The rise of digital watchers

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Abstract

Many consumers use payment instruments to control their budget. Previously, such behavior has been associated with checking disposable cash ("pocket watching"). Based on recent survey data, we show that "digital watchers" have emerged, i.e., noncash payers who use digital applications to control their budget. Both watcher types have distinct characteristics. Pocket watchers tend to have lower incomes than other consumers, while digital watchers ascribe low security risk to payment cards. Watching behavior influences current and future payment behaviors. Pocket watchers use cash more intensively than nonwatching cash payers. Digital watchers expect to intensify their reliance on noncash payment instruments more strongly than nonwatching noncash payers.

Key words: payment behavior, control motive, pocket watcher, digital watcher, survey data, central bank digital currency

JEL classification: D14, E41, O33, G20

1. Introduction

Cash as a payment instrument is unique in providing consumers with an integrated payment and monitoring device. As of yet, noncash payment instruments cannot provide both features in one device, which implies that cash generates utility, particularly for consumers with a budget control motive, i.e., to consumers with an interest in monitoring their past expenses and remaining budgets. To reduce their watching costs, these consumers are likely to rely on "pocket watching", i.e., they keep track of their expenses and their remaining budget by glancing into their pockets. As their watching cost decreases with an increasing cash-paying share, pocket watchers predominately pay in cash (von Kalckreuth et al., 2014 – henceforth vKSS).

Recent technological advances have reduced the monitoring disadvantage of noncash payment instruments. Mobile devices and applications enable consumers to access information on sight deposit balances and on past transactions in near real-time where and whenever they want. Often, mobile banking or credit card applications offer personalized add-on services next to providing aggregate information on consumers' past expenses and remaining budget. Against this background, we postulate the following three hypotheses.

First, assuming that such innovations provide consumers with the means to monitor their past expenses and remaining budget as conveniently as cash, digital watchers have emerged as a new category of payment instrument watchers alongside pocket watchers. Pocket watchers operationalize their watching strategy through the predominant use of cash. Likewise, digital watchers operationalize their watching strategy through the predominant use of debit and credit cards and watch their budget through related mobile applications.

Second, we expect payment instrument watching to have explanatory power for the observed heterogeneity in consumer payment instrument usage even after controlling for sociodemographic determinants as well as direct and indirect cost factors. Specifically, we expect pocket watchers (digital watchers) to show a stronger cash-based (noncash-based) payment behavior than nonwatching cash payers (watching noncash payers).[4]

Third, we expect payment instrument watchers to exhibit a future trajectory of payment instrument choice that is in line with their current watching strategy. To minimize monitoring costs, payment instrument watchers narrow their use of payment instruments over time to instruments consistent with their watching strategy. Specifically, we predict that pocket (digital) watchers expect to use cash more (less) intensively in the future than their respective nonwatching counterparts.

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[4] We denote *nonwatching cash payers* as all consumers who declare that they predominantly use cash but do not mention a control motive as a reason for doing so. Similarly, *nonwatching noncash payers* are consumers who declare that they predominantly use noncash but do not mention a control motive for doing so.

Based on data from the "Survey on Payment Methods 2017" commissioned by Swiss National Bank (SNB, 2018), we find supportive evidence for all three hypotheses.

First, digital watchers have indeed emerged in Switzerland alongside pocket watchers. Overall, 25% of consumers make use of payment instrument watching for budget control purposes. Approximately 7% of consumers in Switzerland can be classified as digital watchers, and 18% are pocket watchers. The distinctive characteristics of pocket watchers compared to all other consumers include lower income, being male, a rural residential environment, and a self-assessed cost advantage of cash relative to noncash payment instruments. Cost factors include both the perceived direct costs of using payment instruments and indirect costs, such as anonymity. In contrast, the distinctive characteristics of digital watchers compared to all other consumers include the low security risk ascribed to card payments (relative to the security risk ascribed to cash) and an urban residential environment.

With respect to our second hypothesis, we find that payment instrument watching explains the heterogeneity in *current* payment behavior. Pocket watchers use cash more intensively than nonwatching cash payers. In contrast, the intensity of noncash instrument usage by digital watchers does not differ significantly from the behavior of nonwatching noncash payers. Furthermore, the cash share of pocket watchers is higher than that of digital watchers. These results suggest that using both types of payment instruments (cash and noncash) entails higher marginal costs for pocket watchers than for digital watchers.

Taking into consideration that digital watching is a relatively new phenomenon, digital watchers' payment behavior is likely to evolve further in the years to come and has likely already evolved since autumn 2017, when the data underlying this analysis were collected.

This interpretation is supported by the findings related to our third hypothesis. Digital watchers expect to intensify the use of their preferred noncash watching instrument more strongly than nonwatching noncash payers. In contrast, the expected future payment behavior of pocket watchers and nonwatching cash payers do not differ significantly. This finding is consistent with the fact that cash payers – pocket watchers in particular – had already exhausted their potential to increase cash usage further.

Related literature

Our paper is closely related to two strands of the payment instrument choice literature. First, conceptually, the paper is related to the theoretical literature arguing that consumers optimize their payment instrument usage based on cost considerations (see Baumol, 1952, and Tobin, 1956). More recently, Alvarez and Lippi (2009, 2013 and 2017) document cash management patterns for households that are at odds with the predictions of deterministic inventory models that abstract from precautionary motives. They extend Baumol-Tobin in various directions, such as in a dynamic environment, to allow for the possibility of withdrawing cash at random times at a low cost or by an inventory model with a cash-credit choice.

Building on the Baumol-Tobin currency model framework, vKSS adds a self-control feature to the usual list of factors influencing payment instrument choice at the point of sale (POS). Assuming that cash is unique in providing a means of payment and monitoring in one instrument, this feature makes cash the least expensive payment instrument in terms of monitoring consumers' remaining budget and past expenses, in particular for consumers with an elevated need to meet tight budgets and for those with comparatively low information processing capabilities. We go beyond vKSS by relaxing their "cash is unique" assumption. Specifically, we assume that the aforementioned advances in information technology have substantially reduced the cost of budget control and monitoring expenditure as financial information is available instantaneously and on a continuous basis through digital devices. As a consequence, for consumers who derive utility from monitoring expenses, we assume that doing so by means of digital devices is no longer costlier than monitoring through cash.

Second, our paper contributes to the empirical literature on payment instrument choice at the POS location (among many others, see Bagnall et al., 2016, and Brown et al., 2020). On the one hand, we provide further evidence that watching through payment instruments is an important explanatory factor for the heterogeneity in *current* payment instrument usage (Hernandez et al., 2017, and vKSS). On the other hand, we add insights into the impact of current watching strategies on consumers' expected *future* payment instrument usage to the existing literature.

From a more general perspective, our paper adds valuable policy insights related to the demand for money (see, for instance, Brown et al., 2020, and the related literature). First, understanding how payment and related innovations affect the demand for money is of first-order importance to monetary policy makers. Second, understanding how innovation affects the demand for cash is of key interest for central banks in fulfilling their cash provision duties. Third, our findings are informative regarding the ongoing active investigation by central banks into the foundational principles and core features of central bank digital currencies (CBDC, see for instance, BIS, 2020).

Section 2 describes the data, the payer type and watcher type classification and the empirical strategy. Section 3 discusses the prevalence of watching strategies and reveals the distinctive characteristics of both watching types in terms of sociodemographic variables as well as the perceived direct and indirect costs of cash and noncash instruments. Section 4 analyzes the impact of watching strategies on current and expected future payment behaviors. Section 5 concludes our research.

2.   Data and empirical strategy

We use data from a representative survey on payment behavior commissioned by the Swiss National Bank (SNB) that was conducted in autumn 2017 (SNB, 2018). In face-to-face interviews, respondents were asked about a broad range of aspects regarding their current and

expected future payment behaviors and underlying motives. Furthermore, respondents filled out a payment diary, recording information on all (nonrecurring[5]) payments over a period of seven consecutive days. Overall, 1968 individuals aged 15 years and older were interviewed and provided diaries containing a total of 22,689 transactions.

