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Article

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Suggested Citation: Kuramoto, Yu et al. (2024) : Temporal dynamics of payment choices: Unraveling the interplay between time preferences and credit card utilization in Japan, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-12, <https://doi.org/10.1080/23322039.2024.2369278>

This Version is available at:

<https://hdl.handle.net/10419/321523>

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To cite this article: Yu Kuramoto, Koichiro Takeuchi, Honoka Nabeshima, Sarasa Nakamichi, Mostafa Saidur Rahim Khan & Yoshihiko Kadoya (2024) Temporal dynamics of payment choices: Unraveling the interplay between time preferences and credit card utilization in Japan, Cogent Economics & Finance, 12:1, 2369278, DOI: [10.1080/23322039.2024.2369278](https://doi.org/10.1080/23322039.2024.2369278)

To link to this article: <https://doi.org/10.1080/23322039.2024.2369278>



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Temporal dynamics of payment choices: Unraveling the interplay between time preferences and credit card utilization in Japan

Yu Kuramoto, Koichiro Takeuchi, Honoka Nabeshima, Sarasa Nakamichi, Mostafa Saidur Rahim Khan and Yoshihiko Kadoya

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ABSTRACT

This study investigates whether the present bias influences the payment behavior of credit card holders in Japan. We hypothesize that credit card holders with present bias prefer to delay bill payment, even at the cost of accepting interest charges. To test this hypothesis, we utilize a dataset comprising 128,032 observations from a leading securities company. Our analysis reveals that a significant number of respondents indeed delayed credit card bill payments, suggesting a potential association with present bias behavior. Probit regression models further confirm the link between impatience, impulsivity, and credit card payment behavior. Specifically, impatience and impulsivity exhibit a positive association with credit card payments, indicating that impatient and impulsive credit card users are more likely to postpone payment, even when interest charges are incurred. The implications of this study extend to both credit card users and issuers, highlighting the influential role of impulsivity in the timely payment of bills.

IMPACT STATEMENT

This study investigates how present bias affects credit card payment behavior in Japan. Analyzing 128,032 observations from a major securities company, it finds that impatient and impulsive users are more likely to defer payments. The findings of this research have crucial implications for both credit card users and issuers. For users, understanding the role of impulsivity in payment behavior can lead to more informed financial decisions and strategies to avoid unnecessary interest charges. For issuers, recognizing the patterns of present bias can inform the development of products and policies aimed at encouraging timely payments, ultimately benefiting both parties. This study contributes to the literature by providing empirical evidence on the time-inconsistent behavior of Japanese credit card holders and underscores the need for tailored financial education and interventions to mitigate the effects of present bias in financial decision-making.

ARTICLE HISTORY

Received 19 April 2024
Revised 23 May 2024
Accepted 7 June 2024

KEYWORDS

Credit card debt; bill payment behavior; impatience; impulsive; time-consistent decision-making; Japan

REVIEWING EDITOR

Dr David McMillan,
Academic Editor, University
of Stirling, United Kingdom
of Great Britain and
Northern Ireland

SUBJECTS

Finance; Credit & Credit
Institutions; Economics

1. Introduction

Previous studies explain consumers' higher borrowing propensity from the viewpoint of their time-inconsistent behavior, such as impatience and impulsivity (also known as present bias), where they prefer present consumption over future costly repayments (Bradford et al., 2017; Meier & Sprenger, 2010). For example, Bradford et al. (Bradford et al., 2017) and Meier and Sprenger (Meier & Sprenger, 2010) found that impulsive or present-biased individuals are more likely to use credit cards and have significantly higher credit card debt. Additionally, present-biased individuals are more prone to borrow from credit cards that offer short-term interest benefits (Shui & Ausubel, 2005). Behavioral economists argue that present-biased consumers tend to place higher importance on the utility gain from maximizing current consumption than on the future loss of utility from repaying even more (Samuelson, 1937; Laibson, 1997; Green & Myerson, 1996). This tendency is also supported by the neuroeconomic explanation for the use of credit cards, where

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.

