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Indonesian Household Payment Choice: A Nested Logit Analysis[1]

Abstract: We examine the preferences of respondents for six types of payment instruments, namely cash, debit and credit cards, card and server-based electronic money, and internet or mobile banking. By applying a nested logit model to 500 household data covering six provincial capitals in Indonesia, we find that the decision to choose payment instruments is made sequentially. Socio-economic characteristics, including education, age, income, and transaction objectives or functionality have a significant effect on the probability of using non-cash electronic payment instruments. We find a substitution pattern between payment instruments, not only between cash and non-cash instruments but also between non-cash instruments. In light of these findings, appropriate payment system policies are in order to hasten the use of non-cash payment.

Keywords: Payment Preferences; Payment Instruments; Substitution between Payment Instruments.

JEL Classification: D14

1. Introduction

In this paper, we examine the preferences of respondents for six types of payment instruments, namely cash, debit and credit cards, card and server-based electronic money, and internet or mobile banking. This is necessary, given the impor-

[1] The conclusions, opinions, and views expressed by authors in this paper are the authors' conclusions, opinions, and views and are not conclusions, opinions, and views of Bank Indonesia.

tance of the payment instruments in economic activities. For instance, studies show that non-cash payments provide advantages to the economy because they can drive the efficiency of transactions (Bolt et al., 2010), contribute to increasing gross domestic product (GDP), create new jobs (Zandi et al., 2016), and ensure smooth business transactions as well as reduce the risk of crime (Mieseigha and Ogbodo, 2013). Non-cash payments also increase the share of demand deposits and quasi-money to broad money, increasing individual bank's liquid fund (reserve). As a result, individual bank have greater capacity to create money by extending credit to households and firms (Gross, 2019). By paying attention to these benefits, we need to continually improve the adoption of non-cash payments.

The level of non-cash payment adoption is influenced not only by the supply side, but also the demand side (Stavins, 2017). However, prior studies focus on the supply side, particularly the structure and cost comparison between payment instruments (Stavins, 2017; Klee, 2008), and infrastructure availability (Bolt et al., 2010). Therefore, it is important to carry out demand-side analysis (or analysis from the users of non-cash instruments). Studies on the choice of demand-based household payment instruments, especially in Indonesia, are relatively limited mainly due to limited data at the household or individual level.[2] Meanwhile, the level of non-cash payment adoption could support individuals gaining access to financial services to increase the financial inclusion in Indonesia, which is currenctly 49% (World Bank, 2018). Analysis at the household or individual level is very important because household decisions to own and use payment instruments are reasonably complicated. Consequently, households face a trade-off between various attributes, such as security, speed, costs (Koulayev, et al., 2016), destination or transaction value (Arango, 2011), and demographic characteristics, such as education and income (Bagnall and Flood, 2011).

From the Indonesian perspective, there are few studies which found various financial services has positive effect on consumption and economic growth at macroeconomic level (Tarsidin and Rakhman, 2018; Sharma et al., 2018; Juhro and Iyke, 2019; Narayan, 2019; Prabheesh and Rahman, 2019). Narayan (2019) investigates the role of FinTech industries which provide financial services like lending, payment and investment on Indonesia's economic growth and found positive relationship. Similarly studies by Sharma et al. (2018), Juhro and Iyke (2019), and Prabheesh and Rahman (2019) examined the role of credit card for understanding consumption smoothing and macroeconomic data of Indonesia. At micro level, one study that examines the payment instrument decisions from the demand side is Sahabat et al. (2017), which analyzes the impact of payment attributes and demographic characteristics of Indonesian households on payment choice decisions. This study find that the payment choice decision is sequential or

[2] See Sui and Niu (2018) for example, using a household survey of China, they investigate the size of China's urban–rural gap in ownership of bank deposits, risky financial assets, and credit cards. Further, they find evidence of both demand-side barriers and supply-side barriers to financial inclusion exist in China.

gradual. It furthermore reveals that security, costs, facilities, and revenues significantly affect payment choices, especially for debit and credit cards.[3] The socio-economic characteristics of the household, such as age, education, income, and employment status of the household head significantly increase the probability of non-cash payments.

Our study mainly extends prior studies, particularly Sahabat et al. (2017), in two ways. Firstly, we analyze the functionality or purpose of the transaction and estimate the elasticity of shifting between payment instruments. Secondly, we extend the sample to cover six of the biggest cities and provincial capitals in Indonesia, spread across the archipelago, namely Medan (North Sumatra), Bengkulu (Bengkulu), Jakarta (DKI Jakarta), Yogyakarta (DI Yogyakarta), Makassar (South Sulawesi), and Palangkaraya (Central Kalimantan), whereas Sahabat et al. (2017) consider only Jakarta and Surabaya. Thus, our analysis better considers the variation in the level of usage of non-cash payments geographically, which depends on the degree of financial literacy and electronic infrastructure availability.

By applying a nested logit model to 500 household data covering six provincial capitals in Indonesia, we find that the decision to choose payment instruments is made sequentially, which is consistent with Sahabat et al. (2017). Socio-economic characteristics, including education, age, income, and transaction objectives or functionality have a significant effect on the probability of using non-cash electronic payment instruments. We find a substitution pattern between payment instruments, not only between cash and non-cash instruments but also between non-cash instruments. We argue that, in light of these findings, appropriate payment system policies are in order to hasten the use of non-cash payment.

Our analysis provides firm support for prior findings. Koulayev et al. (2016), applying structural models to the Consumer Payment Options Survey data, show that demographic and income factors have significant influence on the adoption and usage of various payment instruments.[4] Bagnall and Flood (2011) earlier find that education, age, and income significantly influence consumer payment choices. Besides, Schuh and Stavins (2011) find, using an interregional data, that demographic characteristics, special age, education, and income are linked to the level of adoption and usage of payment instruments in the United States. Their study shows that cash is more used by people who are young, less educated, or have low income, while credit cards are usually used by elderly people, the wealthy, or the highly educated people.

