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at point-of-sale: their
drivers

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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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Changing payment patterns at point-of-sale: their drivers*

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Abstract

Based on household surveys from 2004 and 2014 we show how payment patterns in the Netherlands have changed. This data is unique because it covers a long time span and includes detailed information on payment behaviour per point-of-sale (POS). In this period the usage of the debit card has increased sharply. Perceived characteristics of payment instruments have affected both their adoption and the intensity by which they are used. Of these, user-friendliness and safety are the most important drivers of the adoption of electronic payment instruments. Socio-demographic determinants of payment instrument adoption are quite robust over time. However, we find that the relevance of payment characteristics and socio-demographic characteristics for the intensity of use of payment instruments varies per POS and over time when instruments get generally adopted. Overall, user-friendliness is still the most important aspect and safety and speed remained relevant aspects, whereas costs are the least important aspect for the intensity by which payment instruments are used.

Keywords: payment patterns, cash, debit card, credit card, households, survey data.

JEL classifications: C25, D12.

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1. Introduction

Over the past decade, payment patterns in the Netherlands have changed considerably. Consumers' use of the debit card has increased, while the number of cash payments has diminished. This has had implications for the social costs of point-of-sale (POS) payments. Research has shown that a move to electronic means of payment can result in considerable cost savings (Brits and Winder 2005, Danmarks Nationalbank 2012, and Segendorf and Jansson 2012). In the Netherlands social costs of debit card payments are lower than those of cash payments (Jonker 2013). The replacement of cash by debit card payments has therefore contributed positively to the efficiency of Dutch POS payments. Besides costs, retailers have an interest in reducing cash payments for security reasons. It is therefore useful for both researchers and stakeholders to know what the drivers behind these payment patterns are.

The market for card payments is an example of a two-sided market, with two distinct groups of end-users: merchants and consumers. Growth in the number of card payments depends both on card acceptance by merchants and on adoption and usage of payment cards by consumers. A large body of literature has studied the optimal price structure between these two groups of users (see Bolt 2013). In two-sided industries, different prices tend to be applied to each user group, the least price-sensitive side subsidizing the other (Evans 2003, Bolt and Chakravorti 2008). In most payment systems this results in only fixed adoption fees for consumers, while merchants pay transaction fees (Guibourg and Segendorf 2007, Evans 2011). Unless merchants pass on these fees to consumers in the form of surcharges (see Bolt, Jonker and Van Renselaar 2010), this means there are no financial incentives steering consumers towards socially efficient payment behaviour (Jonker 2013).

However, there are many other factors influencing consumers' payment behaviour, which have also attracted considerable interest worldwide (see Kosse (2014) for an up-to-date overview). The basis for this mainly empirical research is that consumers with heterogeneous preferences (related to e.g. opportunity costs, habits and openness to new technologies) choose between payment instruments with different costs and benefits. In general, it has been shown that the way consumers pay is influenced by demographic and transaction characteristics¹, as well as perceptions of e.g. security, cost and convenience of the available payment instruments.²

¹ See e.g. Arango et al. (2011), Borzekowski et al. (2008), Bounie and Francois (2006), Deutsche Bundesbank (2012), Klee (2008), Kosse, and Jansen (2013), Koulayev et al. (2013), Ossolinski et al. (2014), Schuh and Stavins (2010), Schuh and Stavins (2013), Stavins (2001), Von Kalckreuth et al. (2014b), Wakamori and Welte (2012).

² See e.g. Arango et al. (2011), Jonker (2007), Kosse (2013), Koulayev et al. (2013), Schuh and Stavins (2010, 2013), Wakamori and Welte (2012).

Card usage generally increases with education and income level, and tends to be lower among the elderly (although Von Kalckreuth et al. (2014b) find that most age-related differences can be explained by differences in other characteristics). Additionally, consumers use cash more often for lower transaction amounts, in sectors with mostly low-value purchases, and when other payment instruments are surcharged or not accepted at all. Regional differences have also been found in some studies (Borzekowski et al. 2008, Ossolinski et al. 2014, and Stavins 2001). When it comes to drivers of changing payment patterns over time, the Deutsche Bundesbank (2012) found that while there were some changes in payment behaviour between 2008 and 2011, consumers' preferences regarding payment instruments in specific retail locations and situations remained stable, as did the ranking of criteria for choosing which payment instrument to use and the effects of demographic factors. In Germany the main criteria for choosing which payment instrument to use remained the amount of cash in one's pocket. Similarly, Klee (2006) found that during a time of significant changes in adoption and use of payment instruments, the effects of demographic characteristics generally remained the same.

In this study we show how payment patterns and their determinants have changed during the past decade in the Netherlands. The fact that our data covers a long time span is a key advantage, since it often takes a long time before use of a new payment instrument becomes widespread. Network effects are one reason for this, but learning costs, lack of familiarity and the need to invest in software, POS devices and training are also contributing factors (Berger, Hancock and Marquardt 1996, Farrell and Klemperer 2003). According to the theory of diffusion of innovations, consumers have different appetites for adopting new technologies. This results in an S-shaped adoption curve, starting with a small group of early movers, then moving through an acceptance stage in which adoption accelerates, and finally the maturity stage where the adoption rates slows down until the saturation point is reached (Rogers 2003). Moreover, due to persistent habits the shift from cash to card payments may be slow even among those consumers who have a preference for cards (Van der Crujisen, Hernandez and Jonker 2015 and Van der Horst and Matthijsen 2013).

Another advantage of our data is that it includes detailed information per POS. We are therefore able to check to what extent the determinants of payment behaviour are robust over time and whether there are differences between POS. In contrast to Deutsche Bundesbank (2012) we estimate formal models and include perceptions of payment instruments as explanatory variables. A key advantage compared to Klee (2006) is also the inclusion of

perceptions and the fact that we do not only have detailed information on the adoption of payment instruments but also on the intensity of use.

The research questions that we address in this study are as follows:

- (1) How have payment patterns changed the past decade?
- (2) How is the adoption and intensity of use of payment instruments related to perceptions of their characteristics and socio-demographic characteristics?
- (3) Do these relationships depend on the POS?
- (4) How robust are these relationships over time?

Our key findings are as follows. First, we find that adoption rates did not change much since 2004 but that there were strong shifts in the intensity of use of payment instruments. The adoption of the debit card remained high and consumers have been paying more and more by debit card instead of cash. The adoption of the credit card increased from 49% of the respondents to 55% of the respondents. Second, both the adoption and intensity of use of payment instruments depend on perceptions of payment instrument characteristics as well as socio-demographic factors. Perceived user-friendliness, safety, and speed are stronger related to payment behaviour than perceived costs. Third, these relationships strongly vary across POS. Fourth, we also find significant changes over time. Relations depend on the adoption stage of payment instruments. For example, several socio-demographic factors have become unrelated to the intensity of debit card usage now that paying by debit card has been generally adopted. Furthermore, the importance of regional variables has increased. To steer payment behaviour effectively it is key that one knows of whom and where one is trying to influence payment behaviour. It is important to have up-to-date information because relationships change over time.

Our paper proceeds as follows. In Section 2 we present our data and describe how payment patterns have changed the past decade. In Section 3 we discuss the empirical models that we will use to study payment behaviour. Our findings on the adoption and intensity of usage of payment instruments are presented in Section 4. Section 5 we show the results of regressions that give insight into how determinants of payment behaviour vary between POS. We end this paper with a conclusion in Section 6.

2. Payment patterns: 2014 versus 2004

2.1 Data

Based on two surveys among the Dutch CentERpanel, one in 2004 and one in 2014, we research how payment behaviour has changed over the past decade. We study both changes in the adoption rate of payment instruments and changes in the intensity by which payment instruments are used. The dataset is rich. It includes information on payment behaviour at different POS but also information on a broad set of socio-demographic variables and consumers' perceptions of the characteristics of payment instruments.³ Using this information we can analyse how perceived costs, transaction speed, safety, user-friendliness and acceptance of various payment instruments changed and to what extent their importance for payment behaviour has changed. The 2004 survey distinguished eight types of POS, whereas the classification in the 2014 survey was even more detailed: fourteen types of POS.

The CentERpanel is an internet panel that is representative for the Dutch population and is run by Tilburg University's CentERdata. Members of this panel answer annual sets of standard questions, the DNB Household Survey (DHS), which includes questions to gather background information.⁴ They also answer additional ad-hoc questionnaires. The CentERpanel has been used frequently to study all kind of topics, e.g. financial literacy, retirement planning and household wealth (Van Rooij et al., 2012) and the impact of the crisis on saving behaviour (Van der Crujssen et al., 2012). It has also been used before to study payment behaviour, for example Jonker (2007) studied perceptions of payment instruments whereas Hernandez et al. (2014) examined the role of budget control in affecting payment behaviour.

2.2 Adoption of electronic payment instruments

In 2004 and 2014 we have asked Dutch consumers which payment instruments they have adopted. Table 1 summarizes the results. The first line reports the adoption rates for consumers in general, whereas the remainder of the table shows the adoption rates by socio-demographics. In 2004 the adoption of the debit card, e-purse, credit card, fuel card and other electronic payment instruments was measured. In 2014 respondents indicated whether they had a Dutch

³ See Appendix A for the survey questions.

⁴ Panel members without internet access are provided with special terminals. For more information see http://www.centerdata.nl/en/TopMenu/Projecten/DNB_household_study/index.html.

debit card that can also be used abroad, a foreign debit card from a bank from another euro country, and/or a mobile phone that can be used to pay in stores.

Table 1. Adoption of electronic payment instruments

	2004						2014				
	debit card	e-purse	credit card	fuel card	other	none	Dutch debit card	foreign debit card	credit card	mobile	none of these
Total	98%	55%	49%	16%	3%	1%	98%	2%	55%	3%	1%
Gender											
female	98%	51%	36%	9%	2%	2%	98%	2%	45%	3%	1%
male	99%	58%	60%	21%	4%	1%	98%	3%	64%	4%	1%
Age											
15 - 24	96%	47%	7%	1%	3%	4%	98%	1%	8%	4%	2%
25 - 34	100%	72%	53%	22%	3%	0%	100%	1%	56%	5%	0%
35 - 44	99%	57%	52%	15%	2%	1%	99%	2%	62%	4%	0%
45 - 54	98%	49%	53%	20%	2%	1%	98%	3%	55%	1%	1%
55 - 64	99%	54%	56%	16%	4%	1%	97%	3%	55%	3%	2%
65 or over	97%	47%	50%	10%	4%	2%	97%	2%	54%	2%	2%
Education											
primary school	95%	39%	14%	5%	2%	4%	96%	4%	24%	3%	3%
preparatory intermediate vocational	97%	46%	37%	12%	2%	2%	97%	4%	37%	3%	2%
secondary pre-university	99%	55%	49%	14%	2%	1%	98%	2%	53%	4%	2%
intermediate vocational	99%	57%	45%	19%	4%	1%	98%	2%	48%	3%	1%
higher vocational	99%	64%	66%	20%	4%	1%	99%	1%	67%	4%	1%
university	100%	59%	75%	19%	3%	0%	100%	2%	76%	2%	0%
Status											
single	98%	54%	57%	10%	4%	1%	97%	2%	54%	3%	2%
(un)married living together, no children	99%	58%	55%	16%	3%	1%	99%	3%	57%	3%	1%
(un)married living together, children	98%	52%	41%	19%	3%	2%	98%	1%	55%	3%	1%
single, children	98%	55%	43%	4%	0%	0%	100%	5%	41%	10%	0%
other	100%	50%	22%	0%	0%	3%	94%	8%	48%	0%	2%
Household income											
<= EUR 1150	96%	46%	34%	6%	1%	2%	97%	5%	33%	2%	3%
EUR 1151 - EUR 1800	99%	49%	39%	12%	3%	1%	97%	1%	35%	2%	1%
EUR 1801 - EUR 2600	99%	57%	44%	15%	3%	1%	98%	2%	50%	3%	1%
> EUR 2600	99%	58%	62%	20%	3%	1%	99%	2%	65%	4%	1%
missing	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	100%	0%	0%	0%	0%

Source: CentERpanel.

