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Short-run Distributional Effects of VAT Rate Change: Evidence from a consumption tax rate increase in Japan

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Abstract

Households will purchase more items than usual prior to a value added tax (VAT) rate increase in order to avoid taxation. Since this type of arbitrage requires resources such as shopping time and storage space, the impacts of tax increases vary across households, which has brought distributional effects in the short-run. Using the case of a consumption tax rate increase in Japan in 1997, we show that households who are non-working, with non-working spouses and residing in larger houses, benefited from more arbitrage. To minimize short-run economic disturbances, step-by-step increases would be useful.

Keywords: Value Added Tax, Consumption, Durability, Storability

JEL classification: H24 H31 D12

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1. Introduction

This paper examines the short-run consequences of a Value Added Tax (VAT) rate increase. A pre-announced rate increase will potentially induce large fluctuations in consumption expenditure in the periods surrounding implementation, which poses different welfare consequences to different types of households if households differ in their ability to shift expenditures over time. Nevertheless, such heterogeneity has been ignored, while the long-run distributional impact of a VAT rate increase has been well documented (Auerbach, Kotlikoff, and Skinner, 1983; Pechman, 1985; Caspersen and Metcalf, 1994; Tamaoka 1994 for Japan).

It is highly controversial in Japan to increase the VAT to solve the solvency problem, which is caused by unfortunate combination of aging society and unfunded, or pay-as-you-go, public pension system. Given that a change in the VAT rate is a politically sensitive issue, an investigation of the distributional consequences of a VAT rate increase is important, although the short-run effects emerge once with a rate increase and relatively minor. To evaluate the impact, we focus on the short-run consequences of 1997 VAT rate increase in Japan. Using aggregate expenditure data, Cashin and Unayama (2011) found that household expenditure in the month prior to the rate increase was about 9 percent greater than it otherwise would have been in response to the rate, and stayed slightly smaller until 6 month after. Such large fluctuation of expenditure should cause non-negligible welfare costs, which may differ across household types. To evaluate the impacts, we use the disaggregated micro-data.

Once a rate change is announced, a utility-maximizing household should change its expenditure path. We decompose these changes in expenditure into three effects: income effects; intertemporal substitution effects; and arbitrage effects. The former two affect the consumption path: consumption would be dropped when a rate increase is announced since a higher tax rate, ceteris paribus, implies smaller life-time resource, which is referred as income effects; due to the intertemporal substitution effects, households spend more when the price level is lower. That is, consumption should be increased at the time of announcement and decreased at the implementation. These two effects are well established in economics, but Cashin and Unayama (2011) show that they are numerically small and insignificant.

On the other hand, arbitrage effects are associated not with consumption behavior but with stock piling behavior. Barrell and Weale (2009) pointed out that “purchases of non-perishable consumption goods rise ahead of the event (rate increase) and fall afterwards because people will buy goods to store ahead of use”, and referred it as arbitrage effects. For example, households would purchase more toothpaste or toilet paper immediately before the implementation, while their consumption would not change. In other words, durability or storability of consumption goods, which causes difference between consumption and expenditure, are the sources of arbitrage effects.

Although total purchase will be almost unchanged since the temporary rise will be offset by a fall of similar magnitude afterwards, arbitrage behavior requires some effort. We consider two types of cost. The first is a cost associated with purchasing durables, which is akin to an adjustment cost for investment. Since the purchase of a durable good is an infrequent event, some efforts are needed such as collecting catalogues; identifying key specs; and shopping around to get a better price. We assume that such costs are heterogeneous across households and convex in expenditure on durables since the marginal utility of leisure is different across households and concave. The other cost we consider is a cost to hold storable goods (canned food; toothpaste; toilet paper etc.). These costs can vary across household types depending, for example, on the size of a house.

The model here shows that the magnitude of the arbitrage effect is determined by the shape of the cost functions for stock piling behavior. We expect that costs associated with durable purchase would be more convex for households with less leisure time; and therefore, arbitrage effects should be smaller for busier households. Similarly, those who live in a larger house would have less convex cost function, and their responses are expected to be larger. The more arbitrage effects households take, the more benefits they can receive through purchasing more goods with lower price due to lower tax rate. In other words, the tax burden should be larger for those who show smaller responses to a rate change.

We examine average monthly household expenditure patterns in the months surrounding Japan's April 1997 rate increase from three to five percent to determine who loses more. A Japanese household survey allows us to construct three categories of expenditure: nondurables; durables; and storables, from detailed commodities. Consistent with our model, we find that non-working households exhibit larger responses, while households with children exhibit a smaller response for durables. Also, households living in a larger house purchase more storable goods just before the implementation. Our results suggest that younger households, who tend to be busier and live in smaller houses, bear a larger share of the tax burden in the short-run, while the difference would be very small. The short-run distributional effects considered here are almost independent of the long-run ones, on which most previous studies focus; that is, progressivity (or regressivity) of VAT (see, for example, Pechman, 1985; Caspersen and Metcalf, 1994; Tamaoka 1994 for Japan).

The remainder of the paper is organized as follows. Section 2 presents a representative agent model and discusses the expenditure response to a rate increase. The empirical specification is also discussed in this section. Section 3 shows some facts on Japan's VAT tax increase in 1997 that suggest the rate increase can be treated as an expected proportional price increase. Section 4 reports the empirical results. Section 5 summarizes and discusses our findings.

2. Consumption Responses to Tax Increase

2.1. The Model

In this section, we construct a model to show what will happen to household expenditure with an expected price change. A household consumes three types of goods: non-storable non-durable goods and services (N); storable non-durable goods (S); and durable goods (D). This categorization reflects that previous studies have shown empirically that demand is affected by storability (See, for example, Hendel and Nevo, 2004, 2006). Since we are focusing on short-run dynamics, our model ignores the labor/leisure choice, or effectively assuming that labor supply is fixed during the period of interest[1].

Household *i* maximizes its life time utility function, *U*, which is the discounted sum of the instantaneous utility, *u*. Suppose the utility function at time *s* is as follows:

$$U_s = E_s\left[\sum_{t=s}^{\infty} \beta^t u(C_t^N, C_t^S, D_t)\right],$$

where β is the subjective discount factor; and C_t^N and C_t^S are consumption of N and S, respectively; and D_t is the stock of D at end of period *t*.

To maximize their life time utility, households face three constraints: budget constraint and laws of motion for the stock of S and D. The intertemporal budget constraint is

$$A_t = (1+r)A_{t-1} + Y_t - P_t^N C_t^N - P_t^S X_t^S - P_t^D\{X_t^D + \varphi_i(X_t^D)\} - \theta_i(S_t) \quad \text{for} \quad t = s \cdots \infty,$$

where $A_{i,t}$ is financial wealth (that is, values of stocks of S and D are not included) at end of period *t*; r is nominal interest rate; Y_t is income; P_t^N, P_t^S, and P_t^D are prices of N, S, D, respectively; and X_t^S and X_t^D is gross expenditure on S and D, respectively; S_t is stock of S at the end of period *t*. The functions θ_i and φ_i represent costs associated with purchase and storage of S and D, which is discussed below. With this notation, A_{s-1}, D_{s-1}, S_{s-1} are all given.

[1] Crossley and Wakefield (2009), which investigate a VAT rate change in UK, also ignored labor the supply decision.

The function θ_i represents costs of having a level of stock of S. This consists of costs from stock shortage and storage costs. Some additional expenditure should be needed when you run out of stock of S such as toothpaste and toilet paper because you have to make an additional run to a shop and may have to buy an expensive one, while much stock needs more space. As an induced form, there is the bliss point for stock of S, S^*. That is, we assume $\theta_i{}'(S_t) \leq 0$ if $S_t \leq S^*$ and > 0 if $S_t > S^*$.

On the other hand, φ_i represents costs associated with a purchase of D. Since a purchase of durable goods is an infrequent event, a consumer needs more efforts such as collecting catalogues; identifying key specs; and shopping around to get a better price. Along with this interpretation, we assume that φ_i is increasing and convex in its argument, or $\varphi_i' > 0$ and $\varphi_i'' > 0$.

Finally, evolutions of stocks of S and D follow the equations below:

$$S_t = (1 - \delta^s)S_{t-1} - C_t^S + X_t^S \qquad \text{for } t = s \cdots \infty,$$

and

$$D_t = (1 - \delta^D)D_{t-1} + X_t^D \qquad \text{for } t = s \cdots \infty.$$

where $\delta^S$and δ^D are the depreciation rate of S and D. These two, δ^S and δ^D, are sources of storability and durability, respectively. In other words, in the case that δ^S and δ^D is one, S and D effectively become N, respectively.

