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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Pandemic payment patterns*

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Abstract

COVID-19 has temporarily changed the relative cost and benefits of different payment methods: cash has become more costly in terms of health risks, ease of use and likelihood of acceptance, whereas debit card usage has become less costly. As a result, consumers have shifted away from cash. For some, this may speed up the adoption of electronic payment methods, resulting in a permanent change in payment behaviour. Others will return to their preferred payment method once the influence of COVID-19 on our health and daily lives has faded away. Based on unique payment diary survey data collected among a representative panel of Dutch consumers, we study the shift in payment behaviour and payment preferences during the first phase of the COVID-19 pandemic. Since the start of the lockdown in the Netherlands the likelihood of debit card usage at the expense of cash has increased by 13 percentage points. About 60 percent of this shift has persisted seven months after the start of the pandemic in the Netherlands and appears to be long-lived. Also, the pandemic has resulted in a shift in payment preferences towards more contactless payments. Both effects are largest for elderly people.

Keywords: COVID-19, consumer payment behaviour, consumption, payment diary data.

JEL classifications: D12, E21, E42, O33.

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1. Introduction

The COVID-19 pandemic has changed the daily lives of people all around the globe; it has not only made our lives more contactless but also the way we pay. Electronic payment instruments at physical retail locations – point of sales (POS) – have become more attractive relative to cash, because the latter involves more physical contact. Retailers promoted the usage of contactless payments at the expense of cash, and banks made it easier for consumers to pay contactless. As a result, electronic payment instruments have gained further ground.

We examine the impact of the COVID-19 pandemic on consumer payment behaviour and preferences using unique payment diary data for Dutch consumers. In contrast to other studies on the effect of COVID-19 on payment behaviour, our payment diary data includes information on cash payments, in addition to information on electronic POS payments (e.g. Golec et al. 2020; Kraenzlin et al. 2020). Moreover, our payment diary data not only provides information on payment behaviour at the POS but also on payment preferences and a wide range of background information on respondents. The daily data used in this paper covers the Netherlands and ranges from January 1 2018 until October 13 2020. The nature of the data allows us to examine the extent to which the outbreak of COVID-19 has led to a shift in payment behaviour and payment preferences. If the shift speeds up adoption by forcing consumers to incur learning cost and breaking cash habits or if the shock leads to a change in preferences, the change in payment behaviour is expected to persist.

Besides the richness of our payment diary data, the Netherlands is a specifically good setting to examine the impact of the COVID-19 pandemic on payment behaviour. First, there are two key payment instruments which almost all people have adopted and which are well-accepted: cash and the debit card. The latter can be used with PIN and contactless. In addition people can pay contactless with their smartphone or credit card. In 2019, 32% of POS payments were in cash, 24% by debit card with PIN and 43% contactless (DNB 2020a). Paying contactless by debit card is done much more often than paying contactless by smartphone, as 90% of all debit cards are contactless-enabled (DNB 2020a). Therefore, if people want to switch from one payment method to another, they can easily do so. Second, Dutch banks have taken several measures to simplify contactless payments in order to prevent infection through manual contact. Pre-COVID-19, consumers were required to enter their PIN code when they made a payment of more than EUR 25 and to insert their payment card into the payment terminal. If payments of EUR 25 and below reached a cumulative limit of EUR 50 the PIN code was also required. In 2020 the cumulative limit

was increased to EUR 100 on March 19, while the transaction limit was raised to EUR 50 on March 24. Third, storekeepers stimulated people to pay electronically as it lowers the likelihood of hand contact. For example, they had door plates and notices next to the cash desk asking people to pay electronically. Moreover, the Centraal Bureau Levensmiddelenhandel (CBL) – the Dutch organisation that looks after the interests of supermarkets – appealed to consumers to pay contactless.[1] Fourth, during the lockdown in the Netherlands, which started on March 16, people were still allowed to leave their home and visit a POS as often as they wanted, except for POS in particular sectors such as restaurants and bars, recreation and culture and the services sector. Furthermore, kinder gardens, schools and universities were closed and people were encouraged to work from home and to avoid public transport as much as possible.

From May 11 restricting measures were gradually relaxed, starting with the re-opening of kinder gardens and primary schools, a part of the services sector and re-opening of libraries. From June 1 high schools re-opened, and venues in the recreation and cultural sector as well as cafes and restaurants were allowed to receive at most 30 guests. On July 1 the pandemic appeared to be under control, illustrated by the low number of new COVID-19 contagions and a lasting low level of people who needed to go to the hospital to recover from a serious COVID-19 infection. As a result from July 1 most of the COVID-19 measures were relaxed by the government: the maximum of people that could visit a pub, restaurant or recreational/cultural venue was increased to 100, people were allowed to participate in sport competitions, and those working from home, were allowed to go to the office. On October 14 the Dutch government tightened the COVID-19 measures to combat the second wave of infections. The impact of these stricter measures is outside the scope of this paper.

Foreshadowing our main results, we find a huge decline in cash usage at the POS. The share of POS transactions paid in cash declined from 31% at the beginning of 2020 to 13% in the first two weeks of April, reverting back to 21% of the transactions by October 13. Cash usage has been substituted by the usage of debit cards. We also find that a substantial part of this shift in payment behaviour is likely to be long-lived as payment preferences have also shifted. The share of people who prefer to pay contactless by debit card has increased at the expense of the share of people who prefer to use their debit card with a PIN code. Surprisingly, although the usage of cash remained much lower than before the lockdown, the lockdown did not significantly lower the share of people preferring cash.

[1] See the press release of on https://www.cbl.nl/pinnen-als-voorzorgsmaatregelen-tegen-coronavirus/ (in Dutch).

The remainder of this paper is structured as follows, section 2 reviews the related literature on payment behaviour and formulates our hypotheses. Section 3 presents the context, data and method. Section 4 describes the regression results. We end with a discussion and conclusion in Section 5.

2. Related literature and hypotheses

2.1 Literature on consumer payment behaviour

In the past decades numerous studies were conducted on the drivers of payment patterns and how to influence them. A wide range of factors emerges. Various studies find that cash usage increases with age and decreases with education and income (e.g. Jonker 2007; Arango-Arango et al. 2018). In addition, people are more likely to opt for electronic payments when they need to pay a large amount than when the transaction size is low (Wang and Wolman 2016; Arango-Arango et al. 2018). Moreover, it is shown that payment choice depends on the ability to monitor liquidity (von Kalckreuth et al. 2014), keep control of one's budget (Hernandez, Jonker and Kosse 2017) and the perceived speed of payment, its user-friendliness, and safety (Jonker 2007; Schuh and Stavins 2010; van der Cruijsen and Plooij 2018). Financial incentives matter too (Arango-Arango et al. 2018; Bolt et al. 2010; Stavins 2018; Simon et al. 2010). In addition, payment behaviour depends on how well a payment instrument is accepted at the POS (Bagnall et al. 2016). For example, in the Netherlands cash is much more popular in bars and restaurants than in supermarkets (DNB 2020a). Finally, there is a limited number of studies showing the importance of socio-psychological factors for payment behaviour (van der Horst and Matthijsen 2013; Khan et al. 2015; van der Cruijsen and Knoben 2020; van der Cruijsen and van der Horst 2019). For example, they show the importance of social norms (perceptions of how others pay and perceptions of how one should pay), attitudes, and feelings. Solnick (2007) examines whether the payment method affects behaviour in an experimental setting and she finds that participants using cash were less generous towards other participants than those using alternative ways to track their monetary rewards.

In spite of this large literature on the drivers of payment behaviour, relatively little is known about the effect of external shocks and measures taken by governments, banks and retailers on consumers' payment behaviour. Using 2005-2008 data on the Netherlands, Kosse (2013) finds that newspaper articles on skimming fraud go along with somewhat less debit card usage on the

same day. These small effects of information shocks do not sustain or accumulate in the long run. Choi and Loh (2019) show that the downsizing of ATMs in Singapore – a densely populated city – has increased customers' travel distances to ATMs and increased their usage of the bank's digital platform.

The COVID-19 pandemic offers a unique opportunity to study to what extent an external shock and accompanying measures by the government, banks and retailers can result in a change in payment behaviour and payment preferences. There are a few first studies. According to Chen et al. (2020) there is some early survey evidence from Spring 2020 that cash usage at the POS by Canadian citizens has decreased at the expense of debit and credit card payments, but that the role of cash as a store of value has somewhat increased. In particular, a third of the survey respondents reported that they had decreased their use of cash in response to the pandemic. Similarly, based on a yearly payment diary carried out in May 2020 in the U.S., Kim et al. (2020) find that, in general, participants hold more cash in their wallet and as a store of value in their homes, compared to trends reported in the 2019 diary. Moreover, focusing on changing payment behaviour, the results show that approximately 20% of the participants have switched to paying online or over the phone.

There are some first studies showing that the pandemic has accelerated the use of electronic payment instruments in Europe. Four out of ten respondents of an ECB study carried out in July 2020 say they use less cash since the beginning of the COVID-19 pandemic and a majority of these people expect to continue this behaviour after the ending of the pandemic (ECB 2020). The fact that electronic payment instruments have been made more convenient is the most often mentioned reason for the change in behaviour. In a recent report by the Danish central bank (Danmarks Nationalbank 2020), the analysis shows that contactless and online payments quickly gained ground while cash payments fell during the lockdown. More specifically, 30% of the Danish respondents reported increased payment card use relative to before the lockdown, and 41% reported less cash usage. The Danish study also indicates that the use of cash gradually increased during the reopening of the economy by the end of August. In addition, online payments have returned to pre-lockdown levels in Denmark. In Mínguez et al. (2020) information on the usage of cards as a means of payment is used to estimate the drop in consumptive expenditures during the lockdown in Spain. The study reports that immediately after the start of full lockdown and the state of alert was declared in Spain, payment card spending and ATM withdrawals saw a drastic drop of around 50% (year-on-year). Payment card spending returned back to normal levels by

the end of June, while ATM withdrawals remained well below 2019 levels. Online purchases in Spain have shown a large increase and this trend seems persistent. Using transaction data from Dutch customers of ABN AMRO bank, Golec et al. (2020) attempt to separate the economic effects of voluntary responses to COVID-19 from those attributable to government lockdown measures. They compare municipalities that experienced large COVID-19 outbreaks with municipalities that had few or no cases. Their findings suggest that in municipalities with higher levels of infections, the impact on consumption is larger. Finally, for Switzerland, Kraenzlin et al. (2020) investigate card payments in the Swiss retail sector during the COVID-19 crisis. Apart from aggregate effects on retail spending, they provide evidence for pronounced regional shifts – which persist post-lockdown – based on retail card payment spending across areas with different levels of urbanization and across the Swiss cantons. E-commerce and cash substitution are identified as main drivers.

