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# Pay cash, buy less trash? – Evidence from German payment diary data<sup>1</sup>

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## Abstract

This research note empirically investigates whether cash can prevent consumers from making needless purchases in unexpected shopping situations. Cash can have a disciplinary effect on short-term consumption because it imposes a strong temporary budget constraint and also reinforces the pain of paying. I use a sample of unexpected shopping situations that were recorded by participants of the Bundesbank's study on payment behaviour. I find that the probability of a transaction subsequently being declared unnecessary is significantly lower when the consumer had paid the transaction in cash. The results are similar across different socioeconomic groups based on age, gender, education and income. I conclude that restricting the use of cash for transaction purposes can entail a reduction in consumer welfare.

**Keywords:** payment behaviour, consumer choice, overspending

**JEL-Classification:** D12, D14, D18

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# 1. Introduction

With the growing availability of electronic payment devices, doubts are emerging as to what extent the use of cash as a payment instrument is still necessary and useful. In the euro area there is a general tendency to restrict the use of cash. In 2016, the ECB decided to stop issuing the 500 euro banknote. Furthermore, several countries have introduced an upper limit for cash payments and a European-wide regulation is under debate.

In the discussion on the future of cash, economists usually focus on private and social costs. They invoke the expensive cash infrastructure, the restraints cash imposes on monetary policy, and the role of cash in the informal and criminal sectors as well as in terror financing (Schmiedel et al. 2012, Rogoff 2014).

However, recent research projects have also explored the usefulness of cash for the consumer. According to the payment behaviour study of the Deutsche Bundesbank, consumers appreciate cash because it is simple, quick, anonymous and riskless (Deutsche Bundesbank 2014, Krueger and Seitz 2017). Furthermore, for some consumers, it is a helpful means of tracking their expenditure and keeping an eye on their remaining budget (von Kalckreuth et al. 2014a, Hernandez et al. 2016).

In this short research note I investigate the usefulness of cash as a disciplinary device, especially in unexpected shopping situations. I analyse consumer diary data on unplanned purchases and payments and investigate whether the use of cash can prevent hasty and unbeneficial decisions.

The distinctive feature of cash is that payments are made physically, whereas electronic payments are digital and invisible. From this physical character, two kinds of disciplinary effects can arise. First, using cash restricts the budget temporarily to the amount of cash in one's wallet. Raising one's budget by withdrawing additional cash involves costs and can

sometimes even be impossible. If cash at hand is not sufficient to settle the upcoming transaction, the consumer might miss out on some advantageous purchases. However, he is also better protected from making hasty purchasing decisions that exceed his budget and which might prove to be unreasonable afterwards. Second, using cash in an unforeseen shopping opportunity gives the consumer a stronger signal of prices. Prelec and Loewenstein (1998) argue that cash payments are transparent and immediate. Counting and handing over a physical amount of cash inflicts a stronger “pain of payment” than transferring digital money by electronic means. The stronger price signal can prove to be particularly helpful when marketing tries to make consumers focus on quality rather than on costs.

Empirical studies from marketing science have already shown that the method of payment affects consumers’ assessment of a concrete shopping situation. Prelec and Simester (2001) find that consumers’ willingness to pay is higher when they pay with debit cards instead of cash. Runnemark et al. (2015) show that the same holds true when comparing cash and debit cards.<sup>2</sup> Thomas et al. (2011) find that paying with cash can increase consumers’ ability to control their impulsive urges.

The empirical studies cited above are controlled environment utilization experiments. With carefully designed test settings, they make it possible to learn more about the psychological mechanisms triggered by different means of payment. However, the results rely on a selective group of volunteers and are therefore not necessarily representative of the population at large. Furthermore, candidates’ behaviour in a test setting might deviate from that in real life.

