries. Omitting cash balances from the regressions, however, does not affect the other findings.

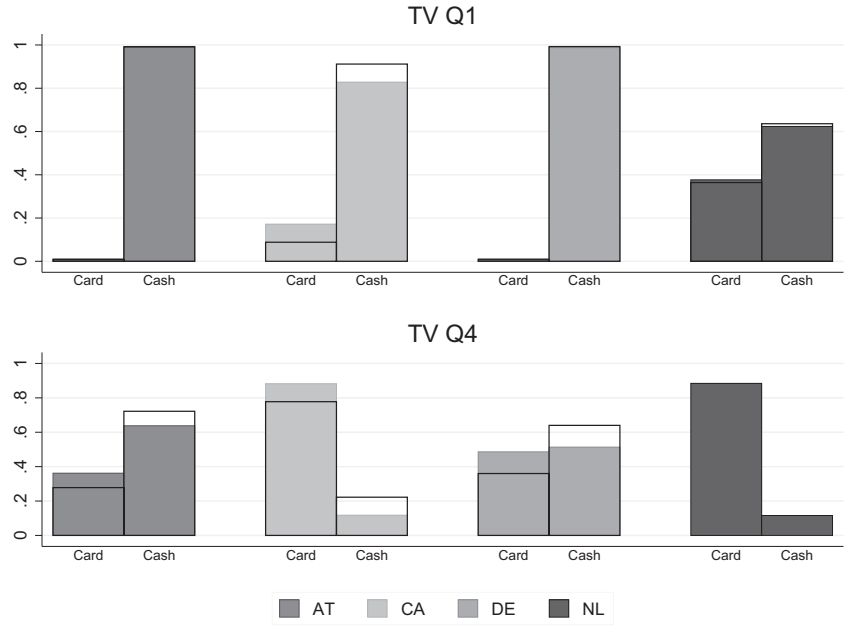
tried to alleviate this issue by using average cash balances of individuals and not cash balances before each transaction, we are aware that this does not completely solve the problem. For deeper analyses of this issue, we refer to Bouhdaoui and Bounie (2012), Arango et al. (2013), and Eschelbach and Schmidt (2013), who arrive at similar findings even when accounting for the possible endogeneity of cash balances.

Several results from our descriptive analysis indicate that card acceptance is likely to be important in consumers' choice between cash and non-cash. This result is reported in table 9, which shows that the rate of acceptance of cards at the POS has a significant negative effect on the probability of using cash (results are only available for AT, CA, DE, and, with limitations, NL). In order to understand the quantitative impact of this factor and to study how much it contributes to the level of cash usage across countries, we conduct a scenario analysis. In particular, we compare the baseline probabilities—i.e., the observed frequencies from the data—with the hypothetical values obtained by assigning each person the maximum group acceptance observed in the sample. Note that this does not necessarily mean that acceptance is raised to 1, because this would imply a far stretch from reality. Thus, the question we ask is by how much cash usage would decline if acceptance were as high as it is for the income/age group that reports the highest rate of acceptance.[31]

Figure 6 summarizes the results for the first and fourth transaction value (TV) quartile. For TV Q1, the effect on payment choice is trivial for AT, DE, and NL, while for CA it is significant. There is an almost 10-percentage-point increase in card usage for low-value transactions if payment cards were universally accepted. However, at TV Q4 the effect is similar across countries, as the probability of card payment increases relative to cash. This would imply that Canadians are more likely to pay with cards at all transactions if cards are universally accepted. High acceptance of cards will only increase card use for AT and DE when the transaction values are high. For NL, the effect would be minimal, which indicates that current levels

[31]This also implies that we do not expect country differences to vanish, as the maximum rate of acceptance can still differ across countries. All other variables are evaluated at their means.

Figure 6. Scenario Analysis: High Acceptance



Notes: The figure compares the unconditional predicted probabilities of cash use (transparent bars) with a scenario in which acceptance is set to the maximum observed group acceptance (and all other explanatory variables evaluated at the mean). The upper (lower) panel refers to transaction values in the first (fourth) quartile.

of acceptance are already relatively high at all transaction quartiles. These results highlight that country differences remain substantial.

6.2 Robustness Analyses

As one important robustness check, we focus on transactions completed at grocery stores and gas stations only. This exercise is inspired by the work of Klee (2008), who uses scanner data from grocery stores, and Cohen and Rysman (2013), who use scanner data from grocery stores and gas stations.[32] The results are reported in

[32]Klee (2008) focuses mainly on the value of time while controlling for census-tract averaged demographics. Her analysis does not have individual

table 10. Focusing on these sectors reduces the sample by about one-half to two-thirds. The results again confirm the roles of demographics and transaction value. These results are consistent with the findings of Klee (2008) and Cohen and Rysman (2013). In addition, we find that the results for the other variables do not change; we still find an independent effect for preferences, cash on hand, and payment location/type of product.

