Predicting the Payment Preference for CBDC: A Discrete Choice Experiment*

Syngjoo Choi[†] Bongseop Kim[‡] Young Sik Kim[§] Ohik Kwon[¶] Soeun Park[‖]

September 23, 2023

Abstract

This paper conduct a discrete choice experiment with a nationally representative sample of over 3,500 participants to predict the preference for Central Bank Digital Currency (CBDC) as a means of payment. We randomly vary nine monetary and non-monetary attributes that cover the wide range of those values to include not only existing payment methods but also potential payment methods such as CBDC. We find that the preference for a payment method is highly responsive to both monetary attributes, such as discount rate, and non-monetary attributes, such as issuance form; for instance, an increase in discount rate can increase the adoption of a payment method by up to 11 percentage point and the change of issuance form from banknotes to smartphone apps has a similar effect size. Simulations based on the estimates from this experiment allow us to predict that about 21% ~ 30% of the respondents choose CBDC as the most preferred payment method, second most popular after credit or debit cards. These results indicate that once introduced, CBDC would be more readily used than cash or mobile fast payment. Further, the preference for CBDC is highly responsive to its own and alternatives' discount rates, implying that financial rewards for CBDC and existing payment methods are likely to play an important role in the adoption of CBDC.

Keywords: Payment Preference, CBDC, Discrete choice experiment
***JEL* classification numbers**: E40, E50, C90

*This study is supported by the Bank of Korea. We received the IRB approval from Seoul National University (IRB No.2109/002-023). This study is registered at the AEA Registry (AEARCTR-0008059). The views expressed in this paper are those of authors and may not necessarily reflect the official views of the Bank of Korea. All errors are our own.

[†]Department of Economics, Seoul National University. Email: syngjooc@snu.ac.kr
[‡]Department of Economics, Seoul National University. Email: bongseop@snu.ac.kr
[§]Department of Economics & SIRFE, Seoul National University. Email: kimy@snu.ac.kr
[¶]Economic Research Institute, Bank of Korea. Email: okwon@bok.or.kr
[‖]Department of Economics, Seoul National University. Email: soeunpark@snu.ac.kr

1 Introduction

Many central banks around the world are considering the issuance of a central bank digital currency (CBDC) at the retail level, which is a type of digital money issued by the central bank to businesses and households. In order to investigate the impact of CBDC, it is essential to predict the preference for CBDC upon its introduction as a means of payment. While there has been a growing body of theoretical research that examines the implications of a CBDC for payment system, financial stability, and monetary policy (e.g., Williamson (2022), Keister and Sanches (2022), Garratt and van Oordt (2021)), the scarcity of data presents a challenge for empirical research.

Specifically, predicting the payment preference for CBDC is challenging because a CBDC is a completely novel central bank money which is yet to be introduced by major central banks around the world. There are a couple of approaches that have been used to address this issue. The first is to survey consumers about their demand for a hypothetical CBDC such as Bijlsma et al. (2021). However, this study relies on an imaginary product that a majority of respondents are not acquainted with.[1] Consequently, the interpretation of the survey findings becomes uncertain. Also, it remains unclear how this survey methodology can be applied to examine the demand for and consequences of a CBDC featuring distinct alternative design elements.

The second approach uses a structural model to estimate consumer preferences for features of the existing means of payment, and then applying the estimated parameters to predict the demand for a CBDC which is characterized as a new bundle of payment features that consumers value (Huynh et al. (2020), Fujiki (2021), Li (2023)). However, as properly noted by Chapman et al. (2023), among the limitations of the existing structural approaches is the restricted range of payment products available, which makes it difficult to identify consumer preferences across all relevant features. For instance, while the central bank's retail payment instrument is in physical form (paper money), private instruments are predominantly electronic. As a result, discerning between preferences for the central bank-issued payment instrument and preferences for the physical instrument becomes difficult.

The goal of this study is to predict the preference for CBDC as a means of payment using a survey experiment analysis which allows us to overcome the potential limitations of the existing studies as mentioned above. Using the method of discrete choice experiments, we examine individual respondents' preferences for the relevant attributes of payment methods and use the estimated preferences to predict the payment preference for CBDC

[1] According to the paper, 53% of participants were unaware of CBDCs, and among those who were aware, 33% lacked understanding of what a CBDC entailed.

characterized as a new bundle of payment attributes. This enables us to examine most of the relevant attributes influencing the payment choice some of which are difficult to identify in observational data, enhancing the plausibility of the prediction regarding the preference for CBDC and allowing for causal interpretation.

Specifically, we consider the following nine attributes as the core features that are found in the literature to be relevant for the choices of available means of payment such as cash, credit or debit card, mobile payment: issuer, issuance form, disclosure of information type, vendor acceptability, risk of loss, discount rate, payment delay, timing of settlement, and monthly fee (see, e.g., Jonker, 2007; Rambure and Nacamuli, 2008; Chen et al., 2019; Drehmann et al., 2002). Each attribute consists of a few values such as three issuers (central bank, private financial institutions, and BigTech companies) and three issuance types (banknote, plastic card, and smartphone app). Profiles of hypothetical payment methods are constructed by randomly assigning a bundle of these attribute values to a hypothetical payment method. Each respondent is then asked to choose between a pair of randomly generated payment methods for five times.

The main findings are as follows. First of all, the preference for a payment method is highly responsive to attributes related to financial incentives. Depending on the monthly fee associated with the use of a payment method, the expected probability of respondents choosing it as their preferred means of payment decreases by up to 14 percentage points. Also, depending on whether a discount is available for a payment method when using it to purchase goods, the expected choice probability increases by up to 11 percentage points. Second, non-monetary attributes also have significant but modest effect on the choice of payment. The willingness-to-pay for a non-monetary attribute such as issuance form is fairly high, close to that for a monetary attribute (e.g., discount rate). In particular, the relatively high willingness to pay when switching from banknotes to smartphone apps is relevant to CBDC in that it is more likely to be provided in the form of smartphone apps.

Third, simulation-based predictions for the existing payment methods – cash, credit or debit card, mobile fast payment – appear to approximate relatively well the actual usage of payment methods in Korea. Upon introducing CBDC with a benchmark design as an additional means of payment, the simulation allows us to predict that about 21% of the respondents choose CBDC as the most preferred payment method, second most popular after credit or debit cards. These results indicate that if CBDC is to be introduced, it is likely to be more readily used than cash or mobile fast payment. Further, the payment preference for CBDC is highly responsive to the level of discount rate, implying that pecuniary reward for CBDC is likely to play an important role in the choice of CBDC as the most preferred payment method. We also investigate how the adoption of CBDC would change in response to adjustments of monthly fees and discount rates of existing payment

methods offered by private institutions.

Our paper contributes to the rapidly growing literature on empirical investigation of CBDC. Bijlsma et al. (2021) conducted a survey in the Netherlands to explore the demand for an account-based CBDC. They discovered a positive relationship between the intended adoption of CBDC and respondents' knowledge of CBDC, trust in central bank, and monetary incentives. Using a structural model, Huynh et al. (2020) predicted that CBDC would be used at the point of sale with probabilities ranging between 19% and 25%. They also identified transaction costs as the primary attribute that would make CBDC attractive for consumers. Using a similar structural model, Li (2023) predicted that the demand for CBDC in Canada as a percentage of total household liquid assets would range from 4% to 52% depending on CBDC-specific effects. Fujiki (2021) utilized Japanese financial literacy survey data to estimate and simulate CBDC adoption. He found out the importance of shortening transaction time in increasing the adoption of CBDC. Using a randomized survey experiment, Choi et al. (2022) showed that the degree of anonymity and privacy protection in the design of CBDC would significantly affect the willingness to use CBDC. Camera (2023) used lab experiments to investigate how the introduction of CBDC would affect the stability and performance of the currency system.

Our paper is also related to the literature on consumer's payment choice. Consumer survey data or transaction records have been used to show how a consumer's payment choice is affected by attributes such as transaction fee, acceptability, safety, speed, and ease of use (e.g., Hirschman (1982), Jonker (2007), Klee (2008), Schuh and Stavins (2010), Wakamori and Welte (2017), Chen et al. (2019)). There are other studies of consumer's payment choice that focus on demographic factors such as age, gender, and education (e.g., Borzekowski et al. (2007), von Kalckreuth et al. (2014)). Recent works by Borzekowski and Kiser (2008), Yang and Ching (2014), and Koulayev et al. (2016) developed structural models of adoption and use of payment methods by incorporating product attributes and consumer demographics into the model.

The rest of this paper proceeds as follows. Section 2 describes the online survey and discrete choice experiments on the preference for payment methods. Section 3 discusses the econometric framework followed by the estimation results in Section 4 about the causal effects of each attribute of payment method on the likelihood of choosing it as a preferred means of payment. It also presents the willingness to pay for a particular attribute. Section 5 uses the estimated model to predict the preference for payment methods, including CBDC, as a means of payment. Section 7 concludes the paper with a few remarks.

2 Survey Experiments

In November 2021, we conducted an online survey via Hankook Research, a professional survey company, using a nationally representative sample of 3,561 participants, born in South Korea and aged 19 years and above. For data quality, each participant received the participation fee of KRW 2,000 (USD1.57, as of June 13, 2023) upon completing the survey. Beginning with a module on respondent characteristics, the whole survey consists of five modules, including the payment behavior module in which we conducted a series of discrete choice experiments to estimate preferences for a broad set of attributes that characterize different payment methods.[2] The full survey questionnaire (the original Korean version as well as its English translation) is available in Online Appendix. Table A1 shows that our samples are quite representative of the South Korean population.

2.1 Discrete Choice Experiments

We employ discrete choice experiments to understand what factors people consider important when using payment methods. Discrete choice experiments have become a popular method for analyzing multidimensional preferences in economics and other social science (see, e.g., de Bekker-Grob et al., 2010; Hoyos, 2010; Mas and Pallais, 2017; Maestas et al., 2023). In our hypothetical scenario, each payment method can be regarded as a combination of several attribute values. By randomly assigning these attribute values to a hypothetical payment method, our experiments allow us to construct random profiles of hypothetical payment methods. For a given pair of hypothetical payment methods, each respondent is asked to choose which payment method they prefer to use. This exercise is repeated five times per respondent, each time with a choice pair of hypothetical payment methods with randomly generated attribute values. Appendix A1 shows the screenshot of an exercise in which a respondent is asked to choose between a pair of hypothetical payment methods.

Discrete choice experiments are an effective tool for identifying preferences for payment methods that may be difficult to discern from real-world data. In the real-world, payment methods exist as a combination of various attributes, making it difficult to identify which attributes play a significant role in the observational usage data of payment products. For example, even if we can observe that people primarily use credit cards, it is difficult to distinguish between preferences for the payment methods that are issued by the private financial institutions and preferences for the instrument that is plastic card.

[2]Before the payment behavior module, we implemented another randomization module regarding the CBDC and privacy. We report the results of these omitted modules in a companion paper, Choi et al. (2022).

Discrete choice experiments overcome this problem by enabling a researcher to capture most of the relevant attributes of the payment methods as well as create situations in which the individual attribute values are exogenously varied for causal interpretation.

A concern of discrete choice experiment is external validity, as preferences is revealed in an artificial survey setting rather than in real-world behavior. Despite this, the literature has shown that well-designed discrete choice experiments are a good reflection of respondents' real-world preferences, as demonstrated by Hainmueller et al. (2015). For example, in recent labor economics literature, a high correlation between their preferences expressed in a discrete choice experiment and actual job choices was found (Wiswall and Zafar, 2018; Maestas et al., 2023), further supporting the validity of our methodology. In Section 5, we also validate our methodology by verifying that the simulated distribution of payment usage, based on preferences measured in our experiment, closely resembled the actual usage rates in reality.