Note: None = I don't have electronic payment instruments; Dutch debit card = Dutch debit card that can also be used abroad; foreign debit card = foreign debit card from a bank from another euro country; mobile = mobile that can be used to pay in stores; None of these = none of the above payment instruments; n.a. = not available. The number of observations is 2019 in 2004 and 2634 in 2014.

The adoption of the debit card is high; already in 2004 98% of the respondents had a debit card. The adoption rate of the debit card did not change much during the last decade and does not vary a lot with demographic characteristics. The debit card was introduced in 1987 to withdraw money from automated teller machines (ATMs) and in 1990 the first payment

terminals were installed at shops. There are no withdrawal fees and for usage of the debit card within the euro area consumers don't have to pay their bank transaction fees.

The story is different for the credit card. This payment instrument is adopted by far fewer consumers. However, its adoption rate did increase from 49% in 2004 to 55% in 2014. The adoption rate of females increased stronger than the adoption rate of males but the credit card is still more popular among males. Especially for consumers aged 24 or under it is uncommon to have a credit card. Adoption of the credit card increases with income and education. Consumers with a credit card pay a periodical fee to their bank.

In the Netherlands a fuel card is in the name of a company and mostly used for driving for business purposes. It is especially popular among leased car drivers. In 2004 18% of the respondents had a fuel card. It was adopted by more male respondents than female respondents and its adoption is positively related to household income and the level of education. Unsurprisingly, this payment instrument was adopted relatively little by respondents in the lowest and highest age class because they are less likely to work and therefore have a leased car.

In 2004 55% of the respondents had an e-purse. The aim of the e-purse, which was introduced in 1996 and mainly used in the catering industry, at vending machines and for car parking, was to be used for low-value transactions. Only the customers of one large bank – the Postbank – had to make a specific choice whether to adopt the e-purse or not on a separate card for an extra fee. For customers of other banks the e-purse was a standard functionality on their bank cards, so adopting the debit card automatically meant adopting the e-purse as well. Nevertheless, respondents who never used the e-purse function may have given a negative answer to the adoption question. Moreover, some respondents may not have been aware that they owned an e-purse.⁵ From 2009 onwards, all banks in the Netherlands included the e-purse on bank cards.

The option to use contactless cards was introduced in 2014. The number of contactless POS terminals is expected to increase, in particular in sectors where transaction speed is important (Dutch Payments Association 2014). These terminals are currently mostly used for contactless card payments, but can be used for mobile payments as well.

⁵ Previous studies have shown that a difference between perceived and actual ownership of payment instruments may exist. Deutsche Bundesbank (2012) found that although the actual prevalence of the GeldKarte increased between 2008-2011, perceived ownership among consumers remained the same. Borzekowski et al. (2008) suggest a similar gap between perceived and actual ownership for debit cards in the US.

In 2014 only 1% of the respondents indicated not using any of the listed electronic payment instruments. Already in 2004 the share of respondents without any electronic payment instruments was this low.

2.3 Intensity of use of payment instruments

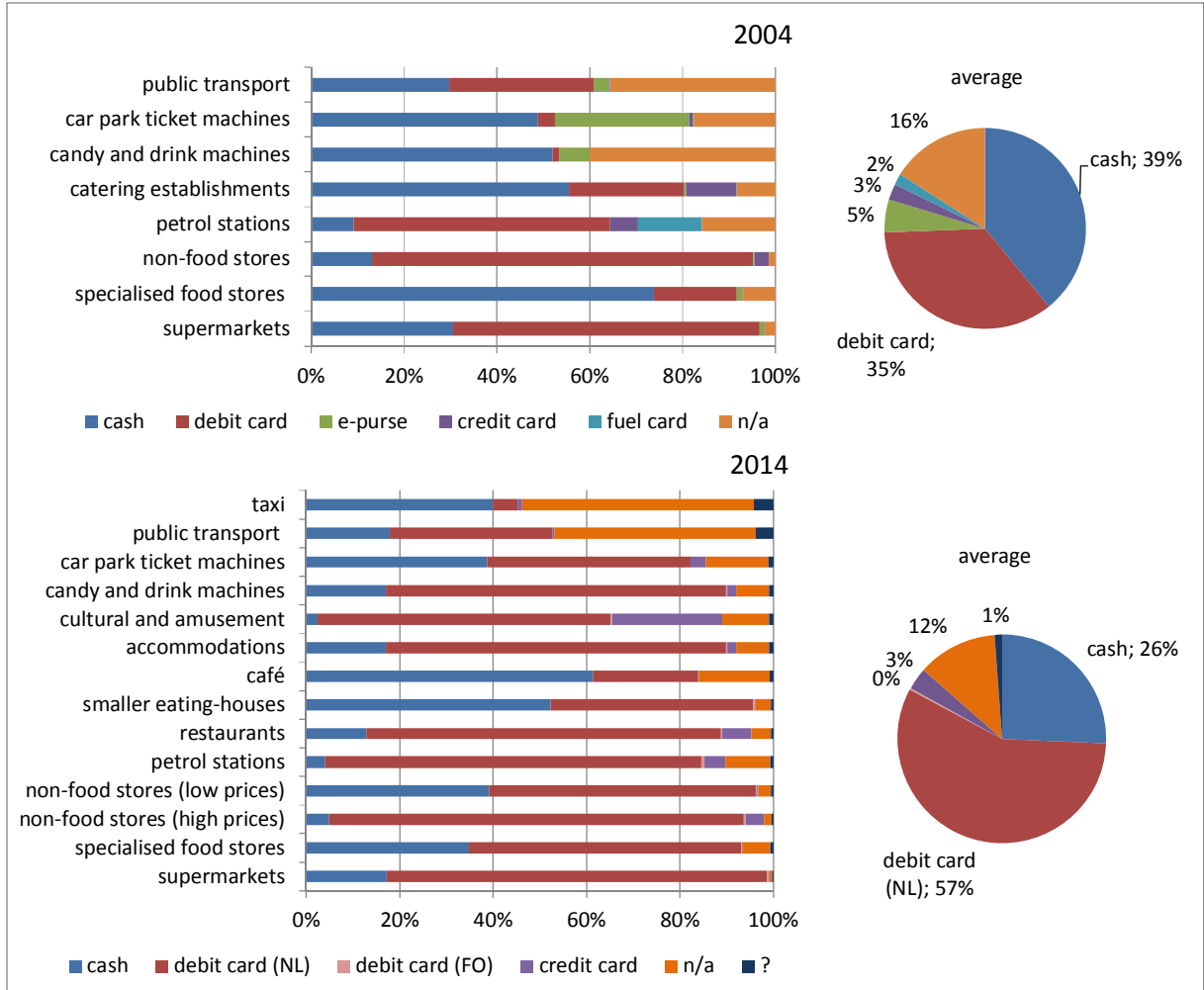
Respondents have reported which payment instruments they mostly use at various POS. For 2004 we have information on payment behaviour at supermarkets, specialised food stores (e.g. butcher and bakery), non-food stores (e.g. clothes and music), petrol stations, catering establishments, candy and drink machines, car park ticket machines and ticket sales for public transport. Respondents could answer they mostly used cash, the debit card, e-purse, credit card, fuel card or indicate that they never visited the particular POS. For 2014 we have even more detailed information. The non-food stores are divided in stores with low-priced products (e.g. souvenirs, flowers and tobacco) and high-priced products (e.g. clothes and music). Furthermore, the catering establishments are split in restaurants, smaller eating-houses (e.g. for lunch and snacks), cafés and accommodations (e.g. hotels, apartments). It is also measured how consumers mostly pay for culture and amusement (e.g. theatre, museum, cinema and amusement park) and for a taxi. Respondents could opt that they mostly used cash, a Dutch debit card, a foreign debit card or a credit card. Alternatively, they could either answer that they never visited the particular POS or that they don't recall which payment instrument they mostly used.

We find that cash has yielded pride of place to the debit card (see figure 1). In 2004, on average over all POS, 39% of the respondents mostly used cash. It was particularly the preferred payment method at specialised food stores and catering establishments. A decade later, again on average over all POS, only 26% of the respondents mostly used cash. The picture per POS is diverse: a majority of consumers still uses cash more intensively than electronic alternatives at cafés or smaller eating-houses. The last decade debit card usage increased sharply. This phenomenon is widespread. In 2014, on average over all POS, 57% of the consumers mostly used the debit card. It is especially common to pay by debit card for expensive products in non-food stores, in supermarkets and at petrol stations.

In contrast, the credit card is not used intensively in the Netherlands. The past decade its usage was relatively stable. 24% of the consumers mostly use the credit card when paying for cultural activities and amusement. At other POS it is not intensively used. Figure 1 shows that the e-purse is also not used intensively. The intensity by which it is used declined the past few years and its acceptance is fairly low and declining quickly (Panteia 2013). Its usage has ended

by the end of 2014. The debit card has become a good alternative to pay low amounts electronically. Mass-media campaigns that were launched by the Foundation for Efficient payments such as “Small amount? Debit card allowed” have further stimulated the usage of the debit card (Jonker et al. 2015). These campaigns informed consumers and small and medium sized merchants that debit card payment cards are safer and also often less costly than cash payments (Panteia 2013).

Figure 1. Most frequently used payment instruments



Source: CentERpanel.

Note: The number of observations is 2019 in 2004 and 2634 in 2014.

Our data on stated payment behaviour reflects developments in actual payment behaviour well.⁶ We have contrasted our findings to these from monitoring studies by De

⁶ Although stated behaviour differs from actual behaviour (Van der Crujzen et al., 2015), our key interest is in

Nederlandsche Bank and the Dutch Payments Association (DNB/DPA 2014) and The National Forum on the Payment System (2014). These studies show that in 2013 Dutch consumers mostly used cash at the POS: 3.8 billion times with a total value of EUR 46 billion. The debit card came in second place. Almost 2.7 billion times (EUR 85 billion) it was used. The e-purse and credit card were used much less intensively; the e-purse 121 million times (EUR 0.3 billion) and the credit card 38 million times (EUR 4 billion). By comparison, in 2002, the total number of cash payments at the POS was 7.1 billion, while the debit card was used 1.1 billion times, the e-purse 87 million times and the credit card 47 million times (National Forum on the Payment System 2004).

2.4 Intensity measures

We construct various intensity measures: *cash intensity*, *Dutch debit card intensity*, *foreign debit card intensity*, *credit card intensity*, *e-purse intensity*, and *fuel card intensity*. To clarify how we make these variables we take *cash intensity* as an example. The other intensity measures are constructed in a similar way. First we create for each respondent a set of cash dummies $cash\ dummy_{POS}$ that are 1 for respondents who most often pay by cash at a particular POS and 0 if they mostly pay otherwise. When respondents report that they don't visit the POS or that they don't recall which payment instrument they most-often use the value is set at missing. N is the total number of POS that a respondent visits. Next, we take the average value of these dummies as described by equation 1.

$$Cash\ intensity = \left(\sum_{POS=1}^{POS=N} cash\ dummy_{POS} \right) / N \quad (1)$$

Table 2 summarizes the average outcomes of these indicators, whereby the intensity measures are expressed in percentages. Cash was the mostly used payment instrument in 2004; on average respondents chose at 47% of the POS that they encountered to mostly use cash. Cash usage has clearly decreased. Currently, the average respondent mostly uses cash in 34% of the sketched situations that apply to them. Especially among respondents of 24 years or under the intensity of use of cash decreased. In contrast to a decade ago, they are now less intensively using cash than respondents of 45 years and above. Cash intensity also decreased strongly

explaining developments over time.

among respondents who only completed primary school. Cash usage is still negatively related to the level of education and income.