The survey reveals that cash was the most common payment method in Switzerland. Overall, 70% of diary transactions were cash payments. These transactions accounted for 45% of the total value. The median Swiss consumer possesses two different noncash payment instruments, the dominant being the debit card (90% of respondents have at least one card of this type) and the credit card (60%). Among the noncash payment methods, debit cards are by far the most commonly used, accounting for 22% (in terms of transaction volume) and 29% (transaction value) of transactions. Credit card payments account for 5% and 10%, respectively.[6]

2.1.   Consumer classification

We classify consumers into payer types and watcher types in two steps (see Figure 1). First, consumers' self-assessments of their payment behavior are used to classify them into three payer types: *cash payers* (paying always or predominantly with cash), *situation-dependent payers* (using cash and noncash instruments depending on the situation) and *noncash payers* (paying predominantly or always with noncash).

Second, in a follow-up question, consumers were asked to state the key reasons for their predominant payment behavior in an open, multiple answer question.[7] Based on these answers, we denote consumers as *pocket watcher*s; those who declare that they always or predominantly pay with cash (cash payer) and mention a control motive as one of the reasons for doing so. Correspondingly, we classify consumers as *digital watchers*; those who pay predominantly or always with noncash instruments and who mention a control motive as one of the reasons for doing so. We further denote cash (noncash) payers as those who do not mention a control motive for their payment behavior as *nonwatching cash (noncash) payers*.

By construction, pocket watchers (digital watchers) form a subgroup of cash payers (noncash payers). Put differently, the sequencing of questions in the survey does not allow us to identify a control motive independent of the payer type. To mitigate potential selection bias when analyzing the impact of a budget control motive on payment behavior, we rely on comparisons of the behavior between pocket watchers (digital watchers) and nonwatching cash (noncash) payers.

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[5] Recurring payments, such as rental expenses, insurance premiums and utility bills, were not recorded in detail.

[6] See SNB (2018) for more detailed descriptive statistics.

[7] Note, there were no predefined answers to this question, i.e., responses were not limited to a set of options and no particular options were offered to consider. A control motive is identified if the answer matches the meaning of, "I use cash/noncash instruments, as I believe cash/noncash instruments allow me to control my expenditures." The matching was performed by the interviewer.

All the consumer categories may comprise consumers who watch by means other than payment instruments (such as memorizing expenses or keeping a diary). However, these other potential *watchers* should not negatively affect our identification. First, consumers who declare that they use a specific payment instrument as a control device are unlikely to use other means of watching. Relying on multiple means of watching would increase monitoring costs. Second, even if payment instrument watchers use additional, nonpayment instrument-related means to watch their expenses, the marginal cost of paying with their respective payment instruments is lower. Otherwise, they would not engage in payment instrument watching at all. Consequently, using additional watching tools does not distort their revealed payment behavior. Third, analogous arguments apply to nonwatching cash (noncash) payers. Hence, even if these consumers would engage in other watching strategies, it would not distort the group-wise comparisons.

[[[Figure 1 about here]]]

2.2.   Empirical strategy and variables

The empirical analysis is conducted in three steps. In Section 3, we provide group-wise (payer types, watcher types) descriptive statistics and discuss group-specific characteristics based on a regression analysis according to the specification in equation (1) presented below. In Section 4, we estimate the impact of watching on current and expected future payment behaviors following the specification in equation (2). In all instances, we rely on OLS/linear probability model estimates using Huber-White heteroscedasticity-consistent standard errors.[8]

(1) $type_i = \text{socdem}'_i * \beta_1 + \text{cost of the payment instruments}'_i * \beta_3 + \text{information processing capabilities}' * \beta_4 + \varepsilon_i$

(2) $paymentbehavior_i = watchertype'_i * \beta_1 + controls' * \beta_2 + \varepsilon_i.$

Dependent variables

In equation (1), the dependent variable *type* denotes a dummy variable that indicates the payment type of a consumer: cash payer, noncash payer, nonwatching cash payer, nonwatching noncash payer, pocket watcher or digital watcher. In equation (2), the dependent variable, *paymentbehavior*, denotes the current or expected future share of cash payments.

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[8] The linear probability model is shown to be equivalent or even more reliable than probit or ordered probit regressions in most cases (see, for instance, Angrist and Pischke (2009) for a general discussion). Corresponding probit-based results are available upon request.

Current shares are calculated based on either transaction volume or transaction value as derived from diary data. For expected future payment behavior, we rely on a survey question asking whether consumers expect to use cash more, equally or less intensively five years into the future compared to their current cash usage.

Explanatory variables

For the main variable of interest in equation (2) – *watchertype* – we rely on our classification of pocket watchers, digital watchers, nonwatching cash payers and nonwatching noncash payers (see Section 2.1).

For all the other explanatory variables used in equations (1) and (2), we closely follow the payment instrument choice literature (e.g., Arango et al., (2014), von Kalckreuth et al., 2013, vKSS). The following set of standard sociodemographic characteristics are included: *age*, *household income*, *education (*dummies; relative to compulsory level*), gender* (dummy; *female* relative to male), *language region of residence*[9] (dummies; *German-* or *French-speaking Switzerland* relative to Italian-speaking Switzerland*),* and *degree of urbanization* (dummies, *agglomeration* or *rural* relative to urban) of the municipality of residence. Moreover, we control for the direct cost of payment instruments incurred or perceived when paying using the following variables: the variable *relative cost assessment* denotes a consumer's assessment of the pecuniary cost of paying with cash relative to paying with noncash payment instruments. This variable is defined as the difference between the cost of cash and the least costly card instrument as reported on an ordinal scale. The variable *average transaction value* is calculated as the total value of all the transactions of an individual divided by the number of transactions the consumer recorded. Because of fixed costs, a higher average value tends to decrease the relative cost of card payments relative to cash payments.

In addition, we control for additional indirect costs defined as the relative cost of using cash versus using noncash payment instruments: *internet usage frequency* (dummies, *high*, *medium* or *low* relative to no internet usage at all) is used as a proxy for a consumer's digital affinity based on the assumption that a higher digital affinity, in general, reduces the relative cost of using mobile devices as payment or watching instruments. The ordinal variable *anonymity important* combines qualitative answers to questions assessing how strongly a consumer values anonymity in payment matters. The ordinal variable *relative security risk assessment* is defined as the difference between a consumer's assessment of the security risk of using cash and the security risk ascribed to the payment card instrument perceived as most secure. We include two proxies for shoe leather costs as well. On the one hand, a dummy variable, *commuter*, was used for all respondents who did not work in the municipality of residence.[10]

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[9] This control is motivated by the fact that descriptive statistics indicate substantial differences in payment instrument usage among the three dominant language regions of Switzerland; see SNB (2018).

[10] The underlying assumption is that commuters have lower shoe leather costs, as they pass by train stations and thus city centers, i.e., locations where ATMs are typically situated. Similar arguments are valid for car commuters. As a result, commuters' marginal costs to go to an ATM are lower.

On the other hand, we include a measure for the size of the *municipality* of residence, assuming that larger municipalities have a higher ATM density, again reducing shoe leather costs.

Finally, given the prominent role ascribed to the information processing capabilities of consumers for pocket watching in vKSS, we control for the *average time to answer a survey question*.[11] All the variables are described in detail in Appendix Table A1.[12]

Sample

Using the full set of observations (1968 individuals and 22,689 transactions) raises the concern that our estimates could be biased by observations from individuals or payment situations without a true choice of payment instruments. This bias could be related to either self-selection, the payment options provided at the POS or merchants actively steering consumers to use specific payment instruments.[13]

To address the potential biases due to self-selection or reduced payment options provided at the POS, we exclude all individuals who indicated possessing no payment instrument other than cash (119 individuals). For the included consumers, we then calculate the payment instrument transaction shares and value shares based on the transactions for which they had a choice between cash and alternative means of payment at the POS.[14] With these corrections, 1849 individuals and 13,531 transactions were included in the empirical assessment.[15]

3. Payment instrument watching

In this section, we describe the prevalence of the watcher types and discuss their defining features.

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[11] While the variable is entered in continuous form in our analysis, vKSS rely on a dummy setup and define all consumers who need more time to answer a survey question than the median respondent as having low information-processing capabilities.

[12] To reduce information loss due to incomplete responses, we make use of *missing control dummies* in the econometric analysis. Thus, individuals enter the estimation even when the information for some explanatory variables is missing. These dummies take a value of 1 in the case of missing values in a specific explanatory variable, and 0 otherwise. For the sake of conserving space, we do not report the corresponding results (the results are available on request).

