The Impact of a Permanent Income Shock on Consumption: Evidence from Japan's 2014 VAT Increase*

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Abstract

We test the Life Cycle/Permanent Income Hypothesis (LCPIH) using Japan's 2014 Value-Added Tax (VAT) rate increase as a natural experiment. The VAT rate increase represents an unanticipated and proportional reduction in lifetime resources for several reasons: few goods and services are exempt from the VAT; the tax rate increase was uncompensated; it was fully passed on to households in the form of higher prices; and the VAT increase was not anticipated prior to Prime Minister Abe's October 2013 announcement. Contrary to the excess smoothness literature, we find that consumption fell in proportion to the income shock upon announcement, implying that we cannot reject the LCPIH.

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1 Introduction

In this study, we test the Life-Cycle/Permanent Income Hypothesis (LCPIH), one of the most important theoretical frameworks for analyzing household decision-making, by evaluating the timing and magnitude of the household consumption response to a Value-Added Tax (VAT) rate increase in Japan.[1] In April 2014, Japan's VAT, which is known as the "Consumption Tax", increased from five to eight percent. In addition, a subsequent tax rate increase from eight to ten percent was scheduled to take effect in October 2015, though its implementation has now been twice postponed. We argue that the VAT rate increases induced a proportional decrease in lifetime resources, and as such, represent a permanent income shock in the LCPIH context. Furthermore, the announcement of the tax rate increases was clear and unanticipated. Consequently, the tax rate increases present a strong natural experiment to test the LCPIH.

According to the basic LCPIH, an unanticipated permanent income shock should cause a proportional change in consumption. However, most studies have found smaller consumption responses. Campbell and Deaton (1989), the seminal paper in this literature, presents the "excess smoothness" concept, defined as consumption being too smooth in the sense that it does not respond sufficiently to an innovation to the permanent component of income. In other words, a household responds to an unanticipated and permanent one percent reduction in lifetime resources by reducing consumption less than one percent. Several other studies have also found evidence of excess smoothness (see West, 1988; Galí, 1991; Hansen, Roberds and Sargent, 1991; Flavin, 1993; Attanasio and Pavoni, 2011).

In regards to the factor responsible for the excess smoothness observed in previous studies, Flavin (1993) and Pistaferri (2001) point out that at least a portion of excess smoothness can be explained by the information gap between households and the econometrician. Because a household's expected income process is private and idiosyncratic information, it is quite difficult to identify an unanticipated income shock. Accordingly, identifying such a shock is the primary methodological challenge for the econometrician.

Most of the studies in the literature apply the methodology that Jappelli and Pistaferri (2010) refer to as a statistical decomposition of income shocks. This approach requires an econometrician to make specific statistical assumptions about the income process, treats deviations from observable income determinants as unanticipated income shocks,

[1] For recent surveys of the LCPIH literature, see Attanasio and Weber (2010) and Jappelli and Pistaferri (2010).

and then uses covariance restrictions on income and consumption growth to identify the parameters that characterize the response of consumption to income shocks.

However, it is difficult to apply an approach of this nature to micro-data because the long-run income path for each household is not available. In fact, there is a dearth of studies that look for evidence of excess smoothness using micro-data, despite the fact that the importance of controlling for heterogeneity across households when conducting tests of the LCPIH is now well recognized.[2]

To overcome these challenges, we exploit the 2014 VAT rate increase episode in Japan. Unlike VAT in many other countries, Japan's VAT has a single flat rate with relatively few exemptions. The government has encouraged the burden of the VAT rate increases to be borne fully by consumers, implying that a higher tax rate leads to a proportional increase in consumer prices. Consequently, under the assumption that the tax rate increases did not affect nominal income expectations, the VAT rate increase induced a proportional decrease in lifetime resources. In addition, although the legislative process for the VAT rate increases concluded in 2012 under outgoing Prime Minister (PM) Yoshihiko Noda, it was not at all clear whether incoming PM Shinzo Abe would confirm their implementation. Because the VAT rate increases were at odds with his economic stimulus program, known as "Abenomics", he repeatedly mentioned the possibility of postponement or cancellation of the VAT rate increases and claimed that he reserved a right to do so. As such, Abe's October 1, 2013 confirmation that the tax rate increases would be implemented as originally planned were not predictable prior to his announcement. It is therefore reasonable to assume that all Japanese households faced the negative income shock at the same time.

Beyond the primary methodological challenges, there exist additional issues that we must address in order to identify the consumption response to the permanent income shock. Unlike a pure innovation to income such as an unexpected and permanent salary increase, the announcement of a VAT rate increase prior to its implementation incentivizes households to engage in substitution of consumption over time (intertemporal), substitution between goods (intratemporal), and stockpiling behavior. Building on Cashin and Unayama (2016), our theoretical model and resulting empirical specification distinguish between the income, intratemporal substitution, and intertemporal substitution effects associated with the VAT rate increase. The model shows that after controlling for durability and storability, household consumption should fall twice - once upon announcement

[2] Although Attanasio and Pavoni (2011) use repeated cross-sectional data from a British household survey, they employ a synthetic-panel technique, which should be regarded as semi-aggregated data.

(so long as the negative income effect dominates the positive intertemporal substitution effect) and again upon implementation of the tax rate increase (negative intertemporal substitution effect). Furthermore, summing the responses to announcement and implementation, consumption should fall one-to-one with the reduction in lifetime resources, which is the implication of our model that corresponds to testing for evidence of excess smoothness.

Our main result is that we cannot reject that household consumption fell in proportion to the reduction in lifetime resources. In other words, our result is consistent with households that consume according to the LCPIH, but is inconsistent with excess smoothness. Our baseline regression estimate shows that after controlling for substitution effects, household consumption declined by 5.19 percent following PM Abe's October 2013 announcement, or 1.1 times the reduction in lifetime resources.

A potential concern with our approach is that the model and resulting empirical specification assume that all households behave according to the LCPIH. However, previous studies reject this assumption by showing that some households exhibit "excess sensitivity", whereby consumption responds to the transitory component of income growth. As Kaplan, Violante, and Weidner (2014) note, the most direct way to account for this behavior is through the existence of a sizable share of hand-to-mouth (HtM) consumers who spend all of their available resources in every pay period. While we have shown that we cannot reject the LCPIH with our excess smoothness test for the full sample, we want to ensure that our main result is not being driven by the behavior of HtM households.

To confirm that our baseline results are not being driven by HtM households, we separate HtM and non-HtM households according to Kaplan, Violante, and Weidner (2014) and Hara, Unayama, and Weidner (2015). We then compare the consumption responses for HtM and non-HtM households upon announcement and implementation of the VAT rate increase. Further reinforcing our baseline result, we find that upon announcement, HtM household consumption remained stable, while we cannot reject that non-HtM consumption fell in proportion to the reduction in lifetime resources. Furthermore, after controlling for substitution effects, we show that non-HtM consumption was significantly lower in the year following implementation of the VAT rate increase than it was beforehand, while HtM consumption grew roughly in proportion to income, as theory predicts.

Additional robustness checks demonstrate that the consumption responses observed upon announcement and implementation were not due to a few outliers or a small pension cut that coincided with PM Abe's announcement. Finally, we show that the ob-

served consumption responses were not consistent with Ricardian equivalence even for non-pensioners that may have expected reduced pensions in the future in the absence of a VAT rate increase.

Coupled with the small announcement effect estimates for the compensated April 1997 VAT rate increase discussed in Cashin and Unayama (2016), the main result of this paper - that household consumption responds to a VAT rate change in a manner consistent with the LCPIH - has an important implication for future changes in VAT rates. In the absence of significant offsetting compensation to households, governments should expect to observe a decline in household consumption that is proportional to the VAT rate increase. On the contrary, our HtM results suggest that the decline in household consumption may not be as acute for countries such as the United States that possess a much higher proportion of HtM households than Japan. In addition, our results suggest that the manner in which governments announce VAT rate changes may have a significant effect on the timing and magnitude of the household consumption response to the change.

The remainder of the paper is organized as follows. Section 2 discusses why Japan's 2014 VAT rate increase presents a strong natural experiment to estimate the impact of a permanent shock to income. Section 3 lays out our identification assumptions, methods for separately identifying income and substitution effects, empirical specification, and the data. We present the results in Section 4. Section 5 concludes.

2 The VAT Rate Increase and Its Announcement

2.1 The VAT Rate Increase as a Permanent Income Shock

In August 2012, the Japanese government decided to increase the VAT rate from five to eight percent in April 2014 and from eight to ten percent in October 2015.[3] Due to the legal and institutional features of Japan's VAT discussed below, we argue that these rate increases would be expected to induce increases in prices roughly proportional to the percentage increase in the tax rate. Taking as given a household's expected future income path, the higher prices caused by a VAT rate increase lead to a reduction in expected lifetime resources. Consequently, the VAT rate increases can be regarded as a negative permanent income shock.

[3] As we discuss below, while the first VAT rate increase was implemented as scheduled, in November 2014 the government postponed the second increase until April 2017. In June 2016, PM Abe announced that the second rate increase would be postponed again until October 2019.

Unlike VAT in many other countries, Japan's VAT has a single flat rate with relatively few exemptions. In fact, based on the weights from the Consumer Price Index (CPI), more than 80 percent of household expenditure is taxable, with pre-committed expenditures such as "Rent for housing" and "School tuition" comprising the major tax-exempt items.[4] These facts suggest that households could not easily avoid the VAT rate increases via substitution to tax-exempt or lower-rated goods and services.

In addition to being largely unavoidable, it was expected that the burden of the VAT rate increases would be borne fully by consumers in the form of higher prices.[5] As documented by Ishi (2001), the Japanese government has made every effort to ensure the VAT is fully passed through to consumer prices. Each time the government increases the VAT rate, it carries out an extensive advertising campaign to ensure that consumers bear the full burden of the tax rate increase in the form of higher prices.

In fact, upon implementation of previous VAT rate increases, prices increased by roughly the same percentage as the tax rate. In April 1989, when the VAT was implemented at a rate of three percent, prices on goods and services not previously subject to tax increased by approximately three percent. Likewise, in April 1997, when the VAT rate jumped from three to five percent, prices on goods and services subject to the VAT increased by about two percent.

Similarly for the 2014 case, the price jump corresponded to the percentage increase in the tax rate (2.85 percent = 108/105-1). Figure 1 shows the CPI for total consumption, non-storable non-durable goods and services, and tax-exempt goods and services before and after the VAT rate increase.[6] The CPI is very stable throughout the sample period except for April 2014 when the government implemented the tax rate increase. In particular, we observe that the CPI for non-storable non-durable goods and services, our dependent variable in this study, jumped by nearly three percent between March and May 2014, while the CPI for tax-exempt goods and services is roughly constant throughout the sample period. These suggest that the price changes observed around implementation were due solely to the tax rate increase.

