

# **Consumption Response to Temporary Price Shock:**

## **Evidence from Singapore's Annual Sale Event<sup>1</sup>**

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# Consumption Response to Temporary Price Shock: Evidence from Singapore's Annual Sale Event

## ABSTRACT

Exploiting debit card and credit card transactions of a large, representative sample of consumers from a leading bank in Singapore, we examine the consumption response to an anticipated, transitory price shock generated by the nation-wide annual sale event. Consumers significantly increase their spending during the sale event. More importantly, we find inter-temporal substitution where consumers spend less immediately before the event, and cross-categorical substitution behavior where consumers decrease spending in items unaffected by the sale event. However, consumers exhibit little substitution behavior when they use credit cards or when they are liquidity constrained, highlighting the importance of heterogeneity in assessing the aggregate impact of such stimulus programs.

**Keyword:** *Consumption, Great Singapore Sale, credit card, debit card, household finance, spending, transitory shocks, fiscal stimulus program*

JEL Code: D12, D14, D21, H3

## 1. Introduction

Many countries introduce tax benefit or price cut schemes in an effort to boost the economy. Such government stimulus programs have been long studied in the macroeconomic policy field of consumer finance (e.g., Johnson, Parker, and Souleles, 2006; Agarwal, Liu, and Souleles, 2007; Shapiro and Slemrod, 2003, 2009; Parker, et al., 2013; Agarwal and Qian, 2014). One such type of policy is implemented through the price mechanism. This channel is explored in a series of papers that tested transitory price changes by government campaigns such as cash for clunkers (Mian and Sufi, 2012) or state tax holidays (Agarwal, Marwell and McGranahan, 2017). Despite these explorations, we have mixed evidence on whether price cut schemes are able to boost aggregate consumption.

One challenge in assessing the effectiveness of such stimulus policies lies in their transitory and predictable nature as well as the differential consumption response across financial and demographic groups. If consumers are able to anticipate the shock, they may take measures to adjust their consumption especially when the shocks are transitory. Such consumption adjustments can occur inter-temporally, or through cross-consumption-item substitution, both of which imply no real impact on the overall consumption. On the other hand, constrained consumers or consumers with behavioral preferences may respond to the temporary reduction in prices with a higher level of spending (with the use of consumer credit). As a result, the overall impact and the specific economic channels of such high-cost and high-stake policy tools are an open question.

In this paper, we offer new evidence by exploiting the government stimulus program of a nationwide annual shopping promotion started in 1994 by the Singapore Tourism Board (STB) in alliance with the Singapore Retailers Association. The shopping event is inclusive: participant merchants range from large department stores to small shops and merchants can join this event without limitation on items or the level of discount. Discount rates during the GSS vary from store to store; some products are sold at up to a 70% discount. In recent years, the total duration of the Great Singapore Sale (GSS) was extended to cover 8 weeks from May to July every year. The effect of this island-wide sales event has been salient enough to attract even foreign shoppers from the countries in the vicinity of Singapore; the retail sales during the two-month period in 2014

amounted to S\$6.4 billion<sup>2</sup>.

We use a unique panel dataset of credit and debit card transactions from a leading bank in Singapore. This bank maintains a market share of over 80 percent in the country, and our dataset covers a random, representative sample of the bank's customers. Specifically, we exploit domestic credit card and debit card spending data from a sample group of more than 120,000 card holders in Singapore. Similar to the U.S., debit and credit cards are important mediums of disposable consumption in Singapore, spending on which account for approximately 30 percent of aggregate personal consumption in Singapore (Agarwal and Qian, 2014).<sup>3</sup> Therefore, compared to existing consumption data used in prior work, our data provide a more complete and accurate measure of individual-level consumption at high frequency. The data contain detailed information about each spending transaction including the amount, time, merchant name, and spending type, as well as demographic information of card holders, which facilitates identification and enables us to explore heterogeneity in the consumption response across spending categories and diversity of card holders.

Given our data coverage, we focus on the GSS in 2010, which was launched on 27<sup>th</sup> of May, 2010.<sup>4</sup> Specifically, we use a distributed lag model to examine the consumption response to the anticipated price shock during the 8 and ½ weeks' period from May 27<sup>th</sup> to July 25<sup>th</sup> of 2010. We show the daily spending response by analyzing credit and debit card transactions at the individual level. We test both average daily responses in pre- and post-treatment periods and the evolution of daily response per week to identify the inter-temporal substitution in spending behavior. The reference period includes 6 weeks: 3 weeks from 4-weeks to 2-weeks before the GSS and 3 weeks from 2-weeks to 4-weeks after the GSS. We also include a separate weekly dummy for one week before and after the GSS to capture the immediate inter-temporal substitution effect. In the model that shows response dynamics, we examine the change of consumption each week in comparison to

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<sup>2</sup> Please see <http://www.greatsingapore.com.sg/2015/participate/GSS%20Website-8-9.pdf>. Also, throughout this paper Singaporean Dollar(SGD) is used as a main currency. According to Monetary Authority of Singapore, the average annual exchange rate for USD to SGD is 1.2875.

<sup>3</sup>The remaining 70 percent of consumption occurs through checks, direct transfers, and cash. Consumers with recurring payments including mortgage, rent, and auto loans payments typically use instruments such as checks and direct deposit.

<sup>4</sup> Though our data also span the 2011 GSS period, there was another fiscal stimulus program—the Growth Dividend program—that was announced (implemented) in February (April) of the same year (please refer to Agarwal and Qian (2014) for more details). Therefore, we choose to focus on the 2010 GSS for cleaner identification.

the reference period. Merchant Category Codes (MCC) included in the dataset enable us to test cross-categorical substitution. Two separate groups are designed to segregate MCC groups that are highly likely to be affected by the GSS (*shopping* category) from the other MCC groups that are supposed to be least affected by the GSS (*non-shopping* category)<sup>5</sup>.

Overall, we find that consumers increase spending by 2.9% during the GSS period compared with the average spending from the reference period. However, the positive response in spending is mitigated by the drop in spending after the GSS. In the *total* category, we find that the spending drops by 4.8% in the first week after the GSS compared with the average daily spending from the reference period. This provides strong evidence of inter-temporal substitution. The inter-temporal substitution effect is more marked in *shopping* category, where the spending increases by 7.4% during the GSS and decreases by 3% and 3.9% one week before and after the GSS respectively. Further investigation of the spending behavior in *shopping* and *non-shopping* categories reveals distinctive patterns of cross-categorical substitution.

Cardholders spend more on the *non-shopping* category one week before the start of the GSS by 5.26% compared to the average spending in the reference period, but the response of spending in the *non-shopping* category drops significantly (-4.08%) during the GSS. We also find that the change in spending is more marked in the front period of the GSS rather than the later period. Overall, these findings cast doubt on the effectiveness of such temporary price cuts in stimulating aggregate consumption.

Relative to the cumulative debit card spending response, credit card spending exhibits not only a much greater spending response, but its effect is also more persistent. Spending response using debit cards shows stronger signs of intertemporal substitution as the spending of *shopping* category

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<sup>5</sup> Throughout this paper, Shopping means spending categories that are closely related to Great Singapore Sale such as Apparel, Art, Crafts, & Hobbies, Automotive Related, etc., while Non-shopping means spending categories that are less likely to be related to Great Singapore Sale such as Airlines, Associations/Memberships, Driving Centers, Education, Fuel, etc. Full list of merchant categories in shopping and non-shopping category is elaborated in the Appendix.

items decreased during the one week after the end of GSS, and intra-temporal substitution as the debit card spending in the *non-shopping* categories decreased during GSS. These results support the hypothesis that behavioral preferences—e.g., present bias—is potentially a driving force of permanent consumption effect in response to the transitory and anticipated price shock. Furthermore, they highlight the importance of assessing the consumption responses to temporary price cuts with a comprehensive measure of consumption, given the differential effect across payment instruments (i.e., debit cards (cash) vs. credit-based payment instruments that allow deferred payment).

Financial liquidity also plays an important role. Consistent with prior evidence, the financially constrained group, which has low checking account balances or low monthly income, responds more markedly and permanently to the GSS. In total spending regardless of categories, cumulative change in daily spending of financially constrained group ranges from 3.40% to 4.31% during the entire period (74 days including one week before and after the GSS event and the GSS period) compared with the reference spending level, while non-constrained group shows response to the GSS ranging from 0.80% to 1.60%. This difference is more evident when the proxy of financial liquidity is the checking account balance normalized by the income level (Olafsson and Pagel, 2018). When (normalized) financial liquidity is used to sort the financially constrained and non-constrained groups, the cumulative spending increases by 5.17% while the spending of constrained group changes only by 0.46%. Importantly, the constrained group exhibits little cross-categorical substitution behavior as they appear to have maintained their spending level in the *non-shopping* category.

We further investigate differential responses across different consumer demographics. Tests of age group comparison indicate that the response for the young group in *shopping* category is stronger than that of the old group in the first few weeks of the GSS. In terms of ethnicity and marital status, Chinese or single consumers show stronger response to the GSS. On the other hand, there is no obvious difference across gender. Lastly, as a robustness check, we test if the significant response is confounded by other unobserved characteristics associated with the GSS event date  $t$ , in particular its start date. We conduct the mean difference tests between spending on the same calendar dates as  $t$  and  $t-1$  in the next year (2011) and find no significant change in spending. In contrast, in our event year (2010), there exhibits a visible spending increase between dates  $t-1$  and

*t.*

Findings in this paper directly contribute to our understanding on the consumption response to anticipated and temporary price cuts. Due to the nature of the price shocks and data limitations, existing studies have difficulty in delineating a comprehensive response by consumers (Mian and Sufi, 2012; Agarwal, Marwell and McGranahan, 2017). By using an accurate, granular, and representative measure of consumption under the unique setting of a salient, large-scale temporary price shock, we are able to uncover new evidence. First, our findings point out that the consumer substitution behavior, both intertemporally and intra-temporally, may significantly dampen the aggregate consumption response to such temporary price cuts. Second, we uncover significant heterogeneity in the consumption response across liquidity constraints or across payment instruments. They imply that the effectiveness of such a program in stimulating the aggregate economy depends on the composition of the (affected) consumers and the prevalent use of consumer credit (relative to cash or debit cards).

More broadly, we contribute to the existing literature on the consumption response to general income shocks. Bodkin (1959) finds significant increase of consumption amongst the veteran group who received National Service Life Insurance dividends in 1950. Poterba (1988) examines two federal income tax policies in the US. Browning and Collado (2001) find little evidence of spending response among Spanish-speaking households. A series of papers examine the consumption response to the US government's tax rebate program in 2001 (Shapiro and Slemrod, 2003, 2009; Johnson, Parker, and Souleles, 2006; Agarwal, Liu, and Souleles, 2007) and Economic Stimulus Act in 2008 (Parker 2017; Parker et al., 2013). Agarwal and Qian (2014) find significant spending responses to an unanticipated one-time government payout program. Other studies also examine alternative types of income shocks (Hsieh, 2003; Stephens, 2003, 2006, 2008; Scholnick, 2013; Di Maggio et al., 2016; Agarwal and Qian, 2017; Agarwal et al, 2018; Olafsson and Pagel, 2018). Other research also shows significant consumption response to borrowing capacity shocks (e.g., de Araujo et al. (2020) and Aydin (2022)). Considering temporary price cuts as an anticipated and transitory income shock, the substitution behavior by consumers in our context suggests no significant spending increase on average after the positive transitory shock.

This paper is organized as follows. Section 2 and 3 discuss the Great Singapore Sale and the

data/methodology respectively. Section 4 documents the response of consumers to the island-wide shopping event and results from additional heterogeneity tests, and Section 5 concludes.

## **2. The Great Singapore Sale**

The Great Singapore Sale is an island-wide shopping event in Singapore. It was launched and organized in 1994 by the Singapore Tourism Board (STB) in alliance with the Singapore Retailers Association. In the early stages, it was held during the school holiday season for about a month. Early participants at the GSS were limited to major department stores and big retailers. The initial goal of the GSS in the first year was to boost Singapore as a shopper's paradise<sup>6</sup> and make Singapore popular tourist destination in the region.<sup>7</sup> However, the scope of participants became much wider and the GSS period was expanded to two months so that the GSS can better promote the shopping experience of both domestic Singaporeans and foreign visitors. In 1994 the STB spent S\$3 million to promote the GSS, with great success. The support of the STB amounted to S\$4 million in the subsequent year. The STB announced that it would invest an estimated S\$20 million on the tourism promotion that encompasses airline, hospitality, retail, food & beverage, and entertainment business in May 2015 to coincide with the GSS period.

Discount rates during the GSS vary from store to store; some products are sold at up to a 70% discount. Participants include department stores and small shops. Products include but are not limited to: apparel and accessories, watches, jewelry, toys, books, stationery, music CDs, homeware, furniture, electrical appliance, beauty and wellness services, food and beverage, and the majority of products sold at department stores. On top of the attractive price, shoppers can enjoy promotions offered by affiliated companies, such as credit card firms. MasterCard is the official credit card sponsor of this event and offers various chances to win freebies or vouchers. A few department stores provide shoppers with opportunities to win various cash cards, vouchers, or even cars.

Corresponding to these efforts of the government and retailers, total retail revenue has been

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<sup>6</sup> <http://www.nas.gov.sg/archivesonline/data/pdfdoc/STPB19940715B.pdf>

<sup>7</sup> [https://www.straitstimes.com/sites/default/files/attachments/2017/06/14/st\\_20170615\\_lifetime1\\_3209757.pdf](https://www.straitstimes.com/sites/default/files/attachments/2017/06/14/st_20170615_lifetime1_3209757.pdf)

growing year after year, except when natural disaster or financial crisis froze the market. The GSS recorded S\$2 billion<sup>8</sup> retail sales in 1996. The retail sales during the two-month period in 2014 amounted to S\$6.4 billion<sup>9</sup> according to a press release from the Singapore Retailers Association, the official organizer of the event. To show the salience of this sales event, we analyze the proportion of MasterCard spending during the GSS to total GDP of Singapore in Figure 1. The figure shows that the percentage of MasterCard spending over GDP gradually increased from 2006 to 2014, particularly, from 2010 onward. Considering the fact that Singaporeans use various types of credit/debit cards, including MasterCard, the total spending during the GSS cannot be considered as a small local event. All these figures lend weight to the salience of the GSS in Singapore's economy.

[Insert Figure 1 here]

### **3. Data and Empirical Methodology**

#### **3.1. Data**

We use a unique, proprietary dataset of credit and debit card spending from a major leading bank in Singapore. The bank has more than four million customers, which comprise over 80 percent of Singapore's population, and over 280 branches across 19 markets in Asia. It also has over four times as many automatic teller machines (ATMs) as other banks in Singapore. It is known that the bank's fee and cost structures are similar to the other major banks (Agarwal and Qian, 2014). According to a survey by HSBC<sup>10</sup>, Singapore's cardholders swipe their main card for 77% of total credit card spending. This means that the majority of credit card transactions are paid via one card even if shoppers hold multiple cards. Although we don't have information regarding to the customers' relationships with other banks, it is less likely for customers in our sample to have other primary banks due to the market share and convenience of the easy access to branches and ATMs with wider geographic coverage.

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<sup>8</sup> The average currency exchange rate in 2010 is SGD1=USD0.736.

<sup>9</sup> <http://www.greatsingaporesale.com.sg/2015/participate/GSS%20Website-8-9.pdf>

<sup>10</sup> <https://sg.finance.yahoo.com/news/singapore-top-asia-credit-cards-105414790.html>

Figure 2 shows the statistics of the credit and charge card markets in Singapore from 2005 to 2014. The solid line is total number of credit and charge cards in Singapore. The dotted line is total card billing amount in millions of Singaporean dollars. We also draw a trend line of billing amount to smooth seasonality. Both the number of cards and the billing amount have increased over the past 10 years. This confirms that credit and charge card has become increasingly important means of transaction. Gross and Souleles (2002) confirm that 20 percent of aggregate personal consumption is transacted by using credit card. As this statistic is based on the American dataset, we collect similar data from Singapore and find a similar dependence on credit card. According to a market report from Visa International<sup>11</sup>, one of the biggest global credit card companies, credit card spending accounted for 21.6 percent of household consumption in Singapore as of 4<sup>th</sup> quarter 2003.

