PRELIMINARY DRAFT -PLEASE DO NOT CITE WITHOUT PERMISSION

Choosing and using payment instruments: Evidence from German micro-data

Ulf von Kalckreuth[*], Tobias Schmidt[+], Helmut Stix[#,∀]

February 27, 2009

Abstract

We shed light on how individuals choose payment instruments and why cash still retains a significant share in some countries, in particular European countries, although card payment would be possible. We propose a two stage empirical framework which explains ownership of credit cards and then the use of cash, given the individual's payment infrastructure. Using a new and unique set of micro data that contains both transaction information and survey data on payment behaviour of German individuals, our results indicate that cash usage is compatible with rational decision making. Consumers decide upon the adoption of payment cards and then use available payment means according to their transaction and personal characteristics, the relative costs of cash and card usage and preferences. Interestingly, we find that the possession of a credit card, notably in addition to a debit card, does not significantly affect the use of cash in Germany, indicating that credit cards and debit cards are close substitutes in Germany

JEL-Code: E41, E58, D12

Keywords: Payment instruments, payment cards, payment behaviour, payment innovation, cash usage, cash substitution, debit cards, credit cards

---

[*] Deutsche Bundesbank and University of Mannheim, Email: Ulf.von-Kalckreuth@bundesbank.de,

[+] Corresponding author: Deutsche Bundesbank, Research Center. Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main, Germany. Email: Tobias.Schmidt@bundesbank.de

[#] Oesterreichische Nationalbank, Economic Studies Division. Email: Helmut.Stix@oenb.at

[∀] This paper represents the authors' personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank, the Oesterreichische Nationalbank or their staff.

1. Introduction*

Payment technologies have been advancing rapidly in recent years and decades. This may well have implications for the use of cash, and the demand for currency. A significant decline in the share of cash payments would exert profound influences on monetary policy transmission, the aggregate cost of payment system and, of course, on seigniorage.

However, cash seems far from fading out, although the diffusion of non-cash payment instruments has progressed very far. Our survey information shows that around 91% of all consumers hold debit cards and 27% hold credit cards. The options for cashless payments have been increasing in recent years, in particular since more and more retailers have introduced point-of-sale terminals. But the data also reveal that cash still accounts for an astounding 82% of the volume and for 58% of the value of all direct payment transactions.[1] These figures imply that cash is being used in many payment transactions for which cashless payments would have been possible, at low costs for consumers.

How can this be explained? Several reasons for a high share of cash transactions are conceivable. Consumers may be subject to some form of habit persistence. There may be specific preferences towards cash usage. The card network may still not be dense enough. Cash may have retained cost advantages over other forms of payments. Consumers may act irrationally. While these explanations seem plausible, relatively little is known about their actual relevance.[2]

The goal of this paper is to identify factors that determine the adoption and use of payment means. We use a unique survey data set that contains a diary of transaction records as well as detailed information on various aspects of payment behaviour.

---

* We are greatful for comments by Stefan Gerlach, Thomas Laubach, Alexander Wolman and participants on seminars at the Oesterreichische Nationalbank and the Deutsche Bundesbank, Our results are still preliminary.

[1] This figure is close to results for Austria where cash payments accounted for 86% of all direct payment transactions in 2005 (Mooslechner, Stix and Wagner 2006). In the survey, direct payment transactions comprise all transactions apart from recurrent transactions, which are typically settled by direct debit or by bank transfers from accounts (e.g. rents, insurance fees, telephone bills).

[2] The high cash share of transactions induces elevated aggregate costs (Brits & Winder 2005, Gresvik & Owre 2003, Humphrey, Kim &Vale 2001).

We present a theoretical and empirical framework that reflects the complex multi-stage decision problem of consumers: individuals can choose their payment infrastructure, requiring an adoption decision. Then, given the adoption decision and hence a set of available payment instruments and given payment alternatives offered at the point-of-sale, households choose a particular payment instrument.[3]

The latter choice may be influenced by various factors. In particular, results by Santomero & Seater (1996), Whitesell (1992) or Shy and Tarkka (2002) suggest that the decision depends on transaction characteristics. Bounie & Houy (2007) empirically refute some of the predictions of Whitesell's model and argue that the payment decision also depends on the stock of available cash balances at the time of the purchase. Another line of reasoning treats cash and card payments as perfect substitutes and argues that the persistence in cash usage observed in some countries can be explained by cost advantages (Markose & Loke 2003). Regarding the relative cost factors associated with the use of cash and payment cards, we refer to the literature on cash management and the effects of withdrawal and payment innovations on cash demand (cf. Baumol 1952, Tobin 1956, Attanasio, Guiso & Jappelli 2002, Alvarez & Lippi 2009, Lippi & Secchi 2009, Stix 2004). Other authors maintain that cash and payment cards are not perfect substitutes and that preferences towards certain characteristics of payment means are important. In particular, distinctive features of cash, like anonymity (Drehmann, Goodhart & Krueger 2002; Economist, 2007), or convenience and cost control have been identified in this context (e.g. Mantel 2000b).

Given these – partly competing – results, our empirical framework accounts for (i) transaction and personal characteristics as well as the expenditure structure, (ii) the relative costs of cash and card usage and (iii) preferences for means of payment characteristics (e.g. the desire for anonymity, cost control). This comprehensive approach allows us to test whether individuals behave rationally, that is whether the high cash intensity still observed in Germany can be explained by economic behaviour or whether it reflects habit persistence.

Our empirical framework contributes to the literature in several dimensions: First, in addition to modelling the *likelihood* of substituting cash by cards (which is typically done in the few related papers that also employ information on transaction characteristics), we also analyse the *extent* of this substitution. Importantly, we are able to condition on the possibility of a true

[3] Note that we treat the available payment infrastructure, like the number of card payment terminals, as given. For example, Markose and Loke (2003) focus on both the demand and the supply side.

choice, ie we are able to exclude transactions that could only be carried out using cash or card payments, respectively.

Second, we do not only look at the share of cash usage over all transactions for a particular consumer but we allow payment behaviour of consumers to differ across spending categories (e.g. daily retail expenditures versus gas stations).

Third, our model explicitly accounts for the simultaneity of the decision to adopt a payment card and the decision on how available payment means are used.

Fourth, due to data limitations, previous empirical studies have often been confined to study only a subset of potential explanatory factors. Among the studies that analyze cash-card substitution at the level of individuals, most focus on the relative costs of cash and card usage while only a few papers also analyze the role of preferences (e.g. Mantel 2000a) or transaction characteristics (Boeschoten 1998, Bounie & Abel 2006, Hayashi & Klee 2003, Shy & Tarkka 2002). The fact that we can consider all of these factors simultaneously allows testing competing hypotheses. Furthermore, previous studies often had to proxy relative costs of cash and card usage by personal characteristics, whereas we are able to provide more direct measures.