2.2. Optimal consumption and expenditure paths

Here, we can set up a Lagrangian to solve the optimization problem:

$$L_{i,s} = E_s\left[\sum_{t=s}^{\infty} \beta^t u(C_t^N, C_t^S, D_t)\right] - \sum_{t=s}^{\infty} \lambda_t[A_t - (1+r)A_{t-1} - Y_t + P_t^N C_t^N + P_t^S X_t^S + P_t^D\{X_t^D + \varphi_i(X_t^D)\} + \theta_i(S_t)]$$
$$- \sum_{t=s}^{\infty} \mu_t\{S_t - (1-\delta^S)(S_{t-1} - C_t^S + X_t^S)\} - \sum_{t=s}^{\infty} \eta_t[D_t + (1-\delta^D)D_{t-1} - X_t^D].$$

Suppose income and price paths are all known, or the perfect foresight case; then, we can use a comparative-static analysis to show responses to price changes. It would not be so problematic since we focus on the short-run dynamics although uncertainty may play an important role for decision making on S and D.

The first order conditions are as follows:

$$\frac{\partial L}{\partial C_t^N} = 0 \quad \Leftrightarrow \quad \beta^t \frac{\partial u}{\partial C_t^N} = \lambda_t P_t^N \tag{1}$$

$$\frac{\partial L}{\partial A_t} = 0 \quad \Leftrightarrow \quad \lambda_{t+1} = \frac{1}{1+r} \lambda_t \tag{2}$$

$$\frac{\partial L}{\partial C_t^S} = 0 \quad \Leftrightarrow \quad \beta^t \frac{\partial u}{\partial C_t^S} = \mu_t \tag{3}$$

$$\frac{\partial L}{\partial X_t^S} = 0 \quad \Leftrightarrow \quad \lambda_t P_t^S = \mu_t \tag{4}$$

$$\frac{\partial L}{\partial S_t} = 0 \quad \Leftrightarrow \quad -\lambda_t \theta_i{}'(S_t) = \mu_t - (1-\delta^S)\mu_{t+1} \tag{5}$$

$$\frac{\partial L}{\partial X_t^D} = 0 \quad \Leftrightarrow \lambda_t P_t^D \{1 + \varphi_i{}'(X_t^D)\} = \eta_t \tag{6}$$

$$\frac{\partial L}{\partial D_t} = 0 \quad \Leftrightarrow \quad \beta^t \frac{\partial u}{\partial D_t} = \eta_t - (1-\delta^D)\eta_{t+1}. \tag{7}$$

From (1) and (2), the usual Euler equation for N:

$$\frac{\partial u / \partial C_{t+1}^N}{\partial u / \partial C_t^N} = \frac{1}{\beta(1+r)} \frac{P_t^N}{P_{t+1}^N}. \tag{8}$$

This represents the intertemporal substitution effect, which makes households spend more when the price level is lower. This property would be held even when uncertainty is taken consideration.

Substituting (1) and (3) into (4), we get

$$\frac{\partial u / \partial C_t^S}{\partial u / \partial C_t^N} = \frac{P_t^N}{P_t^S}, \tag{9}$$

which shows that *consumption* of S is determined through substitution across commodities and depends only on relative prices in the current period. Combining with (8), parallel shifts of consumption paths of N and S will be observed if prices of N and S are increased by the same rate.

However, *expenditure* is, in general, different from consumption for S, and does depend on a future price. With (1), (2), and (4), (5) can be rewritten as

$$\theta_i'(S_t) = \theta_i'\Big((1-\delta^S)S_{t-1} - C_t^S + X_t^S\Big) = \left\{\frac{1}{1+r}P_{t+1}^S - P_t^S\right\}. \tag{10}$$

This shows that the stock level is under the bliss point if there is no price change (that is, $S_t < S^*$ when $P_{t+1}^S = P_t^S$). Intuitively, the right-hand side should be negative because a household gives up returns from financial asset by holding wealth as the form of S. This equation shows that expenditure on S, X_t^S, is passively determined by its consumption without price change, while a household purchase more to get higher stock level when the price will go up in the exactly next period. We refer the difference between C_t^S and X_t^S as the arbitrage effects for S. Unlike C_t^S, X_t^S will go up just before a price increase and drop more sharply than C_t^S after the increase since not only the intertemporal substitution effect but also the arbitrage effect drive the path of X_t^S.

The expenditure on D can be derived with putting (1), (2), and (6) into (7).

$$\beta^t \frac{\partial U}{\partial D_t} = \lambda_t P_t^D\{1+\varphi_i'(X_t^D)\} - (1-\delta^D)\left[\frac{\lambda_t P_t^D}{1+r}\frac{P_{t+1}^D}{P_t^D}\{1+\varphi_i'(X_t^D)\}\right]$$

or

$$\frac{\partial u/\partial D_t}{\partial u/\partial C_t^N} = \frac{P_t^D}{P_t^N}\left[\left(1-\frac{1-\delta^D}{1+r}\frac{P_{t+1}^D}{P_t^D}\right)+\left\{\varphi_i'(X_t^D)-\frac{1-\delta^D}{1+r}\frac{P_{t+1}^D}{P_t^D}\varphi_i'(X_{t+1}^D)\right\}\right]. \tag{11}$$

This shows that is there is no additional cost for searching, shopping, and purchasing D (that is, $\varphi_i' = 0$ for all X_t^D), the stock of D is determined by the user cost of D, which is corresponding to the first term in square bracket on right-hand side of (11). Given the stock level in the previous period (D_{t-1}) and the expenditure in the next period (X_{t+1}^D), equation (11) determines X_t^D, or

$$X_t^D = \varphi_i'^{-1}\left[\frac{\partial u/\partial D_t}{\partial u/\partial C_t^N}\cdot\frac{P_t^N}{P_t^D} - \left(1 - \frac{1-\delta^D}{1+r}\frac{P_{t+1}^D}{P_t^D}\right) + \frac{1-\delta^D}{1+r}\frac{P_{t+1}^D}{P_t^D}\varphi_i'(X_{t+1}^D)\right]. \tag{12}$$

Although stock of D is carried over to the next period just like that of S, the evolution of D would be different from that of S. One reason comes from the assumption of φ_i. Since φ_i is a convex function, it is beneficial to smooth their purchases of D; and thereby, forward-looking households change their expenditure path well before a price change. In addition, durability itself also causes a difference between the time path of S and D. While a household can independently determine the level of consumption from expenditure for S, purchases of D directly affect the service flow of D; and therefore, once the stock level goes up, the expenditure would be affected not only in the next period but also further future. Accordingly, expenditures on D are affected by every future price, while those on S are affected by the price in the next period.

2.3. Empirical Specifications

To obtain empirical implications, we specify the utility function and the two cost functions as follows:

$$U_s = \sum_{t=s}^{\infty} \beta^t u(C_t^N, C_t^S, D_t) = \sum_{t=s}^{\infty} \beta^t \{w^N (C_t^N)^\alpha + w^S (C_t^S)^\alpha + w^D (D_t)^\alpha\},$$

$$\theta_i(S_t) = \frac{a_i}{2}\left(S_t - S^*\right)^2,$$

$$\varphi_i = \frac{b_i}{2}(X_t^D)^2.$$

Suppose there is no price change other than that due to a VAT rate increase, and the tax rate is increased from t_0 to t_T at period T. In other words, a VAT rate increase is regarded as a proportional price increase. As discussed below, Japanese VAT, or Consumption Tax, is highly comprehensive and adopt single rate to all commodity and the government tried to make the tax passed through to consumer; hence, prices of all goods shift up parallel. Under the specifications above, without loss of generality, the price of N, S, and D can be denoted as 1 for t=0…T; and $(1 + t_T)/ (1 + t_0) \equiv \tau$ for t=T+1…∞.

According to the equation (8), taking the logarithm of both sides, the consumption changes are

$$\ln C_{t+1}^N - \ln C_t^N = \begin{cases} k & t \neq T \\ k - \frac{1}{1-\alpha}\tau & t = T \end{cases}$$

where $k = -\frac{1}{1-\alpha}\{\ln\beta(1+r)\}$. This demonstrates that expenditure on N would decrease when the VAT rate is increased as a result of intertemporal substitution in consumption. We call the drop, $-\frac{1}{1-\alpha}\tau$, as the intertemporal substitution effect associated with the VAT rate change.

