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Abstract

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 classification: E41, D12, E58
Bank classification: Bank notes; Econometric and statistical methods; Financial services; E-money

Résumé

Les auteurs mesurent l'usage des espèces en harmonisant les données de journaux d'achats tenus par les consommateurs de sept pays. Les journaux d'achats proviennent d'enquêtes administrées en 2009 (Canada), 2010 (Australie), 2011 (Allemagne, Autriche, France et Pays-Bas) et 2012 (États-Unis). L'étude montre qu'il existe des différences entre pays : par exemple, le niveau d'usage des espèces varie d'un pays à l'autre. Les espèces n'ont pas disparu en tant que moyen de paiement, en particulier pour les achats de faible valeur. Les auteurs constatent également que l'usage des espèces est fortement corrélé avec la valeur de l'achat, les caractéristiques individuelles et les caractéristiques du point de vente telles que l'acceptation de la carte de paiement et le type de commerce.

Classification JEL : E41, D12, E58
Classification de la Banque : Billets de banque; Méthodes économétriques et statistiques; Services financiers; Monnaie électronique

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 the emergence of an ironic consensus: 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 21st century for a select group of industrial countries. In most of 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 behaviour 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 an updated comparative study of payments that includes

[1] Examples include Amromin and Chakravorti (2009), Lippi and Secchi (2009), and Evans, Webster, Colgan, and Murray (2013).

[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 10 years.

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: (1) a careful, thorough harmonization and analysis of these international diary data; and (2) a relatively simple econometric analysis of consumers' use of cash versus non-cash payment instruments that employs the microeconomic data from the payment diaries. We also provide a comprehensive review of other research that has used payment diary micro data and assess opportunities for future research that could use or develop diary data.

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 analysis and adjustment of the technical details of the diary survey design and concept definitions. Seemingly minor details, such as the inclusion of recurring bill payments (or not), can have substantial effects on the resulting statistics. Therefore, we have harmonized the underlying

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

[4] Jonker, Kosse, and Hernández (2012) and Arango, Bouhdaoui, Bounie, Eschelbach, and Hernández (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), UK Payments Council (2013), and Danish National Bank (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, Lipsey, Branstetter, Foley, Harrigan, Jensen, Kletzer, Mann, Schott, and Wright, 2010), or the ECB wealth survey project (Household Finance and Consumption Survey, 2009).

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 socio-demographic variables and point-of-sale (POS) characteristics (e.g., card acceptance and the spending location), which permits a disaggregated view of payment behaviour. 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 cheques 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 allows 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 behaviour more broadly. This literature extends back at least to Stavins (2001), 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), Arango, Huynh, and Sabetti (2011), or von Kalckreuth, Schmidt, and Stix (2014b), 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]

Although our econometric analysis is a simple first step toward what ultimately can be done with the diary data, it nevertheless generates a few notable results. In the logit estimation of

[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.

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. In the penultimate section of this paper, we survey other research that has already used various forms of this diary data to study consumer payment choice in other contexts.

Using comprehensive, cross-country information on cash usage to develop a more refined understanding of consumer payment choices is important for policy-makers 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 behaviour 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. In the final section of this paper, we analyse the applicability of the consumer payment diary data to some frontier theoretical models in these areas. 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 this new resource for future research.

The paper is organized as follows. Section 2 presents salient aggregate results regarding the payment behaviour 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. Section 7 reviews the existing research that uses consumer payment diary data. Section 8 assesses the value of the diary data for a selected subset of the

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

literature in a few fields to which the diary data are particularly well-suited for econometric application, and notes how diary data need to develop, improve, and expand to be useful to a wider variety of theoretical applications. Section 9 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% and 82% of the number of all payment transactions are conducted by cash.
- In value terms, differences across countries are accentuated. For AT and DE, cash dominates (more than 50%); 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. For AU, CA, and US, credit cards are more important, while they are of only minor relevance for the European countries considered, where debit cards are the chief electronic means of payment. Cheques remain an important payment instrument for FR and are a component of the *other* category for US alongside prepaid cards.
- The overwhelming fraction of payments is conducted with only a few payment instruments: the accumulated cash, debit and credit share greater than 95% for AU, AT, CA, DE and NL, and greater than 88% 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 card-intensive countries, the average card transaction value is lower than it is in cash-intensive countries.

- 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 behaviour. 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 analyse cash use by looking at (1) the expenditure structure in the various countries, (2) whether cash usage differs across transaction types and POS characteristics (transaction value, type of expenditure, acceptance) and (3) whether the use of cash varies across socio-demographic factors. Similarly, we (4) further assess the interrelation between cash holdings and payment behaviour 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, or about 30 purchasing-power parity (PPP)-USD. This suggests that consumers behave rather similarly in different countries. We will further exemplify and analyse this issue by looking at withdrawals and other aspects of cash management behaviour.

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 behaviour 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 behaviour at the consumer level. Some data are proprietary, so individual behaviour cannot be tracked. Scanner data do not usually provide info about the consumer and are focused on only a certain portion of consumer behaviour (e.g., grocery purchases).

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 this collection method generates data that allow for thorough analyses of general behavioural patterns as well as the underlying drivers, it is less suitable for analysing 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]

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

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 behaviour.

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.

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

[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, Elliehausen, Kennickell, and Spindt (1986) and Boeschoten (1992). Mooslechner and Wehinger (1997) conducted a payment diary in Austria in 1996.

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

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 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 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 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.

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: (1) the date (and sometimes even the time), (2) the transaction value, (3) the payment instrument used, and (4) the merchant's sector where the purchase occurred. AT, CA, DE, and NL

[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 18 and 75 years.

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 aged between 18 and 75 years, although some diaries were also distributed among children and people aged over 75 years. 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 overestimation of card usage. More-

over, in order to prevent any such biases, all panellists for US were provided with a computer or with Internet access.

Second, differences exist with respect to the length of the diaries, as follows: 1-day (NL), 3-day (CA, US), 7-day (AT, AU, and DE), and 8-day (FR). Research by Ahmed, Brzozowski, and Crossley (2006), Jonker and Kosse (2013), and McWhinney and Champion (1974) shows that longer diaries may lead to survey fatigue (i.e., under-reporting of expenditures), especially for small-value transactions.[14] 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:

1. We distilled all payments from persons aged 18 years and older.

2. We only consider the payments made at the POS; 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,

[14] Ahmed, Brzozowski, and Crossley (2006), Jonker and Kosse (2013), and Schmidt (2011) study the effect of survey fatigue and the efficacy of data collection via payment diaries.