[4]Exempted transactions include: transfer or lease of land; transfer of securities; transfer of means of payment; interest on loans and insurance premiums; transfer of postal and revenue stamps; fees for government services; international postal money orders; foreign exchange; medical care under the Medical Insurance Law; social welfare services specified by the Social Welfare Services Law; midwifery service; burial and crematory service; transfer or lease of goods for physically handicapped persons; tuition, entrance fees, facilities fees, and examinations fees of schools designated by the Articles of the School Education Law; transfer of school textbooks; and the lease of housing units.

[5]Evaluating the pass-through of indirect taxation has been a major topic of previous research. See, for example, Poterba, 1996; Besley and Rosen, 1999; Carbonnier, 2007; Benedek, de Mooij, and Wingender, 2015.

[6]Definitions of our goods and services categories are presented in subsection 3.4.

Contrary to the jump in the price level upon implementation of the VAT rate increase, other factors that could affect consumption patterns were relatively stable. As shown in Figure 1, nominal interest rates barely moved throughout our sample period. As for income, Figure 2 represents average monthly "Periodical Income" (in thousands of yen) of employees in our sample and its $\pm 2\sigma$ confidence interval. Periodical Income includes the salary of the household head excluding bonuses and other special payments, and hence it should reflect households' normal earnings patterns. Upon examination of this measure, household income appears to have been quite stable around the VAT rate increase other than statistical fluctuations. Furthermore, unlike the 1989 VAT implementation and 1997 tax rate increase, which were part of tax system reforms that were intended to be revenue neutral, households received little or no offsetting compensation for the VAT rate increase in 2014.[7] Thus, we can rule out potential confounding factors, and simply assume that the most recent VAT rate increase represents a permanent income shock that was roughly proportional to the tax rate increase.

As a caveat, it is worth noting that one might argue the VAT rate increases should be treated as a temporal shock, despite the fact that they were intended to be permanent. Given the well-documented financial strains on the Japanese "pay-as-you-go" public pension system, households may have already expected the VAT rate to rise in the near future. If so, the government's decision to increase the tax rate would only alter prices between the expected and actual timing of the increase, thereby having little effect on a household's expected lifetime resources while still creating intertemporal substitution incentives.

According to public opinion polls, however, this was not be the case for most Japanese households. Polls conducted by several major Japanese newspapers in August 2013 showed that only twenty percent of individuals thought the VAT rate should be increased.[8] Another poll conducted in Diamond magazine revealed that only one-third of surveyed individuals understood the connection between a VAT rate increase and the sustainability of the public pension system.[9] The results of these polls suggest that households regarded the VAT rate increase as a significant reduction of expected lifetime resources rather than

[7] Households who are not subject to the income tax because of low income and who receive the earnings-tested child benefit received a cash rebate in 2014, which was worth 10,000 yen (roughly 100 US dollars) per eligible individual. Total expenditures on the rebate were only about 3 percent of the revenue increase per year resulting from the VAT rate increase.

[8] 17, 21, and 25 percent of respondents believed the VAT rate should be increased as planned in polls conducted by the Yomiuri Shimbun, Mainichi Shimbun, and Asahi Shimbun, respectively.

[9] This was conducted as an online survey by Diamond, a Japanese popular business magazine.

a temporal shock.

Related to this point, it is also worth noting that our treatment of the VAT rate increase as a permanent income shock contradicts the "Ricardian equivalence" theorem discussed in Barro (1974). According to the theorem, the timing of tax payments should not alter households' consumption decisions because it does not affect their intertemporal budget constraint. However, it seems unlikely that households would behave in this manner given that most did not understand the purpose of the VAT rate increase. Moreover, it should be emphasized that our test of the LCPIH proposed below is still valid and that we would expect to find evidence of excess smoothness if Ricardian equivalence holds.

2.2 The VAT Rate Increase as an Unanticipated Shock

While the previous subsection makes the case that Japan's VAT rate increase can be treated as a permanent income shock, in this subsection, we argue that the most recent tax rate increase was unanticipated prior to its announcement, but the announcement itself was quite clear.

This is critical for our purposes because the basic LCPIH predicts that consumption will adjust immediately upon the arrival of new information. Furthermore, as Flavin (1993) and Pistaferri (2001) note, one reason why previous studies have found evidence of excess smoothness is because econometricians have difficulty identifying when a shock becomes known to a household. As such, identifying an unanticipated and permanent income shock whose timing was common to all households should lead to a cleaner test of the LCPIH.

In our case, we identify an exact point in time when households received "new information" about the VAT rate increase. More concretely, we treat PM Abe's televised press conference on October 1, 2013 as the "announcement". While the legislative process to increase the VAT rate was completed in 2012, PM Abe simply declared that the government would increase the VAT rate as planned. Nevertheless, we believe that the October 2013 press conference was the critical juncture when households recognized the VAT rate increase.

According to the legislation, the VAT rate was to increase from five to eight percent on April 1, 2014, which was to be followed by another two percentage point increase on October 1, 2015. However, even upon passage of the bill to increase the VAT rate in August 2012, news outlets emphasized that implementation of the tax rate increase was

not a forgone conclusion, as the bill included a vague provision making an "economic upturn" a condition for implementing the rate hike.[10]

Furthermore, a change in leadership to an anti-tax administration prior to the law's scheduled implementation gave credibility to its repeal. Soon after passage of the legislation, the Liberal Democratic Party (LDP) defeated the Democratic Party of Japan (DPJ), with Shinzo Abe replacing Yoshihiko Noda as PM in late 2012. Once in office, PM Abe repeatedly claimed that he reserved a right to cancel the VAT rate increase altogether. Such a claim was thought to be reasonable because the tax rate increase was recognized as a serious obstacle to "Abenomics", his cabinet's policy package intended to help the Japanese economy emerge from its long period of stagnation. The debate over the proposed VAT rate increase culminated in the "Intensive Review Meetings", which began in late August 2013. During these meetings, PM Abe met with specialists including economists, company managers, and nonprofit organization representatives who advised him on the expected short- and long-run impacts of the proposed VAT rate increase.

Accordingly, households would have been skeptical about whether the tax rate increase would be implemented as planned or cancelled. However, such expectations were dashed. Following the completion of these meetings, PM Abe held a press conference at the beginning of October 2013 to announce that the VAT rate increase would be implemented as originally specified in the August 2012 tax bill. Because repeal of the VAT legislation seemed quite plausible until PM Abe's press conference, we treat this event as the "announcement".

In addition to the political timeline, there is evidence that suggests the press conference was unanticipated and contained "new information". First, Figure 4 presents tax-inclusive inflation expectations from the Consumer Confidence Survey for the years 2013 and 2014. In October 2013, the percentage of households that expected an inflation rate of two percent or more over the next 12 months jumped by seven percentage points relative to the previous month, by far the largest month-to-month change observed since the survey methodology was updated in April 2013. Inflation expectations then remained relatively stable until they fell upon implementation of the VAT rate increase in April 2014. In contrast, for the April 1997 VAT rate increase, inflation expectations increased much more gradually, the reasons for which are discussed in Cashin and Unayama (2016). [11]

[10] Sekiguchi, Toko. (2012, August 10). Japan Parliament Passes Sales-Tax Increase. *The Wall Street Journal*. Retrieved from http://www.wsj.com

[11] Cashin and Unayama (2016) discuss several events that likely contributed to the gradual uptick in inflation expectations associated with the April 1997 VAT rate increase. In 1996 Q2, the LDP submitted the FY1997

Second, in concert with the abrupt increase in inflation expectations in October 2013, Figure 5 illustrates that the consumer confidence index fell precipitously upon PM Abe's announcement, and continued to fall until implementation of the VAT rate increase. Such a large drop seems unlikely without households obtaining new information.

Finally, sharp downward movements in the Japanese stock market following PM Abe's announcement strongly suggest that his announcement was a surprise. Figure 6 displays the Nikkei 225 and TOPIX stock market indexes in the days leading up to and following the PM's announcement. It shows that stocks dropped by about two percent immediately after the announcement in spite of an upward trend just before and after the announcement. Although we cannot rule out that other confounding factors were responsible for the abrupt movement in inflation expectations, consumer confidence, and the stock market that followed PM Abe's announcement, the fact that the timing of these changes corresponded to a spike in news coverage of the VAT (Figure 3) suggests that households updated their VAT information sets upon Abe's announcement.

In order to treat PM Abe's press conference as the announcement of an unanticipated and permanent income shock, it is not sufficient that the announcement contained "new information". Awareness of the VAT among Japanese households is also important. While the movement in inflation expectations, consumer confidence, and the stock market following the PM's press conference certainly suggest a general awareness of the VAT, heavy news coverage of the VAT over the last several years provides further evidence. Figure 3 reports the number of articles between 2010 and 2015 that mention the phrase "Consumption Tax" ("Shouhi zei" in Japanese) in the Yomiuri and Asahi newspapers, which are two leading non-business newspapers with a circulation of over 10 million (in 2010). From the figure, it is clear that the VAT received significant attention in recent years, and the rate should thus be known to households. The figure also shows that the news coverage of the VAT jumped in October 2013 to a level that was similar to the levels observed in June 2012 and April 2014, when the bill to increase the VAT rate was introduced in the Japanese Diet (Congress) and the rate increase was implemented, respectively. The jump in coverage in October 2013 suggests that households were well aware of PM Abe's announcement.[12]

budget confirming the VAT rate increase. In 1996 Q4, the LDP won an election that was based on their support of the proposed VAT rate increase. And finally, the LDP officially passed the FY1997 budget at the tail end of 1996 Q4, confirming that the VAT rate increase would be implemented as originally planned.

[12] Another peak around December 2014 was associated with the postponement announcement.

2.3 Additional Announcements

While our primary focus in this study is the consumption response to PM Abe's October 2013 VAT rate increase announcement and its April 2014 implementation, we note that there was an additional announcement several months later - the postponement of the second VAT rate increase. Recall that the VAT legislation initially scheduled the second tax rate increase for October 2015. However, discussions to postpone this tax rate increase began once economic conditions deteriorated beyond the government's expectations following implementation of the April 2014 tax increase.

The 2012 VAT legislation allowed the government to reconsider the second tax rate increase if it felt the increase was likely to cause serious harm to the economy. In fact, Figure 3 shows that postponement received a great deal of attention in the fourth quarter of 2014 as the economy was faltering. While a deadline to decide on the additional tax rate increase was set for March 31, 2015, PM Abe instead decided on November 18, 2014 to postpone the additional tax rate increase and dissolve the Diet in an effort to get the voting public to judge his decision. The LDP won the election in December 2014, and new legislation that set a date of April 1, 2017 for the second tax increase passed the Diet on March 31, 2015.

The postponement of the second tax rate increase is theoretically equivalent to an unexpected temporary income increase for the period between the originally planned (October 1, 2015) and the postponed (April 1, 2017) tax rate increase dates. In that sense, postponement of the tax increase was equivalent to a temporal VAT rate cut (e.g. the 2009 VAT cut in the UK), and accordingly, we should expect a small consumption increase upon announcement. For this episode, however, the timing of the announcement was unclear. The fate of the postponement depended on the results of the election, but the LDP was widely expected to win the December 2014 election. Moreover, the opposition parties, including the DPJ, largely agreed with the postponement. Accordingly, we assume that announcement of the postponement occurred sometime between late November 2014 and January 2015 and control for the announcement in our regression analysis below.