With the above specification of the cost function associated with the stock of S, θ_i, the expenditure on S, X_t^S, can also written as

$$X_t^S = \frac{1}{a_i}\left(\frac{1}{1+r}P_{t+1}^S - P_t^S\right) + S^* - (1-\delta^S)S_{t-1} + C_t^S.$$

Substituting the price in each period $P_t^S = 1$ for t=0…T; and τ for t=T+1…∞, the expenditure on S can be denoted as

$$X_t^S = \begin{cases} \delta^S\left(S^* - \frac{1}{a_i}\frac{r}{1+r}\right) + C_t^S & t < T \\ \delta^S\left(S^* - \frac{1}{a_i}\frac{r}{1+r}\right) + \frac{1}{a_i}\left(\frac{\tau-1}{1+r}\right) + C_T^S & t = T \\ \delta^S\left(S^* - \frac{1}{a_i}\frac{\tau r}{1+r}\right) - \frac{1-\delta^S}{a_i}(\tau-1) + C_{T+1}^S & t = T+1 \\ \delta^S\left(S^* - \frac{1}{a_i}\frac{\tau r}{1+r}\right) + C_t^S & t > T+1 \end{cases}$$

or

$$X_{t+1}^S - X_t^S = \begin{cases} C_{t+1}^S - C_t^S & t < T \\ \frac{1}{a_i}\left(\frac{\tau-1}{1+r}\right) + C_T^S - C_{T-1}^S & t = T \\ -\delta^S\frac{1}{a_i}\frac{(\tau-1)}{1+r}(1+r+1-\delta^S) + C_{T+1}^S - C_T^S & t = T+1 \\ C_{t+1}^S - C_t^S & t > T+1 \end{cases}$$

This reveals that, just before the price of S is going up, X_t^S becomes larger and S_t may exceed the bliss point. In the case of $\beta(1+r)=1$, $C_{t+1}^S - C_t^S$=0 if $t \neq T; T+1$ since consumption path becomes simply parallel to that of N. Accordingly, response to a VAT rate change can be decomposed into two components: the intertemporal substitution effects represented by $C_{T+1}^S - C_T^S$, and the arbitrage effects observed in period T and T+1. The size of the arbitrage effects is determined by the concavity of the cost function, θ_i, or a_i in this simplified case. The more convex the function is (the larger a_i is), the smaller the arbitrage effect is for S.

Unlike the expenditure path for S, that for D cannot be written in a simple closed-form even under the simple situation here. With the assumptions above, we can rewrite equation (12) as

$$X_t^D = \frac{1}{b_i}\left[\sum_{s=t}^{\infty}\left(\frac{1-\delta^D}{1+r}\frac{P_{s+1}^D}{P_s^D}\right)^{s-t}\left\{\frac{\partial u/\partial D_s}{\partial u/\partial C_s^N}\cdot\frac{P_s^N}{P_s^D} - \left(1-\frac{1-\delta^D}{1+r}\frac{P_{s+1}^D}{P_s^D}\right)\right\}\right].$$

This shows that evolution of D (D_s s=t…∞) depnends on X_t^D, which is affected by all future prices (not only the price in the next period but also far future). It would be helpful to understand how a VAT rate change affects expenditure on D each period; for example, the intertemporal substitution effect is captured by the term $\partial u/\partial C_s^N$, Similar to the case of S, size of response to a price change is determined by the concavity of the cost function, φ, or b_i in the simplified case. The more convex the function is (the larger b_i is), the smaller the arbitrage effect is for D.

Although it is difficult to obtain the closed form solution (or even the Euler equation) for S and D, it would be worth while noting that, if the depreciation rate of S and D are both one, or in the case in which D and S are substantially nondurable, expenditure on S and D are determined by that on N. That is, under the assumptions here,

$$X_t^S = C_t^S = \left(\frac{P_t^S}{P_t^N}\right)^{\frac{1}{1-\alpha}} C_t^N$$

and

$$X_t^D = \left(\frac{P_t^D}{P_t^N}\right)^{\frac{1}{1-\alpha}} C_t^N$$

The deviation from the consumption path for N is basically caused by non-perfect depreciation. We define the deviation of consumption path of S and D from that of N as the arbitrage effects.

Until here, we have focused on the deterministic case; in other words, the VAT rate change is perfectly expected from the beginning (at period *s*). In the real economy, prices and income are uncertain and expectations are revised time to time. To accommodate innovation of expectations, we assume that consumers solve their utility maximization problem every period to decide a new consumption path based on income and price paths that are given by the new information. This type of comparative static approach would be plausible since we focus on the short period after the VAT rate increase finally decided.

For example, the log-difference of consumption of N can be written as

$$\ln C_{t+1}^{N} - \ln C_{t}^{N} = \frac{1}{1-\alpha}\{-\ln\beta(1+r)\} - \frac{1}{1-\alpha}\,(\ln P_{t+1}^{N} - \ln P_{t}^{N}) + e_t,$$

where e_t represents the innovation of expectations. Specifically, when a VAT rate increase is announced, e_t is the sum of the intertemporal substitution effect and the income effect of the increase.[2]

To capture the impacts of VAT rate change more precisely, we consider some factors that were not shown up in the theoretical model such as time trend, seasonality, and demographics. Accordingly, we express the logarithm of real monthly household expenditure on good type *k* (*k*=D,S,and N), by household i in year y and month m as follows.

$$E_{i,y,m}^{k} = \left(\mu_i^k + \boldsymbol{X_{i,y,m}}\phi^k\right) + \boldsymbol{Z_m}\delta_m^k + T^k + I_{y,m} + S_{y,m} + A_{i,y,m}^{k}.$$

The first two terms represent household specific factors: μ_i is a household-specific fixed effect; $\boldsymbol{X_{i,y,m}}$ is a vector of (potentially) time-varying household-specific characteristics; and ϕ^k is the impact of each characteristic. We include the month dummy vector $\boldsymbol{Z_m}$, and so δ_m^k represents the seasonal effects, while T^k represents time trend. The last three terms $I_{y,m}$, $S_{y,m}$, and $A_{i,y,m}^{k}$ are the income, the intertemporal substitution, and the arbitrage effects associated with tax rate increase, respectively.

[2] There is also a literature that suggests that the income effect associated with a tax change is absent until the tax change is implemented. See, for example, Watanabe et al. (2001), Mertens and Ravn (2010).

Taking first differences, we can cancel out the income effect and the intertemporal substitution effects in all months other than the month in which each effect first appears (that is, the month of announcement and the implementation). Formally, taking the first difference of expenditures yields

$$\Delta E_{i,y,m}^{k} = \Delta \boldsymbol{X_{i,y,m}} \phi^{k} + \Delta \boldsymbol{Z_m} \delta_{m}^{k} + t + \gamma_A D_A + \gamma_I D_I + \Delta A_{i,y,m}^{k} \tag{13}$$

where the delta means the first difference of each variable and D_A and D_I are dummies for the announcement and the implementation.

At the time of announcement, $I_{y,m}$ and $S_{y,m}$, which represents the income and the intertemporal substitution effects, would change. A part of D_A caused by the income effect should be negative since the rate increase is a negative income shock; while another part would be positive since the intertemporal substitution effects represented by $S_{y,m}$ should be positive between the announcement and the implementation. Accordingly, D_A is the sum of the income effects and the intertemporal substation effects, that means the dummy for announcement cannot identify the income effect from the intertemporal substitution effect, while it is not our interest. On the other hand, at the timing of implementation, only the intertemporal substitution effect that is negative emerges without further price changes; thus D_I can represent the pure intertemporal substation effects. Both $I_{y,m}$ and $S_{y,m}$ can be observed with dummies for the timing of announcement and implementation in consumption path for N.

The model shows that the arbitrage effects, or $\Delta A_{i,y,m}$, vary across periods, goods types, and household types. For example, the arbitrage effects are zero for N throughout periods, while they are positive just before the implementation and negative immediately after then. Since the size of response to a price change depends on the curvature of θ_i and φ_i, the arbitrage effects depend also on household type. The more convex the function is (that is, larger θ_i'' or φ_i''), the less a household spends on S and/or D.

With this specification, in the estimation below, we specifically include following household factors, $\boldsymbol{X_{i,y,m}}$: 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, and interview dummies, which control for “survey fatigue”, the tendency of households to report lower expenditure in later interviews. For the seasonal effects, the full set of first difference of month dummies, which take 1 in the corresponding month and -1 the month after. To represent the time trend, we include the full set of year dummies. The dummy for the implementation period D_I is simply defined as the dummy for April, 1996 when the rate was increased. Once we get the estimate of D_I, which corresponds to the intertemporal substitution effects; and thereby, we can calculate the elasticity of intertemporal substitution. On the other hand, the timing of the announcement is ambiguous since it is closely related with expectations that households have. As discussed in the next section, we assume the month of announcement is December 1996, or D_A is the dummy for December, 1996. Even the assumption would be true, we cannot interpret the estimate of D_A is the income effect because the positive intertemporal substitution effects coincided with the income effects. Our main interest is estimating the arbitrage effects, $\Delta A_{i,y,m}^{k}$. We estimate them with including year-month dummies for January through December, 1997, since we can expect $\Delta A_{i,y,m}^{k}$ is zero before December, 1996, the month of the announcement; and the arbitrage effects would disappear at least by December, 1997. Since the dummy for April, 1997 is also used to estimate the intertemporal substitution effects, we cannot identify the negative arbitrage effect from the intertemporal substitution effects. It would worth while noting that the arbitrage effects in April, 1997 is identified by the first difference of April-1997-dummy, while the intertemporal substitution effects is done by April-1997-dummies itself (not the first difference).