2.2 Attributes of Payment Method

In the discrete choice experiment we randomly vary the following nine attributes: issuer, issuance form, disclosure of information type, vendor acceptability, risk of loss, discount rate, payment delay, timing of settlement, and monthly fee. Table 1 displays the full list of attribute values. While our list of attributes does not encompass all the features of payment methods, it covers a core set of attributes relevant to the available payment methods these days. In the remaining part of this section, we briefly explain the attributes we selected, along with the literature that motivates the selections.

Issuer

Alongside central bank which issues its own money as a means of payment, private financial institutions and BigTech companies have been emerging as the new payment service providers. The preference for a particular issuing institution could directly influence the choice of payment methods. For example, in societies with high trust in the government, there may be a tendency to use central bank money as a main payment instrument. In the survey experiment, we consider three types of issuers: central bank, private financial institutions, and BigTech companies.

Issuance form

Payment methods can take a physical or digital form which differs in the convenience of use and storage as well as the ability to cope with uncertain situations. This implies that the form of issuance can influence the usage of payment methods. For example, Rambure and Nacamuli (2008) and Chen et al. (2019) found that people avoid using cash due to

Table 1: Attributes for Payment Methods Profiles

Attributes	**Values**
Issuer	central bank private financial institutions IT or BigTech companies
Issuance form	banknote plastic card smartphone apps
Disclosure of information type	none personal identification information personal identification & transaction information
Vendor acceptability	always (100%) most (80%) half (50%)
Risk of loss	1% 5% 10%
Discount rate	none 3% 5%
Payment delay	less than ten seconds about one minute about two minutes
Timing of settlement	immediately specific date after payment installment
Monthly fee	none KRW 3,000 KRW 5,000

the inconvenience of having to carry it around. On the other hand, an issuance form like smartphone apps requires a network connection which is susceptible to technological malfunction, thereby affecting the usage of payment methods. In the experiment, the following three issuance forms are considered: banknote, plastic card, and smartphone apps.

Disclosure of information type

Drehmann et al. (2002) pointed out that the extent of anonymity in the use of a payment instrument can significantly affect consumers' preference for certain payment methods. In particular, people are reluctant to disclose their purchase records of privacy-sensitive goods or services (e.g., psychiatric services, adult products, etc.). Privacy protection is considered a key feature in the design of CBDC. According to the recent online survey by the European Central Bank, the largest majority of respondents (41%) chose privacy protection as the most important characteristic to consider when issuing CBDC (European Central Bank, 2021). The Federal Reserve is also exploring privacy as one of the key issues of CBDC (Board of Governors of the Federal Reserve System, 2022). In the experiment, the disclosure of information type takes one of the following three cases: none of personal identification and transaction information are disclosed, only personal identification information is disclosed, and both personal identification and transaction information are disclosed.

Vendor acceptability

The use of a payment method could depend on its acceptability by vendors. Each payment method differs in the degree to which it is accepted. For example, in Korea, cash is the only payment method occasionally accepted in some small business stores, whereas only cards or smartphone apps can be used to pay for public transportation. Jonker (2007) noted that the more vendors or places accept a payment method, the more it is used as a means of payment. In the experiment, vendor acceptability is considered by allowing the probability of acceptance to take one of the following three values: 50%, 80%, and 100%.

Risk of loss

A payment method has a risk of loss or theft, which also affects its use as a means of payment. In particular, Jonker (2007) found that a major aversion against cash is its lack of safety due to the risk of theft or money being lost. In the experiment, we consider the risk of loss by assigning one of the following three values to the probability of loss: 1%, 5%, and 10%.

Discount rate

There are many situations where some discounts are applied when using a specific payment method. For instance, financial institutions or BigTech companies provide discounts

when their payment services or platforms are used for purchases at affiliated stores. On the other hand, at small-scale stores, discounts are often given by sellers for the purpose of tax evasion when paying with cash. In addition, in the case of debit card, one can also earn interest income through the connected deposit account.[3] These monetary incentives can influence the use of payment methods. In particular, given the possibility of providing remuneration for CBDC, it is important to understand the extent to which monetary incentives can affect the choice of CBDC as a means of payment. In the experiment, we examine the following three cases of a discount rate: zero discount, a 3% discount, and a 5% discount.

Payment delay

The convenience of use is an attribute generally considered in the literature about the preference for payment methods (Koulayev et al., 2016; Wakamori and Welte, 2017). Specifically, Fujiki (2021) found that survey respondents value shorter transaction time as the most important attribute when using a means of payment. In the experiment, we focus on the time a payment method takes to make payment as a key aspect of the convenience of use. A payment method profile is given one of the following three cases with regard to the time taken for payment: less than ten seconds, about one minute, and about two minutes.

Timing of settlement

Some payment method (e.g., credit card) allows for not only settlement on a specific day instead of at the point of purchase, but also installment payments if consumers want to. According to Jonker (2007), people use credit cards to take advantage of installments or delayed payments. On the other hand, Arango et al. (2011) found that some consumers avoid using credit cards to prevent themselves from overspending. In order to investigate how the timing of settlement affects the preference for a payment method, we consider the following three cases: immediately, specific date after payment, and installment.

Monthly fee

There are many cases in which using a payment method involves some financial cost. For instance, there is a membership fee that consumers have to pay for using a credit card and data usage fees are charged for mobile fast payment. According to Jonker (2007), among those dissatisfied with credit cards, 45% cited high financial costs as the reason for dissatisfaction. In our experiment, we consider the following three monthly fees for using a payment method profile: none, KRW 3,000, and KRW 5,000.

[3] Li (2023) found that the deposit-to-cash ratio varies greatly according to the rate of return.

3 Econometric Framework

In order to estimate preferences for attributes of payment methods, we begin by assuming that the underlying choice process can be expressed by an indirect utility function as follows:

$$U_{i,j,k} = \beta X_{i,j,k} + \delta c_{i,j,k} + \epsilon_{i,j,k} \tag{3.1}$$

where $U_{i,j,k}$ denotes an individual i's utility from a payment method scenario j for a choice pair $k = 1, 2, .., 5$, $X_{i,j,k}$ is the vector of attributes that the individual i faces in the payment method scenario j for the choice pair k, and $c_{i,j,k}$ denotes the cost that the individual i pays monthly to use the payment method j for the choice pair k. For a given choice pair k, assuming that $\epsilon_{i,j,k}$ is independently and identically distributed with type I extreme value distribution, the probability that an individual i will choose a payment method scenario j with characteristics $X_{i,j,k}$ and cost $c_{i,j,k}$ over another payment method scenario $l \neq j$ with characteristics $X_{i,l,k}$ and cost $c_{i,l,k}$ is given by

$$P(U_{i,j,k} > U_{i,l,k}) = \frac{\exp(\beta X_{i,j,k} + \delta c_{i,j,k})}{\exp(\beta X_{i,j,k} + \delta c_{i,j,k}) + \exp(\beta X_{i,l,k} + \delta c_{i,l,k})} \tag{3.2}$$

We estimate the above equation through a conditional logit model using the maximum likelihood.

3.1 Willingness-to-Pay for Attributes

Following the literature as in Hensher et al. (2015), we can use the estimates of parameter vectors (β, δ) to derive willingness-to-pay for a particular attribute r, denoted WTP_r, as the extra cost that would make an individual indifferent between payment methods with and without the given attribute r. By controlling out the other attributes not being varied in this exercise, we assume that if a payment method does not have the attribute value r, an individual would just pay c. On the other hand, if the payment method has the attribute value r, she would be willing to pay $c + WTP_r$ for an increase in utility by β_r associated with the given attribute value r . In other words, we seek to establish the value WTP_r that satisfies the following indifference condition:

$$\delta c = \beta_r + \delta(c + WTP_r) \tag{3.3}$$

This implies that an estimate of WTP_r given by:

$$WTP_r = -\frac{\beta_r}{\delta} \tag{3.4}$$

3.2 Predictions of Preferences for Payment Methods

We suppose that an individual i chooses a payment method out of cash, credit or debit card, mobile fast payment, and CBDC. Each of these means of payment can be regarded as being composed of its own unique bundle of attributes. Then, with the distributional assumption on ϵ_{ij} as in (3.2), the probability of choosing a payment method $j \in$ {cash, credit/debit card, mobile, CBDC} is expressed as:

$$P_{i,j} = \frac{\exp(\beta X_{i,j} + \delta c_{i,j})}{\sum_j \exp(\beta X_{i,j} + \delta c_{i,j})} \tag{3.5}$$

Therefore, using the estimates of parameter vectors (β, δ), we can predict the preference for each means of payment, including CBDC.

4 Empirical Results

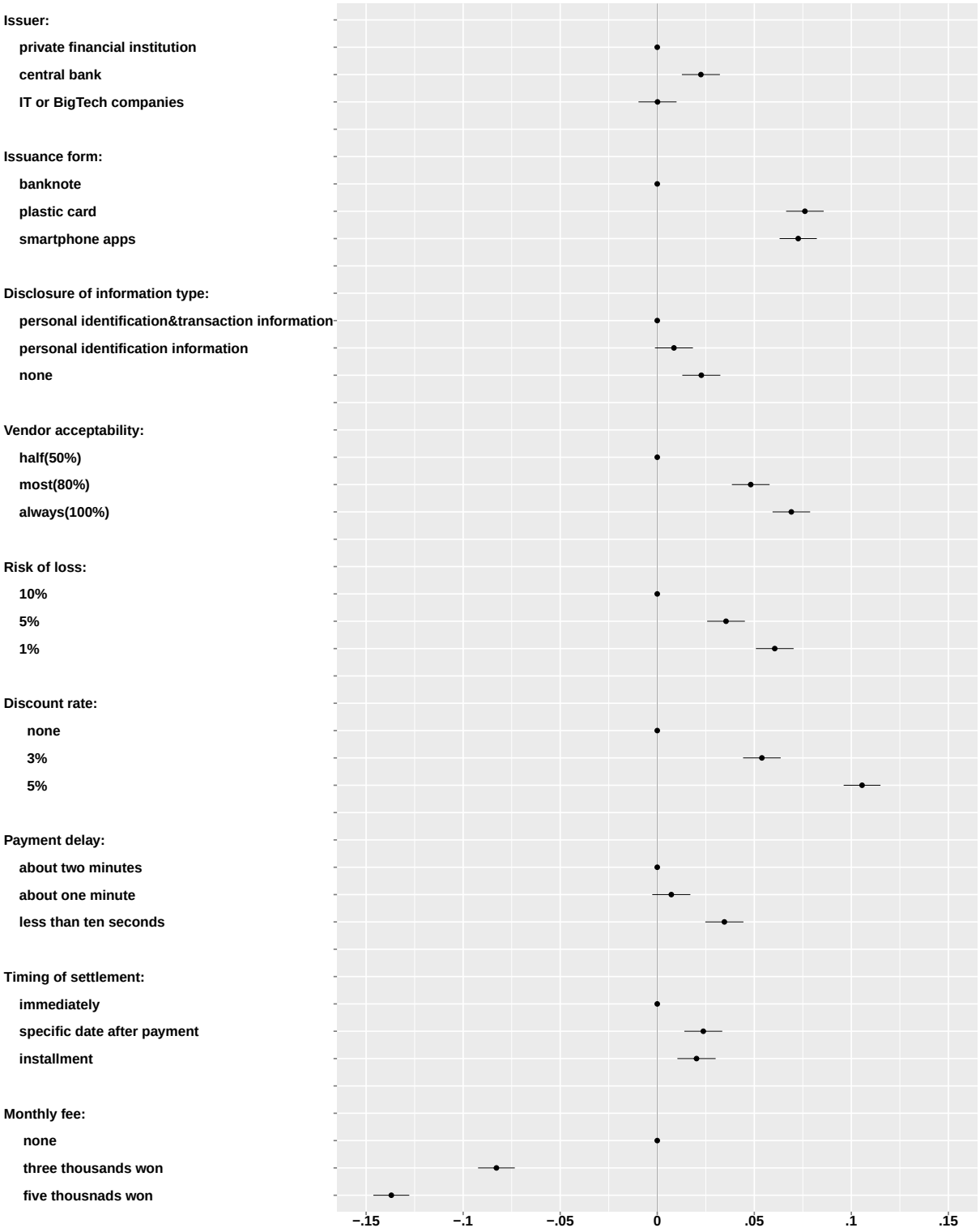
We start with the estimation results of the parameter vectors (β, δ). We then report the estimates of average marginal effect of a change in the value of each attribute on the expected probability of choosing the payment method profile with the corresponding attribute. These results will be used in the next section to predict preferences for payment methods such as cash, credit and debit cards, mobile payment, and CBDC. We also present the measures of willingness-to-pay for each attribute using the estimates of the parameter vectors (β, δ).