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credit card purchases are found to be more rewarding than cash purchases (Banker et al., 2021). While there is evidence that impatience and impulsivity explain higher borrowing tendencies, no study has explicitly examined whether consumers' time-inconsistent behavior could explain their payment behavior—specifically, why some consumers defer payment even after incurring interest costs. In other words, it remains unresolved whether time-inconsistent consumers, who are likely to borrow more, also defer payments for credit card installments. Based on the theoretical foundation and empirical evidence of present bias, we hypothesize that present-bias behavior is associated with consumers' preference for installment payments (Bradford et al., 2017; Meier & Sprenger, 2010; Samuelson, 1937; Laibson, 1997; Green & Myerson, 1996). The 2023 wave of the panel survey jointly conducted by Rakuten Securities and Hiroshima University provides data for this study. Using 128,032 observations, this study aims to investigate the association between the choice of credit card payment and card users' time-inconsistent behaviors, such as impatience and impulsivity, while controlling for their demographic and socioeconomic factors.

Financial decision-making is a complex process determined by a combination of economic and psychological factors. The theoretical foundation of time-consistent decision-making is rooted in economic theories that assume exponential discounting of future values with delays, as proposed by Samuelson (1937). According to these rational theories, individual preferences are time-consistent, implying consistent exponential discounting of future utility over time. However, psychology offers an alternative perspective by introducing the concept of present bias. This suggests a tendency to heavily discount immediate rewards compared to those in the distant future (Laibson, 1997; Green & Myerson, 1996; Banker et al., 2021; Sloan et al., 2014; Ikeda et al., 2010). Ainslie (1991) and Laibson (1997) argue that individuals tend to maximize a discounted utility stream that places disproportionate emphasis on present payoffs over future ones. This phenomenon, known as present bias, indicates that individuals are overly impatient in the short-term relative to their long-term preferences. Laibson (1997) further posits that time inconsistency arises when individuals experience interpersonal conflict between their current selves (which they prioritize) and all future selves (which they prioritize less). Time inconsistency in decision-making is a well-explored area and finds applications in various fields, including financial decision-making related to smoking (Bradford, 2010), BMI (Chabris et al., 2008), exercise (Chabris et al., 2008), preventive healthcare (Bradford, 2010; Wang & Sloan, 2018), credit card debt (Bradford et al., 2017; Meier & Sprenger, 2010), credit score (Arya et al., 2013), savings, and retirement preparedness (O'Donoghue & Rabin, 1999). Present bias becomes particularly relevant in the loan market, where individuals often borrow excessively and struggle to repay loans on time (Meier & Sprenger, 2010; Kuchler, 2013; Skiba & Tobacman, 2008).

We analyzed the payment behavior of credit card holders through the lens of time inconsistency or present bias. Concerning credit card bill payments, present bias behavior suggests that cardholders may postpone payment, even accepting higher interest charges, due to increased impatience and impulsivity. From a time-consistent perspective, the prompt payment of credit card bills, which avoids interest charges, maximizes the benefits for cardholders. However, empirical evidence from previous studies contradicts time-consistent behavior, indicating that time-inconsistent individuals often borrow excessively or delay debt installment payments despite facing higher interest charges (Bradford et al., 2017; Meier & Sprenger, 2010). Within the realm of time inconsistency, two distinct types of behavior have emerged: sophisticated time-inconsistent behavior and naïve time-inconsistent behavior (Bradford et al., 2017; O'Donoghue & Rabin, 1999; Kuchler, 2013). Sophisticated time-inconsistent borrowers, aware of their time inconsistency, often mitigate their effects through commitment, enabling them to refrain from incurring higher interest charges and pay credit card bills promptly. In contrast, naïve time-inconsistent borrowers, who lack awareness of their time inconsistency, repeatedly struggle to make timely credit card payments or defer them. However, it should be noted that even sophisticated discounters can fail to execute their plans for timely credit card payments, potentially experiencing delays as their impatience increases (O'Donoghue & Rabin, 1999). Consequently, the decision to defer credit card bill payments and accept costly interest charges may be based on a combination of impulsivity and impatience.

The world is moving towards a cashless society, with credit card use rising sharply. Compared to the United States and other Western countries, Japan has historically been more inclined to cash-based transactions (Tomomi, 2024). However, the use of credit cards has been increasing steadily in Japan, particularly since the emergence of the COVID-19 pandemic (Tomomi, 2024; Statista, 2024). Evidence shows that the average annual credit card transactions were 60 in the United States compared to 4 in Japan in 2002