Finally, we perform a few additional robustness checks to ensure that difference in survey design does not drive the results. One, we estimate a logit using the transactions conducted on the first day of each diary to compare with the Dutch payment diary, which only collected data per respondent for one day. Two, we also generate estimates using only the first three days for AU, AT, DE, and FR that are comparable to those for CA and US. Neither of these modifications affects the main results. Three, we estimate the logit conditioning on the sample of respondents who owned a payment card (either debit or credit). The results for all sectors and the gas and groceries were quantitatively similar. These robustness checks are available in a supplementary appendix on the IJCB website (http://www.ijcb.org).

7. Reasons for Cross-Country Differences in Cash Usage

The estimation results provide a set of factors that are correlated with cash use. To understand why the cash share is higher in AT and DE compared with the other countries, we provide a brief discussion of the following six potential reasons for cross-country differences: (i) payment card acceptance at the POS, (ii) structure of purchases, (iii) shoe-leather costs and opportunity costs, (iv) financial and nonfinancial incentives, (v) behavioral aspects of payment choice, and (vi) the size of the shadow economy.[33]

demographics, perceptions, or acceptance of cards. Cohen and Rysman (2013) analyze rich data on grocery purchases and are able to follow consumers over a longer time period. Their paper highlights the role of the transaction size.

[33]A deeper discussion of these factors is available in a supplementary appendix on the IJCB website (http://www.ijcb.org).

Table 10. Cash versus Non-Cash Payment Choice at Gas and Groceries (marginal effects)

	AU	AT	CA	FR	DE	NL	US
Medium Income	−0.025	−0.072*	0.042	−0.046**	−0.009	0.007	−0.133***
	(0.024)	(0.033)	(0.029)	(0.017)	(0.014)	(0.017)	(0.027)
High Income	−0.039	−0.08*	0.002	−0.073*	−0.012	−0.023	−0.162***
	(0.029)	(0.034)	(0.037)	(0.032)	(0.015)	(0.018)	(0.038)
Aged 36 to 59	0.086***	0.017	0.077**	0.056**	0.026	0.025	0.105***
	(0.023)	(0.026)	(0.024)	(0.017)	(0.014)	(0.017)	(0.032)
Aged Over 60	0.127***	0.04	0.08	0.042	0.069**	0.019	0.059
	(0.039)	(0.036)	(0.043)	(0.027)	(0.022)	(0.021)	(0.04)
Medium Education	−0.069*	0.056	−0.073	−0.053*	−0.043***	−0.005	−0.138*
	(0.028)	(0.045)	(0.051)	(0.023)	(0.013)	(0.016)	(0.061)
High Education	−0.102***	0.004	−0.123*	−0.106***	−0.118***	−0.03*	−0.21***
	(0.021)	(0.037)	(0.052)	(0.028)	(0.019)	(0.015)	(0.06)
Not Homeowner	0.035		0.046				0.053
	(0.02)		(0.029)				(0.029)

(*continued*)

Table 10. (Continued)

	AU	AT	CA	FR	DE	NL	US
Perceptions of:							
Ease	0.212***		0.161**				0.24***
	(0.055)		(0.055)				(0.048)
Cost	−0.077*		0.108				0
	(0.037)		(0.061)				(0.061)
Security	0.114***		−0.055*				0.045*
	(0.024)		(0.026)				(0.02)
Acceptance	−0.134*		−0.051				−0.008
	(0.056)		(0.076)				(0.057)
Card Acceptance	−0.178***		−0.561***		−0.08***	−0.565***	
Share at the POS	(0.032)		(0.036)		(0.018)	(0.04)	
Cash on Hand	0.003*	0.053**	0.006***	0.001***	0.003***	0.006***	0.002**
	(0.001)	(0.017)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Gasoline	−0.088***	−0.071***	−0.011		−0.114***	−0.036	0.024
	(0.017)	(0.017)	(0.028)		(0.008)	(0.02)	(0.02)
TV Q2	−0.201***	−0.273***		−0.261***	−0.189***	−0.094***	−0.176***
	(0.029)	(0.025)		(0.036)	(0.028)	(0.018)	(0.027)
TV Q3	−0.302***	−0.409***		−0.495***	−0.34***	−0.207***	−0.336***
	(0.03)	(0.023)		(0.034)	(0.028)	(0.018)	(0.024)
TV Q4	−0.42***	−0.586***		−0.677***	−0.481***	−0.316***	−0.466***
	(0.029)	(0.021)		(0.029)	(0.027)	(0.021)	(0.024)
Observations	3,875	6,569	5,079	7,098	10,364	4,184	3,688

Notes: The dependent variable takes a value of 1 if a payment is made by cash and 0 if it is made by debit or credit. Results for location (urban/rural), marital status, gender, employment status, and family size are not shown. Variables are defined in table 13 in the appendix. TV Q2, TV Q3, and TV Q4 denote the second to fourth quartile of transaction values. We cluster standard errors at the person level. Standard errors are in parentheses and the 1, 5, and 10 percent levels of significance are denoted by ***, **, and *, respectively.