4.1 Effects of Payment Method Attributes on Payment Choice

We first present results from the maximum likelihood estimation of the conditional logit model using equation (3.2). Most of the coefficient estimates of the parameter vectors (β, δ) are highly significant as reported in Table A2. Figure 1 reports the point estimates of average marginal effect (AME) of each attribute with 95 percent confidence intervals for all respondents.[4] This shows how a change in a particular attribute of payment method affects the expected probability of choosing a payment method profile with the corresponding attribute. Each estimate is specified relative to a particular baseline value for the corresponding attribute. For example, in the case of Issuer attribute which consists of three values (central bank, private financial institutions, and BigTech companies), we take private financial institutions as a base value. Therefore, the "central bank" row in Figure 1

[4]The average marginal effect (AME) of each attribute is calculated using the associated coefficient estimates of the parameter vectors (β, δ) and the values of $X_{i,j,k}$ and $c_{i,j,k}$ in the equation (3.2).

Figure 1: Average Marginal Effect (AME) Estimates for Attributes



Notes: The graph plots the average marginal effect (AME) estimates for each attribute value with a 95% confidence interval. Each estimate is specified relative to a baseline value for the corresponding attribute.

indicates that a payment method profile with central bank as its issuer, as opposed to private financial institutions, increases the probability of respondents choosing the payment method profile as their preferred means of payment by 2.3 percentage points on average.

We find that the choice of payment method is highly responsive to attributes related to monetary incentives. Depending on the monthly fee associated with the use of payment method, the expected probability of respondents choosing it as their preferred payment method decreases by up to 14 percentage points. Also, depending on whether a discount is available for a payment method when purchasing goods, the expected choice probability increases by up to 11 percentage points.

In addition, we find that attributes such as issuance type, acceptability, and probability of loss also have a significant impact on the choice of payment method. In the case of Issuance type, both plastic card and smartphone app increase the expected likelihood of choosing a payment method by approximately 7.5 percentage points compared to banknote. And a payment method that is acceptable with the probability of 80% and 100% respectively increases the expected likelihood of choosing the payment method by 4.8 and 6.8 percentage points compared to the one acceptable only with 50%. The probability of losing a payment method also had a significant effect, increasing the expected likelihood of choosing the payment method by 6 percentage points.

In the case of the other attributes, we find significant but modest effects. When the issuer of a payment method is central bank, the expected probability of choosing the payment method increases by 2.2 percentage points compared to private financial institutions. BigTech companies as the issuer of a payment method has no marginal effect on the probability of choosing the payment method relative to the one issued by private financial institutions. And there are only minor effects of the timing of settlement and the payment delay (i.e., the time it takes for payment to be processed). Further, the expected probability of choosing a payment method increases by up to 2.3 percentage points when the personal identification and transaction information associated with the use of the payment method are not exposed. It is possible that disclosure of information affects the choice differently depending on the level of financial incentives such as a discount. But, the interaction effect between disclosure of information type and discount rate is small and insignificant, i.e., the two dimensions act independently in predicting choice (Table A3).

Finally, considering that these are estimated preferences for attributes of payment methods in a general context of consumption, caution is required when applying these findings to a specific context. For example, in the case of purchasing privacy-sensitive goods or services, the degree of information disclosure could have a large effect on the choice of a payment method as shown in Choi et al. (2022).

Table 2: Willingness-to-Pay (in USD/Month) for Attributes

Attributes	WTP (USD/Month)
Issuer	
private financial institutions (base value)	
central bank	0.63
IT or BigTech companies	0.00
Issuance form	
banknote (base value)	
plastic card	2.11
smartphone apps	2.01
Disclosure of information type	
personal identification & transaction information (base value)	
personal identification information	0.24
none	0.63
Vendor acceptability	
half (50%) (base value)	
most (80%)	1.34
always (100%)	1.91
Risk of loss	
10% (base value)	
5%	0.97
1%	1.66
Discount rate	
0% (base value)	
3%	1.49
5%	2.93
Payment delay	
about two minutes (base value)	
about one minutes	0.21
less than ten seconds	0.97
Timing of settlement	
immediately (base value)	
specific date after payment	0.66
installment	0.56

Notes: The table provides respondents' mean willingness to pay for an attribute value r relative to a baseline value for the corresponding attribute. The 1,273 is the applied exchange rate between USD and KRW (as of June 13, 2023)

4.2 Measuring Willingness-to-Pay for Attributes

While the above estimates of average marginal effect are useful in understanding the relative importance of each attribute of payment method, they do not lead directly to pecuniary-value interpretations. We calculate the WTP_r's for each attribute of payment method using the equation (3.4) and the parameter estimates in Table A2. Each number in Table 2 represents the willingness to pay for a specific attribute value of payment method when switching from a base value for the corresponding attribute.

First of all, with regard to a monetary attribute, the WTP_r's for the discount rate of 5% and 3% are respectively USD 2.93 and USD 1.49. Further, it is worth noting that the WTP_r for a non-monetary attribute such as issuance form is fairly high relative to a monetary attribute (e.g., discount rate), exceeding USD 2. The relatively high WTP_r when switching from banknotes to smartphone apps is particularly relevant to CBDC in the sense that it is more likely to be provided in the form of smartphone apps. We also find that WTP_r's for vendor acceptability and risk of loss are moderately high, exceeding or close to USD 1. Meanwhile, the WTP_r's for the other non-monetary attributes (e.g., issuer, disclosure of information type, payment delay, and timing of settlement) are relatively modest, below USD 1.

5 Prediction of Payment Preference for CBDC

Now, we conduct simulations to predict the preference for CBDC as a means of payment. In order to check the plausibility of our simulations, we first carry out simulations to predict the preference for the existing payment methods (not including CBDC) and compare the simulation results with the actual usage of payment methods in Korea.

5.1 Predicting Preferences for Existing Payment Methods

We begin with assigning attribute values to the existing payment methods such as cash, credit or debit card, and mobile payment. Table 3 shows a combination of the attribute values assigned to each of the existing payment methods. Attribute-value assignment to the existing payment methods reflects the current situation in Korea that was described in Bank of Korea (2022) payment survey in 2021. We then predict payment preferences for cash, credit or debit card, and mobile fast payment using the equation (3.5).

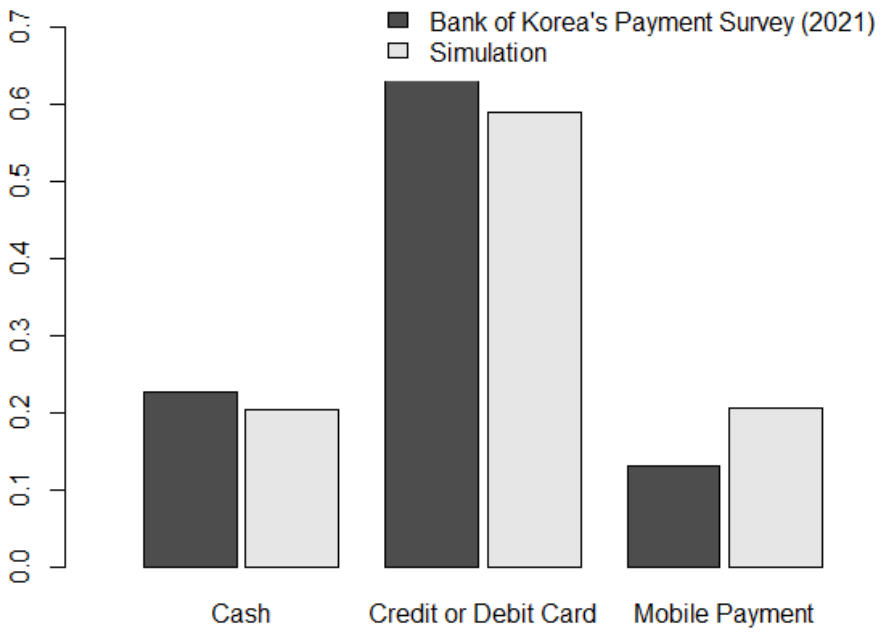
Figure 2 shows our simulation results in comparison with the actual usage of payment methods as surveyed by the Bank of Korea. Overall, our simulation-based predictions for

Table 3: Attributes under Different Payment Methods

	Cash	Credit card	Debit card	Mobile payment
Issuer	central bank	private financial institutions	private financial institutions	IT or BigTech companies
Issuance form	banknote	plastic card	plastic card	Apps
Disclosure of information type	none	personal identification & transaction	personal identification & transaction	personal identification & transaction
Vendor acceptability	most (80%)	most (80%)	most (80%)	half (50%)
Risk of loss	5% ~ 10%	1% ~ 5%	1% ~ 5%	1% ~ 5%
Discount rate	0% ~ 5%	3% ~ 5%	0% ~ 5%	0% ~ 5%
Payment delay	thirty seconds	ten seconds	ten seconds	fifteen seconds
Timing of settlement	immediately	specific date or installment	Immediately	Immediately
Monthly fee	none	a thousand won	none	five hundreds won

Notes: The table shows the attributes of each different payment method: cash, credit card, debit card, and mobile payment. Issuer, issuance form, disclosure of information type, and timing of settlement each represent fixed inherent values for each payment method. Vendor acceptability is set lower for mobile payment methods to capture the fact that there are many places where they are not used. Risk of loss is set higher for cash by reflecting Jonker (2007). Payment delay follows results of Fujiki (2021). Discount rate and monthly fee are set within a range that aligns with the nowadays in Korea (Bank of Korea (2022))

Figure 2: Comparison between Bank of Korea's Payment Survey and Simulation Results



Notes: Simulation is conducted based on attribute values in Table 3.

the existing payment methods appear to approximate relatively well the actual usage of payment methods in Korea. According to Bank of Korea (2022), the use of credit or debit cards is the highest at approximately 64%. In our simulation, these payment methods also make up the largest proportion at 59%. The proportion of mobile fast payments in the simulation is about 20% which is higher than 12.5% in the actual survey. However, the usage of mobile fast payments is rapidly increasing, doubling every year in Korea (Bank of Korea, 2022).