(Mann, 2002). However, more recent evidence shows that Japan has sharply embraced credit card transactions, leading to a credit card penetration rate of 70%, which is slightly higher than that of the United States (Tomomi, 2024; Kumok, 2024). Despite this increase, the average credit card debt in Japan is significantly lower than in the United States (Kumok, 2024). The increasing use of credit cards requires an understanding of the debt-holding and payment behavior of cardholders. Several studies have documented the time-inconsistent behavior of credit card holders with respect to borrowing propensity (Meier & Sprenger, 2010). However, there is a scarcity of studies explaining the behavior of credit card bill payment, such as paying bills in time without interest or deferring bill payment even after paying interest. Moreover, Japan is a culturally unique country where people are risk-averse, pay installments on time, and rarely use revolving credit options (Statista, 2024). In this context, our study investigates the association between time preferences, as manifested in discount rates, and the choice of payment methods among credit card users in Japan. Using cardholder impatience and impulsivity as proxies for time-inconsistent behavior, we examined their association with deferred credit card payments that incur interest. We contribute to the existing literature in at least two ways. First, we explore time-inconsistent behavior in credit card bill payment using a sample size of 128,032 observations in Japan. Second, we include a variety of covariates that could potentially explain the payment behavior of Japanese credit card holders.

The remainder of this paper is organized as follows: [Section 2](#) outlines the data and methodology, [Section 3](#) provides the empirical results, [Section 4](#) discusses the findings, and [Section 5](#) concludes the paper.

2. Data and methods

2.1. Data

This study mainly used data from the 2023 wave of the online survey titled “Survey on life and money” jointly conducted by Rakuten Securities and Hiroshima University. Data were collected in November and December 2023 from active Rakuten Securities account holders aged 18 and older. However, we incorporated several variables from the 2022 wave, as some respondents were part of the panel data from that year. After removing missing variables, the final dataset comprised 128,032 observations.

2.2. Ethical statement

Review and approval by an ethics committee was not needed for this study because this study does not involve animal experiments, human and behavior studies.

2.3. Variables

The dependent variable of this study is `credit_interest`, which indicates that consumers defer the payment of installments and pay interest. The dependent variable is a binary variable that takes the value 1 when respondents prefer credit card bill payment with interest and 0 otherwise.

To measure the impatience and impulsivity variables, we estimated discount rates using the two questions shown in [Appendix A](#). We followed the methodology of Ikeda et al. (2010) and Fukuda et al. (2023) to measure these variables. The questions were used to assess the intertemporal choices of the respondents, controlling for the delay length. For example, we asked respondents to choose whether they preferred to receive a reward in 2 or 9 days. Generally, receiving a reward closer to the present (option A) is more valued than receiving a reward in the more distant future (option B). However, when the utility from option B exceeds that from option A, respondents are likely to change their choices from A to B. Respondents would continue to select B in subsequent responses because the interest rate was set to increase as they progressed from the top to the bottom of each answer. Finally, we measured the time discount rates of the respondents based on the discount rates at their switching points. We named the discount rates DR1 for the discount rate elicited over the recent time horizon (2–9 days) and DR2 for the distant time horizon (90–97 days). We excluded data from respondents who changed their choice multiple times.

Impatience and impulsivity are the main independent variables of this study. Impatience indicates the degree of preference for current consumption. A higher discount rate indicates a consumer’s preference

Table 1. Variable definitions.

Variables	Definition
Dependent variable	
Credit_no_interest	Binary variable: 1 = participants pay credit card bill without interest (full payment or interest-free installments), 0 = otherwise
Credit_interest	Binary variable: 1 = participants pay credit card bill with interest (installments with interest charges or revolving payments), 0 = otherwise
Independent variables	
Impatience	Continuous variable: the simple mean of the standardized values of the elicited discount rates (DR1 and DR2) as a measure of the degree of impatience
Hyperbolic discounting (impulsivity)	Binary variable: 1 = being a hyperbolic discounter (DR1 > DR2), 0 = otherwise
Men	Binary variable: 1 = men, 0 = women
Age	Continuous variable: respondents' age
Age squared	Continuous variable: age squared
Education	Continuous variable: years of education
Married	Binary variable: 1 = currently have a spouse, 0 = otherwise
Number of children	Discrete variable: the number of children
Full-time employment	Binary variable: 1 = having a full-time job, 0 = otherwise
Household income	Continuous variable: annual earned income before taxes and with bonuses of the entire household (unit: JPY)
Log of household income	Log (household income)
Household assets	Continuous variable: balance of financial assets (savings, stocks, bonds, insurance, etc.) of the entire household (unit: JPY)
Log of household assets	Log (household asset)
Risk aversion	Continuous variable: risk of rain preference (percentage score from the question, "Usually when you go out, how high must the probability of rainfall be before you take an umbrella?")
Financial literacy	Discrete variable: average values of the correct answers to the three financial literacy questions

for current consumption over future consumption. The average of the standardized values of DR1 and DR2 provides the measure of impatience.