Although the arbitrage effect would exist after then, but we should also note that events that occurred later in 1997 may cause a noisy result. In late November 1997, the Japanese banking crisis began with the bankruptcy of Sanyo Securities, and was followed in December 1997 by the bankruptcies of the Hokkaido Takushoku Bank and Yamaichi Securities. According to National Accounts data published by the Cabinet Office, Japanese households sustained a loss in financial wealth of ¥42 trillion (~$420 billion) in 1997, or roughly $10,000 per household. The wealth loss suffered by shareholders should have reduced the permanent income of the average Japanese household, and as a result, observed household expenditure would decline.

3. 1997 VAT rate increase in Japan[3]

3.1. Consumption Tax in Japan and 1997 Rate Increase

Japan's consumption tax was first imposed on April 1, 1989. The initial rate was three percent and remained at that level until April 1, 1997, when the rate was increased to five percent. We focus on the rate increase in 1997 to avoid relative price movements since the introduction of

[3] The information of this Section comes mainly from Ishi (2001) and Takahashi (1999).

VAT in 1989 was coincided with the removal of several other indirect and excise taxes. Unlike VAT in many other countries, Japan has a single flat rate with a relatively small number of exemptions.[4] Actually, Japan's consumption tax is one of the broadest in the world. A flat rate implies that a change in tax rate does not affect the relative prices among goods and services that are subject to the tax; and therefore, we can regard it as a parallel price shift, which would not cause intra-temporal allocation changes.

The government decided the tax increase originally in late 1994 with a tax reform package called the Murayama Tax Reform that coupled a future increase in the consumption tax rate with immediate cuts in income tax rates. It set a target date of April 1997 for the consumption tax rate increase, but the legislation also stated that the rate increase would be imposed "only if the economy had sufficiently recovered". Having judged the economy to have sufficiently recovered, the ruling Liberal Democratic Party (LDP) moved in June 1996 to pass the consumption tax rate increase. Legislation passed through the Upper House on June 25, 1996, and the rate increase was scheduled to become effective April 1, 1997. However, there were still big debates whether the government should postpone the rate increase, and became a main issue in Fall 1996 elections to the Lower House of the Diet. LDP won the election and keep them as the ruling party. Finally, on December 26, 1996, the government submitted the fiscal year 1997 budget, which is the final chance to revisit the issue, and decided to increase the consumption tax rate to five percent as planned.

These episodes show how people recognize the rate increase. People may not be confident even though the tax reform scheduled the tax increase at April, 1997, while it became certain by the end of 1996. The income and intertemporal-substitution effects should firstly appear at some point of time between 1994 and 1996, but it would be reasonable to assume the fourth quarter of 1996 is the time of announcement[5].

According to the number of newspaper articles mentioning the consumption tax in the Nihon Keizai Shinbun and the Yomiuri Shinbun[6], people were really aware of the tax increase. Figure 1 reports the number of articles that mention the phrase "consumption tax" in the months leading up to and following the rate increase. Coverage initially peaked in September 1994, which coincided with the passage of the Murayama reform package. Following a decline in coverage in 1995, there is a

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[4] Exemptions included fees for government services; 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] Cashin and Unayama (2011) assumes that people recognize the tax increase at fourth quarter in 1996.

[6] Nihon Keizai Shinbun is Japan's leading business newspaper with a circulation of over three million and Yomiuri Shinbun is a leading non-business newspaper with a circulation of over 10 million. Circulation numbers come from Japan's Audit Bureau of Circulations in 2010.

steady upward trend in coverage of the proposed rate increase beginning with initial passage in June 1996; a spike in coverage in October 1996, which coincided with elections to the Lower House of the Diet; and overall coverage was consistently high in the months following final passage, but prior to the tax change, with nearly 300 articles in the Nihon Keizai Shinbun mentioning the consumption tax in March 1997. News coverage of the consumption tax rate increase was consistently high beginning in the fourth quarter of 1996, and the rate increase became a certainty in December. That is consistent with our assumption that the tax increase was known by December 1996.

3.2. Tax Increase and Prices

It is reasonable to assume not only that households were aware of the consumption tax rate increase prior to its implementation but also that they anticipated an increase in price levels as a result of the tax change. As documented by Ishi (2001), the Japanese government's official stance was that the burden of the consumption tax should be borne fully by consumers at the time of the rate increase.[7] Moreover, the smooth transition to the consumption tax in 1989, in which prices on goods and services subject to the new tax increased by under three percent in the month the three percent tax was introduced, should have allayed fears of excessive hikes in pre-tax prices when the rate increase took effect. Furthermore, households should not have expected any changes in interest rates by the central bank that would offset the intertemporal substitution incentives. While we do not have direct evidence of consumer price or interest rate expectations before the rate increase, we believe consumers expected a price increase from March to April 1997 of about two percent on goods and services that were subject to the consumption tax, and interest rates would remain constant.

Carroll et al. (forthcoming) find that full forward shifting at the time of a consumption tax rate increase is the norm across most countries, which the authors speculate is primarily due to wage rigidities that prevent backward shifting. Alternatively, a study by House and Shapiro (2008) suggests that the pre-tax prices of durable goods should have risen by two percent following announcement, but prior to the tax change, with a two percent fall immediately after (and thus, no change in after-tax prices before and after the change), since the intertemporal elasticity of investment for long-lived durable goods is nearly infinite. Indeed, a German study cited by Carroll et al. finds nearly full forward shifting of a consumption tax rate increase, with one-third of the shift

[7] When the consumption tax was introduced in 1989, the government took several steps to ensure this outcome. First, a Special Council on the Transition was formed to promote enforcement of the consumption tax across agencies. Second, the government carried out an extensive advertising campaign to allay the public's fear of price hikes and to restrain overcharging by traders. A telephone service was also set up so consumers could report complaints about prices. Finally, the Economic Planning Agency increased the budget for the price monitoring system. The situation was nearly identical in 1997.

occurring before enactment as a result of intertemporal substitution. While the timing of the price increase may depend on the durability of a good or service, it seems reasonable to believe that consumers expected about a two percent increase in prices at the time of the consumption tax rate increase.

As shown in Figure 2 average prices on goods and services subject to the consumption tax rose by 2.45 percent between March and April 1997, due mostly to a rather large increase in the price of durable goods and services of 3.18 percent, while the price changes for non-durable goods and services were closer to 2 percent. Furthermore, it does not appear as if there is any systematic tendency for prices to increase markedly in April (prices in April 1996 and April 1998 increased by 0.56 and 0.17 percent, respectively), which leads us to believe that this price increase was primarily due to the tax change. Nor do we observe any systematic decline in prices after April 1997 that would suggest retailers bore any burden of the tax over a longer time frame. Finally, we do observe an increase in the price of durable goods of 1.36 percent in March 1997, but the subsequent increase in durable price levels in April 1997 would appear to be at odds with House and Shapiro's prediction.

The price of current consumption relative to future consumption is also affected by expectations of nominal interest rates. In particular, expectations of an increase in the nominal interest rate that coincides with the consumption tax rate increase would blunt intertemporal substitution incentives, and vice versa. Figure 3 presents the average contracted interest rates on short-term loans and discounts. These are the average interest rates applied to a contract of less than one year between a commercial bank and lender. As the figure makes clear, the average interest rate fell precipitously throughout 1995, but remained relatively constant thereafter. For this reason, it seems safe to conclude that households did not expect to observe a significant change in nominal interest rates in the months following announcement of the consumption tax rate increase.

4. Empirical Evidence

4.1. Data

To estimate the intertemporal substitution and income effects associated with the April 1997 consumption tax rate increase, we use data from the Japanese Family Income and Expenditure Survey (JFIES).[8] The JFIES is a rotated panel survey in which households are interviewed for six consecutive months and approximately 8,000 households are interviewed each month.[9]

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

[9] Until2002, single-person and agricultural households were excluded in 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.

Our estimates make use of JFIES data from the period 1992-2002. We use a symmetric five year window around the rate increase at April, 1997. It would be better if we exclude the "bubble" years before April 1992 because household expenditures prior to 1992 grew at a much faster pace than they did after the bursting of the economic "bubble" in 1991. After 1992, real household expenditures remained more or less flat. Our sample period ends in March 2002, which is the start of another boom. We limit the sample to households who complete all six interviews, but substantially all samples can be used since response rate of JFIES is quite high. Although data for agricultural households can be available in JFIES after 1999, we drop them to keep consistency over sample period. Also, we use male headed households and those whose head does not change his job. The sample selection leaves us 636,315 observations from 127,263 households.

