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Marginal Propensity to Consume and Personal Characteristics: Evidence from Bank Transaction Data and Survey

Kozo Ueda*

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Abstract

The marginal propensity to consume (MPC) is heterogeneous and depends on liquidity, while liquidity is affected by both temporary circumstances and persistent characteristics. Using bank account transaction data and a survey of its account holders, this study aims to distinguish the sources of MPC heterogeneity. The results indicate that individuals with higher levels of risk aversion and time discount rates tend to exhibit a higher MPC, whereas lower wealth and tighter liquidity constraints are also linked to a higher MPC. These findings suggest that MPC heterogeneity is influenced by both temporary and persistent factors.

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*Waseda University (E-mail: kozo.ueda@waseda.jp). The data were made available through a strict contract between Mizuho Bank and Waseda University in the form of a consignment agreement, and were analyzed in a setting where measures such as masking and other anonymous processing were taken to prevent the identification of individuals. The survey was approved by the Ethics Review Committee on Research with Human Subjects of Waseda University (2022-312).The author would like to thank the many staff of Mizuho Bank, Fei Gao, So Kubota, and Yuta Toyama. The author is also grateful for financial support from the JSPS (16KK0065, 19H01491). The views and opinions expressed in this paper are solely those of the author and do not reflect those of Mizuho Bank.

1 Introduction

The marginal propensity to consume (MPC) is one of the most important variables in macroeconomics, frequently referenced in the evaluation of policy effects and in the development of macroeconomic models. Previous studies have shown that the magnitude of the MPC is closely linked to liquidity constraints, which determine whether an individual's asset holdings are sufficient to meet current payments. However, liquidity constraints are endogenous variables. Recent research has emphasized the need to distinguish between temporary circumstances and persistent characteristics when analyzing liquidity levels (e.g., Jappelli and Pistaferri 2020, Gelman 2021, and Aguiar, Bils, and Boar 2021). For instance, liquidity may be limited because of persistent characteristics such as high time discount rates that lead to a consistently low propensity to save. Alternatively, liquidity may be constrained because of time-varying economic conditions such as temporary adverse income shocks, where time discount rates remain constant.

This study's main contribution is analyzing the sources of heterogeneity in MPC by combining transaction data from one of Japan's major banks with a survey of its account holders. To estimate MPC, this study uses bank transaction data and examines outflow changes in response to three types of income shocks: the large-scale special cash program (SCP) implemented by the Japanese government during the COVID-19 pandemic, receipt of bonuses (which are widely distributed in Japan twice a year among most regular workers), and regular salary receipts. These findings are then combined with a new survey that aims to obtain information on personal characteristics such as age, gender, education, and factors that may affect consumption and investment behaviors, such as time discount rates and risk aversion. The relationships between these personal characteristics and the magnitude of the MPC are then investigated.

This study's main results are as follows. First, utilizing two-way fixed effects regression to estimate the change in consumption in response to income shocks, we find that the magnitude of the MPC is approximately 0.2 (i.e., 20%) during the week of an income shock. Across all three types of income shock analyzed in the study (i.e., the SCP, salary, and bonus payments), the magnitude of MPC is similar despite differences in the characteristics of these income shocks.

Second, the study finds that heterogeneity in the MPC is related to both temporary circumstances and persistent characteristics. The estimation of the MPC is conducted by including cross-terms of income shocks and various explanatory variables on the right-

hand side of the equation. The results are noteworthy, particularly for bonuses, as higher risk aversion and higher time discount rates lead to a higher MPC. Temporary circumstances, represented by time-varying wealth (deposits) and the presence of liquidity constraints, also have significant coefficients. However, some variables that appear to be significant as permanent characteristics, such as age and gender, do not yield significant results, although education is negatively correlated with MPC. Furthermore, the extent to which these temporary circumstances and persistent characteristics are associated with MPC is considerable. Specifically, the estimation results indicate that a one standard deviation increase in risk aversion, discount rate, and the liquidity constraint dummy increases the MPC by 0.031 (i.e., 3.1 percentage points), 0.084, and 0.094, respectively, whereas a one standard deviation increase in education decreases the MPC by 0.041.

Empirical studies on MPC have used various methodological approaches to estimate the magnitude and determinants of the MPC. These approaches have advantages and disadvantages, and researchers have selected them depending on the availability of data and the research questions they want to answer. Group (1) studies using actual transaction data and particular events have the advantage of being able to capture actual consumption behavior following an income shock, but they may be limited in terms of the types of income shocks they can analyze.[1] Our study falls into this group. Group (2) studies using surveys can cover a wider range of income shocks but may be limited in terms of the accuracy of consumption measures (e.g., Shapiro and Slemrod 1995, 2003; Jappelli and Pistaferri 2020).[2] Group (3) studies using household panel data can provide information on how MPC varies over time and across different groups but require imposing identifying restrictions on household income and consumption, because the income in the data is not necessarily transitory, salient, or unexpected (e.g., Bodkin 1959; Blundell, Pistaferri, and Preston 2008; Olafsson and Pagel 2018, Gelman 2021, 2022; Crawley and Kuchler 2023). A meta-analysis can provide a comprehensive summary of the existing evidence (e.g., Havranek and Sokolova 2020).

[1]The examples of income shocks are lottery wins (Olafsson and Pagel 2019; Fagereng, Holm, and Natvik 2021) and government transfers during the COVID-19 pandemic (Baker et al. 2022; Kaneda, Kubota, and Tanaka 2021; Kubota, Onishi, and Toyama 2021; Yannelis and Amato 2022). The estimation of MPC is relatively simple because income shocks are often transitory, salient, and unexpected.

[2]Group (2) studies also use particular events to estimate MPC, such as government transfers during COVID-19 (Coibion et al. 2020; Parker et al. 2022) and other stimulus payments (Johnson, Parker, and Souleles 2006; Agarwal, Liu, and Souleles 2007; Parker et al. 2013; Parker 2017; Kueng 2018).

Gelman (2021), Jappelli and Pistaferri (2020), and Aguiar, Bils, and Boar (2021) have shown that both temporary circumstances and persistent characteristics play a significant role in determining MPC. Specifically, Gelman (2021) uses household panel data from a personal finance app to estimate the MPC to the arrival of a tax refund and finds that both temporary circumstances and persistent characteristics account for roughly half of the MPC variance. Jappelli and Pistaferri (2020) use household surveys in Italy conducted twice in 2010 and 2016 and report that unobserved heterogeneity exaggerates the sensitivity of self-reported MPC to cash on hand, but the size of the bias is moderate, which suggests that both temporary circumstances and persistent characteristics are important. Aguiar, Bils, and Boar (2020) do not estimate the MPC and instead use data from Panel Study of Income Dynamics to point out that hand-to-mouth households do not display higher growth in spending, which shows the importance of persistent characteristics. There are two main differences between these studies and this study. First, this study uses a combination of bank transaction and survey data to estimate the MPC. In other words, whereas Gelman (2021) and Jappelli and Pistaferri (2020) fall in groups (3) and (2), respectively, our study falls in group (1). Second, our study is unique in that we conduct a survey to obtain personal characteristics such as the time discount rate and risk aversion.

There has been a steady increase in studies using bank transaction data. Baker and Kueng (2022) provide a review on household financial transaction data. Kubota, Onishi, and Toyama (2021) and Ueda (2022, 2023) use the same Mizuho Bank data as we do. We follow Kubota, Onishi, and Toyama (2021) in most of the analysis, where the largest difference is that we extend the observation period to 2021–22 to estimate the MPC to subsequent SCPs.

The remainder of this paper is structured as follows. Section 2 describes the data. Section 3 explains our estimation methodology and results and Section 4 concludes.

