

# 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.<sup>1</sup> 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; Gali, 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,

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<sup>1</sup>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.<sup>2</sup>

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 (intra-temporal), and stockpiling behavior. Building on Cashin and Unayama (2016), our theoretical model and resulting empirical specification distinguish between the income, intra-temporal substitution, and intertemporal substitution effects associated with the VAT rate increase. The model shows that after controlling for dura-

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<sup>2</sup>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.

bility and storability, household consumption should fall twice - once upon announcement (so long as the negative income effect dominates the positive intertemporal substitution effect) and again upon implementation of the tax rate increase. 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 sizeable 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.

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 Consumption Tax 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 Shock**

The Japanese government introduced the VAT, or Consumption Tax, in 1989 at a rate of three percent, and in 1997, increased the rate to five percent. Then, in August 2012, the government decided to increase the tax rate from five to eight percent in April 2014 and to ten percent in October 2015. While the first increase was implemented as scheduled in April 2014, in December 2014 the government postponed the second increase until April 2017. Furthermore, PM Abe announced a further postponement until October, 2019.

Due to the legal and institutional features of Japan's VAT shown below, a rate increase is expected to induce an increase in prices that is roughly proportional to the percentage increase in the tax rate. Given the future income path, higher prices induced by a VAT rate increase cause a reduction of lifetime resources, and therefore, can be regarded as a

permanent income shock.

First, unlike VAT in many other countries, the Japan's VAT has a single flat rate with relatively few exemptions. Based on the weights for 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.<sup>3</sup>

Second, as documented by Ishi (2001), the Japanese government has repeatedly made it clear that it expects the burden of the VAT to be borne fully by consumers, and this is in fact what has been observed. 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 (See Cashin and Unayama, 2016). Due to the efforts of the government, prices increased by roughly the same percentage as the tax rate upon implementation. In April 1989, prices on goods and services not previously subject to tax increased by approximately three percent. Likewise, in April 1997, prices on goods subject to the VAT increased by about two percent. It is thus reasonable to believe that households expected to bear the full burden of the 2014 VAT rate increase, and in turn experience a proportional loss in lifetime resources.

In fact, we observe a similar pattern in prices in April 2014. 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 2014 Consumption Tax rate increase. The overall CPI is very stable throughout the sample period except for April 2014 when the government implemented the tax rate increase. 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. As was the case in 1989 and 1997, the price jump is quite similar to the percentage increase in the Consumption Tax rate (2.85). On the contrary, the CPI for tax-exempt goods and services is roughly constant throughout the sample period, suggesting that the price changes observed around implementation were due solely to the tax rate increase.

While prices jumped in proportion to the Consumption Tax rate increase upon im-

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<sup>3</sup>Exemptions 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.

plementation, other factors affecting households' budget sets, such as nominal income expectations and interest rates, were stable. In addition, given the well-documented financial strains on the Japanese "pay-as-you-go" public pension system, there was no reason to believe that the government would reduce the VAT rate in the future.

Finally, unlike the 1989 and 1997 Consumption Tax rate implementation and increase, households received little to no offsetting compensation in 2014. Households who are not subject to the income tax because of low income and who receive the earnings-tested child benefit were eligible to receive a cash rebate from the Japanese government to offset the additional burden imposed by the VAT rate increase. However, the rebate was only worth 10,000 yen (roughly 100 US dollar) per eligible individual, with total expenditures on the rebate equaling only 180 billion yen, or about 3 percent of the revenue increase per year resulting from the VAT rate increase. On the contrary, the 1989 implementation and 1997 tax rate increases were a part of tax system reform and intended to be revenue-neutral changes. For these reasons, we can treat the most recent VAT rate increase as a permanent income shock for which the income path permanently shifted down.

## **2.2 Announcement of the VAT Rate Increase**

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 announcement of the most recent tax rate increase was clear and unanticipated. This assumption is critical for our purposes since 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.

While one could argue that households are not in general interested in changes in tax systems due to their complexity, this is not the case with the VAT in Japan, where Japanese households have had an acute awareness of the rate of VAT since its inception. Reflecting this awareness, the VAT has always been a major political issue. This is especially true following the every-five-year actuarial review of pension schemes, as the government relies heavily on the VAT revenue to finance the pension benefits of a rapidly

aging society. Following the 2009 actuarial review, the FY 2009 Tax Reform Law required the government to take legislative action to increase the VAT rate. Given the importance of the actuarial review and the government's reliance on the revenue generated by the VAT, we thus assume that the VAT rate is a part of the information set of households.

Figure 2 provides strong support for this assumption. It reports the number of articles between 2010 and 2015 that mention the phrase "Consumption Tax" (Japanese name of the VAT, or "Shouhi zei") in the Yomiuri and Asahi newspapers, which are two leading non-business newspapers with a circulation of over 10 million (in 2010). During this period, the VAT received significant attention on several occasions that generally coincided with political announcements related to the VAT. For example, the initial spike in coverage of the VAT in June 2010 to over 300 articles in that month alone coincided with the ruling Democratic Party of Japan's (DPJ) first announcement of its proposal to increase the VAT rate to 10 percent. Coverage of the VAT remained high throughout this period. Consequently, this figure suggests that Japanese households would be well informed regarding the VAT and share similar information about any potential tax rate increase.

In June 2012, PM Yoshihiko Noda of the DPJ introduced a bill to increase the Consumption Tax rate in a stepwise fashion. It set a target date of April 1, 2014, to increase the VAT rate from five to eight percent, and another two percentage point increase was scheduled for October 1, 2015. The Japanese Diet passed the Consumption Tax Bill on August 10, 2012, which was the first official announcement of the tax rate increase. In other words, at this time, households may have become aware that lifetime resources would decrease by 4.8 percent ( $= 110/105 - 1$ ).

However, despite passage of the legislation, it quickly became unclear whether the government would implement the VAT rate increase as planned. In late 2012, the Liberal Democratic Party (LDP) defeated the DPJ, and Shinzo Abe replaced Yoshihiko Noda as PM. PM Abe immediately reopened discussion of the VAT rate increase because he regarded the tax rate increase as a serious obstacle to "Abenomics", his cabinet's policy package intended to help the Japanese economy emerge from its long period of stagnation.

Because PM Abe repeatedly claimed that he reserved a right to indefinitely postpone the tax rate increase, it seems quite plausible that households became skeptical the tax rate increase would be implemented as planned. In fact, Figure 2 shows that articles that contained both the words "Consumption Tax" and "postpone" increased soon after his appointment in late 2012. This suggests that households believed the tax rate increase



would not be implemented.

Debate over the proposed VAT rate increase culminated in the “Intensive Review Meetings”, which began in late August 2013 (Note that news coverage jumped again upon commencement of these meetings). During these meetings, PM Abe met with “specialists” including economists, company managers, and NPO representatives who advised him on the expected short- and long-run impacts of the VAT rate increase. After confirming that the majority of the meeting participants supported the tax rate increase, on October 1, 2013 PM Abe declared that the government would increase the VAT rate as originally planned.

There exist several pieces of evidence suggesting that PM Abe’s October 2013 announcement was largely unanticipated and contained “new information”. First, the bottom panel of Figure 3 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 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, the top panel in Figure 3 shows that inflation expectations increased much more gradually in the lead up to the April 1997 VAT rate increase, which is consistent with the fact that the LDP passed initial legislation to increase the VAT rate in 1996 Q2, won an election in 1996 Q4 that revolved around their support of the proposed VAT rate increase, and officially passed the legislation to implement the VAT rate increase at the tail end of 1996 Q4 (see Cashin and Unayama, 2016).

In addition to the abrupt increase in inflation expectations in October 2013, Figure 4 illustrates that the consumer confidence index fell precipitously upon PM Abe’s announcement as well, and continued to fall until implementation of the VAT rate increase. Finally, sharp downward movements in the Japanese stock market following PM Abe’s announcement strongly suggest that his announcement was a surprise. Figure 5 shows the Nikkei 225 and TOPIX stock market indexes in the days leading up to and following PM Abe’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 movement in the stock market indexes, the sharp drop that we observe along with another spike in news coverage (Figure 2) suggest that most households became aware of

the VAT rate increase upon Abe's announcement.

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. While the VAT legislation initially scheduled the second tax rate increase for October 2015, discussions to postpone the increase began once economic conditions deteriorated beyond the government's expectations following implementation of the April 2014 tax increase. The 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 2 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 in our 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 permanent income shock. The basic LCPIH predicts that consumption should change immediately after its announcement reflecting the decrease in lifetime resources induced by the shock. Such impact of a permanent income shock is referred to as “income effect”.

Unlike a pure income shock, however, the announcement of a VAT rate increase can affect consumption through additional channels. Specifically, a future VAT rate increase incentivizes households to engage in substitution of consumption over time and across goods and services. The former channel is the “intertemporal substitution” channel, whereby households increase consumption prior to a VAT rate increase when prices are relatively low. The latter channel is the “intra-temporal substitution” channel, where households may alter the composition of their consumption because certain types of goods and services become relatively cheaper than others as a result of the impending VAT rate increase. For example, the price of durable (e.g. televisions) and storable (e.g. toilet paper) goods and services, which can be purchased at a relatively low price prior to the tax rate hike and consumed after, falls relative to non-storable non-durables. Consequently, spending on these goods and services becomes even more attractive to households just prior to a VAT rate increase. Barrell and Weale (2009) refer to such behavior as an “arbitrage effect”. The arbitrage effect further complicates estimation of the income effect associated with the VAT rate increase because the accelerated purchase of durables may also induce a change in non-storable non-durable consumption unrelated to the income or intertemporal substitution effects. For example, a purchase of a television may increase the electricity bill, which we categorize as a non-storable non-durable.