5.2 Predicting the Preference for CBDC

We now introduce CBDC into the simulations as an additional means of payment. Many central banks around the world are going through various stages of developing CBDCs, including their designs, to assess their benefits and risks. Considering that most of the characteristics of CBDCs are yet to be determined by the central banks, we conduct simulations under various CBDC design scenarios. The following attribute values are commonly assigned to all the design scenarios: central bank as issuer, cards or apps as issuance form, 100% vendor acceptability, 1~5% probability of loss, payment delay of ten seconds, immediate settlement, and no monthly fee. These attribute values are regarded as being mostly inherent features of CBDC as an electronic form of central bank money. On the other hand, there are features of CBDC design that central bank can choose such as disclosure of information type when using CBDC as a means of payment and remuneration rate on CBDC which is provided in the form of a discount rate applied to purchases using CBDC as a means of payment.

Table 4 shows combinations of attribute values assigned to four different design scenarios of CBDC that we use in simulations. In each scenario, we vary attribute values for the disclosure of information type and the discount rate to examine their impact on the payment preference for CBDC. Scenario 1 is the benchmark in which both personal identification and transaction information are disclosed and there is zero discount rate when using CBDC. In scenario 2, only personal identification information is disclosed, whereas the discount rate increases to 3% and 5% in scenarios 3 and 4, respectively.

Table 4: CBDC Attributes under Different Design Scenarios

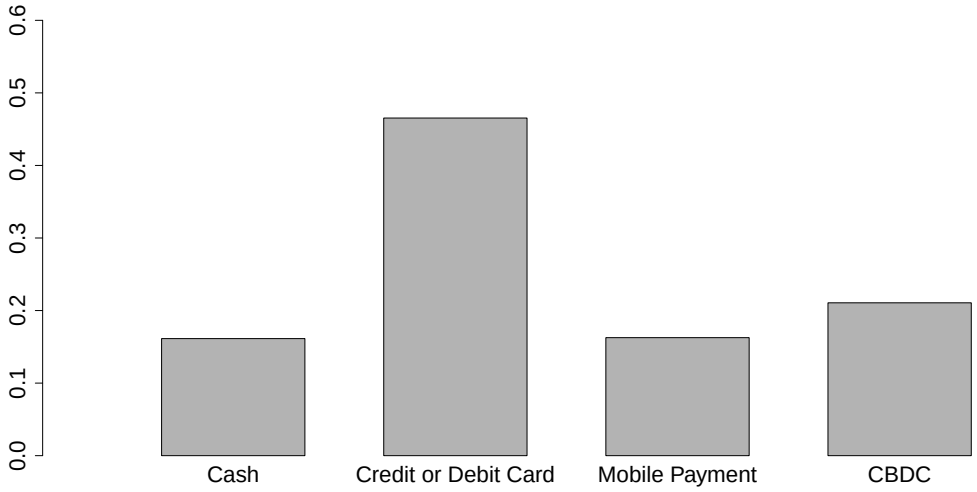
	Scenario 1 (Benckmark)	**Scenario 2**	Scenario 3	**Scenario 4**
Issuer	central bank	central bank	central bank	central bank
Issuance form	cards or apps	cards or apps	cards or apps	cards or apps
Disclosure of information type	personal identification & transaction	personal identification	personal identification & transaction	personal identification & transaction
Vendor acceptability	always (100%)	always (100%)	always (100%)	always (100%)
Risk of loss	1% ~ 5%	1% ~ 5%	1% ~ 5%	1% ~ 5%
Discount rate	0%	0%	3%	5%
Payment delay	ten seconds	ten seconds	ten seconds	ten seconds
Timing of settlement	immediately	immediately	Immediately	Immediately
Monthly fee	none	none	none	none

Notes: The table shows the attributes of CBDC under four different design scenarios. Issuer, issuance form, vendor acceptability, risk of loss, payment delay, and timing of settlement are set the same in all scenarios. Disclosure of information type and discount rate varies depending on each scenario. We set scenario 1, where both personal identification and transaction information are disclosed and there is no discount rate, as the benchmark. Then, in scenario 2, the degree of information disclosure is reduced to only personal identification information. In scenarios 3 and 4, the discount rate increased to 3% and 5%, respectively.

Figure 3 shows the simulation-based predictions of the payment preferences upon the introduction of CBDC which features the benchmark design of scenario 1. In this simulation, the proportion that CBDC is chosen as the most preferred means of payment is about about 21%, ranking the second highest after credit or debit cards. These results imply that if CBDC is introduced, it is likely to be more readily used than cash or mobile

fast payment.

Figure 3: Prediction of Payment Preference with CBDC

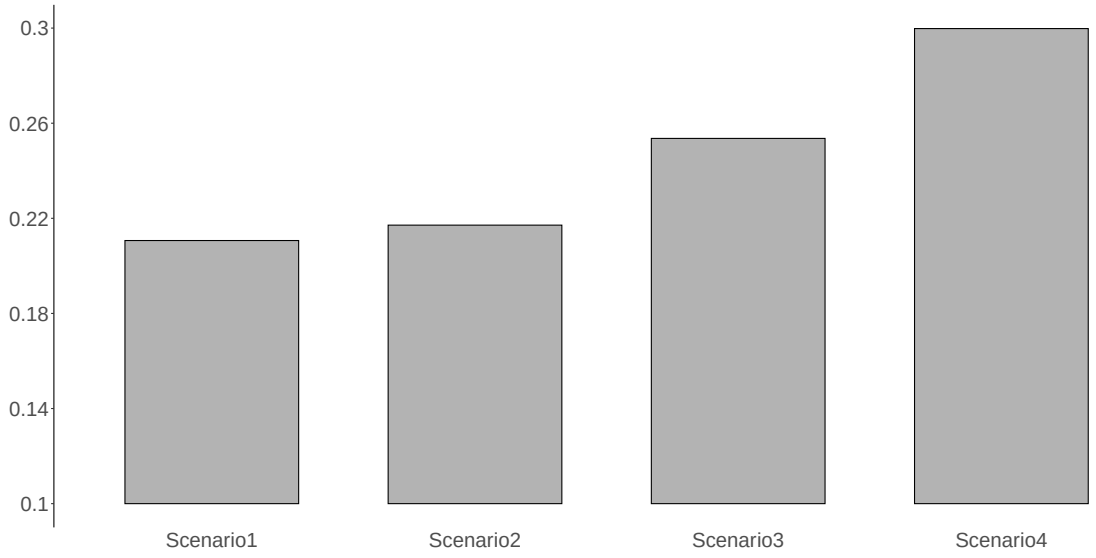


Notes: This simulation is conducted based on attribute values in Table 3 and Table 4 with the Scenario 1 (Benchmark) design of CBDC.

Second, we examine how the demand for CBDC changes in response to variations in the disclosure of information type and the discount rate as in scenarios 2 through 4. Figure 4 shows that, in the case of scenario 2 in which only personal identification information is disclosed, there is a slight increase of about 0.7 percentage points in the demand for CBDC relative to the benchmark scenario 1. This appears to be consistent with our earlier findings in Section 4, which shows the relatively modest average marginal effect (AME) of the disclosure of information type on the expected probability of choosing a payment method with disclosure of neither personal identification nor transaction information. On the other hand, as the discount rate increases (i.e., scenarios 3 and 4), the demand for CBDC increases by about 9 percentage points, amounting to 40% increase relative to that in the baseline scenario 1. This implies that pecuniary reward when using CBDC is likely to play an important role in the choice of CBDC as the most preferred payment method.

Finally, we investigate the situations in which private financial institutions and BigTech companies proactively respond to the introduction of CBDC by adjusting attributes of credit cards and mobile payments to sustain their competitiveness. It is possible that they respond by providing financial incentives in the form of lowering monthly fees and raising the discount rate. We examine how the demand for CBDC changes in three different scenarios: the monthly fee of credit card and mobile payment decreases, the discount rate of credit card and mobile payment increases, and both the monthly fee and the discount rates are adjusted. Figure A2 shows the demand for CBDC in each scenario. On the far

Figure 4: Prediction of Payment Preference for CBDC under Different Design Scenarios



Notes: The simulation is conducted based on attribute values in Table 3 and Table 4.

left, the no adjustment refers to the baseline scenario in Table 3 and scenario 1 in Table 4. In the case of competition through fee adjustment Where the monthly fees for credit cards and mobile payment methods decrease to five hundreds won and zero respectively, the demand for CBDC decreases by 0.53 percentage points, amounting to 2.5% decrease relative to that in the baseline scenario. In the case of competition through discount adjustment where the discount rates for credit cards and mobile payment methods increase by 5% and 3% ~ 5% respectively, the demand for CBDC decreases even further by 1.2 percentage points, amounting to 5.8% decrease relative to that in the baseline scenario. Finally, in the case of competition through both fee and discount adjustments where both monthly fees and discount rates adjust, the demand for CBDC decreases by 1.5 percentage points, amounting to 7.1% decrease relative to that in the baseline scenario. These results imply that the adoption of CBDC would likely decrease if private financial institutions and BigTech companies compete against CBDC by lowering their monthly fees and/or increasing their discount rates.

6 Heterogeneous Analysis

We report the heterogeneous analysis across subgroups to understand the difference in preferences for the attributes of payment instruments and in the prediction of preference for CBDC. We focus on the four social and demographic factors - gender, age, education, and income. The subgroup models in this section are also estimated using conditional logit

models.

First, we estimate separately by gender and present the average marginal effect (AME) results in Figure A3. Overall, no differences in preference for attributes are found between men and women, except that women react slightly more to the degree of vendor acceptability. These preferences in attributes also lead to no difference in the preference for CBDC as well as shown in Figure A8. Similarly, we find no significant differences in preferences for attributes and preferences for CBDC between education groups (Figure A6, A11) and income groups (Figure A7, A12).

In the case of age, we find a significant difference in preference for attributes between the younger age group (19-39) and older age groups (40-70) (Figure A4). The most notable difference is in the valuation of the issuer. For older age groups, when the issuer is the central bank, the expected probability of choosing the payment method increases by 3.0 percentage points, but for younger age groups, there are no significant effects. On the other hand, when the issuer is the IT or BigTech companies, the probability of choosing the payment method increases by 3.2 percentage points for younger age groups but decreases by 1.5 percentage points for older age groups. Also, in the issuance form, we find differences between age groups. For younger age groups, there is an increase in the probability of choosing payment methods by 8.6 percentage points when the issuance form is a smartphone app, and by 7.9 percentage points when the issuance form is a plastic card. So, a smartphone app is the most preferred form of payment methods. On the other hand, for older age groups, there is an increase by 6.6 percentage points when a smartphone app and by 7.5 percentage points when a plastic card, indicating that plastic card is the most preferred form of payment methods. Figure A9 shows that the differences in attributes by age lead to differences in preferences for payment methods. CBDC is preferred similarly to mobile payment methods for younger age groups. However, for older age groups, CBDC is distinctly preferred over mobile payment methods. When narrowing down the older age groups to the 60-70 age range, the above pattern became even more pronounced (Figure A5, A10).

7 Concluding Remarks

We have attempted to predict the preference for CBDC as a means of payment using a survey experiment analysis. First of all, we found that the inclination towards a payment method strongly depends on attributes associated with financial incentives. The likelihood of survey respondents selecting a payment method as their preferred option decreases by up to 14 percentage points in the presence of monthly fee linked to its usage. Similarly, the

availability of a discount for purchasing goods with a specific payment method increases the expected probability of choosing it by up to 11 percentage points.

Secondly, non-monetary attributes also exert a significant but relatively modest influence on payment choices. The willingness-to-pay for non-monetary features, such as the form of issuance, is relatively high, comparable to that of monetary attributes like a discount. Notably, the considerable willingness to pay observed when transitioning from banknotes to smartphone apps is relevant to CBDC as it is more likely to be provided through smartphone apps.