2 Data

We use survey and transaction data thanks to the collaboration with Mizuho Bank. Mizuho bank is one of the three largest banks in Japan, with approximately 24 million accounts held by individual customers (one out of every five people).[3] The data were

[3]https://www.mizuho-fg.co.jp/investors/individual/strength/index.html

made available through a strict contract between Mizuho Bank and Waseda University in the form of a consignment agreement, and were analyzed in a setting where measures were taken to prevent the identification of individuals, such as masking and other anonymous processing.

2.1 Survey

We conducted the survey in November and December, 2022. Mizuho bank sent 400,000 bank account users an email to ask them to answer the survey, stating that we would give an Amazon gift card worth 500 JPY to 1,000 respondents. The 400,000 bank account users were selected randomly from those who received their salary regularly. In total, we collected 5,282 responses (the response rate is 1.32%). The timing of individuals' transactions we use in our analysis precedes the timing of the survey. In this regard, there is no pathway through which the implementation of the survey affects the estimation of the MPC.

In the survey, we asked respondents widely-used questions to infer their personal characteristics related to their saving/investment decisions. Specifically, we referred to the Japan Household Panel Survey on Consumer Preferences and Satisfaction conducted by Osaka University[4]. In our questions, we allowed respondents to select the option "I do not know or do not want to answer." When respondents choose this answer, we exclude it from the estimation (see Online Appendix A for details). After asking respondents' basic characteristics such as gender, age, household type, house type, education, occupation type (Q1 to 7), we collected the following variables.

Risk Aversion We calculate the Arrow–Pratt measure of absolute risk aversion σ for each respondent following Pratt (1964) and Cramer et al. (2002). We ask respondents whether they would buy a lottery ticket for various probabilities to win (Q8 to 13) and calculate $\sigma = -U''/U'$ as $\frac{2(\alpha Z - p)}{\alpha Z^2 - 2\alpha Z p + p^2}$, where α, Z,and p represent the probability to win, prize value, and price of a lottery ticket, respectively. In our survey, Z and p equal 100,000 and 10,000 JPY, respectively, and α is obtained from a respondent's answer such that we set $\alpha = 0.9$ if the respondent answers that he/she would buy a ticket if the probability to win is 0.9 but would not buy if it is 0.5. We set $\alpha = 1$ if the respondent would not buy the ticket even if the probability to win is 0.9. Consequently, the absolute

[4]https://www.iser.osaka-u.ac.jp/survey_data/top_eng.html

risk aversion σ in our study ranges from -4.5 (when $\alpha = 0.01$) and 0.891 (when $\alpha = 1$). When $\alpha = 0.1$, σ equals zero, which means that the respondent is risk neutral.

Further, we calculate other measures of risk aversion by directly asking respondents whether they are risk averse or taking (Q18 and 19, each denoted by risk aversion A and B, respectively, hereafter). The answer takes an integer from one to five, where a larger value indicates a higher risk aversion.

Time Discount Rate We calculate time discount rate r for each respondent from Q14 to 16. In the questions, we ask respondents about the minimum amount of money they are willing to wait one week, one year, or ten years to receive. To be more precise, we ask respondents to compare 100,000 yen one week later, not now, and a certain amount after one week, one year, or ten years plus one week considering hyperbolic discounting. We then calculate r as $X/100,000$ if a respondent answers that the minimum amount of money is $100,000 + X$ JPY. We set $X = 10,000,000$ if a respondent answers that "even if I can receive 1,100,000 yen in 10 years, I would like to receive it now." Consequently, the time discount rate r in our study ranges from 0.01 (when $X = 100$) and 100 (when $X = 10,000,000$).

Further, we obtain another measure of time discount by directly asking respondents which is more important between now and the future (Q20). The answer takes an integer from one to four, where a larger value indicates that the future is more important (i.e., a smaller r).

Other Variables Real interest rates likely influence the MPC through influencing saving decisions. As a proxy, we ask respondents about their views on inflation perceptions in the latest one year, inflation expectations one year from now, and wage expectations one year from now (Q21 to 23).

Because the liquidity constraint matters for the MPC, we ask respondents whether they can pay the same amount of their household income by withdrawing their savings, selling their assets, or borrowing from financial institutions, friends, or relatives (Q17). The answer takes an integer from one to four, where a larger value indicates a tighter liquidity constraint.

Further, we ask respondents how concerned they are about fiscal debt after we explain that Japan's government debt is at a historically very high level (Q24). The answer takes an integer from one to five, where a smaller value indicates a greater concern.

2.2 Transaction Data

Transaction data of Mizuho Bank record all transactions involving Mizuho Bank, including automatic teller machine (ATM) withdrawals, payroll receipts, utility bill payments, and bank transfers, all of which are assigned identification codes and remarks in Japanese. In addition, the data record the balance of deposits and annualized income at the end of each month and information on personal characteristics such as the year of birth, gender, and registered address data (at the municipal level). The time frame is from January 2019 to November 2022, including the period of the COVID-19 pandemic.

Consumption is proxied by total outflows, which includes cash withdrawals from ATMs as well as non-cash payments such as withdrawals from credit card payments, interbank transfers, and automatic utility bill withdrawals. For robustness, we use cash deposit withdrawals from ATMs as a proxy for consumption.

Some caveats in the data are as follows. The individual customers are dispersed across the country but are concentrated in metropolitan areas when compared to the census. All outflows are recorded, but we cannot know the purpose of the outflows. For individuals who have credit cards linked to Mizuho bank, we can obtain a breakdown of their spending from their card statements. However, the coverage is not wide enough to be included in this analysis. Kaneda, Kubota, and Tanaka (2021) use a personal finance management app, which enables them to investigate the types of consumption. Information on transactions at other financial institutions, especially securities companies and postal savings accounts, is not available. Because many individual customers hold accounts with institutions other than Mizuho Bank, the deposits and withdrawals recorded in this data do not necessarily capture all of an individual's transactions. In particular, it should be noted that there is a large omission of information on financial assets, such as stocks, and transfers within households (e.g., parent to child, husband to wife transfers) are recorded as either inflows or outflows.

We collect the transaction records of the survey respondents, such as the amount of outflows and cash withdrawals weekly. Wealth and annualized income, which are provided monthly, are merged using the values at the end of the previous month.[5]

[5]Wealth is defined as the balance of deposits at the Mizuho bank, which is the sum of demand deposits, time deposits, other banking accounts, public bonds, mutual funds, and life and non-life insurance balances. The majority of the deposits are demand deposits.

2.3 Three Types of Income Shock

SCP In this study, we consider three types of income shock to calculate the MPC. The first one is SCPs by the government. The government launched the first wave of SCPs around mid-2020, which provided 100,000 Japanese yen (JPY, approximately 800 US dollars) per person for all residents in Japan. Then, the government provided the second wave of SCPs from the end of 2021 to the beginning of 2022, where households who had a child under 18 and earned income below a certain threshold (9.6 million JPY annually) were eligible to receive 100,000 JPY per child.

SCP receipts are identified in the following way. Using transaction remarks in Japanese, we choose the transactions of inflows that include the keywords related to special payments. Then, we restrict the transactions of inflows to those that were multiples of 50,000 JPY.[6] SCP payments were mostly paid to head-of-household accounts.