2.2 Hypothesis development

Given the COVID-19 outbreak and accompanying measures by the government, banks and retailers, we expect a reduction of the share of POS transactions paid in cash and an increase in the share of electronic payments since the lockdown. The first hypothesis is therefore:

H1: COVID-19 and the accompanying measures have shifted payment behaviour at the POS after the start of the lock-down: they resulted in a lower share of cash payments and a higher share of debit card payments.

There are several reasons why we also foresee a shift in payment preferences and thereby a long-lived shift in payment behaviour. First, a group of prior non-users has made the step towards paying contactless and experienced the ease of paying contactless. It is likely that at least part of these people have become enthusiastic about this payment method and changed their payment preferences. Second, payment preferences depend on perceived payment instrument characteristics. COVID-19 has temporarily changed the relative cost and benefits of different payment methods: cash has become more costly in terms of health risks, ease of use and likelihood of acceptance, whereas debit card usage has become less costly. Moreover, the importance people attach to the safety of payment instruments may have increased. Within the Netherlands, contactless payments have been stimulated by banks and retailers to prevent the spreading of

COVID-19 via the handling of cash or by touching the payment terminal when inserting the PIN code. Third, social norms may have changed. People are probably more likely to think that the social norm is to pay contactless and not use cash as more and more people do so. Prior research has shown that people copy the payment behaviour of others (van der Cruijsen and Knoben 2020). It is also likely that a larger share of people nowadays think that storekeepers want them to pay contactless and not use cash due to the call of CBL and individual stores and other POS. Payment intentions depend on these injunctive norms as well (van der Cruijsen and van der Horst 2019). Our second and third hypothesis therefore are:

H2: COVID-19 and the accompanying measures have had a long-lived effect on payment behaviour at the POS; the lower share of cash payments and higher share of debit card payments remained after the lockdown ended.

H3: As a result of COVID-19 and the accompanying measures the share of people who prefer to pay contactless at the POS has increased.

3. Data and method

3.1 Payment diary data

To test our hypotheses we use unique payment diary data collected from Dutch consumers. De Nederlandsche Bank (DNB) and the Dutch Payments Association (DPA) commissioned the data collection. The main goal of the DNB/DPA Survey on Consumers' Payments (SCP) is to measure payment behaviour of Dutch consumers (Jonker et al. 2018). Members of the *GfK* market research-panel, aged 12 years and over fill in the questionnaire. The results give a representative picture of payment behaviour of the Dutch.

Survey participants register their payment behaviour on the registration day.[2] They give detailed information on the transactions they made during the day such as the payment instrument used, how much they spent at each POS, and what sector the POS belongs to. In addition, participants answer an additional questionnaire. We use this part to get insight in

[2] Prior research has shown that such a one-day payment diary results in more reliable information on payment behaviour than a one-week payment diary because in the latter case people register less transactions per day (Jonker and Kosse 2013).

payment preferences and to construct variables capturing personal characteristics, such as gender and age.

For our analysis of payment behaviour we use data from January 1 2018 until October 13 2020, so our data ends before the introduction of new COVID-19 measures in response to the second wave of COVID-19 infections, which came into effect on October 14. We took the payment dairies where the respondent made at least one payment at a POS on the registration day. Overall, they made about 97 thousand POS payments. We exclude payments that were not made with cash or the debit card, leaving us with 93,343 POS payments because we focus on cash and debit card usage, as these are by far the most frequently used means of payment at the POS in the Netherlands. For our analysis of payment preferences we use data collected from January 1 2019 until October 13 2020. 2018 is not included because payment preferences were not part of the 2018 SCP. This results in 44,241 payment diaries of 35,928 different people. On average, we have 68 diaries per day.[3]

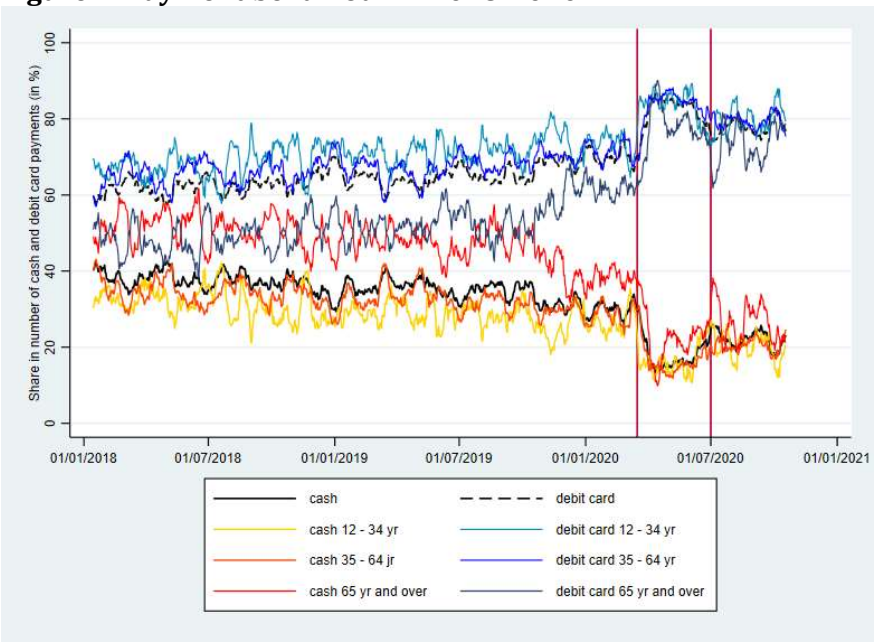
A key advantage of our data set is that it tracks payment behaviour and payment preferences before and during COVID-19 on a daily basis. Moreover, since we use payment diary data we not only have information on the usage of electronic payment instruments but also on cash usage. This allows us to disentangle (1) the drop in the usage of all payment instruments due to decrease in the overall number of transactions at the POS as a result of the lock down, and (2) the substitution between payment methods.

Figures 1 and 2 provide a first impression on the development of payment behaviour, respectively payment preferences over time. Figure 1 shows 14-days moving averages of the share of POS payments made by cash or by debit card by age category from January 14 2018 until October 13 2020. We highlight two key moments in time: the start of the lockdown on Monday March 16 2020 and the end of the lockdown on July 1 2020. At the start of 2020, the proportion of cash in the total number of cash and debit card POS payments still stood at 31%. Bottoming out at 13% on 12 April, cash transactions rebounded to 23% at the end of June, but gradually dropped again and amount around 21% on October 13, still well below pre-pandemic levels. While the decrease in cash use is seen across all age groups, it is more pronounced among consumers above 65 than among consumers between 12 and 64. Furthermore, since the second half of July no major

[3] All days are adequately covered and provide a representative picture (Jonker et al. 2018, p.12). In particular, 97% of the payment diaries were filled in online and 3% of the respondents partake by telephone. Respondents participate at most once every quarter. Note that the reported payment behaviour does not depend on being a fresh or trained participant (Hernandez, 't Hoen and Raat 2017). On average respondents in our payment preference sample participated 1.23 times.

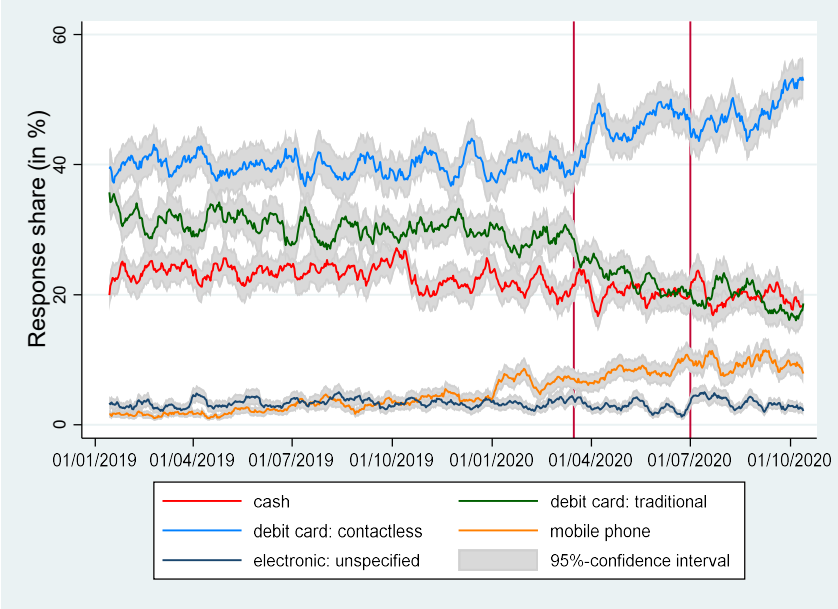
changes have taken place anymore in consumers' payment behaviour, indicating that a large part of the shift in payment behaviour appears to be persistent.

Figure 1. Payment behaviour in 2018-2020



Payment preferences have also changed a lot since the start of the lockdown; contactless payments clearly gained ground. Figure 2 shows 14-days moving averages of the share of people preferring different payment methods. Since March 16 2020 substantially more consumers got a preference for paying contactless, whereas the share of people preferring to pay with their debit card in the traditional way (so including a PIN code) decreased. Both paying contactless by debit card and mobile phone became more popular. The share of consumers preferring these payment instruments increased from respectively 39% to 53% and 7% to 8%, so a combined increase of 15 percentage points. This occurred at the expense of the share of people preferring to use the debit card in a traditional way, which dropped from 29% to 19%. The share of people preferring to pay with cash only declined by 3 percentage points, from 21% to 18%.

Figure 2. Payment preferences



3.2 Empirical approach

To test whether consumers' payment behaviour and payment preferences have changed due to COVID-19 and the accompanying measures, we estimate different sets of regressions.

3.2.1 Dependent variables

We use *debit card* as dependent variable. This dummy variable is 1 for debit payments and 0 for cash payments. Debit payments include both traditional debit card payments, contactless payments with the debit card and contactless debit payments initiated via an app on people's smartphone.[4] Prior to the pandemic, cash is accepted by 97% of the retailers and the debit card by about 87% of them (DNB 2020b).