Finally, on June 1, 2016 PM Abe postponed the VAT rate increase planned for April 2017 until October 2019. However, our data do not cover this period, so we are unable to estimate the consumption response to the second postponement.

3 Theoretical Framework and Empirical Specification

3.1 The Model

As we discussed above, Japan's 2014 VAT rate increase represented an unanticipated and permanent income shock. The basic LCPIH predicts that a permanent negative income shock such as Japan's VAT rate increase should reduce consumption immediately upon realization of the shock, which is referred to as the "income effect".

Unlike a pure income shock, however, the announcement of a VAT rate increase can affect consumption through additional channels. Because a VAT rate increase induces a price hike in the future, it incentivizes households to engage in substitution of consumption over time. This is called the "intertemporal substitution effect", whereby households increase consumption prior to a VAT rate increase when prices are relatively low, but decrease consumption afterwards.

To illustrate these two effects, we construct a simple model of household behavior. Let the utility maximization problem of a household be as follows:

$$\max_{\{c_s|s=t+1\cdots\infty\}} U_t = u(c_t) + E_t\left[\sum (\frac{1}{1+\delta})^{s-t} u\left(c_s\right)\right], \quad (1)$$

$$s.t. \qquad A_t + y_t + E_t\left[\sum \frac{y_t}{(1+r)^{s-t}}\right] = c_t + E_t\left[\sum \frac{p_s c_s}{(1+r)^{s-t}}\right]. \quad (2)$$

where c_s is consumption at period s; δ is the subjective discount rate; r is the nominal interest rate, which is assumed to be constant; A_t is financial wealth; y_s is nominal income; and p_s is the price level.

As discussed in the previous section, households know the size and schedule of the VAT rate increases, but they are not certain of the whether the tax rate increases will actually be implemented. In particular, suppose that the VAT rate increase, if implemented, will be increased in a stepwise fashion by τ_1 and τ_2 percentage points at periods S_1 and S_2, respectively. Also suppose that the VAT rate increases are the only source of price variation - with the price level before the tax rate increase normalized to one - and the tax burden is expected to be borne fully by consumers. The price at period s can then be denoted as

$$p^s = 1 + \tau_1 I_s^1 + \tau_2 I_s^2, \quad (3)$$

where I_t^k is an indicator function which $I_s^k = 0$ when $s < S_k$ and $I_s^k = 1$ when $s \geq S_k$ for

$k = 1, 2$. In our case, $\tau_1 = 0.03/1.05$; $\tau_2 = 0.02/1.08$; S_1 is April 2014; and S_2 is October 2015. Overall, the price level is expected to increase by 4.8 percent (i.e. $= [110/105] - 1$) following the two tax rate increases.

Since households are not certain that the VAT rate increase will be implemented as planned, let ρ_s be their subjective probability of the event occurring. However, because households' information sets are not observable and vary across households, it is, in general, difficult to specify ρ_s. However, as discussed above, the 2014 VAT rate increase presents a strong natural experiment; that is, we treat PM Abe's press conference on October 1, 2013 as the clear and unanticipated announcement of the VAT rate increase. This assumption implies that ρ_s is an indicator function, I_s^Q, for all households

$$\rho_s = I_s^Q = \begin{cases} 0 & (s < Q) \\ 1 & (s \geq Q) \end{cases} \tag{4}$$

where Q is the time of announcement, or October 2013 in our case.

Under two additional assumptions

1. The iso-elastic instantaneous utility function, $u(c) = c^{1-\varepsilon}/(1-\varepsilon)$.
2. A VAT rate increase does not affect the nominal income process.

we derive the following expression via first order conditions and the law of iterated expectations:

$$\begin{aligned} c_t &= \left(\frac{1+\delta}{1+r}\right)^{-\frac{T-t}{\varepsilon}} E_t\left[\frac{p_t}{p_T} c_T^{-\varepsilon}\right]^{-1/\varepsilon}, \\ &= \left(\frac{1+\delta}{1+r}\right)^{-\frac{T-t}{\varepsilon}} \left(I_t^Q \frac{1+\tau_1 I_t^1 + \tau_2 I_t^2}{1+\tau_1+\tau_2} (c_T^1)^{-\varepsilon} + (1 - I_t^Q)(c_T^0)^{-\varepsilon}\right)^{-1/\varepsilon} \end{aligned} \tag{5}$$

where period T occurs sufficiently after the planned implementation of the second VAT rate increase (i.e. $T > S_2$); c_T^1 (c_T^0) is consumption in period T in cases where the VAT rate is increased (not increased). Under either scenario, consumption would not change after period T (i.e. $C_{T+s} = C_T$ for any $s > 0$).

If the period between the announcement, Q, and implementation of the second tax rate increase, S_2, is not too long (e.g. October 2013 to October 2015), the ratio between consumption at period T for the scenarios where the VAT rate is increased or not increased can be approximated as $c_T^1 \sim (1 + \tau_1 + \tau_2)^{-1} c_T^0$. Substituting this expression into (5)

and then taking logs and the first difference between t and $t-1$ yields

$$\Delta \log c_t = \frac{1}{\varepsilon}(\delta - r) - (\tau_1 + \tau_2)\Delta I_t^Q + \frac{1}{\varepsilon}(\tau_1(\Delta I_t^Q - \Delta I_t^1) + \tau_2(\Delta I_t^Q - \Delta I_t^2)) \quad (6)$$

The intuition behind these equations are shown in Figure 7, in which the optimal consumption path is drawn. At announcement, when households receive new information about the VAT rate increase, consumption should fall in proportion to the tax rate increase due to the income effect, as the downward-pointing grey arrow in the figure shows. This reduction in consumption corresponds to the second term on the right-hand side (RHS) of (6).

At the same time, once households expect a future price hike due to the VAT rate increase, they temporarily prefer higher consumption than the new long-run level as a result of positive intertemporal substitution (the upward-pointing white arrow in Figure 7). The size of the intertemporal substitution effect is equal to the intertemporal elasticity of substitution (IES), which is equal to $\frac{1}{\varepsilon}$, multiplied by the expected price change, as shown in Figure 7. The higher level of consumption should be offset by a negative intertemporal substitution effect upon implementation of each VAT rate increase. Following implementation of the second VAT rate increase, consumption will be at its new optimal level. To summarize, the income effect that appears upon announcement is (at least) partially canceled out by a positive intertemporal substitution effect, with offsetting negative intertemporal substitution effects that become evident upon implementation of each VAT rate increase.

3.2 Empirical Specification

Based on the derivation shown in Section 3.1, rearranging the terms in Equation (6) gives us the following regression equation:

$$\Delta \log c_t = \frac{1}{\varepsilon}(\delta - r) - (1 - \frac{1}{\varepsilon})(\tau_1 + \tau_2)\Delta I_t^Q - \frac{1}{\varepsilon}\tau_1 \Delta I_t^1 - \frac{1}{\varepsilon}\tau_2 \Delta I_t^2.$$

The first difference of the indicator functions (ΔI_t^Q, ΔI_t^1, ΔI_t^1) can be captured by the dummies for the months of announcement and implementation. That is, the reduced form should be:

$$\Delta \log c_t = const + \alpha D_{Oct,2013} + \gamma D_{Apr,2014} + \phi D_{Oct,2015}. \quad (7)$$

where $D_{Oct,2013}$, $D_{Apr,2014}$, and $D_{Oct,2015}$ are period dummies for October 2013, April 2014, and October 2015, respectively. The parameters estimated with this reduced form - α, γ, and ϕ - correspond to $(-1+1/\varepsilon)*(\tau_1+\tau_2)$, $(-1/\varepsilon)*\tau_1$, and $(-1/\varepsilon)*\tau_1$, respectively.

Up to this point, we have ignored another channel that may affect the consumption response to a VAT rate increase. While we discuss the determination of household consumption in the model, we do not observe "consumption", but rather "expenditure" in the actual data. The VAT rate increase is likely to affect expenditures for reasons other than income and intertemporal substitution effects. Specifically, expenditures on durable (e.g. televisions; D) and storable (e.g. toilet paper; S) goods and services should increase just before the implementation of the tax rate increase because they can be purchased at a relatively low price and then consumed afterwards. Conversely, expenditures on these items should fall after implementation even though consumption does not change. Barrell and Weale (2009) refer to such last minute purchases as an "arbitrage effect" to distinguish from the intertemporal substitution effect.

To control for the impact of these short-run disturbances, Cashin and Unayama (2016) restrict their analysis to non-storable non-durable goods and services (hereafter, N) because the timing of consumption for these goods and services, which is unobservable, roughly coincides with the timing of expenditure, which the econometrician observes. However, excluding D and S from our consumption measure is not sufficient to control for the arbitrage effect. An additional purchase of D as a result of the arbitrage effect inevitably increases the service flow from D, which in turn could affect consumption of N due to non-separable preferences over D and N. For example, a purchase of a television may increase the electricity bill, which we categorize as N.

Cashin and Unayama (2016) refer to this effect as the "intratemporal substitution effect" and construct a model in which the arbitrage effect is explicitly explained by storage costs and/or shopping costs. The authors then demonstrate that in order to control for the potential intratemporal substitution effect, it is sufficient to add the first difference of month dummies for the period in which the the arbitrage and intra-temporal substitution effects are likely to be present.

Using our data, Figure 8 shows the average expenditures on D and N around the VAT rate increase after controlling for seasonality, time-varying aggregate factors (e.g. number of holidays in a month), household fixed effects, and time-varying household characteristics. From the figure, it is clear that expenditures on D rose immediately following announcement of the VAT rate increase, and fell precipitously upon implemen-

tation. They recovered by September 2014 to roughly the level observed in September 2013, which is the month prior to announcement. This pattern looks consistent with arbitrage behavior. Accordingly, it seems reasonable to include first differenced month dummies for the period between November 2013 and September 2014.

In addition, because the second VAT rate increase was postponed, we add a dummy for the postponement announcement. Unlike the announcement in October 2013, however, the interpretation of the coefficient is ambiguous. Technically, the postponement announcement that was made in the middle of November 2014 (and confirmed by the election in the end of December 2014) should be regarded as announcement of a temporal tax cut (equivalent to a two-percentage point VAT cut for the period between October 2015 and April 2017), but some households may have assumed that the next increase would be canceled altogether. To avoid the complications associated with interpretation of the postponement announcement, we simply include month dummies for December 2014 and January 2015 to control for the impact of the postponement.