[Insert Figure 2 here]

A great advantage of the dataset lies in the detailed information about consumption and representative size of sample. Our original sample contains credit and debit card transactions of more than 180,000 cardholders over a period of 24 months ranging from April 2010 to March 2012. We know the transaction date, the name of merchant, merchant category code (MCC), the exact amount of the transaction, method of payment, i.e. credit card or debit card, and personal identifier for each purchase. The dataset also contains cardholders' demographic and financial information including age, gender, income level, checking account balance, ethnic group, and marital status. The richness of the dataset enables us to conduct various heterogeneity tests. Many papers on consumer spending used survey data (Zeldes, 1989a; Zeldes, 1989b; Carroll, 1997; Hsieh, 2003; Johnson et al., 2006; Parker et al., 2013; Parker, 2017). Even if the survey data contains meaningful information about consumption behaviors, the information of survey cannot be as rich as credit/debit card information<sup>12</sup>. Additionally, credit card datasets are known to have little measurement error (Agarwal, Marwell and McGranahan, 2017).

To test the daily response to the GSS, we aggregate the transaction data at the individual-day level.

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<sup>11</sup> [http://www.visa-asia.com/ap/center/valueofvisa/industrywatch/includes/uploads/Singapore\\_Credit\\_Card\\_Report.pdf](http://www.visa-asia.com/ap/center/valueofvisa/industrywatch/includes/uploads/Singapore_Credit_Card_Report.pdf)

<sup>12</sup> More recent papers used consolidated financial information from personal financial management mobile applications such as Check in the U.S. (Gelman et al., 2014) and Meniga in Iceland (Olafsson and Pagel, 2018).

We only consider domestic retail transactions as the scope of our study is to find the effect of domestic shopping event on consumption. In addition, we drop transactions related to annual fees and other fees that are not affected by the GSS. We only include the cardholders who have transactions by both credit card and debit card during our study period so we can compare the spending behavior between credit and debit cards. The original dataset contains transaction information from April 2010 to March 2012. Although the Great Singapore Sale is held every year, we analyze only 2010 data because Singapore's government announced that all adult Singaporeans aged 21-years-old and above in 2011 would receive Growth Dividend, which was a cash payout program of US\$1.17 billion. On top of the tax reimbursement, Singapore's government topped up the medical pension balance. All the benefits from the Growth Dividend program in 2011 could have affected the budget of Singaporeans. We use the information of April 2010 to identify the customers' pre-treatment characteristics including demographics, checking account balance, and monthly income level. This information is used to test heterogeneity response afterward.

Our target study period is from April 29, 2010 to August 22, 2010. The total period contains 4 weeks before the GSS, whole period of the GSS, and 4 weeks after the GSS. We use the first 3 weeks and the last 3 weeks as the reference period and compare the changes of consumer spending behavior from 1 week prior to the GSS to 1 week after the GSS. We exclude the period shortly after the Great Singapore Sale to isolate the effect from potential confounding events, such as mid-autumn festival or year-end shopping spree, and the NATAS (National Association of Travel Agents) fair, which was held from 27<sup>th</sup> of August 2010. Moreover, we follow Stephens (2003) to examine the immediate spending changes (i.e., within weeks) right around the Great Singapore Sale using high frequency data.

Our data is tested on a daily basis by aggregating transactions per each calendar date. Following Agarwal, Marwell and McGranahan (2017), we fill in the days with missing transactions with a transaction amount of S\$0. This balancing process is repeated for debit card transactions. We divide total spending into two groups depending on the Merchant Category Code<sup>13</sup>. The first

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<sup>13</sup> Several MCCs are dropped from the dataset as it is not clear if those are affected by the GSS or not. For example, MCC of *telecommunications* may have little to do with the GSS if it only includes spending on utility bills. However, *telecommunications* contains spending on purchase of mobile phones or accessories of phones.

category is *shopping*,<sup>14</sup> which includes items likely to be discounted during the GSS. Spending in the *non-shopping*<sup>15</sup> category is less likely to get price discount from the GSS. We include in the Appendix a more detailed discussion on the spending categories in the data.

The final analysis sample includes a total of 124,221 card holders with an average age of 41.6 and an average monthly income of S\$5,926. Females account for 40% of the total cardholders and 81% of the sample group are Chinese. Married cardholders constitute 47% of the sample. Cardholders have a mean checking account balance of S\$37,431 as of April, 2010 and spend \$19.34 per day and \$15.42 per each transaction. For more detailed information about the summary statistics, see Table 1.

[Insert Table 1 here]

### 3.2. Empirical Methodology

We analyze the spending response by using a distributed-lag model with credit and debit card spending at the daily level. This model uses three proxies of spending response: total daily spending at the individual level, average spending per transaction, and the number of daily transactions. Each proxy is regressed on a daily basis and cumulative spending response is plotted on a weekly basis. We classify two separate periods from April 29, 2010 to May 19, 2010 and August 2, 2010 to August 22, 2010 as the reference period, and the period from May 27, 2010 to July 25, 2010 (60 days) as the treatment period. We include separate weekly dummies for one week right before (May 20, 2010 to May 26, 2010) and right after the GSS (July 26, 2010 to August 1, 2010) to find the inter-temporal substitution effect. We capture two forms of spending response: average daily response and dynamics of response. The former shows the change in the average

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<sup>14</sup> The *shopping* category contains the following MCCs: Apparel; Art, Crafts, & Hobbies; Automotive Related; Beauty Salons & Cosmetics & Spa; Books & News; Building Construction; Child & Mother Care; Department Stores; Dining; Electronic & Computer; Entertainment & Recreational; Food & Beverage Stores; Home/Office Furnishing & Appliances; Music; Photography/Photocopy; Sports Merchandise; Specialty Retail; Supermarkets; and Watches & Jewelry.

<sup>15</sup> *Non-shopping* category means spending categories that are less likely to be related to the Great Singapore Sale and includes: Airlines, Associations/Memberships, Driving Centers, Education, Fuel, Government, Hotels/Lodgings, Insurance, Land & Sea Transportation, Medical, NETS-Kiosk, Pets, Professional Services, Rental, Repair, Specialized Cleaning Services, and Tour Agencies.

daily spending response during the post-treatment term, while the latter captures changes in daily spending response after the event. Additionally, we categorize transactions into two groups depending on the merchant category codes (MCC)<sup>16</sup>; the *shopping* category contains transactions that are likely to be affected by the GSS, while the *non-shopping* category is not likely to be affected by the GSS. We test both average daily spending response and dynamics of spending response within each category.

First, we study average daily spending response, which shows the change in spending during three periods: one week before, during, and one week after the GSS. The model specification is as follows:

$$Y_{i,t} = \alpha + \beta_{pre1} \times 1_{pre1} + \beta_{GSS} \times 1_{GSS} + \beta_{post1} \times 1_{post1} + \gamma_i + \sum_1^6 \delta_d + \varepsilon_{i,t} \quad \text{Eq (1)}$$

whereas  $Y_{i,t}$  measures the responsiveness to the GSS (i.e. total daily spending, average daily spending per transaction, or number of daily transaction);  $1_{pre1}$  is a dummy variable for one week right before the GSS;  $1_{GSS}$  is a dummy variable for the total period of the GSS;  $1_{post1}$  is a dummy variable for one week right after the GSS;  $\gamma_i$  is the individual dummy to capture the different level and preference of spending amongst cardholders;  $\delta_d$  is a dummy variable for day of week to capture the difference of spending level per each day of week;  $\varepsilon_{i,t}$  is an error term. Standard errors are clustered at the individual level throughout our study. More detailed description of all the variables is listed in Appendix 1. The coefficients of spending change 1 week before, during, and 1 week after the GSS can be interpreted as the differential spending relative to the mean of spending from the reference period. Thus, we also present mean of spending from the reference period in each table where applicable.

Secondly, we test the dynamics of spending response in each week. Instead of comparing the reference period with 3 separate terms ( $1_{pre1}$ ,  $1_{GSS}$ , and  $1_{post1}$ ), we split the GSS period into 9 weeks; thus, we compare spending from 11 separate periods to the 6 weeks of reference period (3 weeks

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<sup>16</sup> Even though we know the MCC of each transaction, it is not known which item is purchased from the transaction. For example, it is known to us that a cardholder swiped at a Starbucks store, but we do not know if the consumer purchased a cup of coffee or a tumbler.

before and after the GSS respectively). One thing to note is that total period of the GSS is 60 days, or 8 weeks and 4 days as the last week (*Week 8*) contains only 4 days instead of full 7 days. However, as we control for day of week in all the analyses, the comparison of coefficients throughout the window should have no issues. Model specification of the dynamics of spending response is as follows:

$$Y_{i,t} = \alpha + \sum_{w=-1}^9 \beta_w \times 1_{week\ w} + \gamma_i + \sum_1^6 \delta_d + \varepsilon_{i,t} \quad \text{Eq (2)}$$

In addition to Eq (1) and Eq (2), we also test heterogeneity of spending response. The specification of the heterogeneity test is as follows:

$$Y_{i,t} = \alpha + \sum_{w=-1}^9 \beta_w \times 1_{week\ w} + \sum_{w=-1}^9 \beta_{g1,w} \times 1_{g1} \times 1_{week\ w} + \dots + \sum_{w=-1}^9 \beta_{g(N-1),w} \times 1_{g(N-1)} \times 1_{week\ w} + \gamma_i + \sum_1^6 \delta_d + \varepsilon_{i,t} \quad \text{Eq (3)}$$

where N is the total number of subgroups. We divide total consumers into N-groups per each heterogeneity test specification such as checking account balance, income, or age. N<sup>th</sup> group is the reference group, which is not shown in Eq (3).

#### 4. Empirical Results

We start by investigating the average daily spending response to the GSS in the pre- and post-treatment periods. We test the dynamics of spending response on a weekly level during the GSS by using a distributed-lag model. To find the immediate inter-temporal substitution effect, we add two weekly dummy variables for one week before and after the GSS respectively. Starting from the analysis on average spending change before, during, and after the GSS with Eq (1) format, we expand our analysis in weekly format of Eq (2) to study inter-temporal and cross-categorical substitution. Behavioral change of consumers across different categories is examined by categorizing total transactions into two sub-categories consisting of two groups which are likely to be affected by the GSS and what are not. Then, we examine the dynamics of spending response to the GSS across different categories of cardholders; we test heterogeneity of response in terms of age, checking account balance, monthly income, card type (credit vs. debit), ethnicity, gender,

marital status, and product durability. To further test the robustness of the results, we conduct additional tests to see if the significant results are attributable to a specific date.

#### 4.1. Average Daily Response in Spending

Table 2 shows change in average response to the GSS in three periods including one week before the GSS, one week after the GSS, and whole period of the GSS. Panel A of Table 2 shows the spending response to the GSS in total sample by using Eq (1). As  $1_{pre1}$  and  $1_{post1}$  are dummy variables that equal to 1 for the one week right before and right after the GSS respectively,  $\beta_{pre1}$  and  $\beta_{post1}$  captures radical changes of spending before and after the GSS. In the same manner,  $\beta_{GSS}$  captures the response to the shopping event during the GSS period. To consider the differences in spending behavior among days of week, a dummy for day of week ( $\delta_d$ ) is included in Eq (1). We set the first three weeks and the last three weeks as a reference period, and  $\beta_{pre1}$ ,  $\beta_{GSS}$ , and  $\beta_{post1}$  signify relative change in spending compared to the reference period. As explained in section 3.2, we categorize MCCs into two categories: *shopping* and *non-shopping*. Results from the *total*, *shopping*, and *non-shopping* categories are shown in Panel A, B, and C respectively.

[Insert Table 2 here]

In Panel A, we see the spending response to the GSS in the total MCC category. Total daily spending clearly increases during the GSS and drops afterwards. In terms of average spending per transaction, we find significant increase during the GSS and decrease of spending after the GSS. The coefficient of 0.548 indicates that the daily spending increases by 54.8 cents which equates to 2.9% increase compared with the average daily spending during the reference period (3 weeks from 4-weeks to 2-weeks before the GSS and 3 weeks from 2-weeks to 4-weeks after the GSS<sup>17</sup>). We also find negative response in average spending per transaction right before the start of the GSS. However, the coefficient is not statistically significant. The number of transactions changes

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<sup>17</sup> The average daily spending in the reference period (3 weeks from 4-weeks to 2-weeks before the GSS and 3 weeks from 2-weeks to 4-weeks after the GSS) is S\$19.06, S\$11.56, and S\$7.50 in the *Total*, *Shopping*, and *Non-shopping* category respectively.

during the treatment period, but is not economically significant. We expected to find inter-temporal substitution where the spending right before the GSS should decrease. In contrast to our expectation, total daily spending and average spending per transaction are not statistically significant, even though we find significant inter-temporal substitution only during the GSS and post-GSS period. The drop in total spending right after the GSS equals to 4.8% of the average spending in the reference period, which is not negligible. The insignificant results or mixed results might be due to the specification of the transactions from the consumers. In other words, even though the scope of the GSS is not limited to certain product types, it is hard to believe that all the credit/debit card transactions are linked to the GSS. So, we split total transactions into *shopping* and *non-shopping* categories and investigate separately. To further investigate the inter-temporal substitution effect, we test the *shopping* and *non-shopping* categories separately in Panels B and C.

In Panel B, where we exploit only *shopping* category, we find prominent inter-temporal substitution before and after the GSS: cardholders spend significantly less before and after the GSS in terms of total daily spending. The magnitude of the decrease is statistically and economically significant in both weeks before and after the GSS: -3.0% (or 34.5 cents) and -3.9% (or 44.5 cents) respectively. In contrast to this decrease, we find a discernible increase of spending during the GSS. The increase of 85.4 cents a day is equivalent to 7.4% change in comparison to the average daily spending from the *shopping* category during the reference period. The results of column (2) also confirm inter-temporal substitution, where spending per transaction increases during the GSS and drops thereafter. We don't see a significant change in the number of transaction right before the GSS. However, the total number of transaction increases during the GSS and drops afterwards in *shopping* category analysis.<sup>18</sup>

Panel C shows the results from the *non-shopping* category. In contrast to the *shopping* category, we find that consumers spend more in the *non-shopping* category in the pre-treatment period and decrease spending levels during the GSS. The decrease of 30.6 cents per day amounts to 4.08%

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<sup>18</sup> Retailers may be willing to start the sales promotion a few days earlier than the official initiation of the GSS. If so, we expect to observe an increase in spending, especially within the *shopping* category, before the start of GSS. However, the negative spending response before the GSS as shown in Table 2 mitigates this concern—plausibly retailers are less incentivized to extend the shopping event period given the length of the shopping festival.

drop compared to the average daily spending in the *non-shopping* category during the reference period. The results in columns (1) and (2) show that consumers maintain a lower level of spending even after the GSS. When we compare Panels B and C, we find that cardholders spend more in the *non-shopping* category before the GSS and increase spending level in the *shopping* category during the GSS. After the nation-wide shopping event, consumers spend less both in *shopping* and *non-shopping* categories. Thus, our results confirm our expectation that consumers would show both inter-temporal substitution, spending less before the GSS and more during the GSS, and cross-categorical substitution<sup>19</sup>, spending more on items discounted during the GSS and less on the items that are less related to the GSS<sup>20</sup>. We can also infer the aggregate change in spending at the national level. According to the World Bank's Global Findex report, 2,217,293 Singaporeans used either credit or debit card for payment in 2014. Given that the payment method did not change significantly between 2010 and 2014, we infer from Panel A of Table 2 that total spending increases by S\$72,904,594 (S\$0.548 X 60days X 2,217,293) during the GSS. In the *shopping* category, spending level decreases by S\$5,354,763 (-S\$0.345 X 7days X 2,217,293) right before the GSS, and consumers spend less by S\$6,906,868 (-S\$0.445 X 7days X 2,217,293) 1 week after the GSS at the aggregated national level. Moreover, in the *non-shopping* category, spending level increases by S\$6,130,815 1 week before the GSS, and drops by S\$40,709,499 during the GSS followed by a further reduction of S\$7,170,726<sup>21</sup>.