[13] With regard to the latter concern, we argue that for retail transactions and transactions at gas stations, merchant steering is not of great concern in Switzerland: merchant loyalty schemes tend to be independent of payment instruments or are linked to credit cards or merchant cards. Given the low penetration of credit and merchant card payments in Switzerland, such merchant steering through loyalty schemes strengthens our findings as statistically relevant differences emerge despite merchant steering. Furthermore, credit card payers and credit card watchers represent a very small share in our sample. Watching strategies based on payment instruments other than cash, debit or credit cards are not represented. Moreover, merchant-steering is rarely associated with a differentiation along the lines of our explanatory variables.

[14] In the diary, respondents were asked to indicate for each transaction whether a noncash instrument would have been accepted (if they paid in cash) or whether they would have had a sufficient amount of cash on hand (if they paid by any noncash instrument).

[15] Thus, the base data set is reduced by 9,158 transactions, mainly (7,968 transactions) due to excluding payment situations where there was no choice between cash and noncash payment instruments (3,868 transactions are excluded due to nonacceptance of a noncash payment method, and 2,119 are excluded because of a too small amount of cash at hand; the rest of the reduction stems from nonanswers). A further 1,190 transactions are excluded by disregarding all consumers who do not possess any noncash payment instruments.

Descriptive statistics

Table 1 depicts the group-wise descriptive statistics of pocket watchers, digital watchers and their nonwatching counterparts.

Twenty-six percent of consumers are noncash payers, and more than a quarter of them (7% of all consumers) are digital watchers. The sample contains 38% cash payers, and almost half of them (18% of all consumers) are pocket watchers. Put differently, 25% of consumers are payment-instrument watchers. Of these, 28% are digital watchers and 72% are pocket watchers. The remaining 36% of consumers characterize themselves as situation-dependent payers.

The group-wise unconditional means of explanatory variables indicate that pocket watchers belong to lower income groups, have obtained a lower education level and are older than digital watchers. Moreover, pocket watchers are more likely to be female, to reside in smaller municipalities and to be less likely to commute than digital watchers. Pocket watchers tend to be less digitally attuned and to value anonymity more in payment situations than digital watchers. Pocket watchers assess the security risk of cash payments as being lower than the risk of card payments, whereas the opposite holds for digital watchers. Interestingly, both pocket watchers and digital watchers assess cash as less costly than card payments. However, the reported cost advantage is substantially larger for pocket watchers. Finally, digital watchers tend to outperform pocket watchers in terms of their information-processing capabilities.

[[[Table 1 about here]]]

Regression analysis – watcher characteristics

To assess which, if any, of the aforementioned factors are defining features of pocket watchers, digital watchers and their nonwatching counterparts, Table 2 reports the coefficients obtained from an OLS estimation of equation (1).[16] For each regression presented in Table 2, the coefficients obtained reveal the impact of these factors on the likelihood of being the respective watcher type on the left-hand side relative to the reference group "all the other consumers". In each case, the latter comprises all the consumers who are not the respective type on the left-hand side.

Focusing first on *pocket watchers* (Table 2, column I), the estimates indicate that the likelihood of watching expenditures by means of cash is higher for persons with a lower income and is higher for men than for women, whereas education and age do not affect a consumer's likelihood of being a pocket watcher. The residential environment matters in so

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[16] Qualitatively similar results (available on request) are obtained when using the watcher types as binary dependent variables. In particular, considering only cash (noncash) payers and estimating a probit model with pocket (digital) watchers as the dependent variable identifies broadly the same drivers of being a watcher relative to the nonwatching counterpart.

far as consumers in rural regions are more likely to be pocket watchers than those residing in urban areas, while consumers residing in the German-speaking parts of Switzerland are less inclined to rely on pocket watching (compared to consumers in the Italian-speaking parts of Switzerland). Furthermore, the econometric analysis indicates that cost assessments are an important determinant of pocket watching. The perceived lower cost of cash relative to card payments, perceived higher relative security of cash payments, and stronger preference for anonymity in payment situations all increase the likelihood of being a pocket watcher.

With the exception of gender and the security assessment, the aforementioned determinants turn out to be more relevant for explaining pocket watching than for the likelihood of being a *nonwatching cash payer* (Table 2, column II): income, language region, anonymity, and residential environment do not have a significant effect on the likelihood of being a nonwatching cash payer. In contrast, high education and high digital affinity both reduce the likelihood of being a cash payer, whereas these factors are of minor relevance for pocket watching.

Turning to *digital watchers* (Table 2, column III), we find that neither income, education, age nor gender have a significant bearing on the likelihood of opting for the digital watching strategy. Furthermore, the two direct cost and most indirect cost variables have no significant bearing on the likelihood of opting for the digital watching strategy. In particular, and nonintuitively, digital affinity does not explain digital watching. Only consumers perceiving the security advantage of cards to be stronger and those residing in urban areas (compared to rural residents) are more likely to be digital watchers. Consumers residing in the German-speaking parts of Switzerland are less likely to be digital watchers (compared to consumers in the Italian-speaking parts of Switzerland).

In contrast, sociodemographic characteristics, digital affinity and cost variables contribute to the likelihood of being a *nonwatching noncash payer* (Table 2, column IV): higher income, higher education, being female, residing in German-speaking parts of Switzerland and in urban areas and highly intensive internet usage all increase the likelihood of being a nonwatching noncash payer. The same holds for consumers who assess card payments as relatively low cost and relatively secure and who ascribe a relatively low importance to anonymity.

Finally, information processing capabilities do not have any explanatory power either for watching types or for nonwatching types.

Interpretation

Four insights emerge from the characterization of payment-instrument watchers.

First, payment instrument watching is a prevalent phenomenon in Switzerland. While pocket watching is (yet) more important, almost three out of ten watchers rely on digital watching.

Second, while income and the perceived pecuniary cost of paying with cash relative to the cost of paying with noncash payment instruments are important determinants of pocket watching, these factors do not have a bearing on the decision to rely on digital watching. We interpret these contrasting findings, on the one hand, as an indication that consumers with a heightened need to control their budget (for which low income and high cost sensitivity stand in as likely proxies) still conceive watching through cash as a more natural starting point to fulfill their need to control, as suggested by vKSS. On the other hand, the finding that only indirect cost considerations matter for digital watchers suggests that digital watching is likely less sticky and less well entrenched than pocket watching – at least as of now, which suggests that the marginal contribution of cash payments to digital watchers' watching costs is perceived to be close to zero. This interpretation is plausible as cash withdrawals enter the same digital channels as noncash payments and cash balances are available at a glance if necessary.

Third, it is interesting to note that opting for a payment-watching strategy is not only driven by cost considerations. Rather, it tends to be influenced by the social environment and cultural context as well: payment-instrument watching (pocket or digital variety) is less likely in the German-speaking parts of Switzerland. Furthermore, residing in urban areas increases the likelihood of digital watching, while residing in rural areas increases the likelihood of pocket watching.

Fourth, low information processing capabilities seem to have lost their relevance for pocket watching, which contrasts with the finding in vKSS based on 2008 data from a similar survey of German consumers. Our finding lends tentative support to our proposition that technological progress has decreased the disadvantages of noncash payment instruments compared to cash with respect to providing an easy-to-use tool for budget control in real time. More accurate proxies for information processing capabilities in future surveys may improve the corresponding analysis.

[[[Table 2 about here]]]

4. Current and expected future payment behaviors

In this section, we analyze the explanatory power of a budget control motive for current and expected future payment behaviors, providing evidence for our second and third hypotheses.[17]

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[17] Based on the same survey data, Ebner et al. (forthcoming) provide additional evidence on the impact of a control motive on a broader set of payment instrument-related behavior. In line with vKSS (2014), they find that pocket watchers hold a lower number of payment instruments, show a higher switching amount (the value of a transaction that triggers a non-cash payment), withdraw a higher average amount of cash and exhibit a higher withdrawal trigger amount (the amount of cash in the pocket that triggers a cash withdrawal) than digital watchers and other consumers.