Prior studies, including Koulayev et al. (2016) and Rysmann (2010), find that payment instrument attributes such as security, speed, acceptability, identification

[3] See for instance, Akin, Aysan, Ozcelik, and Yildiran (2012) dentify the determinants of customer satisfaction in the Turkish credit card market and Mazibaş and Tuna (2017) examine the dynamics of the growth in consumer loans and credit cards in Turkey.

[4] See for example, China, Zhou and Xiao (2018) for factors of household financial decision making.

features, costs, and facilities influence consumer payment instrument decisions. Arango, Huynh, and Sabetti (2011) find that the dominance of cash in small value transactions is due to the limited acceptability of other payment instruments, while Stavins (2017) find that the acceptance characteristics are very necessary but not sufficient in the use of payment instruments. This is in line with Wakamori and Welte (2012) who find that debit cards will not completely replace cash due to other factors (trustworthiness, usability, and anonymity) that influence acceptability.

The value and type of transaction also influence payment preferences. Stavins (2017) shows that low value transactions usually involve cash. Similarly, Bagnall and Flood (2011) find that when the transaction value increases, the use of cash decreases. Briglevis and Schuh (2014) show that consumers choose certain payment instruments not only based on the benefits obtained from the transaction but also the impact of that choice on future transactions.

Our study contributes to these studies by providing support for their findings from a developing country context. We show that socio-economic characteristics, including education, age, income, and transaction objectives or functionality significantly influence payment instruments decisions. The rest of the paper is organized as follows. Section 2 describes the data and the methods used to achieve our objective. Section 3 presents and discusses the findings. Section 4 provides the concluding remarks and policy implications.

2. Data and Methodology

2.1. Data and Data Collection Method

We obtain the data using the Computer Assisted Telephone Interviewing (CATI)[5] survey methods from six Indonesian provincial capitals, namely Medan (North Sumatra), Bengkulu (Bengkulu), Jakarta (DKI Jakarta), Yogyakarta (DI Yogyakarta), Makassar (South Sulawesi), and Palangkaraya (Central Kalimantan). The six cities are selected based on the value of the highest and lowest Gross Regional Domestic Product (GRDP) in Indonesia in the second semester of 2016.[6] We used the error tolerance limits (e) of 0.045 to determine the number of Slovin[7] samples. Based on the

[5] CATI is a survey technique using a telephone whereby the interviewer follows the script provided by a computer application.

[6] GRDP shows the total value of goods and services produced in a region within a year. Hence, the regional characteristics can also be illustrated by choosing the highest and lowest GRDP representatives from each region of Indonesia (West, Central, and Eastern Indonesia).

[7] Slovin formula, $n = \frac{N}{1+ Ne^2}$, is used to calculate the minimum sample size when the behavior of a population is not known exactly (Sevilla et al., 1960).

total population over the age of 20 years, which is N = 10,470,939 people, we find the optimal sample size to be n = 493 people or to 500 households.

Our survey follows a consumer choice survey conducted by the Federal Reserve of Boston (Foster et al., 2011), which elicited information on consumer preferences for payment methods in the United States mainly based on their transaction objectives. In general, the consumer choice survey was conducted to collect related information regarding: (i) respondents' socio-economic background; (ii) household ownership of various payment instruments; (iii) average frequency and nominal value of use of various payment instruments in one month; (iv) average frequency of use of various payment instruments for the purpose of certain transactions in one month; and (iv) attribute valuation (security, speed, acceptance, cost, facilities, and identification).

2.2. Analytical Methods

Individuals' decisions to choose one payment instrument are assumed to be influenced by the availability of other alternative payment instruments. For example, in selecting between cash and ATM/debit cards, a person may prefer cash to ATM/debit cards. However, when the same person has card-based electronic money, the decision to choose cash instead of ATM/debits and electronic money (card-based) may change. This assumption is referred to as dependent irrational alternatives (McFadden, 1981). The assumption can be tested through the value of Independence of Irrelevant Alternatives (IIA). If the p-value of IIA is less than 0.05, then it means there is a relationship to the error of each alternative payment instrument.

Table 1. IIA Tests

		dissimilarity parameters			
MP	/T_tau	1	189416.6	-371248.8	371250.8
	/NT_tau	0.137	0.034	0.071	0.203
LR test for IIA (tau=1) : chi2(2) = 64.33				Prob > chi2 = 0.000	

This table presents the result of Independence of Irrelevant Alternatives (IIA) test. If the p-value of IIA is less than 0.05, then IIA is rejected.

Table 1 shows that the p-value (indicated by prob>chi2) is less than 0.05, implying that the assumption of IIA is rejected. That is, there is a dependence relationship between payment instruments. For this reason, we use a nested logit model to accommodate the dependent irrelevance characteristics in this study, consistent with McFadden (1981).

Our nested logit model is the two-level random utility model or the 2-level nested logit model, which is defined as follows:

$$U_{jk} + \varepsilon_{jk} = Z_j^T \alpha + X_{jk}^T \beta_j + \varepsilon_{jk} \quad (1)$$

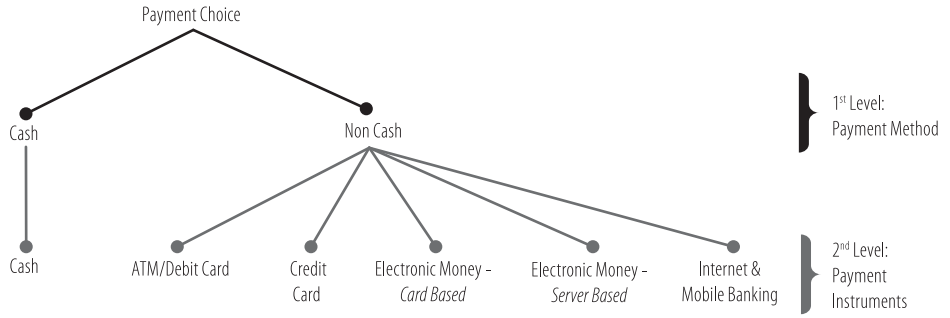
where U_{jk} is the utility for alternative *jk* or utility for using a particular payment instrument; *j* denotes cash or non-cash instruments; *k* represents cash, debit/ATM card, credit card, electronic money (EM) – card, electronic money (EM) – server, and internet mobile banking; *Z* represents the socio-economic characteristics of the household; *X* represents attributes of the payment instrument and the purpose of the transaction; α and β_j are parameters; and ε_{jk} is the error term.