Finally, simulation-based predictions for the existing payment methods in Korea (cash, credit or debit cards, mobile fast payment) align reasonably well with the actual usage patterns. Simulations indicate that if CBDC were introduced as an additional payment option following a benchmark design, approximately 21% of respondents would select CBDC as their most preferred means of payment, ranking second only to credit or debit cards. These findings suggest that once introduced, CBDC would likely be adopted more readily than cash or mobile fast payment. Furthermore, the payment preference for CBDC is highly sensitive to the discount rate, suggesting that the financial rewards associated with CBDC are likely to play a crucial role in its selection as the preferred payment method.

References

Arango, C., Huynh, K., and Sabetti, L. (2011). How do you pay? the role of incentives at the point-of-sale. *SSRN Electronic Journal*.

Bank of Korea (2022). 2021 Payment Method and Mobile Financial Services Usage Survey, Bank of Korea Annual Economic Report.

Bijlsma, M., van der Cruijsen, C., Jonker, N., and Reijerink, J. (2021). What triggers consumer adoption of CBDC?, Available at SSRN.

Board of Governors of the Federal Reserve System (2022). Money and Payments: The U.S. Dollar in the Age of Digital Transformation, Research & Analysis.

Borzekowski, R. and Kiser, E. K. (2008). The choice at the checkout: Quantifying demand across payment instruments. *International Journal of Industrial Organization*, 26:889–902.

Borzekowski, R., Kiser, E. K., and Ahmed, S. (2007). Consumers' use of debit cards: Patterns, preferences, and price response. *Journal of Money, Credit and banking*, 40(1):149–172.

Camera, G. (2023). Introducing new forms of digital money: Evidence from the laboratory. *Journal of Money, Credit and Banking*, pages 1–32.

Chapman, J., Chiu, J., Davoodalhosseini, M., Jiang, J., Rivadeneyra, F., and Zhu, Y. (2023). Central Bank Digital Currencies and Banking: Literature Review and New Questions. *Bank of Canada*.

Chen, H., Huynh, K. P., and Shy, O. (2019). Cash versus card: Payment discontinuities and the burden of holding coins. *Journal of Banking and Finance*, 99:192–201.

Choi, S., Kim, Y. S., Kim, B., and Kwon, O. (2022). Central Bank Digital Currency and Privacy: A Randomized Survey Experiment, Bank of Korea , Working Paper.

de Bekker-Grob, E. W., Ryan, M., and Gerard, K. (2010). Discrete choice experiments in health economics: a review of the literature. *Health Economics*, 21(2):145–172.

Drehmann, M., Goodhart, C., Krueger, M., Boldrin, M., and Rose, A. (2002). The challenges facing currency usage: Will the traditional transaction medium be able to resist competition from the new technologies? *Economic Policy*, 17(34):195–227.

European Central Bank (2021). ECB Digital Euro Consultation Ends with Record Level of Public Feedback, Press Release.

Fujiki, H. (2021). Attributes needed for japan's central bank digital currency. *The Japanese Economic Review*, 74(1):117–175.

Garratt, R. J. and van Oordt, M. R. C. (2021). Privacy as a public good: A case for electronic cash. *Journal of Political Economy*, 129(7):2157–2180.

Hainmueller, J., Hangartner, D., and Yamamoto, T. (2015). Validating vignette and conjoint survey experiments against real-world behavior. *Proc. Nat. Acad. Sci*, 112(8):2395–2400.

Hensher, D. A., Rose, J. M., and Greene, W. H. (2015). Applied Choice Analysis, Cambridge University Press.

Hirschman, E. C. (1982). Consumer payment systems: The relationship of attribute structure to preference and usage. *The Journal of Business*, 55(4):531–545.

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, 69(8):1595–1603.

Huynh, K. P., Molnar, J., Shcherbakov, O., and Yu, Q. (2020). Demand for Payment Services and Consumer Welfare: The Introduction of a Central Bank Digital Currency, Staff Working Paper, Bank of Canada.

Jiang, J. (2020). CBDC adoption and usage: some insights from field and laboratory experiments, Bank of Canada Staff Analytical Note 2020-12.

Jonker, N. (2007). Payment instruments as perceived by consumers – results from a household survey. *De Economist*, 155:271–303.

Keister, T. and Sanches, D. (2022). Should Central Banks Issue Digital Currency? *The Review of Economic Studies*, 90(1):404–431.

Klee, E. (2008). How people pay: Evidence from grocery store data. *Journal of Monetary Economics*, 55:526–541.

Koulayev, S., Rysman, M., Schuh, S., and Stavins, J. (2016). Explaining adoption and use of payment instruments by us consumers. *The RAND Journal of Economics*, 47(2):293–325.

Li, J. (2023). Predicting the demand for central bank digital currency: A structural analysis with survey data. *Journal of Monetary Economics*, 134:73–85.

Maestas, N., Mullen, K. J., Powell, D., von Wachter, T., and Wenger, J. B. (2023). The value of working conditions in the united states and implications for the structure of wages. *American Economic Review*, Forthcoming.

Mas, A. and Pallais, A. (2017). Valuing alternative work arrangements. *American Economic Review*, 107(12):3722–3759.

Rambure, D. and Nacamuli, A. (2008). *Payment Instruments*, pages 23–42. Palgrave Macmillan UK, London.

Schuh, S. and Stavins, J. (2010). Why are (some) consumers (finally) writing fewer checks? the role of payment characteristics. *Journal of Banking & Finance*, 34(8):1745–1758.

von Kalckreuth, U., Schmidt, T., and Stix, H. (2014). Choosing and using payment instruments: Evidence from german microdata. *Empirical Economics*, 46:1019–1055.

Wakamori, N. and Welte, A. (2017). Why do shoppers use cash? evidence from shopping diary data. *Journal of Money, Credit and Banking*, 49(1):115–169.

Williamson, S. (2022). Central bank digital currency: Welfare and policy implications. *Journal of Political Economy*, 130(11):2829–2861.

Wiswall, M. and Zafar, B. (2018). Preference for the workplace human capital and gender. *The Quarterly Journal of Economics*, 133(1):457–507.

Yang, B. and Ching, A. T. (2014). Dynamics of consumer adoption of financial innovation: The case of atm cards. *Management Science*, 60(4):903–922.

Appendices

A Figures and Tables

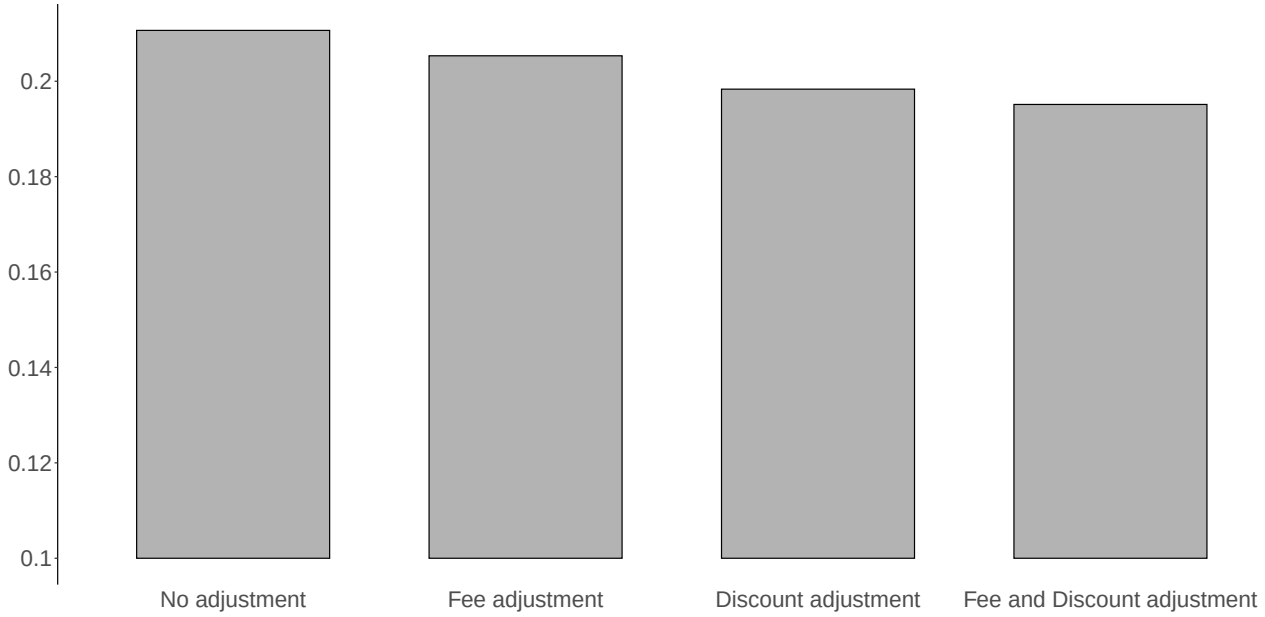
Figure A1: Screenshoot of Hypothetical Payment Method Pair Evaluated by a Respondent

F1-1. When making a purchase at a physical store, which payment method would you prefer between A and B?

Attributes	Payment method A	Payment method B
Issuer	Central Bank	Private financial institutions
Issuance form	Smartphone apps	Plastic card
Disclosure of information type	None	Personal identification information
Vendor acceptability	Half (50%)	Always (100%)
Risk of loss	5%	1%
Discount rate	None	3%
Payment delay	Less than ten seconds	About two minutes
Timing of settlement	Installment	Immediately
Monthly fee	Three thousands won	Five thousands won

1. I will pay with A
2. I will pay with B

Figure A2: Predicted Preference for CBDC in Response to Private Institutions



Notes: The above bar means the predicted demand for CBDC in each scenario. No adjustment refers to the baseline scenario (scenario 1) in Tables 3 and 4. Fee adjustment refers to the case where the monthly fees for credit cards and mobile payment methods decrease to five hundred won and zero respectively. Discount adjustment refers to the case where the discount rates for credit cards and mobile payment methods increase 5% and 3% ~ 5% respectively. Fee and Discount adjustment refers to both the monthly fees and discount rates adjusted.