Our findings support the notion that the choice of payment instruments follows a complex multi-stage and multi-layered decision problem which can be characterized along the following dimensions: First, adoption and use of payment means are to great extent influenced by the same variables and hence joint modelling is essential. In fact, neglecting this simultaneity would result in biased estimates and conclusions concerning the effect of payment card ownership on cash usage would be misleading. Second, we find that transaction and personal characteristics, the relative costs of cash and card usage and preferences are important determinants of cash usage. This finding implies that the use of cash is compatible with rational economic behaviour. Third, our analysis confirms that payment behaviour differs across spending categories. This corresponds to findings in the literature (Boeschoten 1998, Bounie & Abel 2006). We also find correlations that may be due to learning effects: Buying on the internet, which implies experience with non-cash means of payments, increases the likelihood of non-cash payments in daily retail transactions. And fourth, we find that credit card ownership (in addition to owning a debit card), does not significantly affect the use of cash in Germany. This result indicates that credit cards are used as substitutes for other non-cash means of payments rather than cash.

The paper is structured as follows: Chapter 2 develops an analytical framework upon which our empirical model is built. The data about payment behaviour in Germany is presented in Chapter 3. Estimation results are presented in Chapter 4. Chapter 5 concludes.

2. Analytical Framework

In order to fix ideas, we will first outline the individual's decision problem in a transaction cost model. Individual i choose a payment structure to minimize transaction costs. A payment structure is a vector

$$\mathbf{p}_i = (p_i^0, p_i^1, \ldots, p_i^K)' \quad \text{with} \quad p_i^j \geq 0 \quad \forall \quad j \in \{0,1,\ldots,K\}.$$

Here, p_i^j is the sum of transactions using payment instrument j carried out by individual j. More specifically, let the first entry, p_i^0, refer to cash transactions and the other entries, $p_i^1, \ldots, p_i^K$, to transactions associated with various non-cash payment instruments. The expected total transaction volume, $\bar{T}_i$, is given, as are the characteristics of the individual, $\mathbf{x}_i$.

Transaction costs are given as a function of the payment structure and various individual characteristics, including the planned structure of expenditure. For example, the relative costs of using cash or credit cards will also depend on whether a person likes to dine out or orders in the internet. We may assume the following transaction costs function:

$$\begin{aligned} c_i &= c(\mathbf{x}_i, \mathbf{p}_i) \\ &= p_i^0 + \sum_{k=1}^{K} p_i^k (\mathbf{x}_i \beta^k + \gamma^k p_i^k). \end{aligned}$$

We assume that it is possible to pay using cash in every situation and marginal transaction costs are constant. They are normalised to 1. Marginal costs of other payment alternatives depend on the individual's characteristics. The costs of using a given means of payment vary over transaction types – it is easy to pay cash in a retail market, but many retail markets will accept credit cards only reluctantly. Ex post, we may always order transactions by the ease with which they can be carried out using a given payment instrument. Therefore, marginal costs using this payment instrument as compared to cash will increase by definition.

It is clear that not each element of $\mathbf{p}_i$ will be positive for all households. If

$$\mathbf{x}_i \beta^k \geq 1,$$

it will not be worthwhile using payment instrument *k* at all, because even the first transaction will be more expensive than cash. If the inequality does not hold (and the solution foresees the use of cash), then a positive amount of payments will be carried out by k.

Thus, the decision is the outcome of a cost minimisation problem subject to non-negativity constraints regarding the elements of $\mathbf{p}_i$ and the constraint that the sum of payments adds up to the individual's specific transaction volume:

$$\mathbf{p}_i^* = \arg\min_{\mathbf{p}} c(\mathbf{x}_i, \mathbf{p}_i)$$

such that

$$p_i^k \geq 0 \quad \forall \quad k \in \{0,1,\ldots,K\},$$

and

$$\sum_{k=0}^{K} p_i^k = \bar{T}_i.$$

As it stands, this is a corner solution model, one of the ways the general censored regression model can be interpreted (see Wooldridge 2002, p. 517 ff). The solution yields a range of actively used payment instruments, together with the quantities for those in active use. Adoption and the choice of intensity are really just different aspects of the same decision.

In a more complex reality, however, there may also be fixed costs for the use of certain means of payments, such as credit card fees, paperwork, learning costs or other restrictions like credit constraints. Furthermore, unobserved variables may influence the adoption and intensity decisions in different yet correlated ways. We therefore choose to model the decisions on adoption and intensity in a less integrated way, using limited information estimators (probit estimations for the adoption decision and instrumental variable regressions for intensity) as well as full information maximum likelihood estimators (bivariate probit estimation for payment instrument adoption and self-assessed use).

In our dataset, we observe the adoption decisions (ownership) for a variety of means of payments. We have two different measures for their use: the payment diary yields transaction data for a short period of time (one week), and from the interviews we have self-assessments

for the use of cash and a variety of non-cash means of payments, by type of transaction. Not owning a debit card is a rare exception in Germany, and non-cash means of payments other than debit and credit cards are either not widely spread or rather infrequently used. Therefore, we estimate structural relationships for the share of non-cash payment instruments in total payments, aggregating all means of payment other than cash,

$$s_i = 1 - \frac{p_i^0}{\sum_{j=0} p_i^j},$$

together with the empirically most important adoption decision, namely the acquisition of a credit card. In a first set of estimates, a linear model for s_i is chosen, where credit card adoption cc_i figures as an endogenous regressor,

$$s_i = \mathbf{x}_i' ß + \gamma cc_i + u_i . \qquad (1)$$

This is complemented by a standard probit model for credit card adoption:

$$cc_i = \mathrm{I}(\mathbf{x}_i' \rho + \eta_i > 0), \qquad (2)$$

where some identifying exclusion restrictions of ρ and β need to be imposed. Our short run transaction data are rather noisy, as we follow individuals for only one week. Furthermore, payment behaviour is likely to depend very much on the type of transaction. Therefore a second set of estimations combines, in a series of bivariate probits, the credit card adoption decision with the prevalence of non-cash payments for different types of transactions:

$$\begin{aligned} cc_i &= \mathrm{I}(\mathbf{x}_i' \beta_1 + \varepsilon_{1i} > 0) \\ pv_i^j &= \mathrm{I}(\mathbf{x}_i' \beta_2^j + \delta^j cc_i + \varepsilon_{2i} > 0) \end{aligned}, \qquad (3)$$

again with appropriate identifying exclusion restrictions imposed on β_1 and β_2^j. Prevalence pv_i^j is a binary variable indicating whether or not an individual *i* typically carries out all his transactions of type *j* using cash or whether part or all of his transactions are carried out by non-cash payment instruments. This is a recursive simultaneous equation model of the adoption decision and transaction type specific intensity, both measured as discrete variables. See Maddala (1983, pp. 122) on the model and Burnett (1997) for an application.