The JFIES expenditure data is highly disaggregated by item type, which is critical for our purposes, given our distinction between N, S, and D. For example, expenditures on fresh vegetables, which we consider N can be separated from processed vegetables (such as canned pea), which we define as S. Also, it can allow us to exclude some items that were exempt from the consumption tax. Our categorization of goods and services is a two-step process. First, we exclude expenditures on goods and services that were not subject to the consumption tax. As a result, the 'total expenditure' category includes only goods and services that were subject to the tax. Second, we divide the 'total expenditure' category into three subsets: D, S, and N.

We define D as goods and services which depreciate relatively slowly over time if not used and do not depreciate fully with use. This category includes traditional durables such as refrigerators and automobiles, as well as goods such as clothing that are classified as semi-durables in the JFIES. In addition, we include a select group of services such as home repair and tailoring, which consumers derive benefits from long after the service is provided. Given that we are using household-level data, roughly four percent of households have zero expenditure on D in any given month. Since our regression analysis will use the first difference of the logarithm of household expenditure on D as a left hand side variable, we assign durable expenditures of ¥1000 (approximately US$10) to households who report zero durable expenditure.[10] We define S as those that depreciate slowly over time if not used and fully if used. For example, laundry detergent can be stored for long periods of time with little to no effect on its ability to clean clothing, but once it is put into use, whatever amount was used has been fully consumed. This category also includes rail service, due to the fact that many Japanese households purchase passes which are good for train travel for several months.

[10] As a robustness check, we also assigned durable expenditures of ¥1 (approximately US$0.01) to households reporting zero durable expenditure. The results did not significantly differ. We may also experiment with a two-step estimation in the future, where households select into making a positive durable outlay.

Thus, one might expect that a household would purchase a pass good for several months during a low price period, and use the pass during a relatively high price period. Finally, we define N as goods and services which are neither storable nor durable. That is, they depreciate relatively quickly over time when not in use, and when in use, are fully consumed. For example, fresh fruit, if not eaten, will spoil, and is fully consumed with use. This category also includes services such as taxi service, which is consumed at the point of purchase.[11]

After eliminating expenditures on exempt goods and services and placing each good or service into its respective expenditure category, we then deflate total, D, S, and N monthly household expenditures using tax-inclusive consumer price indices specific to our categories.[12] We are left with real monthly expenditures for Japanese households from April 1992 through March 2002. Table 1 presents summary statistics for all observations.[13] This table shows that expenditures on taxed items comprise 70% of total expenditure, and most of excluded expenditure is rent for house. That is, as we discussed above, tax increase can be regarded as an increase of consumer prices. This shows that more than half of total expenditure is on N, while those on D and S are almost same size.

4.2. Empirical Results

Firstly, we show the arbitrage effects for each commodity type. Table 2 reports regression results based on equation (13) for the entire sample. As is shown above, the first-differences of year-month dummies should capture the arbitrage effects. Total expenditure was 7.6 percent higher than usual in March 1997 and statistically significant, while 2.5 percent and 1.8 percent lower in April and May, respectively. In other months, almost no change has been found although economic situations changed so much within 1997. That means the arbitrage effects as the total were very short-lived. Next, the effects varied lot across goods type. The expenditure on D fluctuated much more than the total expenditure; the impact of tax increase was 24.5 percent in March and -7.3 percent in April. The arbitrage effects for S were little larger than that for total expenditure and stayed lower much longer. Almost no effect is evident for N.

According to the model, factors that cause differences in the arbitrage effects across household types should be associated with time costs for purchasing D and/or storage costs for S. We divide whole sample in some different way to identify who responds more to the rate change. Firstly,

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[11] See Appendix Table A.1 for our complete categorization of D, S, and N.

[12] In particular, we construct Laspeyres price indices for each of our four categories using item-specific price indices and expenditure shares in 1990 for each of these items as the weights.

[13] Appendix Table lists summary statistics and definitions for each household type used to examine whether there exists heterogeneity in the intertemporal substitution effects.

we show the heterogeneity between working and non-working households. Working households are defined as those whose head is under age 60 and working, while non-working ones are those whose head is older than age 60 and has no job (that is, retired ones). Retired households likely have more time available to make purchases on big ticket items than do households where the head is working. That means we expect to find larger arbitrage effects for D for non-working ones.

As Table 3 shows, the results are quite consistent with the prediction. The difference of the arbitrage effects is large and statistically and economically significant. Non-working households purchase 40.8 percent more than usual in March, while only 21.6 percent for working. We also found significant difference in expenditures on S between the two types of households. For N, as expected, small arbitrage effects are observed for the both as expected. This sample separation suggests that a busier household responds less, or exhibit smaller arbitrage effects. Similar implication can be obtained from another sample separation among working households. We further divide the working sample into two groups: those with working wife (female spouse) and those without working wife (including both with non-working wife and without "wife"). For those with working wife, marginal cost of time consuming behavior is much higher; and therefore, we expect smaller arbitrage effects for D. The results are shown in Table 4, and the results are again quite consistent with the model. Expenditure on D is 16.4 percent higher than usual, while 25.9 percent for the other group.

For S, determinants of arbitrage effects are different for those for D. More spaces are required with stock piling behavior; and therefore, we divide the working household sample into two groups: those living in larger house (larger than the median size, 100 square meter) and in smaller one. Table 5 shows the results. Unlike the two comparisons above, the arbitrage effects for D are almost same (21.6 percent and 21.4 percent in March, respectively), while the difference between the two groups is statistically significant although it would not be economically significant.

Overall, our model can explain the heterogeneity in the arbitrage effects. The short-run impacts of a VAT rate increase are affected by costs associated with a purchase of D and costs of having a level of stock of S. The arbitrage effects for total expenditure are larger for less busy and more space-abundant households. Table 6 shows pair wise comparisons between groups discussed above. The overall difference is not so large, while the sizes of arbitrage effects seem to be consistent with the model. The reason why the difference is small is that more than half of taxed expenditure is on N, which exhibits almost no arbitrage effect.

In Table 7, we check validity of conventional factor of consumption fluctuations. Many previous studies documented that deviation from smooth consumption path can be explained with the borrowing constraints story (Chah, Ramey, and Starr, 1995). That is, households with less wealth would have a poorer ability to respond to an expected event.[14] The first two columns show the differences between richer and poorer households. We proxy for wealth with current yearly income to sample separation since the JFIES did not include data on wealth. Also, as a proxy for future income growth, we show the difference between younger and older (age 40+) households. However, the both sample separations show the intertemporal substitution response across groups is similar. That is, borrowing constraints may not play an important role to determine the arbitrage effects. That is perhaps not surprising in light of that fact that Japan's household savings rate was high at that time (see Horioka, 1989).

Finally, we compare the intertemporal substitution responses for households located in a metropolitan area, where retailers are abundant, to those located outside a metropolitan area. Again, there is a stark contrast in the March 1997intertemporal substitution response, as households located in metropolitan area spent 45 percent more than they otherwise would have, while households outside metropolitan areas spent only 19 percent more (not shown in Table 7), and therefore, responses are significantly different for total expenditure. We conclude that it is differences in search costs for durable goods driving heterogeneity in the intertemporal substitution response across households.

5. Summary and Discussions

This study evaluates the short-run distributional effects of a VAT rate increase using Japan's consumption tax rate increase in 1997. We found large expenditure fluctuations around the tax increase and they were driven almost exclusively by arbitrage effects for D and S. Also, we found that heterogeneity across households, which would be caused by differences in search costs for D and storage costs for S. More specifically, households who: retired; non-double-income; live in larger house; live in metro area, would response more.

However, overall distributional effect would be small. The arbitrage effect of some households are 1-3 percent point larger than that of others, which roughly correspond to 3-10 thousand yen more since average monthly total expenditure is 317 thousand yen. This means some households can avoid more consumption tax since they can purchase goods 2 percent cheaper due to the arbitrage, but the size of difference is about 60-200 yen.

[14] Chah et al. (1995) demonstrate that substantial intra-temporal substitution between durables and non-durables can occur when a household is borrowing constrained and the relative price of future consumption changes. The direction of the substitution depends on the extent to which durable goods are financeable (i.e. durable goods are treated as assets).

Although the short-run distributional effects are almost negligible, our results suggest that step-by-step rate increase would be preferable if the government wants to avoid larger economic fluctuations and the distributional effects associated with the fluctuation. Since the size of the arbitrage effects are determined by costs associated with purchases of D and/or storage of S, one-time and larger rate increase may cause larger arbitrage effects. In addition, benefits from such arbitrage behavior would be larger for time- and space- abundant households. Given that households in developed economies are aging (and thereby, more retired population is there), increasingly urban, our results suggest that future consumption tax rate increases should lead to larger expenditure fluctuations.

Future work will use a structural model of household consumption and the results from this paper and Cashin (2011) to derive point estimates of the intertemporal elasticity of substitution in consumption, durable search costs, and other parameters of interest.