To address these short-run disturbances, Cashin and Unayama (2016) restrict their analysis to non-storable non-durable goods and services because the timing of consumption for these goods and services, which is unobservable, roughly coincides with the timing of expenditure, which the econometrician observes. In addition, Cashin and Unayama (2016) propose a regression specification to control for intra-temporal substitution. However, their model does not explicitly consider how the announcement of a VAT rate change affects consumption.<sup>4</sup>

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<sup>4</sup>The April 1997 VAT rate increase studied in Cashin and Unayama (2016) was intended to be revenue-neutral. Consequently, Cashin and Unayama (2016) ignore income effects in their analysis.

Below, we introduce a model that demonstrates how the announcement of an uncompensated VAT rate increase affects permanent income, and in turn, non-storable non-durable consumption. Although Cashin and Unayama (2016) empirically confirm the existence of the short-run intratemporal substitution effects discussed above, we first construct a model in which non-storable non-durable consumption is separable from durable and storable consumption, and thereby, can ignore these effects. Nevertheless, our empirical specification presented in Section 3.2 incorporates additional controls for intratemporal substitution.

Let the utility maximization problem of a household be as follows:

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

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

where  $c_s$  is consumption of non-storable non-durable goods and services (N);  $\delta$  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, which is a random variable; and  $p_s$  is the price of N.

Here, we introduce the VAT related variables to describe the situation just before the announcement on October 1, 2013. Suppose that  $100\tau_1$  and  $100(\tau_1 + \tau_2)$  percent stepwise VAT tax rate increases are planned for time periods  $S_1$  and  $S_2$ , respectively. That is, we set  $\tau_1$  is 0.03/1.05;  $\tau_2$  is 0.02/1.05;  $S_1$  as April, 2014;  $S_2$  as October, 2015.

However, households are not certain of the implementation of the tax rate increases and their subjective probability of the implementation at time  $t$  is  $\rho_t$ . As we have seen above, the permanent income shock was revealed to all Japanese households in October 2013. In that sense, the 2014 VAT rate increase presents a strong natural experiment in which households face a negative income shock that is common across households and became known at the same time; that is, we assume  $\rho_s = 0$  until October, 2013 and  $\rho_s = 1$  afterwards.

In addition, suppose that the tax rate increases are the only source of price variation. It follows that  $p_s = 1$  for  $S_1 > s$ ;  $p_s = 1 + \tau_1$  for  $S_2 > s \geq S_1$ ; and  $p_s = 1 + \tau_1 + \tau_2$  for  $s \geq S_2$ .

Using the first order conditions and the law of the iterated expectations, the following

holds:

$$u'(c_t) = \left(\frac{1+\delta}{1+r}\right)^{T-t} E_t \left[ \frac{p_t}{p_T} u'(c_T) \right], \quad (3)$$

where period  $T$  is sufficiently after the planned second implementation (that is,  $T > S_2$ ).

In the specific case of isoelastic utility,  $u(c) = c^{1-\varepsilon}/(1-\varepsilon)$ ,

$$c_t = \left(\frac{1+\delta}{1+r}\right)^{-\frac{T-t}{\varepsilon}} E_t \left[ \frac{p_t}{p_T} c_T^{-\varepsilon} \right]^{-1/\varepsilon}. \quad (4)$$

Taking the log and difference between  $t$  and  $t-1$  yields

$$\log c_t - \log c_{t-1} = -\frac{1}{\varepsilon} \left( \log \left( \frac{1+\delta}{1+r} \right) + \log E_t \left[ \frac{p_t}{p_T} c_T^{-\varepsilon} \right] - \log E_{t-1} \left[ \frac{p_{t-1}}{p_T} c_T^{-\varepsilon} \right] \right). \quad (5)$$

Under the assumption that a VAT rate increase does not affect the income process, the expectation can be decomposed as follows:

$$\log E_t \left[ \frac{p_t}{p_T} c_T^{-\varepsilon} \right] = \log \left( \rho_t \frac{1}{1+\tau_1+\tau_2} E_t [c_T^{-\varepsilon} | \Omega = 1] + (1-\rho_t) E_t [c_T^{-\varepsilon} | \Omega = 0] \right) \quad (6)$$

where  $\Omega = 1$  represents the situation in which the VAT increase occurs and  $\Omega = 0$  the situation in which it does not.

Under the two assumptions 1) the income process is not affected by a VAT rate increase, 2) the utility function is additively separable across periods with the isoelastic instantaneous utility function, a permanent price increase is a synonym of a reduction of lifetime resources and induces a proportional consumption drop through income effects. Accordingly, given the wealth holding, consumption at period  $T$ , sufficiently after the planned implementation, should be proportionally lower if the VAT rate would be increased, or  $\Omega = 1$ .

Additionally, since households would spend more due to the intertemporal substitution effects, the non-human-capital wealth should be lower, or  $E_t[A_T | \omega = 0] > E_t[A_T | \omega = 1]$ . Consumption would thereby be lower than the proportional level.

However, if the period between the announcement and the implementation is not so long, the impacts of the intertemporal substitution effects,  $E_t[A_T | \omega = 0] - E_t[A_T | \omega = 1]$  are negligibly small compare to the total lifetime resources including human capital wealth. The following relationship, therefore, should be true:

$$\frac{E_t [c_T^{-\varepsilon} | \Omega = 1]}{E_t [c_T^{-\varepsilon} | \Omega = 0]} \sim (1 + \tau_1 + \tau_2)^{-\varepsilon}. \quad (7)$$

Putting this into (??) yeilds

$$\begin{aligned} \log E_t \left[ \frac{p_t}{p_T} c_T^{-\varepsilon} \right] &= \log E_t [c_T^{-\varepsilon} | \Omega = 0] \\ &\quad + \log \left( 1 + \rho_t \left( \frac{1}{1 + \tau_1 I_t^2 + \tau_2 I_t^2} \frac{E_t [c_T^{-\varepsilon} | \Omega = 1]}{E_t [c_T^{-\varepsilon} | \Omega = 0]} - 1 \right) \right) \\ &= \log E_t [c_T^{-\varepsilon} | \Omega = 0] \\ &\quad + \log \left( 1 + \rho_t ((1 + \tau_1 I_t^1 + \tau_2 I_t^2)^{-1} (1 + \tau_1 + \tau_2)^{-\varepsilon - 1} - 1) \right) \end{aligned} \quad (8)$$

Using the first order approximation and and rearranging terms, the consumption change between period  $t$  and  $t - 1$  can be written as

$$\begin{aligned} \log c_t - \log c_{t-1} &= -\frac{1}{\varepsilon} (r - \delta - (\rho_t I_t^1 - \rho_{t-1} I_{t-1}^1) \tau_1 - (\rho_t I_t^2 - \rho_{t-1} I_{t-1}^2) \tau_2) \\ &\quad - (\rho_t - \rho_{t-1}) (\tau_1 + \tau_2) + \eta_t \end{aligned} \quad (9)$$

where  $\eta_t = \log E_t [c_T^{-\varepsilon} | \Omega = 0] - \log E_{t-1} [c_T^{-\varepsilon} | \Omega = 0]$ , which represents the evolution of expectations on the income process.

The term  $-(\rho_t - \rho_{t-1}) (\tau_1 + \tau_2)$  captures the income effects. Specifically, the more certain a household becomes that a VAT rate increase will occur, the lower their consumption. Under a scenario in which a household did not believe a VAT rate increase would occur at time  $t - 1$  (i.e.  $\rho_{t-1} = 0$ , but was certain that it would occur at time  $t$  (i.e.  $\rho_t = 1$ , consumption should fall in proportion to the tax rate increase.

The terms  $(\rho_t I_t^k - \rho_{t-1} I_{t-1}^k) \tau_k / \varepsilon$  for  $k = 1, 2$  account for the intertemporal substitution effects. Once households become aware of the tax rate increase, they may engage in intertemporal substitution behavior, in which case consumption would temporarily be higher than its new long-run level. This term demonstrates that consumption should drop upon implementation of the VAT rate increase in period  $S$ . For example, suppose households become aware of a VAT rate increase just prior to its implementation (i.e.  $\rho_{S_k-1} = \rho_{S_k} = 1$ ). Then consumption should drop by  $100\tau_k/\varepsilon$  percent at period  $S_k$  because  $I_{S_k}^k = 1$  and  $I_{S_k-1}^k = 0$ .

## 3.2 Empirical Specification

In this section we discuss how we apply the theoretical model presented in Section 3.1 to the regression analysis. Before doing so, we note that since we use monthly data, a period is equal to one month.

Based on the derivation shown in Equation (??), the regression equation would be the following:

$$\Delta \log c_t = const + \frac{1}{\varepsilon}(\tau_1 + \tau_2)D_{Oct,2013} - \frac{1}{\varepsilon}\tau_1 D_{Apr,2014} - (\tau_1 + \tau_2)D_{Oct,2013} + \eta_t \quad (10)$$

where  $D_{Oct,2013}$  and  $D_{Apr,2014}$  are month dummies for October 2013 and April 2014, respectively. These month dummies result from our assumption on the arrival of the income shock and the date of implementation of the first tax rate increase. In particular,  $\rho_t I_t^1 - \rho_{t-1} I_{t-1}^1 = 1$  and  $\rho_t I_t^2 - \rho_{t-1} I_{t-1}^2 = 1$  in October 2013;  $\rho_t I_t^1 - \rho_{t-1} I_{t-1}^1 = -1$  in April 2014; and  $\rho_t - \rho_{t-1} = 1$  in October 2013.

Because the dummy for October 2013 appears twice, the reduced form regression equation is

$$\Delta \log c_t = const + \alpha D_{Oct,2013} + \gamma D_{Apr,2014} + \eta_t. \quad (11)$$

where  $\alpha$  and  $\gamma$  corresponds  $(-1 + 1/\varepsilon) * (\tau_1 + \tau_2)$  and  $(-1/\varepsilon) * \tau_1$ , respectively.