We make a distinct effort to take due account of household heterogeneity by conditioning on preferences and the structure of expenditure. Regarding certain characteristics of payment instruments, like convenience or anonymity, we use direct measures of preferences, as they

will be evaluated by different households in a different way. In addition, we include measures for the frequency of types of transactions, as there may be supply constraints inducing a propensity to use a payment instrument in one context more than in the other.

3. The Dataset

The data for this study are drawn from a representative survey of individuals living in Germany which are 18 years or older, entitled "Payment Habits in Germany". The survey was conducted by Ipsos on behalf of the Deutsche Bundesbank in April, May and June 2008. Based on a random sample 3,612 individuals were selected and 2,292 actually interviewed in all 16 German Länder.[4] The interviews were conducted face-to-face using a programmed questionnaire tool (CAPI). A special feature of the survey is that the face-to-face interviews were supplemented with a drop-off payment diary which was to be completed by the interviewed person in the seven days following the interview (2,227 persons returned the drop-off diary).

The payment diary collects information on all individual transactions the interviewed person conducts during a one week period (in total, more than 25,500 transactions were recorded). These include the euro amount of each transaction, the type of location where the transaction took place (shop, restaurant, internet, etc.) and the means of payment used to complete it (cash and a list of ten cashless payment methods). The persons keeping the diary were furthermore asked to indicate whether they would have been able to complete a given transaction in cash in case they paid with a non-cash instrument and vice versa.

The CAPI interviews supplement this information by providing data on various aspects of a person's payment behaviour, like ownership of payment cards, preferences for certain features of payment methods (anonymity, convenience, cost control, etc.), and on cash withdrawal behaviour. Additionally, the survey contains questions on factors that may influence an individual's decision to pay cash or use alternative methods of payment, like demographic characteristics and income.

[4] The sampling technique comprised three stages: in the first stage regions were selected ("sample points"), which were used to define starting points/addresses for the second stage, in which interviewers contact households based on a random route procedure. Finally, an eligible person in each contacted household was randomly selected.

Dependent Variables

The first stage of our empirical analysis focuses on the decision to adopt a credit card (described by eqn. 2). Given the analytical framework and data characteristics, we restrict our sample to persons who have already a debit card ("Maestro" or "EC" card).[5] We focus on this sample because almost all persons in Germany have a debit card and almost no persons have a credit card without having a debit card. Also, in light of the very high dissemination of debit cards, it is difficult to sensibly model the debit card adoption decision (given that in a majority of cases there is no choice involved on the side of consumers).[6]

For the second stage, the intensity decision, we focus on two separate types of dependent variables which both measure the cash intensity of an individual. These variables differ in several dimensions and allow tackling different aspects of the payment behaviour.

(i) For our first dependent variable, we make use of the individual transactions recorded in the payment diary and calculate for each person in the sample the volume and value share of all non-cash expenditures (SHARE_NON_CASH). Importantly, the non-cash share of expenditures is calculated only for those transactions for which the respondent was actually confronted with a choice. That is, we exclude those individual transactions for which only one means of payment was accepted by the merchant (cash or non-cash, respectively).

(ii) In contrast, the second set of dependent variables focuses on the payment behaviour at particular spending locations (e.g. retailers and gas stations). In particular, during the CAPI interviews which were conducted before survey respondents recorded their individual payment transactions respondents were asked to give general statements about how they usually pay at various spending locations, choosing among one or more payment means from a given list (e.g. "by cash", "by debit card", "by credit card"). Using this information we construct a binary variable which takes a value of zero if an individual pays "only cash" and one if an individual also (or exclusively) uses non-cash means of payments. In the empirical model we consider this binary

[5] Persons not owning any cards (165 obs.) will - by definition - not be able to make any POS transactions by means other than cash (their cash intensity is 100%). They are therefore excluded from our analysis. We also exclude those stating that they use a Maestro or "EC" card but not owning an account (23 obs.).

[6] Accordingly, a simple model which aims at explaining the adoption decision for debit cards performs particularly poor when it comes to predicting why someone does not own a Maestro card. This seems to be a

variable to be the observed counterpart to the latent variable which measures the share of non-cash expenditures. As regards the choice of expenditure types, we select the location for which we observe the highest total expenditures during the one week diary period (grossed up over all persons): daily retail expenditures (RETAIL_DAILY) and gas stations (GAS_STATIONS).[7]

Descriptive statistics for the dependent variables are summarized in Table 1. Subsequently, we will refer to the two types of payment behaviour as *short-run (diary)* and *long-run (questionnaire)*. Despite this simplifying notation, one should bear in mind that the two sets of variables do not only differ by the covered time horizon but also by their content (actual behaviour versus self-assessed behaviour) and by their source (derived result versus questionnaire answers). Evidently, the also differ by their scope (observed overall share of non-cash expenditures, a continuous variable, versus a latent variable for the share of non-cash expenditures at two particular expenditure types) which, as discussed, requires different estimation techniques. In light of these substantial differences, we are convinced that a comparison of results for both sets of variables will constitute a rather solid basis for making judgments on the robustness of our findings.

Independent Variables

In selecting the independent variables we follow the literature. Our model includes measures of income, consumption patterns, the user cost of cash, preferences for specific characteristics of payment instruments, and network density, as well as several socio-demographic variables. As the list of potentially relevant independent variables is quite long, we will briefly describe the most relevant variables and their expected effects on the adoption and intensity decision[8]. Summary statistics are shown in Table 1.

Income is mainly important for the adoption decision where it plays a dual role. First, household income (HH_INCOME) measures the scale of transaction or the composition of

---

very idiosyncratic decision, we cannot explain with the data from the survey.

[7] In principle, the information about the non-cash share for different spending locations could also be extracted from the short-run payment diary data. However, most of the transactions recorded in the diary are retail transactions (44 %) and no other spending place reaches more than 10% of total transactions recorded. This means, we have only a very small number of transactions for each person at spending places other than retail. Given that we also have to exclude transactions which can be effectuated by cash or non-cash only, the number would be even lower. These limitations imply that we cannot compare the payment behavior at different spending places using the payment diary data and therefore we resort to the long-run (questionnaire) payment behavior.

[8] A more detailed variable description is provided in the Appendix.

expenditures and should be positively correlated with the net-utility from card ownership. Second, income affects the willingness of banks to grant credit cards to costumers. As a monitoring device banks observe income which is transferred onto a given account. Therefore, we construct a variable which measures the net income of a person if this person has an account (ACCOUNT INC). If a person does not have an own account, but nevertheless has access to an account (e.g. joint account with a partner) this variable measures the household income. Therefore, in both cases, the variable proxies the financial situation of a respondent that can be observed by banks). The willingness of banks to grant credit cards is also related to the type of banks where respondents have their account. In particular, direct banks do not have branches and supposedly are more inclined to issue payment cards than banks with a dense net of branches or ATMs (DIRECTBANK).