[15] Harmonization difficulties arose mainly because of (1) 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); (2) 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 (3) 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).

we harmonized the definitions and categories of the various socio-demographic 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 time of day, day of the week and payment channel. About one-third of transactions are conducted before noon, and two-thirds after. 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. Finally, in-person transactions make up the vast majority of payments. For AU and US, Internet/mobile payments at the POS account for a volume share that is higher than 4%, while in all other countries it is almost negligible.

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 expenditures, is similar across countries. Thus, taken together, these results provide evidence that shopping patterns are relatively similar across the seven countries.

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 rather similar across countries with respect to the number and the value of transactions: (1) Consumers conduct only a few payment transactions per day and (2) 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

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

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.

Analysing 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% of all recorded transactions are lower than 25 to 40 PPP-USD.

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, socio-demographics (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.[17] 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., Arango, Huynh, and Sabetti, 2011; Bouhdaoui and Bounie, 2012; Klee, 2008; von Kalckreuth, Schmidt, and Stix, 2014a). 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% of transactions. For the largest 25% of transactions, the use of payment*

[17] 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 analyse POS characteristics, we assume that these are fixed.

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 used only for CA (share of 3%) and US (share of 6%). Other payment instruments have a notable share for low-value transactions only for NL (14%) and US (6%). For all countries, we find that the cash share is higher than 50% up to the median transaction value. In the third quartile, the dominance of cash fades. In this transaction value range, however, cash has a 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: (1) the importance of credit card payments for AU, CA, and US, (2) the importance of cheques for FR and US, and (3) 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 (2013b) 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 Arango, Huynh, and Sabetti (2011), Eschelbach and Schmidt (2013), Bouhdaoui and Bounie (2012), and Arango, Bouhdaoui, Bounie, Eschelbach, and Hernández (2013). 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 USD) and DE (123 USD) are two-times greater than those in other countries (from 51 for NL to 74 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%. It reaches a

maximum of just 65% 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, cashbacks, 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% in all countries. However, the median number of monthly ATM withdrawals greatly varies across countries, from 2 for DE to 4 for CA and AT. These withdrawal patterns seem to be directly correlated with the typical cash withdrawal amounts at ATMs.[18]

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 behaviour. 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, 2013b). 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 Baumol (1952) and Tobin (1956) model on cash management. Following Alvarez and Lippi (2009), two statistics are worth discussing. The first is the ratio between cash holdings at the time of a withdrawal ($\overline{M}$) and average/median currency holdings (M). This statistic provides a measure of precautionary balances. While this ratio is zero in the Baumol-Tobin model, its median in the data ranges from 0.2 for CA to 0.5 for US.

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

The second interesting statistic is the ratio between the withdrawal amount (W) and the average currency holdings (W/M). This ratio equals 2 in the Baumol-Tobin model. The mean of this ratio is substantially higher in the data (from 3.8 for CA to 16 for DE), but if we take the median to eliminate extreme cash withdrawal values, the ratio is relatively close to 2 in most cases. These results suggest a precautionary motive for holding cash. To draw any structural interpretation, however, more work is required.

5.3 Socio-demographic characteristics

This section presents evidence on cash usage along socio-demographics characteristics and we inquire into consumers' preferences by analysing survey evidence on perceptions of cash.

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

5.3.1 Age, income, and education

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, 2001; 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. Note again that these descriptive statistics assume all other factors to be fixed. 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.[19]

Income and education have been cited in the literature as important factors, with cash usage declining with higher income and education (e.g., for CA Arango, Huynh, and Sabetti (2011);

[19] von Kalckreuth, Schmidt, and Stix (2014a) find no evidence in favour 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).

for DE von Kalckreuth, Schmidt, and Stix (2014b); and for US Schuh and Stavins (2010); Cohen and Rysman (2013). 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 analysed 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.[20]

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.[21]

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 analyse 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, 2011).

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.[22] The depicted measures are scale free,

[20] In many respects, these findings mirror the pattern observed for card ownership, which tends to vary along the same socio-demographic lines (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.

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

[22] See Arango, Huynh, and Sabetti (2011) and Jonker (2007) for a description of the normalization. Variables are defined in Table A.1.

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.

Fact 5 *Cash is generally valued 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 favour 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%. 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 socio-demographics, 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).[23] CA and US consumers possess, on average, 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.[24] 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 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.

5.5 POS characteristics

Finally, we discuss two types of POS characteristics: (1) card acceptance at the POS, and (2) the type of economic activity in which transactions occur.

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

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

5.5.1 Card acceptance

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 analyse

[23] 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).

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

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 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 (1) CA has the highest acceptance values in each quartile, and (2) 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 analyse 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

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 behavioural patterns, or by cultural differences. Accordingly, Figure 5 depicts three sectors that we consider interesting with regard to these factors.

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 behaviour, we would expect to find fairly equal levels of cash usage in gas stations 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. 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 show that the cash share for these transactions is substantially higher than the overall cash share for all countries except FR, where cheques account for more than 40% 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 behaviour 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 for 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 versus Non-Cash

This section investigates the usage of 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: (1) transaction size, (2) cash balances, (3) socio-

demographic characteristics (age, income, education), (4) consumer perceptions of ease of use, acceptance, and cost, and (5) POS transaction characteristics (card acceptance and type of purchase). Variables are defined in Table A.1. 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

Table 9 reports the marginal effects on the probability of using cash. 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 36 use significantly more cash than persons younger than 35. Also, the results provide support for a certain habit persistence in some countries (AT, AU, DE, NL), where cash increases homogeneously with age: people aged 60 and older are more likely to use cash than people between 36 and 59.

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), Arango, Huynh, and Sabetti (2011), and von Kalckreuth, Schmidt, and Stix (2014b).

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 pp (FR) relative to the first transaction value quartile.

The results also confirm an independent effect of purchase location/type of purchase. 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.[25] Although we 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 Eschelbach and Schmidt (2013), Bouhdaoui and Bounie (2012), and Arango, Bouhdaoui, Bounie, Eschelbach, and Hernández (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 by 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 one, 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.[26]

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.

[25] 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.

[26] 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.

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

6.2 Robustness: Groceries and gas

As one important robustness check, we focus on transactions completed at grocery stores and gas stations only. The results are reported in 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), who use scanner data from grocery stores, and Cohen and Rysman (2013), who use scanner data from grocery stores and gas stations.[27] 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 two additional robustness checks. 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.

7 Payment Diaries: Past and Present

The usage of consumer payment diaries to understand monetary and payment economics is in the nascent stage. This section provides a brief summary of how payment diaries have been

[27] Klee (2008) focuses mainly on the value of time while controlling for census-tract averaged demographics. Her analysis does not have individual demographics, perceptions, or acceptance of cards. Cohen and Rysman (2013) analyse 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.

used to understand (1) cash usage, (2) determinants of payment instrument choice, and (3) how market structure may matter for payment choice.