The SCP is likely to be a one-time income shock, in which the timing is unknown *ex ante*. The government provided SCPs to soften adverse effects of the COVID-19 pandemic on household finance. The SCPs, including the first one which was distributed around June–July 2020, were temporary, although the government provided the second SCP from the end of 2021 to the beginning of 2022. The top left-hand panel of Figure 1 shows the histogram for the timing of the SCPs for the survey respondents. The distribution is bimodal: one mode around June to July 2020 (the first wave) and the other around December 2021 to February 2022 (the second wave; a dip exists because of new year holidays). This figure further shows that the timing was dispersed within the same SCP wave. Kubota, Onishi, and Toyama (2021) document that the timing was unpredictable and nearly random and exogenous to individuals' characteristics (except for the area of residence) because of the administrative overburdening that occurred at local offices.

Approximately half of the respondents received the SCP payments in their bank accounts. The number of respondents who received the second-wave SCP is much smaller,

[6]Specifically, transaction remarks should include the words "tokubetsu kyufu (special payments)," "teigaku kyufu (fixed-amount payments)," or "tokubetsu teigaku (special fixed-amount)," whereas transaction remarks that include the words "jizoku (continuous)" or "sumai (housing)" are excluded because they do not appear to be related to SCPs. In the two waves of the SCPs, the government provided multiples of 100,000 JPY to individuals; however, some local offices divided the payments into two installments of 50,000 JPY each per child in the second wave of the SCPs. Moreover, local offices provided additional special payments to individuals for less than 100,000 JPY.

because the government restricted recipients to households that had a child under 18 and earned income below a certain threshold (9.6 million JPY annually) only.

Salary The second type of income shock is a salary. Specifically, we select transactions that are inflows and include the remark of "kyuyo (salary)." The properties of a salary differ considerably from those of SCPs. A salary is paid regularly, and thus, it is not an income *shock* to individuals who receive it. Further, an unexpected component in the variation of a salary is not necessarily a one-time shock because a certain fraction is likely to be translated into a change in the permanent income. Although structural models are needed to identify a true income shock (e.g., Bodkin 1959; Blundell, Pistaferri, and Preston 2008; Olafsson and Pagel 2018, Gelman 2021, 2022; Crawley and Kuchler 2023), we crudely use observed salary data as an income shock, because the main purpose is to check the robustness of our estimation results for MPC by using three different types of incomes. The top right-hand panel of Figure 1 shows the histogram for the timing of salaries for the survey respondents. This suggests monthly cyclicality, where the peak is often the final week each month.

Bonus The third type of income shock is a bonus. Most regular employees (not part-time workers) receive bonuses twice a year in Japan, whereas bonuses are often limited to executive classes in the United States (Ito and Hoshi 2020). The bonus accounts for around $15 - 30\%$ of employees' annual income and is determined based on their performance and the performance of the company that they work for. Importantly, the amount is unknown to a large degree until it is received, although employees usually know in advance when they will receive the bonus. In this respect, the bonus shock is considered an intermediate between the SCP and salary shocks. We collect the data on bonuses from inflow transactions that include the remark "shoyo (bonus)." The bottom left-hand panel of Figure 1 shows the histogram for the timing of bonuses for the survey respondents. The histogram has two modes in a year: one from June to August (summer bonus) and the other in December (winter bonus). The timing of bonuses is dispersed among individuals (i.e., some receive in June, whereas others receive in August; some receive in the first week of December, whereas others receive in the third week of December), which helps us estimate the MPC using the time dummy effect.

2.4 Overview of the Data

Table 1 shows the descriptive statistics of the transaction data at the individual level as of 2020 for approximately five thousand survey respondents. To maintain anonymity, the maximum and minimum values are not shown. The median amount of outflows and cash withdrawals is around six million and one million JPY, respectively. The SCP dummy takes the value one if respondents received the SCP in 2020 based on the bank transaction data. The mean of the SCP dummy is 0.47, which suggests that 47% of respondents received the SCP in their Mizuho bank account that year. The mean, median, and top 25% of the SCP (which includes that for non-recipients of the SCP) is 110,000, zero, and 200,000 JPY, respectively, where the last value implies that the household consists of two family members because one person received 100,000 JPY. The mean amounts of the salary and bonus are around 3,400,000 and 700,000 JPY, respectively. The median log wealth and log annual income are 7.4 and 8.3, respectively, which suggests that median wealth and annual income are 1,595 thousand and 4,125 thousand JPY. The median wealth in our study is greater than that in Kubota, Onishi, and Toyama (2021), 444 thousand. The mean age is 48, whereas it is 53 in Kubota, Onishi, and Toyama (2021). The fraction of male respondents is 65%, whereas it is 74% in Kubota, Onishi, and Toyama (2021). These differences reflect that we sent the survey to bank account users who received a regular salary to their Mizuho bank account. Table 2 shows the descriptive statistics of the survey data.

Before estimating the MPC, we examine how respondents' wealth and income are associated with the variables we collect from the survey at the individual level, where respondents' wealth and income are their means from January 2019 to November 2022. In Table 3, column (1) shows that wealth is significantly associated with the following variables at the 5% level: positively with age, education, and the inverse of discount rate (direct) and negatively with the discount rate for one year and ten years and inflation perception in the latest one year. Regarding the time discount rate, this result suggests that myopic individuals (with a high discount rate) tend to have a smaller amount of wealth, which is consistent with standard models of intertemporal substitution. Individuals who perceive higher past inflation tend to have a smaller amount of wealth, which may imply that hand-to-mouth households are attentive to price increases. Meanwhile, all three risk aversion measures are insignificant. Since a difference in wealth can stem not only from a difference in discount rate but also a difference in income, in column

(2), we control for income, which shows that the coefficient on income is positive and significant but the estimation result of column (1) is still robust. In column (3), we use income as the dependent variable and the estimation result shows that income is significantly associated with the following variables at the 5% level: positively with age, male dummy, and education and negatively with inflation perception in the latest one year. Here, all measures of discount rate and risk aversion are insignificant.

3 Estimation

In this section, we explain our estimation strategy and estimation results.

3.1 Estimation Strategy

To estimate the MPC to an income shock, we run the following two-way fixed effect regression:

$$C_{it} = \alpha_i + \alpha_t + \sum_{k=a}^{b} \gamma^k X_{it}^k + \varepsilon_{it}, \tag{1}$$

where C_{it} represents the amount of outflows, a proxy for consumption, for individual i in week t; X_{it}^k is the income shock that takes the amount of the income (SCP, salary, or bonus) in week T_i if $t - T_i = k$, where T_i denotes the week in which individual i received the income; and X_{it}^k takes zero otherwise. By including $k < (>)0$, we consider the effect of the income shock on consumption $|k|$ weeks before (after) the event. Coefficient γ^k indicates the extent to which C_{it} has changed before and after the income shock. The lead terms for $k < 0$ are used to test the presence of the pre-trend before the income shock. We normalize the coefficient γ^{-1} to zero and set $a = -5$ and $b = 5$, as in Kubota, Onishi, and Toyama (2021). Two-way fixed effects α_i and α_t control time-invariant heterogeneity across individuals and the effects of aggregate time-series developments such as the state of emergency declaration and the number of COVID-19 infections on aggregate consumption. This regression is different from that in Kubota, Onishi, and Toyama (2021), where they take differences from the same week in the previous year for the dependent variable in order not to use the individual fixed effect because of the enormous sample size. We cluster the standard error at the individual level. The data are a balanced panel, where there are 194 weeks from January 2019 to November 2022.

3.2 Estimation Results of the MPC

Table 4 and Figure 2 show the estimation results. Columns (1) to (5), (6), and (7) in the table are the cases where the source of income shock (X_{it}^k) is the SCP, salary, and bonus, respectively. Figure 2 shows the change in MPC over weeks (coefficient γ^k), where the horizontal axis is k before/after the income shock. The sample in column (1) is the 2,446 individuals who received the SCP in 2020.