Taking into account the intratemporal substitution effects as well as demographics and other controls, we arrive at the following regression specification:

$$\begin{aligned} \Delta \log c_t &= const + \Delta X\beta + \phi(D_{Dec,2014} + D_{Jan,2015}) \\ &\quad + \sum_{t=Nov,2013}^{Sep,2014} \omega_t \Delta D_t + \alpha D_{Oct,2013} + \gamma D_{Apr,2014} + \eta_t, \end{aligned} \tag{8}$$

where ΔX is a vector of (potentially) time-varying household-specific characteristics, which includes the number of household members; the number of working household members; the number of household members under age 18; the number of household members above age 65; whether a household received a child benefit or pension payment; and interview dummies, which control for "survey fatigue", the tendency of households to report lower expenditure in later interviews (See Stephens and Unayama, 2011).[13]

[13]Based on Figure 8, it may be reasonable to think the arbitrage effect (and associated intratemporal substitution effect) appeared from October 2013, while we included the first differenced month dummies from November 2013. Under this specification, since the combination of $D_{Oct,2013}$, $D_{Oct,2014}$, and $\Delta D_{Oct,2013}$ exhibit perfect collinearity, we cannot identify all coefficients for them. To address this issue, we drop the first differenced dummy for October 2013; or in other words, we impose the restriction $\omega_{2013,10} = 0$.

If this assumption is incorrect, α and γ will include $\omega_{Oct,2013}$ and the resulting estimates will be biased. It is much more likely that $\omega_{Oct,2013} > 0$ because expenditures on D jumped in October 2013 and we observe a positive and highly significant correlation between monthly changes in expenditures on D and N throughout our sample period and following announcement of the consumption tax rate increase. A positive value of $\omega_{Oct,2013}$ would imply that α and γ are under- and overestimated, respectively, in absolute value; and therefore, our test of the LCPIH will be biased towards rejecting the LCPIH and find evidence consistent with excess smoothness.

Based on our specification, a testable implication can be derived:

Augmented Excess Smoothness Test Under the assumptions above, the coefficients should satisfy the following relationship if the LCPIH is true.

$$-\frac{\alpha}{(\tau_1+\tau_2)}+\frac{\gamma}{\tau_1}=1. \tag{9}$$

Because τ_1 and τ_2, which are observable, represent the size of the income shock resulting from the VAT rate increase, the first term on the left hand side can be interpreted as the sum of the negative income effect and the positive intertemporal substitution effect, which is one negative one plus the IES. On the other hand, the second term corresponds to the intertemporal substitution effect observed at the first implementation, which should be equal to the negative of the IES.

In the case of a pure income shock, the income effect should be one and the intertemporal substitution effect zero; that is, this test becomes the test that the marginal propensity to consume (MPC) out of the permanent shock should be one. That is the traditional "excess smoothness test" for which most studies reject the LCPIH, finding $\alpha < 1$. Because we must also account for intertemporal substitution, we refer to this test as an "augmented excess smoothness test". [14]

3.3 Hand-to-Mouth Households

Thus far, we have assumed that all households can consume according to the LCPIH; in other words, the Euler equation derived from the LCPIH holds for all households. However, previous studies have shown that the the Euler equation does not hold for some households. While the LCPIH predicts that anticipated income changes should not affect consumption, several studies have found that consumption is in fact quite responsive to these predictable income changes (See, for example, Parker, 1999; Souleles, 1999; Johnson, Parker, and Souleles, 2006; Stephens and Unayama, 2011; Parker, Souleles, Johnson, and McClelland, 2013), which is referred to as "excess sensitivity".

To reconcile excess sensitivity with the LCPIH, several authors have pointed out that consumption should respond to a predictable income change if households exhibit hand-to-

[14] Examining consumption changes upon implementation of Japan's April 1997 VAT rate increase, Cashin and Unayama (2016) find that the intertemporal elasticity of substitution (IES), or γ/τ_1, is approximately 0.2. Because the timing of announcement was unclear for the 1997 episode, the authors cannot evaluate the impact of the announcement, or α.

mouth (HtM) behavior, whereby a household consumes an amount equal to their current rather than permanent income. Moreover, households would be expected to exhibit HtM behavior if they

1. Are unable to borrow against future income to fund current consumption (Zeldes, 1989)
2. Invest in illiquid assets that have higher expected returns than liquid assets (thus increasing expected future consumption), but which cannot be consumed immediately without paying a transaction cost (Kaplan and Violante, 2014).

Due to these additional constraints, actual consumption in each period would be equal to current income, which is lower than the optimal consumption level in the absence of such constraints. In that sense, HtM behavior is not a violation, but rather an extension of the standard LCPIH model.

This insight suggests that the HtM may behave differently from the non-HtM in response to announcement and implementation of a VAT rate increase. Suppose that nominal current income is constant. Then the HtM are unlikely to change their consumption upon announcement of the VAT rate increase, even if they recognize that their lifetime resources have been reduced. As illustrated in the lower part of Figure 7, HtM behavior is the best available choice upon announcement of the VAT rate increase unless the optimal consumption level falls below current income as a result of the income shock. On the other hand, upon implementation, the HtM are expected to decrease their consumption in proportion to the VAT rate increase because real current income (i.e. nominal current income deflated by the tax-inclusive CPI), which is the upper bound of consumption, decreases. This suggests that upon implementation, for the case where the IES is less than one (as found in Cashin and Unayama, 2016), consumption should decrease by a greater percentage for the HtM than it does for the non-HtM.

Accordingly, we should examine the consumption responses to the VAT rate increase separately for HtM and non-HtM households. Otherwise, there exists the possibility that HtM behavior is driving our results even if the Euler equation does hold for the non-HtM. For the HtM, we modify the estimation equation (8) as follows:

$$\Delta \log c_t = const + \Delta X\beta + \phi(D_{Dec,2014} + D_{Jan,2015}) + \alpha D_{Oct,2013} + \gamma D_{Apr,2014} + \eta_t. \quad (10)$$

Because the HtM cannot purchase additional D and S due to the additional constraints that they face, the intratemporal substitution effect induced by the arbitrage effect is

expected to be zero. As discussed above, in the simplest example where nominal income is constant over time, we expect $\alpha/(\tau_1+\tau_2)=0$ and $\gamma/\tau_1=-1$.[15] We discuss identification of the HtM in the next section.

3.4 Data

We use data from the Japanese Family Income and Expenditure Survey (JFIES) to estimate the MPC out of the permanent income shock.[16] The JFIES is a rotating panel survey in which households are interviewed for six consecutive months and approximately 8,000 households are interviewed each month.[17]

Our estimates make use of JFIES data from the period between October 2008 and September 2015. We choose to exclude the period before the "Great Recession" because trends in household expenditures exhibited large fluctuations. Our sample period ends in September 2015 due to data availability. Thus, we use exactly eight years of data so each month has eight observations for controlling seasonal components of expenditure.

We divide the JFIES expenditure data into four groups: N, D, S, and tax-exempt goods and services (E). Expenditure on taxed items comprises almost 80 percent of total expenditure, while most tax-exempt expenditures consist of pre-committed consumption such as rent for housing and tuition for school. Among taxable items, 60 percent is N, which is our expenditure variable of interest, while expenditures on S and D are similar. We deflate monthly expenditures on N, S, and D using tax-inclusive category-specific CPI.

To identify the HtM, we apply the methodology of Kaplan, Violante, and Weidner (2014). Hara, Unayama, and Weidner (2016) applies the same methodology to Japan, but they use the National Survey of Family Income and Expenditure (NSFIE), another household survey. Because the JFIES has all of the variables required to define a household as HtM or non-HtM, we can use the same definition and criteria as Hara, Unayama, and Weidner (2016).

We define a household as HtM if its liquid wealth balance is: 1) positive and less than or equal to half of its earnings per pay-period; or 2) negative and within half of its per pay-period income from its borrowing limit, where we set the borrowing limit to one

[15] As for the augmented excess smoothness test, we cannot reject the LCPIH for the HtM.

[16] See Stephens and Unayama (2011, 2012) for more information regarding the JFIES design and content.

[17] Until 2002, single-person and agricultural households were excluded from the JFIES. As of the 2009 JFIES, single-person households comprised 11.8 percent of the population and were responsible for 18.1 percent of expenditures, while agricultural households accounted for 2 percent of the population, and 2.1 percent of expenditures.

month's income following the baseline case in the previous studies.[18] Because monthly income is necessary for identification of the HtM, we exclude self-employed households, who do not report the variable in the JFIES.

As for other sample selection criteria, following Cashin and Unayama (2016), we limit the sample to non-agricultural, male-headed households whose head does not change his job while in the sample. In addition, we restrict the sample to those who report asset and debt information. Because almost 90 percent of households report their wealth, we do not believe this restriction will significantly affect our results.

4 Empirical Results

4.1 Descriptive Results

The sample restrictions discussed above leave us with 447,072 observations from 80,102 households. Table 1 presents summary statistics for our sample. The average age of head is much older and the number of working members smaller in our current sample than in Cashin and Unayama (2016), which reflects the rapid aging of the population in Japan. As discussed above, almost half of total monthly expenditure is on N, and tax-exempt items comprise about twenty percent of total monthly expenditure.

Using the approach discussed in the previous section, we find that HtM households comprise about 10 percent of our sample, which is similar to the proportion found in Hara, Unayama, and Weidner (2016). HtM households are on average a bit younger and have more household members. Furthermore, their income and total expenditure is a little lower than those of the non-HtM. These characteracteristics are consistent with the findings in the U.S. and other countries reported in Kaplan, Violante, and Weidner (2014).

To get a rough approximation of the income effect associated with the VAT rate increase, Table 2 reports the percentage change in non-storable non-durable consumption between the year prior to PM Abe's announcement and the year dated October 2014 to September 2015. The adjusted values account for seasonality and other control variables used in the regression analysis. Note that this exercise ignores the period between announcement and several months after implementation of the VAT rate increase in order to

[18] Kaplan, Violante, and Weidner (2014) further categorizes HtM households based on the household's illiquid wealth balance. If the household has a positive illiquid wealth balance, then they are considered as wealthy HtM; otherwise, poor HtM. However, unlike NSFIE, the JFIES does not have information on value of owned house, and therefore, we cannot define a household as poor or wealthy HtM.

account for the inter- and intratemporal substitution effects that may have been present during that time frame.

We find that for all households, consumption of non-storable non-durables fell by a highly significant 3.5 percent between the two periods, which is not much different than the 4.8 percent reduction in lifetime resources that we attribute to announcement of the VAT rate increase. Of course, we want to ensure that this result is not being driven by the behavior of HtM households. When we split our sample into HtM and non-HtM households, we still observe that the consumption of non-HtM households fell by a highly significant 3.5 percent. Interestingly, we also find that total expenditure for HtM households dropped roughly in proportion to the percentage change in their monthly income between the two periods, which suggests there is validity to the methodology that we use to identify this group.

