Effects of Consumption Tax Hike Announcements: Lessons from Japan

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Views expressed are those of the authors and do not necessarily reflect those of the Bank of Japan.

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1 Backgrounds

2 Model and Estimation Strategy

3 Quantitative Analysis
The recent tax hike episode in Japan has notable features.

1. Consecutive Consumption tax hikes were announced at the same time (in 2012/Q3).
2. Second tax hike (from 8 percent to 10 percent) was postponed twice.

**Table:** Consumption Tax Hike Announcements in Japan

<table>
<thead>
<tr>
<th>Year/Quarter</th>
<th>Announcement of consumption tax hikes</th>
<th>Future Postponement</th>
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<tbody>
<tr>
<td>2012/Q3</td>
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Consumption tax hike announcement in Japan

First stage: 2014/Q2: 5% → 8%
Second stage: 2015/Q3: 8% → 10%
Consumption tax hike announcement in Japan

- **New plan announced 2014/Q4**

- **2012 (original) plan**
  - Postponement of second stage tax hike
  - Second stage: 2015/Q3 → 2017/Q2

Consumption tax rate, %

- 2014/Q4: 4%
- 2015/Q3: 5%
- 2017/Q2: 8%

CY 2012 to 2020
Consumption tax hike announcement in Japan

- 2014 plan
- 2012 (Original) plan

Postponement of second stage tax hike
Second stage: 2017/Q2 → 2019/Q4
Empirical Facts: Consumption and Inflation in Japan

(a) Consumption

(b) CPI Inflation

Note: Figures for CPI are adjusted to exclude the estimated effects of changes in the consumption tax rate.
Empirical Facts: Consumption and Inflation in Japan

- A front-loading of consumption prior to the implementation, followed by a subsequent decline.
- The decline in consumption following the tax hike is persistent.
- The effect of consumption tax hike to inflation is unclear.
  - This period also saw a large decline in crude oil prices and a slowdown in overseas economies.
Empirical Facts: Consumption by categories in Japan

Source: Cabinet Office.
Empirical Facts: Consumption by Categories in Japan

- Large demand swings for durables and non-durables before and after the implementation of the consumption tax hike, while services were hardly affected.
- A downward shift in the consumption of all types of goods, as well as services, following the implementation of the consumption tax hike.
Consumption surrounding 25 consumption tax hikes around the world (scaled by the size of tax rate changes)

- Developments of consumption exhibits development similar to Japan.
- Large demand swings and subsequent decline in consumption around a consumption tax hike is observed worldwide!
What We Do

- Build a DSGE model to analyze how consumption tax hike announcements and delaying them affect real activity and inflation, focusing on the recent tax hike episode in Japan.
  - Empirical facts suggest that it is essential to take the heterogeneity of consumption goods into account and introduce consumption tax hike announcement properly.
- We estimate the model with Japanese data and undergo several simulations.
1 Backgrounds

2 Model and Estimation Strategy

3 Quantitative Analysis
Overview

- We extend a standard NK model as follows.

- **Three types of consumption goods**: Services, durables and non-durables.

- **Two types of households**: Ricardian and Non-Ricardian households

- **Consumption tax hike announcements**
  - construct series of news shocks about consumption tax hikes to mimic actual announcements made by the Japanese government.
  - Fujiwara, Hirose, and Shintani (2011) to estimate the effect of the news shocks.
Ricardian Households

Utility: $E_0 \sum_{t=0}^{\infty} \beta^t e^{zt} \left( \frac{U_t \left( C^s_t, C^n_t, S^d_t \right)^{1-\sigma}}{1 - \sigma} - \frac{L_t^{1+\eta}}{1 + \eta} \right)$

$C^s_t$ and $C^n_t$: consumption of services and non-durable goods, $S^d_t$: the stock of durables and they have habit persistence.