## 4.2. The Response Dynamics

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<sup>19</sup> An additional analysis is conducted by including interaction terms with a dummy variable of shopping category (1SH). The model specification is as follows:  $Y_{i,t} = \alpha + \beta_{pre1} \times 1_{pre1} \times 1_{SH} + \beta_{GSS1} \times 1_{GSS} \times 1_{SH} + \beta_{post1} \times 1_{post1} \times 1_{SH} + \beta_{pre2} \times 1_{pre1} + \beta_{GSS2} \times 1_{GSS} + \beta_{post2} \times 1_{post1} + 1_{SH} + \gamma_i + \sum_1^6 \delta_d + \varepsilon_{i,t}$

In accordance with the inter-temporal substitution from Table 2, we find significant gaps across different categories one week before the GSS and during the GSS, while the spending response remains insignificant one week after the GSS. Full table from this analysis is report in the Internet Appendix Table IA. 1, Panel A.

<sup>20</sup> Table 2 reports changes in daily spending. Total change of spending in 1 week before GSS (7 days) equates to S\$0.35 (S.E.=1.42). Total change in spending during GSS (60days) is S\$32.87 (S.E.=6.50), and spending drops by S\$6.35 (S.E.=1.46) in 1 week after GSS period. In total, the sum of spending change in the three terms is S\$26.87 (S.E.=7.63). Thus, in net, we find that there is an increase of net spending by S\$26.87 from 1 week before the GSS till the end of 1 week after the GSS.

<sup>21</sup> While we use Singapore as our empirical setting, prior research shows that Singaporean consumers make spending decisions consistent with theory predictions (e.g., Agarwal and Qian (2014, 2017), Agarwal, Pan, and Qian (2015), and Agarwal, Qian, and Zou (2021)). In particular, Agarwal and Qian (2014) find that the marginal propensity to consume from Singaporean consumers is similar to that of the US consumers. In line with the finding of Parker et al. (2013) and Mian and Sufi (2010), Singaporean consumers show different levels of propensity to consume by product category.

In addition to the average response to the GSS in Table 2, we investigate the dynamic change of the spending during the treatment period per each week by using Eq (2), and the result is shown in Table 3. As previously mentioned in Section 1, total duration of the GSS is 8 weeks. This period seems to be quite long for a shopping event. Thus, we think it is meaningful to study weekly change in response since the degree of response might be stronger in the beginning and revert to previous level in time. In Table 3, Week 0 means the first week of the GSS period and Week 8 means the last week of the GSS. We show total daily spending in the *total*, *shopping*, and *non-shopping* categories in Table 3. The results reconfirm that consumers clearly show inter-temporal and cross-categorical substitution throughout the study period. What is more interesting is that when consumers increase the spending level in the *shopping* category, the coefficient of *non-shopping* category is always negative except for the week right after the GSS. Even when the coefficients are not statistically significant, we find that the estimated response in *shopping* and *non-shopping* category is always opposite. We also find that most of the positive increase of spending behavior in *shopping* category is front-loaded. Although the magnitude of positive response decreases in time, we see that the coefficients are significantly positive in the first 5 weeks in *shopping* category. Accordingly, the response in *non-shopping* category is negative during that period. Lastly, the consumers increase spending in the last week. This seems to be due to the consumption behavior of chasing last-minute deals. In general, we can conclude that consumers spend more on *non-shopping* category before the shopping season and increase the spending level in *shopping* related items during the promotion period. After the shopping spree, consumers step back from spending both in *shopping* and *non-shopping* categories.

[Insert Table 3 here]

Figure 3 shows the cumulative response to the GSS from one week before the GSS (*Pre1*) to one week after the GSS (*Post1*). Two blue vertical lines at 0 and 8 stand for the first and last week of the GSS. The figures plot cumulative spending per *total*, *shopping*, and *non-shopping* categories with corresponding 95 percent confidence intervals. Consistent with the findings in Tables 2 and 3, inter-temporal and cross-categorical substitution is clearly seen in Figure 3, especially when *shopping* and *non-shopping* categories are compared. Panel (a) of Figure 3 plots the change of cumulative total spending in weeks from the total categories. Weekly changes are calculated by

multiplying the daily coefficients from Table 3 by the number of days in each week. Then we sum up the weekly change in spending during the GSS period. It increases in the front but remains almost flat after a few weeks. Since this panel (a) is a comprehensive response from both *shopping* and *non-shopping* categories, it is better to focus on panel (b) and (c), where separate analysis on *shopping* and *non-shopping* category is conducted. We find a much clearer trend of increase and decrease in spending in each panel<sup>22</sup>. Steep slopes in panel (b) and (c) in the first few weeks reconfirm that the response from the consumers are front-loaded, consistent with the finding in Table 3<sup>23</sup>.

[Insert Figure 3 here]

Additionally, it is unlikely that the significant change in spending can be caused by secular or seasonal patterns. Especially, the difference between *shopping* and *non-shopping* categories in the first few weeks is quite significant. We investigate the difference in spending between *shopping* and *non-shopping* categories similar to the results shown in Table 3 and find that the gap in spending between *shopping* and *non-shopping* categories remains significantly different for five weeks (Internet Appendix Table IA.1, Panel B).

#### 4.3. Credit Card vs. Debit Card

One central debate with respect to this type of stimulus program lies in the transitory or permanent effect of spending responses. One might expect consumers to anticipate the transitory shock and adjust consumption both intertemporally and intra-temporally (e.g., see evidence in Mian and Sufi, 2012). However, other studies also find the price discount stimulus boosts aggregate consumption permanently (e.g., Agarwal, Marwell, and McGranahan, 2017). One potential reason that can explain the permanent spending response is a behavioral channel, in which consumers with particular preferences—for example present bias—may respond permanently to the transitory

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<sup>22</sup> We are unaware of any aggressive promotion event during the GSS or consumers' sensitivity in either *shopping* or *non-shopping* category. Specifically, the leading bank that we received the data from did not hold any aggressive promotion to encourage card holders to increase spending in any specific categories.

<sup>23</sup> The gap between *shopping* and *non-shopping* categories is compared in the Internet Appendix Table 1, Panel B. We find that the gap in spending across different categories remains statistically significant at 1% up to 5 weeks from the start of the GSS.

price shock.

To directly test this hypothesis, we examine the difference in spending response by the card type. Existing research shows that credit card users are more bound by the present bias, either by selection or through the delayed payment feature of credit cards (Angeletos, et al., 2001). We estimate the distributed lag model as in Figure 3 for debit and credit card spending response respectively and plot the cumulative responses in Figure 4.

[Insert Figure 4 here]

Relative to the cumulative debit card spending response, credit card spending exhibits not only a much greater spending response, but its effect is also more permanent. More specifically, credit card spending experiences an immediate increase since the start of GSS and stays permanent throughout and after GSS. On the contrary, debit card spending remains flat at the beginning, then sees a modest increase before reverting back<sup>24</sup>. Furthermore, such behavior in credit and debit card spending is unlikely to be caused by any unobserved secular trend or seasonal patterns as we have no reason to expect that such factors would be exclusive to credit or debit card payments.

We find that consumers who used only debit card respond more to the GSS event compared to the consumers with credit card. In general, consumers who use only either credit card or debit card show more marked change of spending in the *shopping* category during the GSS compared to the consumers who use both credit and debit card. Especially, debit card users show clearer intertemporal substitution behavior in the *shopping* category. Consumers with both cards increase spending by S\$0.626 per day while consumers with only debit(credit) card transactions show an increase of S\$0.934(S\$0.759) per day<sup>25</sup>. When the spending change from the debit card users is compared with the spending of consumers who use both debit and credit card, we find the gap between *shopping* and *non-shopping* category during the GSS is wider. This finding is aligned with the comparison of consumers with high and low liquidity in Figure 5. As debit card users have less liquidity, their response is stronger in cross-categorical substitution.

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<sup>24</sup> As Figure 4 reports the cumulative changes in spending during the study period, one might want to know the changes in spending per each week. Thus, we report tables with coefficients per each period (or week) both in static and dynamic format similar to Table 2 and Table 3 in the Internet Appendix (Table IA.2).

<sup>25</sup> Please refer to Internet Appendix Table IA.3 in the Internet Appendix for detailed results.

Looking into the two broad spending categories, the documented pattern becomes more visible. Spending response using debit cards shows stronger signs of intertemporal substitution as the spending of *shopping* category items decreased during the one week after the end of GSS, and intra-temporal substitution as the debit card spending in the *non-shopping* categories decreased during GSS<sup>26</sup>.

Overall, the evidence on the different response patterns with respect to debit card and credit card spending supports the hypothesis that behavioral preferences are a driving force of permanent consumption effect in response to the transitory and anticipated price shock<sup>27</sup>. Furthermore, it helps reconcile the mixed finding in the extant literature and highlights the importance of assessing the consumption responses with debit cards (cash) as well as credit-based payment instruments that allow deferred payment.

#### 4.4. Constrained Consumers

Price discount programs can also provide a permanent consumption through satisfying the pent-up demand of constrained consumers. In this section, we study the differential spending responses of consumers with more or less liquidity constraints. We measure liquidity constraints based on three main proxies: checking account balance, income, and normalized checking account balance scaled by monthly income. Specifically, we sub-group all samples into *high*, *middle*, and *low* groups in the terms of checking account balance and monthly income. We use 25% and 75% as cut-off levels for *low* and *high* groups. That is, cardholders are members of the *low account balance* group if the cardholders have checking account balance below 25% of the checking account balance distribution (or S\$1,795) and members of the *high account balance* group if the checking

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<sup>26</sup> Even though we find marked change in spending pattern in a separate analysis of credit or debit card, the average spending level of credit card during 1 week before GSS, GSS, and 1 week after GSS is not significantly different from that of debit card. When weekly change in spending of credit card is compared with the that of debit card, we find credit card spending is larger in the starting week, after which no constant trend in the spending gap between credit and debit card is found. This result of credit and debit card comparison is reported in Internet Appendix Table IA.2. Panel C and D.

<sup>27</sup> While it is evident that debit card users benefit from the GSS through intertemporal substitution, increase in credit card spending is associated with less degree of intertemporal substitution to credit card users. We compare the credit card debt and the status of delinquency before and after June, 2010 to study if credit card users use more of credit line which can explain the different spending response to the GSS in terms of intertemporal substitution. We find that credit card debt increases by S\$259.35 (t-value=83.10) after the start of the GSS and the chance of being delinquent is higher than before the GSS by 0.1% (t-value=5.42). The results are reported in the Internet Appendix Table IA.4.

account balance is above the 75% level (or S\$28,900). The cutoff line for high and low in monthly income heterogeneity test is S\$6,403 and S\$2,900. In addition to the proxies of checking account balances and income level, we use a normalized proxy by using the checking account balance scaled by monthly income.

Panel A of Figure 5 compares the cumulative total spending responses between the *low account balance* and *high account balance* groups. It is evident that *low account balance* consumers experience a more significant and permanent increase in total spending during the entire period. On the other hand, the *high account balance* consumers increase their spending at the beginning, which then revert back to the baseline level. The cumulative spending of the *low (high) account balance* group on the total category ends at S\$42.61 (S\$15.12), which equates to 4.31% (0.80%)<sup>28</sup> increase from the average spending in the reference period of the *low (high) account balance* group. In the *shopping* category, consumers with the bottom 25% level of checking account balance increase spending during most of the GSS period, while *high account balance* group increase spending in the first 3-4 weeks; their spending remains almost flat until the end of the GSS. Spending changes on the *non-shopping* category is economically insignificant for *low account balance* group and statistically insignificant. However, the spending response from *high account balance* group on the *non-shopping* category decreases throughout the GSS period and is statistically significant from week 7 onward (p value=0.038).

[Insert Figure 5 here]

Panel B of Figure 5, by using income cuts, shows a very similar pattern. We find that the *low income* group responds more to the GSS. The *low income* group shows statistically significant response of cumulative spending in the *shopping* category. The cumulative spending of the *low (high) income* group equates to 3.4% (1.6%)<sup>29</sup> change compared with the average daily spending during the reference period. In the *non-shopping* category, the cumulative spending from the *low*

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<sup>28</sup> The percentage change is calculated by dividing the cumulative spending by the daily average spending during the reference period multiplied by 74 (total number of days including one week before and after the GSS and the GSS period). For example, in case of the low balance group, the cumulative spending is S\$42.61 and the average daily spending in the reference period is S\$13.36.  $S\$42.61 / (S\$13.36 \times 74 \text{ days}) = 4.31\%$ . Daily average spending in *low (high) balance* group from the reference period is S\$13.36 (S\$25.43).

<sup>29</sup> Daily average spending in *low (high) income* group is S\$13.46 (S\$30.50). The interpretation of percentage change followed the same method explained in the footnote 17.

*income* group declines in the first half of the event period and rebounds in the second half. However, all the coefficients are statistically insignificant at the 95% confidence level except for week 2-4. The *high income* group increases spending in the *shopping* category for 3 weeks from the start of the GSS. However, the spending level remains almost flat, albeit with a little fluctuation, during the rest of the event period. In addition, the *high income* group shows a continuous decrease in cumulative spending in the *non-shopping* category. Even though the negative response is statistically insignificant, the effect is economically large.

One thing to note is that previous literature used normalized proxies of liquidity instead of using the absolute value of the credit limit or bank account balance. (Agarwal, Pan and Qian, 2020; Gelman et al., 2014; Olafsson and Pagel, 2018). Following Agarwal, Pan and Qian (2020), we measure the level of liquid wealth using the checking account balance scaled by monthly income. Panel C of Figure 5 shows the cumulative spending of the 1<sup>st</sup> and 4<sup>th</sup> quartile classified by the liquid wealth level. In line with the previous figures based on the account balance and income level, we find that the subgroup with a higher level of liquid wealth responds less significantly from the mid-point of the GSS while the subgroup with a low level of liquid wealth continuously increase spending in the *shopping* category. The findings of Panel C of Figure 5 show that the spending response is much stronger when the normalized proxies are used to sort the financially constraint and non-constraint group. The cumulative spending of the low liquidity group is S\$60.04, while the high liquidity group remains at S\$7.38. These dollar terms are equal to 5.17% and 0.46% increase compared with the average daily spending during the reference period. This is another anecdotal evidence that shows the importance of using normalized proxied of liquidity level and reconfirms that consumers in different level of financial constraint show heterogeneous response.

#### **4.5. The Response by Shopping Subcategories**

In this section, we decompose the *shopping* categories into finer classifications. First, we categorize two sub-groups of the *shopping* category by durability of merchandise<sup>30</sup>. We find a clear

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<sup>30</sup> The definition of *durable* products in our study is slightly different from the definition used in economics. We define *durable* category as consumptions from merchant category codes Apparel; Art, Crafts, & Hobbies; Automotive

switching trend in spending between *durable* and *non-durable* categories (Figure 6). The spending in the *durable* category grows significantly from the start of the GSS until week 3. The response in the *durable* category stays constant for the rest of the study period. In contrast, spending in the *non-durable* category is statistically not different from zero in the first week of the GSS, when most of the heterogeneity tests show highest increase in spending, and remains statistically significant afterwards at the 95% confidence level.

[Insert Figure 6 here]

We also further decompose the *non-durable* category into *apparel*, *dining*, *entertainment*, *other*, *service*, *supermarket*, *transport*, and *travel* to further gauge the heterogeneous response by spending type (please refer to the data appendix for detailed definitions of these categories). The results are reported in Table 4.

[Insert Table 4 here]

In addition to *durables*, we also find a significant spending increase during the GSS in *apparel*, *dining*, *entertainment*, and *service* subcategories. The positive increase of daily spending is strongest in apparel by 37 cents and lowest in dining by 8.4 cents. We also find negative response in consumption in *supermarket*, *transport*, and *travel* by 5.9 cents, 8.3 cents and 47 cents respectively. *Dining* and *travel* show a permanent spending increase; spending in *dining* is still significantly higher than the reference period after the end of the GSS; and spending on *travel* is markedly negative after the GSS. *Entertainment* and *transport* show intertemporal substitution effect during and after the GSS.

## 4.6. Additional Analyses

### 4.6.1. More Heterogeneity Tests

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Related; Books & News; Building Construction; Child & Mother Care; Department Stores; Electronic & Computer; Home/Office Furnishing & Appliances; Music; Photography/Photocopy; Sports Merchandise; Specialty Retail; and Watches & Jewelry. The *non-durable* category contains Beauty Salons & Cosmetics & Spa; Dining; Entertainment & Recreational; Food & Beverage Stores; and Supermarkets.