Column (1) in Table 4 and the left-hand panel of Figure 2 show that coefficient γ^0 on X_{it}^0 is 0.23, which is significant at the 5% level. This suggests that average individuals spent around 20% of the SCP in the week they received it. The size of this on-impact MPC is comparable to that obtained in early studies for Japan, that is, 0.19 in Kubota, Onishi, and Toyama (2021) and 0.15 in Kaneda, Kubota, and Tanaka (2021). Coefficients γ^k for positive $k's$ are insignificant at the 5% level, unlike those in Kubota, Onishi, and Toyama (2021) and Kaneda, Kubota, and Tanaka (2021), which is probably because the number of observations is smaller.

We check the robustness of the estimation results in columns (2) to (5) in Table 4. In column (2), we estimate equation (1) for the year of 2020 only, rather than using the full period of January 2019 to November 2022. In column (3), the sample is all 5,259 survey respondents that include respondents who did not receive the SCP in 2020. In column (4), the proxy for consumption is cash withdrawals from ATMs. Finally, in column (5), we use the sample of individuals who received the second-wave SCP in 2021–22 in their Mizuho bank account, which amounts to only 200 individuals. Table 4 shows that the estimation result of column (1) is more or less robust, although coefficient γ^0 is insignificant in column (5) probably because the number of observations is insufficient.

The estimation results are similar when we use salary and bonus as the income shock. We use all 5,282 survey respondents when we use salary as the source of income shock, because the survey is sent to bank account users who receive a salary regularly. Column (6) in Table 4 and the middle panel of Figure 2 show that coefficient γ^0 is 0.20, which is significant at the 5% level. The sample in column (7) in Table 4 and the right-hand panel of Figure 2 is the 3,722 individuals who received a bonus at least once in our observation period. The estimation result shows that coefficient γ^0, the MPC in response to the bonus, is 0.22, which is significant at the 5% level. Coefficients γ^k for $k = 0$ to 2 are significantly positive at the 5% level, suggesting that salary and bonus effects on consumption persist for three weeks including the week when the income shock occurs.

The result that the size of the MPC is similar among the three types of income shock is confirmed in Table 5. Here, we estimate the following equation:

$$C_{it} = \alpha_i + \alpha_t + \gamma^{SCP} SCP_{it} + \gamma^{salary} Salary_{it} + \gamma^{bonus} Bonus_{it} + \varepsilon_{it}, \tag{2}$$

where SCP_{it}, $Salary_{it}$, $Bonus_{it}$ take the amount of the income (SCP, salary, and bonus, respectively) in week t for individual i. The estimated coefficients are given by $\gamma^{SCP} = 0.21$, $\gamma^{salary} = 0.19$, and $\gamma^{bonus} = 0.21$.

This similarity may be surprising considering the different properties of the three types of income shock. SCP payments are transitory and unexpected income shocks. By contrast, a salary is regular and expected in terms of both the timing and amount, so that a change in an individual's salary may change his/her permanent income, which may increase the size and persistence of his/her consumption responses. Further, the Ricardian equivalence may decrease the MPC to SCP payments because SCP payments are governmental transfers, which may increase tax in the future. However, our estimation results show that the MPC to SCP payments is similar to that to salary, and if anything, the former is greater than the latter. Bonuses are relatively closer to SCPs in that they are paid only twice a year and the amount of the bonus is largely unknown to individuals, although the Ricardian equivalence does not exist.

Table 4 and Figure 2 also provide a support for the parallel trend in consumption between individuals who differ in the timing of income shocks. Coefficient γ^k for negative k represents a consumption response before an income shock occurs, which is mostly insignificant.

3.3 MPC Heterogeneity

A heterogeneity in the MPC can arise from two distinct sources: temporary circumstances and persistent characteristics, as emphasized in Jappelli and Pistaferri (2020), Gelman (2021), and Aguiar, Bils, and Boar (2021). Specifically, low wealth may be the consequence of bad luck (temporary adverse income shock) or impatience (persistent characteristics). Our estimation helps us distinguish these two sources. By using both survey and time-varying transaction information, individual i's characteristics obtained from the survey, such as time discount rate and risk aversion, can be linked to persistent characteristics, whereas the time-varying log wealth and liquidity constraint dummy can be linked to temporary circumstances.

Multivariate Regression We investigate a heterogeneity in the MPC by running the following two-way fixed effect regression with cross terms:

$$C_{it} = \alpha_i + \alpha_t + \sum_{k=a}^{b} \gamma^k X_{it}^k + \delta X_{it}^0 \times Z_{it} + \varepsilon_{it}, \tag{3}$$

where Z_{it} represents individual i's characteristics. The cross term of $X_{it}^0 \times Z_{it}$ captures how the MPC depends on Z_{it}, where Z_{it} represents variables related to individual i's characteristics obtained from the survey as well as log wealth and a liquidity constraint dummy. The liquidity constraint dummy at t is defined following Kubota, Onishi, and Toyama (2021) as the variable takes one if the end-of-month wealth at $t-1$ was below the individual's monthly income (annual income at $t-1$ divided by 12). We do not include income to avoid multicollinearity. We use the unweighted average of discount rates of one week, one year, and ten years as the discount rate to save the number of regressors.

Table 6 presents the estimation results. In columns (1) and (2), the income shock is SCPs, individuals are those who received the SCP in 2020, and the observation period is only in 2020; in columns (3) and (4), the income shock is salaries; and in columns (5) and (6), the income shock is bonuses and individuals are those who received a bonus at least once. We do not control for the cross term of income shock with log wealth and the liquidity constraint dummy in columns (1), (3), and (5), whereas we do in columns (2), (4), and (6).

The table shows that all coefficients δ on the cross terms are insignificant at the 5% level when the income shock is SCPs and salaries (columns (1) to (4)). This result may suggest that persistent characteristics are unimportant for the MPC or the number of observations is insufficient, particularly for the SCP events.

However, when the income shock is bonuses, the following three kinds of coefficients δ for the cross terms are significant at the 5% level (columns (5) and (6)). First, the cross-term coefficient related to the liquidity constraint dummy is positive, suggesting that liquidity-constrained individuals tend to have a higher MPC than non liquidity-constrained individuals. Because we control for a number of personal characteristics obtained from the survey, this significance of the coefficient of the liquidity constraint suggests that temporary circumstances matter. However, the cross-term coefficient related to the survey-based liquidity constraint is insignificant. In the survey, we asked whether respondents can pay the same amount of their household income by withdraw-

ing their savings, selling their assets, or borrowing from financial institutions, friends, or relatives, and the answer takes an integer from one to four. This insignificance suggests that the measure of liquidity matters for the MPC.

Second, the cross-term coefficients related to risk aversion and discount rate are positive and significant. This result suggests that the MPC increases as individuals are more risk averse or myopic. It is straightforward to understand that myopic individuals have a higher MPC. A higher risk aversion increases the MPC if we consider that such individuals dislike uncertainty about investment returns in the future and thus are inclined to consume today rather than save. However, note that risk aversion may decrease, rather than increase, the MPC if it is combined with precautionary saving. Indeed, when the income shock is SCPs, coefficient δ for the cross term of the SCP and risk aversion is negative and significant at the 10% level, but not at the 5% level. These results suggest that permanent characteristics matter as well.

Third, the cross term with education is significantly negative, irrespective of whether we control for the cross terms of bonuses with log wealth and the liquidity constraint dummy. This result implies that educated individuals have a low MPC.

Robustness Checks: Univariate Regression The surveyed variables Z_t are not limited to those used in the previous analysis. For simplicity and to check the robustness of the results, we estimate equation (3) by including the cross term of X_{it}^0 and one of the surveyed variables in separate regressions. We provide two results when we control for the cross term of income shock with log wealth and the liquidity constraint dummy and when we do not.