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Table 1. Summary statistics

Variable	Mean	Std.	Min	Max
Age of head	51.5	13.7	17	99
Number of household members	3.38	1.24	2	11
Number of household members under age 15	0.69	0.98	0	7
Number of household members aged 65+	0.46	0.75	0	4
Number of working members	1.56	0.95	0	7
Yearly income (1,000 yen)	7,116	4,658	0	97,043
Total expenditure (1,000 yen)	317	266	21	14,346
Exculuding Tax Exempted items (1,000 yen)	221	195	15	9,255
Durables (D) (1,000 yen)	47	138	0	7,678
Storable non-durables (S) (1,000 yen)	52	32	1	3,790
Nonstorable non-durables (N) (1,000 yen)	120	78	7	5,523
Number of Observations	636,315			
Number of Households	127,263			

Source: Japanese Family Income and Expenditure Survey (April 1992-March 2002). For sample selection, see text.

Table 2. Percentage deviation in household expenditures around the 1997 Consumption Tax rate increase

	Expenditure category							
	Total		Durable		Storable non-durable		Non-storable non-durable	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects								
January, 1997	0.005	0.007	0.028	0.023	-0.010	0.007	0.006	0.006
February, 1997	0.006	0.008	0.053**	0.027	-0.006	0.008	-0.001	0.006
March, 1997	0.076***	0.009	0.245***	0.029	0.097***	0.008	0.012	0.007
April, 1997	-0.025**	0.011	-0.073*	0.038	-0.065***	0.011	-0.006	0.010
May, 1997	-0.018*	0.010	-0.019	0.036	-0.027***	0.010	-0.015	0.009
June, 1997	0.002	0.010	0.015	0.035	-0.017*	0.010	0.007	0.009
July, 1997	-0.012	0.010	-0.047	0.033	-0.029***	0.010	0.005	0.009
August, 1997	0.015	0.009	0.02	0.032	-0.010	0.009	0.021**	0.008
September, 1997	0.003	0.008	-0.005	0.030	-0.018**	0.009	0.011	0.007
October, 1997	-0.005	0.008	-0.022	0.028	-0.023***	0.008	0.003	0.007
November, 1997	-0.005	0.007	-0.046*	0.026	-0.017**	0.008	0.010	0.006
December, 1997	-0.010	0.007	-0.053**	0.023	-0.007	0.007	0.005	0.006
Observations	636,315							

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.

Table 3. Percentage deviation in expenditures: Working vs. Non-Working Household

	Working		Non-Working		Working		Non-Working		Working		Non-Working	
	Durable		Durable		Storable		Storable		Nondurable		Nondurable	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects												
January, 1997	0.008	0.026	0.134**	0.065	-0.022***	0.008	0.012	0.019	0.004	0.007	0.008	0.014
February, 1997	0.027	0.031	0.168**	0.075	-0.02**	0.009	0.035*	0.019	0.003	0.008	-0.009	0.015
March, 1997	0.216***	0.034	0.408***	0.080	0.081***	0.010	0.134***	0.020	0.017*	0.009	-0.002	0.017
April, 1997	-0.095**	0.044	-0.013	0.106	-0.059***	0.013	-0.094***	0.027	-0.004	0.011	-0.014	0.024
May, 1997	-0.022	0.041	0.030	0.101	-0.026**	0.012	-0.028	0.026	-0.017	0.011	0.003	0.023
June, 1997	0.010	0.039	0.098	0.097	-0.017	0.012	-0.007	0.025	0.005	0.010	0.011	0.022
July, 1997	-0.054	0.038	0.025	0.093	-0.027**	0.011	-0.048**	0.024	0.005	0.010	0.000	0.021
August, 1997	0.012	0.037	0.012	0.087	-0.013	0.011	-0.014	0.022	0.017*	0.010	0.010	0.020
September, 1997	-0.030	0.035	0.084	0.084	-0.023**	0.010	-0.003	0.022	0.009	0.009	0.010	0.018
October, 1997	-0.048	0.032	0.045	0.077	-0.025***	0.009	-0.020	0.020	-0.001	0.008	-0.003	0.017
November, 1997	-0.038	0.029	-0.049	0.072	-0.012	0.009	-0.038*	0.020	0.019**	0.008	-0.024	0.015
December, 1997	-0.061**	0.027	-0.021	0.063	-0.007	0.008	-0.004	0.019	0.006	0.007	0.009	0.014
Observations	440,511		102,524		440,511		102,524		440,511		102,524	

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.

Table 4. Percentage deviation in expenditures: Wife Working vs. Wife Non-Working Households

	Wife Working		Wife Non-Working		Wife Working		Wife Non-Working		Wife Working		Wife Non-Working	
	Durable		Durable		Storable		Storable		Nondurable		Nondurable	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects												
January, 1997	-0.031	0.040	0.042	0.035	-0.020	0.013	-0.023**	0.011	0.012	0.011	-0.003	0.010
February, 1997	-0.012	0.047	0.059	0.042	-0.03**	0.013	-0.011	0.012	0.006	0.012	0.001	0.011
March, 1997	0.164***	0.050	0.259***	0.045	0.071***	0.015	0.091***	0.013	0.017	0.013	0.017	0.012
April, 1997	-0.139**	0.066	-0.059	0.059	-0.083***	0.019	-0.04**	0.017	-0.019	0.017	0.009	0.016
May, 1997	-0.063	0.062	0.011	0.056	-0.044**	0.018	-0.011	0.016	-0.030	0.016	-0.007	0.015
June, 1997	0.016	0.060	0.002	0.053	-0.027	0.017	-0.009	0.016	-0.018	0.016	0.024	0.014
July, 1997	-0.083	0.057	-0.032	0.051	-0.038**	0.017	-0.018	0.015	-0.011	0.016	0.018	0.014
August, 1997	0.031	0.054	-0.008	0.050	-0.04**	0.016	0.010	0.015	0.007	0.015	0.025	0.013
September, 1997	-0.040	0.052	-0.025	0.047	-0.039***	0.015	-0.011	0.014	-0.010	0.013	0.025	0.012
October, 1997	-0.044	0.047	-0.053	0.043	-0.048***	0.014	-0.005	0.013	-0.020	0.012	0.016	0.011
November, 1997	-0.008	0.042	-0.066*	0.040	-0.007	0.013	-0.017	0.012	0.008	0.011	0.029	0.010
December, 1997	-0.098**	0.041	-0.028	0.036	-0.006	0.012	-0.009	0.011	0.009	0.011	0.002	0.010
Observations	204,843		235,668		204,843		235,668		204,843		235,668	

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.

Table 5. Percentage deviation in expenditures: Households Living in a Larger vs. Smaller House

	Smaller House		Lager House		Smaller House		Lager House		Smaller House		Lager House	
	Durable		Durable		Storable		Storable		Nondurable		Nondurable	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects												
January, 1997	-0.005	0.036	0.023	0.039	-0.023**	0.011	-0.019	0.012	0.012	0.010	-0.005	0.011
February, 1997	0.058	0.042	-0.008	0.046	-0.012	0.011	-0.027**	0.013	0.005	0.011	0.001	0.011
March, 1997	0.216***	0.045	0.214***	0.050	0.075***	0.013	0.090***	0.014	0.024**	0.012	0.01	0.013
April, 1997	-0.072	0.060	-0.123*	0.064	-0.061***	0.018	-0.060***	0.018	0.009	0.016	-0.018	0.017
May, 1997	-0.005	0.056	-0.042	0.061	-0.021	0.017	-0.032*	0.017	0.000	0.015	-0.037**	0.016
June, 1997	0.047	0.054	-0.03	0.058	-0.017	0.016	-0.018	0.017	0.022	0.014	-0.014	0.015
July, 1997	-0.013	0.052	-0.097*	0.056	-0.02	0.015	-0.034**	0.016	0.022	0.014	-0.014	0.015
August, 1997	0.031	0.050	-0.008	0.054	0.005	0.015	-0.034**	0.016	0.033**	0.014	-0.001	0.014
September, 1997	0.002	0.048	-0.067	0.051	-0.016	0.014	-0.031**	0.015	0.016	0.012	0.002	0.013
October, 1997	-0.011	0.044	-0.089*	0.046	-0.009	0.013	-0.043***	0.013	0.010	0.011	-0.013	0.012
November, 1997	-0.049	0.041	-0.029	0.041	-0.004	0.012	-0.021*	0.013	0.032***	0.011	0.005	0.011
December, 1997	-0.046	0.037	-0.077*	0.039	0.005	0.011	-0.023*	0.012	0.013	0.010	-0.002	0.010
Observations	229,991		210,321		229,991		210,321		229,991		210,321	

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.