4.1.   Current payment behavior

Current payment behavior is highly heterogeneous among watcher and payer types (see Figure 2). Pocket watchers rely on cash for 88% of their transactions, and digital watchers pay 51% of their transactions with noncash instruments. The difference is even stronger in value terms, with 83% cash for pocket watchers and 60% noncash for digital watchers. In contrast, the payment behavior of watchers differs only marginally when compared to their respective nonwatching counterparts.[18]

[[[Figure 2 about here]]]

Regression analysis

Table 3 reports the estimation results of equation (2) based on the full sample of consumers (columns I and II), implying that the coefficients compare the cash shares of watching types and their nonwatching counterparts to the reference group of situation-dependent payers.[19] We control for the same set of explanatory variables as in Section 3.[20]

Being a pocket watcher implies a 3.2 (4.7) percentage point higher cash volume (value) share than for the average nonwatching cash payer (Table 3, column I). The Wald test for the equality of coefficients reveals a significant difference in the cash usage intensity between pocket watchers and nonwatching cash payers at the 10% level. These findings corroborate the results obtained by vKSS. In contrast, the current payment behavior of digital watchers does not differ from the behavior of nonwatching noncash payers – either in transaction volume or in transaction value terms (column II).

The coefficients of the further explanatory variables are in line with intuition (see Annex Table A3). Consumers from higher household income brackets and with a higher degree of digital affinity show a significantly lower cash intensity, whereas gender, education and age tend to be less important. Consumers residing in the Italian-speaking parts of Switzerland tend to favor cash more strongly, particularly compared to those residing in the German-speaking parts, while the degree of urbanization is not a distinctive driver. The perceived relative cost advantage of cash versus noncash instruments has a strong positive effect on cash shares. A larger average payment size reduces the cash share. The importance ascribed to anonymity in payment situations and the relative security of payment instruments does not significantly

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[18] Mean-comparison tests (available upon request) indicate that the differences in cash shares between pocket watchers and digital watchers are significant. In contrast, there is no significant difference between the cash intensity of pocket watchers (digital watchers) and nonwatching cash payers (nonwatching noncash payers).

[19] As a robustness exercise, Annex Table A2, columns I to IV, report the results of estimating equation (2) based on the subsamples of cash payers (which includes, by definition, pocket watchers) and noncash payers (which includes, by definition, digital watchers).

[20] Differences in the expenditure structure would be an important additional control for the analysis described in this section. However, adding variables measuring the spending shares in different expenditure categories does not alter the reported results for either current or expected future payment behaviors. The results of this robustness exercise are available upon request.

influence cash intensity. The coefficients of the shoe leather cost indicators and information processing capabilities are not significant.

Overall, the analysis described in this section reveals that payment instrument watching contributes to explaining the observed heterogeneity in payment instrument usage beyond standard explanatory factors (sociodemographic, transaction-related and payment instrument-related characteristics). For pocket watchers, the finding is in line with our predictions and the literature. In particular, the finding is remarkable against the background of an already highly intensive cash usage by cash payers (both in terms of volume and value, see Table 1). In contrast, the result that digital watchers do not have a higher noncash intensity than nonwatching noncash payers is not consistent with our prediction.

We relate the latter finding to two factors. First, digital watching is still a relatively new phenomenon, and correspondingly, its sample size is comparatively low. Furthermore, noncash payment instruments and digital means to watch past expenses and remaining budgets are still evolving. The same holds for consumers' use and POS acceptance of new digital payment methods. Experiences with new instruments and monitoring methods may foster a more strongly skewed payment behavior by noncash payers and – even more so – by digital watchers. The evidence on the expected future payment behavior provided in Section 4.2 validates this view.

Second, for digital watchers, the search costs for POS locations that accept the preferred noncash payment instrument might be greater than the increase in monitoring costs of switching to cash. Given that digital watchers monitor the balance on their underlying account, their monitoring costs are likely to be similar whether their account balance changes because of a cash withdrawal or a noncash payment. Put differently, for consumers using both cash and noncash payment instruments, watching entails higher marginal costs for pocket watchers than for digital watchers. In line with this finding, the cash shares of pocket watchers are larger than those of digital watchers.

[[[Table 3 about here]]]

4.2. Expected future payment behavior

Expected future payment behavior – as indicated by the expected change in the intensity of cash usage five years onward – is highly heterogeneous among watcher and payer types. While the difference between pocket watchers and nonwatching cash payers is low, the expected payment behavior differ substantially between watching and nonwatching noncash payers (Figure 3). Notably, on average, both watcher types expect to decrease their cash usage (relative to their current share), but digital watchers do so to a stronger extent.

[[[Figure 3 about here]]]

Regression analysis

According to diary entries, many consumers paid exclusively with one payment instrument. To include only consumers who face a true choice in terms of decreasing or increasing the shares of their respective payment instrument, we estimate equation (2) for the dependent variable, the expected future payment behavior, based on a subsample of consumers who paid a maximum of 95 percent by one instrument. We evaluate the 95% threshold for the transaction volume and the transaction value.[21]

When interpreting the coefficients of the payer and watcher type variables reported in Table 3 (columns III and IV), it is important to note that the reference group – situation-dependent payers – expects to use cash less intensively in the future, which is indicated by the size and significance of the constants in both specifications. Indeed, this downward trend in cash usage intensity generalizes to all payer and watcher groups.

The estimation results indicate that current payment behavior (as indicated by payer types) and current watching strategies (as indicated by watching types) are informative regarding the heterogeneity in the expected future cash usage intensity. On the one hand, cash payers expect to change their cash usage in the future less strongly than indicated by the general downward trend. Moreover, the expected change in payment behavior of pocket watchers does not differ from the change in behavior of nonwatching cash payers (Table 3, column III). On the other hand, noncash payers expect to reduce their cash usage intensity more strongly than the average reference group consumer in the future. Even more importantly, this finding is mainly driven by the digital watcher subgroup of noncash payers. The latter expect to intensify their noncash payment instrument usage to a significantly higher degree than nonwatching noncash payers (Table 3, column IV). These findings hold for both transaction volume-based and transaction value-based specifications.[22]

5. Conclusion

We provide evidence that one of the key advantages of cash – its unique feature of combining a payment and monitoring instrument in a single device – has become less salient given ongoing technological progress. Over the last ten years, consumers have been provided with an increasing number of alternative, digital means allowing for monitoring sight deposit balances and past expenses at the speed of a fingertip that tend to be as easy to use and as informative as glancing into one's pocket. Thus, the unique feature of cash will likely become less relevant for payment instrument choice.

Stripping the theoretical framework of vKSS off the uniqueness assumption provides testable predictions. First, complementing the findings of vKSS based on a 2008 survey, we document

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[21] As a robustness exercise, Annex Table A2, columns V-VIII, report estimation results based on 90%- and 99%-thresholds.

[22] We omit a discussion of controls. Qualitatively, the same results are obtained as in the previous section. See annex Table A3.

the rise of digital watchers based on a 2017 survey. While we find pocket watchers to remain more prevalent, 7% of consumers, or 28% of payment instrument watchers, relied on a digital watching strategy in 2017. From a payment instrument design perspective, it is important to acknowledge that 25% of consumers in Switzerland characterize themselves as payment instrument watchers.

We further document important differences between pocket watchers and digital watchers in terms of their characteristics. Low income and the perception that paying with cash provides cost advantages relative to paying with noncash payments increase the likelihood of being a pocket watcher. In contrast, these factors do not explain the likelihood of being a digital watcher. Rather, digital watching is more likely performed by consumers who perceive the security of noncash payment instruments as being high and who live in an urban environment. These differences suggest, on the one hand, that for consumers with a heightened need to control expenses, pocket watching is (still) the more natural starting point. On the other hand, these findings suggest that digital watching is, as of now, less sticky and less well entrenched than pocket watching.

Second, we provide novel evidence that budget control is an important explanatory factor for the observed heterogeneity in payment instrument usage. Payment instrument watching influences current and expected future payment behaviors. Pocket watchers exhibit cash-intensive current payment behavior, i.e., relative to nonwatching cash payers, they use cash more intensively. Similarly, digital watchers expect to decrease their future cash usage more strongly than nonwatching noncash payers. From a cash demand perspective, it is interesting to note that all payer types expect to use cash less intensively in the future. However, this expectation is much stronger for situation-dependent payers, even stronger for nonwatching noncash payers and strongest for digital watchers.

In more general terms, as cash is losing one of its key advantages over other payment instruments, an accelerated decline in cash usage in the coming years would not be surprising. However, our analysis also provides evidence in favor of partially persistent cash usage in line with vKSS. Consumers with a heightened need to watch are more likely to stick to cash. Moreover, we show that assessments of security and anonymity in payment situations are relevant determinants of cash usage. Given the increasing alertness of the wider public regarding data protection, data ownership and cyber risk issues, this finding hints at further factors supporting a continued demand for cash as a means of payment.