Table 2. Intensity of use of payment instruments by Dutch consumers

	2004					2014			
	cash	debit card	e-purse	credit card	fuel card	cash	Dutch debit card	foreign debit card	credit card
Total	47%	42%	6%	3%	2%	34%	62%	0%	4%
Gender									
female	46%	45%	5%	2%	1%	34%	63%	0%	3%
male	47%	40%	6%	4%	3%	35%	60%	0%	5%
Age									
15 - 24	61%	34%	5%	0%	0%	33%	67%	0%	0%
25 - 34	42%	45%	8%	2%	3%	29%	67%	0%	3%
35 - 44	46%	43%	6%	3%	2%	30%	66%	0%	4%
45 - 54	45%	43%	6%	3%	3%	38%	57%	0%	4%
55 - 64	45%	43%	7%	4%	2%	37%	59%	0%	4%
65 or over	48%	41%	5%	4%	1%	38%	58%	0%	4%
Education									
primary school	63%	32%	3%	1%	1%	41%	57%	0%	2%
preparatory intermediate vocational	48%	42%	5%	3%	2%	39%	59%	0%	2%
secondary pre-university	45%	44%	6%	3%	2%	36%	60%	0%	4%
intermediate vocational	47%	43%	6%	3%	2%	35%	62%	1%	2%
higher vocational	41%	45%	8%	4%	2%	31%	64%	0%	5%
university	44%	43%	7%	4%	2%	30%	64%	0%	6%
Status									
single	48%	42%	6%	3%	1%	38%	58%	0%	3%
(un)married living together, no children	44%	43%	6%	4%	2%	35%	61%	0%	4%
(un)married living together, children	48%	42%	6%	2%	2%	32%	64%	0%	4%
single, children	53%	41%	4%	2%	1%	32%	67%	0%	1%
other	50%	40%	6%	3%	0%	38%	58%	0%	3%
Household income									
<= EUR 1150	55%	38%	4%	2%	1%	43%	56%	0%	1%
EUR 1151 - EUR 1800	51%	41%	5%	2%	2%	39%	59%	0%	2%
EUR 1801 - EUR 2600	45%	43%	7%	3%	2%	36%	61%	0%	3%
> EUR 2600	43%	43%	7%	4%	2%	31%	64%	0%	5%
missing	n.a.	n.a.	n.a.	n.a.	n.a.	45%	55%	0%	0%

Source: CentERpanel.

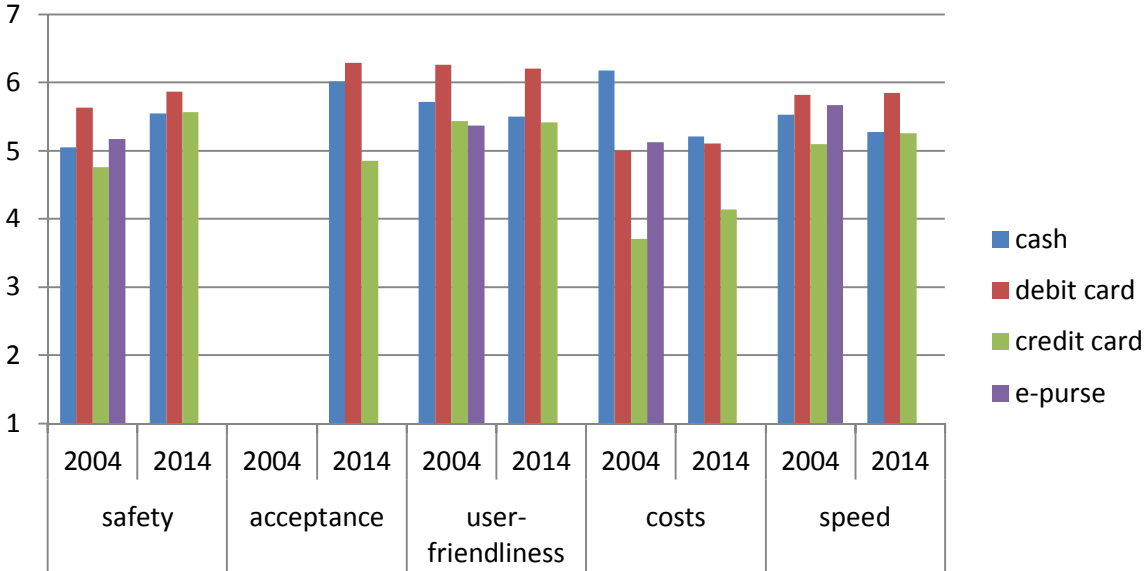
Note: Dutch debit card = Dutch debit card that can also be used abroad; foreign debit card = foreign debit card from a bank from another euro country. Each column shows at which share of the POS the particular payment instrument is the mostly used payment instrument. The number of observations is 2012 in 2004 and 2623 in 2014.

The debit card has become the most often used payment instrument at a higher share of POS than in 2004. In 2014 it was the most often used payment instrument at 62% of the sketched POS, whereas it used to be 42% in 2004. Its usage has especially increased among consumers with a low degree of education and among consumers aged 24 or under. Debit card usage is positively related to the level of education and income and negatively related to age. The intensity of use of the credit card did not change much over the past ten years. It is significantly positively correlated with age, income and education and is stronger among males than females.

2.5 Perceptions of payment instruments

Payment patterns are likely to depend on consumers’ perceptions of the instruments’ safety, speed, costs, user-friendliness, and acceptance by retailers. Figure 2 plots perceptions of characteristics of cash, the debit card, and the credit card in 2004 and 2014. For the e-purse this information is only available for 2004. Perceptions are measured on a seven-point scale, from very negative (1) to very positive (7). A score of 4 indicates a neutral position.

Figure 2. Perceptions of payment instruments



Source: CentERpanel.

Note: Note that the perception questions about the debit card and credit card were answered in 2004 by both adopters and non-adopters of these payment instruments, whereas in 2014 these were only measures for adopters.

In general consumers are very satisfied; they hardly experience any constraints when paying at POS.⁷ All studied payment instruments are perceived as safe instruments. The debit card still receives the highest score. The debit card is also perceived to be the most user-friendly payment instrument. Consumers are also satisfied with the user-friendliness of cash and the credit card, but the degree of satisfaction declined somewhat the past few years. Both cash and the debit card score well on acceptance. Based on 2007-2013 data we know that the perceived acceptance of the debit card increased slightly whereas the perceived acceptance of cash declined a little. The perceived acceptance of the credit card by credit card adopters is relatively bad. These outcomes are in line with data presented by Panteia (2013). Panteia (2013) reports that debit card acceptance is high. It is 100% among petrol stations and large retail chains and 95% among small and medium-sized shops. There is still room for improvement, for example in the catering industry and among market vendors where acceptance is respectively 71% and 54%. The acceptance of the credit card is much lower, especially in the catering industry and among small and medium sized stores (less than 40%), although it is slowly increasing (Panteia 2013). There is wide variation between sectors, credit card acceptance ranging from 18% in specialised food stores (2011, latest available figure) to 80% in stores selling clothes and shoes (HBD 2012). The last decade consumers have become more satisfied with the costs of the debit card and credit card. In 2004 consumers were not so satisfied with the costs of the debit card because banks had introduced annual fees and merchants surcharged consumers when using the debit card to pay small amounts. There are only few merchants that still do so (HBD 2012). In contrast, perceived costs of cash are now higher than in 2004. The credit card is still perceived as the most costly payment instrument.

Last, on average consumers are also satisfied with the speed of payment. Perceptions have been fairly stable over time. The debit card was in 2014 still perceived as the fastest payment instrument.

3. Empirical model

By using two different approaches to analyse the data we make optimal use of the data and get the best picture of the way determinants of payment patterns have changed the past decade. Our primary focus in the regressions is to measure whether perceived payment characteristics and

⁷ This is in line with the finding of Van der Crujisen et al. (2015) that in September 2013 only 1% of consumers' payments could not be done with consumers' preferred means of payment. The most important reason in these cases was that this payment instrument was not accepted.

consumers' demographics affect the adoption and usage of payment instrument and to what extent this depends on the type of POS and varies over time.

3.1 Regression methods

First, we model payment behaviour in general. The adoption of electronic payment instruments is modelled by estimating probit models. The dependent variable is a binary dummy that is 1 for respondent that have adopted the particular payment instrument and 0 for other respondents. This is thus similar to the first-stage of a Heckman selection model. We use a two-stage Heckman selection model to estimate the intensity of use of the debit card and credit card in both years and the e-purse in 2004.⁸ In the second-stage the model explains the intensity of usage given that one has adopted the payment instrument. The dependent variables in this stage are our intensity measures (see equation 1). For cash we only have information on the intensity of use which we model with an Ordinary Least Squares.⁹ Perceptions of safety, speed, costs and user-friendliness are included in the 2004 adoption regressions and 2004 and 2014 intensity of use regressions.¹⁰ We also include socio-demographic variables.

Second, we model payment behaviour at each POS. We construct binary dummy variables that are 1 for respondents who mostly pay cash at a particular POS and 0 for respondents who mostly pay electronically. Next, we estimate probit models with these dummies as dependent variable. We research the relevance of perceptions of payment instrument characteristics and socio-demographic characteristics on the likelihood of preferring cash at a particular POS. We estimate the regressions for 2004 and 2014 and thereby identify changes in relevant factors over time.

3.2 Explanatory variables

As explanatory variables we include the following perceived payment instrument characteristics: *safety*, *speed*, *costs*, and *user-friendliness*.¹¹ Furthermore, we include a set of background characteristics. *Male* is a binary dummy that is 1 for males and 0 for females. We

⁸ For 2014 we combine the information on the Dutch and foreign debit card.

⁹ Because it costs Dutch consumers no money to withdraw cash from the ATM or to pay transactions in cash we think it is not worrisome that we cannot use a two-step model to model the intensity of cash usage.

¹⁰ We were unable to include perceptions in the 2014 adoption regressions because they were only measured for adopters.

¹¹ In 2014 acceptance was also measured. Results including this variable are available upon request. We have decided to not include it in our baseline regressions. This makes it easier to compare the 2004 and 2014 outcomes. Furthermore, user-friendliness and acceptance are strongly correlated and consumers indicated that they have similar things in mind when answering both questions.

examine the effect of age on payment behaviour by including 5 binary dummy variables: (1) *age: 15-24*, (2) *age: 25-34*, (3) *age: 45-54*, (4) *age: 55-64*, and (5) *age: 65+*. Respondents aged between 35 and 45 are in the reference group.¹² We also include two binary education dummies: *education: low* and *education: high* to test for the presence of an education effect. The low category includes respondents with at most primary school or preparatory intermediate vocational education, whereas the high category includes respondents who successfully completed higher vocational education or university education. Respondents with secondary pre-university education or intermediate vocational education are in the reference group.

We distinguish four net monthly household income categories and therefore include the following three dummy variables: *income: EUR 1150-*, *income: EUR 1151-1800* and *income: EUR 2601+*. The reference category includes respondents with a household income of at least EUR 1801 and at most EUR 2600. Furthermore, we include *homeowner*. This is a binary dummy that is 1 for homeowners and 0 otherwise. The inclusion of this variable enables us to test whether financial wealth affects payment behaviour.

Next, we also construct three dummy variables to measure the relevance of household composition for payment behaviour: *single, partner & kids*, and *single & kids*. The reference group consists of respondents who live together with a partner and have no children. We include the binary dummy variable *handles finances* as well. This variable is 1 for respondents who are responsible for the financial administration of the household (e.g. making the payments for rent/mortgage) and 0 for respondents who are not. We furthermore include the variable *paid job*. This binary dummy variable is 1 for consumers in employment, who work in a family business or who are self-employed and 0 otherwise.