$$Impatience = \frac{1}{2} \sum_{i=1}^2 [(DR_i - E(DR_i)) / \sigma(DR_i)]$$

Hyperbolic discounting, or present bias, is a behavioral phenomenon in which people tend to show higher impatience over shorter time horizons compared to relatively longer ones. To create the hyperbolic discounting variable, we utilized DR1 and DR2, which represent the time discount rates for respondents in the near and distant futures, respectively. Respondents whose DR1 was higher than their DR2 were classified as hyperbolic discounters.

This study used gender, age, years of education, marital status, number of children, employment status, household income, household assets, risk aversion, and financial literacy as control variables. In the panel sample, some variables (impatience, hyperbolic discounting, years of education, and financial literacy) are obtained from the dataset collected in 2022. Table 1 provides detailed definitions of each variable.

2.4. Descriptive statistics

The descriptive statistics in Table 2 show that 97.7% of the respondents pay without interest, while 4.4% pay with interest. The impatience and hyperbolic discounting scores were 0.01 and 0.12, respectively. Our results also showed that 38% of the respondents were female and the average age was 44 years. Demographically, respondents had an average of 15.2 years of education, 66% were married, and the average annual household income and assets were 7.52 million yen and 18.9 million yen, respectively. On average, respondents reported a risk aversion level of 0.53 and a financial literacy level of 0.75.

2.5. Methods

This study investigated credit card bill payments from the viewpoint of cardholders' time-inconsistent behaviors, such as impatience and impulsivity. Time consistent economic theories featuring time consistency assume that people discount the value of things exponentially with delays (Samuelson, 1937).

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev	Min	Max
Dependent variable				
credit_no_interest	0.9769	0.1500	0	1
credit_interest	0.0444	0.2060	0	1
Independent variable				
Impatience	0.0143	0.9459	−0.6789	3.5745
Hyperbolic discounting (Impulsivity)	0.1248	0.3305	0	1
Men	0.6169	0.4861	0	1
Age	43.7929	11.7473	18	94
Age squared	2055.8260	1088.1690	324	8836
Education	15.2013	2.0406	9	21
Married	0.6602	0.4736	0	1
Number of children	1.0778	1.1012	0	12
Full-time employment	0.7709	0.4202	0	1
Household income	7519779	4125947	1000000	2.00E + 07
Log of household income	15.6722	0.6005	13.8155	16.8112
Household assets	1.89E + 07	2.34E + 07	2500000	1.00E + 08
Log of household assets	16.15227	1.0768	14.7318	18.42068
Risk aversion	0.5344	0.2284	0	1
Financial literacy	0.7492	0.2934	0	1
Observation		128,032		

Technically, an outcome that has utility A if received immediately ($t = 0$) is valued as $A \times \delta^t$ if t periods are delayed in the future. Thus, the present time value (V) of receiving (A) at time (t) is given by:

$$V(A, t) = A \times \delta^t \quad (1)$$

where the discount rate δ represents a constant proportional decrease in value with each added delay period (Story et al., 2014).

However, psychology proposes that individuals have a propensity for hyperbolic discounting (Green & Myerson, 1996). This means that people tend to discount rewards in the immediate future more heavily than they do in the distant future, contrary to the exponential assumption of a constant proportional discount factor (Story et al., 2014). The discount function for hyperbolic discounters is

$$V(A, t) = A \times \frac{1}{1 + k.t} \quad (2)$$

where k is a parameter that indicates the rate at which the value is discounted.

To investigate the association between the choice of credit card payment and time preference, we estimated Equations (3) and (4).

$$Credit_interest_i = f(IP_i, HD_i, X_i, \varepsilon_i) \quad (3)$$

where *Credit_interest* indicates whether respondents delay and pay credit card bills with interest. *IP* and *HD* represent impatient and hyperbolic discounting, respectively. X is a vector of the individual demographic, socioeconomic, and psychological characteristics. ε is the error term. As our dependent variable was binary, we performed a probit model analysis.

We tested for correlation and multicollinearity to avoid intercorrelation (results available upon request). Our findings show a weak correlation between the relative movements of the two variables (substantially less than 0.70) and no multicollinearity in any model (variance inflation factor < 3).