This model shows that household payment choices are influenced by two factors: (1) an alternative specific variable (X_{jk}) consisting of the attributes of the payment instrument and the purpose of the transaction, and (2) a case specific variable (*Zj*) consisting of the socio-economic characteristics of the household. This model assumes that the error terms ($\varepsilon_{jk},\ldots,\varepsilon_{jK}$) follow Gumbel's multivariate extreme value (GEV) distribution[8]. Furthermore, the opportunity that the alternative (*j, k*) is:

$$P_{jk} = P_j x\, P_{k|j} = \frac{\exp(Z_k^T \alpha + \tau_j I_j)}{\sum_{m=1}^{j} \exp(Z_m^T \alpha + \tau_m I_m)} x \frac{\exp(X_k^T \beta_j / \tau_j)}{\sum_{l=1}^{k_j} \exp(X_{jl}^T \beta_j / \tau_j)} \quad (2)$$

where $I_j = \ln[\sum_{l=1}^{k_j} \exp(X_{jl}^T \beta_j / \tau_j)]$ describes inclusive value or log sum. Inclusive value indicates that there is a gradual/sequential decision relationship simultaneously. In this study the payment option scheme is identified in stages in two levels as shown in Figure 1.

Figure 1. Payment Instrument Choice Nested Logit Scheme



This figure shows process of choosing payment instrument by household. The process is sequential, from first selection on payment method to the second selection on the payment instruments.

[8] The GEV distribution is one of the error distributions in discrete choice theory that is useful for connecting the logistic distribution of two random variables (*j* and *k*) and the only distribution that might normalize the maximum value of a multilevel independent and randomly distributed variable (Hugueny, 2009).

Table 2 provides the operational definitions of the variables in the model as well as the expected signs.

Table 2. Variable definitions and expected signs

No	Variable	Operationalization	Expected Sign	Theoretical Argumentation
Dependent Variable of Payment Choice				
	Payment Options	1 = cash, 2 = ATM/debit card, 3 = credit card, 4 = EM card, 5 = EM server, 6 = Internet/mobile banking		
Specific Alternative Independent Variables: Perception of the Payment Instrument Attributes				
1	Safety	0 = risky, 1 = safe	(+)	Stavins (2017)
2	Speed	0 = slow, 1 = fast	(+)	Stavins (2017); Borzekowski and Kiser (2008)
3	Acceptance	0 = not easily accepted, 1 = accepted anywhere	(+)	Stavins (2017)
4	Facilities	0 = few, 1 = many	(+)	Stavin (2017)
5	Identification	0 = not easily identified, 1 = easily identified	(+)	Soetevent (2011)
Specific Alternative Independent Variable: Transaction Purpose				
6	Grocery	Average frequency per month	(+)	Humphrey, Kim, and Vale (2001); Bounie and Francois (2006), Wang (2016) analogous to the nominal influence and type of transaction.
7	Transportation	Average frequency per month	(+)	
8	Education	Average frequency per month	(+)	
9	Communication	Average frequency per month	(+)	
10	Clothing	Average frequency per month	(+)	
11	Healthcare	Average frequency per month	(+)	
12	Online Shopping	Average frequency per month	(+)	
Case Specific Independent Variable: Socio-Economic Characteristics of the Household				
13	Education	Old (years)	(+)	Zinman (2009), Wang (2016)
14	Gender	0 = Female, 1 = Male	(+)	Loix et al. (2005)
15	Age	Years	(–)	Zinman (2009), Wang (2016)
16	Infrastructure Distance	Meter	(–)	Hayashi and Klee (2003); Ching and Hayashi (2010); Bolt et al. (2010)
17	Household Members	Person(s)	(+)	Stavins (2017)
18	Investment Percentage	(%) from income	(+)	Bennet, et al. (2014)
19	Expenditure	Rupiah / month	(+)	Bennet, et al. (2014)
20	Cash in hand	Average in Rupiah	(–)	Bennet, et al. (2014)

This table presents the operationalization, relationship hypothesis and theoretical argumentation based on previous studies for each variable.

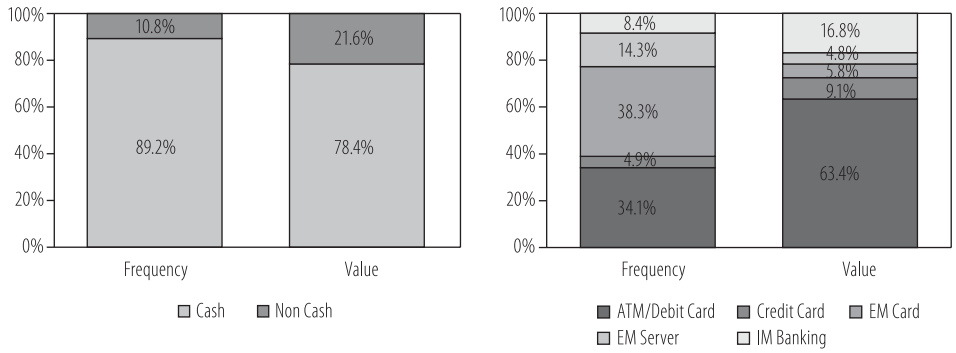
3. Results

This section presents the results. It first describes the data. Then, it reports and discusses the estimation results, including the marginal effects. The marginal effects are estimated to determine the effects of the determinants in Table 2 on payment instrument decisions.

3.1. Description of Data

Figure 2 shows the distribution of cash and non-cash usage among Indonesian households. Overall, cash payments dominate non-cash payments in household payment instrument choices, both in terms of frequency (89.2%) and transaction value (78.4%). The most widely used non-cash instrument, in terms of frequency, is card-based electronic money (38.3%). However, in terms of transaction value, ATM/debit cards dominate, representing 63.4%.