Budget constraint:

$$(1 + \tau_t)(P^s_t E^s_t + P^d_t E^d_t + P^n_t E^n_t) + P_t l_t + P_t a(u_t) K_{t-1}$$

$$= W_t L_t + (1 + R_{t-1}) B_{t-1} - B_t + P_t u_t R_t^k K_{t-1} + D_t - P_t T_t$$

$\tau_t$: consumption tax rate, $E^x_t (x \in \{s, d, n\})$: expenditure for each goods.
Ricardian Households

Laws of motion for stock variables: durables $S^d_t$, non-durables $S^n_t$.

\[ Durables: \quad S^d_t = E^d_t + (1 - \delta^d) S^d_{t-1} \tag{1} \]

\[ Nondurables: \quad S^n_t = E^n_t + S^n_{t-1} - \frac{\gamma^p}{2} (S^n_{t-1})^2 - C^n_t \tag{2} \]

$\delta^d$: depreciation rates of durables $\gamma^p$: parameter for storage costs

- Durables and non-durables are stock-piled with expenditure $E^d_t$ and $E^n_t$, and non-durables perish with consumption $C^n_t$.
- Services have no storage technology, which implies that expenditure $E^s_t$ is equal to consumption $C^s_t$. 
Ricardian Households: Preference Structure

Utility function

- Consumption of services
- Consumption of non-durables
- Stock of durables

Sum of Expenditure for Consumption

- Expenditure for services
- Expenditure for non-durables
- Expenditure for durables

Stock of non-durables at time t

Stock of non-durables at time t-1

Stock of durables at time t-1

Utility function

Sum of Expenditure for Consumption

Expenditure for services

Expenditure for non-durables

Expenditure for durables
Non-Ricardian Households

- Simply consume all of their after-tax disposable income, \( W_t L_t - P_t T_t \).
- Non-Ricardian households’ expenditure, \( E_t^s \), \( E_t^d \), and \( E_t^n \), is determined based on an allocation rule with shares of each type of good fixed at the steady-state shares of Ricardian households.

\[
(1 + \tau_t) \left( P_t^s E_t^s + P_t^d E_t^d + P_t^n E_t^n \right) = W_t L_t - P_t T_t.
\]
Consumption Tax Hike Announcements

\[ \tau_t = \tau_{ss} + Z_t \]

\[ Z_t = Z_{t-1} + \varepsilon_{0,t} + \sum_{n=1}^{N} \varepsilon_{n,t-n} \]

- \( \tau_t \): consumption tax rates
- \( Z_t \): a consumption tax shock, which is decomposed into two components.
  - \( \varepsilon_{0,t} \): Unexpected component
  - \( \sum_{n=1}^{N} \varepsilon_{n,t-n} \): Expected component
    - \( \varepsilon_{n,t-n} \) is a shock announced at time \( t - n \) where a change in the tax hike materialize after \( n \) periods; namely \( t \).
The Rest of the World

- Government
  - Government budget constraint
  - (Ricardian) Fiscal Policy Rule

- Firms
  - Three types of Final-Goods Firms and Intermediate-Goods Firms.
  - Calvo Pricing and indexation to past inflation rates.

- Central Bank
  - Taylor rule

- Aggregation and Market Clearing
  - Aggregate expenditure is the weighted average of each type of household. (Non-Ricardian household share: \( \omega \))
Bayesian Estimation

- Data: Real GDP, real expenditure for each goods, real government expenditure, deflators for consumption, deflator for services, deflator for durables, over-night call rate and announcements of consumption tax hikes.
  - All of the real data are transformed into per-capita terms by dividing each variable by the population aged 15 years and over.
  - All of the deflators exclude the estimated direct contribution of the consumption tax hikes in 1997 and 2014.

- Sample period: 1990Q1 to 2016Q3
### Observation of Consumption Tax Hikes Announcement

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$$A^n_t = \varepsilon^n_{n,t} + \varepsilon^n_{n+1,t-1} + \cdots + \varepsilon^n_{N,t-N+n}:$$

Sum of all news shocks that the consumption tax rates will be raised after $n$ periods, namely, $t + n$. 

A $n$ $t$ = $\varepsilon^n_{n,t}$ $+$ $\varepsilon^n_{n+1,t-1}$ $+$ $\cdots$ $+$ $\varepsilon^n_{N,t-N+n}$.

Sum of all news shocks that the consumption tax rates will be raised after $n$ periods, namely, $t + n$. 
1 Backgrounds

2 Model and Estimation Strategy

3 Quantitative Analysis
Main Transmission Channels of Consumption Tax Hike

- **Real income effect**
  - Consumption tax hike reduces the real disposal income of households directly.