Furthermore, we include regional variables to study to what extent payment behaviour depends on the place of residence of consumers. Regional patterns may for example be due to differences in the ATM or debit card terminal density.¹³ *City* measures the degree of urbanization. This variable ranges from 1 (less than 500 addresses per squared kilometre) to 5 (2500 or more addresses per squared kilometre). We also include four binary region dummies: *region: north*, *region: west*, *region: east*, and *region: south*. Inhabitants from the three largest cities of the Netherlands or their surroundings are in the reference group.

Last, we take into account that the adoption of the e-purse was only an actual decision for consumers who in 2004 only had a checking account at the Postbank and for consumers

¹² So in contrast to Schuh and Stavins (2010) we also have information on young consumers.

¹³ ATM density tends to be higher in more urbanised areas, see National Forum on the Payment System (2013).

without a debit card. Other consumers with a debit card automatically adopted the e-purse. We include a *Postbank only* dummy in the e-purse regressions. This variable is 1 for respondents who in 2004 only had a checking account at the Postbank in 2004 and 0 for other respondents.

4. Regression results: payment behaviour in general

4.1 Adoption

The results of the adoption regressions are in Table 3. Column 1, 2, 3 and 4 portray the outcomes of the 2004 regressions and column 5, 6, and 7 show the results of the 2014 regressions.¹⁴

Payment instrument characteristics

A decade ago perceived payment characteristics significantly affected the adoption of payment instruments. Consumers who perceived the debit card, credit card and e-purse as safe and user-friendly were more likely to adopt these payment instruments than consumers who were less satisfied with these payment characteristics. The effects were small for the debit card, which was adopted by almost all Dutch consumers, but strong for the credit card and e-purse. For example, a one point higher score on the perceived safety and user-friendliness of the credit card increased the likelihood of adopting it by 15 percentage points. For the e-purse the perceived speed was a relevant factor for its adoption. It was even its most important characteristic. A one point higher score on the perceived speed of the e-purse increased the likelihood of its adoption by 5 percentage points. In 2004 perceived costs were not significantly related to the likelihood of adopting a particular payment instrument. These findings highlight the importance of including payment instrument characteristics in the adoption regression, which – as we mentioned before – was unfortunately not possible for the 2014 regressions.¹⁵

Socio-demographic characteristics

Adoption of payment instruments is significantly related to various socio-demographic characteristics. Most of these relationships are quite robust over time. Adoption of payment

¹⁴ Note that multicollinearity is not a problem in our regressions. The mean Variance Inflation Factor (VIF) ranges between 1.62 and 1.73. The minimum VIF found is 1.05 and the maximum is 3.55. As a rule of thumb a VIF smaller than 10 is fine.

¹⁵ Schuh and Stavins (2010) mention it as an important drawback of their study that they only have this information on perceived payment instrument characteristics for adopters. Von Kalckreuth et al. (2014a) show that in Germany the adoption and usage of payment instruments are largely influenced by the same variables.

instruments still depends on gender. Both in 2004 and 2014 males were more likely to have a credit card than females. In 2004 they were more likely to have a fuel card and in 2014 they were more likely to have a mobile phone as a payment instrument.

Table 3. Adoption of electronic payment instruments: 2014 versus 2004

	2004				2014		
	(1) debit card	(2) credit card	(3) e-purse	(4) fuel card	(5) debit card	(6) credit card	(7) mobile
safety	0.00** (0.00)	0.07*** (0.01)	0.04*** (0.01)				
speed	0.00 (0.00)	-0.01 (0.01)	0.05*** (0.01)				
costs	-0.00 (0.00)	0.01 (0.01)	0.02 (0.01)				
user-friendliness	0.00*** (0.00)	0.08*** (0.01)	0.03*** (0.01)				
male	0.00 (0.00)	0.13*** (0.03)	0.03 (0.03)	0.10*** (0.02)	0.00 (0.00)	0.17*** (0.02)	0.01* (0.01)
age: 15-24	-0.00 (0.00)	-0.42*** (0.07)	-0.04 (0.07)	-0.12*** (0.01)	-0.02 (0.02)	-0.43*** (0.05)	0.02 (0.03)
age: 25-34		-0.05 (0.05)	0.09* (0.04)	0.08*** (0.03)		-0.08** (0.04)	0.01 (0.01)
age: 45-54	-0.00 (0.00)	0.01 (0.04)	-0.07 (0.05)	0.03 (0.02)	-0.02* (0.01)	-0.04 (0.04)	-0.02* (0.01)
age: 55-64	-0.00 (0.00)	0.03 (0.05)	-0.08 (0.05)	0.02 (0.03)	-0.04*** (0.02)	-0.02 (0.04)	-0.00 (0.01)
age: 65+	-0.00 (0.00)	0.05 (0.06)	-0.14** (0.07)	-0.01 (0.03)	-0.04*** (0.02)	-0.01 (0.04)	0.00 (0.01)
education: low	-0.00 (0.00)	-0.12*** (0.04)	-0.08** (0.04)	-0.03 (0.02)	0.00 (0.00)	-0.12*** (0.03)	-0.00 (0.01)
education: high	-0.00 (0.00)	0.09** (0.03)	0.03 (0.04)	0.01 (0.02)	0.01** (0.00)	0.15*** (0.02)	-0.01 (0.01)
income: EUR 1150-	-0.00 (0.00)	-0.03 (0.06)	-0.07 (0.07)	-0.03 (0.03)	-0.01 (0.01)	-0.13** (0.05)	-0.02 (0.01)
income: EUR 1151-	0.00 (0.00)	-0.06 (0.04)	-0.06 (0.04)	0.00 (0.02)	-0.00 (0.01)	-0.14*** (0.04)	-0.01 (0.01)
income: EUR 2601+	-0.00 (0.00)	0.14*** (0.03)	0.01 (0.04)	0.04** (0.02)	0.00 (0.00)	0.12*** (0.03)	0.01 (0.01)
homeowner	0.01*** (0.01)	0.14*** (0.04)	0.06* (0.04)	0.05*** (0.02)	-0.01 (0.00)	0.14*** (0.03)	-0.01 (0.01)
single	-0.00 (0.01)	0.04 (0.04)	-0.04 (0.05)	-0.03 (0.02)	-0.02** (0.01)	0.08** (0.04)	0.00 (0.01)
partner & kids	-0.00* (0.00)	-0.05 (0.04)	-0.12*** (0.04)	0.03 (0.02)	-0.02** (0.01)	-0.07** (0.03)	-0.01 (0.01)
single & kids	-0.01 (0.02)	0.12 (0.08)	-0.01 (0.10)	-0.06 (0.04)		0.03 (0.07)	0.10*** (0.04)
handles finances	0.00 (0.00)	0.15*** (0.03)	0.13*** (0.03)	0.04** (0.02)	0.00 (0.00)	0.12*** (0.02)	0.01 (0.01)
paid job	0.00 (0.00)	0.17*** (0.04)	-0.00 (0.04)	0.05** (0.02)	0.01 (0.01)	0.10*** (0.03)	0.02** (0.01)
...

Note: The table shows the marginal effects estimates from probit regressions. * p<0.1, ** p<0.05, *** p<0.01. Robust standard errors are between parentheses.

Table 3. Adoption of electronic payment instruments: 2014 versus 2004 (continued)

	2004				2014		
	(1) debit card	(2) credit card	(3) e-purse	(4) fuel card	(5) debit card	(6) credit card	(7) mobile
...
city	0.00** (0.00)	0.01 (0.01)	0.00 (0.01)	-0.03*** (0.01)	0.00 (0.00)	0.00 (0.01)	0.00 (0.00)
region: west	0.00 (0.00)	-0.12** (0.05)	-0.04 (0.05)	0.04 (0.03)	0.00 (0.01)	-0.05 (0.04)	-0.00 (0.01)
region: north	0.00* (0.00)	-0.19*** (0.07)	-0.13** (0.07)	0.06* (0.04)	-0.01 (0.01)	-0.10** (0.05)	-0.01 (0.01)
region: east	0.00 (0.00)	-0.13** (0.06)	-0.03 (0.06)	0.02 (0.03)	0.01 (0.01)	-0.15*** (0.04)	-0.00 (0.01)
region: south	0.00 (0.00)	-0.14*** (0.05)	-0.12** (0.05)	0.02 (0.03)	-0.00 (0.01)	-0.12*** (0.04)	-0.00 (0.01)
Postbank only			-0.13*** (0.03)				
N	1651	1544	1206	2010	2115	2597	2597
pseudo R-squared	0.32	0.28	0.14	0.13	0.11	0.17	0.07
Chi-squared	127.2	435.3	186.1	216.2	92.3	482.8	52.6
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The table shows the marginal effects estimates from probit regressions. * p<0.1, ** p<0.05, *** p<0.01. Robust standard errors are between parentheses.

The adoption of electronic payment instruments is positively related to both income and homeownership. In 2004 we find a positive relationship between household income and the likelihood of adoption of the credit card and fuel card. For instance, households in the highest income category were 14 percentage points more likely to have a credit card than household in the second highest income category. In 2004 homeowners were more likely to have adopted the debit card, credit card, e-purse and fuel card than consumers who did not own a house. As was the case in 2004 consumers with a high income and homeowners were in 2014 more likely to have a credit card than those with a low income and tenants.

We furthermore find that consumers who are responsible for the household finances are more likely to have a credit card than others. In 2004 they were also more likely to have adopted the e-purse and fuel card. In both years consumers with a paid job were more likely to have a credit card than those without a paid job. In 2004 they were also more likely to have adopted the fuel card.

The composition of the household is relevant for the adoption of payment instruments. There are however some changes over time. In 2004 the household composition mattered for the adoption of the debit card and e-purse. For example, consumers with a partner and having children living at home were less likely to have an e-purse and debit card than those with a

partner but no children living at home. In 2014, we for example find that singles were more likely to have a credit card than consumers with a partner but no children.

Adoption of electronic payment instruments depends on the place of residence but there are some shifts in the relationships. As was the case in 2004, in 2014 consumers living in the North, South and East of the Netherlands were less likely to have a credit card than inhabitants of the three largest cities or their surroundings. However, in contrast to a decade earlier the adoption by consumers who live in the West was not significantly different from that of the reference group. In 2004 inhabitants of the North of the Netherlands were more likely to have a fuel card and debit card than the reference group and adoption of the e-purse was relatively weak in the North and South of the Netherlands. In 2014 the adoption of the debit card was no longer related to region variables. In 2004 consumers who lived in urbanised areas were less likely to have a fuel card than those living in rural areas, which does not come as a surprise. They were instead more likely to have a debit card. The urbanization measure was not significant anymore in the 2014 adoption regressions.

Last, we find that in 2004 consumers with only a Postbank account were less likely to have adopted the e-purse. This finding indicates the presence of a status quo bias and/or the relevance of costs when deciding to adopt a payment instrument.

To summarize, we show that the adoption of electronic payment instruments depends on both perceived payment characteristics and socio-demographic factors. This confirms the findings of earlier studies in this field. Overall determinants of payment instrument adoption are quite robust over time. However, the effects of age, household composition and region have changed.

4.2 Intensity of usage

Table 4 displays the results of models of the intensity of usage: the share of POS where a payment instrument is the most often used payment instrument. The left part shows the outcomes of the 2004 regressions whereas the right part portrays the 2014 results.

Payment instrument characteristics

We find that perceived payment instrument characteristics not only matter for the adoption of payment instruments but also for the intensity by which they are used, again confirming the results of earlier studies. However, the degree to which they matter shifts over time. In 2004 the

intensity of use of the debit card was positively related to its perceived safety, speed and user-friendliness. Speed was also a relevant factor for the e-purse and cash, whereas perceived user-friendliness mattered for the intensity by which all payments instruments were used.

Safety has become a more important factor over the past decade. In 2014 the intensity of use of the debit card, credit card and cash was positively and significantly related to their perceived safety. Perceived user-friendliness was still a relevant factor for the intensity by which the credit card and cash were used. Perceived speed also remained a relevant factor for the intensity by which cash is used. However perceived speed and user-friendliness were not significantly related anymore to the intensity of use of the debit card. For both 2004 and 2014 we do not find a significant relationship between perceived costs and the share of POS where a payment instrument is the most often used payment instrument.