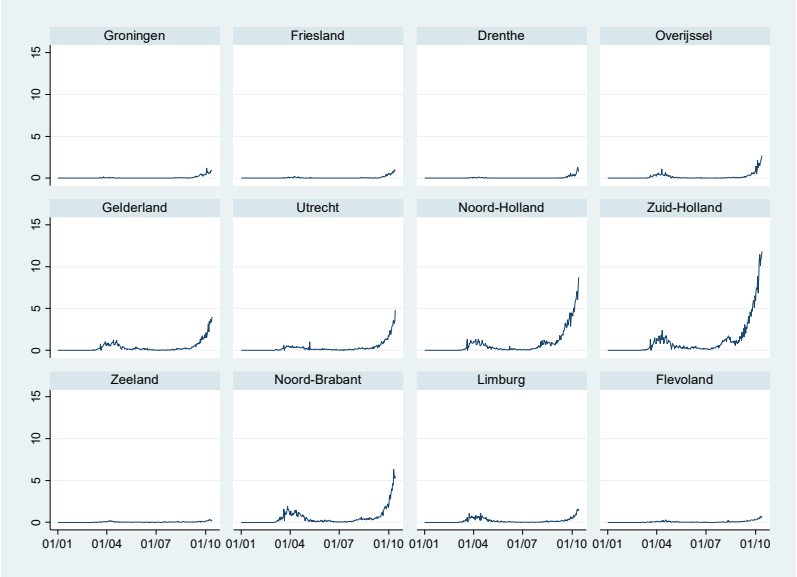
For the analysis on payment preferences we construct a variable that captures the consumers' preferred payment instrument. This variable *payment preference* is 1 for respondents who prefer to use cash, 2 for respondents who prefer to pay in a traditional way with their debit card (using a PIN code), and 3 for respondents who prefer to pay contactless with their debit card and 4 for respondents who prefer to pay with their mobile phone.[5]

[4] We could not make a proper distinction between traditional debit card payments, where the debit cards needs to be inserted in the terminal, and contactless debit card payments as many respondents confused the two ways of paying with the debit card. In the payment diary data, the share of contactless debit card payments is too low, when compared with the information on the number of traditional and contactless debit card payments from debit card acquirers.
[5] See Appendix A Table A.2 for the underlying questions. Respondents who prefer to pay electronically but do not have a preference for a particular type of electronic payment instrument are not included in the analyses.

3.2.2 Explanatory variables

We use several variables related to the pandemic and the subsequent government measures to explain the choice for debit or cash. We use *lockdown: start*, a dummy that takes the value 1 since the start of the lockdown in the Netherlands, so from March 16 2020 onwards. We also include the dummy *lockdown: end* which takes on the value 1 from July 1 2020 onwards when most of the government measures were relaxed, and which allows us to analyse whether people are returning to their old pre-pandemic payment behaviour. Furthermore, we include the continuous variable *COVID-19* which equals the number of daily new infections with COVID-19 per 100,000 inhabitants in the respondent's province of residence at day t (source: National Institute for Public Health and the Environment). This variable reflects the seriousness of COVID-19 contamination in the geographical area where the respondent lives.[6] As there was a shortage in test capacity until June 1, only people with serious COVID-19 symptoms and people working in health care were allowed to get themselves tested for COVID-19. After June 1, test capacity was increased and also people with mild symptoms have been encouraged by the government to get themselves tested. This resulted in a more accurate measurement of the number of new COVID-19 infections, and also in an increase in the measured number of new COVID-19 infections. In order to correct

Figure 3. The number of daily new COVID-19 infections per 100,000 inhabitants by province in 2020



[6] Unfortunately, the payment diary data does not include information on lower levels of spatial aggregation than the province for part of the period of our analysis. This information is not available due to a change in data supplying agency in combination with privacy regulation which forbids the transmission of information from respondents without their explicit consent.

for the change in test policy we also interact *COVID-19* with a binary dummy *June 1*, which equals 1 from June 1 2020, and include the interaction term *June 1×COVID-19* in the set of control variables. Figure 3 shows that there are substantial provincial differences in the seriousness of COVID-19 contamination. Furthermore, it shows that the number of new COVID-19 infections before June 1 is much smaller than after June 1 when the test capacity increased. In addition, we control for a wide range of other variables. In all regressions, we put the following individual-specific binary dummy variables in the set of explanatory variables*: male, between 25 and 34, between 35 and 44, between 45 and 54, between 55 and 64, 65 and over, education: low, education: high, income: low, income: high, income: unknown, partner, children, native and we include 11 province dummies reflecting geographical differences in payment behaviour.* The reference person is a non-native, middle-educated woman who has a gross household income between EUR 23,400 and EUR 51,300 a year, does not live with a partner, has no children, is 24 years or younger and lives in the province of Noord-Holland. Appendix A describes all the variables in more detail and includes summary statistics.

The regressions that explain payment behaviour include additional transaction specific variables. We include the following dummies *amount EUR 5-10*, *amount EUR 10-20* and *amount EUR 20 and above* as it is expected that consumers' payment choice also depends on the transaction size. We also include branch dummies to control for branch-specific payment behaviour resulting from difference in acceptance, social norms and habits across branches: *retail stores: food*, *retail stores: non-food*, *petrol stations*, *vending machi*nes, *street vending*, *cafes and restaurants*, *recreation and culture, transport*, and *services.* The reference category is *supermarkets*. Furthermore, we control for day-specific payment behaviour by including the day of the week dummies: *Monday*, *Tuesday*, *Wednesday*, *Thursday*, *Friday*, and *Saturday*. *Sunday* is the reference day. We also include the variable *trend* in all regressions. This variable increases every day by 1/365 and captures the autonomous trend in debit card usage and payment instrument preferences as we need to control for the fact that also in the absence of COVID-19 and the accompanying measures a shift in payment behaviour and preferences would have occurred.

3.2.3 Methodology

Payment behaviour

Regarding payment behaviour at the POS, we use a series of pooled binomial logit regression models to analyse consumers' choice of payment instrument when paying for a purchase i at a given day t and the possible impact of the pandemic on it. See Cameron and Trivedi (2010) for a description of the logit model. We focus on the two dominant payment instruments: cash and the debit card who together cover more than 95% of the POS payments in the Netherlands, and we exclude transactions with other payment instruments.

We distinguish between the observed usage of the debit card for transaction i at time t *debit* $card_{it}$, and the underlying continuous latent variable $debit\ card^*_{it}$. In our baseline model we assume that $debit\ card^*_{it}$ depends on consumer characteristics x_{it}, purchase characteristics w_{it} and calendar effects c_t, which include the trend and the day of the week dummies:

$$debit\ card^*_{it} = \beta' x_{it} + \gamma' w_{it} + \delta' c_t + \varepsilon_{it} \quad (1)$$

We do not observe the value of the latent variable, but we do see whether the debit card or cash was used:

$$debit\ card_{it} = 1\ \ if\ debit\ card^*_{it} > 0 \quad (2)$$
$$= 0\ \ if\ debit\ card^*_{it} \leq 0$$

We then have

$$Pr(debit\ card_{it} = 1) = Pr(\beta' x_{it} + \gamma' w_{it} + \delta' c_t + \varepsilon_{it} > 0) = F(\beta' x_{it} + \gamma' w_{it} + \delta' c_t) \quad (3)$$

Section 3.2 provides an overview of the covariates included in x_{it}, w_{it} and c_t. We assume that ε_{it} are from the logistic distribution, with zero mean and standard deviation $\frac{\pi}{\sqrt{3}}$ (Cameron and Trivedi 2010). As this analysis takes place at transaction level instead of respondent level, and many respondents have made multiple purchases, we need to cluster the standard errors by respondent to take potential correlation across transactions made by the same respondent into account.

In the next step of our analysis, to assess the influence of the lockdown in the Netherlands on debit card usage at the POS we include several variants of time dummies. First, we include

$$\theta lockdown{:}\ start_t + \vartheta lockdown{:}\ end_t \quad (4)$$

to assess whether the lockdown has raised debit card usage $\theta > 0$, and whether it has a lasting impact on people's payment behaviour, $\vartheta + \theta > 0$. Second, we add

$$\tau COVID - 19_{it} + \varphi\ \text{June}\ 1_t \times COVID - 19_{it} \quad (5)$$

in order to assess whether the actual degree of contamination in the respondent's province influences his payment behaviour. Third, we assess whether the lockdown has a heterogeneous impact on different consumer segments and in different branches by adding the interaction terms

$$\tilde{\theta} lockdown{:}\, start_t \times \tilde{x}_{it} \;\; + \tilde{\tilde{\theta}} lockdown{:}\, start_t \times \; \tilde{w}_{it} + \tilde{\tilde{\vartheta}} lockdown{:}\, end_t \times \tilde{w}_{it} + \tilde{\vartheta} lockdown{:}\, end_t \times \tilde{x}_{it} \qquad (6)$$

where $\tilde{x}_{it}$ denotes the different age and income groups and $\tilde{w}_{it}$ the different branches.

Regarding consumer segments we focus on age cohorts and income segments, as both age and income are strong predictors for debit card usage (see e.g. Jonker 2007; Bagnall et al. 2016).[7] The impact of the lockdown on card usage may differ between sectors, as there is a lot of variation in debit card usage between them (DNB 2020a) and because the way government measures have affected business differs per retail branch.

The impact of the start of the lockdown and the relaxation of the government measures on debit card usage are reflected in the corresponding marginal effects from equations 4 and 5. Whether the lockdown influences debit card usage in the short run (H1), can be assessed by testing $\theta = 0$. Acceptance implies that the lockdown did not affect the likelihood of debit card usage just after the start of the lockdown, whereas its rejection provides support for H1. Whether the lockdown has a long-lived impact (H2) can be assessed by testing $\theta + \vartheta = 0$. Rejection suggests that the pandemic and accompanying measures have led to a long-lived change in the likelihood of using a debit card.