We study the differential responses by consumer demographics, including age, ethnicity, gender, and marital status. We find a generally similar response pattern between young and old consumers. While the *Chinese* group gradually increases total daily spending during the GSS period without much reversion after the end of the GSS, the *non-Chinese* group increases spending in a more delayed fashion and experiences a visible decrease after the end of the GSS. Cutting the sample by gender, we find an almost identical response to the GSS for men and women. Lastly, *single* consumers increase their spending permanently, while the *married* consumers increase spending at the beginning of the GSS and starts to cut back after week 2. For brevity, we leave the results in the Online Appendix.

#### 4.6.2 Robustness Tests

We conduct an additional test to address the concern that positive or negative response to the GSS might be due to unobserved characteristics associated with the special calendar date on which GSS was launched in 2010. We test the difference of daily spending between two consecutive days, which are 1) starting date of the GSS in 2010 and 2) one day before the GSS. However, as we find opposite responsiveness in *shopping* and *non-shopping* category, a comprehensive mean test can bring up biased results. Thus, we test the mean difference of total daily spending in the *shopping* and *non-shopping* categories in 2010 and repeat the same test in 2011 with the same date to see if that specific date is related to the increase or decrease of spending.

Firstly, we compare total daily spending of May 26 and May 27, 2010, one day prior to the GSS and the first day of the GSS respectively. We conduct t-test of mean difference in daily spending between May 26 and May 27, 2010. In the *shopping* category, the mean of spending on May 27<sup>th</sup> is significantly higher (p value<0.01) than that of May 26<sup>th</sup>. In the *non-shopping* category, the spending level on May 27<sup>th</sup> is significantly lower (p value<0.05). Thus, we can easily see that the starting date of the GSS in 2010 has higher level of spending in the *shopping* category and lower level of spending in the *non-shopping* category. If this effect is from the unobserved characteristics of a specific date, i.e. May 27<sup>th</sup>, we should find similar mean difference in 2011. Following the method that we use for the t-test in 2010, we test mean difference between May 26 and May 27,

2011. We find no significant difference in the *shopping* category. In the *non-shopping* category, we find that spending on May 27<sup>th</sup> is higher ( $p$  value $<0.05$ ) than that of May 26<sup>th</sup>, the opposite result from the test in 2010.

Since using different sets of reference period can affect the changes of spending, we conduct an additional test with different specification of reference period to investigate whether the inter-temporal and cross-category substitution behavior remains effective when the specification of the reference period is altered. In the alternative model, we use the first 3-week period of the study period (4 to 2 week before the start of the GSS) as a reference period and regress on three separate terms composed of 1 week before the GSS, GSS, and 4 weeks after the GSS, so that we can find the major impact on the substitution effect changes or not. As shown in Table 5, the tenor of the major finding related with the inter-temporal and cross-categorical substitution effect is not altered by using an alternative specification of reference period. It is also important to note that the results in Table 5 reconfirm that there are no long-term impacts on spending, and the change in spending during the GSS is a transitory change.

[Insert Table 5 here]

## **5. Conclusion**

This paper studies the response of spending to anticipated price shock by investigating the recurring annual shopping event of Singapore (The Great Singapore Sale) and a unique panel dataset of credit and debit card transactions from approximately 124,000 consumers who hold accounts at a leading domestic bank. The scope of the merchandise affected by the promotion is not limited to certain product categories and reportedly shoppers can enjoy discounts of up to 70%. We investigate if shoppers spend less before and after the shopping event, the inter-temporal substitution effect. We also sort the data by merchant category code (MCC) to test cross-category substitution effect across MCC groups related to the event and the groups that are not. We test the responsiveness to the shopping event in 2010 by using a distributed-lag model with a reference period which ranges from 4 to 2 weeks prior to the start of the event and 2 to 4 weeks after the end of the event.

Consumers significantly increase their spending during the sale event. More importantly, we find inter-temporal substitution where consumers spend less immediately before the event, and cross-categorical substitution behavior where consumers decrease spending in items unaffected by the sale event. However, consumers exhibit little substitution behavior when they use credit cards or when they are liquidity constrained.

These findings in this paper directly contribute to our understanding on the consumption response to anticipated and temporary price cuts. First, our findings point out that the consumer substitution behavior, both intertemporally and intra-temporally, may significantly dampen the aggregate consumption response to such temporary price cuts. Second, we uncover significant heterogeneity in the consumption response across liquidity constraints or across payment instruments. They imply that the effectiveness of such a program in stimulating the aggregate economy depend on the composition of the (affected) consumers and the prevalent use of consumer credit (relative to cash or debit cards).

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## Appendix 1: List of Variables and Definitions

### Outcome variables

#### Spending and transaction

*Total daily spending* measures deviation of total amount that a person spends per day during the event weeks compared to the spending amount during the 3 weeks before and 3 weeks after the event weeks, which starts one week before the Great Singapore Sale.

*Daily spending per transaction* measures deviation of personal spending amount per transaction in each day compared to average spending during the 3 weeks before and 3 weeks after the event weeks, which starts one week before the Great Singapore Sale.

*# of daily transaction* means deviation of number of daily transaction per person compared to average spending during the 3 weeks before and 3 weeks after the event weeks, which starts one week before the Great Singapore Sale.

#### Weekly variable in Figure 3 and Figure 4

Variable	Description	Calendar Date
Pre1	1 week before GSS	From May 20 <sup>th</sup> , 2010 to May 26 <sup>th</sup> , 2010
0*	1 <sup>st</sup> week of GSS	From May 27 <sup>th</sup> , 2010 to June 2 <sup>nd</sup> , 2010
1	2 <sup>nd</sup> week of GSS	From June 3 <sup>rd</sup> , 2010 to June 9 <sup>th</sup> , 2010
2	3 <sup>rd</sup> week of GSS	From June 10 <sup>th</sup> , 2010 to June 16 <sup>th</sup> , 2010
3	4 <sup>th</sup> week of GSS	From June 17 <sup>th</sup> , 2010 to June 23 <sup>rd</sup> , 2010
4	5 <sup>th</sup> week of GSS	From June 24 <sup>th</sup> , 2010 to June 30 <sup>th</sup> , 2010
5	6 <sup>th</sup> week of GSS	From July 1 <sup>st</sup> , 2010 to July 7 <sup>th</sup> , 2010
6	7 <sup>th</sup> week of GSS	From July 8 <sup>th</sup> , 2010 to July 14 <sup>th</sup> , 2010
7	8 <sup>th</sup> week of GSS	From July 15 <sup>th</sup> , 2010 to July 21 <sup>st</sup> , 2010
8**	9 <sup>th</sup> week of GSS	From July 22 <sup>nd</sup> , 2010 to July 25 <sup>th</sup> , 2010
Post1	1 week after GSS	From July 26 <sup>th</sup> , 2010 to August 1 <sup>st</sup> , 2010
GSS	Total GSS period	From May 27 <sup>th</sup> , 2010 to July 25 <sup>th</sup> , 2010

\*The official Great Singapore Sale started on May 28, 2010. However, as some of the major retailers started pre-sale, the first day of Great Singapore Sale is set to May 27, 2010 in our study.

\*\*8 contains 4 days instead of 7 days.

#### Spending type

*Shopping* means spending categories that are closely related to Great Singapore Sale. Consumers are likely to have benefited from Great Singapore Sale when they spend money on the items under this category. The *shopping* category contains the following Merchant Category Codes: Apparel; Art, Crafts, & Hobbies; Automotive Related; Beauty Salons & Cosmetics & Spa; Books & News;

Building Construction; Child & Mother Care; Department Stores; Dining; Electronic and Computer; Entertainment & Recreational; Food & Beverage Stores; Home/Office Furnishing & Appliances; Music; Photography/Photocopy; Sports Merchandise; Specialty Retail; Supermarkets; and Watches & Jewelry.

*Non-shopping* means spending categories that are less likely to be related to Great Singapore Sale. *Non-shopping* contains: Airlines, Associations/Memberships, Driving Centers, Education, Fuel, Government, Hotels/Lodgings, Insurance, Land and Sea Transportation, Medical, NETS-Kiosk, Pets, Professional Services, Rental, Repair, Specialized Cleaning Services, and Tour Agencies.

*Durable* is a sub-category *shopping*. It contains transactions in the following MCCs: Apparel; Art, Crafts, & Hobbies; Automotive Related; Books & News; Child & Mother Care; Department Stores; Electronic and Computer; Home/Office Furnishing & Appliances; Music; Photography/Photocopy; Sports Merchandise; Specialty Retail; and Watches & Jewelry. Unlike the conventional definition of durable goods, we define durable goods as products that are likely to last over one year. The other categories are *non-durable* items in our study.

### **Nine subcategories in Table 3**

*Apparel* is a subcategory of total transactions from Merchant Category Codes (MCC) Department Stores, Watches & Jewelry, Apparel, Specialty Retail, Fashion Acc & Apparel, Jewelry, and Child & Mother Care.

*Dining* is a subcategory of total transactions from Merchant Category Codes (MCC) Dining and Restaurants, Café, and Bars.

*Durable* is a subcategory of total transactions from Merchant Category Codes (MCC) Automotive Related, Electronic and Computer, Home/Office Furnishing & Appliances, Building Construction, and Repair.

*Entertainment* is a subcategory of total transactions from Merchant Category Codes (MCC) Entertainment & Recreational; Music; Art, Crafts, & Hobbies; Photography/Photocopy, Associations/Memberships; Pets; Books & News; and Sports Merchandise.

*Other* is a subcategory of total transactions from Merchant Category Code (MCC) NETS-KIOSK.

*Service* is a subcategory of total transactions from Merchant Category Codes (MCC) Insurance, Education, Government, Medical, Professional Services, Specialized Cleaning Services, Beauty Salons & Cosmetics & Spa, and Driving Centers.

*Supermarket* is a subcategory of total transactions from Merchant Category Codes (MCC) Supermarkets and Food & Beverage Stores.

*Transport* is a subcategory of total transactions from Merchant Category Code (MCC) Fuel.

*Travel* is a subcategory of total transactions from Merchant Category Codes (MCC) Tour Agencies, Hotel/Lodgings, Airlines, Land and Sea Transportation, Fuel, and Rental.

**Personal characteristics**

*Old* is defined as a group with ages above 75% of age distribution as of April, 2010.

*Young* is defined as a group with ages below 25% of age distribution as of April, 2010.

*High balance* is defined as a group with checking account balance above 75% of checking account balance distribution as of April, 2010.

*Low balance* is defined as a group with checking account balance below 25% of checking account balance distribution as of April, 2010.

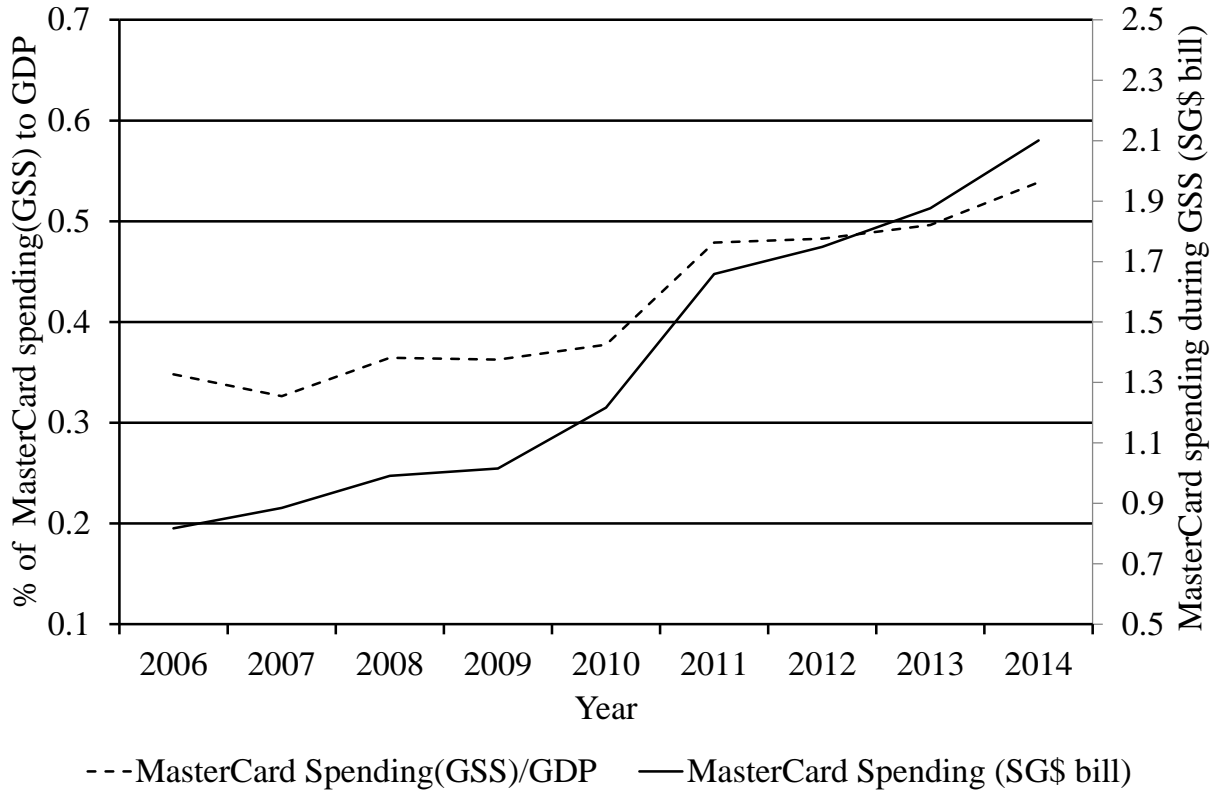
*High credit limit* is defined as a group with credit limit above 75% of credit limit distribution as of April, 2010.

*Low credit limit* is defined as a group with credit limit below 25% of credit limit distribution as of April, 2010.

*High income* is defined as a group with income level above 75% of income distribution as of April, 2010.

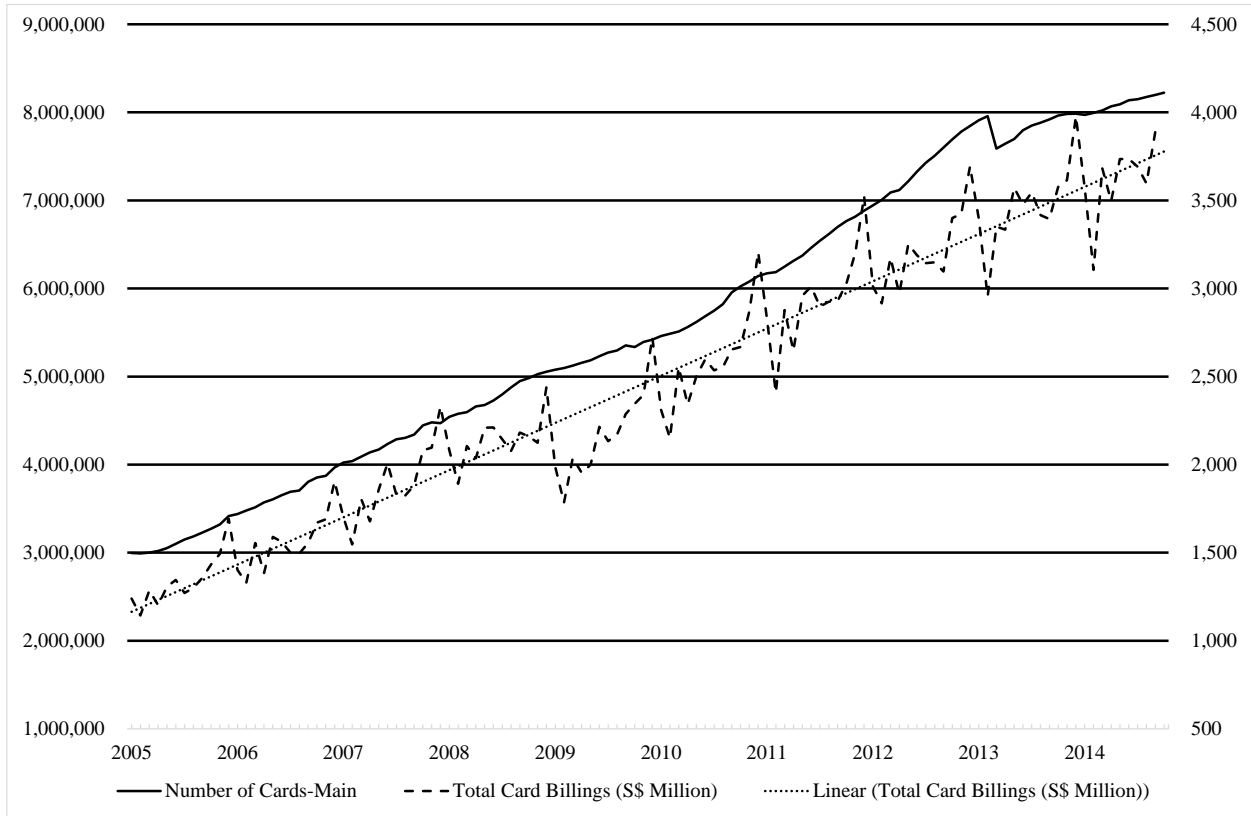
*Low income* is defined as a group with income level below 25% of income distribution as of April, 2010.