Individual assessments of relative costs, relative security and the anonymity of noncash payment instruments may change over time in light of further technological progress and against the background of more widespread use and acceptance. It is likely that these assessments have already changed since 2017. For instance, debit cards equipped with a contactless function have become more widespread in Switzerland, with the share of debit cards with that function increasing from approximately 30% (the end of 2016) to

approximately 80% (the end of 2019).[23] At the same time, mobile payment instruments have gained considerable market share since 2017 (Dietrich and Wernli, 2019). Additionally, the COVID-19 pandemic may prove a key catalyst for driving changes in cost and risk perceptions (Kraenzlin et al., 2020). The next survey on payment methods in Switzerland, conducted in autumn 2020, will shed new light on the implications of these developments for the general trends in cash and noncash usage and the application of watching strategies.

Our findings further elucidate ongoing investigations by several central banks and Bank for International Settlement on the foundational principles and core features of retail CBDCs (BIS, 2020). In terms of foundational principles, central banks endorse the coexistence of CBDC and cash for as long as there is sufficient public demand for cash. In terms of core features, central banks seek a convenience level similar to cash and a high degree of interoperability with private service providers. Our findings indicate that satisfying a budget control motive is a key convenience provided by cash, at least for some consumers. Hence, only if adequate interoperability arrangements ensure the provision of this convenience feature to a sufficient degree in cooperation with private payment service providers would a retail CBDC speak to those consumers.

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[23] SNB Dataportal: https://data.snb.ch/en/topics/finma#!/cube/zavezaka?fromDate=2016-12&toDate=2019-12&dimSel=D0(T1,DZ1).

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Figures

Figure 1. Current payment behavior
Cash usage in %, by type

Figure 2. Expected future payment behavior
Distribution of the expected future cash usage intensity, by type
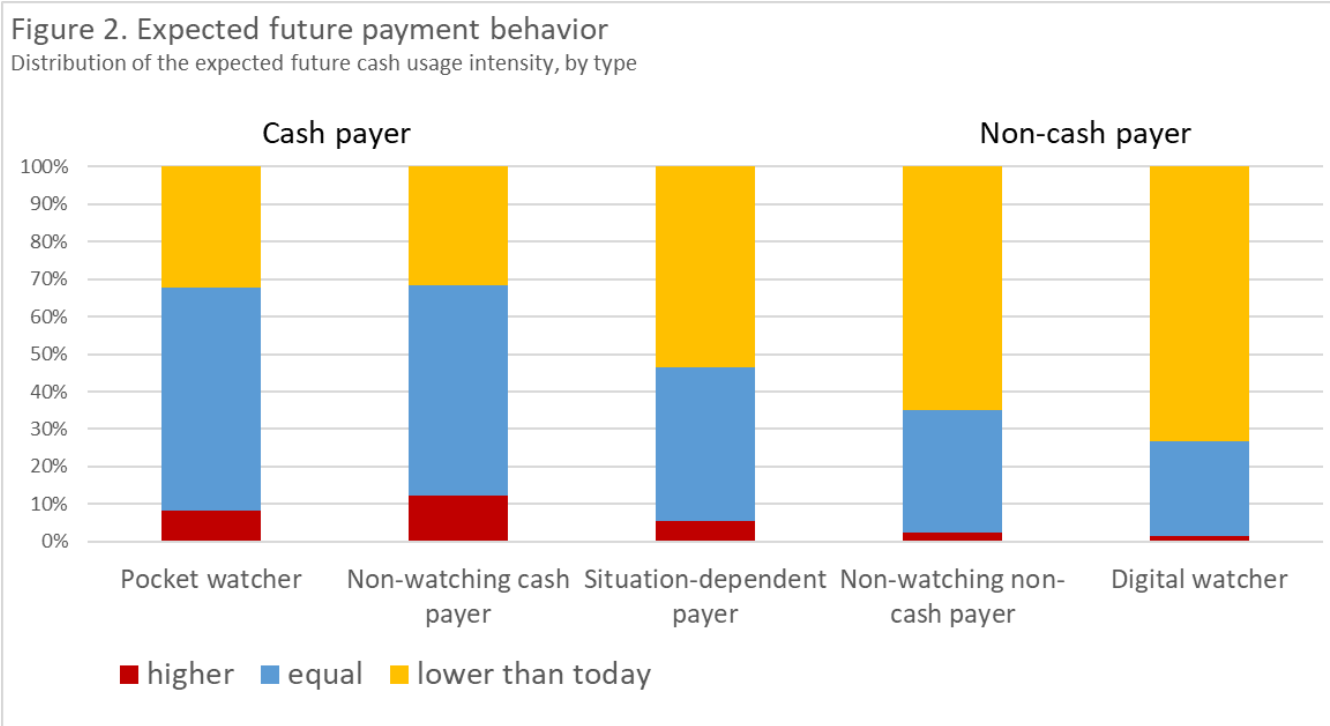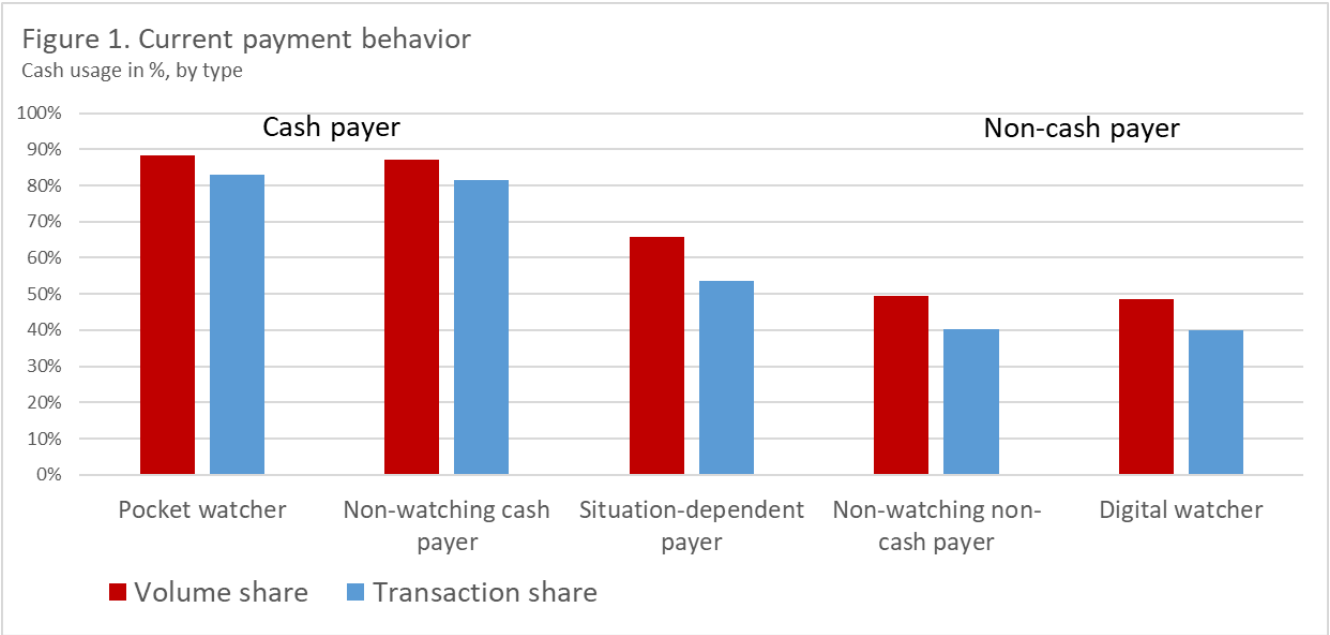
Tables

Table 1. Payer and watcher types

Payment behavior	"always/predominantly cash"		"depending on the situation"	"always/predominantly noncash"	
Payer type (population share)	Cash payer		Situation-dependent payer	Noncash payer	
Control motive	Yes	No	n/a	Yes	No
Watcher type (population share)	Pocket watcher	Nonwatching cash payer	n/a	Digital watcher	Nonwatching noncash payer