Even when accounting for income, heterogeneity in the composition of consumption expenditures can be substantial. For example, those conducting internet transactions will derive a greater net utility from having a credit card and will have a higher non-cash share of expenditures than those who do not make such transactions. To account for such effects, we have included information from the CAPI interviews about how frequent respondents make certain transactions (FREQ X).[9] Following the literature, another source of heterogeneity could be the average value of transactions (AVG_VAL_TRANS) and the difference between the largest and the smallest transaction (SPAN_VAL_TRANS, cf. Whitesell 1992).

The costs of cash and card usage should both affect the adoption and the intensity decision. Our data set allows considering three types of cash related costs. First, we include the time (in minutes) it takes the respondent to get to the location where cash is usually withdrawn (a bank or and ATM, whichever is closer – DISTANCE_WITHDR). The second type of cash related costs arises from the subjective risk of being robbed or pick-pocketed (RISK_THEFT). Third, those who earn income in cash, have no cash acquisition costs and hence cash is relatively cheaper. To account for these reduced costs of cash, we include the share of respondents annual income received in cash (SHARE CASH). We also include a variable for measuring the availability of payment cards at the POS. In particular, we have constructed a dummy variable which measures whether respondents are frequent users of ATMs (ATM USER) – as the payment function and the withdrawal function are often integrated on the same card we suspect that availability of this card in the wallet eases its use also for payments and thereby

[9] In total, we have information on the monthly frequency of transactions for 16 types of consumption

reduces the cost of card usage relative to cash usage.

We also consider preferences for certain payment characteristics as potentially important for the adoption and the intensity decision. In particular, respondents were questioned about what characteristics they consider important for a payment instrument. Using this information we include whether the protection of privacy/anonymity (PREF. ANONYMITY), whether the possibility to make payments abroad (PREF. ABROAD) and the possibility to make payments on the internet (PREF. INTERNET) are important or very important characteristics for a person.[10] In a similar vein, we construct a dummy variable for the importance that respondents have long-lasting experience with payment means (PREF. HABIT). Furthermore, we include information whether respondents have a preference for expenditure control. Again, we separate between those for whom expenditure control is not important and those whom expenditure control is important. However, for the latter group we suspect that for some individuals expenditure control can be achieved by using cash while for some expenditure control can be achieved by card payments (as transactions are recorded on the account statement). To account for this ambiguity, we have defined two dummy variables, on for the former (PREF_EXP (CASH)) and one for the latter group (PREF_EXP (CARD)).

The density of the POS terminal network differs regionally – a higher POS terminal density should reduce the net costs of card adoption and, evidently, should increase the share of non-cash expenditures. To account for this effect we have calculated from the payment diary data the share of transactions in a given region that could have been carried out by card payments (POS_DENSITY).

Finally, we include a set of socio-demographic characteristics: The age of the respondent at the time of the interview (AGE), gender (MALE), as well as dummies for different labour market statuses (e.g. EMPLOYED), categories of jobs (e.g. CIVIL SERVANT), and levels of education (e.g. EDU MED). Depending on the context (adoption or intensity), some of these variables control for opportunity costs of time (education, employment status and occupation) and others for creditworthiness (banks are less likely to issue credit cards to unemployed persons). Also age might exert an effect via different channels: e.g. the shadow value of time or the propensity to adapt to new technologies or the composition of expenditures.

As discussed, our empirical framework accounts for the endogeneity of the credit card

---

expenditures.

[10] The formulation of this question is such that it refers to payment instruments in general and not to a particular

variable. Identification of the instrumental variable approach (eqn. 1) or the recursive simultaneous bivariate probit model (eqn. 3) requires finding variables that are correlated with the credit card adoption decision but uncorrelated with the intensity decision. In our estimation approach we choose the following three variables as instruments: JOINT_ACCOUNT takes a value of one if the person does not have a bank account himself, DIRECTBANK and ACCOUNT_INC. The variables referring to accounts are proxies for information that banks are able to observe and can use when deciding whether to provide an applicant a credit card or not.

4. Results

The estimation results are summarized in Table 2. The results are grouped into the adoption equation (column I) and the intensity decision (columns II-V). Within the intensity decision, we present results for the share of non-cash transactions (SHARE_NON_CASH) from an OLS regression (column II) and an instrumental variable approach (column III).[11] Columns IV and V summarizes results for the bivariate probit estimations, with the dependent variables RETAIL_DAILY and GAS_STATIONS.[12]

We begin the discussion of our findings with a short overview of the main results and move on to a discussion of some detailed results regarding specific groups of explanatory variables.

[INSERT TABLE 2 ABOUT HERE]

The major results of our analysis concern the role of credit card ownership in the intensity decision. The results from an OLS estimation of the intensity decision equation that treats the credit card variable as exogenous, yields a positive and significant coefficient of credit card ownership: owning a credit card seems to depress the share of cash in total payments. However, if credit card ownership is treated as endogenous, the variable becomes insignificant. This result is very robust, holding for both the long-term and the short-term payment behaviour as well as for different sets of instruments. After controlling for the fact

payment instrument.

[11] We concentrate on the share based on the volume of transactions. The results for the share based on the value of transactions are very similar, qualitatively.

that the adoption and the intensity decision are driven by largely the same set of variables, exogenous variations in credit card ownership do not seem to influence the cash share in transactions. We will return to this finding in the conclusions.

An important question we address is whether payment behaviour is based on rational decisions or habit persistence. The signs of the estimated coefficients are consistent with rational behaviour, rather than habit persistence. The high predictive power of the choice equations –80% of cases are correctly classified in the adoption decision; 73% and 73% in the the two bivariate probits– indicates that the variables we included in our empirical model explain a significant part of the variation in payment behaviour. At the same time, we observe that our direct measure for habit persistence (PREF_HABIT) is insignificant in all our equations. In our view, this implies evidence against the predominance of habit persistence.

All groups of explanatory variables (demographics, expenditure structure, the relative price of cash usage and preference for certain means of payment characteristics) influence the adoption decision and the long-term payment behaviour (columns IV and V). For the cash share equation using payment diary data (column III), surprisingly enough, only the variables measuring the relative costs of cash usage and very few demographics and preference variables are found to be significant.