**Figure 1. MasterCard Spending during GSS and Comparison to GDP**



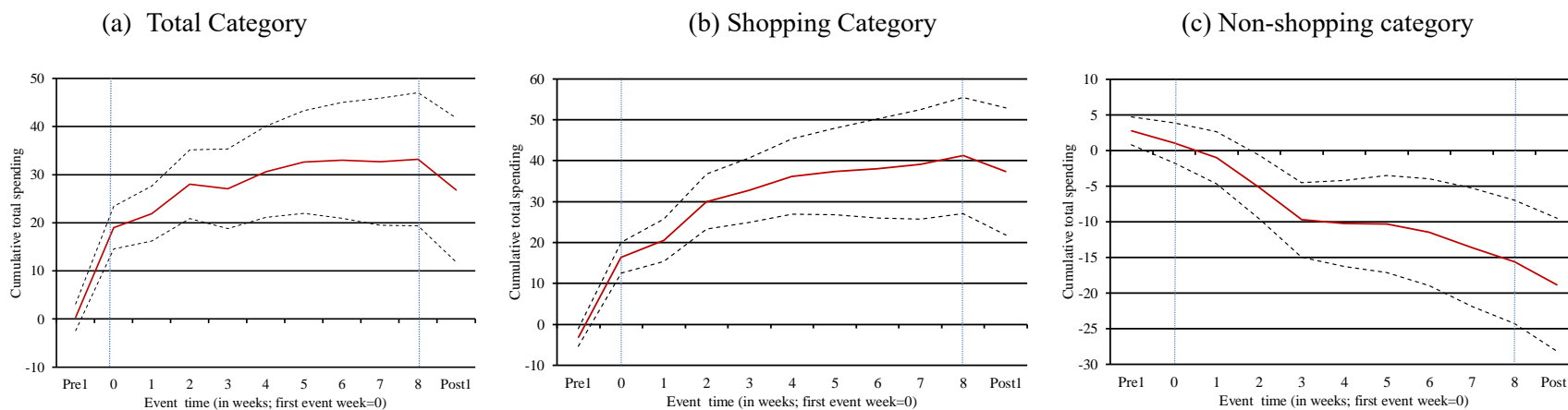
*Note: This figure shows proportion of MasterCard spending during Great Singapore Sale to Singapore's GDP (dashed line) from 2006 to 2014 along with total MasterCard spending (solid line) during the GSS per year in Singapore from 2006 to 2014.*

**Figure 2. Total Credit and Charge Card Market in Singapore**



*Note: This figure shows development of credit and charge card use in Singapore from 2005:1 to 2014:10. The solid line is the total number of cards in Singapore, and the dashed line indicates total card billings in SGD million. The dotted line is the linear trend line of total card billing. Y-axis mean total number of charge card (left) and total card billings in million SGD (right). X-axis indicate month and year.*

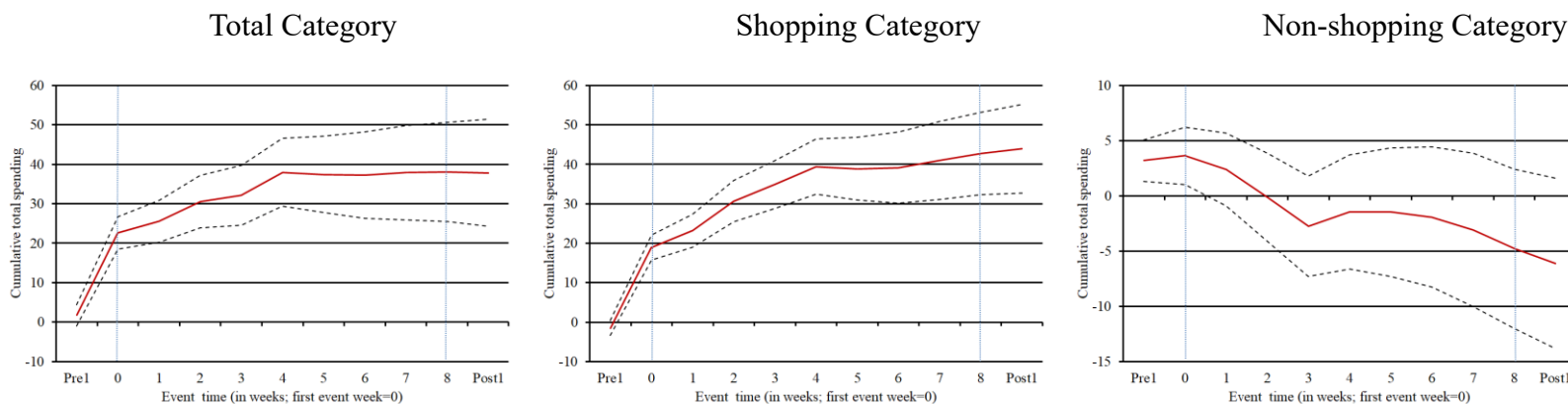
**Figure 3. Estimated Cumulative Total Spending Per Category**



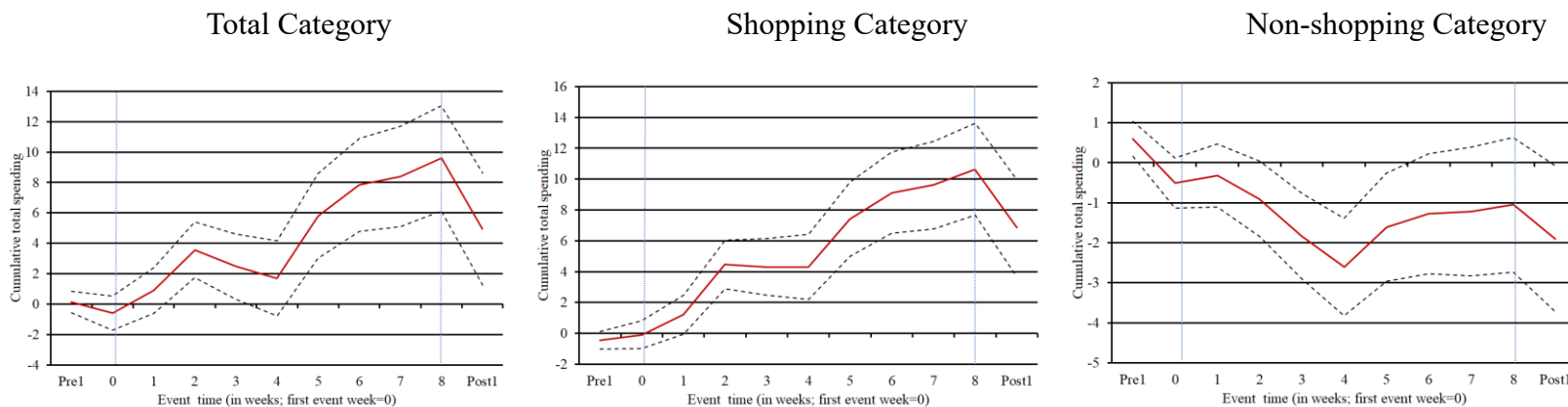
*Note: This figure plots the dynamic responses of cumulative total spending from one week before the GSS to one week after the GSS. Each figure indicates the cumulative change of total spending compared to the period 2 to 4 weeks before and 2 to 4 weeks after the start of the GSS. Panel (a) shows the response for each week in all the merchant categories. In Panel (b) and (c), we design two sub-groups: shopping and non-shopping. The shopping category contains transactions from GSS-related merchant category codes such as apparel, while non-shopping includes merchant category codes least likely to be affected by the GSS. Please refer to Appendix for more detailed definition of shopping and non-shopping categories. The starting and ending weeks of GSS period are demarcated by the blue dotted line from 0 to 8 on the x-axis, which indicates  $i^{\text{th}}$  week of the GSS. One week before and after the GSS are labeled Pre1 and Post1 respectively. The path of the coefficient is plotted in solid line along with the corresponding 95% confidence intervals (dotted lines).*

**Figure 4. Cumulative Total Spending Response by Card Type**

**Panel A: Credit Card**



**Panel B: Debit Card**

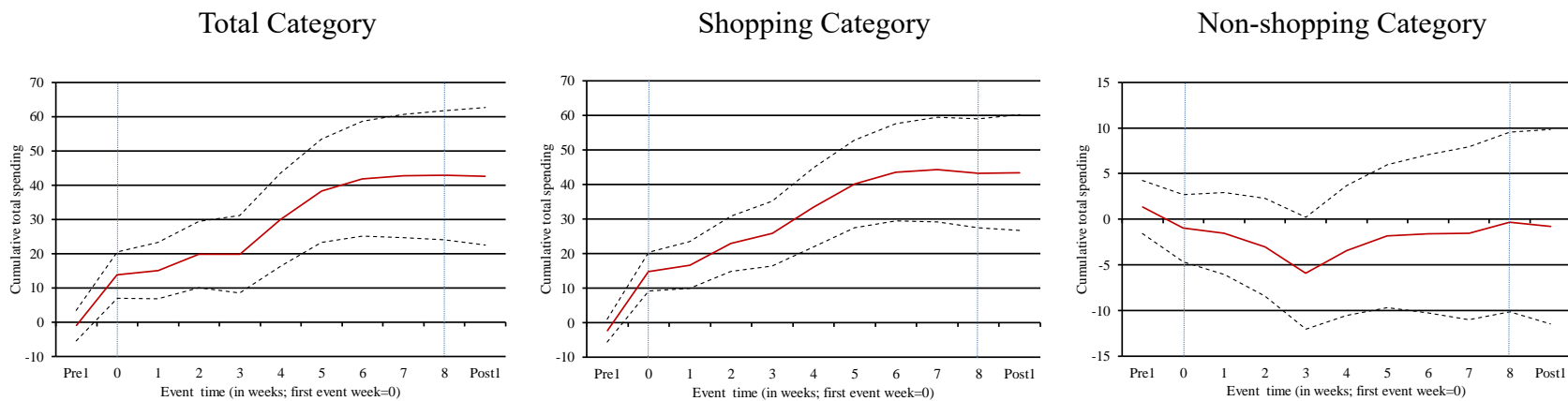


*This figure plots the dynamic response for credit card spending (Panel A) and debit card spending (Panel B) respectively. The construction of the figures is similar to that in Figure 3.*

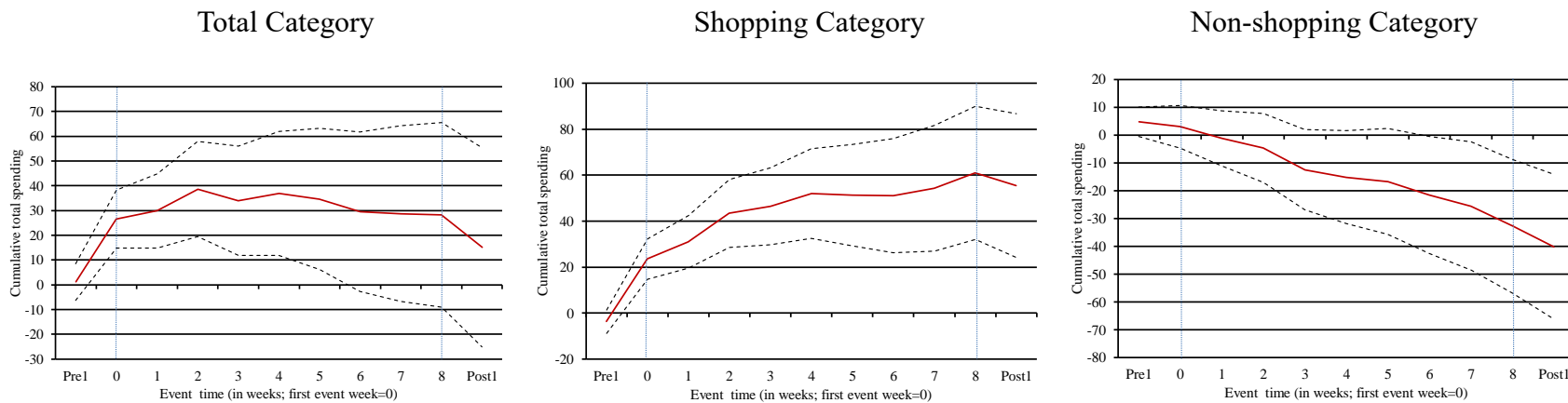
**Figure 5. Cumulative Total Spending Response by Liquidity Constraints**