Our primary interest is whether the arrival of news about a permanent negative income shock induces a proportional decrease in consumption. In other words, is the consumption response to the VAT rate increase consistent with the predictions of the LCPIH? Given our specification, a testable implication of the LCPIH is

$$-\frac{\alpha}{(\tau_1 + \tau_2)} + \frac{\gamma}{\tau_1} = 1. \quad (12)$$

Because  $\tau_1$  and  $\tau_2$  are equal to the size of negative permanent income shock, the left hand side represents the marginal propensity to consume (MPC) out of the permanent shock. Equation (??) shows that if households consume according to the basic LCPIH, the MPC should be one, while the excess smoothness literature shows smaller consumption responses to permanent shocks. That is, the  $MPC < 1$ . 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  $\gamma/\tau_1$ , is approximately 0.2. However, since the timing of announcement was unclear for the 1997 episode, they cannot evaluate the impact of the announcement, or  $\alpha$ ; and therefore, they cannot test the MPC out of the income shock.

Up to this point, we have ignored the arbitrage effects and associated intratemporal substitution effects between D, S, and N that may also arise in response to a VAT rate increase. As discussed in Cashin and Unayama (2016), failure to properly control for these effects can induce bias in the estimate of the IES, which would in turn bias our estimate of the MPC. Figure 4 shows the average percentage deviation in household expenditures on D, S, and N relative to September 2013 (the month prior to announcement) 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, fell precipitously upon implementation, and recovered by the third quarter of 2014, a pattern which is consistent with arbitrage behavior. To control for the potential intratemporal substitution behavior induced by durable arbitrage, Cashin and Unayama (2016) 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. Based on the evidence presented in Figure 4, we expect that any intratemporal substitution between D and N should have ceased by September 2014. Consequently, it would appear that inclusion of the first difference of month dummies for October 2013 to September 2014 is appropriate.

As we showed in the previous subsection, the postponement of the second VAT rate increase should have a positive impact on consumption. Unlike announcement of the April 2014 consumption tax rate increase, however, the postponement announcement occurred in the middle of December 2014. To address this, we include month dummies for December 2014 and January 2015.

Considering these additional factors as well as demographics and other controls, we arrive at the following regression specification:

$$\begin{aligned} \Delta \log c_t = & \text{const} + \Delta X\beta + \phi(D_{Dec,2014} + D_{Jan,2015}) \\ & + \sum_{t=Oct,2013}^{Sep,2014} \omega_t \Delta D_t + \alpha D_{Oct,2013} + \gamma D_{Apr,2014} + \eta_t, \end{aligned} \quad (13)$$



where  $\Delta X$  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). It is worth noting that household-specific fixed effects are already controlled for by taking the first difference of the logarithm of household consumption. To address the possibility of correlation among information updating,  $\eta$ , standard errors are clustered by household, and are thus robust to serial correlation within households. The coefficient  $\phi$  captures the postponement effects.

Under this specification, an identification problem arises because the combination of  $D_{Oct,2013}$ ,  $D_{Oct,2014}$ , and  $\Delta D_{Oct,2013}$  exhibit perfect collinearity. Without imposing an additional restriction, we would be unable to identify our main coefficients of interest,  $\alpha$  and  $\gamma$ . To address this issue, we impose the restriction  $\omega_{2013,10} = 0$ , which implies that intratemporal substitution between  $D$  and  $N$  was not present in October 2013.

If this assumption is incorrect,  $\alpha$  and  $\gamma$  will include  $\omega_{Oct,2013}$  and the resulting estimates will be biased. If  $\omega_{Oct,2013} \neq 0$ , we believe 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  $\alpha$  and  $\gamma$  are under- and overestimated, respectively, in absolute value.

### 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 some households exhibit hand-to-mouth (HtM) behavior, in which a household consumes an amount equal to their current rather than permanent income. Testing whether households exhibit HtM behavior is also known as the excess sensitivity test, and several studies find the LCPIH is rejected by the test.<sup>5</sup>

Kaplan, Violante, and Weidner (2014) provide microfoundations for HtM behavior,

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<sup>5</sup>See, for example, Parker, 1999; Souleles, 1999; Johnson, Parker, and Souleles, 2006; Stephens and Unayama, 2011; Parker, Souleles, Johnson, and McClelland, 2013

demonstrating with a two-asset model that households become HtM when they

1. Are unable to borrow against future income to fund current consumption.
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.

In other words, it is not a violation of the standard intertemporal budget constraint that leads to deviations from the LCPIH, but rather other constraints.

Due to these additional constraints, actual consumption, which should be equal to current income, is expected to be lower than the optimal level. Accordingly, even if HtM households recognize that their lifetime resources are reduced by a VAT rate increase, we would not expect them to change their consumption upon announcement of the VAT rate increase. That is, it should be the case that  $\alpha/(\tau_1 + \tau_2) = 0$ .

On the other hand, upon implementation, HtM consumption should decrease. Given nominal income, real consumption (i.e. nominal consumption deflated by the CPI) should decrease in proportion to the tax rate increase. That is,  $\gamma/\tau_1 = -1$ . This suggests that upon implementation, for the case where the IES is less than one (as found in Cashin and Unayama, 2016), HtM consumption should decrease by a greater percentage than it does for the non-HtM.

In the results below, we show that even when we include HtM households in the regression analysis, we cannot reject that consumption fell in proportion to the reduction in lifetime resources (i.e.  $\alpha/(\tau_1 + \tau_2) + \gamma/\tau_1 = 1$ ). However, there exists the possibility that HtM behavior is driving our results despite the fact that the Euler equation does not hold for them. If this were the case, we may erroneously conclude that household consumption behavior is consistent with the LCPIH. To avoid making this error, we separate our sample into HtM and non-HtM households.

## 4 Empirical Results

### 4.1 Data

We use data from the Japanese Family Income and Expenditure Survey (JFIES) to estimate the MPC out of the permanent income shock.<sup>6</sup> The JFIES is a rotating panel

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<sup>6</sup>See Stephens and Unayama (2011, 2012) for more information regarding the JFIES design and content.

survey in which households are interviewed for six consecutive months and approximately 8,000 households are interviewed each month.<sup>7</sup>

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.

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 more than 80 percent of households report their wealth, we do not believe this restriction will significantly affect our results. The sample restrictions leave us with 447,072 observations from 80,102 households.

Table 1 presents summary statistics for our sample as well as those reported in Table 2 of Cashin and Unayama (2016). The average age of head is much older and the number of working members smaller in our sample than in Cashin and Unayama (2016), which reflects the rapid aging of the population in Japan.

Also following Cashin and Unayama (2016), we divide the JFIES expenditure data into four groups: non-storable non-durables (N); durables (D); storable non-durables (S); and tax exempt goods and services (E). As shown in Table 1, expenditure on taxed items comprises almost 80 percent of total expenditure, while most tax-exempt expenditures consist of rent for housing and education (e.g. 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 consumer price indices specific to each category.

To provide a rough measure of the long-run impact of the 2014 VAT rate increase, Table 1 also reports average expenditures for each category for one year before the October 2013 announcement and one year after the April 2014 implementation. Following implementation, all categories decreased by 3-7 percent. This observation is consistent with the prediction of the model in which the VAT rate increase is perceived by households as a permanent negative shock to lifetime resources.

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<sup>7</sup>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.

To examine the short-run evolution of expenditures around the time of the 2014 VAT rate increase, we displays plots of seasonally-adjusted real monthly household expenditure on N, S, D, and E in Panel B of Figure 4.<sup>8</sup> Note that once expenditures on N are seasonally adjusted, as is the case in our empirical specification presented in Section 3.3, there appears to be relatively little variation in N before and after implementation of the VAT increase, whereas expenditures on S and D exhibit a large spike in March 2014, followed by somewhat lower expenditure after the tax rate increase.

## 4.2 Regression Results: Pooled Results

We first provide regression results for our full sample. Despite the fact this implies that HtM households will be included in the analysis, we present results from the full sample so as not to completely exclude self-employed households from our analysis. The self-employed do not report their monthly income in the JFIES, which is necessary to classify households as HtM or non-HtM.

Column 2 of Table 2 presents our baseline regression result. Upon announcement of the VAT rate increase in October 2013, household consumption fell by 2.79 percent ( $\alpha$ ), 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. We also find that once we properly control for intratemporal substitution effects, consumption fell by 1.51 percent ( $\gamma$ ) 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 0.53, which is larger than the corresponding estimate in Cashin and Unayama (2016). As we discussed 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, when durable arbitrage effects were present. 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

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<sup>8</sup>Specifically, we estimate a regression for each expenditure category that includes month dummies to control for seasonality as well as the other controls we discussed in Section 3.3. We then calculate the residuals, add the constant, and average this value to arrive at the “seasonally-adjusted” values. In Panel A of Figure 4, we also show the same figure for 1997 episodes from Cashin and Unayama (2016) as well.

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)<sup>9</sup>.

Column 1 of Table 2 confirms the finding in Cashin and Unayama (2016) that failing to control for intratemporal substitution induces an estimate of the IES that is biased upwards. To test the robustness of the coefficients of interest to the choice of the period over which we allow for intratemporal substitution, we include additional first difference dummies for August and September 2014. The results appear in Columns 3 and 4 of Table 2. While the addition of the August 2014 dummy has a negligible impacts on our baseline results, inclusion of the September 2014 dummy reduces the IES estimate. Unlike the IES, the announcement effect estimate is robust to the choice of the time horizon for which we allow intratemporal substitution effects.