Table 2. Descriptive statistics of the explanatory variables by type

	Pocket watcher		Digital watcher		Nonwatching cash payer		Nonwatching noncash payers		Situation-dependent payer		Full sample	
	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.
Household income group	2.11	[1.17]	2.77	[1.43]	2.28	[1.22]	2.96	[1.40]	2.67	[1.36]	2.56	[1.35]
Level of education	2.00	[0.54]	2.17	[0.56]	1.99	[0.53]	2.23	[0.61]	2.15	[0.55]	2.11	[0.56]
Age	47.79	[18.15]	41.25	[15.25]	50.87	[18.65]	42.08	[14.83]	45.67	[15.59]	46.11	[16.85]
Female ratio	0.48	[0.50]	0.52	[0.50]	0.43	[0.50]	0.58	[0.49]	0.55	[0.50]	0.51	[0.50]
Internet usage frequency	1.60	[1.04]	1.18	[0.65]	1.70	[1.09]	1.13	[0.45]	1.25	[0.66]	1.38	[0.84]
Commuter	0.63	[0.49]	0.69	[0.47]	0.62	[0.49]	0.68	[0.47]	0.65	[0.48]	0.65	[0.48]
Size of municipality of residence	35566	[59962]	44026	[80373]	41789	[76214]	39274	[83810]	48563	[86096]	42790	[79243]
Relative cost assessment (cash vs. cards)	1.50	[1.40]	0.89	[1.32]	1.21	[1.27]	0.87	[1.29]	1.11	[1.33]	1.14	[1.34]
Anonymity important	0.16	[0.36]	0.05	[0.23]	0.13	[0.34]	0.04	[0.19]	0.09	[0.29]	0.10	[0.30]

Relative security risk assessment (cash vs. cards)	0.24 [1.88]	-1.40 [1.91]	0.25 [1.65]	-1.42 [1.98]	-0.56 [1.74]	-0.48 [1.92]
Average time to answer a survey question (seconds)	233 [909]	170 [483]	258 [876]	194 [651]	193 [623]	212 [734]
Observations	328	129	376	353	663	1849
Share (%)	18%	7%	20%	19%	36%	100%

For detailed variable descriptions, see Sections 2.1 and 2.2 and annex table A.1

Table 3. Watching types and payer types - regression analysis

Dependent variable	(I) Pocket watcher	(II) Nonwatching cash payer	(III) Digital watcher	(IV) Nonwatching noncash payer
	OLS	OLS	OLS	OLS
Household income: CHF 4,000 to 5,999	-0.02	-0.01	0.04	0.02
	[0.04]	[0.03]	[0.02]	[0.03]
Household income: CHF 6,000 to 7,999	-0.10***	0.00	0.03*	0.01
	[0.03]	[0.03]	[0.02]	[0.03]
Household income: CHF 8,000 to 9,999	-0.12***	-0.02	0.02	0.06*
	[0.04]	[0.04]	[0.02]	[0.04]
Household income: CHF 10,000 and more	-0.12***	-0.0405*	0.04	0.07*
	[0.04]	[0.04]	[0.03]	[0.04]
Education: Upper secondary level	-0.03	-0.03	0.03	0.01
	[0.04]	[0.04]	[0.02]	[0.03]
Education: Tertiary level	-0.05	-0.10**	0.03	0.11***
	[0.04]	[0.04]	[0.03]	[0.04]
Age	0.00	0.00	0.00	0.00
	[0.00]	[0.00]	[0.00]	[0.00]
Age, squared	0.00	0.0001*	0.00	0.00
	[0.00]	[0.00]	[0.00]	[0.00]
Gender: female	-0.04**	-0.06***	0.01	0.04**
	[0.02]	[0.02]	[0.01]	[0.02]
Internet usage: high	-0.11*	-0.12**	0.00	0.09***
	[0.06]	[0.06]	[0.03]	[0.03]
Internet usage: medium	-0.09	-0.03	-0.03	0.06*
	[0.06]	[0.07]	[0.03]	[0.03]

Internet usage: low	-0.05	0.06	-0.04	0.06
	[0.08]	[0.09]	[0.03]	[0.04]
Language region: German-speaking	-0.14***	0.01	-0.03*	0.13***
	[0.03]	[0.03]	[0.02]	[0.02]
Language region: French-speaking	-0.05	-0.04	0.03	0.10***
	[0.03]	[0.03]	[0.03]	[0.03]
Residential environment: Conurbation	0.00	0.01	-0.02	0.03
	[0.03]	[0.03]	[0.02]	[0.03]
Residential environment: Rural	0.10***	0.00	-0.06***	-0.01
	[0.04]	[0.03]	[0.02]	[0.03]
Relative cost assessment (cash vs. cards)	0.02***	-0.01	0.00	-0.01*
	[0.01]	[0.01]	[0.01]	[0.01]
Average transaction value	0.02	0.00	-0.01	-0.03
	[0.01]	[0.01]	[0.01]	[0.01]
Anonymity important	0.11***	0.04	-0.02	-0.09***
	[0.04]	[0.04]	[0.02]	[0.02]
Relative security risk assessment (cash vs. cards)	0.02***	0.03***	-0.017***	-0.04***
	[0.01]	[0.00]	[0.00]	[0.01]
Commuter	0.00	-0.02	0.00	0.00
	[0.02]	[0.02]	[0.01]	[0.02]
Size of municipality	0.00	0.01*	-0.01	-0.02***
	[0.01]	[0.01]	[0.01]	[0.01]
Average time to answer a survey question	-0.01	0.00	0.00	0.00
	[0.01]	[0.01]	[0.01]	[0.01]
Constant	0.46***	0.33**	0.18*	0.24**

	[0.14]	[0.14]	[0.09]	[0.12]
Observations	1433	1433	1433	1433
R-squared	0.12	0.10	0.05	0.13
F-statistic	6.89	6.03	2.82	7.65

Values in brackets denote standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Dummies controlling for missing values are not shown.

The estimation is based on individual-level data. The reference individual is a male with a household income <4000 CHF and a compulsory education level who never uses the internet and lives in an urban environment in the Italian-speaking part of Switzerland.

For detailed variable descriptions, see Sections 2.1 and 2.2, and annex Tables A.1.

Table 4. Watching, current and future payment behaviors

Dependent variable	(I) Transaction share of cash payments	(II) Value share of cash payments	(III) Expected future cash usage	(IV) Expected future cash usage
Sample	Full sample	Full sample	<95% transaction share	<95% value share
	OLS	OLS	OLS	OLS
Pocket watcher	0.21***	0.27***	-0.15**	-0.18**
	[0.02]	[0.02]	[0.07]	[0.07]
Nonwatching cash-payer	0.18***	0.23***	-0.17***	-0.20***
	[0.02]	[0.02]	[0.07]	[0.07]
Digital watcher	-0.17***	-0.14***	0.20***	0.23***
	[0.03]	[0.04]	[0.05]	[0.05]
Nonwatching noncash payer	-0.14***	-0.11***	0.01	0.03
	[0.02]	[0.03]	[0.05]	[0.05]
Constant	1.06***	1.10***	2.81***	2.91***
	[0.09]	[0.11]	[0.26]	[0.27]
Controls omitted (see Annex Table A3)				
Observations	1433	1433	880	821
R-squared	0.31	0.30	0.20	0.21
F-statistic	20.18	19.01	6.66	6.80
p-values: Pocket watcher vs. nonwatching cash payer	0.07	0.05	0.81	0.75
p-values: Digital watcher vs. nonwatching noncash payer	0.45	0.65	0.00	0.00

Values in brackets denote standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. P-values are derived from Wald test for equality of the coefficients. Dummies controlling for missing values are not shown.

The estimation is based on individual-level data. The reference individual is a situation-dependent paying male with a household income < 4000 CHF and compulsory education level who never uses the internet and lives in an urban environment in the Italian-speaking part of Switzerland.