The coefficients in equation (6) reflect the influence of the lockdown on the likelihood of debit card usage for a payment of debit card usage by age, income and branch. The influence of the start of the lockdown by age and income is captured by $\theta + \tilde{\theta}$, and its impact by income by $\theta + \tilde{\tilde{\theta}}$. Whether the start of the lockdown led to a change in the likelihood of a debit card transaction for specific age and income groups can be assessed by testing $\theta + \tilde{\theta} = 0$. Analogously, we test the influence of the beginning of the lockdown on debit card usage by branch. The long term effect of the lockdown on debit card usage by age and income $\theta + \tilde{\theta} + \vartheta + \tilde{\vartheta}$ and branches $\theta + \tilde{\tilde{\theta}} + \vartheta + \tilde{\tilde{\vartheta}}$ can be used to assess whether the lockdown has had a long-lived impact on the likelihood of debit card usage by testing: $\theta + \tilde{\theta} + \vartheta + \tilde{\vartheta} = 0$, respectively $\theta + \tilde{\tilde{\theta}} + \vartheta + \tilde{\tilde{\vartheta}} = 0$. Acceptance indicates that the likelihood of debit card usage by people in that specific age or income group or branch has returned to its pre-lockdown level.

[7] We have also included interaction terms with educational level. However due to multicollinearity with the interaction terms with income we decided to exclude them from the analysis.

Payment preferences

Regarding payment preferences, we use a similar approach. We use a series of multinomial logit regression models to analyse consumers' payment preferences. First we run a regression with the set of controls and *lockdown: start* and *lockdown: end* to test the impact of the pandemic and accompanying measures on the likelihood of preferring particular payment instruments. Second, we include COVID-19 control variables. Third, we include interaction terms with the age and income dummies to test whether the effect of the pandemic differs for different age and income groups.

4. Regression results

4.1 Shift in payment behaviour towards more card payments

Our main finding is that the COVID-19 pandemic has led to an increase in the likelihood of a debit card transaction at the POS in the Netherlands at expense of cash, see Table 1 (column 2). Since the start of the lockdown on March 16 the likelihood that consumers use their debit card instead of cash has increased by 13 percentage points compared to debit card usage before the lockdown. This supports H1 "*COVID-19 and the accompanying measures have shifted payment behaviour at the POS during the lock-down: they resulted in a lower share of cash payments and a higher share of debit card payments*". The main part of the shift in payment behaviour still lasts seven months after the start of the lockdown as the Wald test testing based on: $\theta + \tilde{\theta}$=0 using the estimation results in column 3 Table 1 is rejected at the 1% level of significance (p=0.000). This supports H2 *"COVID-19 and the accompanying measures have had a long-lived effect on payment behaviour at the POS; the lower share of cash payments and higher share of debit card payments remained after the lockdown ended"*. From July 1 onwards the likelihood that consumers use the debit card for a POS transaction has fallen by only 5 percentage points, indicating that 8 percentage points of the initial 13 percentage points increase in debit card usage appears to be long-lived. As times goes by more information will become available on the temporary or permanent nature of the change.

When we include *COVID-19* and *June 1 ×COVID-19*, we see that the number of new COVID-19 infections correlates positively with debit card usage during the first months of the pandemic (column 3). For every newly infected person per day per 100 thousand inhabitants the likelihood that a purchase is paid with the debit card increases by 1 percentage point. However, after June 1, new infections do not seem to influence the likelihood of debit card usage anymore, as the

estimated effect of the interaction term *June 1 × COVID-19* is negative, and of the same order of magnitude as the effect of COVID-19. We use a Wald test to test whether the sum of these two variables differs significantly from zero or not. The results show that their cumulative effect does not differ significantly from zero. This finding suggests that before June 1 the number of new infections per day influenced people's payment behaviour at the POS, but that after June 1 the effect has become negligible. Furthermore, the estimated effects of the two lockdown dummies change only mildly. The marginal effect of *lockdown: start* is reduced by two percentage points to +11 percentage points and the marginal effect of *lockdown: end* changes from -5 percentage points to -4 percentage points. These results suggest that the larger part of the change in debit card usage from March onwards stems from the measures taken by the government, banks and retailers and that only a small part appears to be attributable to the actual spread of the COVID-19 virus among the Dutch.

Regarding the other control variables, most effects are as expected. All the effects as listed in columns 1-3 are average marginal effects for the entire period of our data. In column 4 we also show average marginal effects for age, income and branch interacted with the two lockdown dummies. We find that debit card usage decreases with age. For instance, consumers aged between 35 and 44 are 4 percentage points less probable to pay a POS transaction with the debit card than those aged between 12 and 24 (reference group, columns 1-3), while people of 65 and older are 17 percentage points less likely to use their debit card than the reference group. Furthermore, we find that the likelihood of using the debit card instead of cash increases with education and income. In addition, people who have a partner are 3 percentage points more likely to use their debit card for a POS payment than those without a partner. In addition, we find small effects for gender and having children. There are also regional differences. People living in the province Limburg (southern part of the Netherlands) are 9 percentage points less likely to use the debit card than those living in the province Noord-Holland (western part including the capital city Amsterdam; reference group), while people living in the province Flevoland are 4 percentage points more likely to use the debit card instead of cash.

Characteristics of the transaction and calendar effects matter. Debit card usage strongly increases with the transaction amount. For example, consumers are 25 percentage points more likely to use the debit card when the transaction amount is EUR 20 or higher than when the amount is EUR 5 or less (reference group). Debit card usage also strongly depends on the branch.

Table 1. COVID-19 and payment behaviour: logit regression results

Average marginal effects based on logit regressions

	(1) Baseline	(2) Lockdown	(3) See (2) + COVID-19 victims	(4) See (3) +Lockdown interaction terms with age and branch
	Debit card	Debit card	Debit card	Debit card
Lockdown: start		0.13***	0.11***	0.06*
Lockdown: end		-0.05***	-0.04***	0.01
COVID_19			0.01**	0.01**
June 1 X COVID_19			-0.01*	-0.01**
Male	0.01*	0.01	0.01*	0.01
Between 25 and 34	-0.02*	-0.02**	-0.02*	-0.01
X Lockdown: start				-0.02
X Lockdown: end				-0.03
Between 35 and 44	-0.04***	-0.04***	-0.04***	-0.04***
X Lockdown: start				0.01
X Lockdown: end				-0.01
Between 45 and 54	-0.08***	-0.08***	-0.09***	-0.08***
X Lockdown: start				0.05
X Lockdown: end				-0.08**
Between 55 and 64	-0.12***	-0.12***	-0.12***	-0.13***
X Lockdown: start				0.09***
X Lockdown: end				-0.06
65 and over	-0.17***	-0.17***	-0.17***	-0.18***
X Lockdown: start				0.10**
X Lockdown: end				-0.04
Education: low	-0.05***	-0.04***	-0.04***	-0.04***
Education: high	0.05***	0.05***	0.05***	0.05***
Income: low	-0.04***	-0.04***	-0.04***	-0.04***
X Lockdown: start				-0.05*
X Lockdown: end				0.01
Income: high	0.05***	0.05***	0.05***	0.05***
X Lockdown: start				-0.02
X Lockdown: end				0.01
Income: unknown	0.01**	0.01*	0.01*	0.01*
X Lockdown: start				0.01
X Lockdown: end				-0.01
Partner	0.03***	0.03***	0.03***	0.03***
Children	0.01	-0.01	-0.01	-0.01
Native	0.01	0.01	0.01	0.01
Province: Groningen	0.01	0.01	0.01	0.01
Province: Friesland	0.01	0.01	0.01	0.01
Province: Drenthe	-0.00	-0.00	-0.00	-0.00
Province: Overijsse;	-0.01	-0.01	-0.02*	-0.02**
Province: Gelderland	-0.01	0.01	-0.01	-0.01
Province: Utrecht	0.02***	0.03***	0.02***	0.02***
Province: Zuid-Holland	0.01	0.01*	0.01	0.01
Province: Zeeland	-0.03**	-0.03**	-0.03**	-0.03**
Province: Noord-Brabant	-0.02**	-0.02**	-0.02***	-0.02***
Province: Limburg	-0.09***	-0.09***	-0.09***	-0.09***
Province: Flevoland	0.04***	0.04***	0.04***	0.04***
Amount EUR 5–10	0.10***	0.10***	0.10***	0.10***
Amount EUR 10–20	0.16***	0.16***	0.16***	0.16***
Amount EUR 20 and over	0.25***	0.25***	0.25***	0.25***
Retail stores: food	-0.07***	-0.07***	-0.07***	-0.07***
X Lockdown: start				0.04*
X Lockdown: end				-0.02
Retail stores: non-food	-0.01***	-0.01***	-0.01***	-0.01***
X Lockdown: start				0.03
X Lockdown: end				-0.02
Petrol stations	0.04***	0.04***	0.05***	0.05***
X Lockdown: start				-0.11***
X Lockdown: end				0.10**
Vending machines	0.08***	0.08***	0.08***	0.08***
X Lockdown: start				-0.08*
X Lockdown: end				0.05

Table 1 continued

	(1) Baseline	(2) Lockdown	(3) See (2) + COVID-19 victims	(4) See (3) +Lockdown interaction terms with age and branch
	Debit card	Debit card	Debit card	Debit card
Street vending	-0.34***	-0.34***	-0.34***	-0.38***
X Lockdown: start				0.10***
X Lockdown: end				0.05
Cafes and restaurants	-0.09***	-0.09***	-0.09***	-0.09***
X Lockdown: start				0.07***
X Lockdown: end				-0.07**
Leisure	-0.20***	-0.20***	-0.20***	-0.20***
X Lockdown: start				0.18**
X Lockdown: end				-0.16*
Transport	-0.07***	-0.07***	-0.07***	-0.08***
X Lockdown: start				-0.03
X Lockdown: end				0.25**
Services	-0.28***	-0.28***	-0.27***	-0.26***
X Lockdown: start				-0.08**
X Lockdown: end				0.00
Monday	0.02***	0.02***	0.02***	0.02***
Tuesday	0.03***	0.03***	0.03***	0.03***
Wednesday	0.04***	0.03***	0.03***	0.03***
Thursday	0.03***	0.03***	0.03***	0.03***
Friday	0.04***	0.04***	0.04***	0.04***
Saturday	0.03***	0.03***	0.03***	0.03***
Trend	0.06***	0.03***	0.03***	0.03***
Pseudo R^2	0.127	0.131	0.131	0.133
Log-pseudolikelihood	-51,544.4	-51,337.6	-50,976.2	-50,860.7
Wald χ^2	7,359.9***	7,354.3***	7,428.0***	7,734.4**

Note: The number of observations is 93,343 in columns 1 and 2, and 92,660 in columns 3 to 4. The dependent variable is *debit card*. This variable equals 1 for debit card payments and 0 for cash payments. Debit payments include both traditional debit card payments, contactless payments with the debit card and contactless debit payments initiated via an app on people's smartphone. Standard errors are adjusted for clusters at respondent level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

Consumers are least likely to use the debit card and go for cash in case of street vending; the likelihood of debit card usage is 34 percentage points lower than in the supermarket (reference group). They are relatively the most likely to use the debit card at vending machines for drinks and snacks (+8 percentage points).