7.1 Consumer cash usage

A key advantage of payment diaries is the proper accounting of cash payments relative to all methods of payment. Stix (2004), Jonker and Kettenis (2007), and Bounie, Francois, and Waelbroeck (2013) demonstrate that cash demand is affected by debit card usage for AU, NL, and FR. For DE, credit cards are relatively interchangeable with debit cards for the usage of cash; see von Kalckreuth, Schmidt, and Stix (2014a). Further work by von Kalckreuth, Schmidt, and Stix (2014b) uses payment diary data for DE to show that cash is used as a method to monitor expenditures (*pocket-watching*). Fung, Huynh, and Sabetti (2012) investigate the effect of retail payment innovations (i.e., contactless credit cards and stored-value cards) on cash usage and find that there is a reduction. Finally, Bounie, Francois, and Waelbroeck (2013) and Huynh, Schmidt-Dengler, and Stix (2014) study the impact of card acceptance on cash usage. They find that the lack of card acceptance is a reason for precautionary cash balances.

7.2 Consumer adoption and use of payment instruments

The study by Bounie and Francois (2006), based on a 2005 French payment diary, was an early attempt to disentangle the effect of demographics from the effect of payment characteristics such as transaction value on payment choice. Further work by Bouhdaoui and Bounie (2012) proposes a cash holding model as an alternative to a transaction-size explanation for payment choice.[28] Kosse (2013) focuses on the perception of safety aspects for cash versus debit, while Kosse and Jansen (2013) demonstrate that a variation in demographics such as foreign background has a strong effect on payment choice for NL.

Simon, Smith, and West (2010) (for AU), Arango, Huynh, and Sabetti (2011) (for CA) and Wakamori and Welte (2012) (for CA) extend the analysis beyond demographics and payment characteristics to pricing incentives such as card affinity programs (rewards) and acceptance of payment cards. The analysis by Briglevics and Schuh (2013a) estimates a structural inventory

[28] Arango, Bouhdaoui, Bounie, Eschelbach, and Hernández (2013) extend this work by conducting the test for CA, FR, DE, and NL.

model of cash holdings and finds a significant effect on payment choice.

7.3 Merchant steering

The payment diaries have been used to study the effect of market structure on payment choice. Recent work by Shy (2014) investigates the effect of the debit card interchange fees and sorts out the transaction value at which interchange fees become higher or lower due to the new rule. Briglevics and Shy (2012) use the payment diaries to understand merchant steering. They compute the expected net cost of discounts on cash and debit card payments and find that, for the most part, steering is unprofitable. Welte (2014) studies and extends the steering exercise by embedding a consumer choice into the expected net cost calculations for CA.

7.4 Scanner data projects

Scanner data have been touted as an alternative to payment diaries as a method of data collection on payments. For US, Klee (2008) uses data to show that payment choice is a function of the amount of time spent processing the items purchased. Research by Polasik, Górka, Wilczewski, Kunkowski, Przenajkowska, and Tetkowska (2012) for Poland demonstrates the usage of chronometric methods to enumerate the processing time of payments. Recent work by Wang and Wolman (2014) extends the work of Klee (2008) by using scanner data from a large discount retailer.

These scanner data studies provide rich detailed information, including the opportunity cost of time. One drawback of these scanner data projects is that direct demographic data are not collected. Therefore, it is hard to infer the role of consumer demographics on payment choice. Recent work by Cohen and Rysman (2013) avoids this criticism by obtaining demographic information with the scanner data.

8 Payment Diaries: Going Forward

This section describes possible future use of payment diaries. We focus on three main points: structural models of cash and alternative means of payment, high-frequency consumption/savings, and the study of two-sided markets. We also discuss some caveats and ideas to improve the collection of data.

8.1 Structural models of cash and alternative method of payments

The estimation of money demand has relied mostly on the workhorse Baumol-Tobin model. However, this model was constructed in the absence of payment cards. The presence of payment cards has been exploited to understand household money demand elasticities; see Mulligan and Sala-i-Martin (2000) or Attanasio, Guiso, and Jappelli (2002). These studies also document that consumers do not wait until a zero cash balance before withdrawing. This inspired Alvarez and Lippi (2009), who explain this puzzle by introducing a positive probability of a *free withdrawal*. Another salient feature is that some consumers hold large amounts of cash. Alvarez and Lippi (2013b) rationalize this feature by modeling the large and lumpy purchases that require cash. Further, Alvarez and Lippi (2013a) allow merchant non-acceptance of cards as a reason to hold precautionary cash balances.

Most payment diaries contain information about cash management behaviour but little is known about the rationale for such holdings. Most diaries do not include questions on precautionary motives or the need to make lumpy purchases. Therefore, it is hard to distinguish between cash management versus acceptance of payment cards as a reason to hold cash. Further, care must be taken to conduct the statistical sampling behind these questions. The diaries rely on a short-term window to focus in on behaviour that may be infrequent.

Nosal and Rocheteau (2012) offer an extensive discussion of the new monetarist approach, which has stressed various real trading frictions to explain the coexistence of cash with cards. For example, Telyukova and Wright (2008) explain why households hold cash while having a credit balance with a rate-of-return dominance puzzle; i.e., cash is held for liquidity reasons to settle claims. The current payment diaries focus mainly on payment choice and expenditures. There is scant information about credit arrangements, i.e., an indicator of whether or not a household has carried a balance from month-to-month. Therefore, to empirically validate these models would require detailed household balance-sheet information.

8.2 High-frequency consumption and saving

Recent work by Aruoba, Diebold, and Scotti (2009) highlights the usefulness of real-time monitoring of consumption for business cycles. Private and public sector forecasters spend enormous resources to understand consumption, as it is a large component of GDP. Galbraith and

Tkacz (2013) demonstrate the utility of using network data on debit and credit card payments to understand consumption. The recent financial crisis has highlighted the need to understand high-frequency movements in consumption and consumer confidence; see Parker, Souleles, Johnson, and McClelland (2013) and Lachowska (2013).

Payment diaries could be a useful method to track the high-frequency consumption and/or expenditures of households. They could be used to understand the effect of fiscal policy on consumption. Agarwal and McGranahan (2012) argue that sales tax holidays have an effect on consumption but the timing of these effects cannot be clearly identified. Also, Mastrobuoni and Weinberg (2010) demonstrate that exact pay dates have an impact on consumption, especially for social security recipients. Payment diaries would need to be redesigned to incorporate questions to determine these effects.

8.3 Two-sided markets and regulation

Rochet and Tirole (2002) and Wright (2003) discuss the theoretical nature of two-sided markets for the payments literature. The work on estimating these two-sided markets, with the exception of Rysman (2007), uses network data to study the usage of credit cards, network externalities, and multi-homing. Also, recent work by Shy and Wang (2011) discusses why interchange fees are proportional.