The full specifications for Equations (3) and (4) are as follows:

$$\begin{aligned} Credit_interest_i = & \beta_0 + \beta_1 Impatience_i + \beta_2 Hyperbolic_discounting_i + \beta_3 Male_i + \beta_4 Age_i + \beta_5 Age_squared_i \\ & + \beta_6 Education_i + \beta_7 Married_i + \beta_8 Number_of_children_i + \beta_9 Full_time_employment_i \\ & + \beta_{10} Log_of_household_income_i + \beta_{11} Risk_aversion_i + \beta_{12} Financial_literacy_i + \varepsilon_i \end{aligned} \quad (5)$$

3. Empirical findings

Our full sample results, using *credit_interest* as the dependent variable, are presented in Table 3. The goodness of fit tests, such as the Pseudo R^2 and AUC-ROC, show higher values when impatience and

Table 3. Regression results: Full sample.

Variables	Model 1	Model 2	Model 3
impatience		0.0323*** (0.0066)	0.0249*** (0.0069)
d_hyperbolic			0.1458*** (0.0187)
men	0.2340*** (0.0154)	0.2312*** (0.0154)	0.2289*** (0.0154)
age	0.0360*** (0.0042)	0.0362*** (0.0042)	0.0368*** (0.0042)
agesquared	−0.0003*** (0.0000)	−0.0003*** (0.0000)	−0.0003*** (0.0000)
year_of_educ	−0.0220*** (0.0034)	−0.0221*** (0.0034)	−0.0222*** (0.0034)
marriage	−0.1977*** (0.0179)	−0.1984*** (0.0179)	−0.1995*** (0.0179)
number_of_children	−0.0363*** (0.0083)	−0.0362*** (0.0083)	−0.0363*** (0.0083)
fulltime	−0.0396** (0.0188)	−0.0388** (0.0188)	−0.0397** (0.0188)
loghincome	0.1422*** (0.0158)	0.1415*** (0.0158)	0.1415*** (0.0158)
loghasset	−0.3925*** (0.0097)	−0.3916*** (0.0097)	−0.3922*** (0.0097)
risk_aversion	0.0637** (0.0289)	0.0678** (0.0290)	0.0665** (0.0290)
financial_literacy	−0.4011*** (0.0215)	−0.4049*** (0.0215)	−0.4017*** (0.0215)
Constant	2.0335*** (0.2344)	2.0357*** (0.2344)	2.0170*** (0.2346)
Observations	128,610	128,610	128,610
Log likelihood	−21282	−21270	−21240
Pseudo R ²	0.0897	0.0902	0.0914
AUC-ROC	0.7446	0.7451	0.7464
LR Chi ² statistics	3060	3067	3114
p-value	0	0	0

Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

impulsivity are included as independent variables indicating that time-inconsistent behavior of consumers is an important factor in predicting the behavior of credit card payment. The regression results show that both impatience and hyperbolic discounting are significantly and positively associated with credit_interest at the 1% level. The positive association between credit_interest and impatience indicates that consumers prefer delaying credit card bill payments even at the cost of interest. Similarly, the positive association between credit_interest and hyperbolic discounting indicates that present-biased consumers are more likely to delay paying their credit card bills and incur interest. Additionally, credit_interest is positively associated with age, male gender, household income, and risk aversion. Conversely, years of education, marital status, number of children, full-time employment, household assets, and financial literacy exhibit negative relationships with credit_interest.

To improve our understanding of the correlation between time preferences and credit card payment methods, we performed subsample analyses based on gender and age. Tables 4 and 5 present the regression results for the gender- and age-based subsamples, respectively. In the gender subsample analysis for credit_interest, impatience showed a positive association with women, whereas hyperbolic discounting demonstrated a positive association with both men and women. Among the control variables, age and household income showed positive associations for both men and women, whereas years of education, marriage, number of children, and household assets showed negative associations for both genders. The remaining variables either exhibited inconsistent or non-significant relationships.

In the age group analyses with credit_interest, we found a positive association with impatience from the ages of 41 to 60 years. Hyperbolic discounting also displays a positive relationship with credit_interest among individuals under 60. Among the control variables, male showed a positive correlation with credit_interest across all age groups. Conversely, marriage, financial literacy, and years of education exhibited negative relationships with credit_interest for all age groups. Furthermore, household income was positively associated with credit_interest across all age groups. The remaining variables either demonstrated inconsistent relationships or were not significantly correlated.