In this research note, I analyse the disciplinary effects of cash in short-term consumption decisions by a regression analysis of survey data. My results are based on the payment behaviour study of the Deutsche Bundesbank which is representative for the German

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<sup>2</sup> There is also research on the long-term effects of cash vs. card usage. See, for example, Soman (2001), Raghuram and Srivastava (2008) as well as Chatterjee and Rose (2012).

population. I am thus able to examine whether the effects described above are relevant on a larger economic scale. Furthermore, the data also make it possible to look for heterogeneities in the effects. This is particularly important as both payment and consumption behaviour has been shown to be highly dependent on income and other socio-economic variables (see, for example, von Kalckreuth et al. 2014b).

My regression results suggest that paying with cash in unforeseen shopping situations can indeed prevent consumers from buying things they do not need: in the data, the probability of an unplanned transaction subsequently being seen as unnecessary by the consumer is significantly lower when payment was in cash. This result is robust to different endogeneity tests. Furthermore, the disciplinary effect of cash is highly homogenous across socio-economic subgroups based on gender, income, education and age. It is thus not a marginal phenomenon relevant only for special types of consumers, but applies to most parts of the population.

The results make clear that from a consumer's point of view, cash and electronic payment instruments are not perfect substitutes. In previous studies, cash has already been found to be particularly useful in terms of anonymity, convenience, risk avoidance, and budgeting. My results suggest that it can also have a correctional effect on short-term consumption, with consumers reflecting more when making unplanned purchases. I conclude that the trend to restrict the use of cash for transaction purposes, which could end in the total abolition of cash in the long run, can also entail a reduction in consumer welfare.

## **2. Empirical strategy**

### **2.1. Data**

The empirical analysis of this research note is based on data collected as part of the Bundesbank's study on payment behaviour. The study provides a representative sample of the

German-speaking population aged 18 and above living in Germany. The study has been conducted regularly every three years since 2008. Each wave is independent and comprises around 2,000 participants. The first part of the surveys consists of a face-to-face interview on the participants' payment habits and their socio-economic background. After the interview, the participants are asked to keep a payment diary over a one-week period. For each transaction, the respondents are asked to write down the type of location, the transaction amount and the payment instrument used. Each wave provides information on around 20,000 transactions.

I use transaction data from 2014 and restrict the sample to purchases that were not “planned”, as indicated by the participants in their diaries (4,634 transactions). In these cases, the purchasing decision was mainly taken on the spot or at least at short notice and the use of cash could have the disciplinary effect described above. Furthermore, I focus on transactions at local retailers for day-to-day needs and long-term purchases (1,567 transactions). I do this to avoid confounding effects that might result from the location in which a purchase is made. The perceived usefulness of a transaction probably varies substantially depending on the type of location (e.g. café vs. pharmacy), and at the same time, the type of location has been shown to be a major determinant of payment behaviour (e.g. Eschelbach and Schmidt 2013). After deleting 18 transactions with missing information, I use information on 1,545 transactions from 833 individuals for my analysis.

At the end of the reporting week, participants were given the opportunity to name up to three transactions which they “could have most likely gone without during this week” and which were thus “unnecessary”. Table 1 shows descriptive statistics of my sample. Around 16% of unplanned transactions were seen as unnecessary.

## 2.2. Regression model

I estimate a linear regression model of the form:

$$unnecessary_{ij} = \alpha_0 + \alpha_1 cash_{ij} + x'_{ij}\beta + \gamma_i + \varepsilon_{ij} \quad (1)$$

The dependent variable *unnecessary* has a value of one if individual *i* considers transaction *j* to be unnecessary; otherwise it is zero. The main explanatory variable, *cash*, is an indicator variable which has a value of one if the respondent *i* pays transaction *j* in cash; otherwise it is zero.  $\alpha_0$  is a constant,  $\alpha_1$  is the parameter that gives the effect of *cash*. *X* is a vector of control variables and  $\beta$  the vector of the corresponding parameters. On the individual level, my set of controls includes age, gender, educational level, household size, income and nationality. On the transaction level, I include information on the amount paid, the location and the day of the week.

If using cash has a disciplinary effect on spending, the probability of a transaction subsequently being judged as unnecessary should be lower for cash payments. In this case, I would expect  $\alpha_1$  to be negative.