7.1 Card Acceptance at the POS

Tables 4 and 7 illustrate a correlation between card acceptance and cash usage. Table 7 shows that the share of purchases where cards are accepted is strictly smaller in DE and AT in comparison to CA; no such data are available for the other countries. This pattern can be observed for all transaction value ranges, but the difference is weaker for the transaction values above the median. This finding, which refers to survey respondents' subjective perceptions, is confirmed by the aggregate network data. The first column of table 11, showing the number of POS terminals per 1 million inhabitants, indicates that the POS density is by far the lowest in DE and AT. However, at the same time, we note that the POS density is not much higher in NL than it is in AT but there is a much lower cash share in NL. Yet, Huynh, Schmidt-Dengler, and Stix (2014) show that card acceptance exerts a strong impact on average cash balances, and table 4 confirms that cash balances are indeed higher in AT and DE. Further, Eschelbach and Schmidt (2013) utilize the German diary data to show that higher cash balances correlate with higher cash usage at the POS.

7.2 Structure of Purchases

The aggregate cash share for a given country could be influenced by the composition of expenditures, e.g., higher expenditure shares for food (FR) or for services (US). Additionally, the market structure of retailers could affect the cash share, e.g., if retailers are small or very large. While the effect of the latter channel is controlled for via card acceptance, the evidence we have presented in table 8 about the sectoral composition of expenditures does display some differences. We analyze the potential size of this compositional effect by computing a hypothetical cash share that assumes that all countries have the expenditure structure of Germany utilizing sectoral cash shares of table 8. These results suggest only minor differences—at most, 2 percentage points—in comparison to unadjusted cash shares. This suggests that the differences in cash usage are weakly correlated with differences in expenditure patterns.

Table 11. Number of ATMs and POS Terminals, Incidence of Robbery

	POS Density	ATM Density	Robberies
Australia	32,008	1,362	16.9
Austria	12,754	969	48.2
Canada	21,045	1,728	86.4
Germany	7,221	947	57.9
France	19,537	820	190.3
Netherlands	15,525	475	92.4
United States	17,019	1,385	112.6

Notes: Columns 1 and 2 show "Terminals located in the country: number of respective terminals per million inhabitants." Source: BIZ "CPSS Red Book statistical update" (Table 11b) and ECB Statistical Data Warehouse, values from 2011. Column 3 shows the number of robbery cases per 100,000 inhabitants. According to the United Nations Office on Drugs and Crime (UNODC) definition, "robbery" means the theft of property from a person, overcoming resistance by force or threat of force. Where possible, the category "Robbery" should include muggings (bag snatching) and theft with violence, but should exclude pickpocketing and extortion. Source: UNODC, values from 2011.

7.3 Shoe-Leather Costs and Opportunity Costs

Shoe-leather and opportunity costs, such as ATM density, risk of theft, and interest rate differentials, have been used to explain the difference in cash use. First, table 11 shows that the lowest ATM density is in FR and NL, which have a low share of cash usage and low cash balances. AT and DE are in the mid-range of observed values, while the highest ATM density is found in AU, CA, and US. This provides mixed evidence as to whether having high ATM density is negatively correlated with low cash share.

Second, table 11 summarizes the number of robberies per 100,000 inhabitants. Again the figures only provide partial support for the high cash share in AT and DE. These two countries have a lower crime rate than CA, US, FR, and NL. However, AU has the lowest robbery density. Hence, high cash balances and high cash use could be due to low crime rates in AT and DE.

Third, interest rate differentials are unlikely to explain much of the cross-country differences in cash use. Given the average size of

cash balances, forgone interest income is small in absolute terms and cross-country interest differentials are small; see table 2 for a summary of interest rates.

7.4 Payment Steering through Financial and Non-financial Incentives

Table 12 summarizes the various financial and non-financial incentives for consumers to use payment methods. In CA and FR, the usage of surcharges is forbidden by the contractual rules of the payment schemes. In AU, AT, DE, NL, and in most US states, retailers are legally allowed to surcharge, but, as in CA and FR, the incidence of surcharging for POS payments is still rather low.[34] In all seven countries, retailers seem to sometimes provide discounts on cash payments, but for most consumer payments, cash discounts are not usual. Hence, the large cash usage in AT and DE does not seem to stem from differences in terms of surcharges and discounts applied by retailers.