Figure 2. Cash vs. Non-Cash Use and Use of Non-Cash Instruments



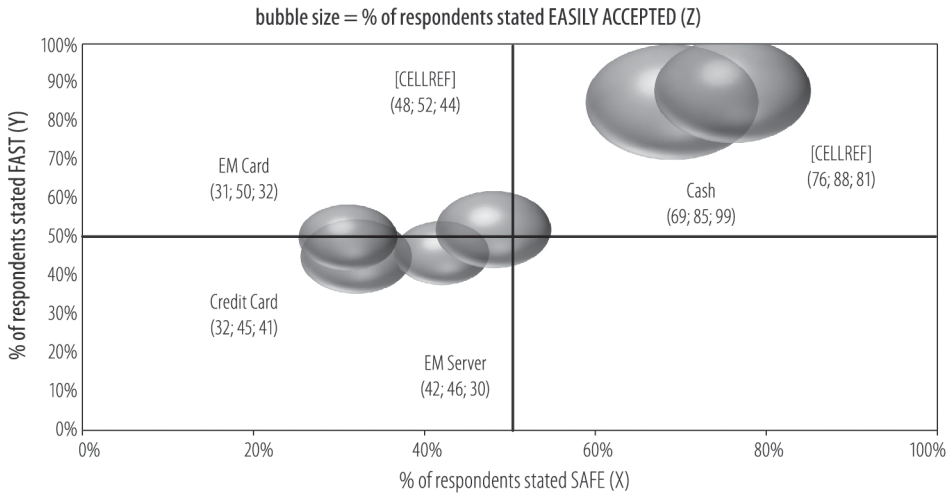
The left figure represents the proportion of cash and non-cash usage in terms of frequency and value. The right figure represents the proportion of various non-cash instruments usage (also in frequency and value). Both frequency and value are represented in percentages.

Figure 3 shows the respondents' perceptions regarding the three attributes of payment instruments, namely security, speed, and acceptance.

The respondents perceived cash, ATM/debit cards, and Internet/mobile banking differently in terms of being safe, fast, and easy to accept. ATM/debit cards are superior in terms of security and speed than cash, while cash is superior in terms of acceptance as opposed to ATM/debit cards. Internet/mobile banking is the next best instrument in terms of speed and security attributes.

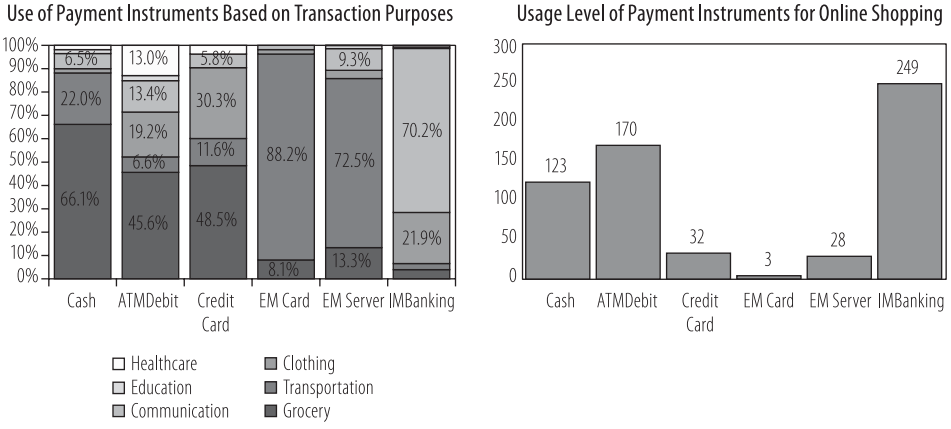
In addition to the payment instrument attributes, we also present data on the distribution of the transaction objectives. The transaction objectives are grouped into six payment purposes, namely food/grocery, transportation, clothing, communication, education, and healthcare. We also report additional information on the use of the payment instruments for online shopping transactions.

Figure 3. Assessment of Primary Payment Instrument Attributes



The figure represents the comparison of payment instruments perception in terms of three primary instrument attributes (security, speed, and acceptance). The value are represented in percentage of number of respondents who stated that the instrument is safe (X); fast (Y); easily accepted (Z/bubble size).

Figure 4. Use of Payment Instruments Based on Transaction Objectives



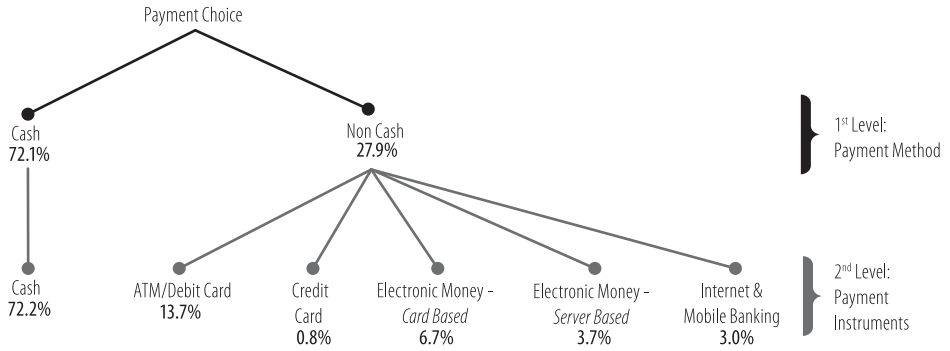
The top figure represents the usage proportion of each instrument based on transaction purposes, where value is represented in percentages. The bottom figure represents the usage level of each instrument when used for online shopping payment, where value is represented in level (frequency of use).

Figure 4 shows that cash is most often used for food/grocery transactions (66.1%), followed by ATM/debit cards (45.6%). Credit cards are mostly used for food/grocery transactions (48.5%), clothing (30.3%), and transportation (11.6%). For the other payment instruments, card-based electronic money is most often used for transportation transactions (88.2%), followed by server-based electronic money (72.5%). In addition to transportation, server-based electronic money is also used for food/grocery transactions (13.3%) and communication (9.3%). This is supported by the growing development of start-ups that create online transportation applications and food ordering and top-up services. Finally, internet/mobile banking payment services are most often used for communication spending (70.2%). Interestingly, payments for online shopping are most often made via internet/mobile banking and ATM/debit cards which need consumers to go to ATM or open banks' website or application to complete the transactions, not directly done in the online shopping platform.