Table 4. Intensity of use of payment instruments: 2014 versus 2004

	2004				2014		
	(1) debit card	(2) credit card	(3) e-purse	(4) cash	(5) debit card	(6) credit card	(7) cash
safety	0.01*	0.01	0.01	0.01	0.01*	0.01***	0.01***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
speed	0.03***	-0.00	0.01*	0.01***	0.01	0.00	0.01**
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
costs	-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)
user-friendliness	0.02***	0.02***	0.03***	0.03***	0.01	0.01***	0.02***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
male	-0.04***	0.01	0.01	0.02**	-0.02**	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
age: 15-24	-0.08***	-0.10**	-0.00	0.12***	0.04	-0.04	-0.02
	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.09)	(0.03)
age: 25-34	0.01	-0.02	0.01	-0.02	0.01	-0.00	0.00
	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
age: 45-54	0.00	0.01	-0.00	-0.01	-0.08***	0.02*	0.07***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
age: 55-64	0.00	-0.00	-0.01	-0.01	-0.06***	0.01	0.04***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
age: 65+	-0.01	0.02	-0.02	0.01	-0.06***	-0.00	0.05***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
...

Table reports parameter estimates from the second stage of the Heckman selection model in which adoption is the first stage (column 1, 2, 3, 5 and 6). Column 4 and 7 show the estimates of an OLS regression with robust standard errors between parentheses. The dependent variable in each column is the share of POS where the particular type of payment instrument was used most often.

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Intensity of use of payment instruments: 2014 versus 2004 (continued)

	2004				2014		
	(1) debit card	(2) credit card	(3) e-purse	(4) cash	(5) debit card	(6) credit card	(7) cash
...
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)
education: low	-0.03**	0.01	-0.02	0.03**	-0.01	-0.01	0.02
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
education: high	0.00	0.00	0.03**	-0.02	0.01	0.03*	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
income: EUR 1150-	-0.05**	-0.01	-0.05*	0.07***	-0.02	-0.04*	0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
income: EUR 1151-1800	-0.02*	-0.02*	-0.03*	0.04***	-0.02	0.00	0.02
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
income: EUR 2601+	-0.01	0.01	-0.01	-0.01	0.00	0.00	-0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
homeowner	0.03**	0.01	0.02	-0.05***	0.01	0.01	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
single	-0.00	-0.01	0.01	0.02	-0.02	-0.01	0.03*
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
partner & kids	-0.00	-0.02*	-0.01	0.01	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
single & kids	0.00	-0.00	0.01	0.02	0.05*	-0.02	-0.03
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.02)	(0.03)
handles finances	0.01	-0.01	0.02	-0.03**	0.00	0.01	-0.02
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
paid job	-0.01	0.01	0.01	-0.02	0.01	-0.00	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
city	-0.00	-0.00	0.00	0.01*	0.00	0.00	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
region: west	0.01	-0.01	0.01	-0.00	0.03**	-0.03**	-0.02
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
region: north	0.00	-0.04**	-0.02	0.02	0.02	-0.05***	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
region: east	0.02	0.00	-0.00	-0.01	0.04**	-0.03	-0.03*
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
region: south	-0.04**	0.00	-0.02	0.03*	-0.03*	-0.01	0.04**
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Postbank only			-0.03				
			(0.02)				
Constant	0.13**	-0.08	-0.30**	0.18***	0.46***	-0.10	0.17***
	(0.06)	(0.08)	(0.14)	(0.05)	(0.04)	(0.09)	(0.04)
Lambda	0.08	0.04	0.15*		0.03	0.04	
	(0.10)	(0.04)	(0.08)		(0.18)	(0.06)	
Observations	1959	1544	1206	1959	2342	2260	2340
R-squared				0.15			0.13
Censored observations	24	585	393		38	1171	
Uncensored observations	1935	959	813		2304	1089	
Chi-squared	165.6	78.5	51.8		147.0	116.6	
p-value	0.00	0.00	0.00		0.00	0.00	

Table reports parameter estimates from the second stage of the Heckman selection model in which adoption is the first stage (column 1, 2, 3, 5 and 6). Column 4 and 7 show the estimates of an OLS regression with robust standard errors between parentheses. The dependent variable in each column is the share of POS where the particular type of payment instrument was used most often.

*** p<0.01, ** p<0.05, * p<0.1

Socio-demographic characteristics

The intensity by which payment instruments are used also depends on socio-demographic characteristics. We observe various changes in the relationship between these variables and the intensity of use of payment instruments.

The gender effect is quite robust. In 2004 males used cash more intensively than females and the debit card less intensively. In 2014 males were still using the debit card less intensively. We find some shifts in the age effects. In 2004 consumers in the youngest age class used the debit card and credit card less intensively than consumers in the reference category and were more intensively using cash instead. In 2014 these effects were gone and debit card usage was negatively related to the age of the consumer and cash usage positively.

Payment behaviour also depends on consumers' education level. In 2004 consumers with a low degree of education used cash more intensively than those with a medium degree of education, and the debit card less intensively. Consumers with a high degree of education used the e-purse more intensively than the reference group. In 2014 consumers with a high degree of education were more intensively using the credit card than the reference group and used cash less intensively. The level of education has become an irrelevant factor for the intensity of debit card usage.

We also find that income has become an irrelevant factor for the intensity of debit card usage. In 2004 consumers with a relatively low income were using cash more intensively than those with a high income and electronic payment instruments were relatively unpopular among low income consumers. In 2014 there was still an income effect in the credit card model. Consumers in the lowest income category were less intensively using the credit card than those in the reference category. Consumers in the highest income category used cash less intensively than the reference group.

In 2014 the intensity of debit card use was also no longer related to homeownership. Homeowners still used cash less intensively than tenants but the difference between the two type of consumers was somewhat smaller in 2014 than a decade before.

The relationship between household composition and the intensity of use of payment instruments has clearly changed over time. In 2004 compared to consumers with a partner but no children living at home, those with a partner and children living at home used the credit card less intensively. In 2014 this effect is gone and we find that singles mostly used cash at a higher share of POS than consumers in the reference group. We also find that consumers with children

living at home but without a partner were more intensively using the debit card than consumers with a partner and children living at home.

As was the case ten years earlier, in 2014 it did not matter for the intensity of use of payment instruments whether one had a paid job or not. In 2014 there was also no significant relationship between the intensity of use and *handles finances*. The latter is a change compared to 2004. In 2004 consumers who were in charge of household finances were less intensively using cash than others.

Last, we find significant regional patterns with noticeable shift over time. In 2004 consumers in urbanised regions were more intensively using cash than consumers in rural areas. In 2014 the degree of urbanization was instead negatively related to the intensity of cash usage. The effect was still small. In 2004 and 2014 consumers in the South of the Netherlands used the debit card less intensively than inhabitants of one of the three largest cities or their surroundings. Instead, they used cash at a higher share of POS. Only in 2014 consumers in the East of the Netherlands portray the opposite behaviour. In 2004 and 2014 the credit card was used relatively little in the North of the Netherlands. In 2014 also consumers in the West used it less intensively than consumers in the three largest cities and their surroundings. They instead used the debit card relatively intensively.

To sum up, we find several shifts in the relevance of payment characteristics and socio-demographic characteristics for the intensity of use of payment instruments. Some characteristics that earlier research has shown to be relevant, such as income and education, no longer mattered in the Netherlands in 2014. These findings indicate that when a payment instrument has been generally adopted, such as the debit card in the Netherlands, its intensity of usage no longer depends on various demographic characteristics.

5. Regression results: payment behaviour per POS

Next, we study payment behaviour at various POS. Recall that for each POS we have modelled the likelihood that someone mostly uses cash. Table 5 summarizes the marginal effects of the perceived payment instrument characteristics. The left part shows the results of the 2004 intensity regressions and the right part the results of the 2014 regressions. The complete set of regression results is in Appendix B.

Table 5. Perceived payment instrument characteristics and the likelihood of preferring cash at various POS

	2004				2014			
	Safety	Speed	Costs	User-friendliness	Safety	Speed	Costs	User-friendliness
supermarket	0.02** (0.01)	0.03*** (0.01)	-0.01 (0.01)	0.06*** (0.01)	0.01 (0.01)	0.02** (0.01)	-0.01* (0.01)	0.03*** (0.01)
specialised food stores	0.02*** (0.01)	0.01 (0.01)	0.01* (0.01)	0.03*** (0.01)	0.02** (0.01)	0.04*** (0.01)	-0.01 (0.01)	0.04*** (0.01)
non-food stores, high prices	0.00 (0.01)	0.01* (0.01)	-0.01 (0.01)	0.03*** (0.01)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.01** (0.00)
non-food stores, low prices					0.04*** (0.01)	0.03*** (0.01)	-0.01 (0.01)	0.03** (0.01)
petrol stations	0.00 (0.01)	0.01 (0.01)	-0.01*** (0.00)	0.02*** (0.01)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.02*** (0.00)
catering establishments	0.02** (0.01)	-0.00 (0.01)	-0.00 (0.01)	0.03** (0.01)				
restaurants					0.01 (0.01)	0.00 (0.01)	-0.00 (0.01)	0.02** (0.01)
smaller eating-houses					0.03*** (0.01)	0.02** (0.01)	-0.02** (0.01)	0.04*** (0.01)
café					0.03*** (0.01)	0.02** (0.01)	-0.01 (0.01)	0.02** (0.01)
accommodation					-0.00** (0.00)	-0.01*** (0.00)	0.01*** (0.00)	0.01** (0.00)
cultural and amusement					0.02** (0.01)	0.01* (0.01)	-0.00 (0.01)	0.01 (0.01)
candy and drink machines	-0.00 (0.01)	0.03*** (0.01)	-0.00 (0.01)	0.01 (0.01)	0.02** (0.01)	0.00 (0.01)	-0.00 (0.01)	0.01 (0.01)
car park ticket machines	0.00 (0.01)	0.03** (0.01)	-0.01 (0.01)	0.04*** (0.01)	0.02 (0.01)	0.01 (0.01)	-0.02** (0.01)	0.02* (0.01)
public transport	-0.00 (0.01)	0.01 (0.01)	0.00 (0.01)	0.04*** (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.02* (0.01)
taxi					0.03*** (0.01)	-0.00 (0.01)	0.02*** (0.01)	0.00 (0.01)

Source: CentERpanel.

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The complete set of regression results is in Appendix B. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. In 2004 the 0 category includes consumers who mostly pay by debit card, credit card, e-purse or fuel card. In 2014 it includes consumers who mostly pay by debit card or credit card. * p<0.1, ** p<0.05, *** p<0.01.

Payment instrument characteristics

The extent to which perceptions matter for payment behaviour depends on the POS and varies over time. In 2004 perceived safety, speed, costs and user-friendliness were all relevant for payment behaviour. Especially the perceived user-friendliness mattered. The more satisfied a consumer was with the user-friendliness of cash the more likely it was that he or she mostly paid by cash at 7 out of 8 POS. The strongest effect was present at the supermarket. Perceived safety mattered for payment behaviour at the supermarket, specialised food stores and at catering establishments. Speed was a relevant factor at half of the POS. Consumers who were satisfied with the speed of payment of cash were more likely to mostly opt for cash at supermarkets, non-food stores with high prices, candy and drink machines and car park ticket machines than consumers who were less satisfied about the speed of payment of cash. Compared to consumers who found paying cash costly, consumers who did not perceive it as costly were more likely to mostly use cash at specialised food stores. However, they were less likely to use it at petrol stations.

In 2014 user-friendliness was still the most important characteristic. It significantly affected payment behaviour at 11 out of 14 POS. The effect was the strongest at specialised food stores and smaller eating-houses. Safety and speed of payment were also still relevant factors; at various POS they significantly affected the likelihood that consumers preferred cash. Safety was especially relevant for payment behaviour at non-food stores with low prices, smaller eating-houses, cafes and taxis. Speed mainly mattered at specialised food stores and non-food stores with on average low prices, but for example also still at the supermarket.