While the results presented in Table 2 certainly suggest that consumption fell roughly in proportion to the reduction in lifetime resources associated with the VAT rate increase, examining the change in household consumption several months after implementation increases the likelihood that other confounding factors - such as postponement of the second VAT rate increase - are at work. In the regression analysis presented in the next section, we instead directly control for inter- and intratemporal substitution behaviors that may have been present following announcement and implementation of the VAT rate increase using the methodology discussed in Section 3. The advantage of this approach is that it allows us to examine household consumption in the periods immediately following announcement and implementation rather than several months after the fact. And of course, this approach also permits us to exploit the panel nature of the JFIES.

4.2 Baseline Regression Results

Column (1) of Table 3 presents our baseline regression result for non-HtM households. Upon announcement of the VAT rate increase in October 2013, household consumption fell by 3.84 percent (α), which is significant at the one percent level. This result implies that the negative income effect associated with the tax rate increase dominated the positive intertemporal substitution effect. As for the intertemporal substitution effect, we find that consumption fell by three-quarters of a percent (γ) upon implementation of the VAT rate increase in April 2014. Given the 2.85 percent increase in the price level, we can infer that the IES is 0.26, which is similar to the corresponding estimate in Cashin

and Unayama (2016).[19]

Applying the estimates of α and γ to the left hand side of (9), we estimate the MPC out of the permanent shock. For the non-HtM, the estimated MPC is 1.06, which is not significantly different from 1. In other words, we cannot reject the hypothesis that the LCPIH can explain the decrease in consumption in response to the VAT rate increase.

Turning to the behavior of HtM households in Column (2) of Table 3, we find that consumption did not change upon announcement of the VAT rate increase, but that it did fall by a highly significant 3.70 percent upon its implementation, roughly in proportion to the increase in the price level. These results are consistent with the hypothesized consumption response of HtM households that we presented in Figure 7.

Column (3) of Table 3 provides us a result of pooling regression. By pooling the both Non-HtM and HtM households, the resulting coefficients are not affected much but standard errors are also almost unchanged. This suggests that using the common control variables such as month dummies and changes in number of household members should be problematic since seasonal pattern of consumption would be different between Non-htM and HtM households. To address this, calculations below in the next subsection, we use Non-HtM samples only.

Based on the results presented in Table 3, we conclude that there is no evidence for excess smoothness and that we cannot reject the LCPIH for households who are non-HtM. In addition, our results for HtM households - that they did not respond to announcement of the VAT rate increase, but significantly reduced consumption upon its implementation - potentially shed some light on previous findings from the consumption literature that are drawn from countries possessing a larger share of HtM households than Japan (e.g. the U.S. and U.K.). The former result suggests that previous findings of excess smoothness are due not only to the econometrician's inability to identify the timing of the realization of an income shock to a household, but also because a significant share of the population

[19] As we discussed in footnote 13 above, if our identifying assumption that the intratemporal substitution effect was not present in October 2013 is incorrect, our IES estimate may be biased upward. The intratemporal substitution effects, given by the coefficient estimates for the first differenced month dummies, are in general positive prior to the VAT rate increase (see Appendix Table 1), when durable arbitrage effects were present. Furthermore, the coefficient estimate for March 2014, when durable arbitrage peaked, is statistically significant at the one percent level. That is, non-durable consumption rose when the relative price of durables was lowest. Following the VAT rate increase, the coefficient estimates are generally negative, when durable expenditures dipped. Together, the estimates corroborate previous estimates showing that durables and non-durables are strong complements (see Pakos, 2011; Cashin and Unayama, 2016; and Cashin, 2016). As further evidence of the strong complementarities between durables and non-durables, we find a positive and highly significant correlation between monthly changes in household durable and non-storable non-durable expenditures during the period in which we allow for intratemporal substitution effects. From November 2013 to August 2014, the correlation is 0.08 with a p-value of 0.00. Given these findings, our IES estimate is likely an upper bound.

is HtM, and it is suboptimal for these households to respond to an income shock upon its announcement. The latter finding suggests that without appropriately controlling for HtM behavior, estimates of the IES are biased in the sense that they partially capture the realization of the income effect from a price change for HtM households rather than substitution of consumption over time.

4.3 Robustness Checks and Discussions

Column (3) of Table 3 reports the results of a regression that pools the HtM and non-HtM, allowing only the α and γ coefficients to differ for the two groups. Again, we cannot reject that the MPC out of the permanent shock is 1 for non-HtM households. For the HtM, we still find that consumption did not fall significantly upon announcement. And while we find the decline in consumption for the HtM upon implementation of the VAT rate increase was proportional to the increase in the price level, the coefficient is no longer statistically significant.

Columns (1) and (2) of Table 4 test the robustness of our coefficients of interest to the choice of the period over which we allow for intratemporal substitution (only non-HtM households are included). In Column (1), we exclude the first difference dummy for August 2014, while in Column (2), we include an additional first difference dummy for September 2014. The coefficients on the announcement and implementation dummies are little changed relative to our baseline result, and we thus conclude that our results are robust to the choice of the time horizon for which we allow intratemporal substitution effects.

In Columns (3) and (4), we examine the effects of a potential confounding factor. Because our identification strategy relies heavily on time-series variation in monthly consumption, it is important to consider the effects of confounding factors unrelated to the VAT rate increase. One potential confounding factor was a reduction in public pensions that was implemented in the same month as PM Abe's announcement. Due to Japan's macroeconomic "slide" system, which is a type of cost of living adjustment, public pension benefits were cut in a stepwise fashion by 1.0 percent in October 2013, 1.0 percent in April 2014, and 0.5 percent in April 2015. One may therefore worry that the consumption drops we observed in October 2013 and April 2014 were instead caused by the benefit cuts (though it is worth noting the cuts were announced in 2012).

To test whether our results are affected by the pension cut, we exclude households

receiving public pensions from the sample. As shown in Column (3), exclusion of pension receivers hardly affects our baseline results. However, there may still be possibility that some pension receivers are included in the sample because, as Stephens and Unayama (2012) point out, some households are regarded as non-pension-receivers due to misreporting of their pension income. To avoid such an error, in Column (4) we also exclude all households whose members are aged 65 and over. While the coefficients become slightly smaller in absolute value, we still we do not find evidence of excess smoothness.

To further demonstrate the robusstness of our results, we use a "placebo approach. That is, we estimate the same regression equation, but with the alternative assumption that households recognized the VAT rate increase at an earlier date. If our baseline assumption is correct, the estimated coefficients for another date specified as a "placebo" should be statistically insignificant.

We consider two separate placebo months. The first is August 2012, the month the legislation for the VAT rate increase passed the Japanese Diet. The second is August 2013, the month in which PM Abe's Intensive Review Meetings took place. The results, which are shown in Columns (1) and (2) of Table 5, show that the consumption responses to the alternative announcement dates were not significantly different from zero. As such, it would appear that October 2013 was the critical month in which households recognized the permanent shock.

Our results, which suggest that households perceived the VAT rate increase to be an unanticipated permanent income shock, are inconsistent with Ricardian equivalence. In the discussion that follows, we provide some reasoning for why it does not appear to hold in our case.

In general, Ricardian equivalence relies on two assumptions:

1. Each household has a dynastic utility function.
2. Households understand the relationship between government spending and taxation.

Suppose instead that households do not consider the utility of future generations, but assumption (2) holds. Under this scenario, a VAT rate increase would be regarded as an income shock only to older households whose pension benefits are fixed and not in danger of being cut in the absence of the VAT rate increase. For younger households, a VAT rate increase would have little effect on their lifetime resources because in its absence, cuts to their pension benefits would be likely. We can test the validity of this story by splitting our sample into older and younger groups.

In Column (3) of Table 5, we divide the sample into two groups. Those whose head is older than the median household head age (46) are categorized as "Older"; otherwise, they are categorized as "Younger". The results shows that the MPC out of the VAT rate increase was similar for both groups, and was in fact a bit larger (in absolute value) for the Younger group. As such, our results are inconsistent with the alternative scenario that we posit above, which is not surprising given that the public opinion polls discussed in subection 2.1 showed that most households did not understand the relationship between the VAT rate increase and future government spending. Without a solid understanding of the fiscal situation, a VAT rate increase simply implies a reduction of lifetime resources for households, and is thus regarded as an income shock.

5 Conclusion

In this paper, we test the LCPIH using Japan's 2014 VAT rate increase as a natural experiment. Because the VAT has a single rate with relatively few exemptions and the tax burden is borne fully by consumers, a rate increase induces a proportional price change. Given no change in nominal income expectations, the higher price level causes a proportional decrease in lifetime resources. In addition, we treat this particular VAT rate increase as an unanticipated shock. While legislation associated with the VAT rate increase was completed in 2012, the fate of the tax rate increase became highly uncertain following the 2012 election in which Shinzo Abe became Prime Minister (PM). To promote his economic policy package, known as "Abenomics", PM Abe repeatedly mentioned the possibility of cancelling the tax rate increase altogether. As a result, we assume that households did not anticipate the income shock associated with the VAT rate increase prior to PM Abe's October 2013 announcement that the rate increase would be implemented as originally scheduled.

We then construct a model to derive a testable implication of the LCPIH. Under the assumption of an iso-elastic instantaneous utility function, the model predicts that consumption falls by $1 - IES$ times the size of the tax rate increase at the time of announcement. That is, the announcement effect is a combination of a negative income and positive intertemporal substitution effect, where the income effect, or marginal propensity to consume (MPC) out of the income shock, is one. To obtain an estimate of the MPC, we subtract our estimate of the IES from the estimated announcement effect. If the resulting MPC estimate does not differ significantly from 1, then we cannot reject the

LCPIH.

While the standard LCPIH assumes that the Euler equation holds for all households, it is well known that the consumption behavior of HtM households does not correspond to the Euler equation. Following this insight, we divide our sample into HtM and non-HtM households and test the implication of the model separately for each group. We find that consumption changes at the time of announcement and implementation satisfy the predictions of the LCPIH for non-HtM households. For HtM households, consumption did not change at announcement, but fell significantly upon implementation, as the HtM literature predicts. Overall, contrary to the excess smoothness literature, we show that consumption changes around the 2014 VAT rate increase are well explained by the LCPIH.

Coupled with the small announcement effects observed in response to the compensated 1997 VAT rate increase (see Cashin and Unayama, 2016), the results in this study suggest that in the absence of significant offsetting compensation, a VAT rate increase will induce households to decrease their consumption in proportion to the tax rate increase. Furthermore, the lack of a significant negative consumption response among HtM households suggests that the long-run impact of a VAT rate increase may be mitigated in an economy with a greater share of HtM households.

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Table 1: Descriptive Statistics

	All		Non-HtM		HtM	
	Ave.	Std. Dev.	Ave.	Std. Dev.	Ave.	Std. Dev.
Age of head	56.6	15.2	56.9	15.1	55.4	15.2
Num of members	3.09	1.12	3.06	1.10	3.20	1.17
Num of members aged 18−	0.65	0.96	0.63	0.95	0.73	1.02
Num of members aged 65+	0.73	0.90	0.74	0.90	0.67	0.88
Num of working members	1.21	0.95	1.19	0.95	1.28	0.96
Yearly income	5,995	3,252	6,092	3,318	5,543	2,880
Total expenditure	292	244	294	239	285	264
Non-storable non-durables	136	92	138	92	129	89
Storable nondurables	44	32	44	32	44	31
Durables	46	165	46	159	46	192
Tax Exempted items	66	104	66	103	66	106
Observations	369,323		302,697		66,626	

Note: All amount are 1,000 yen.