3.2. Estimation Results

We formulated the respondents' preference for the payment instruments by the frequency of use and the perception or assessment of the attributes of the payment instruments, including security, speed, ease of transaction, number of facilities, and ease of identification. The higher the usage and the perception on the payment instruments, the higher the preference over a payment instrument. We also obtained the predicted probability of each payment instrument as the respondent's preference from the data. Figure 5 shows the predicted probability of the payment instruments.

Figure 5. Predicted Probability of the Payment Instruments



This figure presents the predicted probability for each payment instrument, ie the opportunity for an individual to choose an instrument if the individual is randomly chosen. The total probability for each level is 1.

Level 1 shows that the average probability for selecting the cash payment method is 72.1% and the non-cash payment method is 27.9%. That is, if one individual was to

select at random, then the probability that the individual will select the non-cash payment method is 0.279 or 27.9%. At level 2, the probability of selecting a ATM/debit card non-cash payment instrument is the largest, 13.7%. That is, if one individual chooses at random, then the probability that the individual will choose an ATM/debit card is 13.7%.

To establish the determinants of the payment instrument selection behavior, we consider the influence of factors such as household characteristics, the attributes of the payment instruments, and the type/purpose of the transaction on payment preferences. The household characteristics (referred in this study as 'specific case variables') are specific to households because they differ across households and individuals. Meanwhile, the payment instrument attributes and the type/purpose of transactions differ across payment instruments and are thus categorized, in this study, as 'alternative specific variables'. The coefficients of the specific alternative variables cannot be directly interpreted as the influence of these variables on payment instrument preferences. Therefore, we explore the influence of these variables via marginal effects, which is discussed in the next subsection.

Table 3 shows the results based on the case specific variables (i.e., household characteristics of payment options).

Table 3. The Effect of Socio-Economic Variable on Payment Choice

Socio-Economic Variable (Case Specific) Base: Cash	ATM/Debit	Credit Card	EM Card	EM Server	IM Banking
Education	0.661	0.232**	-0.013	0.111*	0.093*
	(0.196)	(0.027)	(0.824)	(0.054)	(0.091)
Gender	0.371	-0.130	0.400	0.281	0.364
	(0.179)	(0.723)	(0.193)	(0.361)	(0.241)
Age	-0.538**	-1.322***	-0.815***	-1.518***	-0.900***
	(0.021)	(0.004)	(0.003)	(0.000)	(0.001)
Expenditure	0.358***	0.510***	0.386***	0.496***	0.408***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment Percentage	0.678	2.075**	0.436	1.205	-0.218
	(0.404)	(0.046)	(0.655)	(0.185)	(0.813)
Household Members	-0.065	0.087	0.017	0.148	0.005
	(0.536)	(0.591)	(0.882)	(0.218)	(0.966)
Cash in hand	0.001	0.002*	0.001	0.002	0.002*
	(0.210)	(0.062)	(0.532)	(0.147)	(0.080)
Infrastructure Distance	-0.000	-0.000	-0.001*	-0.000	-0.000
	(0.120)	(0.261)	(0.079)	(0.258)	(0.102)

Notes: *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively. p-values are in the parentheses.

This table presents the estimation result of the socio economic variables. Since socioeconomic variables are case specific variables, this table presents the effect of each socioeconomic variable on the choice of non-cash payment instruments by comparing them to cash.

The age coefficient is negative, indicating that the older the respondent, the lower the probability of using non-cash payment instruments compared to cash. This is consistent with Arango, Huynh, and Sabetti (2011) and Wang (2016), who find that older people prefer to use cash. The results also show that education has a significantly positive effect on non-cash payments, implying that more educated people tend to use non-cash payment instruments. This is consistent with the hypothesis that households with high education have better awareness and adaptability to technology and is in line with Schuh and Stavins (2010), Bolt and Chakravorti (2008), and Klee (2008). However, ATM/debit cards are not statistically significant in the model, considering that ATM/debit card adoption has been longer than any other instruments.

The results suggest that revenue, which is proxied by expenditure, is the most significant factor influencing the choice of non-cash payment instruments. Higher income households tend to do more transactions with higher value, thereby increasing the use of non-cash payment instruments. Bolt and Chakravorti (2008), Klee (2008), and Schuh and Stavins (2010) find similar results.

The socio-economic variable, i.e. the percentage of savings and investment that represent the economic capacity of the respondents, is only significant in the use of credit card payment instruments. In this socio-economic category, two variables, namely gender and number of household members, do not significantly influence the use of payment instruments. As far as gender is concerned, Sahabat et al. (2017) also find that there is no difference in payment instrument choices between men and women in Indonesia. In contrast, Bolt and Chakravorti (2008), and Bounie and François (2006) find that gender significantly affects the choice of payment instruments. The contrasting findings are due to differences in the cultural characteristics of the respondents. With regards to the number of household members, our results contradict Sahabat et al. (2017), who find that the number of household members (as a proxy for expenditure amounts) significantly affects the choice of payment instruments. This difference is due to the large number and variety of household members in Sahabat et al. (2017), i.e., four family members in theirs relative two family members in ours.

Table 4 shows the results based on alternative specific variables (i.e., the valuation of payment instrument attributes and the type/purpose of transactions).

Table 4. The Effect of Payment Instrument Attributes and Transaction Purpose on Payment Choice

Variable Attribute Perception (Alternative Specific)	Coefficient	P-value
Attribute Assessment		
Safety	0.088	0.334
Speed	0.196	0.129
Acceptance	0.108	0.273
Facilities	0.041	0.648
Identification	0.357***	0.002
Transaction Type/Purpose		
Grocery	0.019***	0.001
Transport	0.058***	0.000
Education	0.222*	0.097
Communication	0.076***	0.000
Clothing	0.145***	0.002
Healthcare	0.305***	0.000
Online Shopping	0.013***	0.005

Notes: * and *** indicate statistical significance at 10% and 1%, respectively. p-values are in the parentheses.