Regarding calendar effects, we find a strong effect for trend and moderate effects for day of the week. The variable trend shows that even without the pandemic, there is an upwards trend of increased debit card usage at the expense of cash. Without the inclusion of the two lockdown dummies, the estimated rise in the share of debit card payments is estimated at 6 percentage points (column 1). When the lockdown dummies are included (columns 2 - 4) the estimated yearly rise in the likelihood of debit card usage is 3 percentage points. These findings suggest that the pandemic appears to have triggered a rise in debit card usage within half a year time that would usually have taken around 2.5 years of time, as the average *trend* indicates a 3 percentage points

yearly rise in debit card usage (column 2).[8] Lastly, POS payments made at Fridays have the highest likelihood to be paid with the debit card, i.e. +4 percentage points compared to Sunday (reference day). At other days of the week, the likelihood for debit card usage is 3 percentage points higher compared to POS payments on Sundays.

We estimate pooled logit regressions including interactions with the lockdown dummies to gain more insight on the influence of the pandemic and accompanying measures on payment behaviour for different age and income groups of people, at different types of venues (Table 1, column 4). When including the interaction terms, the marginal effects of the two lockdown dummies decrease and amount to +6 percentage points for *lockdown: start* and +1 percentage point for *lockdown: end* (column 4). Only the former remains significant. These figures can be interpreted as follows: since the start of the lockdown the likelihood that a purchase done in the supermarket by a 12-24 year old with an intermediate household income l has increased by 6 percentage points, and there is no evidence of a partial turning back to cash after July 1 (see also the discussion of the Wald tests in Table 2).

The lockdown has had the strongest effect on the payment behaviour of elderly people. The estimated interaction effects with age show no significant difference in the way the lockdown has influenced debit card usage of the 25–44 year olds and the 12–24 year olds (reference group). However, the start of the lockdown has led to a 9 percentage points higher rise in the likelihood of debit card usage among people between 55–64 years of age than among younger people. For people aged 65 and over the impact on debit card usage is slightly higher, i.e. +10 percentage points. So elderly people, who rely relatively strong on cash, have reacted stronger on the beginning of the lockdown than younger people. For the interaction effects with *lockdown: end*, we find a significant effect for the 45–54 year olds. The likelihood that they pay with the debit card after July 1 reduced 8 percentage points more than for the reference group. For people older than 55 years we also find negative interaction effects, but these are not significant.

The impact of the lockdown differs by household income. The rise in the likelihood of debit card usage at the start of the lockdown is less steep for people in the lowest income group (-5 percentage points) than for people in the intermediate income group (reference group). There is no difference in the effect of the lockdown between people in the intermediate and the other two income groups.

[8] The yearly rise in the share of debit card payments on the total number of POS payments between 2017 and 2019 was 4 percentage points, indicating that not controlling for the Lockdown would have led to an overestimation of the yearly rise in relative debit card usage (DNB 2020a)

The impact of the lockdown also differs by branch. The initial rise in debit card usage is relatively stronger in cash intensive branches, like recreation and culture (+18 percentage points), street vending (+10 percentage points), cafes and restaurants (+7 percentage points) and specialized food stores (+4 percentage points) than in supermarkets (reference). In two of these branches debit card usage drops relatively strong after July 1, i.e. in recreation and culture by -16 percentage points and in cafes and restaurants by -7 percentage points, indicating a (partial) reversion to cash. In the other two branches, there is no significant evidence of a relatively stronger return to cash than in supermarkets. In three branches, the likelihood of using the debit card has dropped since the start of the lockdown relative to debit card usage in supermarkets: at petrol stations (-11 percentage points), in services (-8 percentage points) and at vending machines (-8 percentage points). For petrol stations and vending machines, this may be explained by the already high share of debit card payments prior to the lockdown (DNB 2020a). Inspection of the data shows that debit card usage hardly altered during the lockdown in these branches, reducing the gap in the share of debit card payments between them and the supermarkets where debit card usage did rise.

Using the estimation results from column 4 in Table 1, we test H1 and H2 by age, income and branch (see Table 2). For the reference group, the estimated effect of lockdown: start on the likelihood of debit card usage is positive and differs significantly from zero at the 10% level of significance, indicating that the likelihood that the reference transaction was paid with a debit card rose after the lockdown. The sum of the estimated effects of *lockdown: start* and *lockdown: end* is positive and differs significantly from zero, indicating that part of the increased debit card usage appears to persist. So both H1 and H2 are supported for the reference group. Furthermore, for the age group 25–34 years old the start of the lockdown – as measured by the cumulative effect of *lockdown: start* and *between 25 and 34* interacted with *lockdown: start* – does not have a significant impact on debit card usage. This also holds for the cumulative effect of the start and the end of the lockdown for this age group. These outcomes indicate that these people's debit card usage has not changed since the start of the pandemic. For the other age groups, we find a significant positive effect of the start of the lockdown on their usage of the debit card and – apart from the 45–54 year olds – also for the cumulative effect of the start and the end of the lockdown. These results indicate that, apart from the latter group, we find support for H1 and H2. People aged between 45 and 54 used the debit card more frequently just after the lockdown (H1), but the

change in their payment behaviour was just temporary. They have returned to their pre-pandemic payment habits.

Regarding income, the estimation results show that the likelihood of debit card usage by people who did not report their income rose at the start of the lockdown and that it has remained relatively high also after July 1. So, for this group we find support for H1 and H2. For people with a low income, the test results indicate that the pandemic has not changed their payment behaviour at the POS; their debit card usage remained low. People with a high income did not change their payment behaviour significantly at the start of the lockdown. However, the sum of the estimated effects of *lockdown: start and lockdown: end* for this group is positive and significantly different from zero, suggesting that during the pandemic, the likelihood that they pay with the debit card has risen. For them we find support for H2.

Table 2. Wald tests H1 and H2: Impact lockdown on debit card usage by age, income and branch

	Wald test H1		Wald test H2	
	Wald χ^2	p-value	Wald χ^2	p-value
Reference	3.52*	0.06	6.01**	0.01
Age (reference = between 12 and 24)				
Between 25 and 34	1.07	0.30	0.27	0.61
Between 35 and 44	7.52***	0.01	8.08***	0.01
Between 45 and 54	19.50***	0.00	1.68	0.20
Between 55 and 64	33.90***	0.00	15.37***	0.00
65 and over	49.00***	0.00	38.01***	0.00
Income (reference = income: middle)				
Income: low	0.22	0.64	1.09	0.30
Income: high	1.31	0.25	3.63*	0.06
Income: unknown	5.55**	0.02	6.64***	0.01
Branch (reference = supermarkets)				
Retail stores: food	6.78***	0.01	6.52**	0.01
Retail stores: non-food	6.61**	0.01	5.52**	0.02
Petrol stations	1.64	0.20	2.13	0.14
Vending machines	0.14	0.71	1.84	0.18
Street vending	14.88***	0.00	28.22***	0.00
Cafes and restaurants	11.78***	0.00	5.00**	0.03
Recreation and culture	7.80***	0.01	3.66*	0.06
Transport	0.10	0.75	9.08***	0.00
Services	0.32	0.57	0.13	0.72

Both in debit card intensive branches (petrol stations, vending machines, transport) and in services there is no significant impact of *lockdown: start*. This indicates that debit card usage has not changed in these branches since the start of the lockdown. For three of these four branches there is no significant cumulative effect of *lockdown: start* and *lockdown: end* either, indicating

that debit card usage has not changed during the lockdown, apart from the general trend. For transport the cumulative effect of *lockdown: start and lockdown: end* is significantly different from zero. In this branch the likelihood of a debit card payment has actually risen *after* July 1 (Table 1; column 4). For the branches specialised food stores, stores selling non-food, street vending, cafes and restaurants, and the recreation and culture branch both the start of the lockdown and the cumulative effect of *lockdown: start* and *lockdown: end* are significantly different from zero, indicating that debit card usage has risen since the start of the Lockdown (H1), and has stayed relatively high after July 1 (H2).

4.2 Shift in payment preferences towards more contactless payments

In this section, we study how stated preferences have changed due to COVID-19. The regression analyses show that the pandemic has increased the likelihood that someone prefers to pay contactless by debit card by 8 percentage points compared to before the lockdown (Table 3 column 1c), whereas the likelihood of preferring to use the debit card in a traditional way decreased with 6 percentage points (column 1b).[9] There is no significant effect of the pandemic and accompanying measures on the likelihood that people prefer to use cash (column 1a) and their mobile phone (column 1d). The variable trend shows that there is a trend of increased preference for contactless payments by phone at the expense of a preference for other payment instruments. We do not observe a reversal of payment preferences after the end of the lockdown. The likelihood that people prefer to pay contactless by debit card increased by an additional 4 percentage points after July 1, whereas the likelihood that someone prefers to use the debit card in a traditional way declined by an extra 2 percentage points. There is a 1 percentage point decrease in the likelihood that people prefer to pay with their mobile phone. All in all, these findings confirm that the pandemic has resulted in a shift in payment preferences towards more contactless payments in support of H3: *"As a result of COVID-19 and the accompanying measures the share of people who prefer to pay contactless at the POS has increased"*.

Regarding the control variables, most findings are in line with expectations. The likelihood that someone prefers to use the debit card in the traditional way (with PIN code) increases with age, whereas the likelihood of preferring to pay contactless decreases with age. Cash usage is most popular among people above 55. The likelihood of preferring cash and of preferring the debit card

[9] As an additional analysis, we looked at the payment preferences of the 1,446 people that participated in 2020 both before the start of the lockdown and afterwards and find similar pattern. The most frequent shift in payment preferences is from preferring to use the debit card in the traditional way to using it to pay contactless.

in a traditional way decreases with education and income, whereas the likelihood of preferring contactless payment methods increases with education and income. People with a partner are less likely to prefer to use cash than people without a partner. Natives are 2 percentage points more likely to prefer to pay contactless by debit card and 1 percentage point less likely to prefer to use a PIN code than non-natives. There are regional differences in payment preferences. For example, people living in Groningen, Friesland, Noord-Brabant and Limburg are less fond of paying contactless by debit card than inhabitants of the province Noord-Holland, whereas people living in Utrecht are frontrunners with respect to the preference for this payment instrument.