Figure A3: Average Marginal Effect (AME) Estimates for Attributes by Gender

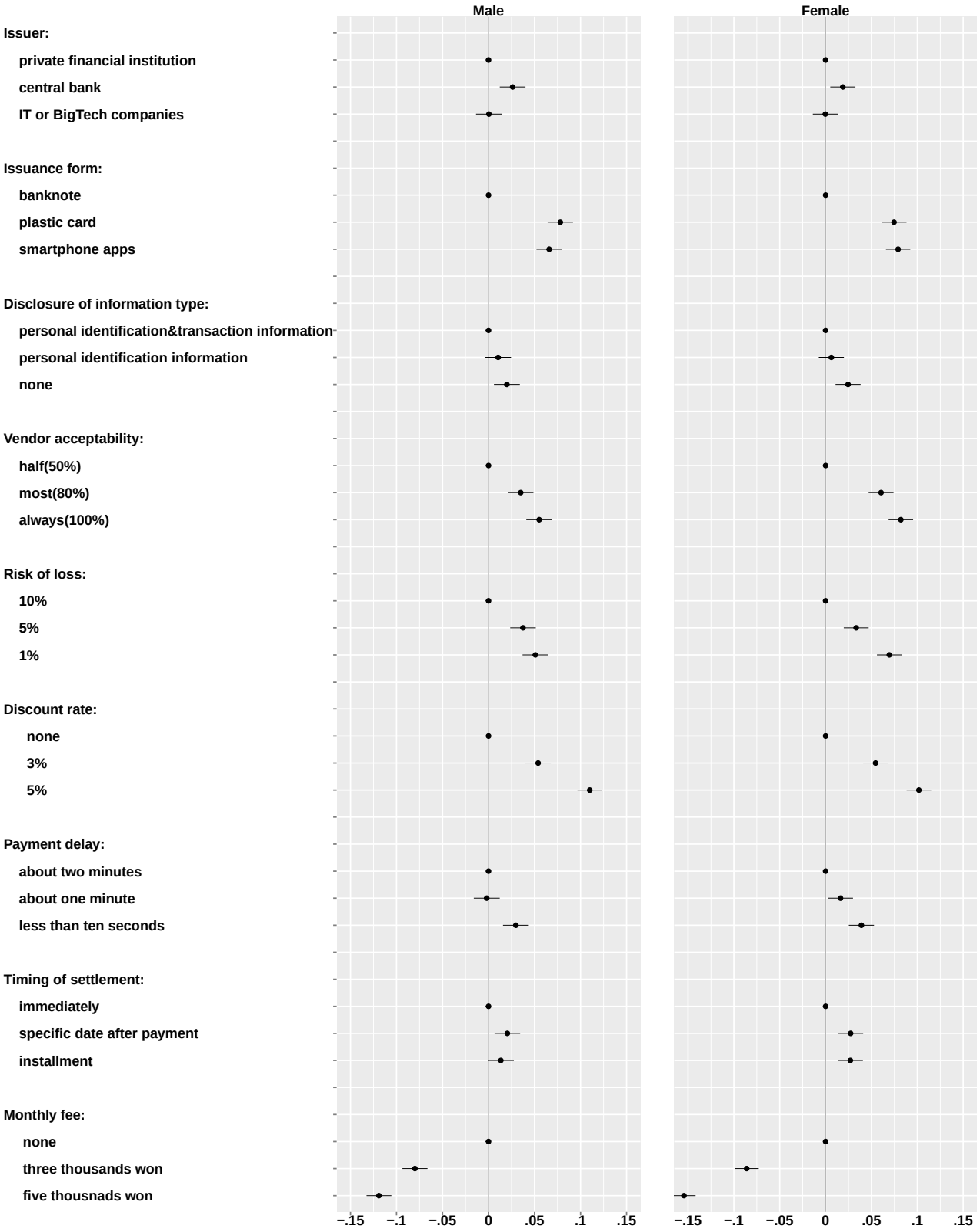


Figure A4: Average Marginal Effect (AME) Estimates for Attributes by Age

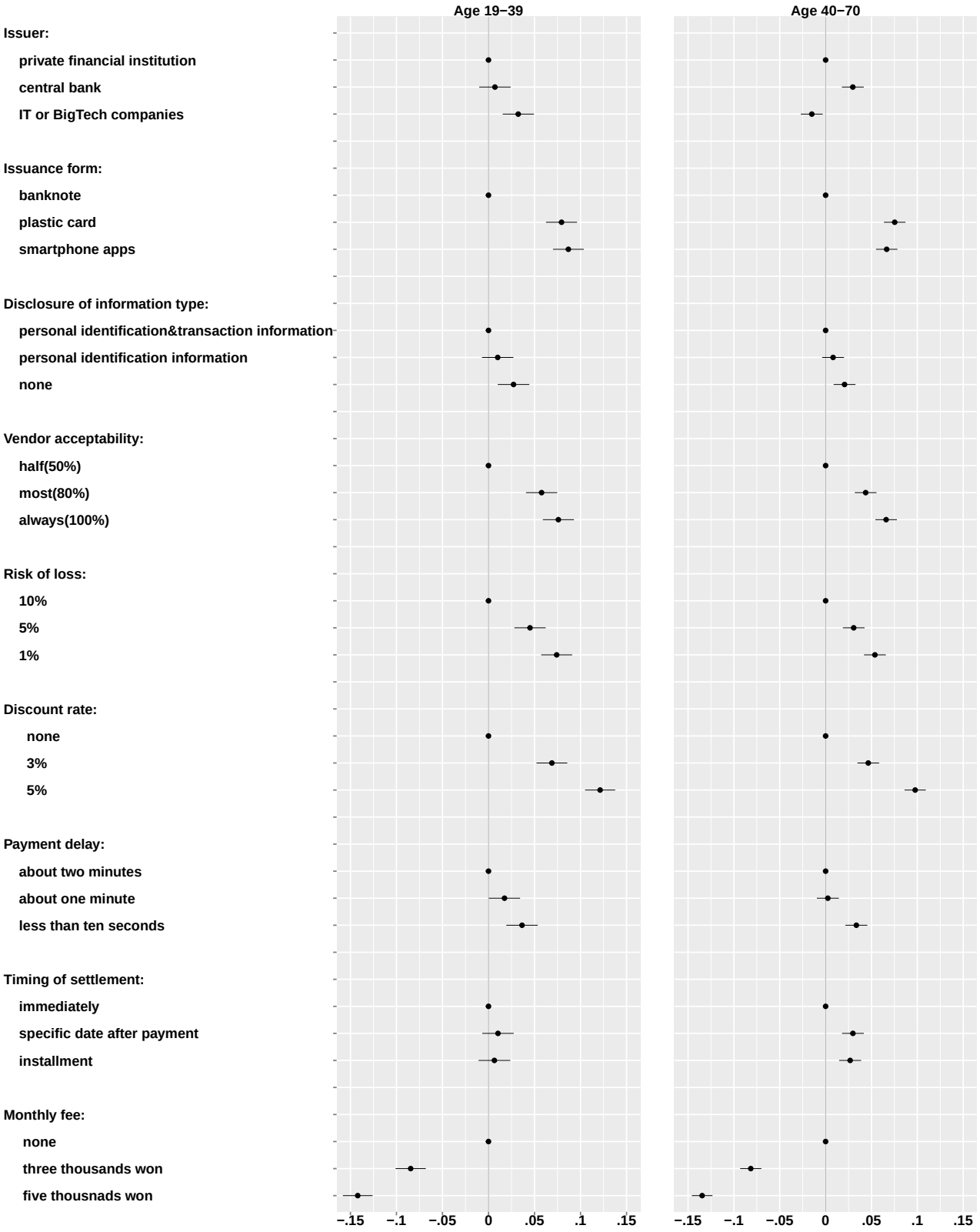


Figure A5: Average Marginal Effect (AME) Estimates for Attributes by Age

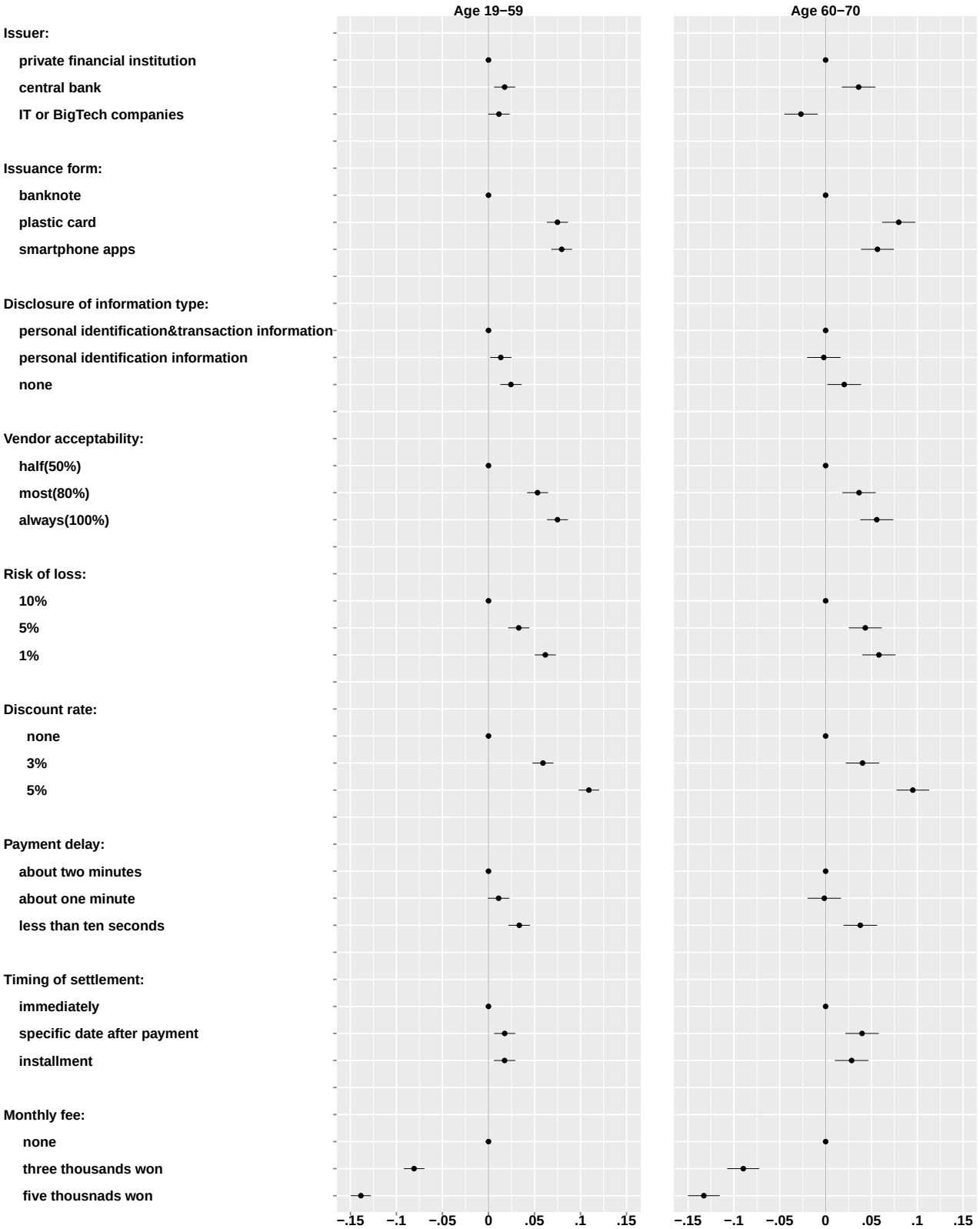


Figure A6: Average Marginal Effect (AME) Estimates for Attributes by Education

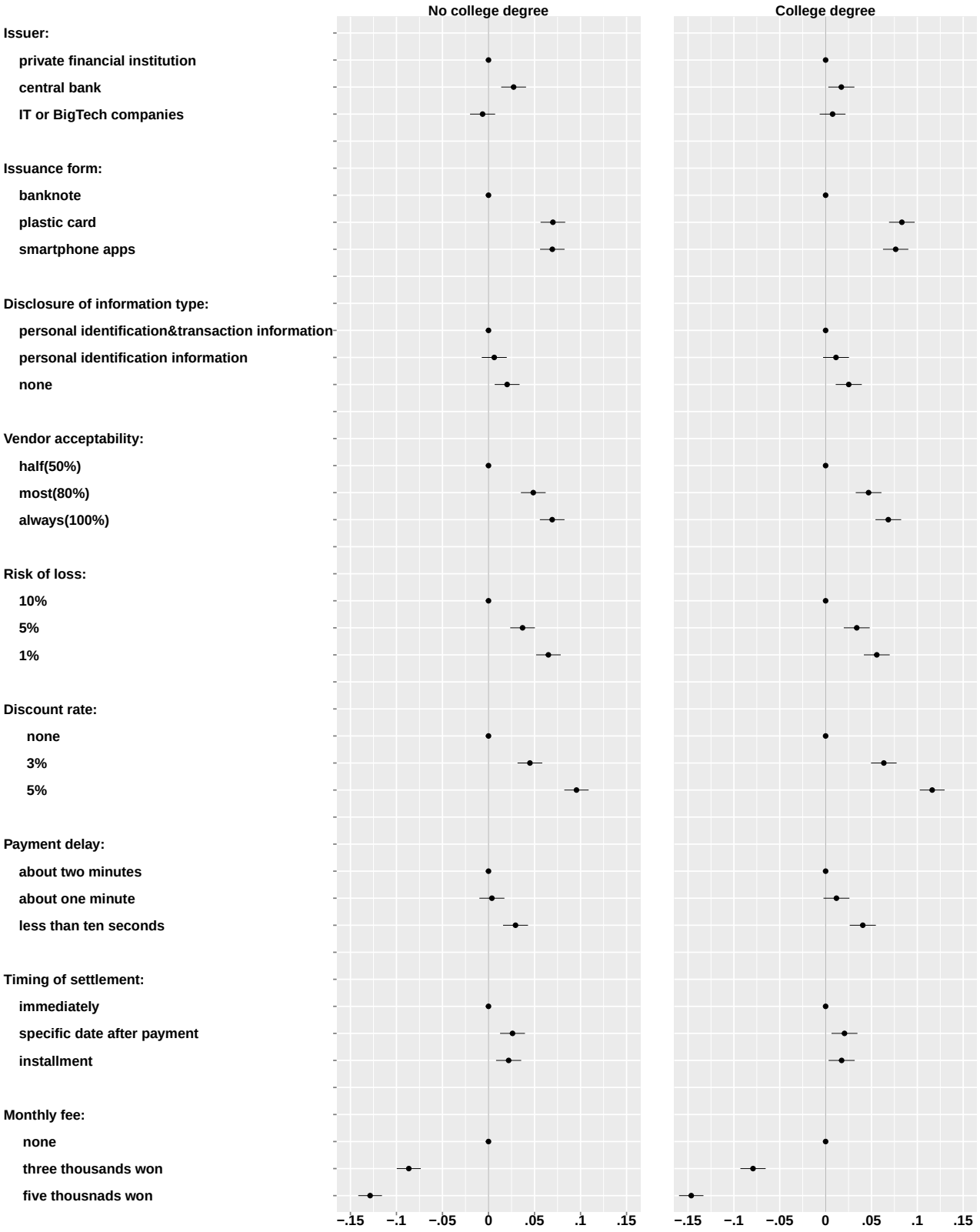