For detailed variable descriptions, see Sections 2.1 and 2.2, and annex Table A1

Appendix

Table A1. Variable descriptions

	Variable	Type	Description	Source
Payment behavior	Transaction share of cash payments	continuous	Share of cash transactions in total transactions based on all transactions for which both cash and noncash payments were possible. Consumers who do not possess noncash payment instruments are excluded from the analysis.	Payment diary
	Value share of cash payments	continuous	Value share of cash transactions in total transactions based on all transactions for which both cash and noncash payments were possible. Consumers who do not possess noncash payment instruments are excluded from the analysis.	Payment diary
	Expected future cash usage	categorical	Expected future cash usage 5 years into the future according to a corresponding survey question: 1 for all consumers expecting to use cash more intensively than today, 2 for all consumers expecting their individual cash intensity to remain at current levels, and 3 for all consumers expecting their individual cash intensity to be lower in the future.	Survey question
Watching and payer type	Pocket watcher	dummy	1 for all consumers who (a) pay "always cash" or "predominantly cash" and (b) indicate a control motive as one of the underlying reason for their usual payment behavior.	Survey questions
	Regular cash payer	dummy	1 for all consumers who (a) pay "always cash" or "predominantly cash" and (b) do not indicate a control motive as one of the underlying reasons for their usual payment behavior.	Survey questions
	Cash payer	dummy	1 for all consumers who pay "always cash" or "predominantly cash".	Survey question
	Digital watcher	dummy	1 for all consumers who (a) pay "always noncash" or "predominantly noncash" and (b) indicate a control motive as one of the underlying reasons for their usual payment behavior.	Survey questions

Variable	Type	Description	Source
Regular noncash payer	dummy	1 for all consumers who (a) pay "always noncash" or "predominantly noncash" and (b) do not indicate a control motive as one of the underlying reasons for their payment behavior.	Survey questions
Noncash payer	dummy	1 for all consumers who pay "always noncash" or "predominantly noncash".	Survey question
Situation-dependent payer	dummy	1 for all consumers who state using cash and noncash payment instruments "depending on the situation".	Survey question
Household income	ordinal	Household income group: 1 = average monthly gross household income below CHF 4000; 2 = income between CHF 4000 and 5999; 3 = income between CHF 6000 and 7999; 4 = income between CHF 8000 and 9999; 5 = income CHF 10'000 and above. In the regressions, individual dummies for each income group are used.	Survey question
Education	ordinal	Level of education: 1 = compulsory; 2 = upper secondary level; 3 = tertiary level. In the regressions, individual dummies for each education level are used.	Survey question
Age	continuous	Age at the time of participating in the survey.	Survey question
Gender	dummy	Female = 1, male = 0.	Survey question
Digital affinity	dummies	Average frequency of internet usage over the previous three months: 1 = daily or almost daily, 2 = at least weekly, 3 = less than once a week, 4 = never. In the regressions, individual dummies for each frequency are used.	Survey question
Language region	dummies	Set to 1 for residents in the German-, French- and Italian-speaking parts of Switzerland.	Survey question (ZIP-code of municipality of residence) matched with SFSO structural survey and based on the most commonly spoken local language

Controls

29

Variable	Type	Definition	Source
Degree of urbanization	dummies	Set to 1 for residents in rural areas, agglomeration, or urban centers.	Survey question (ZIP-code of municipality of residence) matched with SFSO classification
Relative cost assessment (cash vs. noncash)	ordinal	Difference between the ordinal value ascribed to the pecuniary cost of cash payments (scale: 1 = very high to 7 = very low) and the corresponding value ascribed to the least costly noncash payment instrument (either debit or credit card).	Survey questions
Average transaction value	continuous	Sum of the value of transactions divided by the number of transactions, based on all transactions for which paying either with cash or noncash was possible.	Payment diary
Anonymity important	dummy	Set to 1 for all consumers indicating in at least one of five different survey questions the importance of anonymity for both current and expected future payment behavior, and set to 0 otherwise	Survey questions
Relative security risk assessment (cash vs. noncash)	ordinal	Difference between the ordinal value ascribed to the security of cash payments (scale: 1 = very bad to 7 = very good) and the corresponding value ascribed to the most secure noncash payment instrument (either debit or credit card).	Survey questions
Commuter	dummy	Set to 1 for all consumers working outside their municipality of residence (based on ZIP-code), and set to 0 otherwise.	Survey questions
Size of municipality	continuous	Number of inhabitants of the municipality of residence.	Survey question (ZIP-code) matched with SFSO data
Information processing capabilities	continuous	Average time to answer a survey question (time needed to answer the whole survey divided by the effective number of questions asked) in seconds	Survey

Table A2. Watching, current and future payment behaviors - subsample estimations

Dependent variable	(I) Transaction share of cash payments	(II) Value share of cash payments	(III) Transaction share of cash payments	(IV) Value share of cash payments	(V) Expected future cash usage	(VI) Expected future cash usage	(VII) Expected future cash usage	(VIII) Expected future cash usage
Sample	Cash payer	Cash payer	Noncash payer	Noncash payer	<90% transaction share	<90% value share	<99% transaction share	<99% value share
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Pocket watcher	0.04** [0.02]	0.05** [0.02]			-0.11* [0.07]	-0.17** [0.07]	-0.15** [0.07]	-0.16* [0.07]
Nonwatching cash-payer					-0.17** [0.07]	-0.18*** [0.07]	-0.18*** [0.07]	-0.9** [0.07]
Digital watcher			-0.03 [0.04]	-0.03 [0.04]	0.19*** [0.06]	0.23*** [0.06]	0.20*** [0.05]	0.20*** [0.05]
Nonwatching noncash payer					0.01 [0.05]	0.01 [0.05]	0.01 [0.05]	0.01 [0.05]
Household income: CHF 4,000 to 5,999	-0.02 [0.02]	-0.04 [0.03]	-0.06 [0.06]	-0.04 [0.06]	-0.05 [0.06]	-0.02 [0.07]	-0.02 [0.06]	-0.02 [0.06]
Household income: CHF 6,000 to 7,999	-0.04	-0.07*	0.04	0.05	0.08	0.15**	0.12*	0.12*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	[0.03]	[0.04]	[0.06]	[0.07]	[0.06]	[0.06]	[0.06]	[0.06]
Household income: CHF 8,000 to 9,999	-0.04	-0.10*	-0.09	-0.07	0.15**	0.24***	0.19***	0.19**
	[0.04]	[0.05]	[0.06]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]
Household income: CHF 10,000 and more	-0.07	-0.06	-0.16**	-0.16**	0.14**	0.13*	0.15**	0.15*
	[0.05]	[0.06]	[0.06]	[0.07]	[0.07]	[0.08]	[0.07]	[0.07]
Education: Upper secondary level	-0.03	-0.03	0.13**	0.14*	-0.06	-0.12*	-0.08	-0.07
	[0.02]	[0.04]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]
Education: Tertiary level	-0.05	-0.06	0.07	0.06	-0.01	-0.07	-0.02	-0.02
	[0.03]	[0.05]	[0.07]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]
Age	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[0.00]	[0.00]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Age, squared	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Gender: female	-0.04*	-0.03	0.02	0.00	0.00	0.01	0.01	0.01
	[0.02]	[0.03]	[0.03]	[0.04]	[0.04]	[0.04]	[0.04]	[0.04]
Internet usage: high	-0.05*	-0.09**	-0.01	-0.10	0.15	0.13	0.19	0.19
	[0.03]	[0.04]	[0.11]	[0.11]	[0.13]	[0.11]	[0.12]	[0.12]

Internet usage: medium	-0.04	-0.07*	0.07	-0.01	0.02	0.00	0.07
	[0.03]	[0.04]	[0.13]	[0.14]	[0.14]	[0.13]	[0.13]
Internet usage: low	-0.02	-0.07	-0.10	-0.23	0.13	0.09	0.1779
	[0.04]	[0.05]	[0.17]	[0.18]	[0.16]	[0.16]	[0.15]
Language region: German-speaking	0.03	0.07**	0.02	0.06	-0.16***	-0.19***	-0.15***
	[0.02]	[0.03]	[0.05]	[0.06]	[0.05]	[0.06]	[0.05]
Language region: French-speaking	0.02	0.02	0.02	0.04	-0.12**	-0.15**	-0.12**
	[0.02]	[0.04]	[0.05]	[0.06]	[0.06]	[0.06]	[0.06]
Residential environment: Conurbation	0.01	0.02	0.04	0.02	0.00	-0.01	-0.01
	[0.03]	[0.04]	[0.05]	[0.05]	[0.06]	[0.07]	[0.06]
Residential environment: Rural	0.00	0.03	-0.05	-0.10	0.05	0.06	0.03
	[0.03]	[0.04]	[0.06]	[0.07]	[0.07]	[0.07]	[0.06]
Relative cost assessment (cash vs. cards)	0.01*	0.03***	0.01	0.01	-0.02	-0.03*	-0.03*
	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]
Average transaction value	-0.05***	-0.07***	-0.08***	-0.09***	-0.09***	-0.09**	-0.08***
	[0.01]	[0.02]	[0.02]	[0.03]	[0.03]	[0.04]	[0.03]
Anonymity important	-0.04	-0.07*	0.18**	0.26***	-0.48***	-0.48***	-0.50***