Table 4. Regression results by gender.

Variables	credit_interest	
	Men	Women
impatience	0.0088 (0.0084)	0.0608*** (0.0124)
d_hyperbolic	0.1393*** (0.0227)	0.1627*** (0.0332)
men	–	–
age	0.0423*** (0.0052)	0.0365*** (0.0081)
agesquared	–0.0004*** (0.0001)	–0.0004*** (0.0001)
year_of_educ	–0.0204*** (0.0040)	–0.0368*** (0.0066)
marriage	–0.2234*** (0.0224)	–0.1168*** (0.0310)
number_of_children	–0.0321*** (0.0104)	–0.0327** (0.0139)
fulltime	–0.1529*** (0.0298)	0.0675*** (0.0261)
loghincome	0.1631*** (0.0200)	0.1219*** (0.0267)
loghasset	–0.3604*** (0.0111)	–0.5114*** (0.0203)
risk_aversion	0.0588* (0.0348)	0.0838 (0.0523)
financial_literacy	–0.4365*** (0.0287)	–0.2111*** (0.0335)
Constant	1.4029*** (0.2871)	4.1440*** (0.4347)
Observations	79,357	49,263
Log likelihood	–13823	–7387
Chi ² statistics	1935	987.4
p-value	0	0

Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.**Table 5.** Regression results by age.

Variables	credit_interest		
	<41	41–60	>61
impatience	0.0134 (0.0114)	0.0334*** (0.0095)	0.0130 (0.0226)
d_hyperbolic	0.1870*** (0.0281)	0.1281*** (0.0270)	0.0330 (0.0703)
men	0.2133*** (0.0214)	0.2166*** (0.0237)	0.2567*** (0.0747)
age	0.0300 (0.0244)	–0.0202 (0.0337)	–0.0629 (0.1203)
agesquared	–0.0003 (0.0004)	0.0002 (0.0003)	0.0005 (0.0009)
year_of_educ	–0.0412*** (0.0054)	–0.0123*** (0.0046)	–0.0137 (0.0134)
marriage	–0.2285*** (0.0289)	–0.1812*** (0.0258)	–0.1962*** (0.0710)
number_of_children	–0.0084 (0.0147)	–0.0551*** (0.0110)	–0.0676** (0.0279)
fulltime	–0.0570** (0.0284)	–0.0435 (0.0277)	0.0481 (0.0604)
loghincome	0.0815*** (0.0255)	0.1786*** (0.0221)	0.2520*** (0.0505)
loghasset	–0.3569*** (0.0174)	–0.4246*** (0.0127)	–0.4439*** (0.0289)
risk_aversion	0.1373*** (0.0434)	0.0153 (0.0408)	–0.0835 (0.1234)
financial_literacy	–0.4072*** (0.0313)	–0.2796*** (0.0322)	–0.3381*** (0.0959)
Constant	2.7867*** (0.5073)	3.2339*** (0.8771)	4.1765 (4.2211)
Observations	55,142	61,528	11,950
Log likelihood	–9624	–10386	–1225
Chi ² statistics	1144	1593	320.1
p-value	0	0	0

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4. Discussion

The question of why individuals prefer to delay bill payment of credit card even with accepting substantial interest charges remains puzzling. We employ a time-consistent decision-making framework and hypothesize that individuals who consistently prioritize the immediate payment of credit card bills are time-consistent, whereas those who postpone payments despite higher interest rates exhibit time-inconsistent behaviors, emphasizing present utility at the expense of future utility. To proxy for time inconsistency, we utilize both impatience and impulsivity. This study contributes to the existing literature by providing a more comprehensive examination of the relationship between credit card payment methods and time-inconsistent behavior.

Univariate tests reveal that most credit card holders in Japan prioritize the timely payment of bills, avoiding significant interest costs. However, approximately 4.5% of credit card holders choose to delay bill payments and incur higher interest charges. Additionally, our study highlights that only 1.43% of respondents exhibited impatience, whereas 12.49% displayed impulsivity. The relatively high percentage of impulsive respondents suggests a potential association between impulsivity and delayed credit card payments.