**Panel A**

Low Account Balance



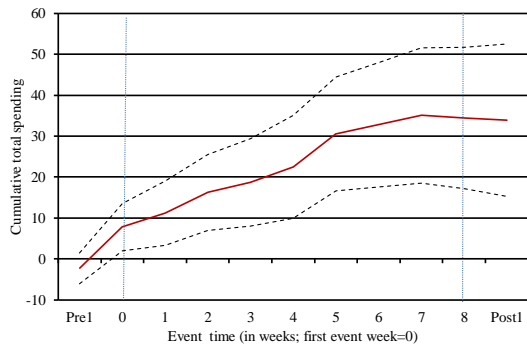
High Account Balance



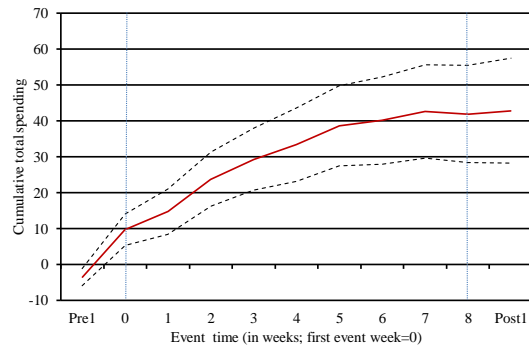
## Panel B

### Low Income

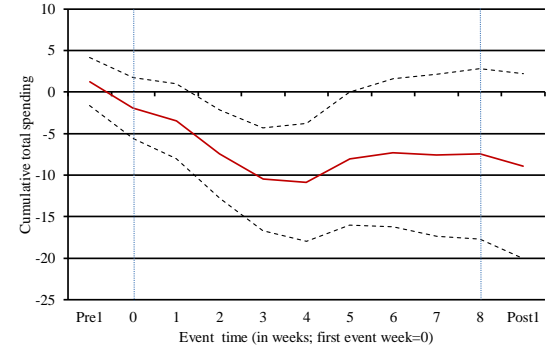
#### Total Category



#### Shopping Category

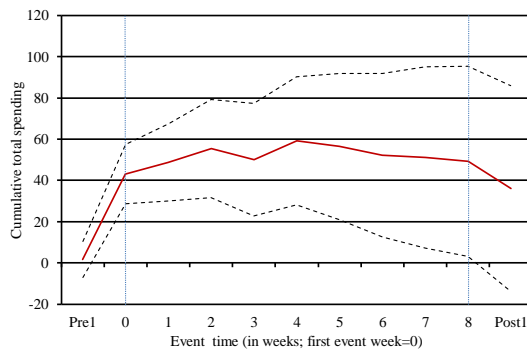


#### Non-shopping Category

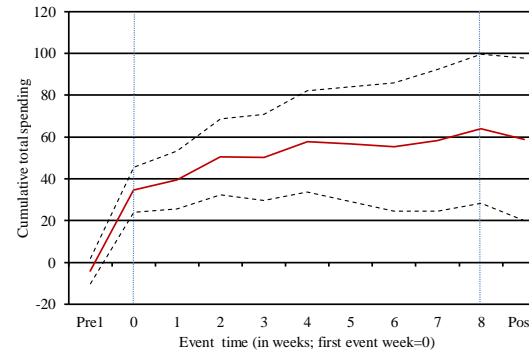


### High Income

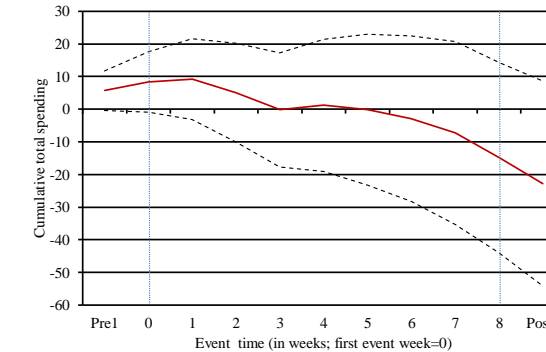
#### Total Category



#### Shopping Category

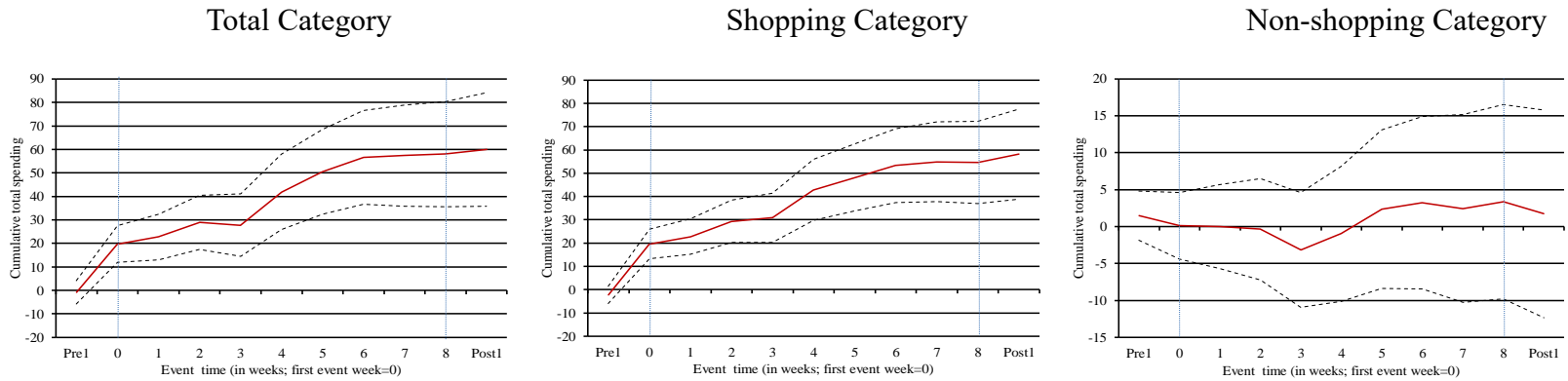


#### Non-shopping Category

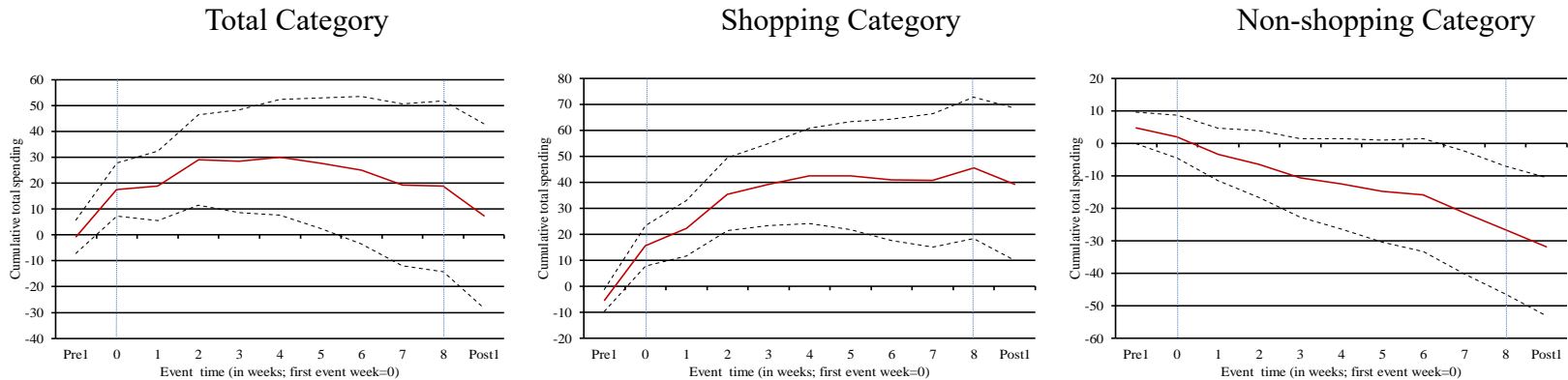


## Panel C

### Low Liquid Wealth

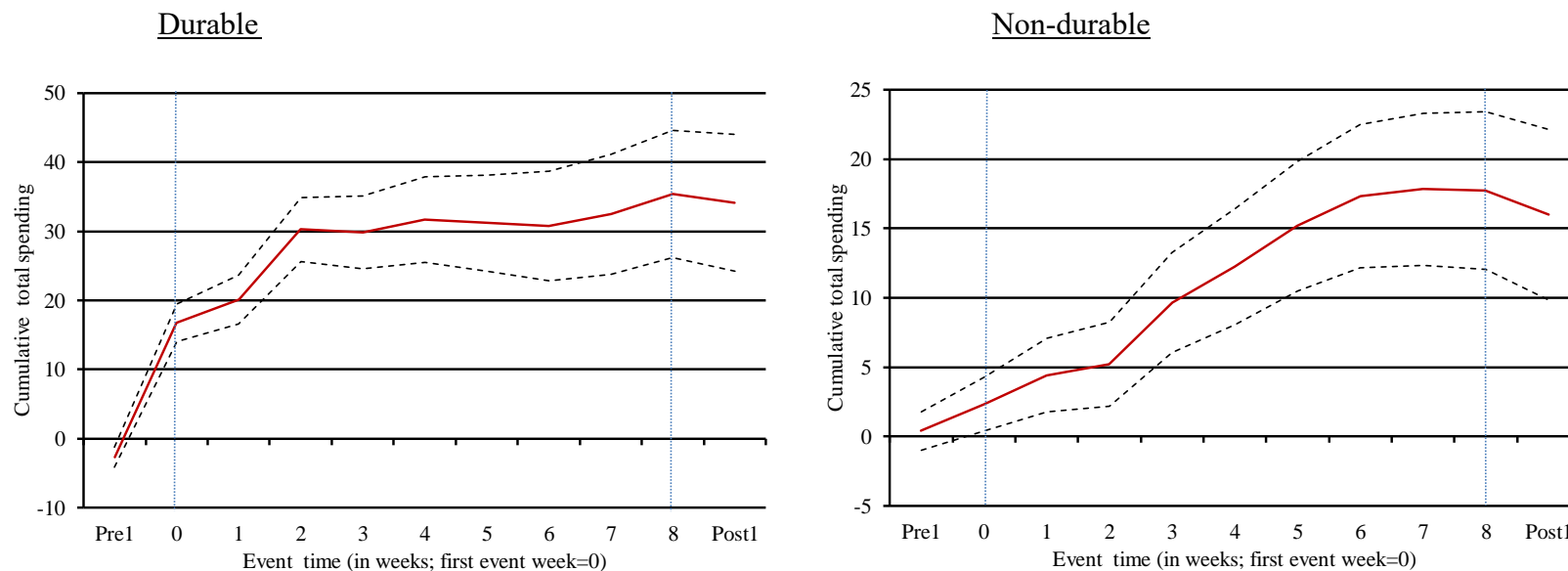


### High Liquid Wealth



This figure plots the dynamic response by liquidity constraints, using checking account balance (Panel A), income (Panel B), and liquid wealth (Panel C) as measures of liquidity. The financial information is based on the cardholders' status as of April 2010. Two separate group at the bottom 25% and top 25% in the distribution of the checking account balance, income level, and liquid wealth are classified based on Eq (3). The construction of the figures is similar to that in Figure 3.

**Figure 6. Cumulative Total Spending by Product Durability**



*This figure plots the dynamic responses of cumulative total spending in durable and non-durable products within the shopping category. The definition of durable products in our study is slightly different from the definition used in Economics. We define durable as consumption from merchant category codes Apparel; Art, Crafts & Hobbies; Automotive Related; Books & News; Building Construction; Child & Mother Care; Department Stores; Electronic & Computer; Home/Office Furnishing & Appliances; Music; Photography/Photocopy; Sports Merchandise; Specialty Retail; and Watches & Jewelry. The non-durable category contains Beauty Salons & Cosmetics & Spa; Dining; Entertainment & Recreational; Food & Beverage Stores; and Supermarkets. The construction of the figures is similar to that in Figure 3.*

**Table 1. Summary Statistics**

Variable	(1) Mean	(2) Std. Dev.	(3) 25%	(4) 75%
<b>Panel A: Demographic information</b>				
Age	41.6	9.98	33.7	48.4
Female	40%			
Married	47%			
Ethnicity				
Chinese	81.40%			
<b>Panel B: Financial information</b>				
Checking Account Balance	\$37,431	\$139,796	\$1,795	\$28,900
Credit Limit	\$9,179	\$8,238	\$5,000	\$10,000
Monthly Income	\$5,926	\$8,483	\$2,900	\$6,403
Number of consumers	124,221			
<b>Panel C: Spending information</b>				
Total daily spending	\$19.34	\$178.32	\$0.00	\$0.00
Average spending per transaction	\$15.42	\$149.59	\$0.00	\$0.00
Number of transactions	0.20	0.58	0.00	0.00

*Note: This table provides summary statistics for individuals who made transactions with credit card and debit card during the sample periods (i.e., 4:2010-8:2010) in the bank dataset. Variables include demographic information such as age, gender, ethnicity, marital status, financial information including checking account balance, credit limit of credit card, and monthly income as of April 2010, and spending information such as total daily spending, average spending per transaction, and the number of transactions. Column (1) shows the mean of each variable and column (2) reports standard deviation. Column (3) and (4) shows cutline of bottom 25% and top 25% of the distribution respectively. All the amounts in financial information are in Singaporean Dollar (SGD), and 1 SGD=0.78 USD as of February 2011.*

**Table 2. Consumer Spending Response to GSS by Category**

Variables	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
<b>Panel A: Total category</b>			
1 Week before GSS	0.049 (0.24)	-0.076 (-0.45)	0.002*** (4.19)
GSS	0.548*** (5.05)	0.312*** (3.50)	0.004*** (13.31)
1 Week after GSS	-0.907*** (-4.34)	-0.690*** (-3.94)	-0.011*** (-16.94)
Reference period, consumer mean	19.062	15.277	0.197
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.039	0.029	0.271
<b>Panel B: Shopping category</b>			
1 Week before GSS	-0.345** (-2.44)	-0.305** (-2.55)	0.000 (0.05)
GSS	0.854*** (10.09)	0.626*** (8.96)	0.004*** (16.40)
1 Week after GSS	-0.445*** (-2.63)	-0.319** (-2.24)	-0.010*** (-17.29)
Reference period, consumer mean	11.559	9.003	0.124
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.037	0.026	0.321
<b>Panel C: Non-shopping category</b>			
1 Week before GSS	0.395*** (2.76)	0.229* (1.91)	0.002*** (7.94)
GSS	-0.306*** (-4.55)	-0.315*** (-5.52)	-0.000 (-0.65)
1 Week after GSS	-0.462*** (-3.82)	-0.372*** (-3.63)	-0.001*** (-4.70)
Reference period, consumer mean	7.503	6.274	0.073
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.026	0.022	0.090

*Note: This table reports the outcome of regression based on Eq(1). We measure response to the Great Singapore Sale (thereafter GSS) in three ways: total daily spending, daily spending per transaction, and number of transactions during 3 separate periods. These periods include 1 Week before GSS, GSS, and 1 Week after GSS. The reference period is a 6-week term consisting of 3-week term before “1 Week before GSS” and 3-week term after “1 Week after GSS”. Total daily spending means total amount of credit and debit card transaction at daily level per each cardholder. Daily spending per transaction is an average amount of dollar spent in each transaction at daily and individual level. Total number of transactions is the number of transactional per each day at individual level. Panel A shows the total; response, which we also decompose into shopping and non-shopping categories in Panels B and C. The shopping category contains transactions from GSS-related merchant category codes such as apparels, while non-shopping category includes merchant category codes least likely to be affected by the GSS such as fuel. Please refer to Appendix for more detailed definitions. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

**Table 3. Dynamic Response in Total Daily Spending**

Variables	(1) Total category	(2) Shopping category	(3) Non-shopping category
1 Week before GSS	0.049 (0.24)	-0.458*** (-2.94)	0.395*** (2.76)
Week 0	2.662*** (12.40)	2.791*** (15.43)	-0.242* (-1.89)
Week 1	0.419** (1.97)	0.605*** (3.41)	-0.299** (-2.23)
Week 2	0.874*** (4.00)	1.351*** (7.08)	-0.590*** (-4.63)
Week 3	-0.142 (-0.72)	0.400** (2.45)	-0.654*** (-5.21)
Week 4	0.510** (2.32)	0.469** (2.53)	-0.072 (-0.52)
Week 5	0.289 (1.39)	0.184 (1.12)	-0.009 (-0.06)
Week 6	0.051 (0.21)	0.100 (0.46)	-0.163 (-1.29)
Week 7	-0.044 (-0.21)	0.152 (0.89)	-0.309** (-2.28)
Week 8	0.123 (0.49)	0.520** (2.31)	-0.510*** (-3.89)
1 Week after GSS	-0.907*** (-4.34)	-0.558*** (-3.01)	-0.462*** (-3.82)
Reference period, consumer mean	19.062	11.559	7.503
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.039	0.037	0.026

*Note: This table reports the result of regressing total daily spending on the dummy variables indicating each week before, during, and after the GSS in weekly format. Each point estimate indicates the response of total spending compared to the period 2 to 4 weeks before “1 Week before GSS” and 2 to 4 weeks after “1 Week after GSS”. Week 0 is the first week of the GSS and Week 8 is the last week of the GSS. Column (1) shows the response in total sample including all the merchant category codes. The shopping category of column (2) contains transactions from the GSS-related merchant category codes such as apparels, while non-shopping category includes merchant category codes least likely to be affected by the GSS such as fuel. Please refer to Appendix for more detailed definition of shopping and non-shopping categories. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent*

**Table 4. Consumer Spending Response to GSS in 9 Subcategories**

VARIABLES	(1) Apparel	(2) Dining	(3) Durable	(4) Entertainment	(5) Others	(6) Service	(7) Supermarket	(8) Transport	(9) Travel
1 Week before GSS	-0.282*** (-3.94)	0.044 (0.54)	-0.103 (-1.55)	0.047 (0.94)	0.009 (1.02)	0.303*** (3.16)	-0.036 (-1.34)	-0.048*** (-4.48)	0.066 (0.63)
GSS	0.372*** (6.78)	0.084** (2.28)	0.185*** (4.67)	0.278*** (9.71)	0.002 (0.50)	0.156*** (3.26)	-0.059*** (-4.58)	-0.083*** (-12.43)	-0.470*** (-10.00)
1 Week after GSS	-0.147 (-1.62)	0.221** (2.01)	0.033 (0.44)	-0.105** (-2.16)	0.007 (0.83)	0.070 (0.79)	-0.363*** (-15.84)	0.034*** (2.86)	-0.623*** (-8.38)
Reference period, consumer mean	2.920	2.328	1.839	1.969	0.073	3.517	2.362	1.525	4.054
Observations	14,409,636	14,409,636	14,409,636	14,409,636	14,409,636	14,409,636	14,409,636	14,409,636	14,409,636
R-squared	0.020	0.020	0.017	0.071	0.034	0.023	0.111	0.103	0.023

*Note: This table reports the responsiveness of total daily spending in 9 sub-categories classified by similar characteristics in merchant category codes. Each column shows response in total daily spending on three separate dummy variables indicating one week before the GSS, whole GSS period, and one week after GSS in comparison to the reference period consisting of 3-week term before “1 Week before GSS” and 3-week term after “1 Week after GSS”. Total daily spending for each of the nine subcategories is analyzed based on Eq (1). Detail of Merchant Category Code per each subcategory is described in the Appendix. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