Similarly, the larger use of cash in AT and DE does not seem to stem from differences in non-financial incentives used by merchants. In FR and NL, retailers have started various initiatives to stimulate card payments as opposed to cash payments, i.e., using stickers, special "card-only" registers, and explicitly asking consumers to pay by card. In the other five countries too, retailers use various methods to steer customers' payment behavior. However, in most cases, this involves steering consumers away from using high-cost payment cards to less expensive card alternatives, or from using cards for small transactions. Hence, there is no clear pattern of retailers steering clients away from cash in the countries where cash usage is significantly lower than in AT and DE.

The countries considered in this study differ in terms of initiatives taken by banks and card schemes to stimulate the use of payment cards. In AU, CA, FR, and US, consumers may receive rewards when using (particular) payment cards. However, in AT and DE,

[34]For instance, in AU, the incidence of surcharges being paid was estimated by a payment diary study conducted in November 2013 at around 4 percent of card transactions; see Ossolinski, Lam, and Emery (2014).

Table 12. Overview of Payment Market Structure

	AU	AT	CA	FR	DE	NL	US
Is surcharging allowed?	Yes	Yes	No	No	Yes	Yes	Yes
Do retailers surcharge particular methods?	Yes	No	Yes	No	Yes	Yes	Yes
Do retailers provide discounts of cash?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do retailers use other, non-financial incentives to steer consumers (e.g., stickers, posters at the POS)?	Yes	No	Yes	Yes	Yes	Yes	Yes
Are retailers allowed to not accept particular cash denominations?	Yes	Yes	Yes	No	Yes	Yes	Yes
Have banks and other organizations launched initiatives to stimulate particular payment behavior (e.g., national campaigns)?	Yes	Yes	Yes	Yes	No	Yes	No
Were these initiatives taken by each organization jointly?	Yes	No	No	Yes	—	Yes	—
Do consumers get rewards for using cards?	Yes	No	Yes	Yes	Yes	No	Yes
Do consumers need to pay when withdrawing cash from an ATM of their own bank?	No	No	Yes	No	No	No	No
Do consumers need to pay when withdrawing cash from an ATM of another bank?	Yes	No	Yes	Yes	Yes	No	Yes

Notes: This table is collected from an informal survey of the co-authors from each respective country. For brevity, we denote the response with either Yes or No. However, there are some nuances to each of the questions, and a detailed table is available upon request.

card rewards are only minor. This may partly explain the relatively low card usage in AT and DE. In addition, in AU, CA, FR, and NL, nationwide campaigns have been used by card schemes, banks, and in some cases retail organizations, to promote the use and acceptance of payment cards and contactless payments among consumers and retailers. In AT, DE, and US, by contrast, promotional activities of banks and card schemes to stimulate (contactless) card usage are mainly limited to basic marketing activities. So, overall, the use of rewards and/or promotion campaigns for card payments in AU, CA, FR, NL, and US may have affected consumers' preferences and finally explain the relatively low usage of cash, as opposed to AT and DE, where both the use of rewards and promotion campaigns are limited.

Finally, differences in pricing of ATM withdrawals may affect consumers' payment choices. However, it is difficult to tell to what extent this may explain the differences across our seven countries. In AT, consumers can withdraw money at no cost at either an ATM of their own bank or another bank's ATM. However, the same is true in the NL. In all other countries, consumers may be faced with a fee, depending on the ATM they visit or the banking packages they have. Hence, there is no clear one-on-one relationship between ATM fees and cash usage.

7.5 Behavioral Aspects

There have been several behavioral explanations offered to explain payment choice. For example, von Kalckreuth, Schmidt, and Stix (2014b) show that cash is used by some consumers because it helps to monitor expenditures. However, Hernández, Jonker, and Kosse (2016) argue that cards may be used for the same purpose too. Budgeting features (e.g., frequency, actuality, and level of detail of account statements) of payment instruments may differ across countries. Therefore, someone who aims to keep track of their expenses could be a heavy cash user in DE, but in US or FR, for example, they could be a check user or a person who keeps a written record of their expenses.

The inter-war and post-World War II experience of very high inflation in AT and DE is sometimes cited as a reason for a preference

for cash.[35] Although difficult to prove, we are skeptical about the relevance of this line of reasoning to explain payment behavior. First, one would suspect that the direct effect of previous high inflation history would be to use less (and not more) cash. Second, even if one recognizes that it is debt aversion that matters, according to which Germans and Austrians could use cash because they dislike debt, then one would presume that AT and DE use fewer credit cards and more debit cards (which is confirmed by our results), but not necessarily more cash. Third, in figure 3 we have documented that cash use by young AT and DE cohorts, which were not affected by any crisis, is also much higher than in the other countries.