We employ probit regression models on the full sample and age- and gender-based subsamples to investigate the impact of impatience and impulsivity on the promptness of credit card bill payments. In psychology, both impatience and impulsivity are linked to an individual's aversion to patience and reluctance to wait for the future. Impatience involves a sense of annoyance or restlessness in the face of delays, whereas impulsivity involves spontaneous actions or behaviors without considering consequences (Winch, 2019). In terms of discounting, impatience reflects a desire for a higher discount, sacrificing present benefits, whereas impulsivity indicates a preference for a disproportionately higher discount rate in the short run compared to the long-term discount rate (Bradford et al., 2017; Sloan et al., 2014; Ikeda et al., 2010). Consequently, individuals with time-inconsistent credit card behavior are more likely to delay bill payments to maximize their current consumption at the expense of higher future interest payments. Supporting this hypothesis, our results reveal that impatience is positively associated with deferred credit card bill payment with interest. This implies that individuals with a higher discount rate are more inclined to make delayed credit card payments meaning that they prioritize present consumption over the future, in accordance with Bradford et al. (Bradford et al., 2017).

Concerning impulsive credit card users, our findings reveal that hyperbolic discounting is positively associated with deferred credit card bill payment with interest. This aligns with our hypothesis that credit card bill payment behavior is characterized by time inconsistency. The allure of deferring payments in exchange for interest is particularly attractive to time-inconsistent individuals, who tend to overestimate present value over future value, consistent with the features of impulsivity (Laibson, 1997; Green & Myerson, 1996; Banker et al., 2021; Sloan et al., 2014; Ikeda et al., 2010). The arguments put forth by Ainslie (1991) and Laibson (1997), stating that individuals tend to maximize a discounted utility stream that disproportionately emphasizes present payoffs over future ones, also elucidate why impulsive individuals accept higher future costs against short-term benefits. From this perspective, the findings of our study align with other areas of research that have identified impulsivity as a factor influencing behaviors such as smoking (Bradford, 2010), BMI (Chabris et al., 2008), exercise (Chabris et al., 2008), preventive healthcare (Bradford, 2010; Wang & Sloan, 2018), credit card debt (Bradford et al., 2017; Meier & Sprenger, 2010), credit score (Arya et al., 2013), savings, and retirement preparedness (O'Donoghue & Rabin, 1999).

In addition to impatience and impulsivity, our study reveals that several demographic and socioeconomic factors contribute to the likelihood of delaying credit card payments. Specifically, men, middle-aged individuals, unmarried individuals, those without children, those with lower levels of education, those without full-time employment, those with higher household income balances, those with lower financial asset balances, risk-averse individuals, and those with lower financial literacy are more likely to delay credit card bill payments. These findings align with those of previous research, providing evidence that men are more likely to postpone payments (Wang et al., 2011a; Wang et al., 2011b), older credit card holders tend to accumulate more debt than their younger counterparts (Worthy et al., 2010), individuals with higher education levels carry higher credit card balances (Kim & DeVaney, 2001), and family

size correlates with increased credit card balances (Kim & DeVaney, 2001). Thus, the results of our study support previous findings that demographic and socioeconomic backgrounds play a crucial role in influencing credit card balance and payment behaviors.

Our study had a few limitations that should be considered when interpreting the results. First, we collected data from a securities company using an Internet survey, which may restrict the generalizability of the sample. Second, our data collection period occurred during the post-pandemic era, characterized by heightened concerns about economic conditions and future prosperity. This may have influenced credit card payment behavior. Despite these limitations, an examination of credit card bill payment behavior from the perspective of impatience and impulsivity based on a large dataset provides insights into why some individuals delay credit card payments irrespective of their financial conditions.

5. Conclusions

In the context of an increasing credit card debt balance, we investigate the tendency of credit card holders to delay bill payments, incurring substantial interest costs, as opposed to making immediate payments. We used the time-consistent decision-making framework to distinguish between individuals exhibiting time-consistent behavior by prioritizing immediate payment and those displaying time-consistent and time-inconsistent behavior by delaying payment despite higher interest rates. We introduced impatience and impulsivity as proxies for time inconsistency and employed probit regression models to analyze their impact on credit card payment behavior.

Univariate tests revealed that most credit card holders in Japan prefer timely bill payments; however, approximately 4.5% exhibit delayed payment behavior, incurring higher interest costs. In particular, 12.49% of respondents displayed impulsivity, indicating a potential link between impulsive behavior and delayed credit card bills. Probit regression models confirmed the association between impatience, impulsivity, and credit card payment behavior. Impatience is positively associated with deferred credit card payments, suggesting that individuals with a higher discount rate are more likely to delay and pay credit card bill with interests. Furthermore, impulsivity is positively associated with payments that incur interest charges. This aligns with the hypothesis that time inconsistency influences credit card payment behavior because impulsive individuals are attracted to deferred payments with interest, consistent with hyperbolic discounting.