Because I use real-life data and not experimental data, *cash* is not an exogenous variable in equation 1. The consumption and payment decisions are usually the result of a simultaneous optimization process. Therefore, I must be careful when interpreting  $\alpha_1$  as a causal effect. First, participants might differ in terms of unobserved characteristics  $\gamma_i$  that might affect both the probability of paying in cash and the probability of declaring a transaction as unnecessary. If, for example, participants with low spending discipline generally use cashless payment instruments in order to always be liquid, the strength of the disciplinary effect of cash would be overestimated. Therefore, I additionally calculate a model with individual fixed effects. Second, there might also be a correlation between  $\varepsilon_{ij}$  and *cash*. Consumers might use cash only for their regular expenditure and use cashless payment methods whenever they buy

something on top. As on-top purchases might have a higher probability of being deemed unnecessary, the strength of the disciplinary effect of cash would be overestimated. Also, there is evidence that consumers feel a greater affection for goods when they have paid for them in cash (Shat et al. 2016). In this case, the causality between *cash* and *unnecessary* would be reversed.

The proper method to overcome these endogeneity problems would be to use an instrumental variable approach and generate exogenous variation in *cash*. The instrument must be highly correlated with the individual's decision to use cash but must not be correlated with the subsequent evaluation of the transaction afterwards. Unfortunately, there is no such information available in the payment behaviour study. Instead, I analyse the extent of a possible bias by running a simple robustness check. I compare my estimate of  $\alpha_I$  in the sample of unplanned transactions with an estimate of  $\alpha_I$  for a sample of planned transactions. In the sample of planned transactions there should be (almost) no disciplinary effect of cash, as the purchasing decision was probably not taken under the influence of transaction-specific variables such as payment mode. However, if the endogeneity problem described above leads to a spurious correlation between *cash* and *unnecessary*, we should also see this in the sample of planned transactions.

The analysis is based on a linear model, even though the outcome variable in equation one is clearly binary. The reason for this is that a linear framework offers an easy and established way to control for individual specific fixed effects by estimating a Within or a Least Squares Dummy Variable Model. In a non-linear framework, the inclusion of individual fixed effects in the form of indicator variables gives rise to the incidental parameter problem and leads to inconsistent estimates (e.g. Wooldridge 2010). Non-linear models that partial out family fixed effects, such as Chamberlain's Logit Model, have the disadvantage that they yield no estimates for the actual size of these effects (Chamberlain 1980). The estimation of



predictions and marginal effects must then rely on further assumptions (Hosmer et al. 2000). To address the heteroscedasticity problem of linear probability models, I use robust standard errors in all estimations.

### **3. Results**

Table 2 displays the results of a linear regression as described in section 2. The table presents estimated coefficients and robust standard errors. Columns one and two show the results of a model where unobserved heterogeneity among individuals is interpreted as a random effect, uncorrelated with the regressors. The coefficient of *cash*,  $\alpha_1$ , is negative and statistically significant, which is the first evidence of a disciplinary effect of cash. According to the results, paying a transaction with cash is correlated with a five percentage point lower probability of considering the transaction as unnecessary afterwards.

The correlation patterns of the control variables are largely as expected. Longer-term purchases have a significantly higher probability of being seen as unnecessary than those for daily needs. Older people regret their transactions less often than younger people. One explanation for this might be that their greater life experience helps them to restrain their desire to buy. Women are more likely to subsequently declare their transactions as having been unnecessary. Either they actually do buy unnecessary things more often or they are simply more sceptical about their consumption behaviour.

The estimate of  $\alpha_1$  in the random effects model is inconsistent when the unobserved heterogeneity among consumers is correlated with payment behaviour. Columns three and four of Table 2 show the results of a model where unobserved heterogeneity is captured by individual fixed effects. In this model, the disciplinary effect of cash payments is even stronger. Paying with cash is correlated with a ten percentage point lower probability of considering the transaction as unnecessary afterwards. The effect is statistically significant at

the five percent level. I test the hypothesis that the coefficient of *cash* in the fixed effects model is the same as in the random effects model by using a heteroskedasticity-robust version of the Hausman test (Wooldridge 2010). The null hypothesis is rejected at the ten percent level ( $p = 0.058$ ). For the further analysis, I thus concentrate on the fixed effects model.