Payment diaries contain detailed data on consumer payments but only a few questions on merchant characteristics (i.e., venue and acceptance of cards). Recent work by Bounie, Francois, and Hove (2014) matches payment diary data to a nationwide French merchant survey to investigate the probability that the merchant will accept cards. Future payment diaries could attempt to collect or at least link their data to merchant costs, or expand the supply-side information. However, work by Shy and Stavins (2013) illustrates the difficulty of this task, as they attempt to embed questions about merchant steering into US payment diaries. Their results are inconclusive and they discuss the challenges and pitfalls of this exercise. Future attempts to improve payment diaries should bear this in mind.

9 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 point-of-sale 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 market structures and the pricing policies of retail payments. Rysman (2009), for instance, highlights how market structure affects payments, or vice-versa. Third, we point at an important correlation between cash use and the amount of cash balances consumers carry. The direction of the correlation remains unclear. Therefore, as country differences are still substantial, 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.

References

AGARWAL, S., AND L. MCGRANAHAN (2012): "Spending Responses to State Sales Tax Holidays," *Working Paper, Federal Reserve Bank of Chicago, No. 2012-10*.

AHMED, N., M. BRZOZOWSKI, AND T. CROSSLEY (2006): "Measurement Errors in Recall Food Consumption Data," IFS Working Papers 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.

——— (2013a): "Cash Burns," mimeo.

——— (2013b): "The Demand of Liquid Assets With Uncertain Lumpy Expenditures," 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), 315–335.

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 2013-53, Bank of Canada.

ARANGO, C., K. HUYNH, AND L. SABETTI (2011): "How Do You Pay? The Role of Incentives at the Point-of-Sale," Working Paper 2011-23, Bank of Canada.

ARUOBA, S. B., F. X. DIEBOLD, AND C. SCOTTI (2009): "Real-Time Measurement of Business Conditions," *Journal of Business & Economic Statistics*, 27(4), 417–427.

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), 317–351.

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 Economics*, 66, 545–556.

BETHLEHEM, J. (2008): "Representativity of Web Surveys - An Illusion?," in *Access Panels and Online Research, Panacea or Pitfall?*, ed. by I. Stoop, and M. Wittenberg, pp. 19–44. Proceedings of the DANS symposium, Amsterdam, Aksant.

BOESCHOTEN, W. (1992): *Currency Use and Payment Patterns*. Kluwer Academic Publishers.

BOESCHOTEN, W. C. (1998): "Cash Management, Payment Patterns and the Demand for Money," *De Economist*, 146(1), 117–142.

BOESCHOTEN, W. C., AND M. M. G. FASE (1989): "The Way We Pay with Money," *Journal of Business & Economic Statistics*, 7(3), pp. 319–326.

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), 149–172.

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), 175–195.

BOUNIE, D., AND A. FRANCOIS (2006): "Cash, Check or Bank Card? The Effects of Transaction Characteristics on the Use of Payment Instruments," mimeo.

——— (2008): "Is Baumol's 'Square Root Law' Still Relevant? Evidence from Micro-Level Data," *Applied Financial Economics*, 18(13), 1091–1098.

BOUNIE, D., A. FRANCOIS, AND L. V. HOVE (2014): "Merchant Acceptance of Payment Cards in France: "Le Client est Roi!"," http://ssrn.com/abstract=2405361.

BOUNIE, D., A. FRANCOIS, AND P. WAELBROECK (2013): "Debit Card and Demand for Cash," http://dx.doi.org/10.2139/ssrn.2084641.

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," Discussion paper, FRB of Boston Working Paper No. 13-23.

BRIGLEVICS, T., AND O. SHY (2012): "Why Don't Most Merchants Use Price Discounts to Steer Consumer Payment Choice?," Public Policy Discussion Paper 12-9, 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, 409–421.

CHING, A. T., AND F. HAYASHI (2010): "Payment Card Rewards Programs and Consumer Payment Choice," *Journal of Banking & Finance*, 34(8), 1773–1787.

COHEN, M., AND M. RYSMAN (2013): "Payment Choice with Consumer Panel Data," 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*, NBER Chapters. National Bureau of Economic Research, Inc.

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," http://goo.gl/ruzBdq.

ESCHELBACH, M., AND T. SCHMIDT (2013): "Precautionary Motives in Short-Term Cash Management: Evidence from German POS Transactions," Discussion Papers 38/2013, Deutsche Bundesbank, Research Centre.

EUROPEAN CENTRAL BANK (2012): "Virtual Currency Schemes," http://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf.

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," 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," `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 Papers 16254, National Bureau of Economic Research, Inc.

FISCHER, B., P. KÖHLER, AND F. SEITZ (2004): "The Demand for Euro Area Currencies: Past, Present and Future," Working Paper Series 330, European Central Bank.

FUNG, B., K. HUYNH, AND L. SABETTI (2012): "The Impact of Retail Payment Innovations on Cash Usage," Working Paper 2012-14, Bank of Canada.

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

GALBRAITH, J. W., AND G. TKACZ (2013): "Analyzing Economic Effects of September 11 and Other Extreme Events Using Debit and Payments System Data," *Canadian Public Policy*, 39(1), 119–134.

HAYASHI, F., AND E. KLEE (2003): "Technology Adoption and Consumer Payments: Evidence from Survey Data," *Review of Network Economics*, 2(2), 175–190.

HOUSEHOLD FINANCE AND CONSUMPTION SURVEY (2009): "Survey Data on Household Finance and Consumption - Research Summary and Policy Use," Occasional Paper Series 100, European Central Bank.

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), 914–939.

HUYNH, K. P., P. SCHMIDT-DENGLER, AND H. STIX (2014): "Whenever and Wherever: The Role of Card Acceptance in the Transaction Demand for Money," mimeo.

JACK, W., T. SURI, AND R. TOWNSEND (2010): "Monetary Theory and Electronic Money: Reflections on the Kenyan Experience," *Economic Quarterly*, (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 T. KETTENIS (2007): "Explaining Cash Usage in the Netherlands: The Effect of Electronic Payment Instruments," DNB Working Papers 136, Netherlands Central Bank, Research Department.

JONKER, N., AND A. KOSSE (2013): "Estimating Cash Usage: The Impact of Survey Design on Research Outcomes," *De Economist*, 161, 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.

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 Papers IFDP 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), 526–541.

KOSSE, A. (2013): "The Safety of Cash and Debit Cards: A Study on the Perception and Behavior of Dutch Consumers," *International Journal of Central Banking*, 9(4), 77–98.

KOSSE, A., AND D.-J. JANSEN (2013): "Choosing How to Pay: The Influence of Foreign Backgrounds," *Journal of Banking & Finance*, 37(3), 989–998.