Applying the estimates of  $\alpha$  and  $\gamma$  to the left hand side of (??), we estimate the MPC out of the permanent shock. For our baseline specification presented in column 2, the estimated MPC is 1.11, 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. Inclusion of the first difference dummies for August and September 2014 does not affect our baseline result. Even when the September 2014 dummy is included, the estimated MPC is 0.66, and we cannot reject the LCPIH.

We also examine the impact of postponement of the October 2015 VAT rate increase to April 2017. In Column 2 of Table 2, we observe that household consumption jumped by 1.21 percent following the postponement, which is significant at the five percent level. The size of the response is consistent with the evidence provided by Barrell and Weale (2009) and Crossley, Low and Wakefield (2009), who theorized that the 2.5 percent temporal VAT cut in 2009 in the UK would increase consumption by 1.2 percent.

### 4.3 Heterogeneity between Non-HtM and HtM

As discussed above, our failure to reject the LCPIH could be erroneous because the test of the LCPIH that we proposed is not compatible with HtM behavior. In addition, given the expected consumption response of HtM households upon implementation, our estimate of the IES may be biased upward if the true IES is less than one. To address these issues,

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<sup>9</sup>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.

we divide the sample into two groups: HtM and non-HtM.

To identify the HtM, we apply the methodology of Kaplan, Violante and Weidner (2014).<sup>10</sup> 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 month's income following the baseline case in the previous studies.<sup>11</sup> 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). With this approach, we identify about 10 percent of households as the HtM as shown in Table 3,

Table 3 also reports the results of a difference of means test for consumption in the year prior to announcement and the year following implementation, when both the negative income and intratemporal substitution effects should be evident.<sup>12</sup> Specifically, we report the mean of the log deviation from average adjusted real monthly income and non-storable non-durable consumption. The adjusted values account for seasonality and other control variables used in the regression analysis. Consistent with our baseline result, consumption fell significantly for non-HtM households, while HtM consumption increased significantly by an amount that was roughly in line with income growth over the period.

Table 4 provides the regression results separating the HtM and non-HtM. Consistent with the discussion, we found a statistically significant impact of the announcement only for the non-HtM. Column 4 of Table 4 displays the regression estimates for a pooled analysis in which the announcement, implementation, and postponement responses for HtM and non-HtM households are allowed to differ. Note that while consumption for non-HtM households fell by a highly significant 4.13 percent upon announcement, it actually increased, albeit insignificantly, for HtM households. Furthermore, in Columns 2 and 4, we see that the exclusion of HtM households from our test of the LCPIH does not alter our baseline result.

Based on the results presented in Tables 3 and 4, we conclude that there is no evidence for excess smoothness and the LCPIH is not rejected if households are non-HtM. In addi-

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<sup>10</sup>Hara, Unayama, and Weidner (2016) applies the same methodology as that used in Kaplan, Violante and Weidner (2014) to Japan's National Survey of Family Income and Expenditure. Because the JFIES has all of the variables required to define a household as HtM or non-HtM, we use the same definition and criteria as Hara, Unayama, and Weidner (2016).

<sup>11</sup>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.

<sup>12</sup>We ignore the period between announcement and implementation of the VAT rate increase because of the positive intratemporal substitution effects observed during that time frame.

tion, once we exclude HtM households, the estimated IES becomes smaller. This implies that most of impacts of the VAT rate increase were observed not upon implementation but rather announcement.

#### 4.4 Robustness Checks

In addition to the main results, we provide several robustness checks. First, we compare the share of households whose consumption decreased upon announcement and implementation relative to corresponding months in other years covered in our sample. If the shares are similar, it would suggest that the negative income and intertemporal substitution effect estimates from the baseline regression are driven by a few outliers rather than a more general response to the VAT rate increase.

Figure 5 plots the share of households whose consumption decreased in April and October for each year in our sample. Note that the share of households recording a consumption decrease reached its peak for the sample as a whole and non-HtM households in October 2013. Similarly, we observe the highest share of households reporting a consumption decrease in April 2014. Interestingly, the share of HtM households reporting a consumption decrease is also quite high relative to other years in the sample period, which is consistent with HtM consumption falling in response to the reduction in current real income that occurred in April 2014. Overall, the results from Figure 5 suggest that the decreases in consumption observed upon announcement and implementation of the VAT rate increase were not driven by outliers and instead were consistent with a more general decrease in consumption across households.

Next, because our identification strategy relies on the time-series variation in monthly consumption, it is important to consider the effects of potential confounding factors unrelated to the VAT rate increase. One potential confounding factor that may have affected the consumption response during our periods of interest is a reduction in public pensions. Due to Japan’s “macroeconomic slide” mechanism, in which public pensions fall every year relative to consumer prices, public pension benefits were cut by 1.0 percent in October 2013; 1.0 percent in April 2014; and 0.5 percent in April 2015. And though the pension cuts were announced in 2012, it seems worthwhile to attempt to control for the potential impact of the cut. To do so, we exclude pensioners from the sample. The results are shown in Column (1) of Table 5. Reassuringly, we find that even for non-pensioners, we are unable to reject that consumption fell in proportion to the reduction in lifetime

resources.

Finally, one might suspect that because the revenues from the VAT rate increase were to be used to fund the pension system, the consumption of households who expected smaller pensions in the future in the absence of a VAT rate increase should not have responded to the tax rate increase. That is, Ricardian equivalence should hold. However, the results of Table 5 demonstrate that even young households - those who were likely at the highest risk of reduced pensions without a VAT rate increase - reduced their consumption in a manner consistent with the basic LCPIH. As such, we find no evidence for household consumption behavior that was consistent with Ricardian equivalence.

## 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 postponing or 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. Using the FIES, we test this implication and find that 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, 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. SUMMARY STATISTICS**

Variable	Full Sample		Before Announcement (Oct 2012-Sep 2013)		After Implementation (Apr 2014-Mar 2015)		Cashin and Unayama (2016)	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
Age of head	57.0	14.8	57.5	14.8	58.4	15.0	51.5	13.7
Number of household members	3.11	1.14	3.10	1.13	3.07	1.12	3.38	1.24
Number of household members aged 18- <sup>A)</sup>	0.63	0.96	0.61	0.95	0.60	0.95	0.68 <sup>a)</sup>	0.98 <sup>a)</sup>
Number of household members aged 65+	0.74	0.90	0.76	0.90	0.81	0.92	0.47	0.75
Number of working members	1.35	0.99	1.35	1.00	1.32	0.99	1.52	0.95
Yearly income (1,000 yen)	6,284	3,943	6,308	3,918	6,089	3,901	7,113	4,652
Total expenditure (1,000 yen)	297	249	299	250	290	254	317	266
Excluding Tax Exempted items (1,000 yen)	230	210	234	214	228	216	221	195
Non-storable non-durables (N) (1,000 yen)	139	98	141	100	136	98	120	78
Storable non-durables (S) (1,000 yen)	45	32	46	34	43	30	52	32
Durables (D) (1,000 yen)	46	163	48	172	46	175	47	138
Tax Exempted items (EXPT) (1,000 yen)	66	109	65	104	63	113	-	-
Number of Observations	447,072		63,331		63,288		646,900	

NOTE: YEARLY HOUSEHOLD INCOME AND MONTHLY HOUSEHOLD EXPENDITURES ARE CPI ADJUSTED BY CORRESPONDING CATEGORIES WITH THE BASE YEAR OF 2010. A) CASHIN AND UNAYAMA (2016) REPORTS NUMBER OF HOUSEHOLD MEMBERS NOT UNDER AGE 18 BUT UNDER AGE 15

**TABLE 2. INCOME EFFECTS AND IES: BASELINE RESULTS**

	Dependent Variable: Non-storable Nondurables (multiplied by 100)							
	(1)		(2)		(3)		(4)	
	NSND		NSND		NSND		NSND	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
$\Delta D_{Nov,2013}$			1.35	(1.02)	1.35	(1.02)	1.34	(1.02)
$\Delta D_{Dec,2013}$			0.70	(0.97)	0.70	(0.97)	0.65	(0.98)
$\Delta D_{Jan,2014}$			3.79***	(1.15)	3.79***	(1.15)	3.82***	(1.15)
$\Delta D_{Feb,2014}$			0.85	(1.17)	0.85	(1.17)	0.84	(1.17)
$\Delta D_{Mar,2014}$			4.65***	(1.27)	4.65***	(1.27)	4.70***	(1.27)
$\Delta D_{Apr,2014}$			1.69	(1.18)	1.62	(1.27)	0.54	(1.33)
$\Delta D_{May,2014}$			0.07	(1.09)	0.00	(1.13)	-1.16	(1.24)
$\Delta D_{Jun,2014}$			0.44	(1.04)	0.38	(1.08)	-0.79	(1.19)
$\Delta D_{Jul,2014}$			-0.26	(0.97)	-0.33	(1.02)	-1.45	(1.13)
$\Delta D_{Aug,2014}$					-0.07	(0.95)	-1.17	(1.00)
$\Delta D_{Sep,2014}$							-1.38	(0.99)
$D_{Oct,2013}$ (a)	-2.32***	(0.87)	-2.79***	(0.92)	-2.78***	(0.92)	-2.61***	(0.93)
$D_{Apr,2014}$ (b)	-4.28***	(0.94)	-1.51	(1.58)	-1.44	(1.61)	-0.34	(1.67)
$D_{Dec,2014} + D_{Jan,2015}$	0.97**	(0.49)	1.21**	(0.49)	1.21**	(0.49)	1.19**	(0.49)
<b>Test for Excess Smoothness<sup>+</sup></b> (p-value)	-1.98** (0.01)		-1.11 (0.83)		-1.09 (0.87)		-0.66 (0.57)	
<b>IES (upper bound)</b>	-1.50***		0.53		0.51		0.12	
Observations	372,947							

NOTE: THIS TABLE PRESENTS ESTIMATES FROM A REGRESSION BASED ON EQUATION (13). 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 EACH INTERVIEW; THE NUMBER OF HOUSEHOLD MEMBERS; WORKING MEMBERS; MEMBERS UNDER AGE 18; AND MEMBERS OVER THE AGE OF 65; CHILD BENEFIT RECEIPT DUMMY; PUBLIC PENSION RECEIPT DUMMY; EAST JAPAN EARTHQUAKE DUMMIES. \*, \*\*, AND \*\*\* REPRESENT SIGNIFICANCE AT THE 10, 5, AND 1 PERCENT.