Table 3 shows the results of the fixed effects model when we allow the marginal effect of *cash* to vary across socio-economic groups. The models additionally contain interaction terms between *cash* and variables indicating gender, age, education, and income, respectively. As can be seen from the coefficients and standard errors, the interaction effects are not statistically significant. The disciplinary effect of cash payments is thus not a marginal phenomenon but present among the wider population.<sup>3</sup>

Finally, Table 4 presents the results of a robustness check. I apply the random and the fixed effects model of Table 2 to a sample of transactions that were planned. In these cases, I expect there will be no short-term disciplinary effect of cash payments and that  $\alpha_1$  should be near zero. Otherwise, my prior results are liable to be affected by a spurious correlation. As can be seen from the coefficients and standard errors in Table 4, the mode of payment reveals no correlation with the advantageousness of purchases that were planned. I am thus confident that my prior results are not subject to an endogeneity bias.

## 4. Conclusions

This short research note investigates whether cash has a disciplinary effect in unplanned shopping occasions and whether it protects consumers from unnecessary spending. Using survey data from the Bundesbank payment behaviour study of 2014, I find that the probability of an unplanned purchase subsequently being considered unnecessary is around ten

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<sup>3</sup> In the same way, I tested whether the effect of *cash* depends on the size and the location of the transaction. But again, the coefficients of the interaction terms were not significant (results not presented).

percentage points lower when the transaction was paid in cash. The disciplinary effect does not depend on age, gender, education or income and is thus equally relevant to all consumers.

The main insight of the analysis is that cash and electronic payment methods are by no means perfect substitutes. According to recent polls, consumers favour cash because it is convenient, anonymous and helps budgeting (Deutsche Bundesbank 2014). In this note, I find evidence for a further advantage of cash which most consumers are probably not even aware of: it can save consumers money by making unnecessary unplanned purchases less likely.

Clearly, this paper cannot advise consumers on which payment instrument they should use in order to maximize their welfare from consumption. Such an ambitious endeavour would require much more sophisticated econometric methods to disentangle consumption and payment decisions as well as a broader data base. For example, one would need information on the optimality of transactions that were prevented by the use of cash, as some of them would certainly have been beneficial.

However, the results indicate the need for greater care in the discussion on the future of cash as a payment instrument. Some economists recommend a stronger regulation of cash payments, which might in the long run result in the total abolition of cash. First steps have already been taken with the abolition of the 500 euro banknote and the introduction of upper limits for cash payment in many European countries. Restricting the use of cash might lower social costs and make life harder for criminals and terrorists. However, there is a chance that it will also reduce consumers' welfare by depriving them of a means of encouraging budget discipline.

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## Tables and Graphs

**Table 1: Descriptive statistics of estimation sample**

Variables	Estimation sample	
	<i>Mean</i>	<i>SD</i>
Transaction the respondent could most likely have gone without during the week	0.16	
Cash payment	0.77	
Transaction amount	20.65	34.66
Type of location		
Retail trade for daily needs	0.76	
Retail trade for longer-term purchases	0.24	
Day of the week		
Monday	0.15	
Tuesday	0.17	
Wednesday	0.18	
Thursday	0.13	
Friday	0.16	
Saturday	0.17	
Sunday	0.04	
Age	45.11	14.86
Education		
No qualification / Not specified	0.01	
Secondary education	0.65	
Higher secondary education	0.34	
Income		
income < 500€	0.08	
500€ ≤ income < 1,000€	0.19	
1,000€ ≤ income < 1,500€	0.20	
1,500€ ≤ income < 2,000€	0.19	
2,000€ ≤ income < 2,500€	0.09	
2,500€ ≤ income < 3,000€	0.08	
3,000€ ≤ income < 3,500€	0.03	
3,500€ ≤ income < 4,000€	0.02	
4,000€ ≤ income < 4,500€	0.01	
4,500€ ≤ income < 5,000€	0.01	
5,000€ ≤ income < 7,000€	0.01	
7,000€ ≤ income	0.00	
Not specified	0.11	
Female	0.59	
Non-German citizen	0.10	
Number of household members	2.39	1.25
Number of transactions:		1,545
Number of individuals:		833

Note: Unweighted data.