LACHOWSKA, M. (2013): "Expenditure, Confidence, and Uncertainty: Identifying Shocks to Consumer Confidence Using Daily Data," *Upjohn Institute Working Paper; 13-197*.

LIPPI, F., AND A. SECCHI (2009): "Technological Change and the Households' Demand for Currency," *Journal of Monetary Economics*, 56(2), 222–230.

MASTROBUONI, G., AND M. C. WEINBERG (2010): "Do Social Security Recipients Smooth Consumption Between Checks? Evidence Using New Data With Variation in Pay Dates," *Working Paper*.

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), 411–435.

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), 961–991.

NOSAL, E., AND G. ROCHETEAU (2012): *A Search Approach to Money, Payments, and Liquidity*. Princeton University Press.

PARKER, J. A., N. S. SOULELES, D. S. JOHNSON, AND R. MCCLELLAND (2013): "Consumer Spending and the Economic Stimulus Payments of 2008," *American Economic Review*, 103(6), 2530–53.

POLASIK, M., J. GÓRKA, G. WILCZEWSKI, J. KUNKOWSKI, K. PRZENAJKOWSKA, AND N. TETKOWSKA (2012): "Time Efficiency of Point-of-Sale Payment Methods: The Empirical Results for Cash, Cards and Mobile Payments," http://dx.doi.org/10.2139/ssrn.1769922.

ROCHET, J.-C., AND J. TIROLE (2002): "Cooperation Among Competitors: Some Economics Of Payment Card Associations," *RAND Journal of Economics*, 33(4), 549–570.

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. (2011): "Fatigue in Payment Diaries - Empirical Evidence from Germany," Discussion Paper Series 1: Economic Studies 2011,11, Deutsche Bundesbank Research Centre.

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).

SCHUH, S., AND J. STAVINS (2010): "Why Are (Some) Consumers (Finally) Writing Fewer Checks? The Role of Payment Characteristics," *Journal of Banking & Finance*, 34(8), 1745–1758.

SHY, O. (2014): "Measuring Some Effects of the 2011 Debit Card Interchange Fee Reform," *Contemporary Economic Policy*.

SHY, O., AND J. STAVINS (2013): "Merchant Steering of Consumer Payment Choice: Lessons Learned From Consumer Surveys," Public Policy Discussion Paper 13-1, Federal Reserve Bank of Boston.

SHY, O., AND Z. WANG (2011): "Why Do Payment Card Networks Charge Proportional Fees?," *American Economic Review*, 101(4), 1575–1590.

SIMON, J., K. SMITH, AND T. WEST (2010): "Price Incentives and Consumer Payment Behaviour," *Journal of Banking and Finance*, 34(8), 1759–1772, New Contributions to Retail Payments: Conference at Norges Bank (Central Bank of Norway) 14-15 November 2008.

STAVINS, J. (2001): "Effect of Consumer Characteristics on the Use of Payment Instruments," *New England Economic Review*, 3, 19–31.

STIX, H. (2004): "How Do Debit Cards Affect Cash Demand? Survey Data Evidence," *Empirica*, 31(2), 93–115.

SUDMAN, S., AND R. FERBER (1971): "Experiments in Obtaining Consumer Expenditures by Diary Methods," *Journal of the American Statistical Association*, 66(336), 725–735.

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

TAKÁCS, K. (2011): "A magyar háztartások fizetési szokásai [Payment Habits of Hungarian Households]," Occasional Paper 98-2011, Magyar Nemzeti Bank, Available only in Hungarian.

TELYUKOVA, I. A., AND R. WRIGHT (2008): "A Model of Money and Credit, with Application to the Credit Card Debt Puzzle," *Review of Economics and Statistics*, 75, 629–647.

TOBIN, J. (1956): "The Interest Elasticity of Transactions Demand for Money," *Review of Economics and Statistics*, 38, 241–247.

UK PAYMENTS COUNCIL (2013): "Trends in Consumer Holdings and the Use of Different Payment Methods," http://www.paymentscouncil.org.uk.

VELDE, F. (2013): "Bitcoin: A Primer," *Chicago Fed Letter*, (Dec).

VON KALCKREUTH, U., T. SCHMIDT, AND H. STIX (2014a): "Choosing and Using Payment Instruments: Evidence from German Microdata," *Empirical Economics*, 46, 1019–1055.

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

WAKAMORI, N., AND A. WELTE (2012): "Why Do Shoppers Use Cash? Evidence from Shopping Diary Data," Working Paper 2012-24, Bank of Canada.

WANG, Z., AND A. L. WOLMAN (2014): "Payment Choice and the Future of Currency: Insights from One Billion Retail Transactions," mimeo.

WELTE, A. (2014): "Merchant Payment Steering: Evidence from the 2009 Bank of Canada Method of Payments Survey," mimeo.

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*. Da Capo Press, 1 edn.

WRIGHT, J. (2003): "Optimal Card Payment Systems," *European Economic Review*, 47(4), 587–612.

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

[a] Cheques.
[b] Internet/telephone banking.
[c] Acceptance as perceived by consumers.

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/pricesandpurchasesingpowerparitiesppp/PPP_OECD.xls`.

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

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 labelled "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/pricesandpurchasesingpowerparitiesppp/PPP_OECD.xls`.

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							
Day 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 the 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/pricesandpurchasesingpowerparitiesppp/PPP_OECD.xls`.

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 (# 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
Avg. withdrawal amount (W)							
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 ($\overline{M}$)	.	58	22	.	43	.	67
mean $\overline{M}/M$	.	*0.84*	*0.46*	.	*1.66*	.	*2.29*
median $\overline{M}/M$	.	*0.25*	*0.20*	.	*0.32*	.	*0.73*

[a] Values for AU and NL from questionnaire ("typical" average cash balance), all other values from diary (cash balances at the beginning or end of the diary).

Notes: Authors' calculations 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/pricesandpurchasesingpowerparitiesppp/PPP_OECD.xls`.

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
# 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
# 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 with either a debit or a credit card. Authors' calculations 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 chequing account.

Table 6: Card Ownership by Socio-Demographics

	AU	AT	CA	FR	DE	NL	US
Debit card ownership by socio-demographics							
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 socio-demographics							
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 based on diary and questionnaire surveys.

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

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

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 based on diary surveys. Shares are in percent. Sectoral harmonization across countries is only approximate.