Our findings suggest that the relative costs of cash and card usage are important determinants for the cash share of transactions, both overall and according to spending locations. For this group of variables we find most similarities between the qualitative results for the estimation of the cash share (short-run diary) and the decision to use cash exclusively at gas station and retailers (long-run questionnaire). We show that individuals using ATMs frequently tend to use less cash for their transactions than other individuals. This is surprising at first glance, because for these people withdrawing cash seems to be cheap, which should favour its use in transactions. However, frequent ATM users also have their debit cards at hand most of the time, since they need it in order to be able to withdraw money. They are also familiar with using their cards and providing their PIN-code at an electronic machine. The familiarity and permanent availability of non-cash payment instruments seems to drive their behaviour, rather than low costs of withdrawing money. Not surprising, individuals receiving a high share of income in cash, ie access to cash is cheap, are more likely than others to use cash for transactions. This may also explain the negative effect of the share of cash income on the

[12] Because of our different estimation approaches, point estimates are not directly comparable.

adoption of non-cash payment means. They simply do not have high demand for cashless payment instruments.

A very strong role is also found for the density of electronic POS terminals, with the expected positive effect on non-cash payments. For the adoption decision, POS_DENSITY exerts a negative effect on the likelihood of credit card adoption. This seems plausible, given that a high POS density implies that debit card transactions are possible almost everywhere and credit cards are redundant. However, this result may well be specific for Germany, where only a relatively small number of shops accept credit cards.

The average value of the transactions recorded by the respondent in the diary has a significant influence on the share of transactions carried out by non-cash: The point estimate implies that with higher average values, more non-cash payments occur. This corresponds well with results from the theoretical (Whitesell 1992) and empirical literature (Boeschoten, 1998, Bounie and Abel, 2006; Hayashi, F. and Klee, E. 2003). In contrast no significant effect for the difference between the largest and the smallest transaction (SPAN_VAL_TRANS) is found.

Preferences for certain characteristics of means of payments are closely linked to the credit card adoption decision, as expected. The results for the probit estimation of the adoption equation indicate that individuals who need credit cards, e.g. to conduct transactions on the internet or abroad, have a higher likelihood of credit card ownership. Individuals concerned with anonymity and controlling their expenditures less often own credit cards. An interesting finding from this block of variables is that consumers for whom the ability to use a payment instrument on the internet or abroad is important, less frequently pay cash at retailers and gas station. This may be due to correlated individual specific "technical inclination" effects on several dimensions of behaviour, but learning effects are possible too: the experience gained with electronic payments online and abroad may be transferred to other spending categories.

Demographic factors are a third group of explanatory variables which play an important role for the decision to adopt a credit card. The coefficients we get on the demographics in the adoption equation are in line with our expectations. Relative high household income and high levels of education increase the probability of credit card ownership significantly. Demographic characteristics also have a strong influence on the long-term payment behaviour at retailer shops and gas stations. We find heterogeneity between the two spending categories with regard to the effects of demographics.

This result together with the finding that the qualitative results for other variables are very

similar for both spending categories confirms our view that individuals behave differently for different spending categories. The insignificance of almost all demographic characteristics in the instrumental variable regression for the overall share of non-cash transactions is puzzling and raises questions on the validity of a specification that aggregates over all spending categories.

5. Conclusions

Individuals seem to base their payment behaviour on systematic decisions: it is correlated with variables describing the nature of transactions, the characteristics of payment instruments and individuals. This makes it unlikely that the observed high prevalence of cash payments is the result of habit persistence. *Ceteris paribus*, i.e. with current technology and given the other factors for individual decision, the share of cash in total transactions is unlikely to erode much further. However, with further technological shifts or changes in the strategies of sellers and network providers, this may change of course.

A very important feature of our results is that credit card ownership has no effect on the share of cash transactions, once endogeneity is accounted for. The decisions on adoption and intensity seem to be hierarchical: The share of cash payments is decided first, and it is left to other variables to decide by which of the various instruments the non-cash share is effectuated. The variation of costs between cash and the group of all non-cash payment instruments seems to dominate the variation within the group of non-cash means of payments. In other words: the relative costs of non-cash instruments vis-a-vis cash may be highly correlated. In any given decision context, there does not seem to be a big difference between the costs of using debit and credit cards.

If this explanation is true, the two competing systems of non-cash payments are close substitutes, and only one of them may survive in the long run. In Germany, this is not unlikely: Overdraft credit lines are widespread, and people can access them using their debit card. On the other hand, almost everybody balances credit cards at the end of the month, i.e. the credit card is really used as a payment device. In this situation, it does not matter much which of the two systems is used.

In this paper, we have concentrated on the overall cash share. A different topic of interest is the decision for each single transaction. The significant relationship between the average value of transactions and the non-cash share as well as the different coefficients in equations for different types of transaction already point out indicate that the specific transaction

characteristics may have an influence on the choice of payment means for an individual transaction. Future research should address these issues.

References

Alvarez, F. E. & Lippi, F. (2009). Financial Innovation and the Transactions Demand for Cash, forthcoming Econometrica.

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

Baumol, W. J. (1952). The Transaction Demand for Cash: An Inventory Theoretic Approach, *Quarterly Journal of Economics* 66: 545–556.

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

Bounie, D. and Abel, F. (2006). Cash, Check or Bank Card? The Effects of Transaction Characteristics on the Use of Payment Instruments. SSRN eLibrary http://ssrn.com/paper=891791

Burnett, N. (1997), Gender Economics Courses in Liberal Arts Colleges, *Journal of Economic Education* 28(4), 369-377.

Bounie, David Francois, A. & Houy, N. (2007). The Demand for Currency Versus Debitable Accounts: A Reconsideration. SSRN eLibrary http://ssrn.com/paper=987375.

Brits, H. & Winder, C. (2005). Payments Are No Free Lunch. De Nederlandsche Bank Occasional Studies, Vol 3. Nr. 2.

Drehmann, M., Goodhart, C. & Krueger, M. (2002). The challenges facing currency us-age: Will the traditional transaction medium be able to resist competition from new technologies?, *Economic Policy* pp. 195–227.

Economist (2007). The end of the cash era - Welcome the coming age of electronic money, but safeguard the anonymity of cash. Feb 15th 2007.

Gresvik, O. & Owre, G. (2003). Costs and Income in the Norwegian Payment System 2001. An Application of the Activity Based Costing Framework. Norges Bank Working Paper 2003/8.

Hayashi, F. & Klee, E. (2003). Technology adoption and consumer payment: Evidence from survey data, *Review of Network Economics* 2(2): 175–189.

Humphrey, D. B., Kim, M. & Vale, B. (2001). Realizing the Gains from Electronic Payments: Costs, Pricing, and Payment Choice, *Journal of Money, Credit and Banking* 33(2): 216–34.

Hyytinen, A. & Takalo, T. (2004). Multihoming in the Market for Payment Media: Evidence from Young Finnish Consumers. Bank of Finland Research Discussion Papers 25/2004.

Lippi, F. & Secchi, A. (2009). Technological Change and the Demand for Currency: An Analysis With Household Data. forthcoming *Journal of Monetary Economics*.

Maddala, G. S. (1983), *Limited Dependent and Qualitative Variables in Econometrics*, Cambridge University Press.