Table 7 presents the estimation results. The following four coefficients (cross term with income shock) are significant at the 5% level: negative for own house dummy (bonus, log wealth and the liquidity constraint dummy controlled/uncontrolled), positive for risk aversion (bonus, controlled), positive for time discount rate for one week and ten years (bonus, controlled/uncontrolled), and negative for risk aversion A (direct) (SCP, uncontrolled). The own house dummy takes one if respondents own a house and zero otherwise. Thus, the negative sign of the coefficient suggests that a house owner tends to exhibit a lower MPC. When we allow the 10% significance level, the concern about fiscal debt becomes positive (SCP/bonus, controlled/uncontrolled). Particularly, because SCPs are a fiscal transfer, the MPC may be small under the Ricardian equivalence as individuals are more concerned about fiscal debt and more prepared for future tax

increases.

Finally, we confirm that the cross term coefficient of income shock and the liquidity constraint dummy continues to be positive and significant at the 5% level in all the estimations presented in Table 7 when the income shock is either salaries or bonuses (not shown here). When the income shock is SCPs, the cross term is insignificant at the 5% level, but the cross term coefficient of the SCP income shock and log wealth is significantly negative at the 10% level. This result suggests that temporary circumstances matter.

Magnitudes of Contribution to MPC In the regressions presented in Tables 6 and 7, mainly the following four variables appear to be significantly correlated with the MPC: education, risk aversion (quantitative), time discount rate (quantitative), and the liquidity constraint dummy (the first three variables are obtained from the survey, whereas the last variable is obtained from the transaction data). We calculate how much these variables contribute to variations in the MPC. Because the coefficient of X_{it}^0, which corresponds to the MPC, is given by $\gamma^0 + \delta Z_{it}$ in equation (3), the magnitude of the contribution of each variable Z_{it} to the MPC can be calculated by the estimate of δ multiplied by the standard deviation of Z_{it}.

The result is shown in Table 8. One standard deviation increase in education decreases the MPC by 0.041 (i.e., 4.1 percentage points). An increase in risk aversion, discount rate, and the liquidity constraint dummy increases the MPC by 0.031, 0.084, and 0.094, respectively. These magnitudes of contribution are sizable considering that the estimated MPC is approximately 0.2 (i.e., 20%).

Discussions The main takeaway from this heterogeneity analysis is as follows. First, both persistent characteristics and temporary circumstances are important to explain the heterogeneity in the MPC, particularly to the bonus income shock. On the one hand, individuals' personal characteristics—namely, risk aversion and time discount rate—are associated with the MPC. On the other hand, individuals' time-varying financial positions—namely, whether they are wealthy or liquidity constrained—are also associated with the MPC. In this regard, our study is consistent with Jappelli and Pistaferri (2020) and Gelman (2021).

Second, many personal characteristics, which appear to influence the MPC, are not strong predictors of MPC heterogeneity. Neither age nor gender seem to matter for the

MPC. Even the direct measure of the liquidity constraint—obtained from the survey by asking whether respondents can pay the same amount of their household income by withdrawing their savings, selling their assets, or borrowing from financial institutions, friends, or relatives—is insignificant. An exception is education, which appears to influence the MPC negatively.

Last but not the least, it should be noted that no significance does not mean no importance as the source of MPC heterogeneity. Particularly, the number of individuals may be insufficient and the observation period from 2019 to 2022 may be too short to have time-series variations in log wealth or the liquidity constraint dummy. Meanwhile, we should also be aware that the estimation results may be subject to the multiple testing problem. As the number of tests increases, it becomes more likely that the null hypothesis will be rejected at some point, even if the null hypothesis is correct.

4 Concluding Remarks

In this study, we analyzed the sources of heterogeneity in the magnitude of the MPC by combining transaction data from one of Japan's mega banks and survey data of its bank account holders. The first remaining issue is the endogenous nature of personal characteristics. In this study, we analyzed personal characteristics obtained through the survey, such as time discount rates, as if they were exogenous. However, these individual characteristics are not only genetic, but can also be acquired and change, and responses to the survey may also be affected by the short-term economic environment. Second, various factors other than those considered in this study may contribute to the heterogeneity in the MPC. Consequently, it is too early to draw conclusions about the magnitude or relative magnitude of the two factors, temporary circumstances and persistent characteristics. It is necessary to continue the survey to examine how surveyed personal characteristics change, or to conduct randomized controlled trials to examine how the MPC changes when individuals' environments are randomly changed.

References

[1] Agarwal, Sumit, Chunlin Liu, and Nicholas S. Souleles. 2007. "The Reaction of Consumer Spending and Debt to Tax Rebates—Evidence from Consumer Credit Data." *Journal of Political Economy* 115(6): 986–1019.

[2] Aguiar, Mark, Mark Bils, and Corina Boar. 2020. Who Are the Hand-to-Mouth? Cambridge, MA: National Bureau of Economic Research. http://www.nber.org/papers/w26643.pdf (February 14, 2023).

[3] Baker, Scott R. et al. 2020. "Income, Liquidity, and the Consumption Response to the 2020 Economic Stimulus Payments." https://www.nber.org/papers/w27097 (February 14, 2023).

[4] Baker, Scott R, and Lorenz Kueng. 2022. "Household Financial Transaction Data." *Annual Review of Economics* 14: 47–67.

[5] Blundell, Richard, Luigi Pistaferri, and Ian Preston. 2008. "Consumption Inequality and Partial Insurance." *American Economic Review* 98 (5): 1887–1921.

[6] Bodkin, Ronald. 1959. "Windfall Income and Consumption." *American Economic Review* 49(4): 602–14.

[7] Coibion, Olivier, Yuriy Gorodnichenko, and Michael Weber. 2020. How Did U.S. Consumers Use Their Stimulus Payments? National Bureau of Economic Research, Inc. NBER Working Paper. https://econpapers.repec.org/paper/nbrnberwo/27693.htm (February 14, 2023).

[8] Cramer, J S, J Hartog, N Jonker, and C M Van Praag. 2002. "Low Risk Aversion Encourages the Choice for Entrepreneurship: An Empirical Test of a Truism." *Journal of Economic Behavior & Organization* 48: 29–36.

[9] Crawley, Edmund, and Andreas Kuchler. 2023. "Consumption Heterogeneity: Micro Drivers and Macro Implications." *American Economic Journal: Macroeconomics* 15(1): 314–41.

[10] Fagereng, Andreas, Martin B. Holm, and Gisle J. Natvik. 2021. "MPC Heterogeneity and Household Balance Sheets." *American Economic Journal: Macroeconomics* 13(4): 1–54.

[11] Gelman, Michael. 2021. "What Drives Heterogeneity in the Marginal Propensity to Consume? Temporary Shocks vs Persistent Characteristics." *Journal of Monetary Economics* 117: 521–42.

[12] ———. 2022. "The Self-Constrained Hand-to-Mouth." The Review of Economics and Statistics 104(5): 1096–1109.

[13] Havranek, Tomas, and Anna Sokolova. 2020. "Do Consumers Really Follow a Rule of Thumb? Three Thousand Estimates from 144 Studies Say 'Probably Not.'" *Review of Economic Dynamics* 35: 97–122.

[14] Ito, Takatoshi, and Takeo Hoshi. 2020. "The Japanese Economy." second edition, Cambridge: MIT Press.

[15] Jappelli, Tullio, and Luigi Pistaferri. 2020. "Reported MPC and Unobserved Heterogeneity." *American Economic Journal: Economic Policy* 12(4): 275–97.

[16] Johnson, David S, Jonathan A Parker, and Nicholas S Souleles. 2006. "Household Expenditure and the Income Tax Rebates of 2001." *American Economic Review* 96(5): 1589–1610.