Table 9: Cash versus Non-Cash Payment Choice (Marginal Effects)

	AT	AU	CA	DE	FR	NL	US
Medium Income	-0.031	-0.068**	0.021	-0.005	-0.046**	0.006	-0.119***
	(0.017)	(0.024)	(0.021)	(0.011)	(0.017)	(0.016)	(0.020)
High Income	-0.035	-0.067**	0.014	-0.013	-0.071*	-0.009	-0.119***
	(0.019)	(0.025)	(0.027)	(0.012)	(0.031)	(0.016)	(0.025)
Aged 36-59	0.071***	0.022	0.041*	0.024*	0.051**	0.043**	0.091***
	(0.017)	(0.018)	(0.019)	(0.010)	(0.017)	(0.016)	(0.023)
Aged over 60	0.112***	0.057*	0.026	0.047**	0.042	0.061**	0.073*
	(0.027)	(0.024)	(0.031)	(0.018)	(0.028)	(0.020)	(0.029)
Medium Education	-0.040*	0.047	-0.106**	-0.034***	-0.045*	0.005	-0.126**
	(0.020)	(0.029)	(0.039)	(0.010)	(0.022)	(0.016)	(0.047)
High Education	-0.080***	0.011	-0.134***	-0.085***	-0.097***	-0.037**	-0.194***
	(0.015)	(0.022)	(0.040)	(0.014)	(0.027)	(0.014)	(0.046)
Not home owner	0.012		0.027				0.010
	(0.014)		(0.022)				(0.021)
Perceptions of:							
Ease	0.123***		0.170***				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		-0.080				0.054
	(0.042)		(0.045)				(0.045)
Card acceptance share	-0.104***		-0.480***	-0.105***		-0.546***	
at the POS	(0.025)		(0.033)	(0.016)		(0.041)	
Cash on Hand	0.002	0.038***	0.005***	0.002***	0.001***	0.006***	0.003***
	(0.001)	(0.010)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Gasoline	-0.071***	-0.056***	-0.008	-0.098***	-0.161***	-0.046*	0.020
	(0.014)	(0.015)	(0.028)	(0.007)	(0.027)	(0.022)	(0.019)
Semi-durables	-0.047***	-0.039**	-0.036*	-0.082***	-0.098***	0.060***	-0.060**
	(0.012)	(0.012)	(0.017)	(0.008)	(0.016)	(0.014)	(0.019)
Services	0.080**	0.053***	0.031	0.048***	-0.029*	0.054*	0.138***
	(0.025)	(0.012)	(0.029)	(0.011)	(0.014)	(0.027)	(0.019)
Entertainment	0.167***	0.156***	0.109***	0.081***	-0.098***	0.269***	0.090***
	(0.021)	(0.013)	(0.017)	(0.012)	(0.018)	(0.017)	(0.016)
Other (not groceries)	0.075***	0.122***	0.084***	0.061***	0.040**	0.161***	0.409***
	(0.017)	(0.023)	(0.018)	(0.010)	(0.015)	(0.022)	(0.040)
TV Q2	-0.168***	-0.248***	-0.254***	-0.117***	-0.241***	-0.110***	-0.178***
	(0.022)	(0.015)	(0.016)	(0.021)	(0.035)	(0.016)	(0.016)
TV Q3	-0.263***	-0.372***	-0.397***	-0.243***	-0.454***	-0.264***	-0.305***
	(0.023)	(0.015)	(0.015)	(0.020)	(0.033)	(0.015)	(0.015)
TV Q4	-0.364***	-0.541***	-0.549***	-0.373***	-0.629***	-0.417***	-0.462***
	(0.023)	(0.013)	(0.015)	-0.020	(0.028)	(0.016)	(0.017)
Observations	7841	17303	12652	18676	7549	8233	10671

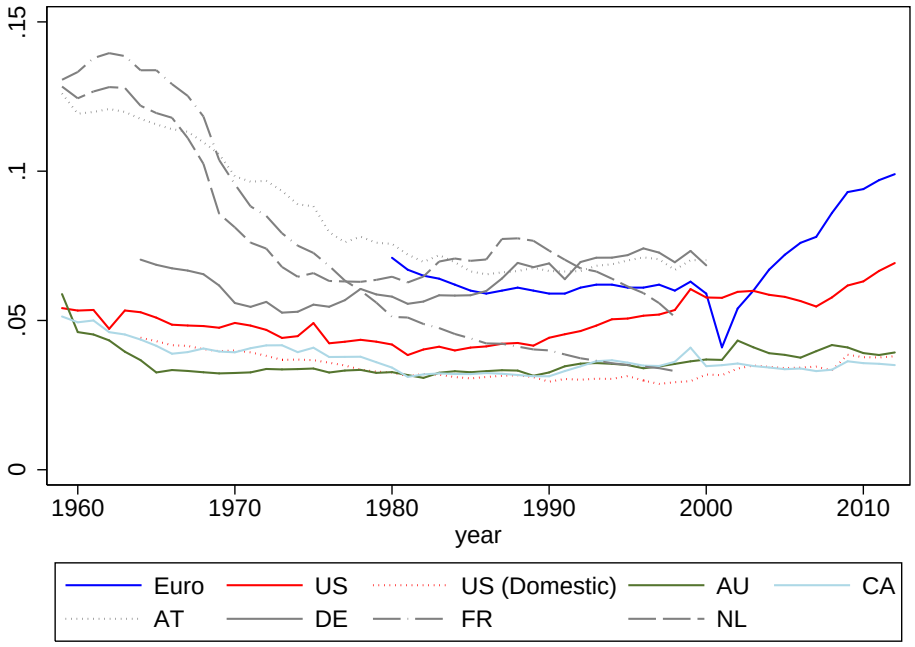
Notes: The dependent variable takes a value of 1 if a payment is made by cash and zero if it is made by debit or credit. Results for location (urban/rural), marital status, gender, employment status and family size are not shown. Variables are defined in Table A.1. TV Q2, TV Q3, and TV Q4 denote the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

Table 10: Cash versus Non-Cash Payment Choice at Gas and Groceries (Marginal Effects)