Table 2: Changes between Before and After

	Before Announcement (Oct 2012-Sep 2013)		After Implementaiton (Oct 2014-Sep 2015)		Difference
	Ave.	Std. Dev.	Ave.	Std. Dev.	Change Rate
			A. All Households		
Total expenditure	297	253	284	243	$-4.1\%^{***}$
Non-storable nondurables	138	97	133	93	$-3.5\%^{***}$
Total Monthly Income	428	402	411	392	$-4.1\%^{***}$
Observations	52,648		53,529		
			B. Non-HtM Households		
Total expenditure	298	243	288	246	$-3.5\%^{***}$
Non-storable nondurables	140	99	135	96	$-3.5\%^{***}$
Total Monthly Income	447	414	430	404	$-3.8\%^{***}$
Observations	42,985		43,500		
			C. HtM Households		
Total expenditure	290	291	270	231	$-6.9\%^{***}$
Non-storable nondurables	130	90	126	76	$-3.4\%^{***}$
Total Monthly Income	341	328	322	318	$-5.4\%^{***}$
Observations	9,663		10,029		

Note: All amount are 1,000 yen. *, **, and *** represent significance at the 10, 5, and 1 percent.

Table 3: Estimated impacts of the 2014 VAT rate increase

	(1)	(2)	(3)	
	Non-HtM	HtM	Non-HtM	HtM
Dummy for Oct 2013 (α)	-3.84^{***}	-0.11	-3.53^{***}	-1.33
	(1.02)	(2.04)	(0.98)	(1.88)
Dummy for Apr 2014 (γ)	-0.75	-3.70^{**}	-0.22	-2.79
	(1.85)	(2.17)	(1.86)	(2.00)
$\alpha/(\tau_1+\tau_2)+\gamma/\tau_1$	-1.06	-1.00	-0.81	-1.25
(p-value for $=-1$)	(0.91)	(0.72)	(0.77)	(0.75)
Estimated IES ($=\gamma/\tau_1$)	0.26	1.30	0.08	0.98
Observations	302,697	66,626	369,323	

Note: This table presents estimates from a regression based on Equation (8) and (10) . The dependent variable is the first difference of the logarithm of real expenditures on non-storable nondurables. Standard errors are robust to serial correlation within households over time. All columns report OLS regressions, which include, in addition to variables in the table, age of household head, the first difference of: month dummies; day of the week controls; indicators for survey interviews; the number of household members; working members; members under age 18; and members over the age of 65; dummy for March 2011. Controlling the intra-temporal substitutions, the first differenced dummies for the months between November 2013 and August 2014 are included for Non-HtM households. *, **, and *** represent significance at the 10, 5, and 1 percent.

Table 4: Robustness Checks of the Baseline Results

	(1)	(2)	(3)	(4)
Intra-temporal Substitution Effects	Nov 2013 - Jul 2014	Nov 2013 - Sep 2014	Nov 2013 - Aug 2014	Nov 2013 - Aug 2014
Dummy for Oct 2013 (α)	-3.83^{***}	-3.72^{***}	-3.51^{***}	-3.17^{**}
	(1.02)	(1.03)	(1.35)	(1.43)
Dummy for Apr 2014 (γ)	-0.33	-0.05	-0.50	-0.38
	(1.78)	(1.91)	(2.53)	(2.74)
$\alpha/(\tau_1+\tau_2)+\gamma/\tau_1$	-0.92	-0.80	-0.91	-0.80
(p-value for $=-1$)	(0.90)	(0.76)	(0.92)	(0.83)
Estimated IES ($=\gamma/\tau_1$)	0.12	0.02	0.18	0.13
Additional Sample Selection	None	None	No Pension	No Pension No age 65+
Observations	302,697	302,697	173,128	151,527

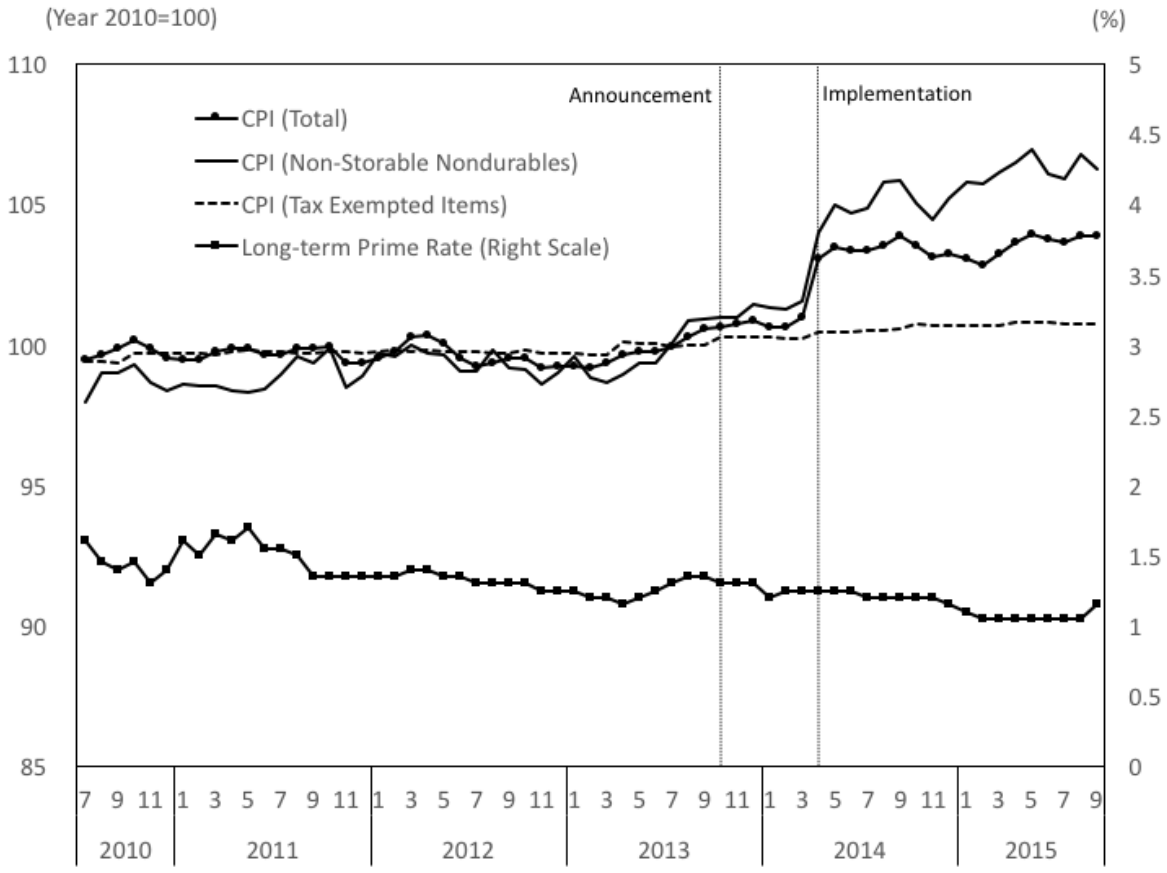
Note: This table presents estimates from a regression based on Equation (8) using the Non-HtM only. The dependent variable is the first difference of the logarithm of real expenditures on non-storable nondurables. Standard errors are robust to serial correlation within households over time. All columns report OLS regressions, which include, in addition to variables in the table, age of household head, the first difference of: month dummies; day of the week controls; indicators for survey interviews; the number of household members; working members; members under age 18; and members over the age of 65; dummy for March 2011. Controlling the intra-temporal substitutions, the first differenced dummies for the months shown in the first line are included. *, **, and *** represent significance at the 10, 5, and 1 percent.

Table 5: Placebo Tests and Ricardian Equivalence

	(1)	(2)	(3)	
	All Age	All Age	Younger	Older
Dummy for Aug 2012	1.55			
	(1.41)			
Dummy for Aug 2013		−0.25		
		(1.03)		
Dummy for Oct 2013			−4.00**	−3.08*
			(1.77)	(1.77)
Dummy for Apr 2014	−0.50	−0.25	−0.46	−0.55
	(2.53)	(2.53)	(2.85)	(2.77)
$\alpha/(\tau_1+\tau_2)+\gamma/\tau_1$	0.15	−0.14	−1.00	−0.83
(p-value for $=-1$)	(0.23)	(0.48)	(0.99)	(0.87)
Estimated IES ($=\gamma/\tau_1$)	0.18	0.09	0.16	0.19
Observations	173,128	173,128	173,128	

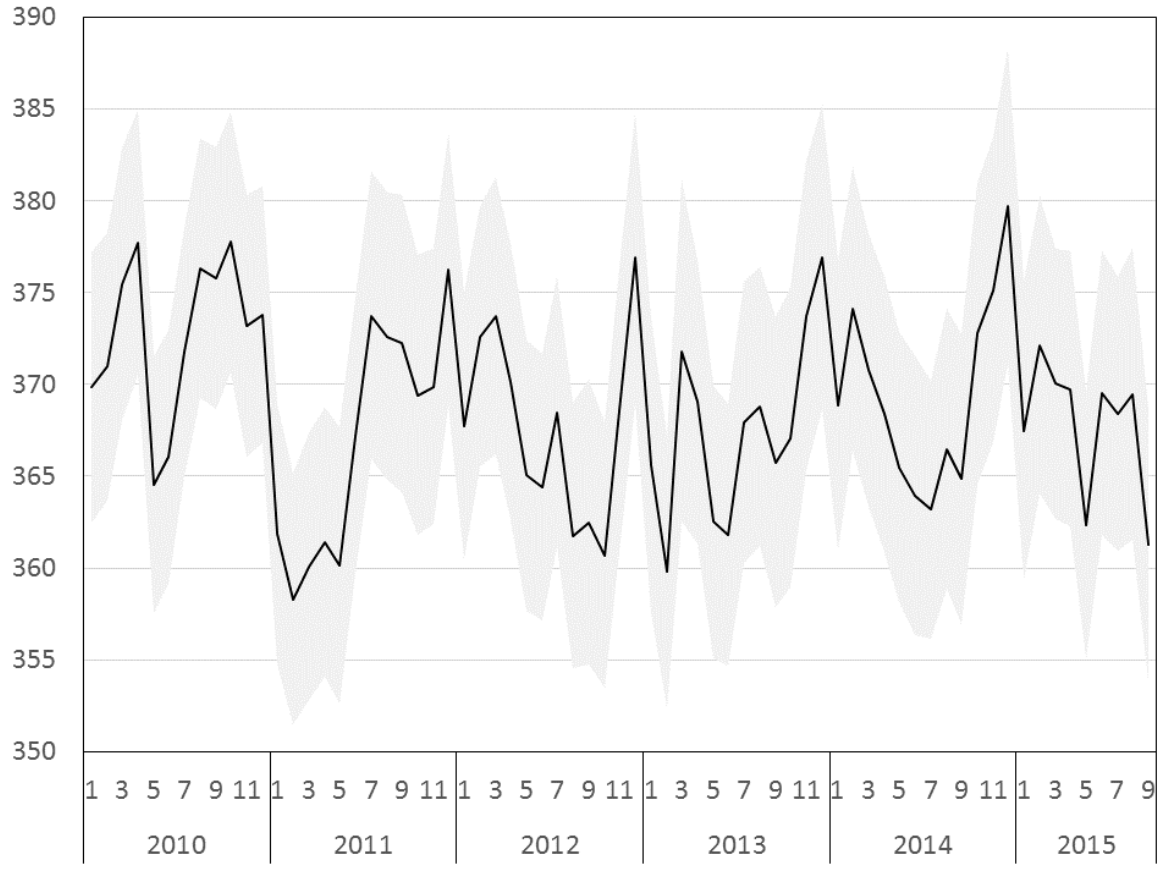
Note: This table presents estimates from a regression based on Equation (8) using the Non-HtM with no pension income. In column (3), Younger households are defined as those whose head is age 45 and younger; otherwise, categorized as Older. The dependent variable is the first difference of the logarithm of real expenditures on non-storable nondurables. Standard errors are robust to serial correlation within households over time. All columns report OLS regressions, which include, in addition to variables in the table, age of household head, the first difference of: month dummies; day of the week controls; indicators for survey interviews; the number of household members; working members; members under age 18; and members over the age of 65; dummy for March 2011. Controlling the intra-temporal substitutions, the first differenced dummies for the months between November 2013 and August 2014 are included. *, **, and *** represent significance at the 10, 5, and 1 percent.