+ BASED ON THE MODEL, THE COEFFICIENTS SHOULD SATISFY  $(D_{Oct,2013})/(5/105) + (D_{Apr,2014})/(3/105) = -1$ .

**TABLE 3. CONSUMPTION CHANGES BY HTM STATUS**

			Before Announcement (Oct 2012-Sep 2013)	After Implementation (Apr 2014-Mar 2015)	Test for the difference
NHtM	ND	Mean	0.012	-0.015	-0.027***
		Std. Dev.	0.463	0.459	0.002
		Obs.	48,055	48,485	
HtM	ND	Mean	-0.006	0.008	0.014***
		Std. Dev.	0.449	0.449	0.0062
		Obs.	5,275	5,168	
	Total Income	Mean	-0.007	0.014	0.021
		Std. Dev.	0.988	0.889	0.013
		Obs.	4,916	4,845	

NOTE: THIS SHOWS THE DEVIATION FROM THE LOG OF THE AVERAGE ADJUSTED REAL MONTHLY HOUSEHOLD INCOME AND NON-STORABLE NON-DURABLE CONSUMPTION. THE ADJUSTED ONES ARE OBTAINED FROM A REGRESSION OF CORRESPONDING VARIABLES ON MONTH DUMMIES AND OTHER CONTROL VARIABLES USED IN THE REGRESSION ANALYSIS. \*, \*\*, AND \*\*\* REPRESENT SIGNIFICANCE AT THE 10, 5, AND 1 PERCENT.

**TABLE 4. INCOME EFFECTS AND IES: HAND-TO-MOUTH RESULTS**

	(1)		(2)		(3)	
	NSND		NSND		NSND	
	Coef.	Std. error	Coef.	Std. error	Coef.	Std. error
$D_{Oct,2013}^{NHtM}$	-4.09***	(1.06)			-4.13***	(1.03)
$D_{Apr,2014}^{NHtM}$	-1.03	(1.86)			-0.39	(1.84)
(Postpone) <sup>NHtM</sup>	1.96**	(0.55)			1.74***	(0.55)
$D_{Oct,2013}^{HtM}$			1.67	(3.35)	2.19	(3.12)
$D_{Apr,2014}^{HtM}$			-1.34	(2.88)	-0.47	(2.51)
(Postpone) <sup>HtM</sup>			-0.98	(1.87)	1.12	(1.73)
<b>Intra-temporal Substitution Effects (<math>\Delta D</math>'s) included</b>	Yes		No		Yes for NHtM	
<b>Test for Excess Smoothness<sup>+</sup></b> (p-value)	<b>N-HtM</b>	-1.21 (0.73)			-1.00 (0.99)	
	<b>HtM</b>			-0.11 (0.49)	-0.29(0.24)	
<b>IES (upper bound)</b>	<b>N-HtM</b>	0.36			0.14	
	<b>HtM</b>			0.47	0.16	
Sample Selection	Non-Hand-to-Mouth		Hand-to-Mouth		Pooled	
Observations	281,821		30,513		312,334	

NOTE: THIS TABLE PRESENTS ESTIMATES FROM A REGRESSION BASED ON EQUATION (13). THE DEPENDENT VARIABLES NOT LISTED IN THIS TABLE ARE SAME AS THOSE IN TABLE 2. SEE FOOTNOTE OF TABLE 2. DUMMIES. \*, \*\*, AND \*\*\* REPRESENT SIGNIFICANCE AT THE 10, 5, AND 1 PERCENT.

+ BASED ON THE MODEL, THE COEFFICIENTS SHOULD SATISFY  $(D_{Oct,2013})/(5/105) + (D_{Apr,2014})/(3/105) = -1$ .

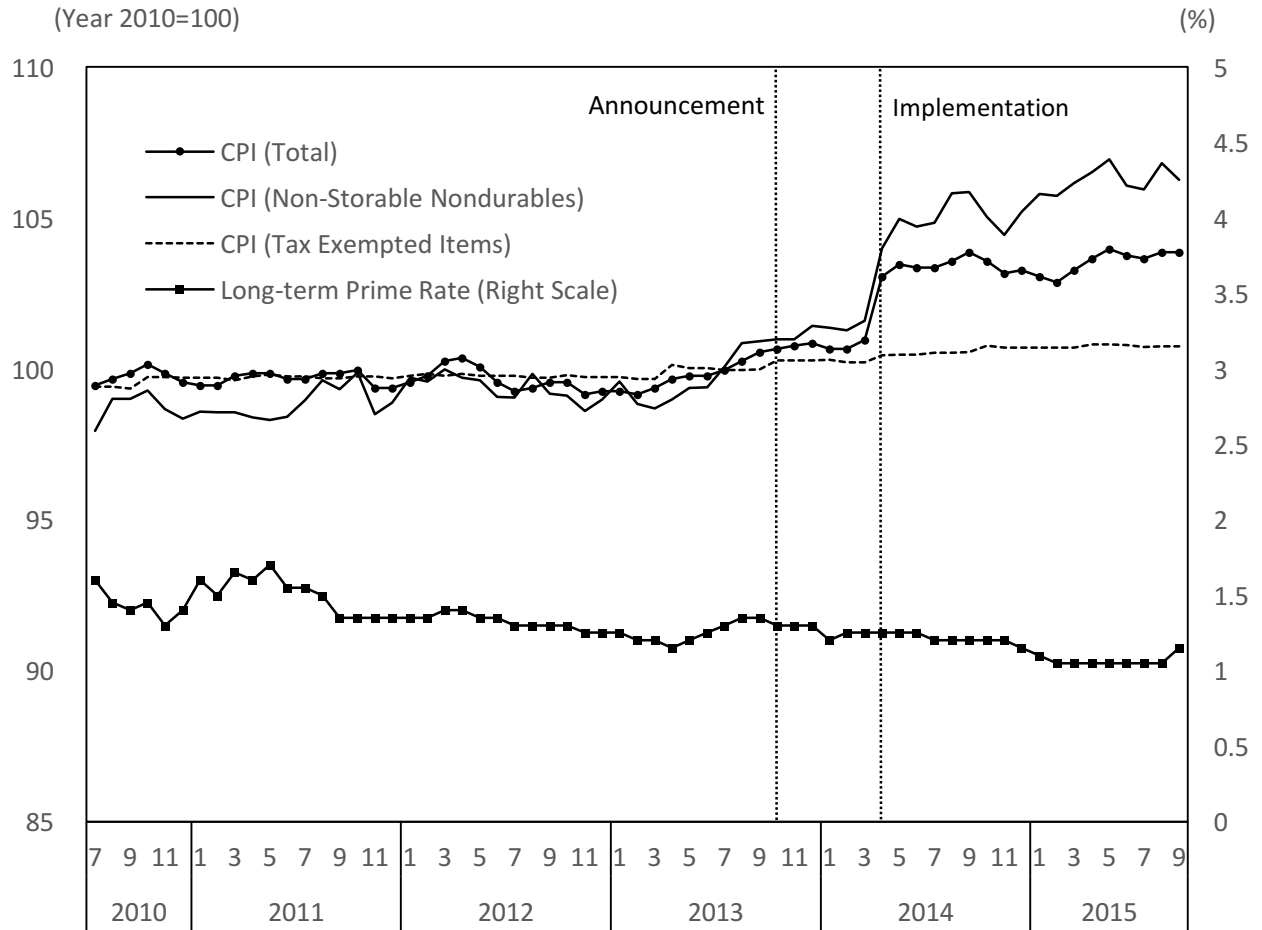
**TABLE 5. WORKING AND YOUNGER HOUSEHOLDS**

		(1)		(2)		(3)	
		NSND		NSND		NSND	
		Coef.	Std. error	Coef.	Std. error	Coef.	Std. error
$D_{Oct,2013}^{NHtM}$		-3.37**	(1.37)	-2.48*	(1.38)	-3.40***	(1.03)
$D_{Apr,2014}^{NHtM}$		-0.15	(2.53)	-0.84	(2.59)	-0.54	(1.84)
(Postpone) <sup>NHtM</sup>		1.94***	(0.70)	2.43***	(0.70)	2.66***	(0.55)
$D_{Oct,2013}^{HtM}$		1.94	(3.59)	2.14	(3.70)	2.89	(5.09)
$D_{Apr,2014}^{HtM}$		-2.29	(2.89)	-1.38	(3.09)	-0.34	(4.13)
(Postpone) <sup>HtM</sup>		-0.26	(2.06)	-0.22	(2.14)	-1.99	(2.74)
<b>Test for Excess Smoothness*</b> (p-value)	<b>N-HtM</b>	-0.72 (0.78)		-0.81(0.84)		-0.90 (0.70)	
	<b>HtM</b>	-0.39(0.63)		-0.03 (0.47)		-0.52 (0.41)	
<b>IES (upper bound)</b>	<b>N-HtM</b>	0.05		0.29		0.19	
	<b>HtM</b>	0.80		0.48		0.12	
Sample Selection		Pooled (HtM & NHtM) Non-Public Pension Receiver					
				Working		Working & Age of HH head <48 (median age)	
Observations		181,527		17,1650		99,302	

NOTE: THIS TABLE PRESENTS ESTIMATES FROM A REGRESSION BASED ON EQUATION (13). THE DEPENDENT VARIABLES NOT LISTED IN THIS TABLE ARE SAME AS THOSE IN TABLE 2. SEE FOOTNOTE OF TABLE 2. DUMMIES. \*, \*\*, AND \*\*\* REPRESENT SIGNIFICANCE AT THE 10, 5, AND 1 PERCENT.  
+ BASED ON THE MODEL, THE COEFFICIENTS SHOULD SATISFY  $(D_{Oct,2013})/(5/105)+ (D_{Apr,2014})/(3/105)=-1$ .