[17] Kaneda, Michiru, So Kubota, and Satoshi Tanaka. 2021. "Who Spent Their COVID-19 Stimulus Payment? Evidence from Personal Finance Software in Japan." *Japanese Economic Review* 72(3): 409–37.

[18] Kubota, So, Koichiro Onishi, and Yuta Toyama. 2021. "Consumption Responses to COVID-19 Payments: Evidence from a Natural Experiment and Bank Account Data." *Journal of Economic Behavior & Organization* 188: 1–17.

[19] Kueng, Lorenz. 2018. "Excess Sensitivity of High-Income Consumers." The Quarterly Journal of Economics 133(4): 1693–1751.

[20] Olafsson, Arna, and Michaela Pagel. 2018. "The Liquid Hand-to-Mouth: Evidence from Personal Finance Management Software." *Review of Financial Studies* 31(11): 4398–4446.

[21] Parker, Jonathan A. 2017. "Why Don't Households Smooth Consumption? Evidence from a $25 Million Experiment." *American Economic Journal: Macroeconomics* 9(4): 153–83.

[22] Parker, Jonathan A, Nicholas S Souleles, David S Johnson, and Robert McClelland. 2013. "Consumer Spending and the Economic Stimulus Payments of 2008." *American Economic Review* 103(6): 2530–53.

[23] Parker, Jonathan, Jake Schild, Laura Erhard, and David Johnson. 2022. Economic Impact Payments and Household Spending During the Pandemic. Cambridge, MA: National Bureau of Economic Research. http://www.nber.org/papers/w30596.pdf (February 14, 2023).

[24] Pratt, J.W., 1964. "Risk Aversion in the Small and in the Large." *Econometrica* 32: 122–136.

[25] Shapiro, Matthew D., and Joel Slemrod. 1995. "Consumer Response to the Timing of Income: Evidence from a Change in Tax Withholding." *American Economic Review* 85(1): 274–83.

[26] ———. 2003. "Consumer Response to Tax Rebates." *American Economic Review* 93(1): 381–96.

[27] Ueda, Kozo. 2022. "Effects of Bank Branch/ATM Consolidations on Cash Demand: Evidence from Bank Account Transaction Data in Japan." CIGS Working Paper 22-003E.

[28] Yannelis, Constantine, and Livia Amato. 2022. "Household Behavior (Consumption, Credit and Investments) During the COVID-19 Pandemic." SSRN Electronic Journal. https://www.ssrn.com/abstract=4256726 (February 14, 2023).

Table 1: Descriptive Statistics of the Transaction Data as of 2020

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Amount of total outflows	5,282	9,736,642	19,221,167	3,140,939	5,645,450	9,747,579
Amount of cash withdrawals	5,282	1,784,225	2,191,529	463,000	1,241,605	2,396,922
SCP dummy	5,282	0.466	0.506	0	0	1
Amount of SCP	5,282	113,877	150,529	0	0	200,000
Amount of salary	5,282	3,391,207	2,744,588	1,706,816	3,067,808	4,507,992
Amount of bonus	5,282	734,883	968,250	0	354,749	1,207,858
Log wealth	5,257	7.201	1.986	5.938	7.375	8.719
Log income	5,257	7.797	1.923	7.763	8.325	8.700
Liquidity constraint dummy	5,257	0.186	0.336	0.000	0.000	0.231
Age	5,257	48.186	9.901	40.923	49.923	55.923

Note: The table provides a summary of actual transactions in 2020 for the individuals who answered the survey. The monetary unit is Japanese yen. Wealth and income are expressed as the mean of the log of one plus total deposits and annual income, respectively, in thousand yen. The SCP dummy takes one if an individual receives an SCP payment. The liquidity constraint dummy takes one if the end-of-month wealth is below the annual income divided by 12. We do not report the maximum or minimum values to maintain anonymity.

Table 2: Descriptive Statistics of the Survey Data

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Male	5,248	0.645	0.479	0.000	0.000	1.000	1.000	1.000
Own house	5,282	0.679	0.467	0	0	1	1	1
Education	5,282	4.543	1.214	1	4	5	5	7
Risk aversion	5,282	0.693	0.637	−4.500	0.784	0.879	0.891	0.891
Discount rate 1 week	5,214	2.311	11.529	0.001	0.010	0.100	1.000	100.000
Discont rate 1 year	5,188	7.653	21.005	0.001	0.100	1.000	10.000	100.000
Discount rate 10 years	5,079	29.441	40.745	0.001	1.000	10.000	10.000	100.000
Liquidity constraint	5,156	1.369	0.712	1.000	1.000	1.000	2.000	4.000
Risk aversion A (direct)	5,255	3.152	1.136	1.000	2.000	3.000	4.000	5.000
Risk aversion B (direct)	5,208	3.206	1.089	1.000	2.000	3.000	4.000	5.000
Discount rate (direct, inverse)	5,164	2.754	0.760	1.000	2.000	3.000	3.000	4.000
Inflation perception	5,123	8.525	7.597	−5.000	5.000	10.000	10.000	50.000
Inflation expectation	5,001	8.138	8.878	−5.000	5.000	5.000	10.000	50.000
Wage increase expectation	4,958	0.975	6.282	−5.000	0.000	0.000	1.000	50.000
Fiscal debt concern (inverse)	5,282	2.257	1.209	1	1	2	3	5
Discount rate	5,073	13.063	19.591	0.001	0.400	3.700	10.000	100.000

Note: The male dummy takes one for male and zero for female. The own house dummy takes one if an individual owns a house and zero otherwise. The discount rate in the last row is the unweighted average of discount rates of one week, one year, and ten years. See Section 2.1 and Appendix A for details.

Table 3: Cross Sectional Relationships between Wealth/Income (Transaction Data) and Personal Characteristics (Survey)

	Dependent variables		
	(1)	(2)	(3)
	Log wealth	Log wealth	Log income
Explanatory variables			
(Intercept)	2.997	1.404	6.196
	(0.253)	(0.276)	(0.264)
Age	0.029	0.024	0.019
	(0.003)	(0.003)	(0.004)
Male	-0.015	-0.192	0.685
	(0.066)	(0.065)	(0.071)
Education	0.379	0.352	0.103
	(0.027)	(0.026)	(0.027)
Discount rate 1 week (quant)	0.0049	0.0042	0.0028
	(0.0037)	(0.0037)	(0.0032)
Discount rate 1 year (quant)	-0.0043	-0.0039	-0.0016
	(0.0021)	(0.0020)	(0.0020)
Discount rate 10 years (quant)	-0.0025	-0.0022	-0.0010
	(0.0008)	(0.0008)	(0.0008)
Discount rate (direct, inverse)	0.325	0.321	0.014
	(0.041)	(0.040)	(0.041)
Risk aversion (quant)	0.057	0.055	0.005
	(0.047)	(0.047)	(0.044)
Risk aversion A (direct)	0.071	0.082	-0.044
	(0.036)	(0.035)	(0.036)
Risk aversion B (direct)	0.022	0.027	-0.018
	(0.037)	(0.036)	(0.038)
Inflation perception	-0.017	-0.013	-0.015
	(0.005)	(0.005)	(0.005)
Inflation expectation	-0.001	-0.001	0.001
	(0.004)	(0.004)	(0.004)
Wage increase expectation	-0.009	-0.007	-0.005
	(0.005)	(0.005)	(0.006)
Log income		0.257	
		(0.019)	
No. of observations	4,438	4,438	4,438
R^2	0.099	0.163	0.053

Note: Figures in parentheses indicate standard errors clustered at the individual level.