This table presents the effect of payment instrument attributes and the effect of transaction purpose on the choice of payment instrument by household. This table shows whether the two variables affect the choice of payment, but the specific effect on each instrument will be further elaborated on the own and cross marginal effects table.

In terms of the valuation in payment instruments attributes, identification attributes have a positive significant impact on payment options. That is, if a payment instrument offers convenience in identifying transactions, then the probability of being chosen by respondents will increase. This condition is mainly derived from the transaction needs recorded for expenditure control for the majority of respondents from the lower middle class with an expenditure level of Rp 2.1 to 4 million (50.3%). This result is consistent with Wakamori and Welte (2012). Furthermore, the results indicate that security, speed, acceptance, and facilities/rewards do not have a significant impact on payment options. However, the coefficients of each of these attributes are consistent with previous studies, such as in Bolt and Chakravorti (2008), and Schuh and Stavins (2010). We conclude that increasing the security and speed of non-cash payments can increase the probability of households selecting non-cash payment instruments. Meanwhile, the finding that facilities have no significant impact on payment instrument options are in line with Bounie and François (2006), who document this evidence for France. The ease of transactions (acceptance) does

not significantly affect the use of payment instruments, reinforcing the finding by Schuh and Stavin (2010) in the United States and Arango, Huynh, and Sabetti (2015) in Canada.

All categories of payment transaction purposes, namely food/grocery, transportation, education, communication, clothing, healthcare, and online shopping, show a positive and significant effect on the use of payment instruments. That is, the higher the frequency of spending, the higher the probability of using both cash and non-cash payment instruments. The results suggest that households choose payment instruments by considering the characteristics of the transaction, such as transaction value and frequency of payment, with the suitability of the instrument to be used for the transaction. In other words, instrument functionality is an important determinant of payment preferences, which is consistent with Humphrey, Kim and Vale (2001), and Bounie and Francois (2006), who find that the nominal and type of transactions influence the use of electronic payment instruments.

3.3. Marginal Effect Results

In this subsection, we explore the influence of the 'specific alternative variables' on payment instruments via marginal effects. A policy is needed to encourage the adoption of non-cash payment instruments. Based on the results from the nested logit model, we show in the preceding subsection that the purpose of the transaction had a significant effect on payment options, while the majority of perceptions/assessments of payment attributes are insignificant. However, knowing the different impacts on each instrument when an attribute is intervened, still provide additional information to optimize the policy intervention to increase non-cash payment instruments adoption. This is achieved through marginal effect analysis.

Table 5 shows the results of the marginal effects, which can be interpreted in two ways, namely the own marginal effect and the cross marginal effect. Using the cross marginal effect, substitution effects can be seen in the available payment instruments.

Table 5. Own Marginal Effect

Payment Instrument	Payment Instrument Attribute				
	Safety	Speed	Ease of transaction	Facilities	Identification
Cash	0.012	0.037	0.051	0.070	0.102
ATM/Debit Card	0.803	0.802	0.744	0.910	0.712
Credit Card	0.004	0.013	0.018	0.024	0.035
EM (Card)	0.007	0.023	0.032	0.043	0.063
EM (Server)	0.008	0.026	0.036	0.049	0.071
Internet Mobile Banking	0.011	0.036	0.049	0.067	0.098

Payment Instrument	Transaction Type/Purpose						
	Food/ Grocery	Transport	Education	Communication	Clothing	Healthcare	Online Shopping
Cash	0.005	0.018	0.343	0.089	0.307	0.385	0.129
ATM/Debit Card	0.019	0.028	0.258	0.048	0.101	0.068	0.198
Credit Card	0.002	0.006	0.118	0.031	0.106	0.119	0.040
EM (Card)	0.003	0.011	0.214	0.056	0.191	0.215	0.072
EM (Server)	0.004	0.013	0.241	0.063	0.216	0.242	0.081
Internet Mobile Banking	0.005	0.018	0.331	0.086	0.296	0.333	0.112

This table shows the marginal effect of the payment instrument attributes and transaction purpose on the opportunity to use a particular instrument (own marginal effect). If there is a change in one unit of attribute perceptioan or a change in the frequency of spending for a particular purpose, then the chances of choosing an instrument will change according to the amount in the table below.

In general, the attributes that have the strongest influence (as indicated by the largest coefficient) on payment behavior are facilities/rewards and ease of identification. A large effect of facilities/rewards occurs because households are rational and take into account the financial benefits of selecting non-cash payment instruments. The process of comparing rewards in the form of facilities such as discounts, points, and free transaction costs incurred in household decision-making. The ease of identification gives strong influence on payment behavior since the instruments provide the financial management mechanism to facilitate budget control as the transactions are recorded transparently. This is consistent with Hernandez, Jonker & Kosse (2017). It should also be noted that non-cash payment instruments that are most sensitive to attribute changes are ATM/debit cards, Internet/mobile banking, and server-based electronic money. For example, the marginal effect of facilities is 0.910, implying that interventions that increase ATM/debit card facilities will increase consumer choice for ATM/debit cards by 0.910 percentage points.

In terms of transaction objectives, food/grocery expenditure has the most influence on ATM/debit card payment instruments (0.019) compared to other payment instruments. These results indicate that ATM/debit cards are more likely to be used in the food/grocery industry sector, when compared with other means of payment. The ease of use of ATM/debit cards in the food/grocery industry should be increased in response to this, by making sure that infrastructure and interoperability of electronic data capture (EDC) machines are well established. As for transportation expenditure, non-cash payment instruments that are more likely to be used are in transportation transactions are ATM/debit cards (0.028), followed by internet/mobile banking (0.018), and server-based electronic money (0.013). The use of ATM/debit cards and internet/mobile banking for transportation is allegedly of great value, such as for booking airplane and train tickets, and for purchasing fuel. The server-based electronic money affirms the penetration of online transportation companies that also provide payment services for companies in their business groups, such as Go-Pay (Gojek) and Ovo (Grab).