Table 3. COVID-19 and payment preferences: regression results

Average marginal effects based on multinomial logit regressions

	(1) Baseline				(2) With new infections			
	(a) Preference cash	(b) Preference debit card: traditional	(c) Preference debit card: contactless	(d) Preference mobile phone	(a) Preference cash	(b) Preference debit card: traditional	(c) Preference debit card: contactless	(d) Preference mobile phone
Lockdown: start	-0.01	-0.06***	0.08***	-0.00	-0.01	-0.07***	0.08***	-0.01
Lockdown: end	-0.00	-0.02**	0.04***	-0.01***	-0.00	-0.01	0.02**	-0.01*
COVID-19					-0.01	0.02	-0.01	0.00
June 1 X COVID-19					0.01	-0.02	0.02	-0.01
Male	-0.02***	-0.01	-0.01**	0.03***	-0.02***	-0.01	-0.01**	0.03***
Between 25 and 34	-0.02**	0.05***	-0.01	-0.01*	-0.02**	0.05***	-0.01	-0.01*
Between 35 and 44	0.04***	0.08***	-0.10***	-0.02***	0.04	0.08	-0.10	-0.02
Between 45 and 54	0.07***	0.09***	-0.14***	-0.03***	0.07***	0.09***	-0.14***	-0.03***
Between 55 and 64	0.10***	0.13***	-0.18***	-0.04***	0.10***	0.13***	-0.18***	-0.04***
65 and over	0.09***	0.17***	-0.20***	-0.06***	0.09***	0.17***	-0.20***	-0.06***
Education: low	0.07***	0.02***	-0.05***	-0.03***	0.07***	0.02***	-0.05***	-0.03***
Education: high	-0.05***	-0.02***	0.06***	0.01**	-0.05***	-0.02***	0.06***	0.01**
Income: low	0.08***	-0.02**	-0.06***	-0.00	0.08***	-0.02**	-0.06***	-0.00
Income: high	-0.08***	-0.02***	0.08***	0.03***	-0.08***	-0.02***	0.08***	0.03***
Income: unknown	0.03***	0.01	-0.04***	-0.00	0.03***	0.01	-0.04***	-0.00
Partner	-0.03***	0.01**	0.02***	0.00	-0.03***	0.01**	0.02***	0.00
Children	0.00	-0.00	-0.01	0.01**	0.00	-0.00	-0.01	0.01**
Native	-0.01	-0.01*	0.02***	-0.00	-0.01	-0.01*	0.02***	-0.00
Groningen	-0.00	0.04***	-0.03**	-0.01	-0.00	0.04***	-0.03**	-0.01
Friesland	0.00	0.06***	-0.05***	-0.01*	-0.00	0.06***	-0.05***	-0.01**
Drenthe	-0.01	0.04***	-0.01	-0.02**	-0.01	0.04***	-0.00	-0.02**
Overijssel	-0.01	0.02	0.00	-0.01*	-0.01	0.02	0.00	-0.01*
Gelderland	-0.02**	0.02***	0.00	-0.01**	-0.02**	0.02***	0.01	-0.01**
Utrecht	-0.04***	0.01	0.03***	-0.00	-0.04***	0.01	0.03***	-0.00
Zuid-Holland	-0.03***	0.03***	-0.00	0.00	-0.03***	0.03***	-0.00	0.00
Zeeland	-0.02	0.06***	-0.02	-0.02**	-0.02*	0.06***	-0.02	-0.02**
Noord-Brabant	-0.02***	0.06***	-0.03***	0.00	-0.02***	0.06***	-0.03***	-0.00
Limburg	0.01	0.09***	-0.09***	-0.01**	0.01	0.09***	-0.09***	-0.01**
Flevoland	-0.06***	0.05***	0.02	-0.01	-0.06***	0.05***	0.02	-0.01
Trend	-0.02***	-0.04***	-0.02*	0.07***	-0.02***	-0.04***	-0.02**	0.07***
Pseudo R^2	0.06				0.06			
Log-pseudolikelihood	-47119.3				-47110.0			
Wald χ^2	5451.6***				5445.0***			

Note: The dependent variable can take four values: 1 for respondents who prefer to use cash, 2 for respondents who prefer the debit card in a traditional way, 3 for respondents who prefer to pay contactless by debit card and 4 for respondents who prefer to pay contactless with their smartphone. The number of observations is 41,526. Data period: January 1 2019 – October 13 2020. Robust standard errors. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

Additional regressions indicate that the changes in payment preferences stem from the measures taken by the government, banks and retailers and are not caused directly by the fear of getting infected as the likelihood of preferring contactless does not relate significantly to the severity of the pandemic, which is proxied by the number of new infections by province. We run regressions with the inclusion of *COVID-19* and *June 1 X COVID-19* and still find a 8 percentage point increase in the share of people preferring to pay contactless by debit card after March 16, whereas the decrease in the share of people preferring to use the debit card with PIN code is now 7 percentage points instead of 6 (Table 3, part 2). Again, we find that the likelihood of preferring cash did not change significantly due to the lockdown. After July 1 the likelihood of preferring to pay contactless did not increase further.

Last, we find that the impact of the pandemic and the measures taken depends on the age and income of consumers. This is the outcome of an additional set of regressions in which we include interactions between the age dummies and lockdown dummies and between the income dummies and lockdown dummies. The results are in Table B.1 of Appendix B. The shift towards a stronger preference for contactless payments is most pronounced for people aged 65 and above. The effect of the pandemic and accompanying measures on the likelihood to prefer to pay contactless by debit card is 4 percentage points higher for people aged 65 and above than for people below 25. The impact of the lockdown on payment preferences does not depend on income.

4.3 The findings are robust

For both the regressions on debit card usage and on payment preferences we have conducted robustness checks. As a first robustness check for debit card usage we re-estimated equations 4 and 5, only using the payment transactions that were paid with the payment instrument that respondents wanted to use in the payment behaviour regressions and compare the outcomes with those reported in Table 1, columns 2 and 3. This allows us to test whether our initial findings on the overall impact of the lockdown, the spread of the COVID-19 and accompanying measures were mainly influenced by altered payment acceptance policies by retailers or not. For each payment respondents were asked to indicate whether they could pay with the payment instrument they wanted to use. Before the lockdown respondents could not pay with the desired payment instrument in less than 2% of the payments at the POS. During the first weeks of the lockdown this share increased, reaching a peak of 5% in the first half of April, but after a few weeks the share declined and returned to its pre-lockdown level of around 2%. Instead of using 93,343 payment

transaction for equation 4, we use 91,698 payment transactions made at the POS. For equation 5 we use 91,033 payments instead of 92,660 payments (Table C.1 in appendix C).

Again, for equation 4 we find that since the start of the lockdown the likelihood to pay with the debit card has increased by 13 percentage points, and that from July 1 onwards the likelihood of a debit card payment has dropped by 5 percentage points. Also for the re-estimation of equation 5 we only find small changes. The initial impact of the lockdown and the influence of the COVID-19 variables remain unaltered. Only the estimated effect of *lockdown: end* on the likelihood to pay with the debit card diminishes slightly from -4 percentage points to -3 percentage points. The majority of the estimated effects of control variables are unaltered. For both equation 4 and 5 the estimated effects for four controls changed, leading to an at most 1 percentage point change in estimated average marginal effects.

As a second test, we checked to what degree our findings are sensitive to the construction of *lockdown: start* and *lockdown: end*. In the baseline model *lockdown: start* takes the value 1 as of March 16. As alternatives we use *March 10* (the day of the CBL announcement to consumers to pay contactless), *March 19* (the day that the cumulative transaction limit of contactless payments was increased to EUR 100), and *March 24* (the day the transaction limit of contactless payments was increased to EUR 50). In addition to these three alternatives, we run regressions without *lockdown: end* and regressions with *June 15* instead of *lockdown: end*. By then travelling became easier.

Our results are robust to the use of these alternative start and ending dates. In all cases, we find that the pandemic resulted in a significant increase in the likelihood that consumers use the debit card which are in line with the effects in the baseline model (see Table C.2 in Appendix C). The effect of using alternative dates for the start of the lockdown on the likelihood of debit card usage ranges between +11 and +14 percentage points and the effect of using the alternative end date June 15 amounts -5 percentage points and - 6 percentage points. The effect of *lockdown: start* on the likelihood of debit card usage is +9 percentage points and +10 percentage points in the specification without the inclusion of *lockdown: end*. These effects are in line with the cumulative effect of *lockdown: start* and *lockdown: end* in the other specifications. This robustness test also confirms that payment preferences have shifted: the likelihood that people prefer to pay contactless has increased and the likelihood that they prefer to use the debit card with PIN code has declined (Table C.3 in Appendix C). The effect on the likelihood that people prefer to pay cash

ranges between 7 and 9 percentage points. In some cases we now find a significant decline in the likelihood that someone prefers cash by 1 or 2 percentage points.

5. Conclusion and discussion

We find that COVID-19 and the accompanying containment measures initially led to a 13 percentage points increase of the likelihood of debit card usage at the expense of cash usage. The impact of the pandemic on people's payment behaviour appears to be mainly triggered by the measures taken to control the pandemic. Only during the first months of the pandemic, the likelihood to pay with the debit card correlates positively with the number of new COVID-19 infections, but even then the larger part of the change in payment behaviour appears to be triggered by measures and not by increasing infections. In addition, for many people payment behaviour has not returned to pre-COVID-19 levels. The share of cash payments at the POS has only partially reversed since its lowest point in April 2020: seven months after the start of the first lockdown debit card usage is still 8 percentage points higher than before the lockdown. The lockdown did not have a homogeneous impact on people's payment behaviour; in some age and income groups debit card usage has hardly changed, whereas in other age groups, especially the people aged 55 and over, there is evidence of a stronger and more lasting effect. The impact of the pandemic also differs by branch. In most branches the pandemic has led to a lasting rise in debit card usage, but not in all branches, depending on the initial level of debit card usage and the way the branch has been affected and reacted on government measures.