- **Intertemporal substitution effect**
  - Purchase goods prior to the tax hike to take advantage of lower prices compared to after the tax hike for *current* utility.

- **Stock-piling effect**
  - Stock-pile durables and nondurables prior to the tax hike for *later* utility.
Impulse Responses to the Announcement of 3 Percent Consumption Tax Hike After Two Years

(a) Durables
(b) Non-Durables
(c) Services
Impulse Response: Points

Durables and non-durables:

- A front-loading of demand prior to the tax hike [Stock-piling Effect], followed by a subsequent decline in demand [Real Income Effect]. But..

**Difference 1** The demand swings in durables are larger than those in non-durables,

**Difference 2** It takes much longer for durables to recover.

Why?
Impulse Response of Stock of Durables

The graph illustrates the deviation from the steady-state percentage for the stock of durables over 20 quarters. The deviation peaks at around 7 quarters after the announcement and then gradually returns to the steady state over the subsequent quarters.
Impulse Response: Points

Intertemporal substitution effect:

- It occur in all three types of goods, even in services, implying that it plays a minor role in demand swings around the tax hike.
- Stock-piling channel plays a pivotal role in large demand swing before and after the tax hike.
Breakdown of Total Expenditure for Consumption

deviation from steady-state, %

Implementation

- Ricardian households
- Non-Ricardian households
- Total expenditure of consumption

quarters

Announcement

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Breakdown of Total Expenditure for Consumption

- There are small demand swings for non-Ricardian households, because they are hand-to-mouth consumers.
- Both household type’s level of consumption shifts downward after the tax hike.
  - Non-Ricardian households’ consumption decline due to real income effect.
  - Ricardian households’ consumption decline due to excessive stock of durable goods and dead-weight loss of the consumption tax hike.
Impulse Response of Consumption and Inflation

- Total expenditure for consumption
- Inflation (right scale)

deviation from steady-state, %
deviation from steady-state, y/y % chg., % points

Announcement
Implementation

quarters

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Impulse Response of Consumption and Inflation

- Following the tax hike announcement, inflation responds with a mild rise but starts declining prior to the actual tax hike.
  - Forward-looking firms take the decline in demand after implementing the tax hike into account when they set a price of goods.
- After the tax hike, inflation declines severely due to the downward pressure from the real income effects and excessive stock of durable goods.
Policy Analysis

- Generate the news shocks consistent with the actual tax hikes plans in Japan.

**Table:** Consumption Tax Hike Announcements in Japan

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Case 1: Tax Hike Plans as of 2012/Q3

Consumption Tax Rate

- First stage: 2014/Q2: 5% → 8%
- Second stage: 2015/Q3: 8% → 10%

Expenditure for consumption
Inflation (right scale)

% points

y/y % chg., % points


Consumption Tax Hike Announcement

First stage: 2014/Q2: 5% → 8%
Second stage: 2015/Q3: 8% → 10%
Case 2: Tax Hike Plans as of 2014/Q4

- Expenditure for consumption
- Inflation (right scale)

Consumption Tax Rates

- New plan from 2014/Q4
- 2012 (original) plan

Postponement of second stage tax hike
Second stage: 2015/Q3 → 2017/Q2
Case 3: Tax Hike Plans as of 2016/Q2

- Expenditure for consumption
- Inflation (right scale)

Consumption Tax Rates

- 2014 plan
- 2012 (original) plan
- New plan announced 2016/Q2

Postponement of second stage tax hike
Second stage: 2017/Q2 → 2019/Q4
Delaying the second tax hike had the effect of mitigating the downward pressure on the economy and inflation.

- Consecutive consumption tax hikes mean that the negative pressure from the adjustment of the stock of durables in the wake of the first tax hike overlaps with the negative real income effect of the second hike.
The front-loading of consumption prior to the tax hike and the subsequent decline after the tax hike are generated mainly by the effects of stock-piling by Ricardian households.

The consumption decline following the tax hike is exacerbated by the real income effect on non-Ricardian households, which puts non-negligible downward pressures on the economy and inflation.

The delay of the second tax hike in Japan had the effect of mitigating the downward pressure on the economy and inflation.