Other transactions (i.e., education, healthcare, clothing, and communication) largely influence the choice internet/mobile banking payment instruments. This potential can be utilized by increasing internet/mobile banking payment electronification through billing services and delivery channel services in the education, healthcare and communication sectors. In addition, an increase in the frequency of online shopping has the greatest impact on the use of ATM/debit cards (0.198), followed by internet/mobile banking (0.112). Online shopping requires non-cash payment instruments that have a safe perception when used to transact in cyberspace. ATM/debit cards and internet/mobile banking have high ratings on security attributes. The increasing online shopping transactions encourage the use of ATM/debit cards and internet/mobile banking as well.

Based on the marginal effects, we find that changes in the perceptions of payment instrument attributes can also cause changes in the probability to use payment instruments. Table 5 shows that improving the quality of certain payment instrument attributes will reduce the chances of using other instruments (which is indicated by negative coefficients), and vice versa. In other words, there is a substitution effect between payment instruments. The largest coefficient indicates the substitution the strongest sensitivity between these instruments.

Table 6. Cross Marginal Effect

Attributes	Payment Instruments					
	Cash	ATMDebit	Credit Card	EM (Card)	UE (Server)	IM Banking
Safety						
Cash	-	-0.0067	-0.0004	-0.0015	-0.0014	-0.0015
ATM/Debit Card	-0.2743	-	-0.0647	-0.1131	-0.0951	-0.2559
Credit Card	-0.0004	-0.0016	-	-0.0004	-0.0011	-0.0004
EM (Card)	-0.0015	-0.0028	-0.0004	-	-0.0014	-0.0011
EM (Server)	-0.0014	-0.0023	-0.0011	-0.0014	-	-0.0018
Internet/Mobile Banking	-0.0015	-0.0062	-0.0004	-0.0011	-0.0018	-
Speed						
Cash	-	-0.0218	-0.0014	-0.0049	-0.0046	-0.0047
ATM/Debit Card	-0.2740	-	-0.0646	-0.1130	-0.0950	-0.2560
Credit Card	-0.0014	-0.0052	-	-0.0013	-0.0037	-0.0014
EM (Card)	-0.0049	-0.0090	-0.0013	-	-0.0045	-0.0037
EM (Server)	-0.0047	-0.0080	-0.0040	-0.0045	-	-0.0058
Internet/Mobile Banking	-0.0050	-0.0204	-0.0014	-0.0040	-0.0060	-
Acceptance						
Cash	-	-0.0296	-0.0018	-0.0066	-0.0063	-0.0064
ATM/Debit Card	-0.2540	-	-0.0599	-0.1047	-0.0881	-0.2370
Credit Card	-0.0019	-0.0070	-	-0.0017	-0.0050	-0.0018
EM (Card)	-0.0066	-0.0122	-0.0017	-	-0.0061	-0.0050
EM (Server)	-0.0064	-0.0103	-0.0050	-0.0061	-	-0.0080
Internet/Mobile Banking	-0.0064	-0.0277	-0.0018	-0.0050	-0.0080	-
Facilities						
Cash	-	-0.0406	-0.0025	-0.0090	-0.0087	-0.0088
ATM/Debit Card	-0.3108	-	-0.0733	-0.1282	-0.1078	-0.2900
Credit Card	-0.0026	-0.0096	-	0.0024	-0.0068	0.0025
EM (Card)	-0.0091	-0.0168	-0.0024	-	-0.0083	-0.0069
EM (Server)	-0.0090	-0.0141	-0.0070	-0.0083	-	-0.0110
Internet/Mobile Banking	-0.0088	-0.0380	-0.0025	-0.0069	-0.0109	-
Identification						
Cash	-	-0.0594	-0.0038	-0.0132	-0.0127	-0.0129
ATM/Debit Card	-0.2433	-	-0.0574	-0.1003	-0.0844	0.2270
Credit Card	-0.0038	-0.0140	-	-0.0035	-0.0100	-0.0037
EM (Card)	-0.0132	-0.0245	-0.0035	-	-0.0122	-0.0100
EM (Server)	-0.0127	-0.0206	-0.0100	-0.0121	-	-0.0159
Internet/Mobile Banking	-0.0129	-0.0560	-0.0037	-0.0100	-0.0158	-

Transaction Purposes	Payment Instruments					
	Cash	ATMDebit	Credit Card	EM (Card)	UE (Server)	IM Banking
Food/Grocery						
Cash	-	-0.0032	-0.0002	-0.0007	-0.0007	-0.0007
ATM/Debit Card	-0.0064	-	-0.0015	-0.0026	-0.0022	-0.0060
Credit Card	-0.0002	-0.0008	-	-0.0002	-0.0005	-0.0002
EM (Card)	-0.0007	-0.0013	-0.0002	-	-0.0007	-0.0005
EM (Server)	-0.0007	-0.0011	-0.0005	-0.0007	-	-0.0009
Internet/Mobile Banking	-0.0007	-0.0030	-0.0002	-0.0005	-0.0009	-
Transportation						
Cash	-	-0.0106	-0.0007	-0.0024	-0.0023	-0.0023
ATM/Debit Card	0.0095	-	-0.0022	-0.0039	-0.0033	-0.0089
Credit Card	-0.0007	-0.0025	-	-0.0006	-0.0018	-0.0007
EM (Card)	-0.0024	-0.0044	-0.0006	-	-0.0022	-0.0018
EM (Server)	-0.0023	-0.0037	-0.0020	-0.0022	-	-0.0030
Internet/Mobile Banking	-0.0023	-0.0099	-0.0007	-0.0018	-0.0028	-
Education						
Cash	-	-0.1999	-0.0127	-0.0445	-0.0429	-0.0434
ATM/Debit Card	-0.0881	-	-0.0208	-0.0364	-0.0306	-0.0823
Credit Card	-0.0127	-0.0470	-	-0.0117	-0.0337	-0.0125
EM (Card)	-0.0446	-0.0826	-0.0117	-	-0.0410	-0.0340
EM (Server)	-0.0430	-0.0700	-0.0340	-0.0410	-	-0.0530
Internet/Mobile Banking	-0.0435	-0.1870	-0.0125	-0.0340	-0.0540	-
Communication						
Cash	-	-0.0521	-0.0033	-0.0116	-0.0112	-0.0113
ATM/Debit Card	-0.0164	-	-0.0039	-0.0068	-0.0057	-0.0154
Credit Card	-0.0033	-0.0123	-	-0.0031	-0.0088	-0.0033
EM (Card)	-0.0116	-0.0215	-0.0030	-	-0.0107	-0.0088
EM (Server)	-0.0112	-0.0181	-0.0088	-0.0107	-	-0.0140
Internet/Mobile Banking	-0.0113	-0.0490	-0.0032	-0.0088	-0.0140	-
Clothing						
Cash	-	-0.1790	-0.0113	-0.0399	-0.0384	-0.0388
ATM/Debit Card	-0.0345	-	-0.0081	-0.0142	-0.0120	-0.0322
Credit Card	-0.0114	-0.0424	-	-0.0105	-0.0302	-0.0112
EM (Card)	-0.0399	-0.0740	-0.0100	-	-0.0367	-0.0304
EM (Server)	-0.0432	-0.0700	-0.0340	-0.0413	-	-0.0540
Internet/Mobile Banking	-0.0390	-0.1680	-0.0112	-0.0304	-0.0480	-