Mantel, B. (2000a). Why Do Consumers Pay Bills Electronically? An Empirical Analysis, *Economic Perspectives of the Federal Reserve Bank of Chicago* Q4: 32–48.

Mantel, B. (2000b). Why Don't Consumers Use Electronic Banking: Towards a Theory of Obstacles, Incentives, and Opportunities. Federal Reserve Bank of Chicago Emerging Payments Occasional Paper Series EPS-2000-1.

Markose, S. M. & Loke, Y. J. (2003). Network Effects on Cash Card Substitution in Transactions and Low Interest Rate Regimes, *Economic Journal* 113(487): 456–76.

Mooslechner, P., Stix, H. & Wagner, K. (2006). How Are Payments Made in Austria? Results of a Survey on the Structure of Austrian Households' Use of Payment Means in the Context of Monetary Policy Analysis, *Monetary Policy & the Economy* Q2: 111–134.

Penz, E., Meier-Pesti, K. & Kirchler, E. (2004). "It's Practical, But No More Control-lable": Social Representation of the Electronic Purse in Austria, *Journal of Economic Psychology* 25: 771–787.

Santomero, A. M. & Seater, J. J. (1996). Alternative Monies and the Demand for Media of Exchange, *Journal of Money, Credit, and Banking* 28(4): 942–60.

Shy, O. & Tarkka, J. (2002). The market for electronic cash cards, *Journal of Money, Credit and Banking* 34(2): 299–314.

Soman, D. (2001). Effects of Payment Mechanism on Spending Behavior: The Role of Rehearsal and Immediacy of Payments, *The Journal of Consumer Research* 27(4): 460–474.

Stix, H. (2004). How Do Debit Cards Affect Cash Demand? Survey Data Evidence, *Empirica* 31(2-3): 93–115.

Thaler, R. H. (1999). Mental Accounting Matters, *Journal of Behavioral Decision Making* 12(3): 183 – 206.

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

Whitesell, W. C. (1992). Deposit Banks and the Market for Payment Media, *Journal of Money, Credit and Banking* 24(4): 483–498.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, Mass.

Appendix

Table 1 Descriptive Statistics

	Full Sample[13]		Individuals without Credit Card		Individuals with Credit Card		Test for Mean Differ.
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Dependent variables:							
SHARE_NON_CASH_TRANS	0,21	0,29	0,17	0,27	0,28	0,32	***
RETAIL_DAILY	0,41	0,49	0,33	0,47	0,60	0,49	***
GAS_STATIONS	0,61	0,49	0,51	0,50	0,84	0,04	***
CREDIT CARD	0.30	0.46	-	-	-	-	
Independent variables:							
HH_INCOME	7.56	0.59	7.45	0.59	7.84	0.50	***
AGE	46.39	17.13	46.44	17.81	46.27	15.43	
AGE2	2,445	1,680	2,473	1,745	2,378	1,519	
MALE	0.47	0.50	0.42	0.49	0.58	0.49	***
EDU_OTHER (reference)	0.30	0.46	0.36	0.48	0.16	0.37	***
EDU_MEDIUM	0.44	0.50	0.45	0.50	0.42	0.49	
EDU_HIGH	0.13	0.34	0.11	0.32	0.18	0.39	***
EDU_UNI	0.12	0.32	0.07	0.26	0.23	0.42	***
RETIRED (Reference)	0.25	0.43	0.27	0.44	0.21	0.41	**
EMPLOYED	0.53	0.50	0.46	0.50	0.68	0.47	***
UNEMPLOYED	0.06	0.23	0.08	0.26	0.01	0.11	***
OTHER EMPL STATUS	0.17	0.37	0.20	0.40	0.09	0.29	***
WORKER	0.54	0.50	0.52	0.50	0.60	0.49	***
EMPLOYEE	0.05	0.23	0.03	0.18	0.10	0.30	***
CIVIL_SERVANT	0.09	0.28	0.06	0.24	0.15	0.36	***
SELF_EMPLOYED	0.06	0.25	0.08	0.27	0.03	0.16	***
OTHER_JOB TYPE (reference)	0.25	0.43	0.31	0.46	0.13	0.33	***
ATM_USER	0.46	0.50	0.46	0.50	0.47	0.50	
DIST_WITHDR	2.04	0.67	2.10	0.64	1.89	0.71	***

[13] "Full sample" stands for the sample, for which none of the listed variables is missing. Descriptive statistics for other samples are available upon request.

RISK_THEFT	0.45	0.31	0.48	0.31	0.38	0.31	***
SHARE_CASHINC	0.06	0.17	0.07	0.18	0.06	0.15	
POS_DENSITY	0.50	0.11	0.50	0.11	0.49	0.11	*
AVG_VAL_TRANS	31.02	35.36	29.81	38.30	33.86	27.10	**
SPAN_VAL_TRANS	131.53	391.67	127.43	435.72	141.10	261.60	
PREF_EXP (CASH)	0.37	0.48	0.42	0.49	0.24	0.43	***
PREF_EXP (CARD)	0.52	0.50	0.50	0.50	0.57	0.50	***
PREF_TIME	0.97	0.18	0.97	0.18	0.96	0.18	
PREF_ANONYM	0.88	0.33	0.91	0.29	0.81	0.39	***
PREF_INTERNET	0.33	0.47	0.25	0.43	0.54	0.50	***
PREF_ABROAD	0.81	0.39	0.76	0.43	0.93	0.25	***
PREF_HABIT	0.90	0.30	0.91	0.29	0.89	0.32	
ACCOUNT_INC	7.02	0.74	6.89	0.72	7.33	0.69	***
JOINT_ACCOUNT	0.05	0.22	0.06	0.24	0.04	0.18	**
DIRECTBANK	0.03	0.16	0.01	0.11	0.06	0.24	***
FRQ RETAIL DAILY	8.38	3.32	8.41	3.31	8.29	3.34	
FRQ RETAIL LONG	1.20	1.49	1.11	1.44	1.42	1.58	***
FRQ GAS STATIONS	2.58	2.50	2.45	2.57	2.86	2.30	***
FRQ PHARMACY	0.95	1.33	0.95	1.33	0.94	1.33	
FRQ SERVICES OUT	0.76	0.94	0.69	0.88	0.93	1.05	***
FRQ SERVICES IN	0.39	1.11	0.33	1.07	0.51	1.18	***
FRQ VENDING	3.06	3.86	2.99	3.88	3.21	3.82	
FRQ INTERNET	0.45	1.17	0.35	1.06	0.68	1.36	***
FRQ MAIL-ORDER	0.34	1.18	0.28	1.06	0.48	1.42	***
FRQ RESTAURANT	1.28	1.91	1.03	1.70	1.86	2.23	***
FRQ FAST FOOD	2.87	3.28	2.75	3.29	3.16	3.23	**
FRQ LEISURE	1.51	2.11	1.38	2.09	1.82	2.14	***
FRQ HOTEL	0.25	0.97	0.18	0.88	0.41	1.14	***
FRQ BED AND BREAKF	0.19	0.88	0.17	0.93	0.22	0.73	
FRQ PRIVATE	0.74	1.27	0.70	1.29	0.82	1.22	*
FRQ POCKETMONEY	0.70	1.45	0.66	1.45	0.80	1.43	*
BIK_1 (reference)	0.05	0.22	0.05	0.22	0.04	0.21	
BIK_2	0.28	0.45	0.29	0.46	0.24	0.43	**
BIK_3	0.68	0.47	0.66	0.47	0.72	0.45	**
Number of Obs	1,414		990		424		