Table 4: MPC Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Dependent variables			
	Outflows	Outflows	Outflows	Cash withdrawals	Outflows	Outflows	Outflows
	SCP recipients	SCP recipients	All survey	SCP recipients	SCP recipients	All survey	Bonus
	in 2020	in 2020 & 2020	respondents	in 2020	in 2021–22	respondents	recipients
Explanatory variables	SCP	SCP	SCP	SCP	SCP	Salary	Bonus
Income^{-5}	-0.132	-0.135	-0.134	0.003	-0.180	-0.062	-0.026
	(0.060)	(0.063)	(0.056)	(0.012)	(0.091)	(0.015)	(0.018)
Income^{-4}	0.036	0.041	0.027	-0.009	0.055	0.019	-0.008
	(0.103)	(0.106)	(0.100)	(0.011)	(0.170)	(0.018)	(0.024)
Income^{-3}	-0.111	-0.112	-0.125	-0.007	-0.110	-0.011	-0.037
	(0.058)	(0.060)	(0.052)	(0.010)	(0.071)	(0.021)	(0.016)
Income^{-2}	-0.058	-0.052	-0.086	-0.001	-0.154	0.021	-0.042
	(0.089)	(0.092)	(0.084)	(0.011)	(0.078)	(0.016)	(0.013)
Income	0.232	0.235	0.199	0.162	0.104	0.198	0.221
	(0.071)	(0.074)	(0.065)	(0.016)	(0.092)	(0.048)	(0.033)
Income^{1}	0.094	0.099	0.057	0.071	0.036	0.090	0.179
	(0.078)	(0.081)	(0.073)	(0.013)	(0.073)	(0.041)	(0.072)
Income^{2}	0.058	0.060	0.028	0.026	0.341	0.079	0.050
	(0.100)	(0.103)	(0.092)	(0.011)	(0.223)	(0.024)	(0.022)
Income^{3}	-0.011	-0.007	-0.014	0.007	0.385	0.009	-0.002
	(0.067)	(0.069)	(0.074)	(0.009)	(0.293)	(0.017)	(0.013)
Income^{4}	0.226	0.226	0.183	0.014	0.203	0.036	-0.001
	(0.188)	(0.193)	(0.176)	(0.009)	(0.208)	(0.026)	(0.017)
Income^{5}	-0.051	-0.053	-0.075	0.011	0.083	0.047	-0.012
	(0.062)	(0.064)	(0.060)	(0.009)	(0.147)	(0.018)	(0.016)
Fixed effects				individual/week			
No. of observations	474,524	127,192	1,024,708	474,524	38,800	1,024,708	722,068
No. of individuals	2,446	2,446	5,282	2,446	200	5,282	3,722
No. of weeks	194	52	194	194	194	194	194
R^2	0.034	0.076	0.041	0.051	0.064	0.042	0.041

Note: Figures in parentheses indicate standard errors clustered at the individual level.

Table 5: MPC Estimation Results (2)

	Dependent variable
	Outflows
	All survey respondents
Explanatory variables	
SCP	0.206
	(0.063)
Salary	0.189
	(0.042)
Bonus	0.208
	(0.029)
Fixed effects	individual/week
No. of observations	1,082,810
No. of individuals	5,282
No. of weeks	205
R^2	0.041

Note: Figures in parentheses indicate standard errors clustered at the individual level.

Table 6: Estimation Results of MPC Heterogeneity

	Dependent variable					
	Outflows					
	(1)	(2)	(3)	(4)	(5)	(6)
	Type of income shocks					
Explanatory variables	SCP	SCP	Salary	Salary	Bonus	Bonus
Income	1.133	1.556	0.308	0.296	0.288	0.126
	(0.826)	(0.789)	(0.281)	(0.358)	(0.157)	(0.207)
Income × age	-0.001	0.002	0.000	0.001	0.000	0.001
	(0.007)	(0.007)	(0.003)	(0.003)	(0.002)	(0.002)
Income × male	-0.457	-0.456	-0.045	-0.054	0.048	0.026
	(0.280)	(0.294)	(0.064)	(0.068)	(0.079)	(0.079)
Income × education	-0.141	-0.120	-0.005	-0.003	-0.037	-0.034
	(0.092)	(0.092)	(0.045)	(0.040)	(0.016)	(0.016)
Income × risk aversion (quant)	-0.203	-0.198	-0.010	0.003	0.042	0.049
	(0.113)	(0.113)	(0.041)	(0.030)	(0.022)	(0.019)
Income × discount rate (quant)	0.000	0.000	-0.001	0.000	0.004	0.004
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Income × liquidity constraint (direct)	-0.025	-0.083	-0.018	-0.042	0.001	-0.023
	(0.077)	(0.069)	(0.037)	(0.049)	(0.034)	(0.035)
Income × income	1.17E-06	1.12E-06	-8.18E-10	-6.91E-10	-5.39E-09	-3.92E-09
	(6.52E-07)	(6.49E-07)	(4.63E-09)	(3.67E-09)	(5.95E-09)	(5.87E-09)
Income × log wealth		-0.081		-0.011		0.014
		(0.068)		(0.035)		(0.022)
Income × liquidity constraint		0.018		0.218		0.280
		(0.271)		(0.116)		(0.079)
Fixed effects	individual/week					
No. of observations	119,496	119,496	958,182	958,182	681,053	681,053
No. of individuals	2,298	2,298	4,940	4,940	3,511	3,511
No. of weeks	52	52	194	194	194	194
R^2	0.076	0.076	0.042	0.042	0.042	0.042

Note: Figures in parentheses indicate standard errors clustered at the individual level. For simplicity, we do not show the coefficients of Income^k for $k = -5$ to -2 and $k = 1$ to 5.

Table 7: Estimation Results of MPC Heterogeneity (2)

	(1)	(2)	(3)	(4)	(5)	(6)
	Type of income shocks					
	SCP		Salary		Bonus	
Explanatory variables (cross term with income shocks)						
Age	-0.006	-0.003	0.000	0.001	0.001	0.002
	(0.007)	(0.006)	(0.003)	(0.003)	(0.002)	(0.002)
Male	-0.436	-0.408	-0.032	-0.033	0.014	-0.005
	(0.287)	(0.297)	(0.066)	(0.063)	(0.086)	(0.086)
Own house	-0.292	-0.252	-0.007	0.000	-0.168	-0.163
	(0.205)	(0.204)	(0.054)	(0.052)	(0.078)	(0.082)
Education	-0.147	-0.124	-0.006	-0.008	-0.030	-0.026
	(0.084)	(0.085)	(0.035)	(0.032)	(0.019)	(0.020)
Risk aversion	-0.098	-0.096	-0.003	0.009	0.042	0.052
	(0.086)	(0.085)	(0.041)	(0.032)	(0.023)	(0.021)
Discount rate 1 week	-0.002	-0.001	-0.001	-0.001	0.002	0.002
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Discount rate 1 year	0.000	0.000	-0.001	-0.001	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Discount rate 10 years	0.001	0.001	0.000	0.000	0.002	0.003
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity constraint	0.031	-0.042	-0.011	-0.032	0.016	-0.015
	(0.057)	(0.058)	(0.042)	(0.056)	(0.035)	(0.033)
Risk aversion A (direct)	-0.117	-0.106	0.021	0.027	-0.008	-0.003
	(0.051)	(0.054)	(0.026)	(0.026)	(0.023)	(0.020)
Risk aversion B (direct)	-0.045	-0.028	0.015	0.017	-0.005	-0.002
	(0.050)	(0.051)	(0.034)	(0.031)	(0.022)	(0.021)
Discount rate (direct, inverse)	-0.077	-0.037	-0.087	-0.061	-0.059	-0.048
	(0.088)	(0.092)	(0.050)	(0.034)	(0.041)	(0.045)
Inflation perception	0.013	0.010	-0.002	-0.001	0.004	0.004
	(0.009)	(0.009)	(0.006)	(0.005)	(0.004)	(0.004)
Inflation expectation	0.002	0.000	-0.003	-0.003	-0.001	0.000
	(0.004)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Wage increase expectation	0.013	0.009	-0.001	-0.004	0.007	0.006
	(0.010)	(0.011)	(0.003)	(0.003)	(0.004)	(0.004)
Fiscal debt concern (inverse)	0.111	0.104	-0.001	-0.005	0.045	0.039
	(0.059)	(0.058)	(0.026)	(0.022)	(0.020)	(0.020)
Control wealth/liquidity	no	yes	no	yes	no	yes