Compared to other payment characteristics perceptions of costs are not so strongly related to the intensity of use of payment instruments. Over the past decade they have become an irrelevant factor at specialised food stores. As we mentioned before, over the past decade the degree of acceptance of the debit card has improved a lot and at most stores low value transactions can now be done by debit card without surcharges. From 2007 onwards there were several campaigns to stimulate debit card usage, for example the campaign "Small amount? Debit card allowed". Perceived costs are now about the same as those of cash. Only at a few POS there is a significant relationship between the perceived costs of cash and the intensity of use of cash. For example, consumers who think that it is costly to pay a ride in a taxi by cash, e.g. because they think they need to round up the amount or pay a tip, are more likely to pay electronically.

Socio-demographic characteristics

The effects of socio-demographic variables on payment behaviour also depend on the POS. We find that several of these relationships change substantially over time. In 2004 males were more likely than females to mostly use cash at supermarkets, stores with on average high prices, petrol stations and catering establishments. They were instead less likely to mostly pay cash at specialised food stores and candy and drink machines. In 2014 males were more likely to mostly pay cash at petrol stations, smaller-eating houses, cafes and when paying accommodations. The gender effect has disappeared in supermarkets, stores with on average high priced products and at candy and drinking machines. In 2014 males were however still less likely than females to pay cash at specialised food stores. They were also less likely to pay cash at non-food stores with on average low prices.

The age effect also varies per POS and over time. Payment behaviour of consumers in the youngest age class changed strongly the past decade. In 2004 consumers aged 24 or under were much more likely to pay cash at supermarkets and at catering establishments than those aged between 35 and 45. In 2014 they only behaved significantly differently at non-food stores with on average low prices. They are less likely to pay mostly cash than consumers in the reference group. This is a POS where the acceptance of electronic payment instruments used to be relatively bad but has improved significantly. Furthermore, recall that merchants used to surcharge consumers when using the debit card to pay small amounts. It seems that the current youngest generation has a less strong cash habit at this POS. For both years we find at various POS a positive relationship between the age of a respondent and the likelihood that he or she mostly pays cash. For example, in both years consumers aged 65 and above are more likely to pay cash at the supermarket than the reference group. There are however several shifts. For example the positive age effect at car park ticket machines and candy and drink machines was not yet present in 2004.

The effects of education on the intensity of cash usage have changed over time but in general the negative relationship between the level of education and cash usage is still present at many POS. Consumers with a low degree of education were in 2004 more likely to mostly pay cash at supermarkets, stores with on average high prices, petrol stations and for public transport than consumers with a medium degree of education. In 2014 consumers with a low degree of education were instead more likely to mostly pay cash at restaurants and car park ticket machines. In 2004 consumers with a high degree of education were less likely to mostly pay cash at catering establishments and for public transport than those with a medium degree of

education. In 2014 consumers with a high degree of education were less likely to mostly pay cash at supermarkets, specialised food stores, non-food stores with on average high prices, petrol stations, smaller eating-houses, when paying for cultural and amusement and for public transport.

The effect of household income is quite robust. In 2004 there was a negative link between household income and the likelihood of mostly paying cash at the supermarket, non-food stores with on average low prices, the petrol station, catering establishments, car park ticket machines and when paying for public transport. In 2014 there was still a negative relationship at most POS. However, there was no significant effect on the intensity of use of cash in catering establishments anymore.

Payment behaviour at several POS also depends on homeownership. In 2004 homeowners were less likely to mostly pay cash at non-food stores with on average high-priced products, catering establishments and for public transport than tenants. Ten years later homeowners were less likely to mostly pay cash at supermarkets.

The relationships with the composition of the household, *handles finances* and *paid job* have also changed over time. Compared to consumers who live together with a partner but without children, the reference group, singles were in 2004 more likely to mostly pay cash at catering establishments but less likely to mostly pay cash at candy and drink machines. In 2014 they were more likely to pay cash at specialised food stores, restaurants, smaller eating-houses but less likely to mostly pay cash for accommodations. In 2004 consumers with a partner and children were more likely to pay cash for public transportation than consumers with a partner but without children. In 2014 consumers from the first group were less likely to mostly pay cash at non-food stores with on average high prices. In 2004 consumers who took care of household finances were less likely to mostly use cash at non-food stores with on average high prices, the petrol station and car park ticket machines than consumers who were not in charge of household finances. In 2014 they were less likely to use cash at the supermarket, restaurants and car park ticket machines but more likely to mostly use cash at cafes. Consumers with a paid job were in 2004 less likely to mostly pay cash at the petrol station than consumers without a paid job. In contrast, for 2014 we find this job effect at specialised foods stores, non-food stores with on average low prices and candy and drink machines.

Regional patterns are present and we find significant changes over time. For example, the sign of *city* changed. In 2004 inhabitants of urbanised regions were more likely to mostly pay cash at specialised food stores than inhabitants of rural regions. This may have to do with the

type of specialised food stores that are present in urbanised areas. Ethnic stores, in particular, are more common there. These stores used to have a low level of debit card acceptance, but according to Currence (2008), by 2008 they had begun to catch up. Nevertheless, in 2010, the National Forum on the Payment System found that people with a non-Western background in particular would like to be able to use their debit card more in ethnic shops. In that same year, the Foundation for Efficient Payments started a cooperation with an organization for Turkish-Dutch entrepreneurs to further stimulate the use of debit card payments in their stores (Stichting Bevorderen Efficiënt Betalen, 2011). In 2014 consumers who lived in urbanised regions were less likely to mostly pay cash at supermarkets, restaurants, cafes and at cultural and amusement places, candy and drink machines and car park ticket machines than inhabitants of rural arrears.

The importance of regional patterns has increased. Payment behaviour at various POS significantly depends on whether people live in the West, North, East, South of the Netherlands or in one of the three largest cities and their surroundings. In 2004 we find regional differences for 3 out of 8 POS, whereas in 2014 we find regional differences for 12 out of 14 POS. We find the strongest effects for payment behaviour at car park ticket machines. In 2014 consumers who lived in one of the three largest cities or their surroundings were much less likely to mostly pay cash for parking their car than inhabitants of other areas within the Netherlands. In 2004 there was only a significant difference between consumers from the North and those in the reference area.

6. Conclusion

By analysing the outcomes of Dutch household surveys from 2004 and 2014 we improve the understanding of payment behaviour at the POS. We show how payment patterns have changed over time and how robust their determinants are.

Adoption rates did not change much since 2004. The adoption of the credit card increased somewhat and the adoption of the debit card remained high. There were however strong shifts in the intensity of use of payment instruments. Whereas the intensity of use of the debit card increased sharply, the intensity of use of cash declined.

We find that perceived characteristics of payment instruments are significantly related to the adoption of payment instruments. It is therefore important to gather information on the perceptions of both adopters and non-adopters of electronic payment instruments. Of the

perceptions that we included, user-friendliness and safety are the most important drivers of the adoption of electronic payment instruments. We also find that the adoption of payment instruments depends on socio-demographic characteristics and that most of these relationships are quite robust over time. However, the effect of age, household composition and region has changed. Our findings on the e-purse reveal that for adoption rates it matters at which bank consumers have a checking account. Either due to a status quo bias or to prevent extra costs customers of the Postbank were less likely to adopt the e-purse than consumers who automatically got an e-purse on their bank card and only had to start using it.

Perceived payment characteristics also matter for the intensity of use of payment instruments but the extent to which varies over time and per POS. Overall, user-friendliness is still the most important payment instrument aspect and safety and speed remained relevant aspects, whereas costs are the least important aspect for the intensity by which payment instruments are used. User-friendliness is significantly positively related to the intensity of use of cash at 11 out of 14 POS. We find the strongest effects for specialised food stores and smaller eating-houses. Perceived safety and speed of cash are significantly positively related to the intensity of cash use at several POS. For example, perceived safety matters for the intensity of cash usage in cafes and taxis. Speed is still relevant at the supermarket and has become relevant at specialised food stores. At most stores low value transactions can now be done by debit card without surcharges and perceived costs of debit card usage are now about the same as those of cash. In line with this, we find that over the past decade perceived costs have become an irrelevant factor at specialised food stores.

The relationships between socio-demographic characteristics and the intensity of use of payment instruments have also changed the past decade and depend on the POS. As an illustration, in contrast to a decade ago consumers aged 24 or under are now no longer more likely to pay cash at supermarkets and catering establishments than middle-aged consumers. At non-food stores with on average low prices, young consumers are nowadays even less likely to mostly pay cash than middle-aged consumers. It seems that the current youngest generation has a less strong cash habit than middle-aged consumers at this type of POS where the degree of acceptance increased a lot and most merchants stopped surcharging consumers when using the debit card to pay small amounts.

Furthermore, we find that regional payment patterns can change substantially. For example, in 2004 inhabitants of urbanised regions were using cash more intensively than inhabitants of rural areas but nowadays the opposite is the case. A decade ago inhabitants of

urbanised regions were more likely to mostly pay cash at specialised food stores than inhabitants of rural regions. Now this effect is gone. This is probably related to initiatives to further stimulate the use of debit card payments in ethnic stores. These type of stores are more common in urbanised regions. The POS regressions also reveal the increased importance of regional effects for the intensity of cash usage. Especially for car park ticket machines there is a lot of regional variation. Additional research is needed to learn to what extent regional differences are driven by different preferences of consumers or by regional differences in the acceptance of payment instruments.

Shifts in the importance of payment instrument and socio-demographic characteristics may reflect different stages in the adoption process of a payment instrument. Our findings suggest that when paying with a payment instrument has been generally adopted, such as the debit card in the Netherlands, many perceptions and demographic characteristics become irrelevant for the intensity of usage. For example, the intensity of debit card usage has become unrelated to the level of education and income of consumers.

To steer payment behaviour effectively it is important to take into account which group of consumers one wants to influence and at which POS. Furthermore, it is important to keep track of determinants of payment behaviour because their relevance can change substantially over time.

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Appendix A. Questionnaire

2004

Which electronic payment instruments do you have? More answers possible.

Q11 debit card

Q12 e-purse

Q13 credit card

Q14 fuel card

Q15 other payment instrument

Q16 I don't have electronic payment instruments

0 no

1 yes

...

How do you perceive the **safety** of the different payment instruments?

Indicate on a scale from 1 to 7 to which extent you feel safety when using it at home, on the street, in stores, at catering establishments, and the like.

1 means very unsafe

7 means very safe

If you don't know it you can skip the answer

Q2.1 cash

Q2.2 debit card

Q2.3 e-purse

Q2.4 credit card

...

How do you perceive the **speed** of usage of the different payment instruments?

Indicate on a scale from 1 to 7 how you perceive the speed of usage.

1 means very slow and

7 means very fast

If you don't know it you can skip the answer

Q3.1 cash

Q3.2 debit card

Q3.3 e-purse

Q3.4 credit card

...

How do you perceive the **costs** of the different payment instruments?

There are different costs that you can think of. For example, costs related to the adoption and the usage of some payment instruments. You can also think about how a payment instrument affects your spending pattern.

Indicate on a scale from 1 to 7 how you perceive the costs.

1 means very low

7 means very high

If you don't know it you can skip the answer

Q4.1 cash

Q4.2 debit card

Q4.3 e-purse

Q4.4 credit card

...

How do you perceive the **user-friendliness** of the different payment instruments?

Indicate on a scale from 1 to 7 how you perceive the user-friendliness of the different payment instruments.

1 means very inconvenient and

7 means very convenient

If you don't know it you can skip the answer

Q5.1 cash

Q5.2 debit card

Q5.3 e-purse

Q5.4 credit card

...