Figure 1: The consumer price index before and after the implementation



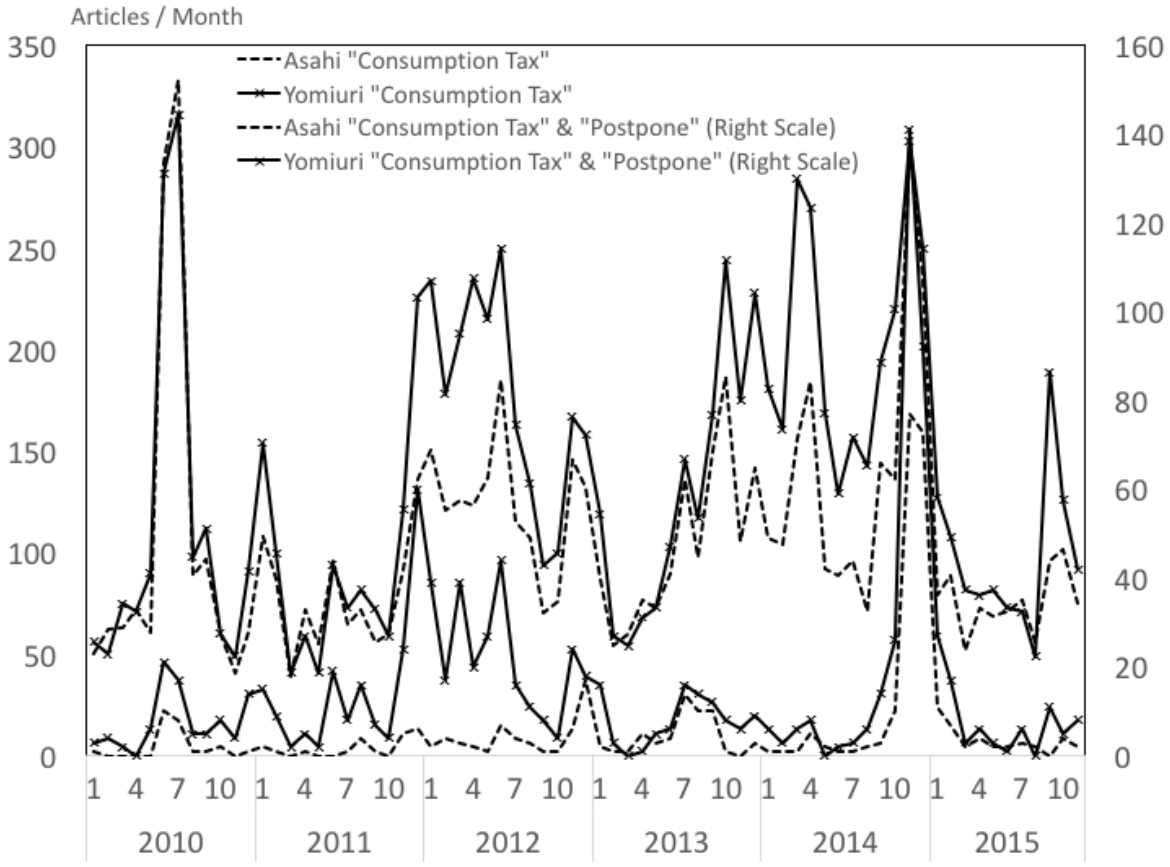
Source: Consumer Price Index (Statistical Bureau) and Prime Rate (Bank of Japan).

Figure 2: Average Periodical Income



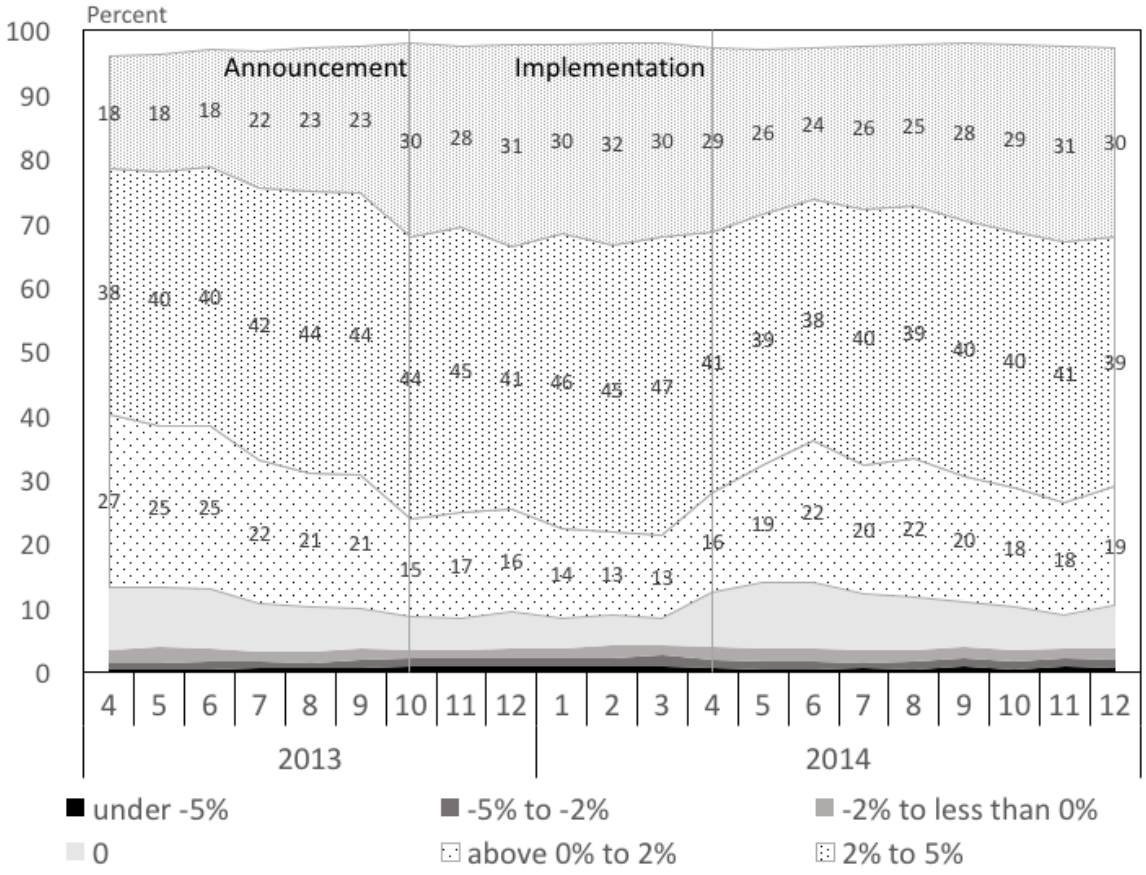
Source: Family Income and Expenditure Survey.

Figure 3: Theoretical consumption response to a VAT increase



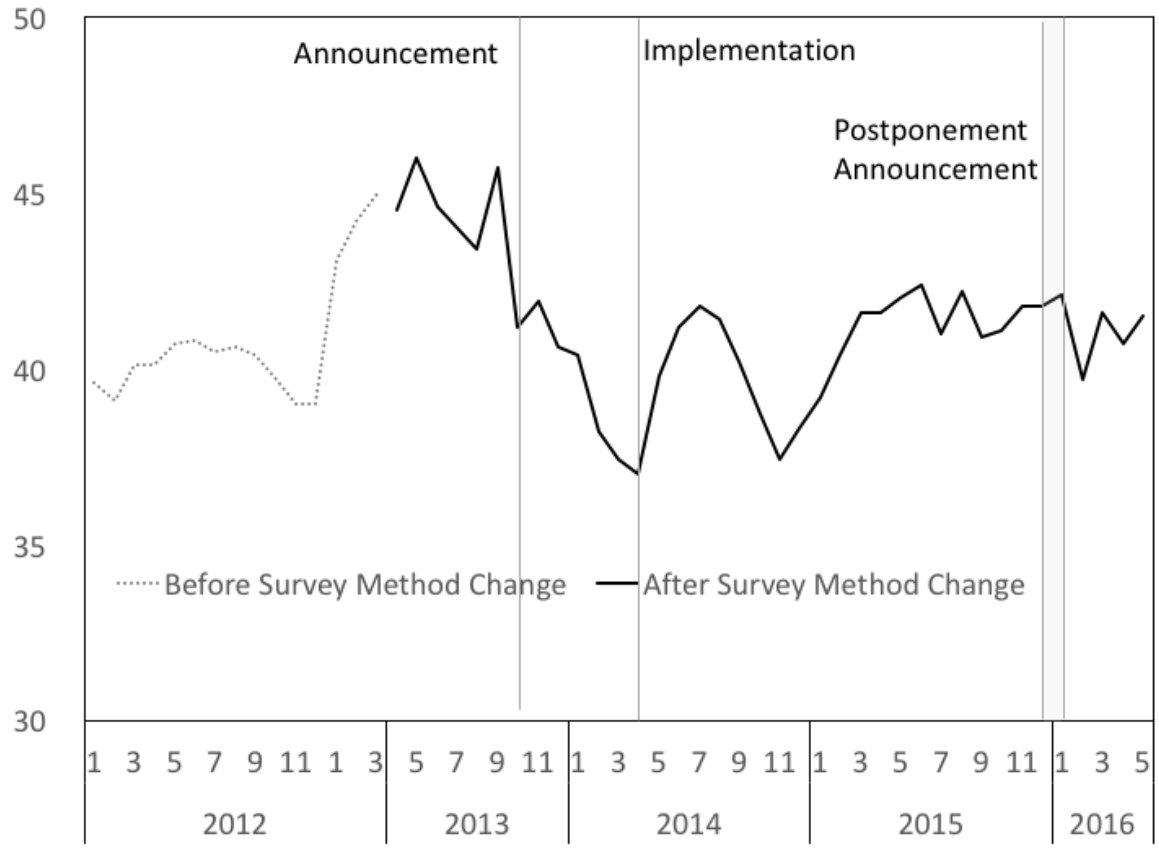
Source: KIKUZO II VISUAL for Asahi and YOMIDAS REKISIKAN for Yomiuri.