Note: In the regression, we use the cross term of income shock (for SCPs, salaries, or bonuses) and one of the explanatory variables listed. Other explanatory variables are the lag and lead of income shocks up to five weeks, log wealth, log income, fixed individual/week effects. In columns (2), (4), and (6) explanatory variables also include income shock $\times$ log wealth and income shock $\times$ the liquidity constraint dummy. Figures in parentheses indicate standard errors clustered at the individual level.

Table 8: Magnitudes of Contribution to the MPC

Education	-0.041
Risk aversion (quant)	0.031
Discount rate (quant)	0.084
Liquidity constraint dummy	0.094

Note: Each figure represents the cross-term coefficient (Table 6) by multiplying by its standard deviation.

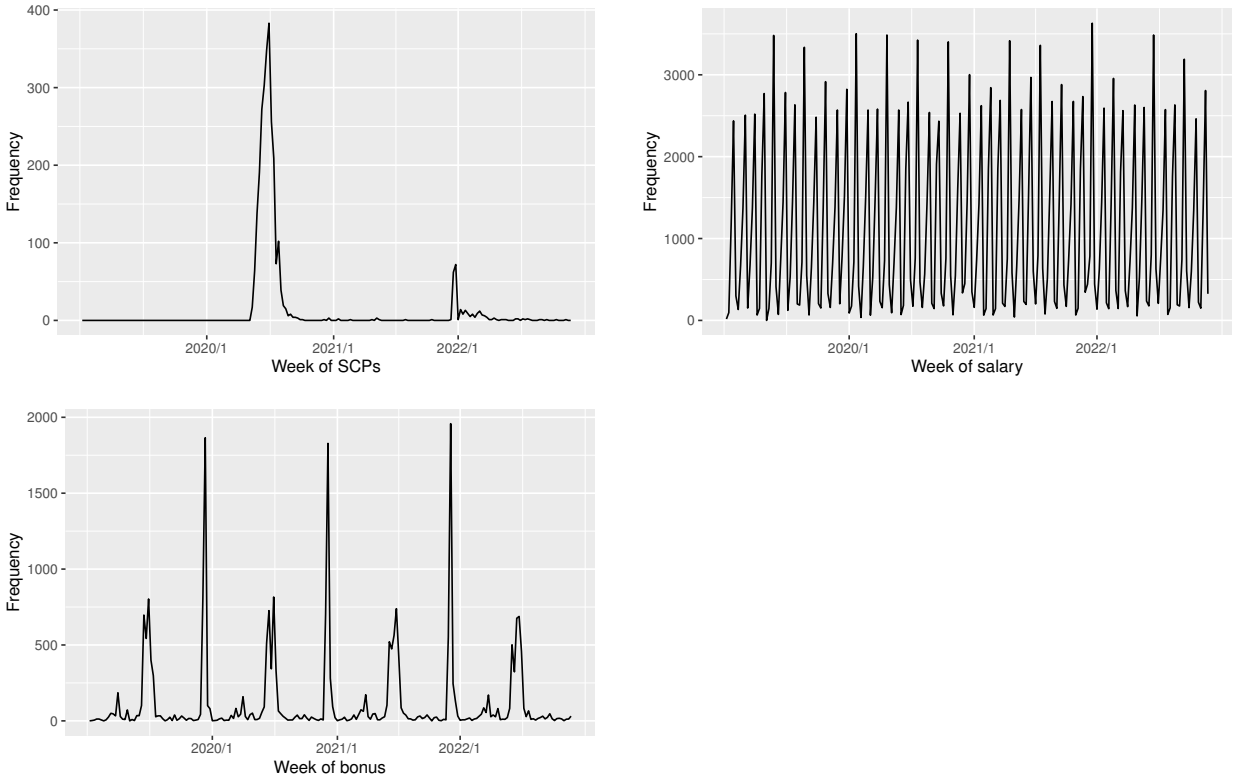

Figure 1: Timing of Income Shocks

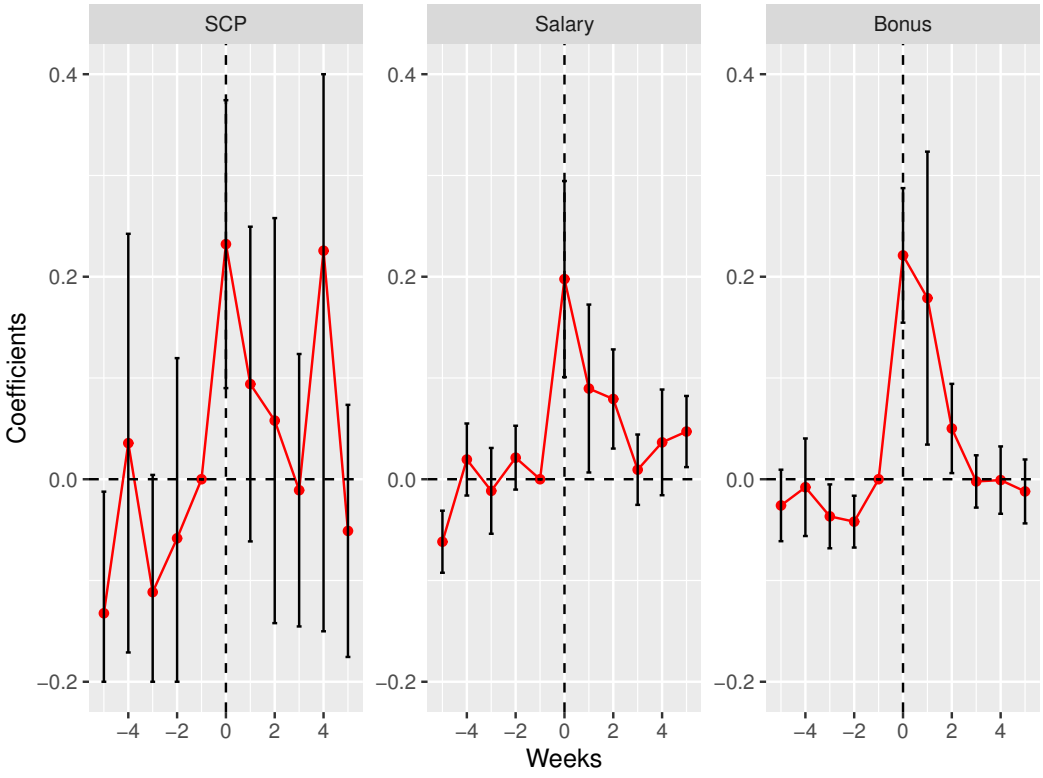

Figure 2: Consumption Responses to Income Shocks

Note: The figure shows estimated coefficients γ^k for $k = -5, -4, \cdots, 4, 5$, which suggests consumption responses in week $|k|$ before/after income shocks. Bars indicate 95% confidence intervals.