Table 6. Percentage deviation in Total expenditures by Household Type

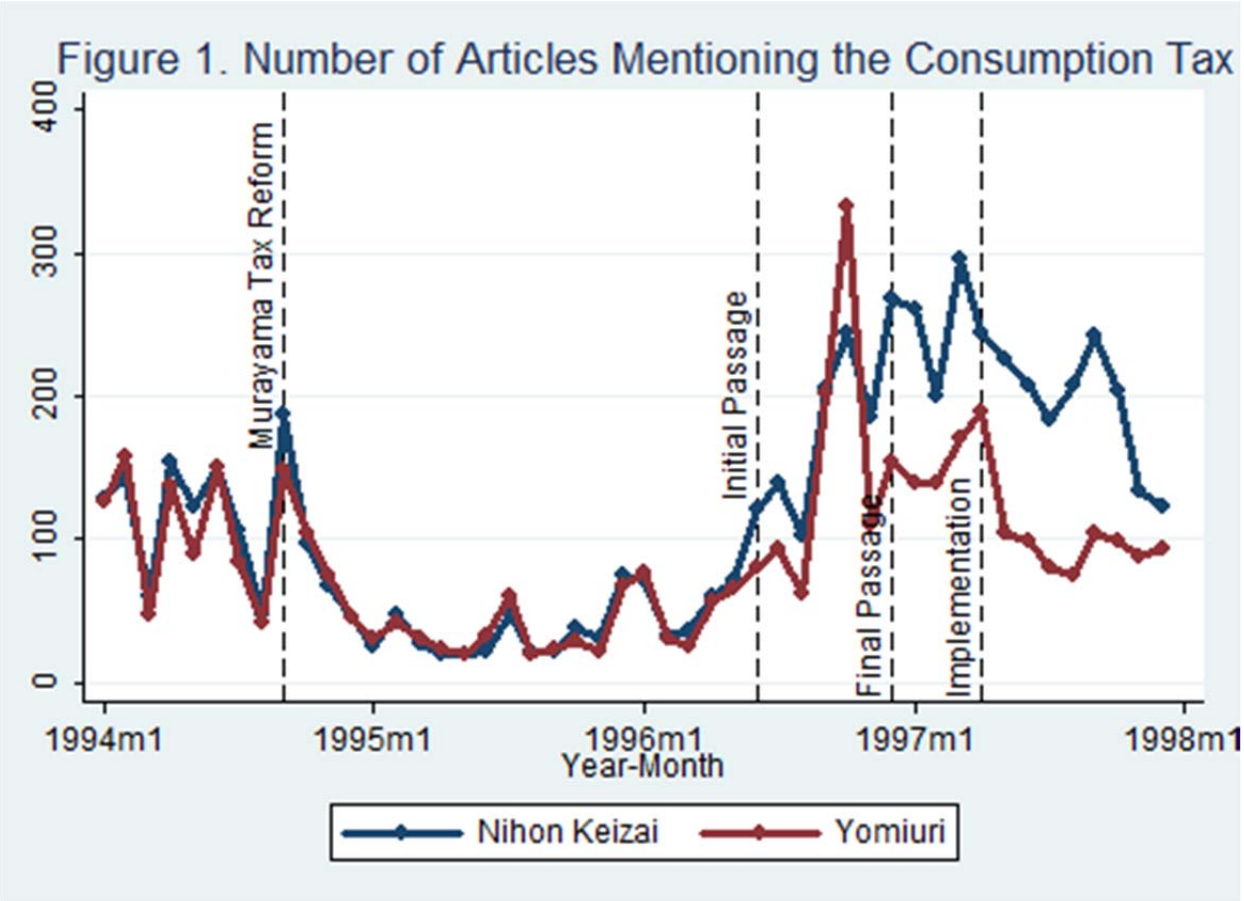
	Working		Non-Working		Wife Working		Wife Non-Working		Smaller House		Lager House	
	Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects												
January, 1997	0	0.008	0.015	0.017	-0.003	0.013	0.002	0.011	0.004	0.011	-0.005	0.012
February, 1997	0.001	0.009	0.028	0.019	-0.005	0.014	0.007	0.013	0.013	0.013	-0.011	0.014
March, 1997	0.078***	0.011	0.091***	0.021	0.072***	0.016	0.084***	0.014	0.072***	0.014	0.085***	0.016
April, 1997	-0.027**	0.013	-0.025	0.027	-0.044**	0.020	-0.012	0.018	-0.024	0.018	-0.032*	0.019
May, 1997	-0.02*	0.012	0.000	0.026	-0.03*	0.018	-0.012	0.016	-0.010	0.017	-0.032*	0.018
June, 1997	-0.003	0.012	0.022	0.025	-0.013	0.018	0.005	0.016	0.005	0.016	-0.013	0.017
July, 1997	-0.013	0.011	0.001	0.024	-0.024	0.017	-0.004	0.015	-0.001	0.016	-0.027	0.017
August, 1997	0.009	0.011	0.008	0.022	-0.001	0.016	0.017	0.015	0.026*	0.015	-0.009	0.015
September, 1997	-0.007	0.010	0.030	0.021	-0.026*	0.015	0.009	0.014	0.006	0.014	-0.022	0.014
October, 1997	-0.012	0.009	0.007	0.020	-0.024*	0.014	-0.002	0.013	0.005	0.013	-0.031**	0.013
November, 1997	-0.003	0.008	-0.023	0.019	-0.004	0.012	-0.002	0.012	0.010	0.012	-0.016	0.012
December, 1997	-0.013	0.008	0.001	0.015	-0.015	0.012	-0.011	0.011	-0.005	0.011	-0.023*	0.012
Observations	440,511		102,524		204,843		235,668		229,991		210,321	

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.

Table 7. Percentage deviation in Total expenditures by Household Type

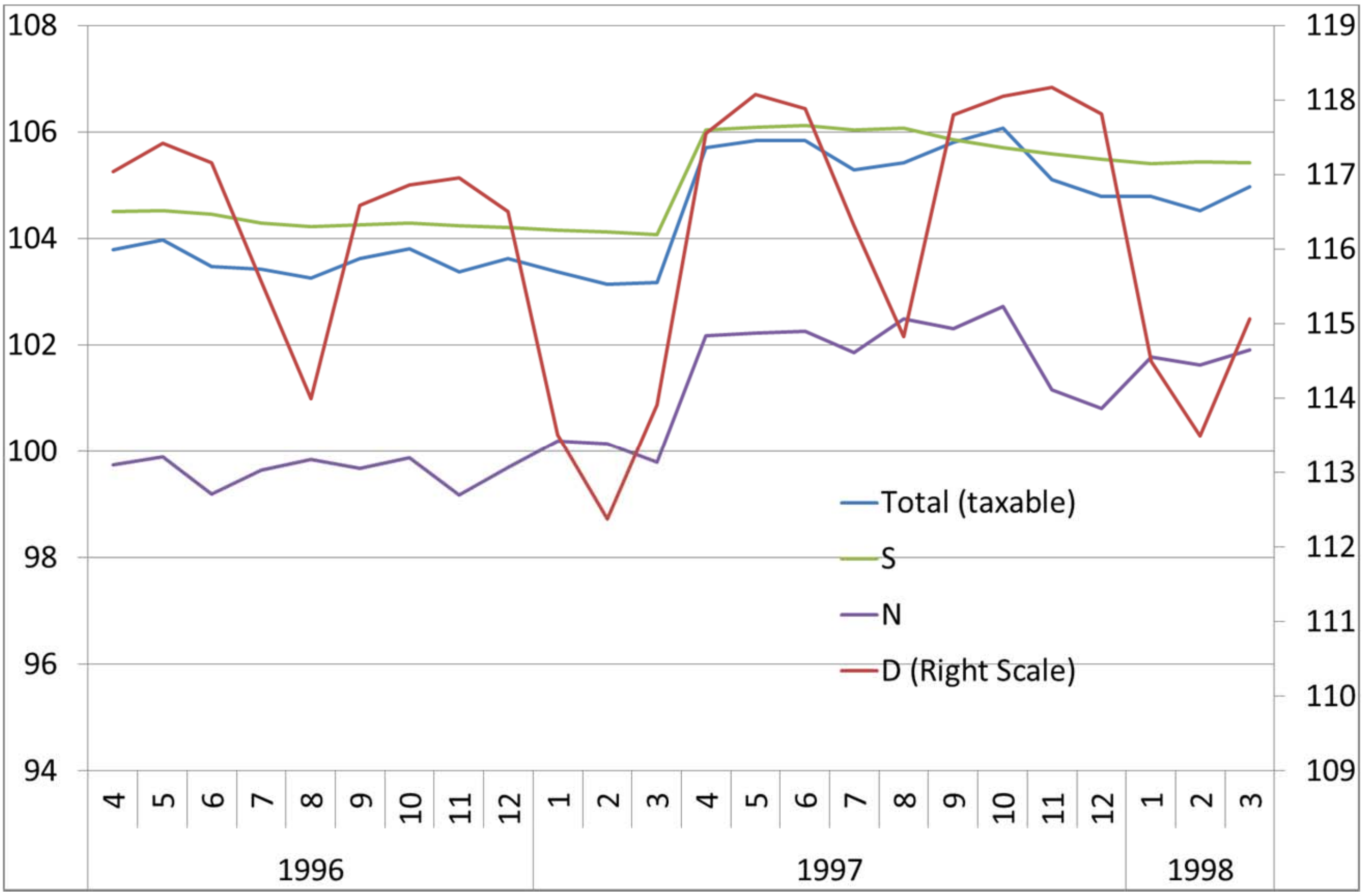
	Lower Income (Working)		Higher Income (Working)		Younger		Older		Metro Area		Non-Metro Area	
	Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure		Total Expenditure	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Arbitrage Effects												
January, 1997	0.008	0.011	-0.002	0.012	0.002	0.010	-0.004	0.014	0.02	0.016	-0.008	0.010
February, 1997	0.018	0.013	-0.008	0.013	-0.005	0.011	0.013	0.016	0.016	0.019	-0.004	0.011
March, 1997	0.082***	0.015	0.076***	0.015	0.079***	0.013	0.077***	0.018	0.108***	0.021	0.068***	0.012
April, 1997	-0.025	0.018	-0.029	0.019	-0.034**	0.016	-0.015	0.023	-0.035	0.026	-0.024	0.015
May, 1997	-0.015	0.017	-0.026	0.017	-0.03**	0.015	-0.002	0.021	-0.007	0.024	-0.024*	0.014
June, 1997	-0.005	0.016	-0.003	0.017	-0.016	0.014	0.020	0.020	0.004	0.024	-0.006	0.013
July, 1997	-0.014	0.016	-0.015	0.016	-0.023*	0.014	0.004	0.019	-0.009	0.023	-0.015	0.013
August, 1997	0.018	0.015	0.000	0.015	0.000	0.013	0.025	0.019	0.026	0.023	0.004	0.012
September, 1997	-0.002	0.014	-0.013	0.014	-0.016	0.012	0.008	0.017	-0.005	0.020	-0.008	0.011
October, 1997	-0.011	0.013	-0.014	0.013	-0.014	0.011	-0.009	0.016	-0.004	0.019	-0.015	0.011
November, 1997	-0.002	0.012	-0.004	0.012	-0.001	0.010	-0.005	0.014	-0.014	0.017	0.001	0.010
December, 1997	-0.013	0.012	-0.015	0.011	-0.018*	0.010	-0.002	0.014	-0.02	0.016	-0.011	0.009
Observations	216,280		224,231		285,831		154,680		110,685		329,826	