Overall, we do not expect payment behaviour to return to its pre-pandemic level in the future as payment preferences of many people have changed. Substantially more people now prefer to pay contactless. The share of people preferring to use their debit card with a PIN code has declined greatly, whereas the share of people fond of cash usage only declined a bit. There are several possible interpretations for the persisting lower share of cash usage. People who prefer to use cash may have continued to pay electronically because of the fear of getting the virus. It could also be that they still perceive that storekeepers and other people do not want them to use cash. Paying electronically may be perceived as the new social norm. COVID-19, together with the accompanying containment measures, may have helped to break old social norms. A few prior studies show the importance of social norms for payment behaviour (van der Cruijsen and van der Horst 2019; van der Cruijsen and Knoben 2020). Another plausible explanation is that COVID-19 and the containment measures have helped people to break their cash habits. Prior research

already indicated that people who prefer to pay electronically find it hard to do so because of strong cash habits (van der Cruijsen et al. 2017).

Our findings provide a better understanding of how an external health shock and accompanying measures by the government, banks and retailers can shift payment behaviour and payment preferences. Within a few months' time, a long-lived change in payment behaviour appears to have taken place that, if we extrapolate pre-pandemic trends, normally would have taken 2.5 years. Compared to other external shocks, the impact of the pandemic on payment behaviour has been relatively large in magnitude and long-lasting in duration. The results indicate that a large shock can help break persistent payment habits.

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Appendix A. Description of variables

Table A.1 Description of variables in the payment behaviour regressions

Variable	Description	Mean	Sd	Min	Max	N
Dependent variables						
Debit card	Dummy (1=debit payment, 0=else).	0.63	0.47	0	1	93,343
Explanatory variables						
Lockdown: begin	Dummy (1=March 16 2020 and onwards, 0=before March 16).	0.18	0.38	0	1	93,343
Lockdown: end	Dummy (1=July 1 2020 and onwards, 0=before July 1).	0.09	0.29	0	1	93,343
COVID-19	Number of new infections per province per 100,000 inhabitants.	0.85	3.85	0	61.85	92,660
June 1 X COVID-19	*COVID-19* interacted with a binary dummy *June 1*, which equals 1 from June 1 2020.	0.66	3.75	0	61.85	92,660
Male	Dummy (1=male, 0=female).	0.46	0.50	0	1	93,343
Between 12 and 24	Dummy (1=age between 12 and 24, 0=else). Reference category.	0.11	0.31	0	1	93,343
Between 25 and 34	Dummy (1=age between 25 and 34, 0=else).	0.10	0.30	0	1	93,343
Between 35 and 44	Dummy (1=age between 35 and 44, 0=else).	0.16	0.37	0	1	93,343
Between 45 and 54	Dummy (1=age between 45 and 54, 0=else).	0.21	0.41	0	1	93,343
Between 55 and 64	Dummy (1=age between 55 and 64, 0=else).	0.19	0.40	0	1	93,343
65 and over	Dummy (1=age 65 and over, 0=else).	0.23	0.42	0	1	93,343
Education: low	Dummy (1= no education/primary school/VMBO/MBO/MAVO/HAVO/VWO (first 3 years), 0=else).	0.29	0.46	0	1	93,343
Education: middle	Dummy (1=MBO 2, 3, 4/MBO old or HAVO/VWO, 0=else). Reference category.	0.31	0.46	0	1	93,343
Education: high	Dummy (1=HBO/WO bachelor or WO/HBO, 0=else).	0.40	0.49	0	1	93,343
Income: low	Dummy (1=yearly gross household income less than EUR 23,400, 0=else or unknown).	0.17	0.37	0	1	93,343
Income: middle	Dummy (1=yearly gross household income ≥ EUR 23,400 and < EUR 51,300, 0=else or unknown). Reference category.	0.33	0.47	0	1	93,343
Income: high	Dummy (1=yearly gross household income ≥ EUR 51,300, 0=else or unknown).	0.27	0.45	0	1	93,343
Income: unknown	Dummy (1=yearly gross household income is unknown, 0=income is known).	0.23	0.42	0	1	93,343
Partner	Dummy (1=living together or married, 0=else).	0.64	0.48	0	1	93,343
Children	Dummy (1=household with kids living at home, 0=else).	0.32	0.46	0	1	93,343
Native	Dummy (1=native, 0 = non-native).	0.80	0.40	0	1	93,343
Noord-Holland	Dummy (1=living in the province Noord-Holland, 0=else). Reference category.	0.15	0.36	0	1	93,343
Groningen	Dummy (1=living in the province Groningen, 0=else).	0.04	0.18	0	1	93,343
Friesland	Dummy (1=living in the province Friesland, 0=else).	0.04	0.19	0	1	93,343
Drenthe	Dummy (1=living in the province Drenthe, 0=else).	0.03	0.17	0	1	93,343
Overijssel	Dummy (1=living in the province Overijssel, 0=else).	0.07	0.25	0	1	93,343
Gelderland	Dummy (1=living in the province Gelderland, 0=else).	0.11	0.31	0	1	93,343
Utrecht	Dummy (1=living in the province Utrecht, 0=else).	0.08	0.26	0	1	93,343
Zuid-Holland	Dummy (1=living in the province Zuid-Holland, 0=else).	0.22	0.41	0	1	93,343
Zeeland	Dummy (1=living in the province Zeeland, 0=else).	0.03	0.16	0	1	93,343
Noord-Brabant	Dummy (1=living in the province Noord-Brabant, 0=else).	0.15	0.36	0	1	93,343
Limburg	Dummy (1=living in the province Limburg, 0=else).	0.06	0.25	0	1	93,343
Flevoland	Dummy (1=living in the province Flevoland, 0=else).	0.03	0.17	0	1	93,343
Amount EUR 5 and less	Dummy (1=amount paid equals EUR 5 or less, 0=else). Reference category	0.27	0.44	0	1	93,343
Amount EUR 5–10	Dummy (1=amount paid lies between EUR 5–EUR 10, 0=else).	0.20	0.40	0	1	93,343
Amount EUR 10–20	Dummy (1=amount paid lies between EUR 10–EUR 20, 0=else).	0.22	0.42	0	1	93,343
Amount EUR 20 and over	Dummy (1=amount paid equals EUR 20 or higher, 0=else).	0.32	0.47	0	1	93,343
Supermarkets	Dummy (1=transaction in a supermarket, 0=else). Reference category.	0.40	0.49	0	1	93,343
Retail stores: food	Dummy (1=transaction in a food store, 0=else).	0.09	0.28	0	1	93,343
Retail stores: non-food	Dummy (1=transaction in a non-food store, 0=else).	0.18	0.38	0	1	93,343
Petrol stations	Dummy (1=transaction at a petrol station, 0=else).	0.06	0.24	0	1	93,343
Vending machines	Dummy (1=transaction at a vending machine, 0=else).	0.04	0.20	0	1	93,343
Street vending	Dummy (1=transaction in street vending, 0=else).	0.04	0.19	0	1	93,343
Cafes and restaurants	Dummy (1=transaction in a cafe or restaurant, 0=else).	0.13	0.34	0	1	93,343
Recreation and culture	Dummy (1=transaction for recreational or cultural purposes, 0=else).	0.02	0.15	0	1	93,343
Transport	Dummy (1=transaction related to transport, 0=else).	0.01	0.09	0	1	93,343
Services	Dummy (1=transaction in the services sector, 0=else).	0.03	0.16	0	1	93,343

Note: This table describes the variables used in the regressions reported in Table 1. The mean, standard deviation (sd), minimum (min), maximum (max), and number of payment transactions used (N) are reported for the sample included in these regressions. Unreported are summary statistics of *trend* and the dummies to control for the week of the day.

Table A.2 Description of dependent variable in payment preference regressions

Variable	Description	Mean	Sd	Min	Max	N
Payment preference	Variable capturing payment preferences (1=prefers to pay in cash, 2= prefers to pay by debit card with PIN code, 3=prefers to pay contactless by debit card, 4=prefers to pay contactless by mobile phone). To construct these variables, we use the answers to three survey questions. The first one is 'Under normal circumstances do you prefer paying by debit card or paying cash?' with answer options 'preference debit card', 'preference cash', and 'no preference/I cannot say'. People who answered 'no preference/I cannot say' got the follow-up question 'And if you had to choose between paying by debit card and cash, what would you prefer?' with possible answers 'preference debit card' and 'preference cash'. Based on these two questions the respondents with a preference for the debit card where asked what they prefer: 'paying by debit card using a PIN code', 'paying contactless with a debit card', 'paying contactless with a mobile phone', 'no preference'.	2.32	0.88	1	4	41,526

Note: This table describes the dependent variable used in the regressions reported in Table 3. The mean, standard deviation (sd), minimum (min), maximum (max), and number of payment diaries used (N) are reported for the sample included in these regressions.

Appendix B. Additional analyses

Table B.1. COVID-19 and payment preferences: with the number of new infections and interaction terms

Average marginal effects based on multinomial logit regressions

	(1) Preference cash	(2) Preference debit card: traditional	(3) Preference debit card: contactless	(4) Preference mobile phone
Lockdown: start	-0.02	-0.04	0.07***	-0.02*
Lockdown: end	0.02	-0.02	0.00	-0.00
COVID-19	-0.01	0.02	-0.01	0.00
June 1 X COVID-19	0.01	-0.02	0.02	-0.01
Male	-0.02***	-0.01	-0.01**	0.03***
Between 25 and 34	-0.04***	0.06***	-0.01	-0.01
X Lockdown: start	0.04	-0.05	-0.01	0.01
X Lockdown: end	0.01	-0.01	0.02	-0.02
Between 35 and 44	0.04***	0.08***	-0.10***	-0.02***
X Lockdown: start	0.03	-0.00	-0.03	0.00
X Lockdown: end	-0.05	0.02	0.02	0.01
Between 45 and 54	0.07***	0.09***	-0.13***	-0.03***
X Lockdown: start	0.03	-0.01	-0.03	0.01
X Lockdown: end	-0.02	0.00	0.02	-0.01
Between 55 and 64	0.09***	0.14***	-0.19***	-0.04***
X Lockdown: start	0.04**	-0.06**	0.02	0.00
X Lockdown: end	-0.03	0.01	0.03	-0.01
65 and over	0.11***	0.19***	-0.22***	-0.07***
X Lockdown: start	-0.01	-0.06**	0.05**	0.02
X Lockdown: end	-0.05*	0.01	0.03	-0.00
Education: low	0.07***	0.02***	-0.05***	-0.03***
Education: high	-0.05***	-0.02***	0.06***	0.01**
Income: low	0.08***	-0.02**	-0.06***	0.00
X Lockdown: start	0.00	0.00	0.01	-0.01
X Lockdown: end	-0.02	0.03	-0.00	-0.01
Income: high	-0.08***	-0.02**	0.08***	0.02***
X Lockdown: start	-0.01	-0.01	0.00	0.01
X Lockdown: end	0.02	-0.02	0.00	-0.00
Income: unknown	0.04***	0.01	-0.04***	-0.01
X Lockdown: start	-0.02	-0.01	0.02	0.01
X Lockdown: end	0.01	-0.01	-0.00	0.00
Partner	-0.03***	0.01**	0.02***	0.00
Children	0.00	-0.00	-0.00	0.01**
Native	-0.01	-0.01**	0.02***	-0.00
Groningen	-0.00	0.04***	-0.03**	-0.01
Friesland	-0.00	0.06***	-0.05***	-0.01**
Drenthe	-0.02	0.04***	-0.00	-0.02**
Overijssel	-0.01	0.02	0.00	-0.01*
Gelderland	-0.02**	0.02***	0.01	-0.01**
Utrecht	-0.04***	0.01	0.03***	-0.00
Zuid-Holland	-0.03***	0.03***	-0.00	0.00
Zeeland	-0.02*	0.06**	-0.02	-0.02**
Noord-Brabant	-0.02***	0.06***	-0.03***	-0.00
Limburg	0.01	0.09***	-0.09***	-0.01**
Flevoland	-0.06***	0.05***	0.02	-0.01
Trend	-0.02***	-0.04***	-0.02**	0.07***
Pseudo R^2		0.07		
Log-pseudolikelihood		-47053.7		
Wald χ^2		5585.5***		