**Table 2: Results of different linear regression models with *unnecessary (0/1)* as dependent variable (unplanned transactions only)**

Variables	Random Effects		Fixed Effects	
	Coeff	SE	Coeff	SE
Cash payment	-0.0519*	0.0293	-0.1000**	0.0472
Transaction amount (log)	0.0042	0.0098	-0.0016	0.0162
Type of location				
Retail trade for daily needs	Ref.		Ref.	
Retail trade for longer-term purchases	0.1654***	0.0285	0.1460**	0.0405
Day of the week				
Monday	0.0154	0.0454	0.0162	0.0646
Tuesday	0.0144	0.0440	0.0347	0.0646
Wednesday	-0.0126	0.0427	-0.0282	0.0624
Thursday	0.0393	0.0478	0.0468	0.0686
Friday	0.0552	0.0477	0.0454	0.0685
Saturday	0.0280	0.0446	0.0342	0.0656
Sunday	Ref.		Ref.	
Age	-0.0279***	0.0447	-	-
Education				
No qualification / Not specified	0.0358	0.0857	-	-
Secondary education	Ref.			
Higher secondary education	-0.0081	0.0226	-	-
Income				
income < 500€	Ref.			
500€ ≤ income < 1,000€	0.0486	0.0408	-	-
1,000€ ≤ income < 1,500€	0.0643	0.0401	-	-
1,500€ ≤ income < 2,000€	0.0528	0.0417	-	-
2,000€ ≤ income < 2,500€	0.0787	0.0481	-	-
2,500€ ≤ income < 3,000€	0.0994	0.0527	-	-
3,000€ ≤ income < 3,500€	0.0618	0.0649	-	-
3,500€ ≤ income < 4,000€	0.1717	0.0966	-	-
4,000€ ≤ income < 4,500€	0.0704	0.0740	-	-
4,500€ ≤ income < 5,000€	0.1424	0.1082	-	-
5,000€ ≤ income < 7,000€	0.2045	0.1925	-	-
7,000€ ≤ income	-0.1325***	0.0494	-	-
Not specified	0.0794	0.0462	-	-
Female	0.0418**	0.0209	-	-
Non-German citizen	0.0447	0.0359	-	-
Number of household members	-0.0005	0.0086	-	-
Constant	0.1341*	0.0954	0.1888	0.1414
Number of transactions:	1,545		1,545	
Number of individuals:	833		833	

Note 1: The table presents coefficients and robust standard errors of a random effects and a fixed effects linear probability model with an indicator for unnecessary transaction as the dependent variable.

Note 2: The estimation sample contains unplanned transactions only.

Note 3: \*, \*\*, and \*\*\* indicate statistical significance at the ten, five, and one percent level, respectively.

**Table 3: Results of different linear fixed effects regression models with *unnecessary (0/1)* as dependent variable: allowing for heterogeneities in the effect of *cash***