	AT	AU	CA	DE	NL	US
Medium Income	-0.025	-0.072*	0.042	-0.009	0.007	-0.133***
	(0.024)	(0.033)	(0.029)	(0.014)	(0.017)	(0.027)
High Income	-0.039	-0.080*	0.002	-0.012	-0.023	-0.162***
	(0.029)	(0.034)	(0.037)	(0.015)	(0.018)	(0.038)
Aged 36-59	0.086***	0.017	0.077**	0.026	0.025	0.105***
	(0.023)	(0.026)	(0.024)	(0.014)	(0.017)	(0.032)
Aged over 60	0.127***	0.040	0.080	0.069**	0.019	0.059
	(0.039)	(0.036)	(0.043)	(0.022)	(0.021)	(0.040)
Medium Education	-0.069*	0.056	-0.073	-0.043***	-0.005	-0.138*
	(0.028)	(0.045)	(0.051)	(0.013)	(0.016)	(0.061)
High Education	-0.102***	0.004	-0.123*	-0.118***	-0.030*	-0.210***
	(0.021)	(0.037)	(0.052)	(0.019)	(0.015)	-0.060
Not home owner	0.035		0.046			0.053
	(0.020)		(0.029)			(0.029)
Perceptions of:						
Ease	0.212***		0.161**			0.240***
	(0.055)		(0.055)			(0.048)
Cost	-0.077*		0.108			0.000
	(0.037)		(0.061)			(0.061)
Security	0.114***		-0.055*			0.045*
	(0.024)		(0.026)			(0.020)
Acceptance	-0.134*		-0.051			-0.008
	(0.056)		(0.076)			(0.057)
Card acceptance share	-0.178***		-0.561***	-0.080***	-0.565***	
at the POS	(0.032)		(0.036)	(0.018)	(0.040)	
Cash on Hand	0.003*	0.053**	0.006***	0.003***	0.006***	0.002**
	(0.001)	(0.017)	(0.001)	(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)	(0.020)	(0.020)
TV Q2	-0.201***	-0.273***	-0.284***	-0.189***	-0.094***	-0.176***
	(0.029)	(0.025)	(0.025)	(0.028)	(0.018)	(0.027)
TV Q3	-0.302***	-0.409***	-0.409***	-0.340***	-0.207***	-0.336***
	(0.030)	(0.023)	(0.023)	(0.028)	(0.018)	(0.024)
TV Q4	-0.420***	-0.586***	-0.572***	-0.481***	-0.316***	-0.466***
	(0.029)	(0.021)	(0.025)	(0.027)	(0.021)	(0.024)
Observations	3875	6569	5079	10364	4184	3688

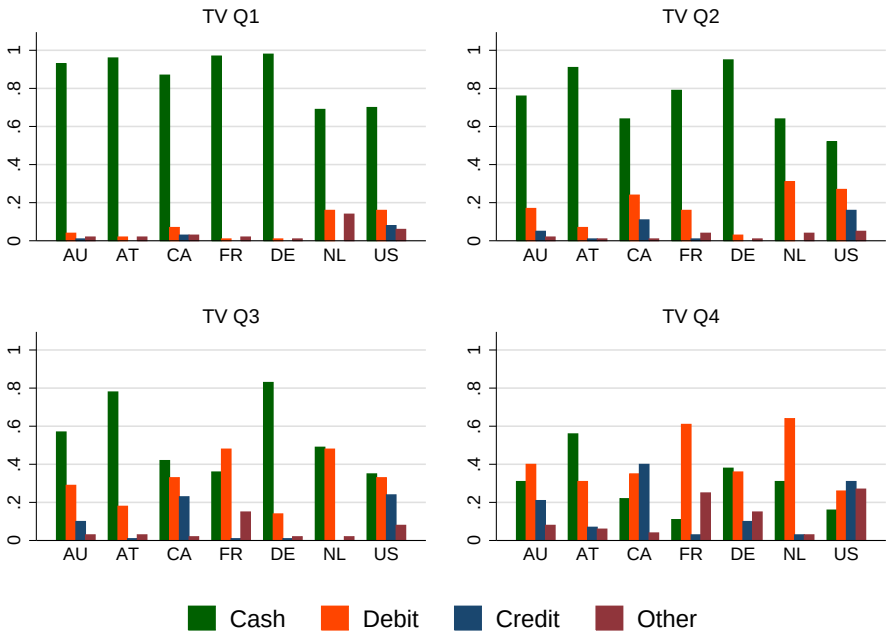
Notes: The dependent variable takes a value of 1 if a payment is made by cash and zero if it is made by debit or credit. Results for location (urban/rural), marital status, gender, employment status and family size are not shown. Variables are defined in Table A.1. TV Q2, TV Q3, and TV Q4 denote the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

Figure 1: Ratios of Currency in Circulation to Nominal GDP



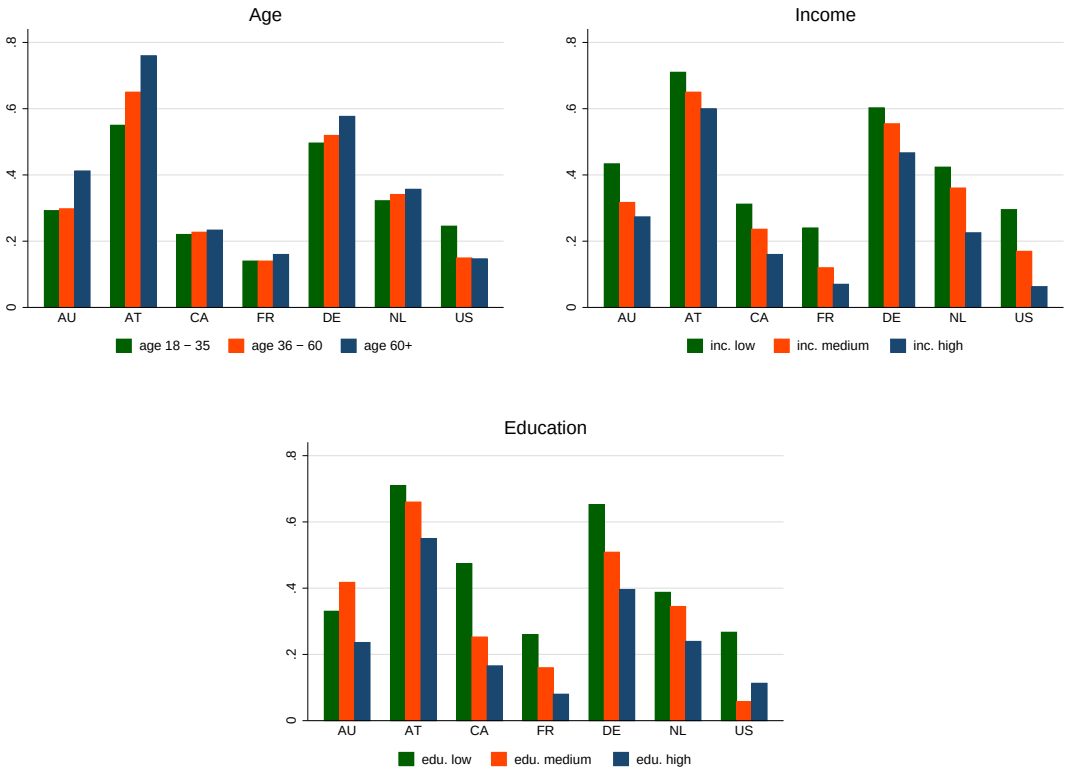
Sources: Haver Analytics, International Financial Statistics, and authors' calculations.