Healthcare						
Cash	-	-0.2241	-0.0142	-0.0499	-0.0480	-0.0486
ATM/Debit Card	-0.0233	-	-0.0055	-0.0096	-0.0081	-0.0217
Credit Card	-0.0128	-0.0480	-	-0.0118	-0.0340	-0.0126
EM (Card)	-0.4880	-0.0831	-0.0117	-	-0.0412	-0.0341
EM (Server)	-0.0432	-0.0700	-0.0340	-0.0413	-	-0.0540
Internet/Mobile Banking	-0.0438	-0.1882	-0.0125	-0.0341	-0.0540	-
Online Shopping						
Cash	-	-0.0750	-0.0048	-0.0167	-0.0161	-0.0163
ATM/Debit Card	-0.0675	-	-0.0159	-0.0278	-0.0234	-0.0630
Credit Card	-0.0043	-0.0160	-	-0.0040	-0.0114	-0.0042
EM (Card)	-0.0150	-0.0278	-0.0040	-	-0.0138	-0.0114
EM (Server)	-0.0145	-0.0235	-0.0113	-0.0140	-	-0.0180
Internet/Mobile Banking	-0.0150	-0.0630	-0.0042	-0.0115	-0.0180	-

This table shows the marginal effect of the payment instrument attributes and transaction purpose on the opportunity to use another instrumen instead of a particular instrument (cross marginal effect), or in other words, it show the probability of payment instruments substitution. If there is a change in one unit of attribute perceptioan or a change in the frequency of spending for a particular purpose, then there will be an opportunity to substitute payment instrument according to the matrix below.

Table 6, which reports the cross marginal effects, shows that a decrease in the quality of the attributes of cash has the largest positive impact on the probability of using ATM/debit cards, and then card-based electronic money. Meanwhile, when we consider amongst non-cash payment instruments, the substitution effects of changes in the quality attributes of payment instruments are quite diverse. For example, the change in the quality of ATM/debit card attributes are most sensitive to substitution to Internet/mobile banking. This is understandable considering that Internet/mobile banking has characteristics similar to ATM/debit cards and is directly characterized by savings accounts. Therefore, the intervention of the most recommended payment instrument attributes is established on ATM/debit cards and Internet/mobile banking as the most sensitive instruments.

In terms of type or purpose of transactions, the results indicate that the ease of using ATM/debit cards in restaurants will increase the frequency of food/grocery shopping using ATM/debit cards and reduce the probability of using cash, internet or mobile banking, card-based electronic money, electronic money server-based, and credit cards by 0.0064, 0.0060, 0.0026, 0.0022, and 0.0015, respectively. In general, the results show a pattern of substitution from cash to ATM/debit cards, then to card-based electronic money as a payment option for all transaction purposes. There are various patterns in the substitution between non-cash payment instruments, depending on the basis of the instrument and the purpose of the transaction.

For example, if there is a decrease in the ease of payment using an ATM/debit card for online shopping, then the non-cash instrument with the highest chance of being used is internet/mobile banking.

Broadly speaking, the best opportunities to increase the use of non-cash instruments can be obtained from education and healthcare transactions. Both are large value transactions. In addition, for education, the nature of transactions is generally not-in-person transactions (bills). This finding is consistent with Stavins (2017). Therefore, policy interventions to encourage non-cash payment instruments should take into consideration various segments of the payment attributes. For example, improving infrastructure and services for non-cash payment instruments in the healthcare and education sector can significantly improve the usage of non-cash payment instruments.

4. Conclusion

In this study, we examine the preferences of respondents for six types of payment instruments, namely cash, ATM or debit cards, credit cards, card-based electronic money and server-based electronic money, and internet or mobile banking. By applying a nested logit model to a sample of 500 households in six provincial capitals in Indonesia, we show that household characteristics, the perceptions of payment instrument attributes, and transaction objectives have significant effects on household preferences for payment instruments. We find that the decision to choose a payment instrument is made sequentially or in stages, beginning with the choice of cash, and then non-cash payments, at the first level. The results indicate that socio-economic characteristics, including education, age, and expenditure have a significant effect on the probability of using non-cash electronic payment instruments. We further find that, among the perception variables, the ease of identification and transaction records have a positive and significant effect on the probability of using non-cash electronic payment instruments. We find indications of a pattern of substitution between payment instruments, not only between cash and non-cash instruments, but also between non-cash instruments.

These findings have implications for policy. Firstly, policies to encourage the convenience and acceptance of non-cash payment instruments are important. To induce people to switch to non-cash payment instruments, policies should focus on creating attributes of non-cash instruments that outperform those of cash instruments. The switch to non-cash payment instruments could broadening access to financial services that support financial inclusion. Secondly, education campaigns and programs on non-cash payment instruments need to prioritize segments of society that tend to choose cash (i.e., the old, less educated, and middle to lower income households). Finally, a thorough understanding regarding the effects of shifting from one non-cash payment instrument to another is important to designing appropriate payment system policy responses and to reducing the externalities of these policies.

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