At which places do you mostly pay with cash, the debit card, e-purse, credit card or fuel card? Per place you can give one answer.

mostlyq supermarkets

mostlya stores (butcher, bakery etc.)

mostlyb stores (clothes, music etc.)

mostlyc petrol stations

mostlyd catering establishments

mostlye candy and drink machines

mostlyf car park ticket machines

mostlyg ticket sales for public transport

1 cash

2 debit card

3 e-purse

4 credit card

- 5 fuel card
- 6 I never visit

2014

Q11 - Q15

Which payment instruments have you adopted? There are more answers possible.

- Q11** Dutch debit card that can also be used abroad
- Q12** foreign debit card from a bank from another euro country
- Q13** credit card
- Q14** mobile phone with which I can pay in stores
- Q15** none of the above
- 0 no
- 1 yes

Q2at1 - Q2at7

Please indicate which payment instrument you mostly use in the Netherlands at below places?

You can choose from:

- 1 = cash
- 2 = Dutch debit card
- 3 = Foreign debit card
- 4 = credit card
- 5 = n/a
- 6 = I don't recall

Mostly used payment instrument...

Q2at1 in the supermarket

Q2at2 in specialised food stores (e.g. bakery, butcher)

Q2at3 in non-food stores with on average high-priced products (e.g. cloths, music and luxurious products)

Q2at4 in non-food stores with on average low-priced products (e.g. souvenir stores, flower shops, and tobacco stores)

Q2at5 at petrol stations

Q2at6 in restaurants

Q2at7 in smaller eating-houses for e.g. lunch and snacks.

- 1 cash
- 2 Dutch debit card
- 3 Foreign debit card
- 4 credit card
- 5 n/a
- 6 I don't recall

Q2b1 - Q2bt7

And which payment instrument did you mostly use in the Netherlands at below places? You can choose again from:

- 1 cash
- 2 Dutch debit card
- 3 Foreign debit card
- 4 credit card
- 5 n/a
- 6 I don't recall

Mostly used payment instrument...

Q2bt1 in the café

Q2bt2 for paying your accommodation e.g. hotel, apartment

Q2bt3 at cultural and amusement places (e.g. theatre, museum, cinema, amusement park, disco)

Q2bt4 at candy and drink machines

Q2bt5 at car park ticket machines

Q2bt6 for public transport

Q2bt7 in the taxi

- 1 cash
- 2 Dutch debit card
- 3 Foreign debit card
- 4 credit card
- 5 n/a
- 6 I don't recall

...

Q10t1 - Q10t4

How do you experience the safety, the degree of acceptance, the user-friendliness, the costs and speed of **cash** when you pay **in the Netherlands**?

Q10t1 (1=very unsafe; 4=neutral; 7=very safe)

Q10t2 (1=very badly accepted; 4=neutral; 7=very well accepted)

Q10t3 (1=very user-unfriendly; 4=neutral; 7=very user-friendly)

Q10t4 (1=very expensive 4=neutral; 7=very cheap)

Q10t5 (1=very slow; 4=neutral; 7=very fast)

1..7

8 don't know

if v011=1

Q12t1 - Q12t4

How do you experience the safety, the degree of acceptance, the user-friendliness, the costs and speed of **the debit card** when you pay **in the Netherlands**?

Q12t1 (1=very unsafe; 4=neutral; 7=very safe)

Q12t2 (1=very badly accepted; 4=neutral; 7=very well accepted)

Q12t3 (1=very user-unfriendly; 4=neutral; 7=very user-friendly)

Q12t4 (1=very expensive 4=neutral; 7=very cheap)

Q12t5 (1=very slow; 4=neutral; 7=very fast)

1..7

8 don't know

ifv013=1

Q14t1 - Q14t5

How do you experience the safety, the degree of acceptance, the user-friendliness, the costs and speed of **credit card payments** in e.g. stores, catering establishments **in the Netherlands**?

Q14t1 (1=very unsafe; 4=neutral; 7=very safe)

Q14t2 (1=very badly accepted; 4=neutral; 7=very well accepted)

Q14t3 (1=very user-unfriendly; 4=neutral; 7=very user-friendly)

Q14t4 (1=very expensive 4=neutral; 7=very cheap)

Q14t5 (1=very slow; 4=neutral; 7=very fast)

1..7

8 don't know

Appendix B. Payment behaviour at point-of-sale: detailed regression results

Table B1. Payment behaviour at POS 2004

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	S	SFS	S(C&M)	PS	CE	CDM	CPTM	PT
safety	0.02** (0.01)	0.02*** (0.01)	0.00 (0.01)	0.00 (0.01)	0.02** (0.01)	-0.00 (0.01)	0.00 (0.01)	-0.00 (0.01)
speed	0.03*** (0.01)	0.01 (0.01)	0.01* (0.01)	0.01 (0.01)	-0.00 (0.01)	0.03*** (0.01)	0.03** (0.01)	0.01 (0.01)
costs	-0.01 (0.01)	0.01* (0.01)	-0.01 (0.01)	-0.01*** (0.00)	-0.00 (0.01)	-0.00 (0.01)	-0.01 (0.01)	0.00 (0.01)
user-friendliness	0.06*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.01)	0.03** (0.01)	0.01 (0.01)	0.04*** (0.01)	0.04*** (0.01)
male	0.05** (0.02)	-0.07*** (0.02)	0.07*** (0.01)	0.04** (0.01)	0.04* (0.03)	-0.05** (0.02)	0.01 (0.03)	0.05 (0.03)
age: 15-24	0.30*** (0.06)	0.05 (0.04)	0.04 (0.04)	0.02 (0.04)	0.30*** (0.04)	-0.05 (0.05)	-0.03 (0.07)	-0.02 (0.07)
age: 25-34	-0.06 (0.04)	-0.02 (0.03)	-0.04* (0.02)	-0.01 (0.02)	0.05 (0.04)	-0.05 (0.03)	-0.05 (0.04)	-0.07 (0.05)
age: 45-54	0.05 (0.04)	-0.01 (0.03)	-0.00 (0.02)	-0.01 (0.02)	-0.04 (0.04)	0.01 (0.03)	-0.00 (0.04)	-0.01 (0.05)
age: 55-64	0.09** (0.04)	0.00 (0.03)	0.03 (0.03)	-0.03 (0.02)	-0.04 (0.04)	0.02 (0.04)	-0.06 (0.05)	0.12** (0.05)
age: 65+	0.15*** (0.05)	-0.01 (0.04)	0.03 (0.03)	-0.01 (0.03)	-0.14** (0.05)	0.05 (0.03)	0.05 (0.05)	0.18*** (0.06)
education: low	0.06** (0.03)	0.00 (0.02)	0.04** (0.02)	0.04** (0.02)	-0.03 (0.03)	0.01 (0.02)	0.01 (0.03)	0.08** (0.04)
education: high	0.03 (0.03)	-0.00 (0.02)	-0.00 (0.02)	-0.01 (0.02)	-0.06** (0.03)	0.00 (0.02)	-0.08** (0.03)	-0.08** (0.04)
income: EUR 1150-	0.07 (0.05)	-0.00 (0.04)	0.08** (0.04)	0.09** (0.04)	0.09* (0.05)	0.04 (0.03)	0.08 (0.05)	0.12** (0.06)
income: EUR 1151-1800	0.08** (0.03)	-0.01 (0.03)	0.03 (0.02)	0.05** (0.02)	0.05 (0.03)	0.02 (0.03)	0.09** (0.04)	0.10** (0.04)
income: EUR 2601+	0.00 (0.03)	0.03 (0.02)	-0.02 (0.02)	0.02 (0.02)	-0.09*** (0.03)	-0.02 (0.02)	-0.01 (0.03)	0.02 (0.04)
homeowner	-0.04 (0.03)	-0.03 (0.02)	-0.06*** (0.02)	-0.03 (0.02)	-0.09*** (0.03)	0.00 (0.02)	-0.01 (0.03)	-0.07* (0.04)
single	0.03 (0.04)	0.04 (0.03)	0.00 (0.02)	0.03 (0.03)	0.10*** (0.04)	-0.10** (0.05)	-0.01 (0.04)	-0.05 (0.05)
partner & kids	0.01 (0.03)	-0.04 (0.03)	0.03 (0.02)	-0.02 (0.02)	0.03 (0.03)	-0.01 (0.02)	0.04 (0.03)	0.07* (0.04)
single & kids	0.07 (0.08)	-0.11 (0.08)	0.06 (0.06)	0.03 (0.05)	0.09 (0.08)	0.03 (0.06)	0.02 (0.08)	0.12 (0.10)
handles finances	-0.04 (0.03)	-0.01 (0.02)	-0.05*** (0.02)	-0.05*** (0.02)	-0.03 (0.03)	0.03 (0.02)	-0.05* (0.03)	0.00 (0.04)
paid job	-0.04 (0.03)	0.00 (0.03)	-0.02 (0.02)	-0.06*** (0.02)	0.02 (0.03)	0.02 (0.03)	-0.03 (0.03)	-0.02 (0.04)
...

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card, credit card, e-purse or fuel card. S = supermarket; SFS = specialised food stores (butcher, bakery); S(C&M) = stores (clothes, music); PS = petrol station, CE = catering establishments; CDM = candy and drink machines; CPTM = car park ticket machine; PT = public transport. * p<0.1, ** p<0.05, *** p<0.01.

Table B1. Payment behaviour at POS 2004 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	S	SFS	S(C&M)	PS	CE	CDM	CPTM	PT
...
paid job	-0.04 (0.03)	0.00 (0.03)	-0.02 (0.02)	-0.06*** (0.02)	0.02 (0.03)	0.02 (0.03)	-0.03 (0.03)	-0.02 (0.04)
city	0.01 (0.01)	0.02* (0.01)	0.00 (0.01)	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
region: west	-0.02 (0.04)	-0.02 (0.04)	0.01 (0.02)	0.02 (0.03)	-0.02 (0.04)	0.01 (0.03)	0.05 (0.04)	-0.02 (0.05)
region: north	-0.06 (0.04)	-0.03 (0.04)	0.00 (0.03)	-0.02 (0.03)	0.03 (0.05)	0.03 (0.04)	0.16*** (0.05)	0.03 (0.06)
region: east	-0.07* (0.04)	-0.08** (0.04)	0.01 (0.03)	-0.01 (0.02)	0.00 (0.04)	0.02 (0.03)	0.07 (0.05)	-0.05 (0.05)
region: south	-0.01 (0.04)	-0.02 (0.04)	0.02 (0.03)	0.04 (0.03)	0.06 (0.04)	0.03 (0.03)	0.07 (0.05)	0.04 (0.05)
N	1924	1832	1939	1664	1804	1180	1627	1266
pseudo R-squared	0.10	0.06	0.11	0.11	0.08	0.06	0.06	0.07
Chi-squared	224.7	107.0	148.3	130.4	180.7	66.6	113.4	105.6
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card, credit card, e-purse or fuel card. S = supermarket; SFS = specialised food stores (butcher, bakery); S(C&M) = stores (clothes, music); PS = petrol station, CE = catering establishments; CDM = candy and drink machines; CPTM = car park ticket machine; PT = public transport. * p<0.1, ** p<0.05, *** p<0.01.