Figure 2: Value Share of Cash by Transaction Value Quartiles



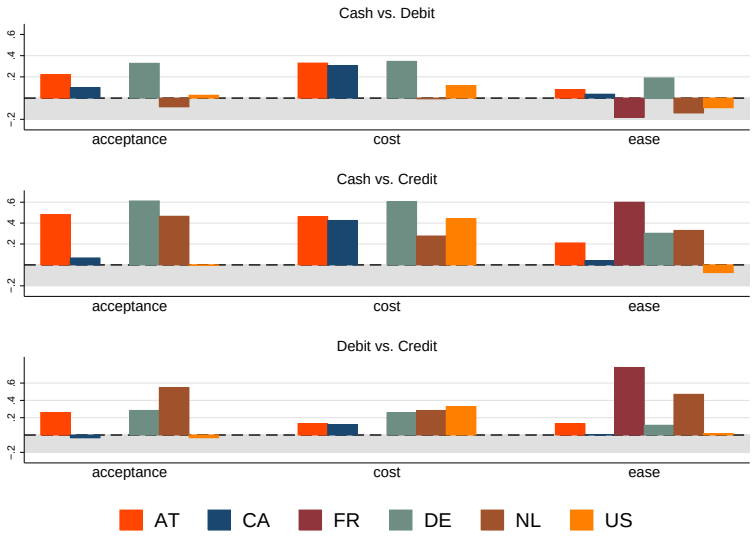
Source: Authors' calculations based on diary surveys.

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



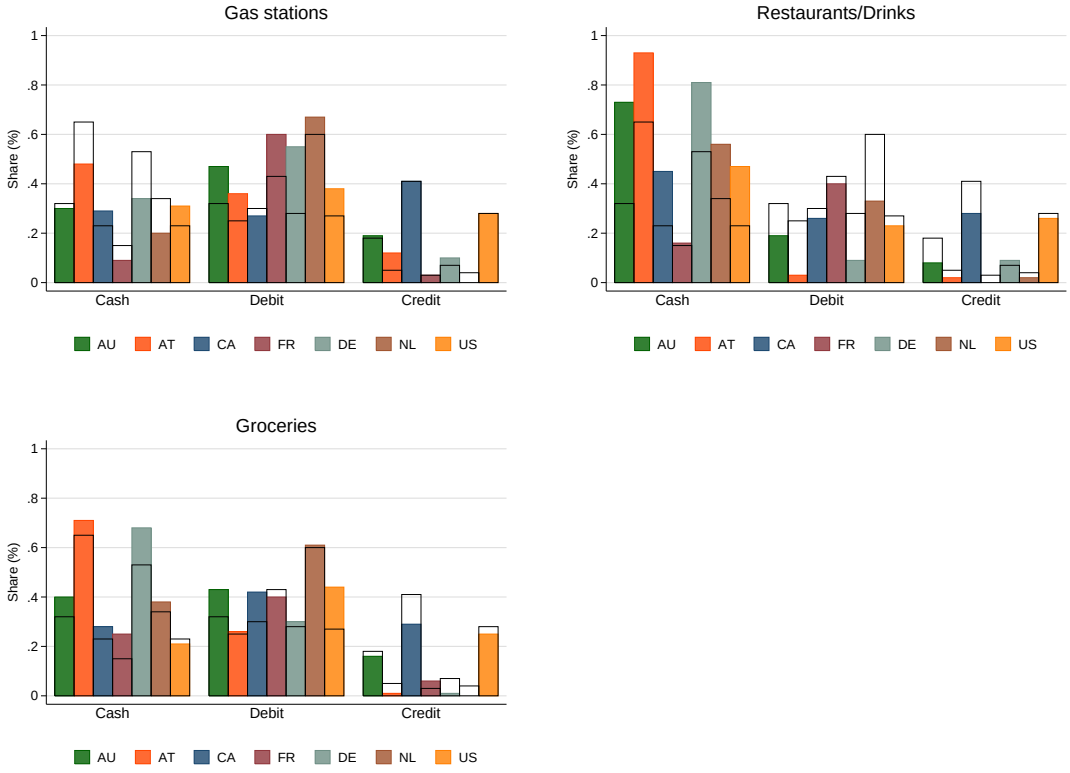
Notes: The figures depict the shares of cash (in value terms) in percentage for the respective subgroup. Authors' calculations based on harmonized diary surveys.

Figure 4: Perceptions of Cash



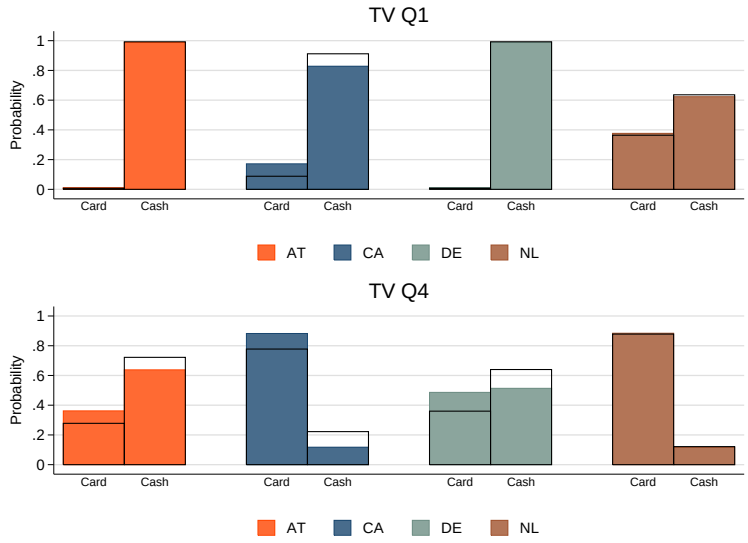
Notes: The figure shows normalized perceptions of cash relative to debit and credit. A positive (negative) value indicates that cash is perceived better (worse) than the respective payment card. Due to differences in the wording of survey questions, the harmonization is only approximate. Values for acceptance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

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.

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.

A Appendix

Table A.1: Definition of Variables

Income	3 dummy variables; 1 if income is in the highest income tercile (High Income), lowest income tercile (Low Income) or in the middle income tercile (Medium Income), 0 else.
Age	3 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), 0 else.
Education	3 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 home owner	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 normalized by results for other methods of payment, such that a positive (negative) value implies that cash is valued better (worse) than cash or credit. The normalization is described in Arango, Huynh, and Sabetti (2011).
Cash on hand	Defined as the usual (average) cash holdings of a person. It is taken from survey questionnaires and not from the diaries. 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, 0 else.
Transaction value quartiles	Quartiles are formed from all observed transaction values. 4 dummy variables, which are 1 if a transaction falls in Transaction Value Quartile 1 to 4 (TV Q1 to TV Q4), 0 else.
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.