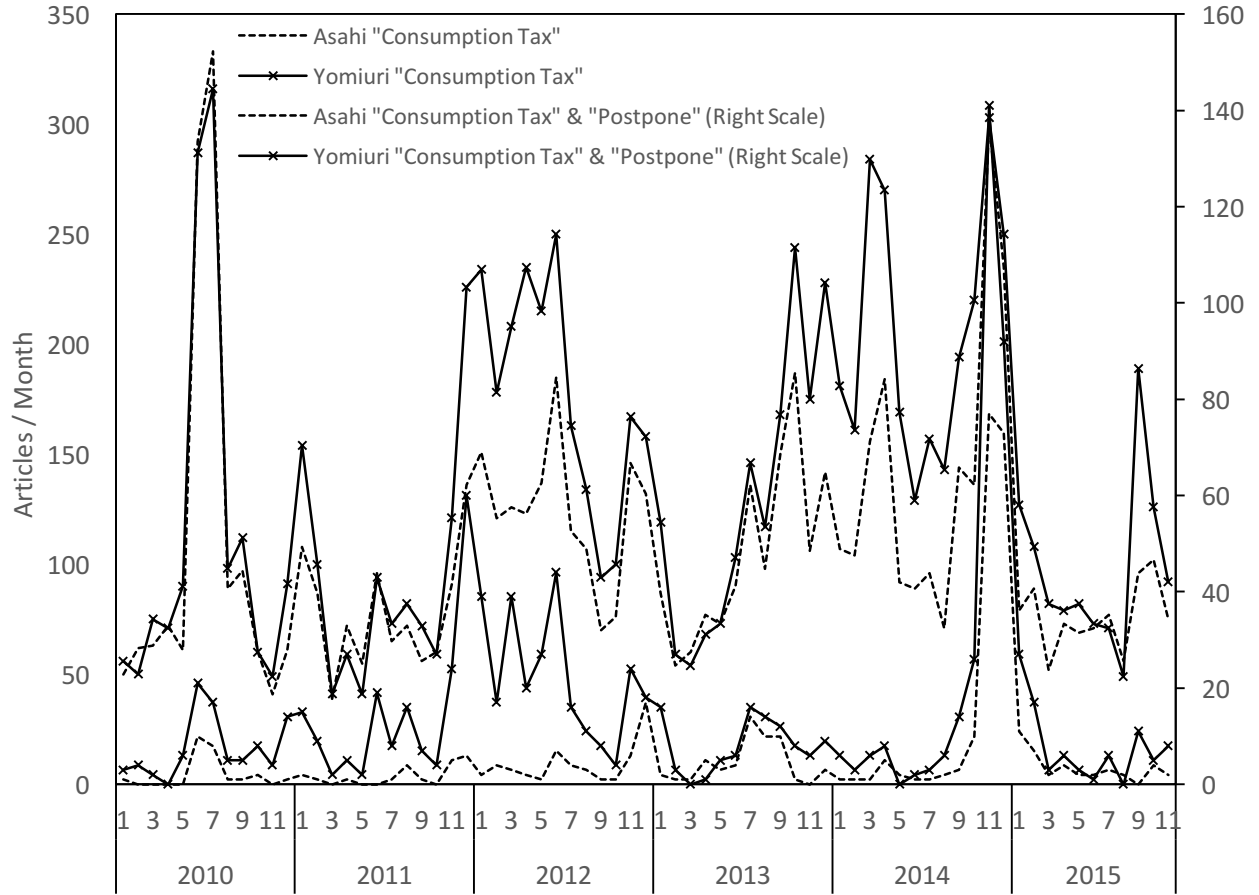


**FIGURE 1. CONSUMER PRICE INDEX AND INTEREST RATE AROUND IMPLEMENTATION**



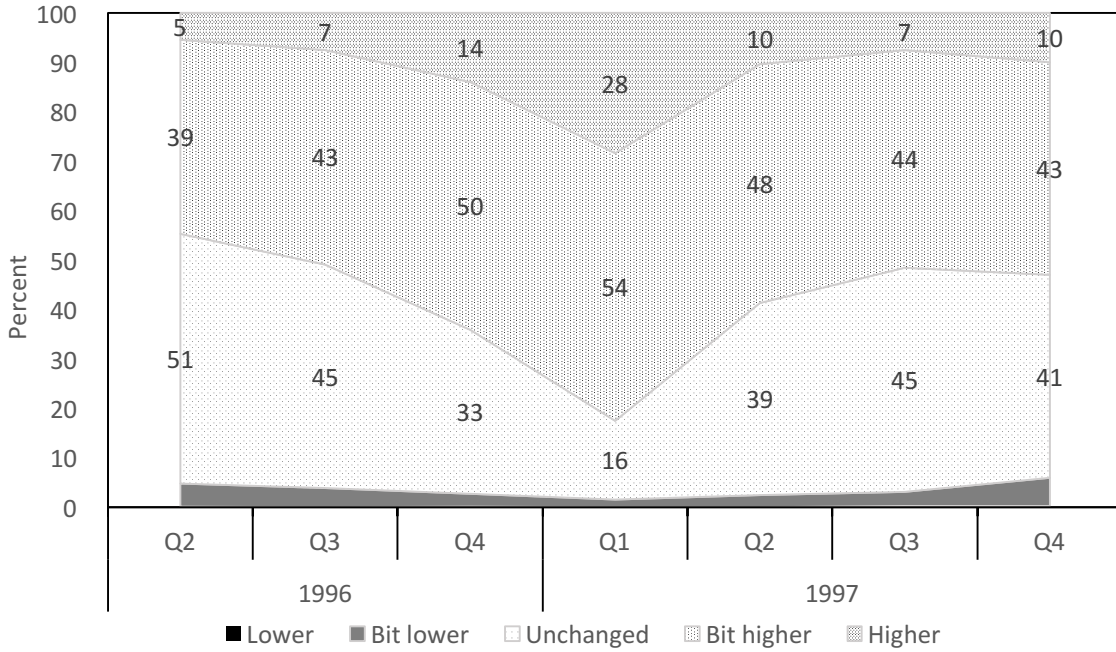
SOURCE: STATISTICAL BUREAU OF JAPAN FOR CPI AND BANK OF JAPAN FOR PRIME RATE.

**FIGURE 2. NUMBER OF ARTICLES MENTIONING THE CONSUMPTION TAX**

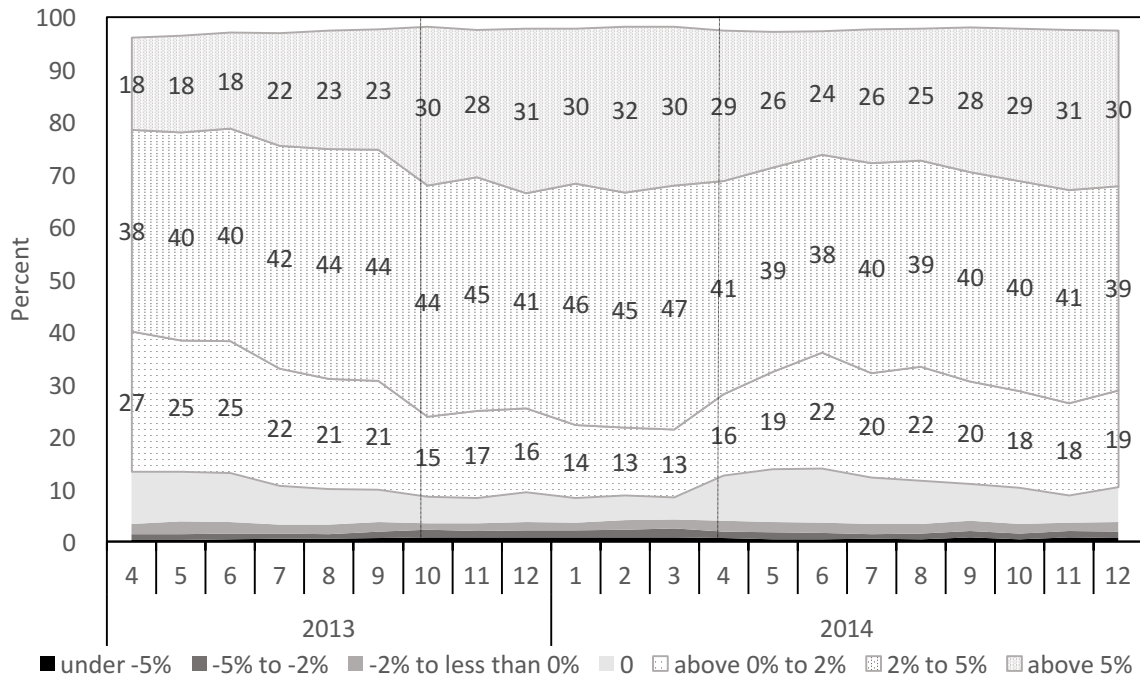


SOURCE: KIKUZO II VISUAL FOR ASAHI NEWSPAPER AND YOMIDAS REKISIKAN FOR YOMIURI NEWSPAPER.