A more relevant explanation for cash preference arises if a country has a history of banking crisis, which often coincides with high inflation and may affect trust in banks; see Stix (2013). However, this effect has been shown only for emerging economies, and we consider it unlikely that people in AT or DE trust their banks less than people from other developed countries. For AT, Knell and Stix (2015) show that trust in banks is very high. Moreover, evidence suggests that memories of a banking crisis fade after about twenty years; see Osili and Paulson (2014). Other behavioral aspects of payment behavior are similarly hard to investigate. Anonymity and security concerns are sometimes cited as influencing people's payment behavior. However, the level of anonymity and security people require when making payments is difficult to measure empirically.

7.6 Size of the Shadow Economy

The size of the shadow economy may have an impact on currency in circulation and hence on average cash balances. Therefore, it may also affect cash use for "official" transactions that are observed in diaries. In fact, a comparison of twenty-seven European Union countries reveals a strong negative correlation between the size of the shadow economy and the use of electronic payments; see figure 9 of AT Kearney (2013). Internationally comparable figures for the size of the gray economy are provided by Schneider and Buehn (2012)

[35] "Why Germans Pay Cash for Almost Everything," http://qz.com/262595/why-germans-pay-cash-for-almost-everything (accessed November 28, 2014).

and reveal that US has the lowest gray economy share with 9.1 percent of official GDP, and CA, FR, and DE have the highest share, with about 15 percent. AT has the second lowest share (11 percent). In other words, we find little evidence for a correlation between the size of the shadow economy and the use of cash for payments in our sample countries.

8. Conclusions

Many have predicted and espoused the view that cash is increasingly disappearing as a payment instrument; see Wolman (2012). However, to paraphrase Mark Twain, we would say that the *reports of the death of cash have been greatly exaggerated.* This paper shows that in all seven countries considered, cash is still used extensively—particularly for low-value transactions. In some European countries such as Austria and Germany, cash even dominates consumer payment choices for all transaction values.

This paper demonstrates that, apart from transaction sizes and consumer preferences for ease of use, the use of cash is strongly correlated with demographics and POS characteristics such as merchant card acceptance and venue. This largely confirms the results of earlier studies that were based on data from only one or a small number of countries. Our finding that these results can be observed for all seven countries assures us that these are universal factors driving cash use.

Our paper signals the importance of cross-country differences. First, the level of cash usage differs across the various countries. Second, differences can be found in the type of alternatives used for cash. Some countries often use credit cards as a substitute; in other countries, mainly debit cards are used. One explanation for these cross-country differences could be found in differences in card acceptance and the pricing and stimulation policies of retail payments banks, payment schemes, and retailers. Rysman (2009), for instance, highlights how market structure affects payments, or vice versa. Third, we point to an important correlation between cash use and the amount of cash balances consumers carry. The direction of the correlation remains unclear.

This paper has provided a comprehensive harmonization of payment diaries so as to understand cross-country differences. We have highlighted substantial cross-country differences that remain unexplained, and, given the remaining questions on the role and effect of cash balances, further work is required to more fully ascertain the underlying drivers of consumers' use of cash and alternative payment methods. Further, we provide a comprehensive review of work completed and outline possibilities for future research.[36]

Appendix

Table 13. Definition of Payment Variables

Income	Three dummy variables; 1 if income is in the highest income tercile (High Income), lowest income tercile (Low Income), or the middle income tercile (Medium Income), and 0 otherwise.
Age	Three dummy variables; 1 if age of respondents is above 60 (Aged over 60), between 36 and 59 (Aged 36 to 59), or between 18 and 35 (Aged under 36), and 0 otherwise.
Education	Three dummy variables: low education, middle education, and high education. Although the exact definitions depend on the country, the definitions are based on whether a respondent has finished mandatory schooling, secondary schooling, and some post-secondary education.
Not Homeowner	Dummy variable; 1 if respondent does not own his place of residence.
Perceptions	The analysis employs perceptions on ease of use, cost, security, and acceptance. These are derived from the question as to how much cash fulfills the listed attributes. The values are

(*continued*)

[36]The supplementary appendix on the IJCB website contains a discussion of the current research conducted and an overview of new potential research avenues using payment diaries.