Note: The dependent variable is *payment preferences*. The number of observations is 41,526. Data period: January 1 2019 - October 13 2020. Robust standard errors. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

Appendix C. Robustness

Table C.1. COVID-19 and payment behaviour: paid with the planned payment instrument

Average marginal effects based on logit regressions

	(1) Lockdown Debit card	(2) See (1) + COVID-19 Debit card	(3) see (1), but paid as planned Debit card	(4) see (2), but paid as planned Debit card
Lockdown: start	0.13***	0.11***	0.13***	0.11***
Lockdown: end	-0.05***	-0.04***	-0.05***	-0.03***
COVID-19		0.01**		0.01**
June 1 X COVID-19		-0.01*		-0.01*
Male	0.01*	0.01*	0.01*	0.01*
Between 25 and 34	-0.02*	-0.02*	-0.02*	-0.02*
Between 35 and 44	-0.04***	-0.04***	-0.04***	-0.04***
Between 45 and 54	-0.08***	-0.09***	-0.09***	-0.09***
Between 55 and 64	-0.12***	-0.12***	-0.12***	-0.12***
65 and over	-0.17***	-0.17***	-0.17***	-0.17***
Education: low	0.05***	-0.04***	-0.04***	-0.04***
Education: high	0.05***	0.05***	0.05***	0.05***
Income: low	-0.04***	- 0.04***	-0.04***	-0.04***
Income: high	0.05***	0.05***	0.05***	0.05***
Income: unknown	-0.01***	-0.01*	0.01*	-0.01*
Partner	0.03***	0.03***	0.03***	0.03***
Children	-0.01	-0.01	-0.01	-0.01
Native	0.01	0.01	0.01	0.01
Province: Groningen	0.01	0.01	0.01	0.01
Province: Friesland	0.01	0.01	0.01	0.01
Province: Drenthe	-0.00	-0.00	-0.00	-0.00
Province: Overijssel	-0.01**	-0.02*	-0.01	-0.02*
Province: Gelderland	-0.01*	-0.01	-0.00	-0.01
Province: Utrecht	0.03***	0.02***	0.03***	0.02***
Province: Zuid-Holland	0.01*	0.01	0.01*	0.01
Province: Zeeland	-0.03**	-0.03**	-0.03**	-0.03**
Province: Noord-Brabant	-0.02**	-0.02***	-0.02**	-0.02***
Province: Limburg	-0.09***	-0.09***	-0.09***	-0.09***
Province: Flevoland	0.04***	0.04**	0.04***	0.04**
Amount EUR 5–10	0.10***	0.10***	0.10***	0.10***
Amount EUR 10–20	0.16***	0.16***	0.16***	0.16***
Amount EUR 20 and over	0.25***	0.25***	0.25***	0.25***
Retail stores: food	-0.07***	-0.07***	-0.07***	-0.07***
Retail stores: non-food	-0.01***	-0.01***	-0.01***	-0.01***
Petrol stations	0.05***	0.05***	0.04***	0.05***
Vending machines	0.08***	0.08***	0.08***	0.08***
Street vending	-0.34***	-0.34***	-0.34***	-0.34***
Cafes and restaurants	-0.09***	-0.09***	-0.09***	-0.09***
Recreation and culture	-0.20***	-0.20***	-0.20***	-0.19***
Transport	-0.07***	-0.07***	-0.06***	-0.06***
Services	-0.28***	-0.27***	-0.26***	-0.26***
Monday	0.02***	0.02***	0.02***	0.02***
Tuesday	0.03***	0.03***	0.03***	0.03***
Wednesday	0.03***	0.03***	0.03***	0.03***
Thursday	0.03***	0.03***	0.03***	0.03***
Friday	0.04***	0.04***	0.04***	0.04***
Saturday	0.03***	0.03***	0.03***	0.03***
Trend	0.03***	0.03***	0.03***	0.03***
Pseudo R^2	0.131	0.131	0.132	0.133
Log-pseudolikelihood	-51,337.6	-50,976.2	-50,230.5	-49,879.4
Wald χ^2	7,354.3***	7,428.0***	7,272.5***	7,348.5***

Note: The number of observations is 93,343 in column 1, 92,660 in column 2, 91,698 in column 3, and 91,033 in column 4. The dependent variable is *debit card*. This variable equals 1 for a debit payment and 0 for a cash payment. Debit payments include both traditional debit card payments, contactless payments with the debit card and contactless debit payments via an app on people's smartphone. Standard errors are adjusted for clusters at respondent level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

Table C.2. COVID-19 and payment behaviour: alternative timing of event dummies

Average marginal effects based on binomial logit regressions

		(1) Lockdown Debit card	(2) See (1) + COVID-19 Debit card
Baseline model	Lockdown: start	0.13***	0.11***
	Lockdown: end	-0.05***	-0.04*
	COVID-19		0.01**
	June 1 X COVID-19		-0.01*
Alternative 1	March 10	0.13***	0.11***
	Lockdown: end	-0.05***	-0.03**
	COVID-19		0.01**
	June 1 X COVID-19		-0.01*
Alternative 2	March 19	0.13***	0.12***
	Lockdown: end	-0.06***	-0.04*
	COVID-19		0.01**
	June 1 X COVID-19		-0.01*
Alternative 3	March 24	0.14***	0.12***
	Lockdown: end	-0.06***	-0.04**
	COVID-19		0.01***
	June 1 X COVID-19		-0.01**
Alternative 4	Lockdown: start	0.10***	0.09***
	COVID-19		0.01***
	June 1 X COVID-19		-0.01**
Alternative 5	Lockdown: start	0.14***	0.13***
	June 15	-0.06***	-0.05**
	COVID-19		0.00
	June 1 X COVID-19		-0.00

Note: The dependent variable is *debit card*. The same set of control variables is included as in Table 1 model 2, respectively model 3. The number of observations is 93,343, respectively 92,660. Data period: January 1 2018 - October 13 2020. Standard errors are adjusted for clusters at respondent level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

Table C.3. COVID-19 and payment preferences: alternative timing of event dummies

Average marginal effects based on multinomial logit regressions

		(1)				(2)			
		(a) Preference cash	(b) Preference debit card: traditional	(c) Preference debit card: contactless	(d) Preference mobile phone	(a) Preference cash	(b) Preference debit card: traditional	(c) Preference debit card: contactless	(d) Preference mobile phone
Baseline model	Lockdown: start	-0.01	-0.06***	0.08***	-0.00	-0.01	-0.07***	0.08***	-0.01
	Lockdown: end	-0.00	-0.02**	0.04***	-0.01***	-0.00	-0.01	0.02**	-0.01*
	COVID-19					-0.01	0.02	-0.01	0.00
	June 1 X COVID-19					0.01	-0.02	0.02	-0.01
Alternative 1	March 10	-0.01	-0.06***	0.08***	-0.00	-0.01	-0.07***	0.08***	-0.00
	Lockdown: end	-0.00	-0.02***	0.04***	-0.01***	-0.00	-0.02*	0.03***	-0.01**
	COVID-19					-0.01	0.02	-0.01	0.00
	June 1 X COVID-19					0.01	-0.02	0.02	-0.01
Alternative 2	March 19	-0.01*	-0.06***	0.08***	-0.00	-0.01	-0.07***	0.08***	-0.00
	Lockdown: end	-0.00	-0.02**	0.04***	-0.01***	-0.00	-0.01	0.02**	-0.01**
	COVID-19					-0.01	0.02	-0.01	0.00
	June 1 X COVID-19					0.00	-0.02	0.02	0.00
Alternative 3	March 24	-0.02**	-0.06***	0.08***	-0.00	-0.01*	-0.06***	0.08***	-0.00
	Lockdown: end	-0.00	-0.02**	0.03***	-0.01***	0.00	-0.02	0.02**	-0.01**
	COVID-19					-0.01	0.01	-0.00	0.00
	June 1 X COVID-19					0.00	-0.01	0.01	-0.00
Alternative 4	Lockdown: start	-0.01	-0.07***	0.08***	-0.00	-0.01	-0.08***	0.09***	-0.01*
	COVID-19					-0.01	0.03**	-0.03**	0.01
	June 1 X COVID-19					0.01	-0.03***	0.04***	-0.01**
Alternative 5	Lockdown: start	-0.01	-0.06***	0.07***	-0.00	-0.00	-0.07***	0.08***	-0.01
	June 15	-0.01	-0.02***	0.04***	-0.01**	-0.01	-0.02	0.03**	-0.00
	COVID-19					-0.02	0.02	-0.01	0.01
	June 1 X COVID-19					0.01	-0.02	0.02	-0.01

Note: The dependent variable is *payment preferences*. The same set of control variables is included as in Table 3 model 1. The number of observations is 41,526. Data period: January 1 2019 - October 13 2020. Robust standard errors. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10 level respectively.

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