**FIGURE 3. EXPECTED TAX-INCLUDED INFLATION RATE**  
**PANEL A: RATE INCREASE IN 1997**

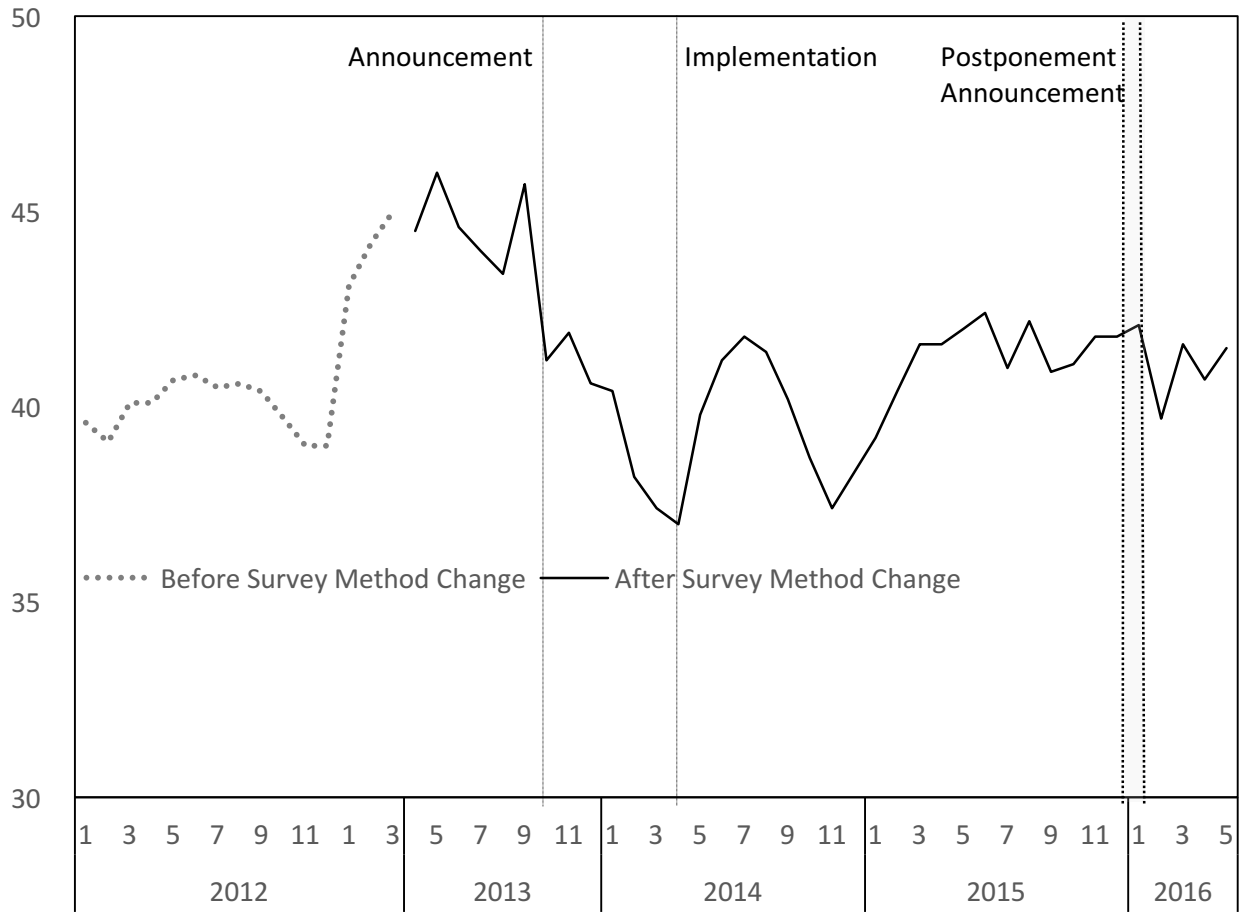


**PANEL B: RATE INCREASE IN 2014**



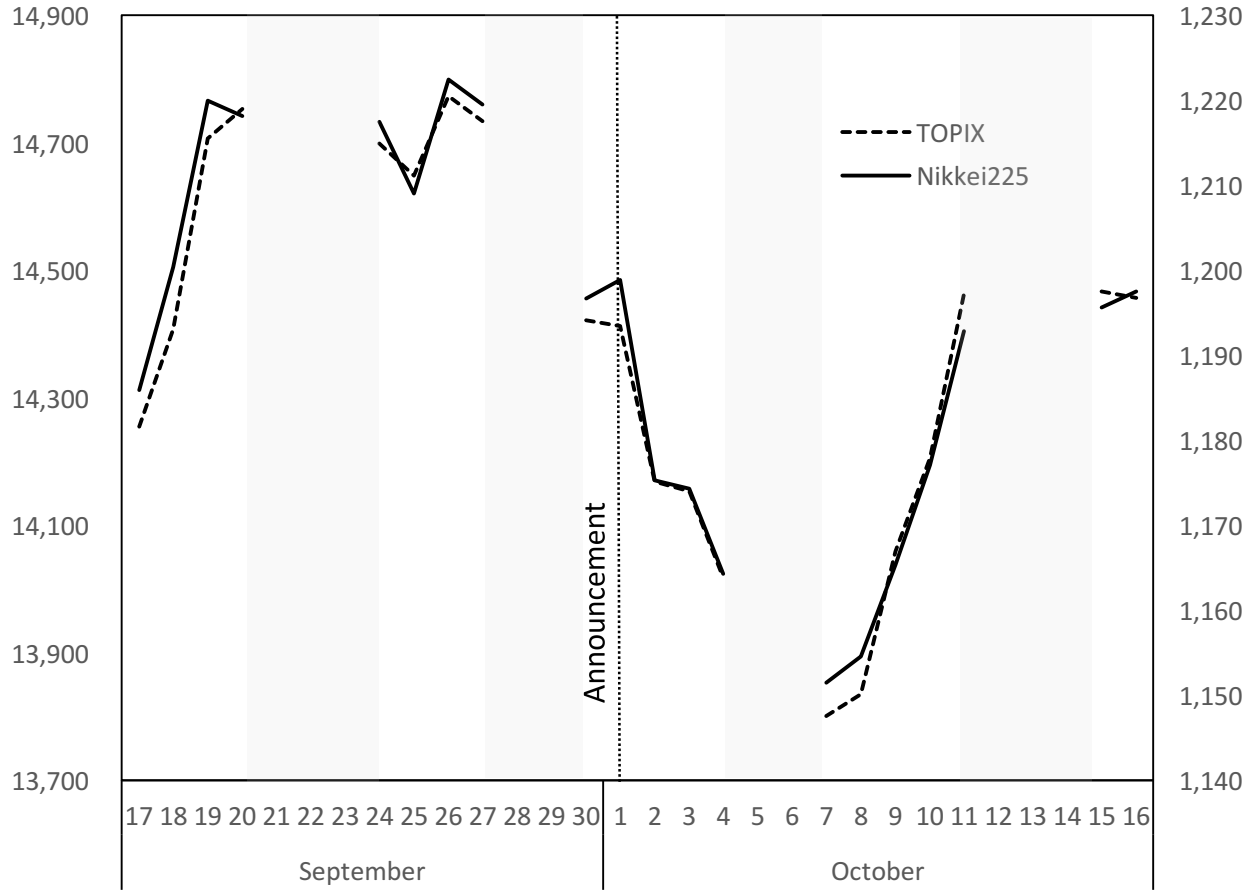
SOURCE: CONSUMER CONFIDENCE SURVEY CONDUCTED BY CABINET OFFICE.

**FIGURE 4. CONSUMER CONFIDENCE INDEX**



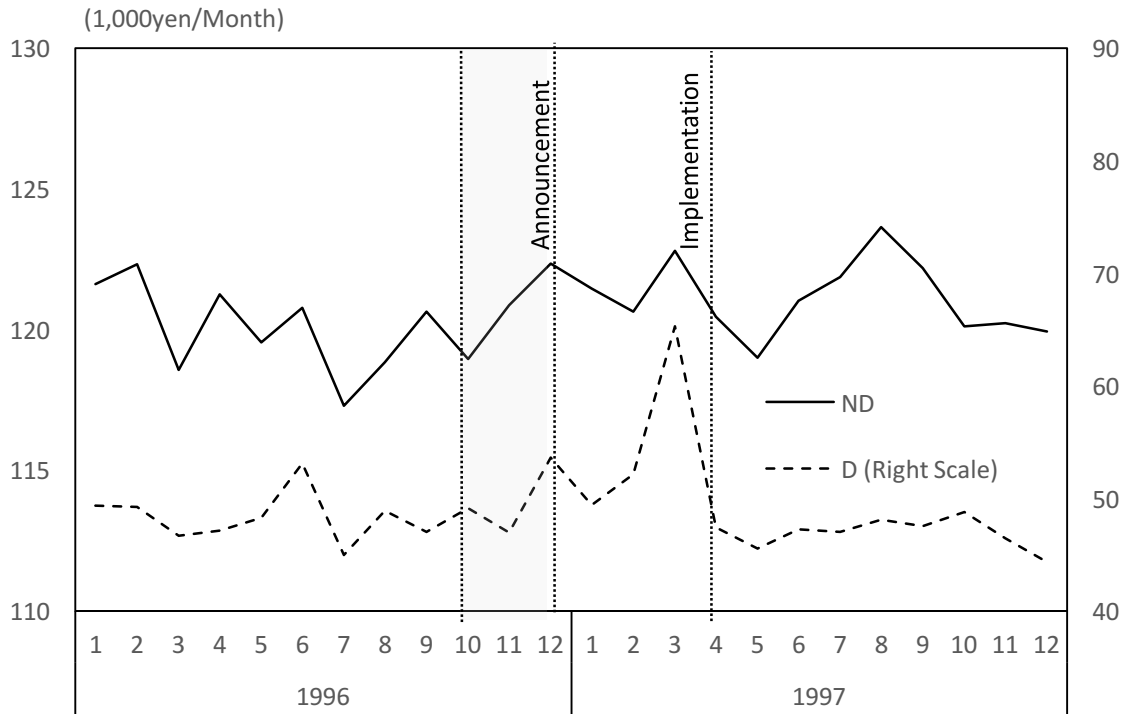
SOURCE: CONSUMER CONFIDENCE SURVEY CONDUCTED BY CABINET OFFICE.