Variables	Heterogeneities related to:		Gender		Age		Education		Income	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Cash payment	-0.1553**	0.0714	-0.0706	0.1096	-0.1359**	0.0581	-0.1460**	0.0573		
Transaction amount (log)	-0.0022	0.0162	-0.0018	0.0163	-0.0027	0.0163	-0.0025	0.0160		
Type of location										
Retail trade for daily needs	Ref.		Ref.		Ref.		Ref.			
Retail trade for longer-term purchases	0.1483***	0.0406	0.1464***	0.04055	0.1477***	0.0405	0.1520***	0.0402		
Day of the week										
Monday	0.0183	0.0649	0.0159	0.0647	0.0147	0.0648	0.0177	0.0644		
Tuesday	0.0370	0.0650	0.0348	0.0646	0.0284	0.0648	0.0316	0.0642		
Wednesday	-0.0285	0.0624	-0.0287	0.0626	-0.0311	0.0626	-0.0291	0.0625		
Thursday	0.0484	0.0686	0.0462	0.0688	0.0424	0.0689	0.0457	0.0684		
Friday	0.0486	0.0688	0.0446	0.0686	0.0402	0.0686	0.0478	0.0687		
Saturday	0.0327	0.0655	0.0340	0.0656	0.0320	0.0657	0.0298	0.0652		
Sunday	Ref.		Ref.		Ref.		Ref.			
Female x Cash payment	-0.0856	0.0885	-	-	-	-	-	-		
Age x Cash payment	-	-	0.0088	0.0286	-	-	-	-		
Higher secondary education x Cash payment	-	-	-	-	-0.0951	0.0865	-	-		
Income ≤ 1.500 € x Cash payment	-	-	-	-	-	-	-0.1112	0.0844		
Constant	0.2457*	0.1478	0.1607	0.1692	0.2357	0.1481	0.2409*	0.1398		
Number of transactions:					1,545					
Number of individuals:					833					

Note 1: See Table 2.

Note 2: See Table 2.

Note 3: See Table 2.

**Table 4: Results of different linear regression models with *unnecessary (0/1)* as dependent variable, planned transactions only**

Variables	Random Effects		Fixed Effects	
	Coeff	SE	Coeff	SE
Cash payment	-0.0112	0.0068	-0.0105	0.0101
Transaction amount (log)	-0.0049	0.0023	-0.0026	0.0031
Type of location				
Retail trade for daily needs	Ref.			
Retail trade for longer-term purchases	0.1364***	0.0165	0.1340	0.0178
Day of the week				
Monday	0.0015	0.0134	-0.0136	0.0146
Tuesday	0.0060	0.0139	-0.0131	0.0151
Wednesday	0.0011	0.0134	-0.0203	0.0145
Thursday	-0.0029	0.0136	-0.0165	0.0150
Friday	-0.0017	0.0135	-0.0184	0.0147
Saturday	-0.0019	0.0133	-0.0208	0.0148
Sunday	Ref.		Ref.	
Age	-0.0000	0.0001	-	-
Education				
No qualification / Not specified	0.0088	0.0187	-	-
Secondary education				
Higher secondary education	0.0084	0.0053	-	-
Income				
income < 500€				
500€ ≤ income < 1,000€	-0.0165	0.0105	-	-
1,000€ ≤ income < 1,500€	-0.0166	0.0104	-	-
1,500€ ≤ income < 2,000€	-0.0234	0.0106	-	-
2,000€ ≤ income < 2,500€	-0.0109	0.0126	-	-
2,500€ ≤ income < 3,000€	-0.0352	0.0119	-	-
3,000€ ≤ income < 3,500€	0.0011	0.0203	-	-
3,500€ ≤ income < 4,000€	-0.0157	0.0199	-	-
4,000€ ≤ income < 4,500€	0.0176	0.0330	-	-
4,500€ ≤ income < 5,000€	-0.0237	0.0201	-	-
5,000€ ≤ income < 7,000€	-0.0226	0.0378	-	-
7,000€ ≤ income	-0.0463	0.0126	-	-
Not specified	-0.0195	0.0110	-	-
Female	0.0017	0.0046	-	-
Non-German citizen	-0.0131	0.0075	-	-
Number of household members	0.0003	0.0020	-	-
Constant	0.0861	0.0269	0.0700**	0.0307
<hr/>				
Number of transactions:	7,283		7,283	
Number of individuals:	1,887		1,887	

Note 1: See Table 2.

Note 2: The estimation sample contains planned transactions only.

Note 3: See Table 2.