Table 13. (Continued)

	normalized by results for other methods of payment, such that a positive (negative) value implies that cash is valued better (worse) than case or credit. The normalization is described in Arango, Huynh, and Sabetti (2015).
Cash on Hand	Defined as the usual (average) cash holdings of a person. Values for AU and NL are from the questionnaire ("typical" average cash balance); all other values are from the diary. We drop all observations above the 99.5 percent mark and normalize this variable. As a consequence, "Cash on Hand" is a unitless scalar.
Type of Purchase	Several dummy variables; 1 if purchase is classified as grocery, gas station, semi-durable, services, or entertainment, and 0 otherwise.
Transaction Value Quartiles	Quartiles are formed from all observed transaction values. Four dummy variables, which are 1 if a transaction falls in trasaction value quartile 1 to 4 (TV Q1 to TV Q4), and 0 otherwise.
Card Acceptance Share	Respondents indicate whether a transaction could have been conducted by card. From these observations, we calculate the share of transactions with card acceptance for each individual. To avoid endogeneity, we then calculate the mean of individual card acceptance shares for nine pre-specified population groups that are formed from three income and three age groups. "Acceptance Group" thus reflects the mean acceptance of the income/education population group that a respondent belongs to.

References

Ahmed, N., M. Brzozowski, and T. Crossley. 2006. "Measurement Errors in Recall Food Consumption Data." Working Paper No. W06/21, Institute for Fiscal Studies.

Alvarez, F., and F. Lippi. 2009. "Financial Innovation and the Transactions Demand for Cash." *Econometrica* 77 (2): 363–402.

———. 2013. "The Demand of Liquid Assets with Uncertain Lumpy Expenditures." Available at http://dx.doi.org/10.1016/j.jmoneco.2013.05.008.

Amromin, G., and S. Chakravorti. 2009. "Whither Loose Change? The Diminishing Demand for Small-Denomination Currency." *Journal of Money, Credit and Banking* 41 (2–3): 315–35.

Arango, C., Y. Bouhdaoui, D. Bounie, M. Eschelbach, and L. Hernández. 2013. "Cash Management and Payment Choices: A Simulation Model with International Comparisons." Working Paper No. 2013-53, Bank of Canada.

Arango, C., K. Huynh, and L. Sabetti. 2015. "Consumer Payment Choice: Merchant Card Acceptance versus Pricing Incentives." *Journal of Banking and Finance* 55 (June): 130–41.

AT Kearney. 2013. "The Shadow Economy in Europe, 2013." Discussion Paper. Available at http://goo.gl/yBRMZO.

Attanasio, O. R., L. Guiso, and T. Jappelli. 2002. "The Demand for Money, Financial Innovation, and the Welfare Cost of Inflation: An Analysis with Household Data." *Journal of Political Economy* 110 (2): 317–51.

Avery, R. B., G. E. Elliehausen, A. B. Kennickell, and P. A. Spindt. 1986. "The Use of Cash and Transaction Accounts by American Families." *Federal Reserve Bulletin* (Feb): 87–108.

Baumol, W. 1952. "The Transactions Demand for Cash: An Inventory Theoretic Approach." *Quarterly Journal of Economic*s 66 (4): 545–56.

Bethlehem, J. 2008. "Representativity of Web Surveys — An Illusion?" In *Access Panels and Online Research, Panacea or Pitfall?* ed. I. Stoop and M. Wittenberg, 19–44. (Proceedings of the DANS Symposium, Amsterdam, October 12.) Amsterdam: Uitgerverij Aksant.

Boeschoten, W. C. 1992. *Currency Use and Payment Patterns.* Kluwer Academic Publishers.

———. 1998. "Cash Management, Payment Patterns and the Demand for Money." *De Economist* 146 (1): 117–42.

Boeschoten, W. C., and M. M. G. Fase. 1989. "The Way We Pay with Money." *Journal of Business and Economic Statistics* 7 (3): 319–26.

Bolt, W., D. Humphrey, and R. Uittenbogaard. 2008. "Transaction Pricing and the Adoption of Electronic Payments: A

Cross-Country Comparison." *International Journal of Central Banking* 4 (1): 89–123.

Borzekowski, R., E. K. Kiser, and A. Shaista. 2008. "Consumers' Use of Debit Cards: Patterns, Preferences, and Price Response." *Journal of Money, Credit and Banking* 40 (1): 149–72.

Bouhdaoui, Y., and D. Bounie. 2012. "Modeling the Share of Cash Payments in the Economy: An Application to France." *International Journal of Central Banking* 8 (4): 175–95.

Bounie, D., and A. Francois. 2008. "Is Baumol's 'Square Root Law' Still Relevant? Evidence from Micro-Level Data." *Applied Financial Economics* 18 (13): 1091–98.

Briglevics, T., and S. Schuh. 2013a. "This Is What's in Your Wallet . . . and How You Use It." Mimeo.

———. 2013b. "U.S. Consumer Demand for Cash in the Era of Low Interest Rates and Electronic Payments." Working Paper No. 13-23, Federal Reserve Bank of Boston.