Table 2 Estimation Results

	(I) CREDIT CARD (dummy)	(II) SHARE OF NON-CASH PAYMENTS (volume)	(III) SHARE OF NON-CASH PAYMENTS (volume)	(IV) RETAIL DAILY (long term)	(V) GAS STATIONS (long term)
	PROBIT ESTIMAT.	OLS ESTIMATION	INSTRUMENTAL VARIABLE ESTIMATION	BIV: PROBIT (respective adoption decision estimations not shown)	BIV: PROBIT
CREDIT CARD		0.055***	-0.030	-0.044	-0.076
		[0.018]	[0.145]	[0.510]	[0.596]
HH_INC	0.376***	0.009	0.016	0.161*	0.371***
	[0.094]	[0.013]	[0.020]	[0.084]	[0.086]
AGE	0.035*	-0.002	-0.001	0.028*	-0.001
	[0.019]	[0.003]	[0.003]	[0.017]	[0.016]
AGE2	-0.000*	0.000	0.000	-0.000**	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
MALE	0.183*	-0.007	-0.003	-0.200**	-0.021
	[0.097]	[0.018]	[0.020]	[0.094]	[0.097]
EDU_MEDIUM	0.134	0.009	0.011	0.273***	0.239**
	[0.092]	[0.015]	[0.019]	[0.092]	[0.095]
EDU_HIGH	0.363**	-0.035	-0.025	0.369***	0.521***
	[0.158]	[0.024]	[0.030]	[0.131]	[0.138]
EDU_UNI	0.439***	0.024	0.037	0.270*	0.419**
	[0.128]	[0.029]	[0.036]	[0.160]	[0.170]
EMPLOYED	-0.118	0.035	0.035	-0.043	0.380**
	[0.165]	[0.029]	[0.030]	[0.152]	[0.165]
UNEMPLOYED	-0.465*	0.017	0.010	-0.309	0.122
	[0.278]	[0.034]	[0.043]	[0.213]	[0.239]
OTHER	-0.292	0.045	0.034	-0.165	0.172
	[0.186]	[0.033]	[0.038]	[0.184]	[0.203]
WORKER	0.433***	0.005	0.014	0.205*	0.211*
	[0.122]	[0.020]	[0.026]	[0.117]	[0.116]
EMPLOYEE	0.543***	0.089*	0.104**	0.499**	0.415*
	[0.183]	[0.049]	[0.045]	[0.207]	[0.219]
CIVIL_SERVANT	0.596***	-0.022	-0.007	0.228	0.265
	[0.170]	[0.026]	[0.040]	[0.177]	[0.194]
SELF_EMPLOYED	0.069	-0.077**	-0.071*	-0.069	-0.355*
	[0.240]	[0.031]	[0.037]	[0.190]	[0.211]
ATM_USER	-0.063	0.044**	0.043***	0.172**	0.157*
	[0.091]	[0.017]	[0.016]	[0.079]	[0.087]
DIST_WITHDR	-0.151**	0.001	-0.001	-0.030	-0.030

	[0.066]	[0.010]	[0.013]	[0.057]	[0.064]
RISK_THEFT	-0.123	0.062**	0.060**	-0.201	0.062
	[0.140]	[0.028]	[0.026]	[0.126]	[0.132]
SHARE_CASHINC	-0.200	-0.089***	-0.099**	-0.478**	-0.391*
	[0.298]	[0.029]	[0.045]	[0.220]	[0.215]
POS_DENSITY	-0.819*	0.187**	0.176**	0.841**	0.635*
	[0.437]	[0.092]	[0.073]	[0.354]	[0.359]
AVG_VAL_TRANS		0.001***	0.001***		
		[0.000]	[0.000]		
SPAN_VAL_TRANS		-0.000	-0.000		
		[0.000]	[0.000]		
PREF_EXP (CASH)	-0.333**	-0.045	-0.053*	-0.194	-0.220
	[0.154]	[0.029]	[0.030]	[0.142]	[0.149]
PREF_EXP (CARD)	-0.245*	0.004	-0.003	0.164	0.195
	[0.149]	[0.029]	[0.028]	[0.135]	[0.151]
PREF_TIME	-0.068	0.072**	0.074*	0.404*	0.329
	[0.190]	[0.034]	[0.040]	[0.224]	[0.213]
PREF_ANONYM	-0.478***	-0.002	-0.014	-0.177	-0.081
	[0.132]	[0.024]	[0.032]	[0.135]	[0.152]
PREF_INTERNET	0.610***	0.023	0.041	0.308***	0.289**
	[0.084]	[0.018]	[0.032]	[0.117]	[0.123]
PREF_ABROAD	0.663***	0.026	0.034	0.421***	0.612***
	[0.134]	[0.019]	[0.025]	[0.121]	[0.119]
PREF_HABIT	0.230	-0.035	-0.030	0.023	-0.073
	[0.141]	[0.028]	[0.027]	[0.131]	[0.143]
ACCOUNT_INC	0.181**				
	[0.086]				
JOINT_ACCOUNT	-0.351*				
	[0.207]				
DIRECTBANK	0.849***				
	[0.252]				
FRQ ….	Monthly Freqencies for 16 different POSs included[14]				
BIK	Two dummies for the size of the region of the respondents household included				
CONSTANT	-5.392***	-0.152	-0.199	-3.274***	-4.458***
	[1.053]	[0.153]	[0.161]	[0.713]	[0.734]

[14] For a detailed description of the 16 FRQ variables see Table 3 below.