	[0.06]	[0.06]	[0.06]	[0.06]	[0.08]	[0.07]	[0.04]	[0.03]
Relative security risk assessment (cash vs. cards)	-0.03**	-0.03***	-0.02**	-0.03***	0.01	0.01	0.00	0.00
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]
Commuter	-0.05	-0.05	-0.03	-0.04	0.0078	0.0227	-0.01	-0.01
	[0.04]	[0.04]	[0.04]	[0.04]	[0.04]	[0.04]	[0.02]	[0.02]
Size of municipality	0.00	0.0023	0.00	0.0016	-0.02	-0.01	0.00	-0.01
	[0.01]	[0.01]	[0.02]	[0.01]	[0.02]	[0.02]	[0.01]	[0.01]
Average time to answer a survey question	0.01	0.0119	0.0202	0.0144	-0.02	-0.02	0.01	0.00
	[0.01]	[0.01]	[0.02]	[0.02]	[0.01]	[0.01]	[0.01]	[0.01]
Constant	2.86**	2.82***	2.91***	2.79***	1.09***	0.94***	1.00***	1.04***
	[0.27]	[0.26]	[0.28]	[0.28]	[0.26]	[0.24]	[0.15]	[0.10]
Observations	874	883	733	828	375	375	527	527
R-squared	0.20	0.20	0.21	0.18	0.18	0.15	0.14	0.12
F-statistic	6.63	6.70	5.89	5.74	2.64	2.24	2.85	2.48

Values in brackets denote standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Dummies controlling for missing values are not shown.

The estimation is based on individual-level data. The reference individual is a predominantly cash paying male with a household income < 4000 CHF and compulsory education level who never uses the internet, and lives in an urban environment in the Italian-speaking part of Switzerland (columns I and II). In columns III and IV, the reference is a noncash payer (other attributes equal), in columns V to VIII, the reference group is situation-dependent payers (other attributes equal).

For detailed variables description, see Sections 2.1 and 2.2, and annex Table A1

Table A3. Watching, current and future payment behaviors - control variables

Dependent variable	(I) OLS Transaction share of cash payments	(II) OLS Value share of cash payments	(III) OLS Expected future cash usage	(IV) OLS Expected future cash usage
Sample	Full sample	Full sample	<95% transaction share	<95% value share
	OLS	OLS	OLS	OLS
Household income: CHF 4,000 to 5,999	0.01	0.01	-0.02	-0.02
	[0.02]	[0.03]	[0.06]	[0.06]
Household income: CHF 6,000 to 7,999	0.00	-0.01	0.12**	0.14**
	[0.02]	[0.03]	[0.06]	[0.06]
Household income: CHF 8,000 to 9,999	-0.04*	-0.08**	0.19***	0.20***
	[0.03]	[0.03]	[0.07]	[0.07]
Household income: CHF 10,000 and more	-0.08***	-0.08***	0.15**	0.15**
	[0.03]	[0.03]	[0.07]	[0.07]
Education: Upper secondary level	0.00	0.01	-0.08	-0.09
	[0.02]	[0.03]	[0.07]	[0.07]
Education: Tertiary level	-0.03	-0.04	-0.03	-0.03
	[0.03]	[0.03]	[0.08]	[0.08]
Age	0.00	-0.0052*	0.00	0.00
	[0.00]	[0.00]	[0.01]	[0.01]
Age, squared	0.00	0.00	0.00	0.00
	[0.00]	[0.00]	[0.00]	[0.00]
Gender: female	-0.01	-0.03	0.00	0.01
	[0.01]	[0.02]	[0.04]	[0.04]
Internet usage: high	-0.08***	-0.1139***	0.19	0.18
	[0.02]	[0.03]	[0.12]	[0.12]

35

Internet usage: medium	-0.05*	-0.06*	0.0655	0.0447
	[0.03]	[0.04]	[0.13]	[0.13]
Internet usage: low	-0.05	-0.06	0.1764	0.1702
	[0.04]	[0.05]	[0.15]	[0.16]
Language region: German-speaking	0.02	0.07***	-0.15***	-0.16***
	[0.02]	[0.02]	[0.05]	[0.05]
Language region: French-speaking	0.02	0.04	-0.12**	-0.13**
	[0.02]	[0.03]	[0.06]	[0.06]
Residential environment: Conurbation	0.01	0.01	-0.01	-0.01
	[0.02]	[0.03]	[0.06]	[0.06]
Residential environment: Rural	0.00	-0.02	0.04	0.04
	[0.02]	[0.03]	[0.06]	[0.06]
Relative cost assessment (cash vs cards)	0.01**	0.02***	-0.03*	-0.03**
	[0.01]	[0.01]	[0.02]	[0.02]
Average transaction value	-0.078***	-0.09***	-0.08***	-0.08**
	[0.01]	[0.01]	[0.03]	[0.03]
Anonymity important	0.03	0.03	-0.50***	-0.49***
	[0.02]	[0.03]	[0.06]	[0.06]
Relative security risk assessment (cash vs cards)	0.01	0.01	-0.03***	-0.03**
	[0.00]	[0.00]	[0.01]	[0.01]
Commuter	0.0099	0.0113	-0.04	-0.04
	[0.01]	[0.02]	[0.04]	[0.04]
Size of municipality	0.00	0.00	0.0027	0.00
	[0.01]	[0.01]	[0.01]	[0.01]

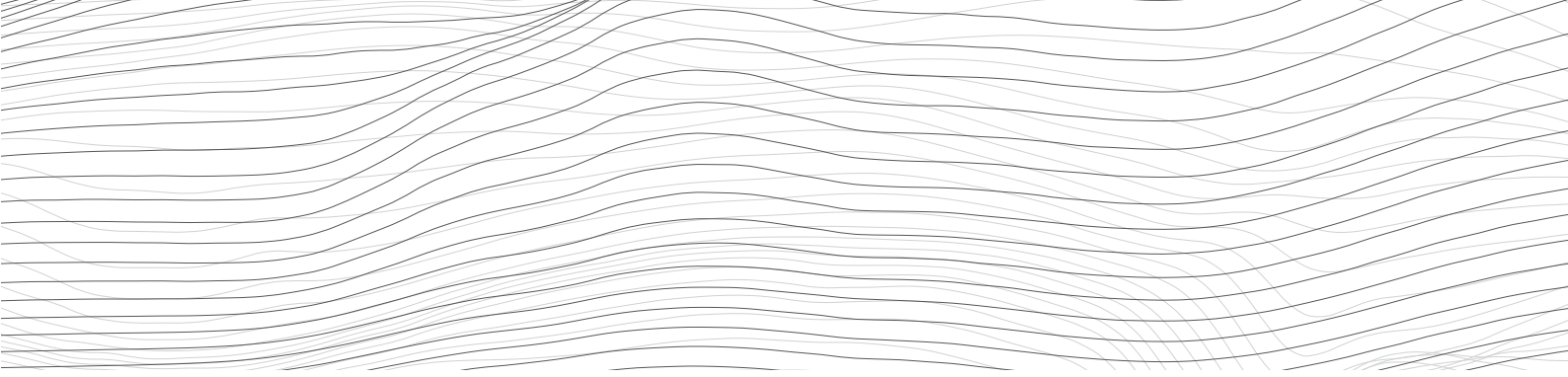|				
Average time to answer a survey question	0.00	0.00	0.01	0.01
	[0.01]	[0.01]	[0.01]	[0.02]
Observations	1433	1433	880	821
R-squared	0.31	0.30	0.20	0.21
F-statistic	20.18	19.01	6.66	6.80

Values in brackets denote standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. P-values derived from Wald test for equality of coefficients. Dummies controlling for missing values are not shown.

The estimation is based on individual-level data. The reference individual is a situation-dependent paying male with a household income < 4000 CHF and compulsory education level who never uses the internet and lives in an urban environment in the Italian-speaking part of Switzerland.

For detailed variable descriptions, see Sections 2.1 and 2.2, and annex Table A1

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