Carow, K. A., and M. E. Staten. 1999. "Debit, Credit, or Cash: Survey Evidence on Gasoline Purchases." *Journal of Economics and Business* 51 (5): 409–21.

Ching, A. T., and F. Hayashi. 2010. "Payment Card Rewards Programs and Consumer Payment Choice." *Journal of Banking and Finance* 34 (8): 1773–87.

Cohen, M., and M. Rysman. 2013. "Payment Choice with Consumer Panel Data." Available at http://dx.doi.org/10.2139/ssrn.2308121.

Crossley, T. F., and J. K. Winter. 2012. "Asking Households about Expenditures: What Have We Learned?" In *Improving the Measurement of Consumer Expenditures,* ed. C. D. Carroll, T. F. Crossley, and J. Sabelhaus. University of Chicago Press and National Bureau of Economic Research.

Daniels, K. N., and N. B. Murphy. 1994. "The Impact of Technological Change on the Currency Behavior of Households: An Empirical Cross-Section Study." *Journal of Money, Credit and Banking* 26 (4): 867–74.

Danish National Bank. 2013. "Rapport om nye betalingsl øsninger." Available at http://goo.gl/ruzBdq.

Eschelbach, M., and T. Schmidt. 2013. "Precautionary Motives in Short-Term Cash Management: Evidence from German POS

Transactions." Discussion Paper No. 38/2013, Deutsche Bundesbank, Research Centre.

European Central Bank. 2012. "Virtual Currency Schemes." Available at http://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf.

Eurosystem Household Finance and Consumption Network. 2009. "Survey Data on Household Finance and Consumption: Research Summary and Policy Use." ECB Occasional Paper No. 100.

Evans, D. S., K. Webster, G. K. Colgan, 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." Available at http://dx.doi.org/10.2139/ssrn.2273192.

Federal Reserve System. 2013. "The 2013 Federal Reserve Payments Study: Recent and Long-Term Payment Trends in the United States: 2003–2012." Available at http://goo.gl/qOnIkJ.

Feenstra, R. C., R. E. Lipsey, L. G. Branstetter, C. F. Foley, J. Harrigan, J. B. Jensen, L. Kletzer, C. Mann, P. K. Schott, and G. C. Wright. 2010. "Report on the State of Available Data for the Study of International Trade and Foreign Direct Investment." NBER Working Paper No. 16254.

Fischer, B., P. Köhler, and F. Seitz. 2004. "The Demand for Euro Area Currencies: Past, Present and Future." ECB Working Paper No. 330.

Fusaro, M. A. 2013. "Why Do People Use Debit Cards: Evidence from Checking Accounts." *Economic Inquiry* 51 (4): 1986–2001.

Hayashi, F., and E. Klee. 2003. "Technology Adoption and Consumer Payments: Evidence from Survey Data." *Review of Network Economics* 2 (2): 175–90.

Hernández, L., N. Jonker, and A. Kosse. 2016. "Cash versus Debit Card: The Role of Budget Control." *Journal of Consumer Affairs*. doi: 10.1111/joca12112.

Humphrey, D. B., L. B. Pulley, and J. M. Vesala. 1996. "Cash, Paper, and Electronic Payments: A Cross-Country Analysis." *Journal of Money, Credit and Banking* 28 (4): 914–39.

Huynh, K., P. Schmidt-Dengler, and H. Stix. 2014. "The Role of Card Acceptance in the Transaction Demand for Money." Working Paper No. 14-44, Bank of Canada.

Jack, W., T. Suri, and R. Townsend. 2010. "Monetary Theory and Electronic Money: Reflections on the Kenyan Experience." *Economic Quarterly* (Federal Reserve Bank of Richmond) (1Q): 83–122.

Jonker, N. 2007. "Payment Instruments as Perceived by Consumers — Results from a Household Survey." *De Economist* 155 (3): 271–303.

Jonker, N., and A. Kosse. 2013. "Estimating Cash Usage: The Impact of Survey Design on Research Outcomes." *De Economist* 161 (1): 19–44.

Jonker, N., A. Kosse, and L. Hernández. 2012. "Cash Usage in the Netherlands: How Much, Where, When, Who and Whenever One Wants?" *Occasional Studies* (De Nederlandsche Bank) 10 (2).

Judson, R. 2012. "Crisis and Calm: Demand for U.S. Currency at Home and Abroad from the Fall of the Berlin Wall to 2011." International Finance Discussion Paper No. 1058, Board of Governors of the Federal Reserve System.

Klee, E. 2008. "How People Pay: Evidence from Grocery Store Data." *Journal of Monetary Economics* 55 (3): 526–41.