Figure A7: Average Marginal Effect (AME) Estimates for Attributes by Income

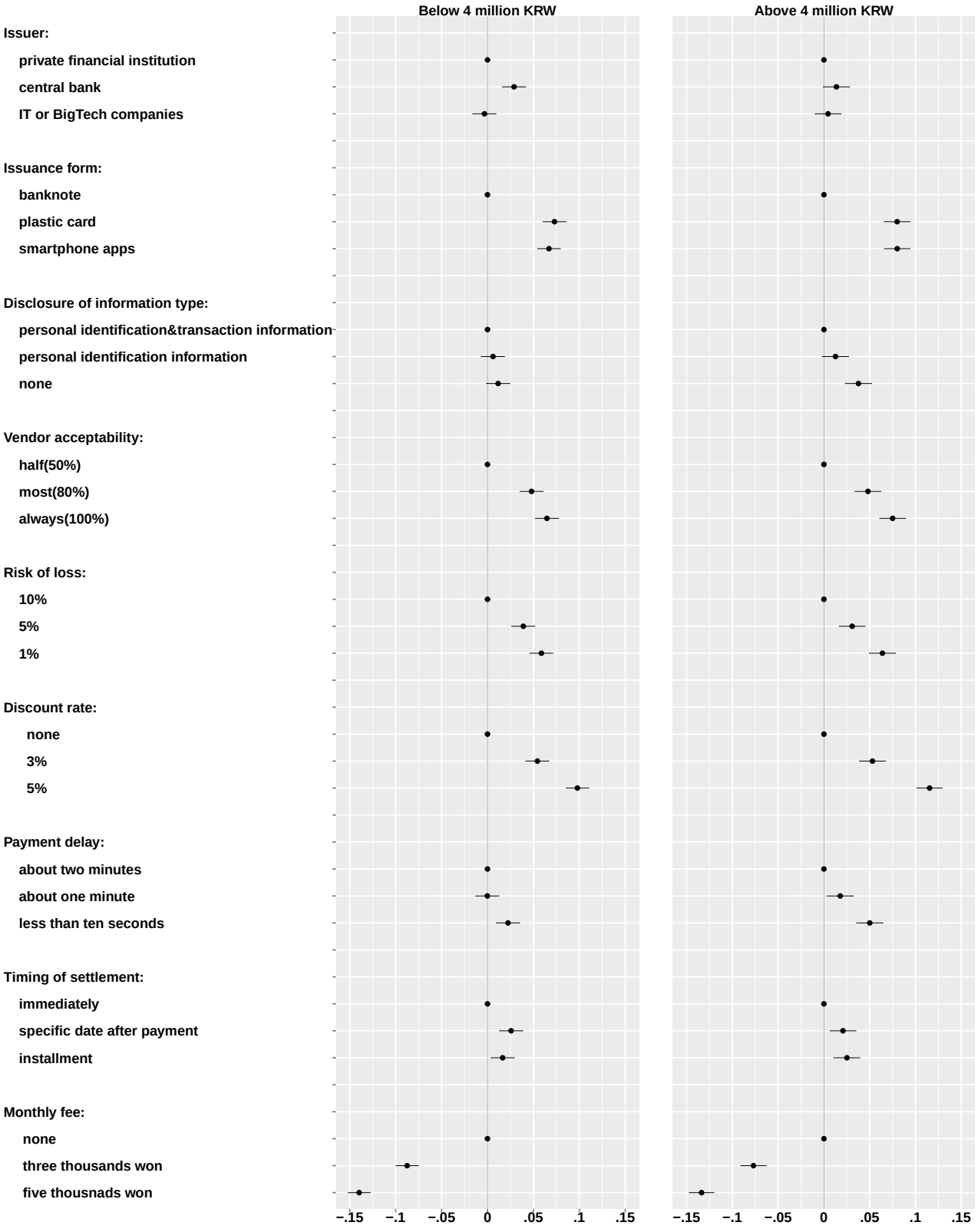
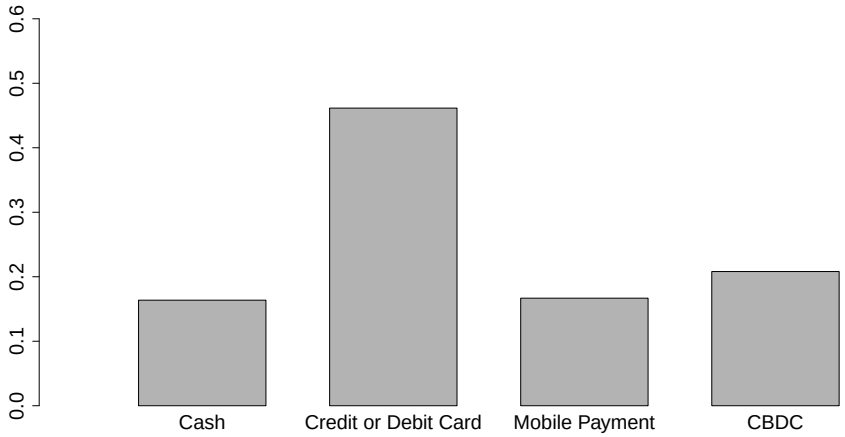


Figure A8: Prediction of Payment Preference with CBDC by Gender

(a) Male



(b) Female

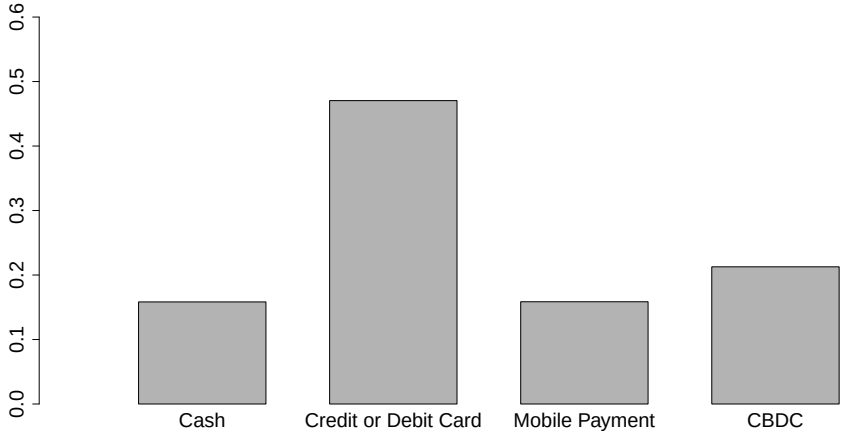
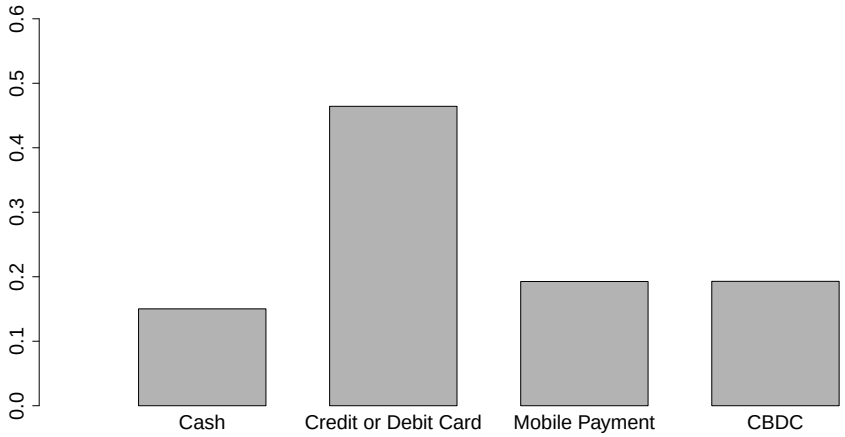


Figure A9: Prediction of Payment Preference with CBDC by Age

(a) Age 19-39



(b) Age 40-70

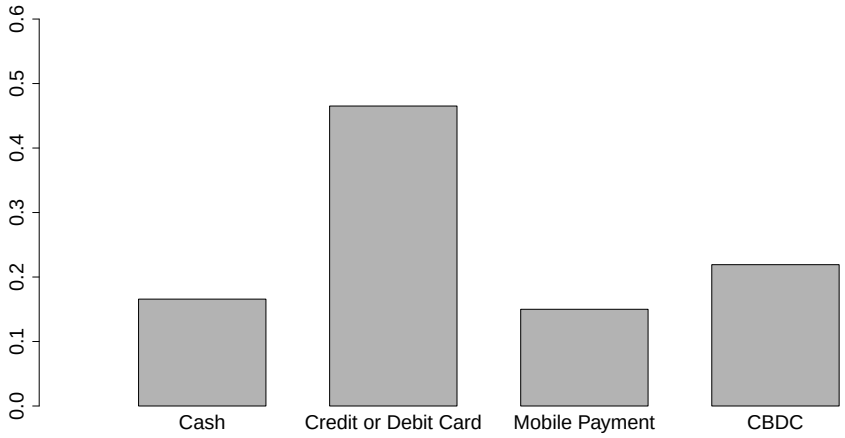
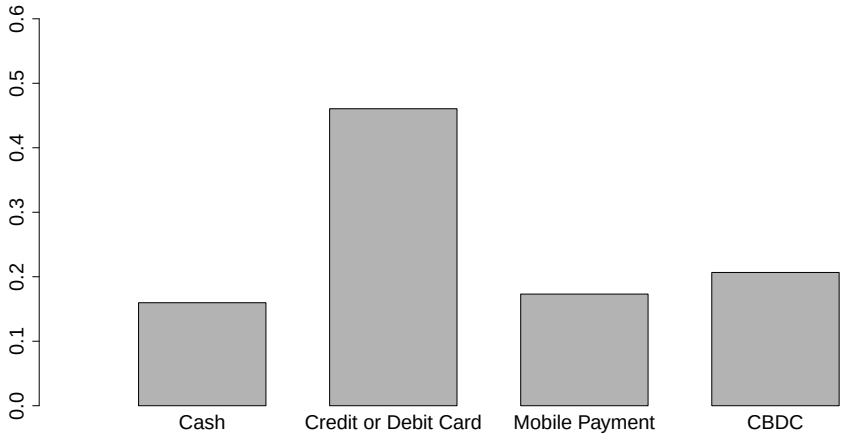