**FIGURE 5. STOCK PRICES AROUND ANNOUNCEMENT OF TAX RATE INCREASE**

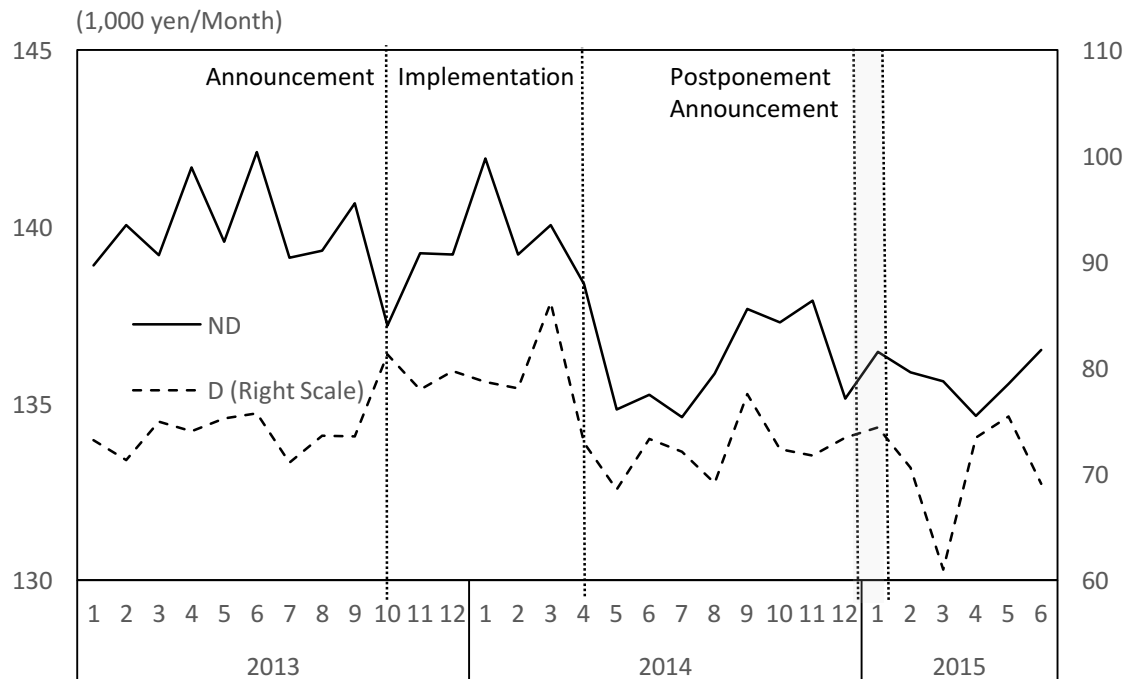


SOURCE: STOCK MARKET DID NOT OPEN IN SHADED DATE DUE TO WEEKENDS OR HOLIDAYS.

**FIGURE 6. REAL HOUSEHOLD EXPENDITURE BY CATEGORIES AROUND RATE INCREASE**  
**PANEL A: RATE INCREASE IN 1997**



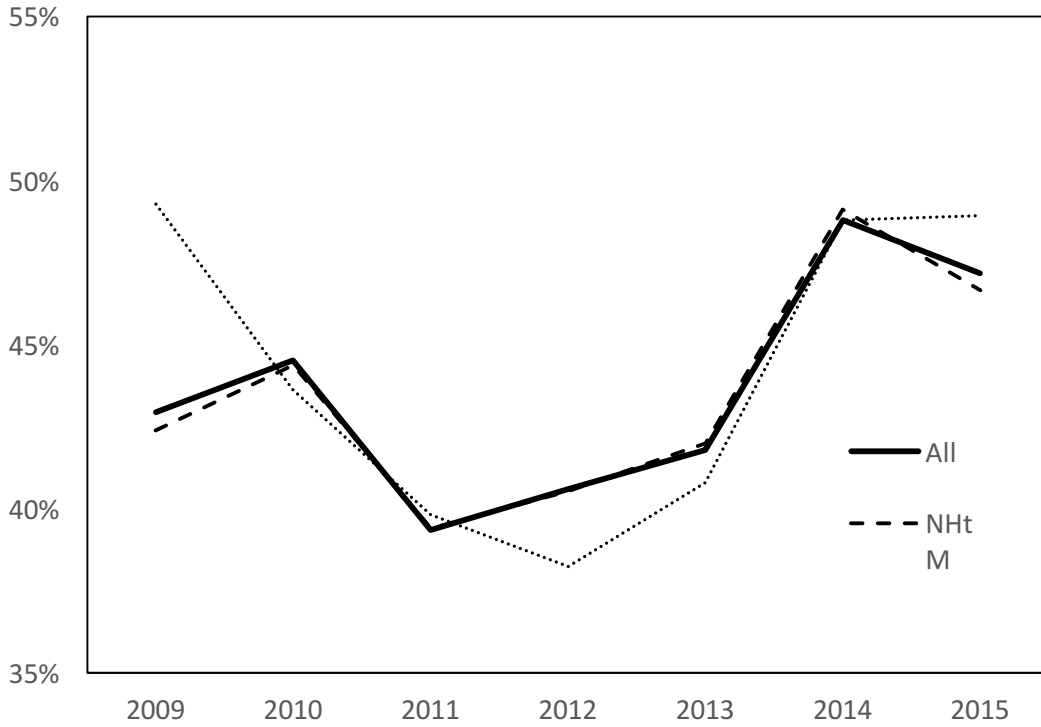
**PANEL B: RATE INCREASE IN 2014**



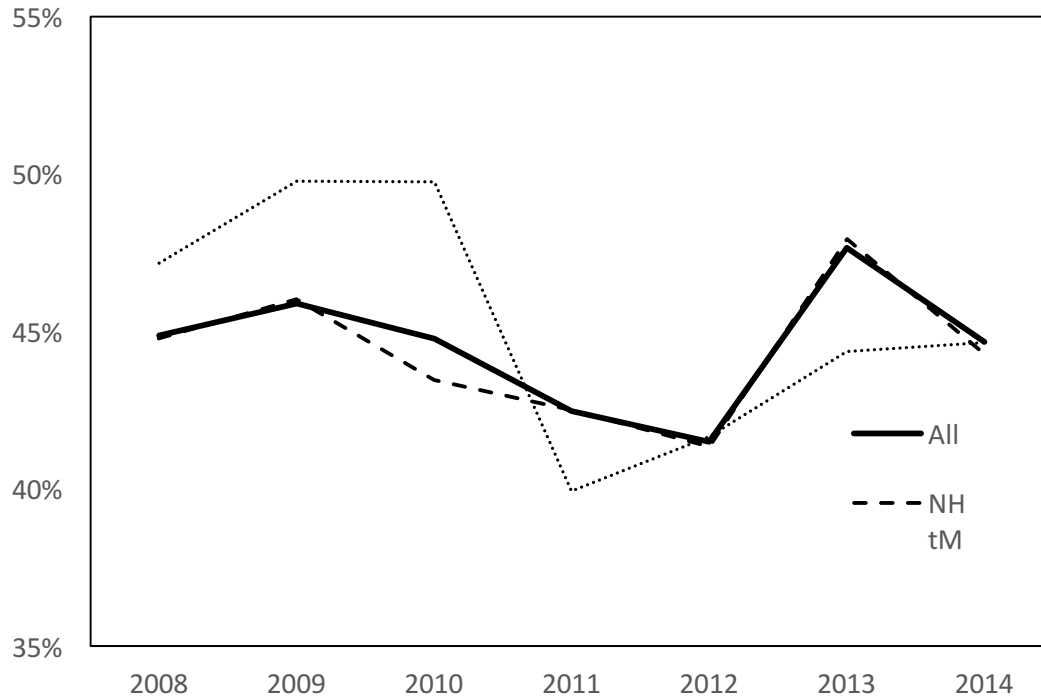
NOTE: THIS SHOWS SEASONALLY-ADJUSTED REAL MONTHLY HOUSEHOLD EXPENDITURES (IN THOUSANDS OF YEN) ON NON-STORABLE NON-DURABLE (N), STORABLE NON-DURABLE (S), DURABLE GOODS (D), AND TAX EXEMPTED ITEMS (EXPT). THE SEASONALLY-ADJUSTED ONES ARE THE RESIDUALS PLUS NON-MONTH SPECIFIC FACTORS FROM A REGRESSION OF REAL MONTHLY HOUSEHOLD EXPENDITURE ON MONTH DUMMIES AND OTHER CONTROL VARIABLES USED IN THE REGRESSION ANALYSIS BELOW. PANEL A IS FROM FIGURE 5 OF CASHIN AND UNAYAMA (2016).

**FIGURE 7. SHARE FOR THOSE WHO DECREASE CONSUMPTION**

PANEL A: APRIL



PANEL B: OCTOBER



NOTE: THIS SHOWS SHARE FOR THOSE WHO DECREASE THEIR CONSUMPTION RELATIVE TO THAT IN THE PREVIOUS MONRTH. CONSUMPTION MESURE USED HERE IS EXPENDITURE ON NON-STORABLE NON-DURABLE GOODS AND SERVICES DEFLATED BY THE ITEM SPECIFIC CPI.