Table B2. Payment behaviour at POS 2014 (part I)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	S	SFS	NFS (HP)	NFS (LP)	PS	R	SEH
safety	0.01 (0.01)	0.02** (0.01)	0.00 (0.00)	0.04*** (0.01)	-0.00 (0.00)	0.01 (0.01)	0.03*** (0.01)
speed	0.02** (0.01)	0.04*** (0.01)	-0.00 (0.00)	0.03*** (0.01)	-0.00 (0.00)	0.00 (0.01)	0.02** (0.01)
costs	-0.01* (0.01)	-0.01 (0.01)	-0.00 (0.00)	-0.01 (0.01)	0.00 (0.00)	-0.00 (0.01)	-0.02** (0.01)
user-friendliness	0.03*** (0.01)	0.04*** (0.01)	0.01** (0.00)	0.03** (0.01)	0.02*** (0.00)	0.02** (0.01)	0.04*** (0.01)
male	-0.01 (0.02)	-0.09*** (0.02)	0.01 (0.01)	-0.06*** (0.02)	0.01* (0.01)	0.01 (0.01)	0.04* (0.02)
age: 15-24	0.03 (0.05)	-0.01 (0.07)	0.02 (0.03)	-0.14** (0.06)	0.02 (0.03)	-0.04 (0.04)	-0.07 (0.07)
age: 25-34	-0.01 (0.03)	-0.02 (0.04)	-0.02 (0.01)	-0.09** (0.04)	-0.00 (0.01)	-0.03 (0.02)	-0.03 (0.04)
age: 45-54	0.14*** (0.04)	0.17*** (0.04)	0.02 (0.02)	0.19*** (0.04)	0.02* (0.02)	0.02 (0.03)	0.15*** (0.03)
age: 55-64	0.12*** (0.03)	0.14*** (0.04)	0.01 (0.01)	0.14*** (0.04)	0.00 (0.01)	-0.03 (0.02)	0.14*** (0.03)
age: 65+	0.16*** (0.04)	0.19*** (0.05)	0.01 (0.02)	0.21*** (0.04)	0.00 (0.01)	-0.01 (0.03)	0.17*** (0.04)
education: low	0.02 (0.02)	-0.03 (0.03)	0.01 (0.01)	-0.02 (0.03)	0.01 (0.01)	0.04* (0.02)	0.01 (0.03)
education: high	-0.04** (0.02)	-0.07*** (0.03)	-0.03*** (0.01)	-0.04 (0.03)	-0.02* (0.01)	-0.03 (0.02)	-0.05** (0.03)
income: EUR 1150-	0.04 (0.04)	0.07 (0.05)	0.04** (0.03)	0.00 (0.05)	0.05** (0.03)	0.03 (0.04)	-0.08 (0.05)
income: EUR 1151-1800	0.05** (0.03)	0.02 (0.04)	0.01 (0.01)	0.07* (0.04)	0.02* (0.02)	0.00 (0.02)	-0.02 (0.04)
income: EUR 2601+	-0.03 (0.02)	-0.00 (0.03)	-0.02** (0.01)	-0.03 (0.03)	-0.01 (0.01)	-0.02 (0.02)	-0.04 (0.03)
homeowner	-0.06*** (0.02)	-0.01 (0.03)	0.01 (0.01)	-0.01 (0.03)	-0.01 (0.01)	-0.01 (0.02)	-0.03 (0.03)
single	0.03 (0.03)	0.10*** (0.04)	0.00 (0.01)	0.03 (0.04)	-0.01 (0.01)	0.05** (0.03)	0.09** (0.04)
partner & kids	0.01 (0.02)	0.02 (0.03)	-0.02* (0.01)	-0.03 (0.03)	-0.01 (0.01)	-0.03 (0.02)	0.01 (0.03)
single & kids	0.01 (0.05)	0.02 (0.07)	-0.01 (0.02)	-0.05 (0.06)	-0.00 (0.02)	-0.01 (0.04)	-0.03 (0.07)
handles finances	-0.04** (0.02)	-0.01 (0.02)	-0.01 (0.01)	-0.03 (0.02)	-0.01 (0.01)	-0.03* (0.02)	-0.01 (0.02)
paid job	-0.01 (0.02)	-0.06* (0.03)	-0.01 (0.01)	-0.08*** (0.03)	-0.00 (0.01)	0.00 (0.02)	-0.04 (0.03)
...

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card or credit card. S = supermarket; SFS = specialised food stores (butcher, bakery); NFS (HP) = non-food stores (high prices, e.g. clothes, music); NFS (LP) = non-food stores (low prices, e.g. souvenir, flower, tobacco); PS = petrol station; R = restaurant; SEH = smaller eating-house for e.g. lunch, snacks. * p<0.1, ** p<0.05, *** p<0.01.

Table B2. Payment behaviour at POS 2014 (part I, continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	S	SFS	NFS (HP)	NFS (LP)	PS	R	SEH
...
city	-0.02*** (0.01)	-0.01 (0.01)	0.00 (0.00)	-0.01 (0.01)	-0.00 (0.00)	-0.01* (0.01)	-0.01 (0.01)
region: west	-0.05* (0.02)	-0.08** (0.03)	-0.02* (0.01)	-0.05 (0.04)	-0.01 (0.01)	-0.04* (0.02)	-0.04 (0.04)
region: north	-0.05* (0.03)	-0.10** (0.04)	-0.01 (0.01)	-0.07 (0.04)	-0.02 (0.01)	-0.08*** (0.02)	-0.05 (0.05)
region: east	-0.03 (0.03)	-0.10*** (0.04)	-0.01 (0.01)	-0.08** (0.04)	-0.02* (0.01)	-0.06** (0.02)	-0.09** (0.04)
region: south	-0.02 (0.03)	-0.03 (0.04)	0.01 (0.01)	0.01 (0.04)	-0.00 (0.01)	0.00 (0.03)	0.03 (0.04)
N	2333	2205	2312	2290	2125	2256	2272
pseudo R-squared	0.10	0.09	0.09	0.10	0.10	0.05	0.08
Chi-squared	225.1	236.3	78.3	295.4	90.6	89.3	225.6
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card or credit card. S = supermarket; SFS = specialised food stores (butcher, bakery); NFS (HP) = non-food stores (high prices, e.g. clothes, music); NFS (LP) = non-food stores (low prices, e.g. souvenir, flower, tobacco); PS = petrol station; R = restaurant; SEH = smaller eating-house for e.g. lunch, snacks. * p<0.1, ** p<0.05, *** p<0.01.

Table B3. Payment behaviour at POS 2014 (part II)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	C	A	CA	CDM	CPTM	PT	T
safety	0.03*** (0.01)	-0.00** (0.00)	0.02** (0.01)	0.02** (0.01)	0.02 (0.01)	0.01 (0.01)	0.03*** (0.01)
speed	0.02** (0.01)	-0.01*** (0.00)	0.01* (0.01)	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.00 (0.01)
costs	-0.01 (0.01)	0.01*** (0.00)	-0.00 (0.01)	-0.00 (0.01)	-0.02** (0.01)	-0.01 (0.01)	0.02*** (0.01)
user-friendliness	0.02** (0.01)	0.01** (0.00)	0.01 (0.01)	0.01 (0.01)	0.02* (0.01)	0.02* (0.01)	0.00 (0.01)
male	0.04** (0.02)	0.01** (0.01)	0.00 (0.02)	-0.02 (0.02)	-0.03 (0.02)	0.02 (0.03)	0.00 (0.02)
age: 15-24	-0.04 (0.06)	-0.00 (0.01)	-0.01 (0.05)	-0.04 (0.05)	0.02 (0.09)	-0.03 (0.08)	-0.04 (0.08)
age: 25-34	0.02 (0.03)	-0.00 (0.01)	0.03 (0.03)	0.02 (0.02)	0.02 (0.04)	0.10** (0.05)	0.03 (0.03)
age: 45-54	0.02 (0.03)	0.01 (0.01)	0.10*** (0.03)	0.03 (0.02)	0.04 (0.04)	0.15*** (0.05)	-0.03 (0.04)
age: 55-64	0.01 (0.03)	0.01 (0.01)	0.05 (0.03)	0.04* (0.02)	0.08* (0.04)	0.16*** (0.05)	-0.00 (0.03)
age: 65+	0.03 (0.04)	-0.00 (0.01)	0.08** (0.04)	0.04 (0.03)	0.10** (0.05)	0.15** (0.06)	-0.03 (0.04)
education: low	-0.01 (0.03)	0.01 (0.01)	0.02 (0.02)	-0.02 (0.02)	0.12*** (0.03)	0.04 (0.04)	0.02 (0.03)
education: high	-0.03 (0.02)	-0.01 (0.01)	-0.03* (0.02)	-0.01 (0.02)	-0.03 (0.03)	-0.10*** (0.03)	0.00 (0.02)
income: EUR 1150-	-0.01 (0.05)	0.06*** (0.03)	0.05 (0.04)	0.03 (0.03)	0.08 (0.06)	0.01 (0.07)	0.04 (0.04)
income: EUR 1151-1800	-0.01 (0.04)	0.02** (0.01)	0.01 (0.03)	0.02 (0.03)	-0.02 (0.04)	0.00 (0.05)	-0.00 (0.03)
income: EUR 2601+	-0.02 (0.03)	-0.01* (0.01)	-0.06*** (0.02)	0.01 (0.02)	-0.07** (0.03)	-0.08** (0.04)	-0.00 (0.03)
homeowner	-0.03 (0.03)	-0.01 (0.01)	-0.03 (0.02)	-0.01 (0.02)	-0.05 (0.03)	-0.04 (0.04)	-0.02 (0.02)
single	0.02 (0.03)	-0.01* (0.00)	0.04 (0.03)	0.00 (0.03)	0.01 (0.04)	-0.07 (0.04)	0.01 (0.03)
partner & kids	0.01 (0.03)	-0.00 (0.01)	-0.03 (0.02)	0.03 (0.02)	0.02 (0.03)	0.01 (0.04)	-0.01 (0.03)
single & kids	0.03 (0.06)	-0.00 (0.01)	-0.03 (0.04)	-0.05 (0.06)	-0.07 (0.07)	0.01 (0.08)	-0.08 (0.08)
handles finances	0.05** (0.02)	-0.01 (0.01)	-0.03 (0.02)	0.02 (0.02)	-0.05* (0.03)	-0.05 (0.03)	-0.00 (0.02)
paid job	-0.01 (0.03)	-0.00 (0.01)	-0.03 (0.02)	-0.05** (0.02)	-0.00 (0.03)	0.04 (0.04)	-0.02 (0.03)
...

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card or credit card. C = cafe; A = accommodation; CA = cultural and amusement (e.g. theatre, museum, cinema, amusement park, disco); CDM = candy and drink machine; CPTM = car park ticket machine; PT = public transport; T = taxi. * p<0.1, ** p<0.05, *** p<0.01.

Table B3. Payment behaviour at POS 2014 (part II, continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	C	A	CA	CDM	CPTM	PT	T
...
city	-0.02** (0.01)	-0.00 (0.00)	-0.02*** (0.01)	-0.01* (0.01)	-0.03*** (0.01)	0.00 (0.01)	0.01 (0.01)
region: west	-0.04 (0.03)	-0.02*** (0.01)	-0.03 (0.03)	-0.04 (0.03)	0.24*** (0.04)	0.00 (0.05)	-0.05 (0.04)
region: north	-0.05 (0.04)	-0.01** (0.00)	0.02 (0.04)	-0.03 (0.03)	0.47*** (0.03)	0.28*** (0.06)	-0.02 (0.04)
region: east	-0.08** (0.04)	-0.01* (0.00)	-0.02 (0.03)	-0.01 (0.03)	0.35*** (0.04)	0.08* (0.05)	-0.06 (0.04)
region: south	0.08** (0.03)	-0.01 (0.01)	0.06* (0.03)	0.02 (0.03)	0.37*** (0.04)	0.19*** (0.05)	0.02 (0.03)
N	1991	2114	2182	1832	2035	1263	1109
pseudo R-squared	0.05	0.15	0.08	0.04	0.11	0.08	0.07
Chi-squared	107.3	84.0	180.1	52.2	261.7	115.5	55.4
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The table reports marginal effects from probit regressions with robust standard errors between parentheses. The dependent variables are binary dummies that are 1 for consumers who mostly pay cash. The 0 category includes consumers who mostly pay by debit card or credit card. C = cafe; A = accommodation; CA = cultural and amusement (e.g. theatre, museum, cinema, amusement park, disco); CDM = candy and drink machine; CPTM = car park ticket machine; PT = public transport; T = taxi. * p<0.1, ** p<0.05, *** p<0.01.

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