Figure 4: Announcement and expected inflation rate



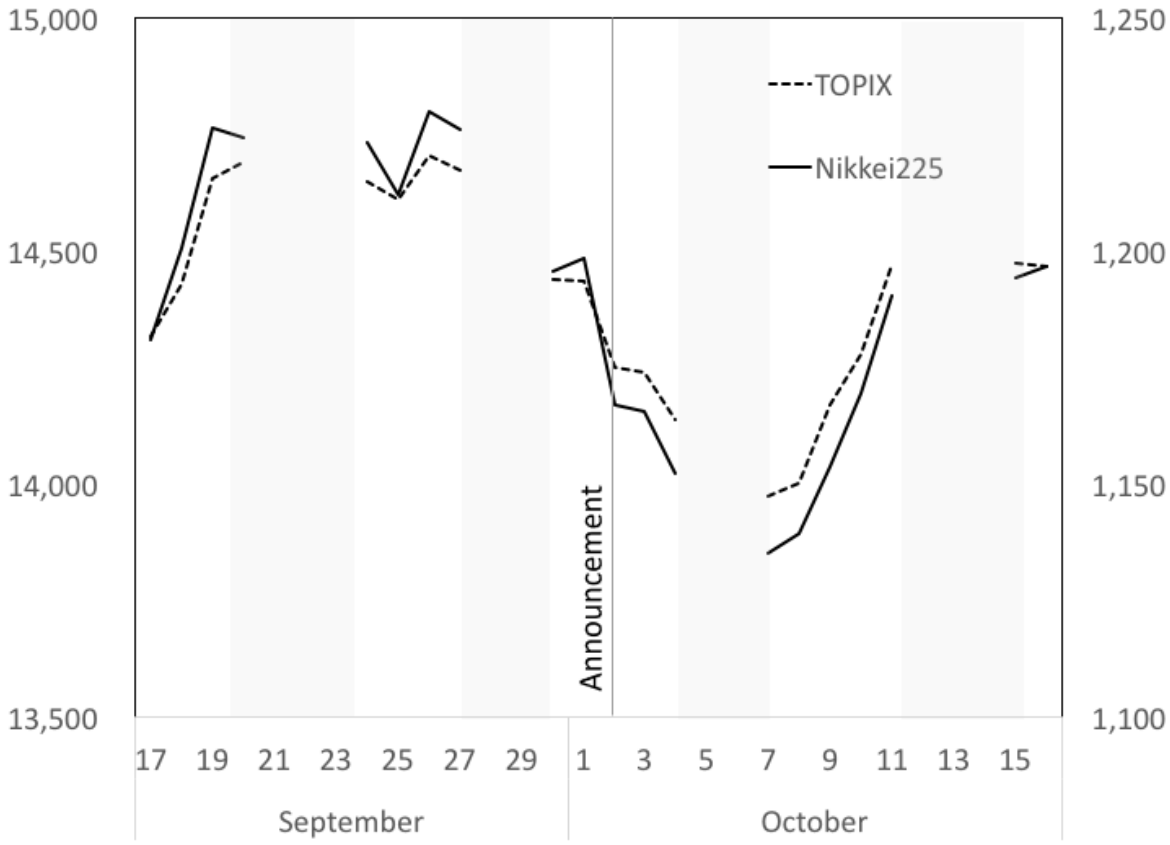
Source: Consumer Confidence Survey (Cabinet Office).

Figure 5: Consumer confidence index



Source: Consumer Confidence Survey (Cabinet Office).

Figure 6: Stock prices around the announcement



Source: Nikkei 225. *Stock market did not open in shaded days due to weekends or holidays.

Figure 7: Theoretical consumption response to a VAT increase

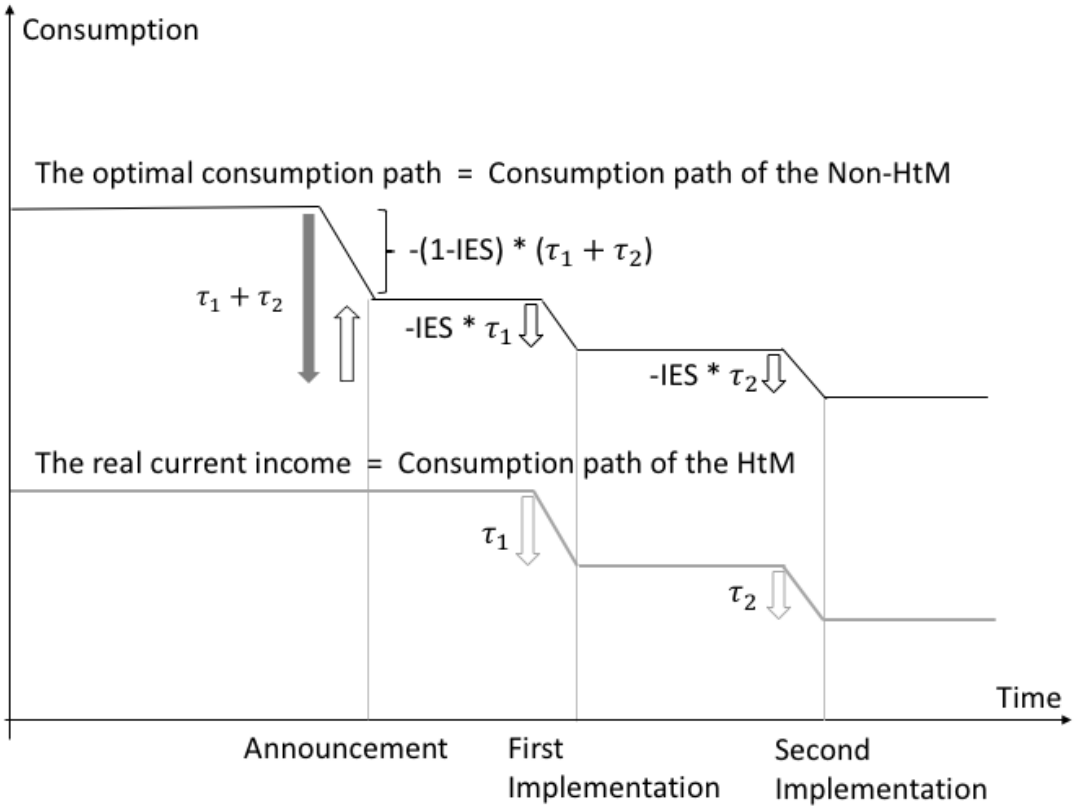
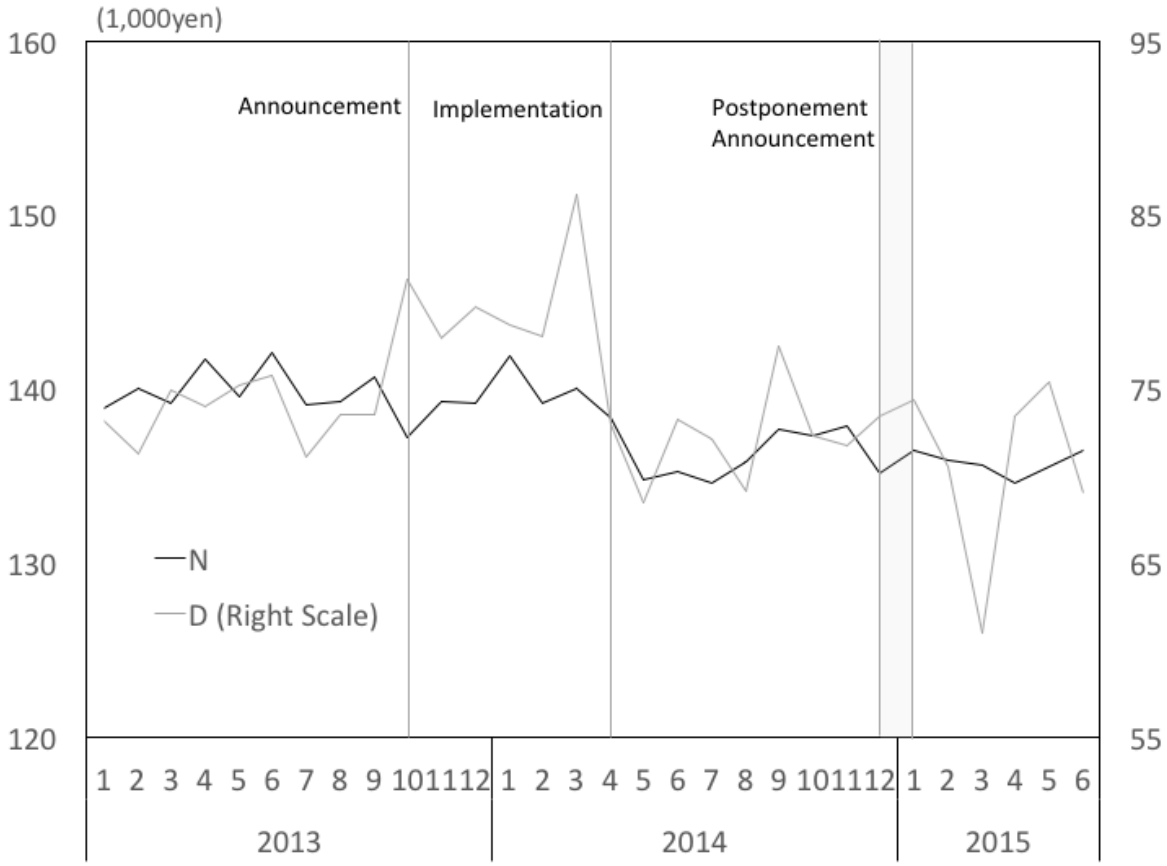


Figure 8: Consumption path around the VAT increase



Note: This shows seasonal-adjusted real monthly expenditures (in thousands of Yen) on non-storable nondurables (N), and durables (D). The seasonal adjusted ones are the residuals plus non-month specific factors calculated from a regressions of real monthly expenditure on month dummies and other controls used in the regressions below.