Figure A10: Prediction of Payment Preference with CBDC by Age

(a) Age 19-59



(b) Age 60-70

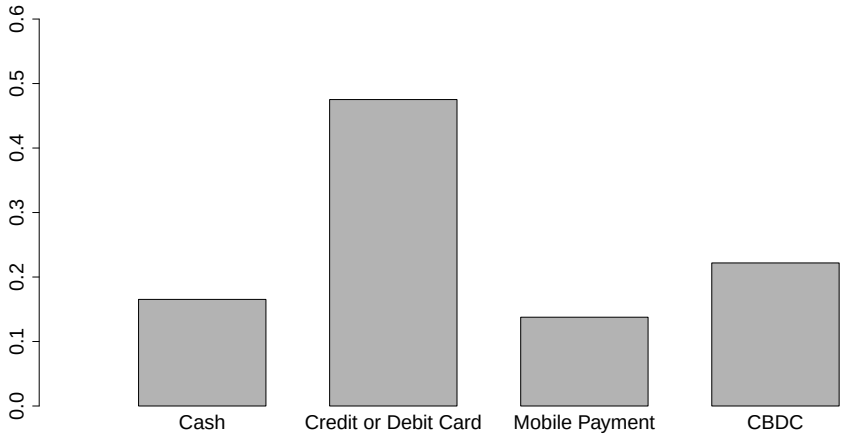
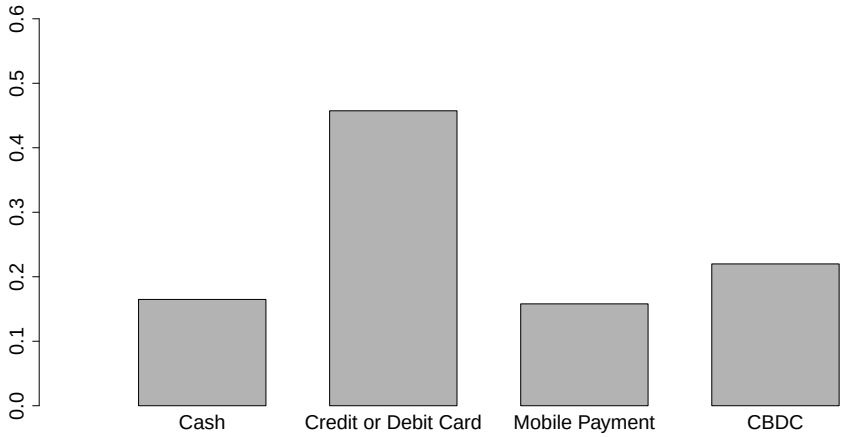


Figure A11: Prediction of Payment Preference with CBDC by Education

(a) No college degree



(b) College degree

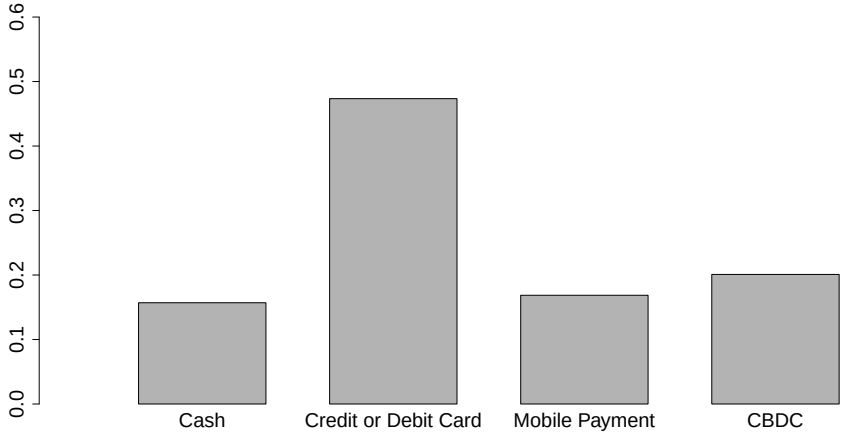
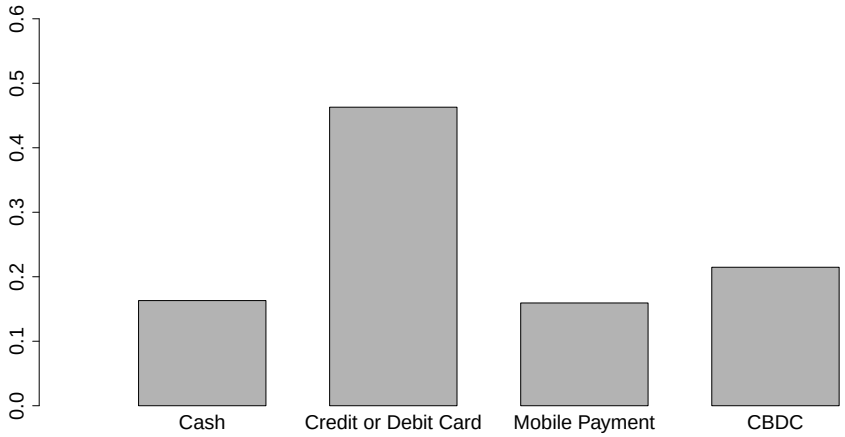


Figure A12: Prediction of Payment Preference with CBDC by Income

(a) Below 4 million KRW



(b) Above 4 million KRW

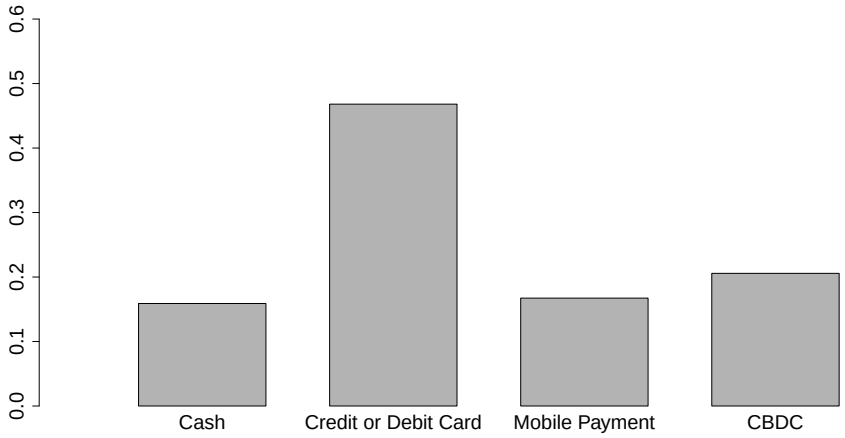


Table A1: Sample Characteristics

	This Survey	South Korea population
Female	0.51	0.50
Age		
19~29	0.16	0.15
30~45	0.26	0.25
46~59	0.29	0.30
Above 60	0.29	0.30
Living in Seoul	0.18	0.18
Married	0.62	0.60
Education		
Above College degree	0.47	0.47
Employment		
Employed	0.50	0.40
Self-employed	0.10	0.15
Not-employed	0.40	0.45

Notes: This table displays statistics for the overall South Korea population and compares it to the characteristics of the sample of surveys. National statics on gender, age, place of residence are from the South Korea Demographic Statistics December 2021. Marriage, education are from the South Korea Population Census 2015, and Employment is from the 2019 Korea Labor Income Panel Study(KLIPS).

Table A2: Estimation Results from Conditional Logit Models

	Coefficient	SE
Issuer		
central bank	0.101***	0.022
IT or BigTech companie	0.001	0.022
Issuance form		
plastic card	0.341***	0.023
smartphone apps	0.325***	0.022
Disclosure of information type		
personal identification information	0.039*	0.023
none	0.102***	0.022
Vendor acceptability		
most(80%)	0.216***	0.022
always(100%)	0.310***	0.023
Risk of loss		
5%	0.159***	0.022
1%	0.271***	0.022
Discount rate		
3%	0.241***	0.022
5%	0.473***	0.022
Payment delay		
about one minutes	0.032	0.022
less than ten seconds	0.155***	0.022
Timing of settlement		
specific date after payment	0.106***	0.022
installment	0.091***	0.022
Monthly fee		
three thousands won	-0.371***	0.022
five thousands won	-0.614***	0.023
Number of observations	35,610	
Number of individuals	3,561	
Log-likelihood	-11,344	

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In issuer attribute, the base value is private financial institutions. In issuance form attribute, the base value is banknote. In disclosure of information type attribute, the base value is transaction & personal identification information. In vendor acceptability attribute, the base value is half (50%). In risk of loss attribute, the base value is 10%. In discount rate attribute, the base value is 0%. In payment delay attribute, the base value is about two minutes. In timing of settlement attribute, the base value is immediately. In monthly fee attribute, the baes value is none.

Table A3: Estimation Results from Conditional Logit Models with Interaction Term

	Coefficient	SE
Issuer		
central bank	0.101***	0.022
IT or BigTech companie	0.000	0.022
Issuance form		
plastic card	0.341***	0.023
smartphone apps	0.326***	0.022
Disclosure of information type		
personal identification information	0.008	0.051
none	0.120***	0.050
Vendor acceptability		
most(80%)	0.216***	0.022
always(100%)	0.310***	0.023
Risk of loss		
5%	0.159***	0.022
1%	0.272***	0.023
Discount rate		
3%	0.230***	0.050
5%	0.472***	0.050
Payment delay		
about one minutes	0.032	0.022
less than ten seconds	0.155***	0.023
Timing of settlement		
specific date after payment	0.106***	0.022
installment	0.090***	0.023
Monthly fee		
three thousands won	-0.371***	0.022
five thousands won	-0.614***	0.023
Interaction term		
personal identification information × 3%	0.086	0.078
personal identification information × 5%	0.005	0.078
none × 3%	-0.050	0.078
none × 5%	-0.002	0.078
Number of observations	35,610	
Number of individuals	3,561	
Log-likelihood	-11,342	

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In issuer attribute, the base value is private financial institutions. In issuance form attribute, the base value is banknote. In disclosure of information type attribute, the base value is transaction & personal identification information. In vendor acceptability attribute, the base value is half (50%). In risk of loss attribute, the base value is 10%. In discount rate attribute, the base value is 0%. In payment delay attribute, the base value is about two minutes. In timing of settlement attribute, the base value is immediately. In monthly fee attribute, the baes value is none.

B Questionnaire

B.1 Korean Version

The original survey questionnaire in Korean is available in the following link:

Questionnaire-Korean Version

B.2 English Version

The translated survey questionnaire in English is available in the following link:

Questionnaire-English Version