Knell, M., and H. Stix. 2015. "Trust in Banks during Normal and Crisis Times—Evidence from Survey Data." *Economica* 82 (Supplement 1): 995–1020.

Lippi, F., and A. Secchi. 2009. "Technological Change and the Households' Demand for Currency." *Journal of Monetary Economics* 56 (2): 222–30.

McWhinney, I., and H. E. Champion. 1974. "The Canadian Experience with Recall and Diary Methods in Consumer Expenditure Surveys." *Annals of Economic and Social Measurement* 3 (2): 411–35.

Mooslechner, P., and G. Wehinger. 1997. "Aspekte des Zahlungsverhaltens privater Haushalte in Österreich." *Berichte und Studien* 4: 44–65.

Mulligan, C. B., and X. Sala-i-Martin. 2000. "Extensive Margins and the Demand for Money at Low Interest Rates." *Journal of Political Economy* 108 (5): 961–91.

Osili, U. O., and A. Paulson. 2014. "Crises and Confidence: Systemic Banking Crises and Depositor Behavior." *Journal of Financial Economics* 111 (3): 646–60.

Ossolinski, C., T. Lam, and D. Emery. 2014. "The Changing Way We Pay: Trends in Consumer Payments." Research Discussion Paper No. 2014-05, Reserve Bank of Australia.

Rysman, M. 2007. "An Empirical Analysis of Payment Card Usage." *Journal of Industrial Economics* 55 (1): 1–36.

———. 2009. "The Economics of Two-Sided Markets." *Journal of Economic Perspectives* 23 (3): 125–43.

Schmidt, T. 2014. "Consumers' Recording Behaviour in Payment Diaries—Empirical Evidence from Germany." *Survey Methods: Insights from the Field* (August). Peer-reviewed online journal available at http://surveyinsights.org.

Schmiedel, H., G. Kostova, and W. Ruttenberg. 2013. "The Social and Private Costs of Retail Payment Instruments: A European Perspective." *Journal of Financial Market Infrastructures* 2 (1).

Schneider, F., and A. Buehn. 2012. "Shadow Economies in Highly Developed OECD Countries: What Are the Driving Forces?" Discussion Paper No. 6891, Institute for the Study of Labor (IZA).

Schuh, S., and J. Stavins. 2010. "Why Are (Some) Consumers (Finally) Writing Fewer Checks? The Role of Payment Characteristics." *Journal of Banking and Finance* 34 (8): 1745–58.

———. 2014. "The 2011 and 2012 Surveys of Consumer Payment Choice." Research Data Report No. 14-01, Federal Reserve Bank of Boston.

Simon, J., K. Smith, and T. West. 2010. "Price Incentives and Consumer Payment Behaviour." *Journal of Banking and Finance* 34 (8): 1759–72.

Stavins, J. 2002. "Effect of Consumer Characteristics on the Use of Payment Instruments." *New England Economic Review* (Q3): 19–31.

Stix, H. 2013. "Why Do People Save in Cash? Distrust, Memories of Banking Crises, Weak Institutions and Dollarization." *Journal of Banking and Finance* 37 (11): 4087–4106.

Sudman, S., and R. Ferber. 1971. "Experiments in Obtaining Consumer Expenditures by Diary Methods." *Journal of the American Statistical Association* 66 (336): 725–35.

Summers, R., and A. Heston. 1991. "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988." *Quarterly Journal of Economics* 106 (2): 327–68.

Takács, K. 2011. "A magyar ha´ztarta´sok fizete´si szoka´sai [Payment Habits of Hungarian Households]." Occasional Paper No. 98-2011, Magyar Nemzeti Bank. Available only in Hungarian.

Tobin, J. 1956. "The Interest-Elasticity of Transactions Demand for Cash." *Review of Economics and Statistics* 38 (3): 241–47.

UK Payments Council. 2013. "Trends in Consumer Holdings and the Use of Different Payment Methods." Available at http://www.paymentscouncil.org.uk.

Velde, F. 2013. "Bitcoin: A Primer." *Chicago Fed Letter* 317 (December).

von Kalckreuth, U., T. Schmidt, and H. Stix. 2014a. "Choosing and Using Payment Instruments: Evidence from German Microdata." *Empirical Economics* 46 (3): 1019–55.

———. 2014b. "Using Cash to Monitor Expenditures: Implications for Payments, Currency Demand, and Withdrawal Behavior." *Journal of Money, Credit and Banking* 46 (8): 1753–86.

Whitesell, W. C. 1989. "The Demand for Currency versus Debitable Accounts: A Note." *Journal of Money, Credit and Banking* 21 (2): 246–57.

Wolman, D. 2012. *The End of Money: Counterfeiters, Preachers, Techies, Dreamers—and the Coming Cashless Society.* First edition. Da Capo Press.