**Table 5. Consumer Spending Response to GSS with Alternative Model Specification**

Variables	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
<b>Panel A: Total category</b>			
1 Week before GSS	-0.167 (-0.77)	-0.251 (-1.37)	0.003*** (4.69)
GSS	0.331** (2.39)	0.137 (1.18)	0.005*** (11.49)
4 Weeks after GSS	-0.606*** (-3.89)	-0.479*** (-3.69)	-0.002*** (-4.14)
Reference period, consumer mean	19.062	15.277	0.197
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.039	0.029	0.271
<b>Panel B: Shopping category</b>			
1 Week before GSS	-0.458*** (-2.94)	-0.394*** (-2.94)	0.001 (1.20)
GSS	0.741*** (6.70)	0.537*** (5.74)	0.005*** (14.69)
4 Weeks after GSS	-0.309** (-2.51)	-0.236** (-2.30)	-0.001*** (-3.50)
Reference period, consumer mean	11.559	9.003	0.124
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.037	0.026	0.321
<b>Panel C: Non-shopping category</b>			
1 Week before GSS	0.291* (1.93)	0.143 (1.13)	0.002*** (7.07)
GSS	-0.410*** (-4.90)	-0.400*** (-5.66)	-0.000 (-1.28)
4 Weeks after GSS	-0.297*** (-3.25)	-0.243*** (-3.11)	-0.001*** (-2.68)
Reference period, consumer mean	7.503	6.274	0.073
Observations	14,409,636	14,409,636	14,409,636
R-squared	0.026	0.022	0.090

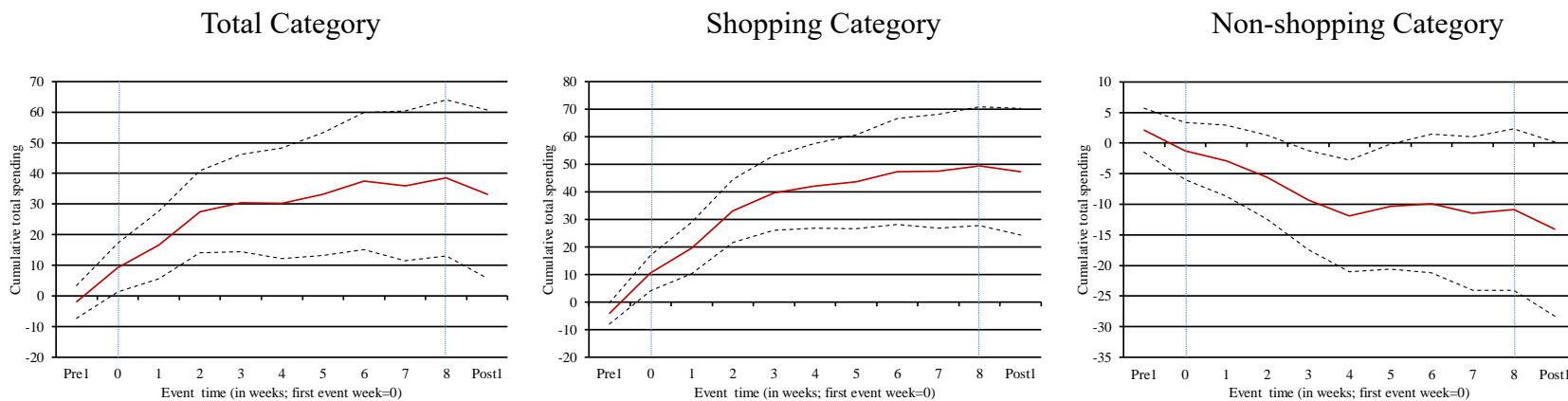
*Note: This table reports the outcome of regression based on Eq(1) with an alternative reference period. We use e period composed of 4 to 2 weeks before the GSS and regress total daily spending, daily spending per transaction, and number of transactions during 3 separate periods. These periods include 1 Week before GSS, GSS, and 4 Weeks after GSS. Panel A shows the total response, which we also decompose into shopping and non-shopping categories in Panels B and C. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

INTERNET APPENDIX  
NOT FOR PUBLICATION

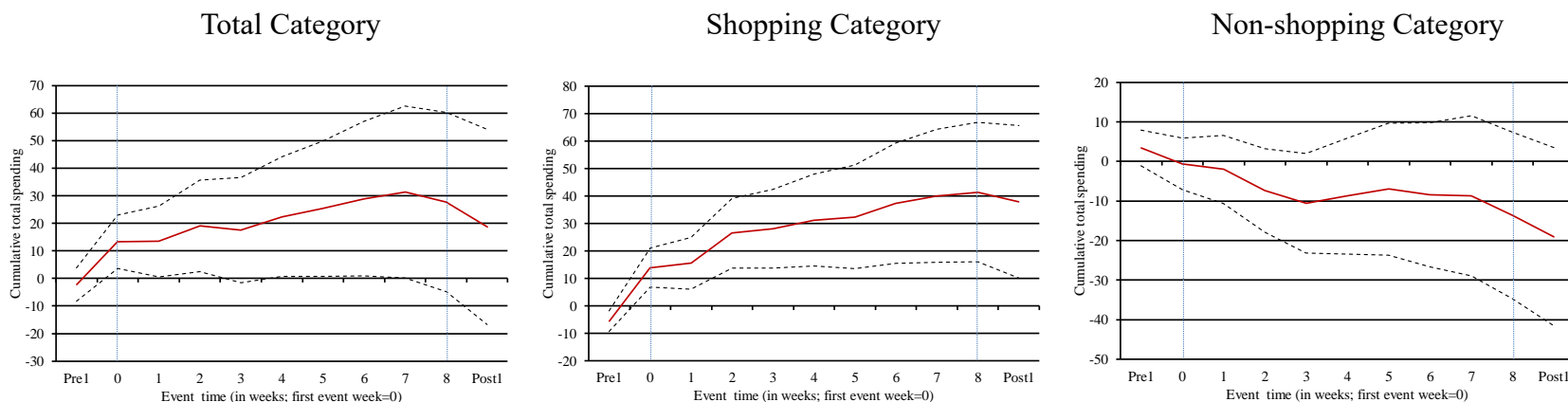
**Figure IA.1: Estimated Cumulative Total Spending: More Heterogeneity Tests**

**Panel A. Cumulative Total Spending by Age Group**

Young



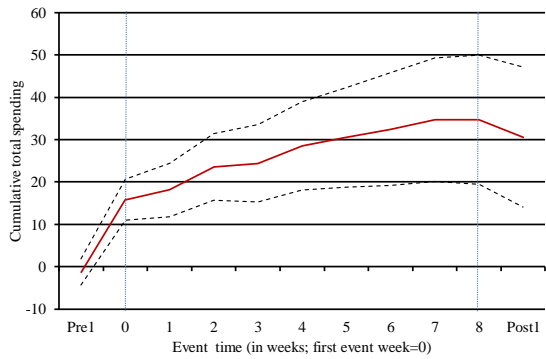
Old



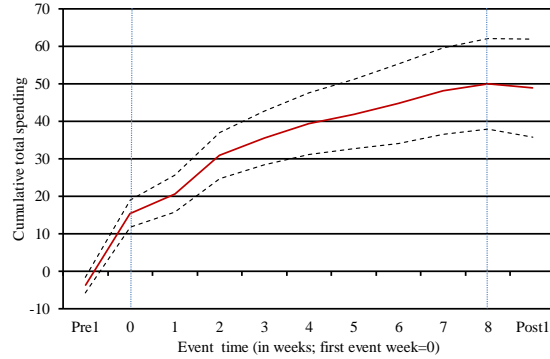
**Panel B. Cumulative Total Spending by Ethnic Group**

Chinese

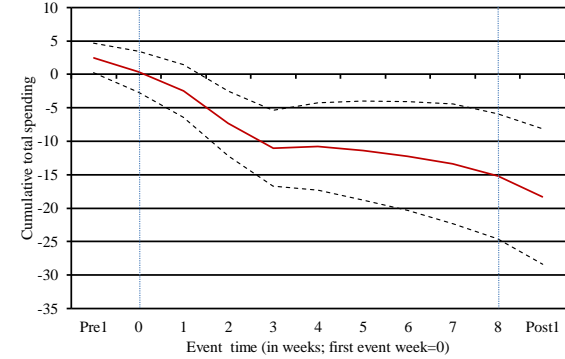
Total Category



Shopping Category

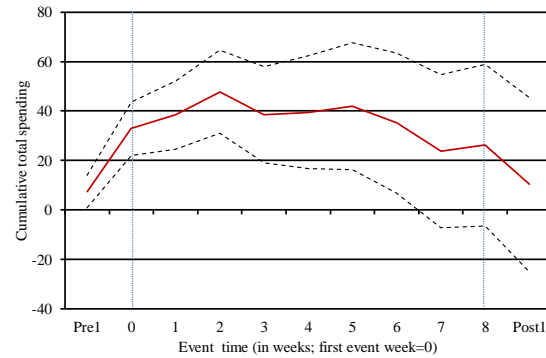


Non-shopping Category

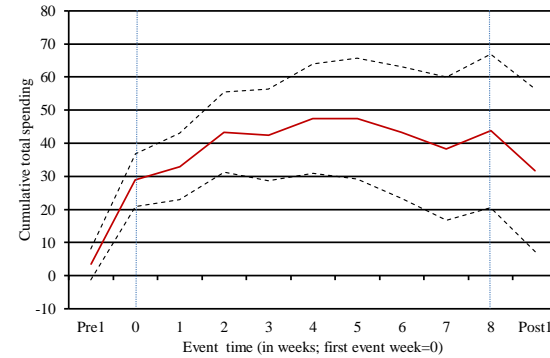


Non-Chinese

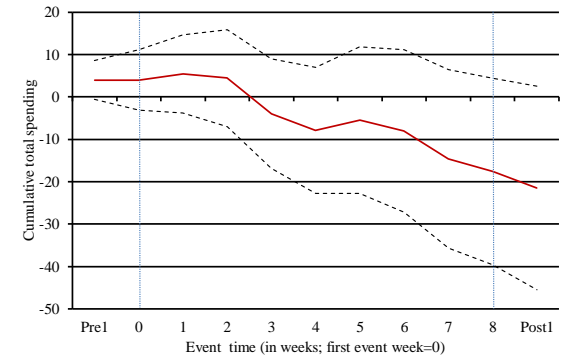
Total Category



Shopping Category



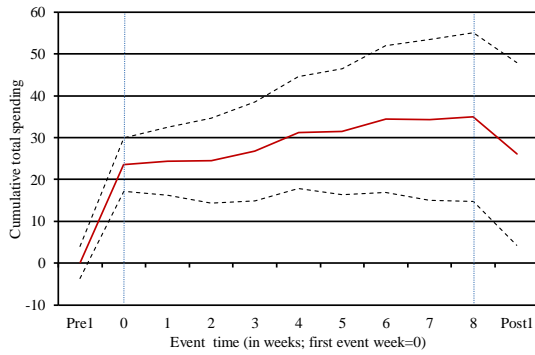
Non-shopping Category



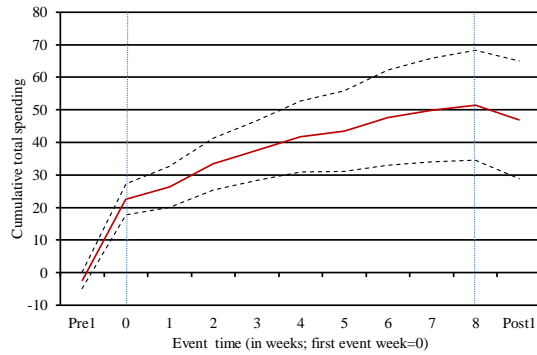
**Panel C. Cumulative Total Spending by Gender**

**Female**

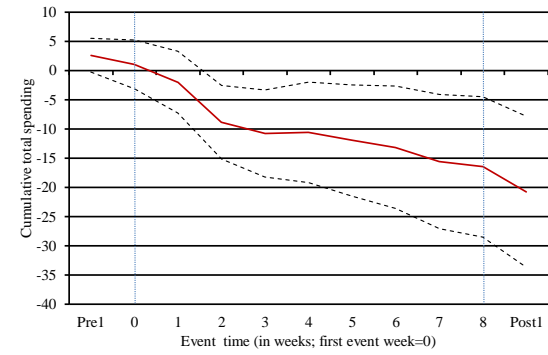
**Total Category**



**Shopping Category**

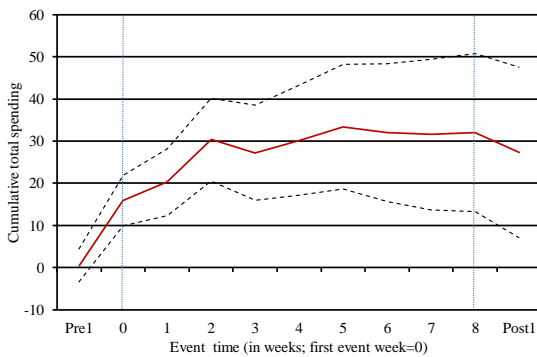


**Non-shopping Category**

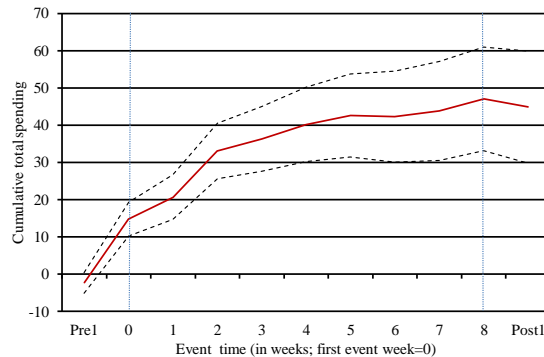


**Male**

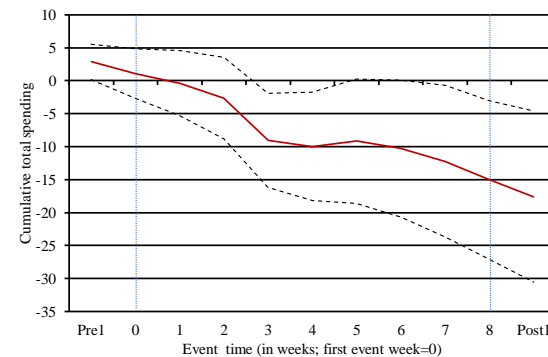
**Total Category**



**Shopping Category**

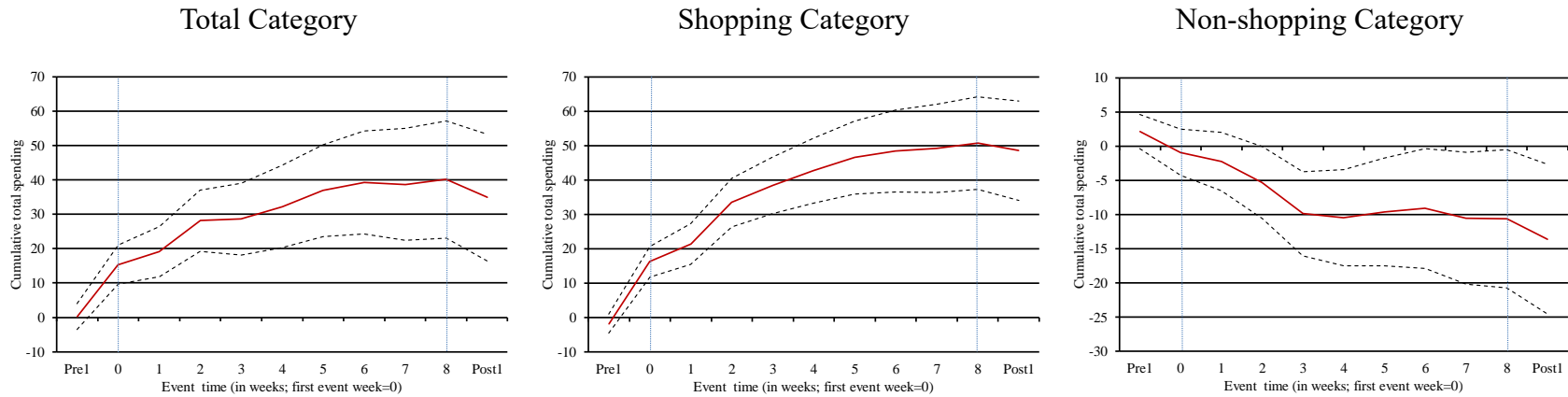


**Non-shopping Category**

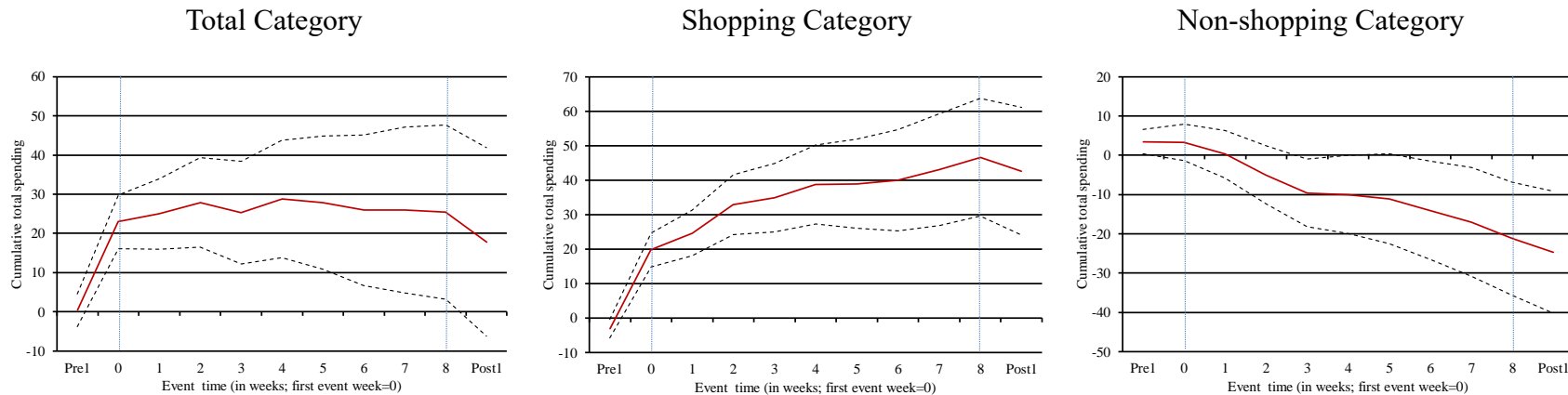


**Panel D. Cumulative Total Spending by Marital Status**

Single



Married



*This figure plots the dynamic response by age (Panel A), ethnic group (Panel B), gender (Panel C), and marital status (Panel D). The cut-off ages for top and bottom age group is 48.4 and 33.7 respectively. Chinese accounts for 81% of the total sample. Female group constitutes 40% of the total cardholders and 47% of the cardholders in the sample is married as of April 2010. Lastly, the construction of the figures is similar to that in Figure 3.*