Observations	1604	1426	1414	1592	1440
Chi2	610.6		286.3	769.6	720.7
logl	-695.3	-109.2		-1532	-1345
Pseudo R2	0.277				
R-squared		0.174	0.162		
Count R2	0.80				
Rho				0.286	0.495
Sargan p-value			0.1590		

Table 3 Construction of Variables

Variable Name	Type	Description
Dependent Variables		
CREDIT_CARD	Dummy	One, if the respondent indicates that she owns a credit card
SHARE_NON_CASH_TRANS	Share (0 to 1)	Share of total number of transactions with the option to pay cash or non-cash conducted non-cash in total number of transactions with the option to pay cash or non-cash during the one week diary period.
RETAIL_DAILY	Dummy	One, if person pays only cash at retailers selling daily consumption goods Zero, if person pays only and non-cash or only non-cash at retailers selling daily consumption goods
GAS_STATIONS	Dummy	One, if person pays only cash at gas stations Zero, if person pays only and non-cash or only non-cash at gas stations
Independent Variables		
AGE	Continuous	Age of respondent at time of the interview
AGE 2	Continuous	Squared AGE variable
HH INC	Natural logarithm	Natural log of monthly net household income in Euros
MALE	Dummy	One, if the respondent is male
EDU MEDIUM	Dummy	One, if the respondent holds a lower secondary education degree (ISCED 2 - "Mittlere Reife, Realschulabschluss, Handelsschule, POS, 10. Klasse")
EDU HIGH	Dummy	One, if the respondent holds a degree that qualifies her for entering university or universities of applied sciences (ISCED 3 and 4 - "Fachhochschulreife, Hochschulreife, Abitur, Abschluss FOS")
EDU UNIVERSITY	Dummy	One, if the respondent completed university or a university of applied sciences (ISCED 5 and 6 - includes doctoral degrees and other university degrees).
EDU OTHER	Dummy (Reference Category)	One, if the respondent has no degree at all, a "Hauptschulabschluss" (ISCED 0,1) or an other degree not included in any of the other EDU variables.
EMPLOYED	Dummy	One, if the respondent is currently either full-time or part-time employed
UNEMPLOYED	Dummy	One, if the respondent is currently not employed and looking for work
RETIRED	Dummy (Reference Category)	One, if the respondent is retired or permanently incapable of working

OTHER	Dummy	One, if the respondent is currently not employed, not retired and not looking for work. This category includes among others: students, people on sick or maternity leave and persons fulfilling domestic tasks.
WORKER	Dummy (Reference Category)	One, if the respondent is currently a worker or used to be a worker ("Facharbeiter, Arbeiter, nicht Selbständiger, Handwerker")
EMPLOYEE	Dummy	One, if the respondent is currently an employee or used to be an employee. ("Angestellter")
CIVIL_SERVANT	Dummy	One, if the respondent is currently a civil servant or used to be a civil servant. ("Beamter")
SELF_EMPLOYED	Dummy	One, if the respondent is currently self-employed or used to be self-employed.
OTHER JOB TYPE	Dummy (Reference Category)	One, if the respondent is currently or used to be without an occupation.
ATM USER	Dummy	One, if the respondent uses an ATM at least once a week
DISTANCE TO WITHDRAWAL	Natural logarithm	Natural log of the average time in minutes it takes the respondent to reach the ATM or bank branch she usually uses to withdraw cash.
RISK_THEFT	Exponentially transformed 0 (no risk) to 1	Exponentially transformed amount in the wallet in Euros (threshold) which causes respondents to feel uncomfortable. Inverted, to associate large sums with little risk. Respondents that indicated that they never feel uncomfortable to carry large amounts of money in their wallet, were assigned the maximum value of 0.
SHARE_CASHINC	Share (0 to1)	Share of income respondent receives in cash
POS_DENSITY	Share (0 to 1)	Share of transactions that have been conducted using cash or could have been conducted using cash in a given region ("Postleitregionen": first two digits of Postleitzahlen)
AVG_VAL_TRANS	Euro amount	Average Euro value of respondent's transactions with the option to pay cash or non-cash
SPAN_VAL_TRANS	Euro amount	Difference between the highest and lowest Euro value of respondent's transactions with the option to pay cash or non-cash
ACCOUNT_INC	Natural logarithm	If respondent owns an account herself, natural log of monthly net personal income in Euros If respondent only owns an account together with her partner, natural log of monthly net household income in Euros
JOINT_ACCOUNT	Dummy	One, if the person has no personal account but only a joint account with his/her partner
DIRECT BANK	Dummy	One, if the respondent indicates that his main sight account is from a direct bank

PREF. EXP (CASH)	Dummy	One, if the respondent indicates that expenditure control is a very important attribute of a payment instrument and cash has this attribute
PREF. EXP (CARD)	Dummy	One, if the respondent indicates that expenditure control is a very important attribute of a payment instrument and debit cards have this attribute
PREF. TIME	Dummy	One, if the respondent indicates that speed and convenience of use is a very important attribute of a payment instrument
PREF. ANONYMITY	Dummy	One, if the respondent indicates that anonymity is a very important attribute of a payment instrument
PREF. ABROAD	Dummy	One, if the respondent indicates that the possibility to use it abroad is a very important attribute of a payment instrument
PREF. INTERNET	Dummy	One, if the respondent indicates that the possibility to use it on the internet is a very important attribute of a payment instrument
FREQ. RETAIL DAILY	Categorical[15]	Frequency of spending money at retailers selling daily consumption goods.
FREQ. RETAIL LR	Categorical[7]	Frequency of spending money at retailers selling long term use/durable goods.
FREQ. GAS	Categorical[7]	Frequency of spending money at gas stations.
FREQ. PHARMACY	Categorical[7]	Frequency of spending money at pharmacies.
FREQ. SERVICES OUT	Categorical[7]	Frequency of spending money on services consumed outside of ones apartment/house.
FREQ. SERVICES IN	Categorical[7]	Frequency of spending money on services consumed inside ones apartment/house.
FREQ. VENDING	Categorical[7]	Frequency of spending money at vending machines.
FREQ. INTERNET	Categorical[7]	Frequency of spending money on the internet.
FREQ. MAIL-ORDER	Categorical[7]	Frequency of spending money for mail-orders.
FREQ. RESTAURANT	Categorical[7]	Frequency of spending money at restaurants.
FREQ. LEISURE	Categorical[7]	Frequency of spending money for leisure activities (sports, music, cultural events).
FREQ. HOTEL	Categorical[7]	Frequency of spending money at hotels.

[15] Number of visits per month. Based on question that asks for the following categories (value of variable in parenthesis): never (0), less than once a year (1/24), once a year (1/12), once every half year (1/6), once every quarter (1/3), once a month (1), twice a month (2), once a week (4), twice a week (8), tree times a week or more often (12).

FREQ. BED AND BREAKF	Categorical[7]	Frequency of spending money at bed and breakfast hotels (“Pension”).
FREQ. PRIVATE	Categorical[7]	Frequency of spending money for purchases from private persons.
FREQ. POCKETMONEY	Categorical[7]	Frequency of spending money on pocket money.
BIK_1	Dummy(Reference Category)	Region with less than 5000 inhabitants
BIK_2	Dummy	Region with 5000 to 99,999 inhabitants
BIK_3	Dummy	Region with more than 100,000 inhabitants