Note: This table presents estimates from a regression based on Equation (13). The dependent variable is the first difference of the logarithm of monthly household expenditures. 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 time trend, the first difference of month dummies, age of household head the first differences of the following variables: indicators for each interview; the number of household members, working members, members under age 18, and members over the age of 65. *, **, and *** represent significance at the 10, 5, and 1 percent level, respectively.



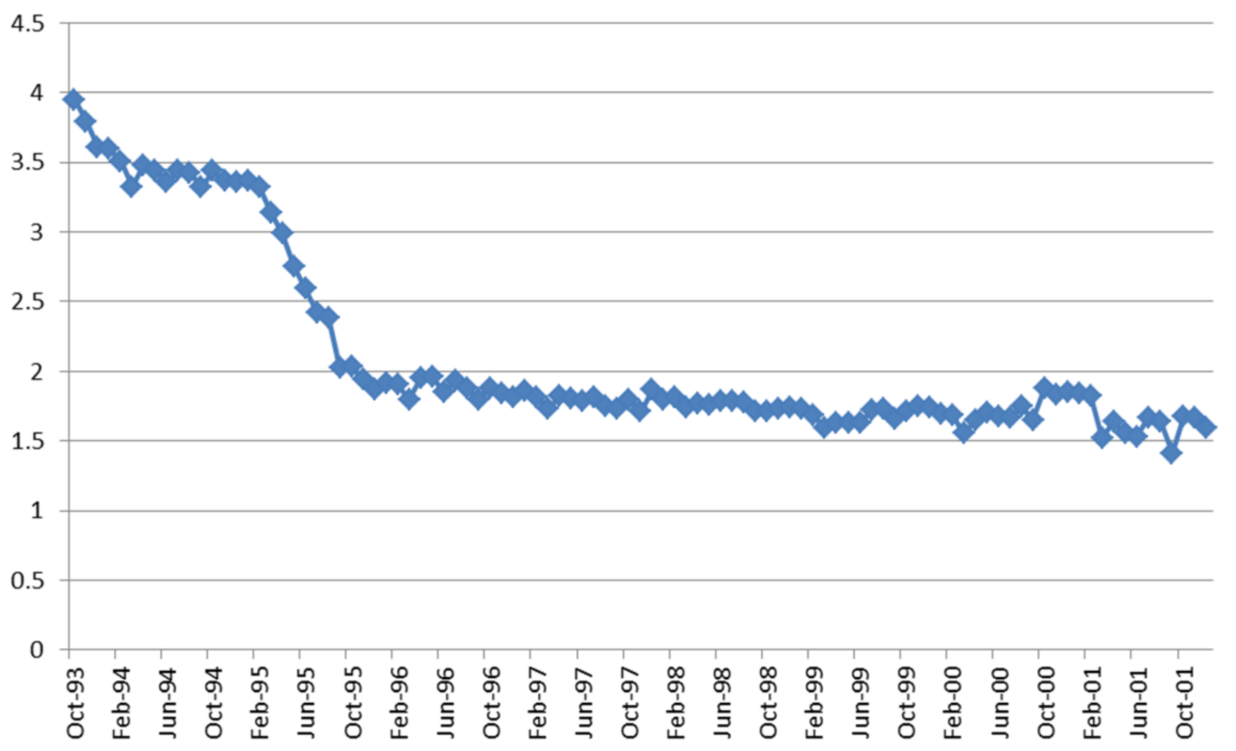
Source: Authors' calculations. Circulation numbers come from Japan's Audit Bureau of Circulations.

Figure 2 Consumer Price Index for each Commodity Type



Source: With the categorization discuss in the text, calculated from Consumer Price Index (2005 base).

Figure 3 Average Interest Rate on Short-Term Loans and Discounts



* presents the average contracted interest rate on short-term loans and discounts. These are the average interest rates applied to a contract of less than one year between commercial banks and lenders. The data comes from the Bank of Japan.

Appendix Table. Categorization of Goods and Services Subject to the Consumption Tax		
Durables	**Storable Non-Durables**	**Non-Storable Non-Durables**
Tools	Grains (e.g. noodles)	Bread
Cooking appliance	Fish (dried, fish paste)	Fish (fresh)
Refrigerator	Meat (processed)	Meat (raw)
Vacuum	Dairy (e.g. butter)	Dairy (e.g. milk)
Washing machine/dryer	Vegetable (e.g. beans)	Vegetable (fresh)
Other household durables (e.g. microwave)	Fruit (canned)	Fruit (fresh)
Air conditioner	Oils, spices, and seasonings	Cake
Fan heaters	Sugar	Cooked food (e.g. sushi)
Stove	Sweets (e.g. chocolate)	Electricity
Other heating and cooling appliances	Cooked food	Natural gas
General furniture	Beverages (e.g. tea)	Water
Clock	Alcoholic beverages	Gasoline
Lighting	Light bulbs	Flowers
Floor coverings and curtains	Domestic goods (e.g. laundry detergent)	Newspaper
Other interior furnishings	Cloth	Eating out
Bedding	Medicine	Domestic services
Utensils	Medical supplies (e.g. bandages)	Bus fare
Japanese clothing	Stationery	Taxi fare
Western clothing	Film	Airfare
Women's coats	Recording media (e.g. CD)	Other public transit
Shirts	Pet food	Automotive fees
Underwear	Personal care items (e.g. toothbrush)	Automotive insurance
Other clothing	Tobacco	Telephone service
Footwear	Rail service	Recreational good repair
Automobile		Recreational durable good repair
Other vehicle		Lodging
Bicycle		Package tour
Auto parts		Lesson fees
Telephone		Television service
Textbook		Movie or play admission
Television		Other admissions
Stereo		Other recreational services
Portable audio equipment		Other insurance
Video recorder		Social expenses (e.g. money gifts)
Camera	**(Durables Cont.)**	
Computer	Personal effects (e.g. umbrella)	
Musical instrument	Handbag	
Desk	Accessories (e.g. watch)	
Other recreational durable goods	Other personal effects (e.g. cane)	
Golf equipment	Home repair (e.g. plumbing)	
Other sporting goods	Clothing services (e.g. tailoring)	
Sport outfits	Auto repair	
Toys	Personal care services (e.g. haircut)	
Other recreational goods	Personal effect services (e.g watch repair)	
Books	Personal care item (e.g. hair dryer)	