**Table IA.1: Estimated Difference in Total Spending between Categories****Panel A. Static Response**

Variables	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
1 Week before GSS X 1 <sub>SH</sub>	-0.740*** (-3.72)	-0.534*** (-3.15)	-0.002*** (-4.44)
GSS X 1 <sub>SH</sub>	1.338*** (12.45)	1.077*** (11.85)	0.006*** (20.43)
1 Week after GSS X 1 <sub>SH</sub>	0.016 (0.08)	0.053 (0.30)	-0.008*** (-13.37)
1 Week before GSS	0.395*** (2.76)	0.229* (1.91)	0.002*** (7.96)
GSS	-0.395*** (-5.88)	-0.383*** (-6.73)	-0.001*** (-5.48)
1 Week after GSS	-0.462*** (-3.83)	-0.372*** (-3.64)	-0.001*** (-4.71)
1 <sub>SH</sub>	4.056*** (39.76)	2.728*** (33.42)	0.050*** (62.40)
Reference period, consumer mean	9.531	7.639	0.985
Observations	28,819,272	28,819,272	28,819,272
R-squared	0.020	0.015	0.146

*Note: This table reports the outcome of regression based on extended version of Eq(1) by including interaction terms with an indicator variable of Shopping category. We measure the difference in response between shopping and non-shopping categories to the Great Singapore Sale (thereafter GSS) in three ways: total daily spending, daily spending per transaction, and number of transactions during 3 separate periods. These periods include 1 Week before GSS, GSS, and 1 Week after GSS. The reference period is a 6-week term consisting of 3-week term before “1 Week before GSS” and 3-week term after “1 Week after GSS”. Total daily spending means total amount of credit and debit card transaction at daily level per each cardholder. Daily spending per transaction is an average amount of dollar spent in each transaction at daily and individual level. Total number of transactions is the number of transactional per each day at individual level. The shopping category contains transactions from GSS-related merchant category codes such as apparels, while non-shopping category includes merchant category codes least likely to be affected by the GSS such as fuel. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

**Panel B. Dynamic Response**

Variables	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
1 Week before GSS X I <sub>SH</sub>	-0.740*** (-3.72)	-0.534*** (-3.15)	-0.002*** (-4.44)
Week 0 X I <sub>SH</sub>	3.146*** (15.03)	2.504*** (14.04)	0.017*** (28.72)
Week 1 X I <sub>SH</sub>	1.017*** (4.86)	0.848*** (4.95)	0.006*** (9.78)
Week 2 X I <sub>SH</sub>	2.054*** (9.54)	1.674*** (9.00)	0.006*** (10.37)
Week 3 X I <sub>SH</sub>	1.167*** (6.07)	0.997*** (6.02)	0.006*** (10.06)
Week 4 X I <sub>SH</sub>	0.654*** (2.92)	0.409** (2.14)	0.001** (2.02)
Week 5 X I <sub>SH</sub>	0.306 (1.51)	0.352** (2.11)	0.002*** (3.03)
Week 6 X I <sub>SH</sub>	0.376 (1.57)	0.273 (1.30)	0.000 (0.82)
Week 7 X I <sub>SH</sub>	0.574*** (2.84)	0.532*** (3.19)	-0.001 (-1.61)
Week 8 X I <sub>SH</sub>	3.797*** (15.58)	2.876*** (15.66)	0.025*** (33.09)
1 Week after GSS X I <sub>SH</sub>	0.016 (0.08)	0.053 (0.30)	-0.008*** (-13.37)
1 Week before GSS	0.395*** (2.76)	0.229* (1.91)	0.002*** (7.96)
Week 0	-0.242* (-1.89)	-0.301*** (-2.80)	-0.005*** (-15.82)
Week 1	-0.299** (-2.23)	-0.355*** (-3.23)	0.000 (0.23)
Week 2	-0.590*** (-4.64)	-0.576*** (-5.59)	-0.002*** (-6.64)
Week 3	-0.654*** (-5.22)	-0.617*** (-5.71)	-0.001*** (-2.83)
Week 4	-0.072 (-0.52)	-0.047 (-0.39)	-0.001*** (-3.40)
Week 5	-0.009 (-0.06)	-0.089 (-0.81)	0.004*** (12.34)
Week 6	-0.163 (-1.30)	-0.112 (-1.03)	0.001** (2.08)
Week 7	-0.309** (-2.29)	-0.328*** (-2.93)	0.003*** (10.12)
Week 8	-1.837*** (-14.04)	-1.504*** (-13.71)	-0.010*** (-25.78)
1 Week after GSS	-0.462*** (-3.83)	-0.372*** (-3.64)	-0.001*** (-4.71)
I <sub>SH</sub>	4.056*** (39.76)	2.728*** (33.42)	0.050*** (62.40)
Reference period, consumer mean	9.531	7.639	0.985
Observations	28,819,272	28,819,272	28,819,272
R-squared	0.020	0.015	0.146

*Note: This table reports the outcome of regression based on extended version of Eq(2) by including interaction terms with an indicator variable of Shopping category and weekly dummy variable. We measure the difference in response between shopping and non-shopping categories to the Great Singapore Sale (thereafter GSS) per each week. Standard errors are clustered at the individual level. The construction of the figures is similar to that in Table 3 except for adding interaction terms with Shopping category.*

**Table IA.2: Consumer Spending Response to GSS by Card Types**

*Panel A. Static Response*

Credit card			
Variables	(1) Total daily spending Total category	(2) Total daily spending Shopping category	(3) Total daily spending Non-shopping category
1 Week before GSS	0.245 (1.27)	-0.212 (-1.57)	0.457*** (3.37)
GSS	0.606*** (6.14)	0.738*** (9.00)	-0.132** (-2.35)
1 Week after GSS	-0.024 (-0.12)	0.167 (1.01)	-0.191* (-1.71)
Reference period, consumer mean	13.268	7.401	5.868
Observations	17,763,603	17,763,603	17,763,603
R-squared	0.030	0.023	0.024
Debit card			
Variables	(1) Total daily spending Total category	(2) Total daily spending Shopping category	(3) Total daily spending Non-shopping category
1 Week before GSS	0.021 (0.40)	-0.065 (-1.58)	0.085*** (2.68)
GSS	0.157*** (5.77)	0.185*** (7.84)	-0.028** (-2.11)
1 Week after GSS	-0.666*** (-13.16)	-0.543*** (-12.97)	-0.123*** (-4.45)
Reference period, consumer mean	5.593	4.110	1.483
Observations	17,763,603	17,763,603	17,763,603
R-squared	0.105	0.137	0.019

**Panel B. Dynamic Response**

Variables	(1)	(2)
	Credit Card	Debit Card
1 Week before GSS	0.245 (1.27)	0.021 (0.40)
Week 0	2.983*** (14.80)	-0.105* (-1.91)
Week 1	0.425** (2.10)	0.210*** (3.65)
Week 2	0.707*** (3.40)	0.383*** (6.49)
Week 3	0.231 (1.24)	-0.156*** (-2.96)
Week 4	0.838*** (4.03)	-0.111** (-2.00)
Week 5	-0.082 (-0.42)	0.587*** (10.48)
Week 6	-0.025 (-0.11)	0.292*** (5.12)
Week 7	0.094 (0.49)	0.079 (1.47)
Week 8	0.024 (0.10)	0.300*** (4.06)
1 Week after GSS	-0.025 (-0.12)	-0.666*** (-13.16)
Reference period, consumer mean	13.268	5.593
Observations	17,763,603	17,763,603
R-squared	0.030	0.105

*Note: The tables above reports the outcome of regression based on Eq(1) and Eq(2) by payment types. Consumers included in this analysis consist of card users who use both credit and debit card during the study period. We use the same model specification as in Table 2 and 3 for static and dynamic analysis respectively. Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

*Panel C. Estimated Difference in Spending between Credit and Debit Card*

Variables	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
1 Week before GSS X 1cc	-3.156 (-1.47)	-4.015** (-2.26)	0.001 (0.61)
GSS X 1cc	-0.112 (-0.10)	-1.262 (-1.46)	0.009*** (10.11)
1 Week after GSS X 1cc	-3.052 (-1.34)	-1.698 (-0.89)	0.009*** (4.86)
1 Week before GSS	0.010 (0.37)	0.015 (0.70)	-0.000 (-0.53)
GSS	0.084*** (5.80)	0.056*** (5.06)	0.000 (1.24)
1 Week after GSS	-0.354*** (-13.27)	-0.295*** (-14.61)	-0.006*** (-24.14)
1cc	156.231*** (146.95)	127.335*** (157.01)	1.114*** (970.61)
Reference period, consumer mean	9.431	7.551	0.098
Observations	35,527,206	35,527,206	35,527,206
R-squared	0.071	0.068	0.423

**Panel D. Estimated Difference in Weekly Spending between Credit and Debit Card**

VARIABLES	(1) Total daily spending	(2) Daily spending per transaction	(3) # of daily transaction
1 Week before GSS X 1 <sub>CC</sub>	-3.153 (-1.47)	-4.013** (-2.26)	0.001 (0.61)
Week 0 X 1 <sub>CC</sub>	14.566*** (7.04)	10.695*** (6.13)	0.025*** (12.64)
Week 1 X 1 <sub>CC</sub>	-0.103 (-0.05)	-2.296 (-1.25)	0.014*** (6.94)
Week 2 X 1 <sub>CC</sub>	4.889** (2.09)	1.967 (0.98)	0.013*** (6.27)
Week 3 X 1 <sub>CC</sub>	-6.576*** (-3.27)	-6.800*** (-4.02)	0.013*** (6.50)
Week 4 X 1 <sub>CC</sub>	-0.763 (-0.34)	-0.562 (-0.30)	0.004** (2.12)
Week 5 X 1 <sub>CC</sub>	-5.816*** (-2.64)	-5.660*** (-3.19)	0.000 (0.07)
Week 6 X 1 <sub>CC</sub>	-0.313 (-0.12)	0.273 (0.12)	-0.000 (-0.24)
Week 7 X 1 <sub>CC</sub>	-5.718*** (-2.67)	-5.609*** (-3.25)	0.002 (1.11)
Week 8 X 1 <sub>CC</sub>	-3.435 (-1.38)	-6.012*** (-3.29)	0.017*** (6.77)
1 Week after GSS X 1 <sub>CC</sub>	-3.056 (-1.34)	-1.701 (-0.90)	0.009*** (4.86)
1 Week before GSS	0.010 (0.37)	0.015 (0.70)	-0.000 (-0.53)
Week 0	-0.031 (-1.09)	-0.102*** (-4.54)	-0.002*** (-10.22)
Week 1	0.112*** (3.70)	0.087*** (3.71)	0.001*** (5.66)
Week 2	0.195*** (6.26)	0.152*** (6.08)	-0.000 (-0.12)
Week 3	-0.085*** (-3.03)	-0.064*** (-2.90)	-0.001*** (-4.01)
Week 4	-0.058** (-1.99)	-0.098*** (-4.50)	-0.003*** (-14.93)
Week 5	0.299*** (10.13)	0.256*** (11.21)	0.004*** (14.82)
Week 6	0.143*** (4.71)	0.101*** (4.42)	0.001*** (6.22)
Week 7	0.038 (1.36)	0.031 (1.44)	0.001*** (4.39)
Week 8	0.195*** (4.49)	0.200*** (6.02)	0.001*** (3.56)
1 Week after GSS	-0.354*** (-13.26)	-0.295*** (-14.60)	-0.006*** (-24.13)
	9.431	7.551	0.098
Observations	35,527,206	35,527,206	35,527,206
R-squared	0.071	0.068	0.423

Note: Panel C reports the outcome of the difference between credit card and debit card spending by regressing each

*spending proxy on the interaction of 3 periods and an indicator variable of credit card payment in addition to other control variables. Panel D presents dynamic analysis based on the weekly analysis of difference in spending between credit card and debit card spending.*

**Table IA.3: Subsample Analysis by Card Types**

***Panel A. Consumers who used only credit card***

Variables	(1) Total daily spending Total category	(2) Total daily spending Shopping category	(3) Total daily spending Non-shopping category
1 Week before GSS	0.056 (0.27)	-0.227 (-1.52)	0.283** (2.08)
GSS	0.427*** (3.98)	0.759*** (9.02)	-0.333*** (-4.92)
1 Week after GSS	-1.056*** (-5.26)	-0.677*** (-4.38)	-0.379*** (-2.98)
Reference period, consumer mean	18.791	11.581	7.210
Observations	12,384,160	12,384,160	12,384,160
R-squared	0.041	0.040	0.026

***Panel B. Consumers who used only debit card***

Variables	(1) Total daily spending Total category	(2) Total daily spending Shopping category	(3) Total daily spending Non-shopping category
1 Week before GSS	0.017 (0.07)	-0.390** (-2.41)	0.407** (2.47)
GSS	0.575*** (4.63)	0.934*** (9.65)	-0.359*** (-4.63)
1 Week after GSS	-0.948*** (-3.95)	-0.431** (-2.22)	-0.516*** (-3.72)
Reference period, consumer mean	20.785	12.429	8.356
Observations	12,484,268	12,484,268	12,484,268
R-squared	0.038	0.035	0.025

*Note: Panel A and B report the outcome of regression based on Eq(1) by subgroups of consumers who use only credit cards or only debit cards during the study period. Subsamples with consumers who show only credit card transactions or debit card transactions are extracted from the total sample and total daily spending is regressed on the three period as specified in Eq(1). Individual- and day-of-week-fixed effects are included. Standard errors are clustered at the individual level. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.*

**Table IA.4: Credit Card Balance and Delinquency Analysis**

Variables	(1) Balance	(2) Delinquency
After	259.354*** (83.10)	0.001*** (5.42)
Observations	621,105	621,105
R-squared	0.717	0.326

*Note:* This table reports the analysis of change in credit card balance and occurrence of delinquency from credit card users after the start of Great Singapore Sale. Credit card balance and occurrence of delinquencies are regressed on the dummy variable indicating the period after the starting month of the GSS. T-statistics are given in parentheses. \*\*\*significant at 1 percent, \*\* 5 percent, \* 10 percent.