Furthermore, this study identifies the demographic and socioeconomic factors that influence credit card payment behavior. The following types of people are more likely to delay credit card bill payments: men, middle-aged, unmarried, without children, with lower education, lacking full-time employment, having higher household income, having lower financial assets, risk-averse, and with lower financial literacy. These findings align with those of previous studies and underscore the impact of demographic and socioeconomic backgrounds on credit card balance and payment behaviors.

The findings of this study have implications for both credit card users and issuers, emphasizing the influence of impulsivity on the timely payment of bills. Although impulsivity is difficult to change in the short term, targeted educational initiatives, personalized financial counseling, transparent communication, and policy interventions could pave the way for more time-consistent credit card payment behaviors.

Acknowledgment

The authors thank Yasuaki Shoda, Maiko Ochiai, Hiroumi Yoshimura, and Takaaki Fukazawa for helping to access the dataset.

Author contributions

Conceptualization: K.T. and Y.K. (Yoshihiko Kadoya); Methodology: Y.K. (Yu Kuramoto), H.N., M.S.R.K. and Y.K. (Yoshihiko Kadoya); Formal analysis: Y.K. (Yu Kuramoto), H.N., M.S.R.K. and Y.K. (Yoshihiko Kadoya); Writing—original draft: Y.K. (Yu Kuramoto), K.T., H.N., S.N., and M.S.R.K.; Writing—review and editing: M.S.R.K. and Y.K. (Yoshihiko Kadoya); Investigation: Y.K. (Yu Kuramoto), K.T., H.N., M.S.R.K. and Y.K. (Yoshihiko Kadoya); Data curation: Y.K. (Yu Kuramoto), H.N.; Software: Y.K. (Yu Kuramoto), H.N.; Supervision: Y.K. (Yoshihiko Kadoya); Project administration: Y.K. (Yoshihiko Kadoya). All authors have read and agreed to the published version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics statement

Review and approval by an ethics committee was not needed for this study because this study does not involve animal experiments, human and behavior studies.

Informed consent statement

The authors obtained written informed consent from the participants to partake in the survey.

Funding

This work is supported by Rakuten Securities and JSPS KAKENHI (grant numbers JP23H00837 and JP 23K25534).

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Data availability statement

Data are available upon request.

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Appendix A

Table A1. You will receive a certain amount of money. You can receive it after 2 days or 9 days, but the amount is different. If you have the following options A or B regarding the date and amount you will receive, which one would you choose? Choose any combination of 1 to 8 you like.

	Option A	Option B
(1)	Receive JPY 10,000 after 2 days	Receive JPY 9,981 after 9 days
(2)	Receive JPY 10,000 after 2 days	Receive JPY 10,000 after 9 days
(3)	Receive JPY 10,000 after 2 days	Receive JPY 10,019 after 9 days
(4)	Receive JPY 10,000 after 2 days	Receive JPY 10,038 after 9 days
(5)	Receive JPY 10,000 after 2 days	Receive JPY 10,096 after 9 days
(6)	Receive JPY 10,000 after 2 days	Receive JPY 10,191 after 9 days
(7)	Receive JPY 10,000 after 2 days	Receive JPY 10,383 after 9 days
(8)	Receive JPY 10,000 after 2 days	Receive JPY 10,574 after 9 days

Table A2. You will receive a certain amount of money. You can get it after 90 days or 97 days, but the amount is different. If you have the following options A or B regarding the date and amount you will receive, which one would you choose? Choose any combination of 1 to 8 you like.

	Option A	Option B
(1)	Receive JPY 10,000 after 90 days	Receive JPY 9,981 after 97 days
(2)	Receive JPY 10,000 after 90 days	Receive JPY 10,000 after 97 days
(3)	Receive JPY 10,000 after 90 days	Receive JPY 10,019 after 97 days
(4)	Receive JPY 10,000 after 90 days	Receive JPY 10,038 after 97 days
(5)	Receive JPY 10,000 after 90 days	Receive JPY 10,096 after 97 days
(6)	Receive JPY 10,000 after 90 days	Receive JPY 10,191 after 97 days
(7)	Receive JPY 10,000 after 90 days	Receive JPY 10,383 after 97 days
(8)	Receive JPY 10,000 after 90 days	Receive JPY 10,574 after 97 days