A Model of Anticipated Consumption Tax Changes

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RQ & Frameworks

What are effects of preannounced VAT changes in a model of durables?

- Is $\tau^c \Downarrow$ asymmetric to $\tau^c \Uparrow$?
  - $\Rightarrow$ *A. asymmetric*
- Which is better, $\tau^c \Uparrow$ *once* or $\tau^c \Uparrow$ with *multiple* times?
  - $\Rightarrow$ *A. mulitple* times

What I do: construct a life-cycle heterogeneous-agent GE model of durables with

$$\mathcal{T}(x^d) = \begin{cases} (1+\tau^c)x^d & \text{if } x^d \geq 0 \\ x^d & \text{if } x^d < 0, \end{cases}$$

where $x^d = d - (1-\delta^d)d_{-1}$

To my best knowledge, this is the **first** work that incorporates the **tax wedge** into **macro GE** model to study anticipated VAT changes

tax

Model : Households

Households problem

Key Ingredients: **Life-cycle, Hetero, Durables, Tax Wedge**

$$v_j(a_{-1}, d_{-1}, e) = \max_{a,c,d} u(c,d) + \beta \sum_{e'} v_{j+1}(a, d, e')\pi(e'|e)$$

$$\text{s.t. } (1+\tau^c)c + a + \mathcal{T}(x^d) = (1+r)a_{-1} + y_j(e) + b$$

$$x^d = d - (1-\delta^d)d_{-1}$$

$$a \geq 0, \quad (c,d) \geq 0.$$

$\mathcal{T}(\cdot)$: tax wedge, τ: taxes, b: received bequest, $y_j(e)$ is given by

$$y_j(e) = \begin{cases} w\kappa_j e & \text{if } j < J^R \\ ss & \text{if } j \geq J^R \end{cases}$$

ss: social security, κ_j age-specific wage component.

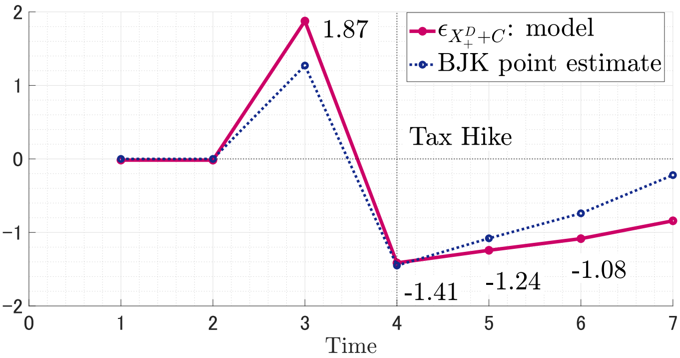
choice-specific VFs | pass-through

Anticipated VAT Changes:

Partial Equilibrium: keeping prices constant

1. Tax Elasticities : $\epsilon_{C+X_+^D}$ & $\epsilon_{X_+^D}$
   - Baseline Model & Empirics

Tax Elasticities



- The model $\epsilon_{C+X_+^D}$ is within 95% confidence interval reported in BJK
- $\epsilon_{X_+^D}$ one period before $\tau^c \uparrow$
  - Empirics: 8.1 – 12.8 for **autos** in Baker et al. ('19)
  - My Model: 10.6
- Literature found it difficult to match: (Mckay& Wieland '19 etc)

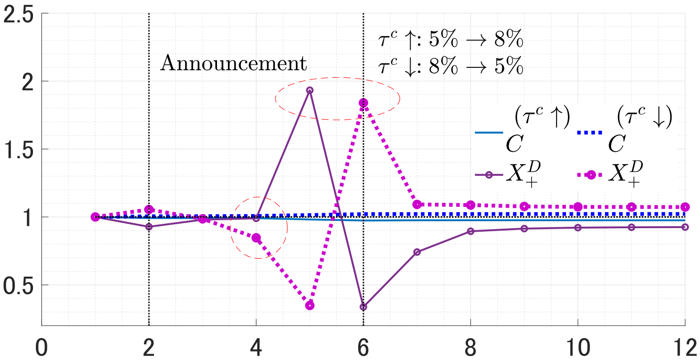
frequency, different tax, Aggregate JPN, trad'l irreversibility

Counter-Factuals:

1. Counter-Factual 1: $\tau^c \downarrow$
2. Counter-Factual 2: multi-times $\tau^c \uparrow$

Tax Cut: 8%→ 5%

(Example: Germany & UK, 2020)

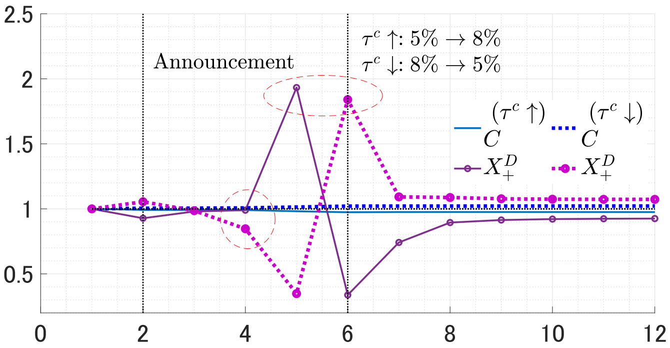


Asymmetric Effects:

(1) Gradual $X_+^D \downarrow$ before $\tau^c \downarrow$

(2) Magnitude of intertemporal substitution

Tax Cut: 8%→ 5%



Asymmetric Effects: Implications

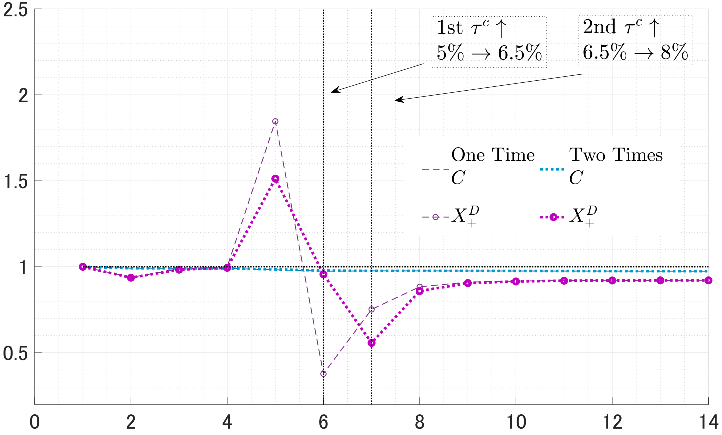
- Linearized Solution: won't capture asymmetricity
- Reduced form: should not mix the sample of $\tau^c \uparrow$ & $\downarrow$

Germany: temporary cut

Multiple-Times Tax Hikes:

How can we better implement the tax hike?

One-Time or Two-Times



- Weaker intertemporal shifting
- Put off the plummet

3 times, 2 times welfare.

Concluding Remarks

[RQ] **What are effects of preannounced VAT changes in a model of durables?**

(1) **Tax Wedge plays a central role:**
- Reproducing dynamic pattern of **empirical tax elasticity**

(2) **Life-cycle:**
- Low **Elasticity of Durables**
  - GE $\approx$ PE

(3) **Counter-Factuals:**
- $\tau^c\downarrow$ is asymmetric to $\tau^c\uparrow$
- Multiple times Tax Hike is welfare improving for most of HHs.

Appendix: **Main Slides for 60+ mins ver.**

Others

(1) **Gov't** budget constraint:

$$G + SS = \tau^c [C + X^d_+]$$

$$\text{where} \quad X^d_+ \equiv \sum_j \int_{x^d_j > 0} x^d_j \mathrm{d}\mu_j$$

(2) **Firm**: Perfect competition with Cobb-Douglas production

$$r + \delta = F_K(K, N), \qquad w = F_N(K, N)$$

(3) Competitive **Dealers** of Durables:

- manage all durable transactions
- exist to prohibit direct and private durable trade btw HHs

clearing, flow chart

Stationary Equilibrium:

Parameterization and Baseline Results

Parameterization: Japanese Annual Model

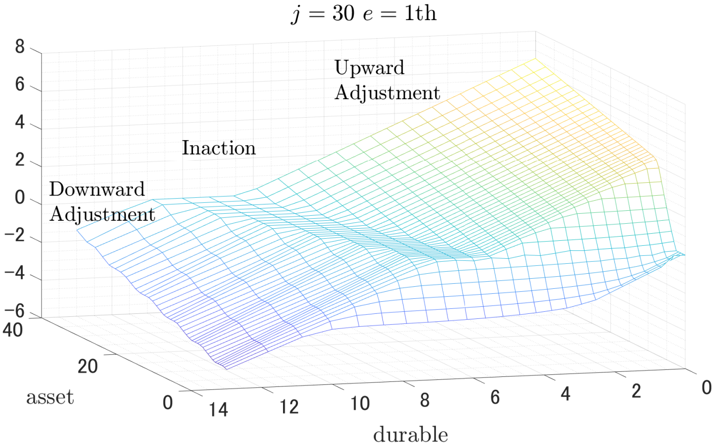
parameters	values	meanings	source (annual) ▸ why Japan?
β	0.977	discounting	standard in Japan (e.g. Hayashi and Prescott)
σ	2.0	inverse IES	standard
δ	0.1	K dep	standard
δ^d	0.15	D dep	expndr share $\times$ each dep rate
ρ_e	0.9	persistence in e	Nakajima and Takahashi (2017)
σ_e	0.2072	std in e	Lise et al. (2014)
$\{\kappa_j\}$	-	age-depend't earnings	Yamada (2011)
τ^{ss}	0.64	social security	report from OECD
q	1.0	resale value	-

$$u(c,d) = \frac{\left(c^{\theta}(d+\epsilon^{d})^{1-\theta}\right)^{1-\sigma}}{1-\sigma}$$

Non-Homothetic Utility to reproduce hump shape in x^d profile.

(S,s) Rule due to Tax Wedge

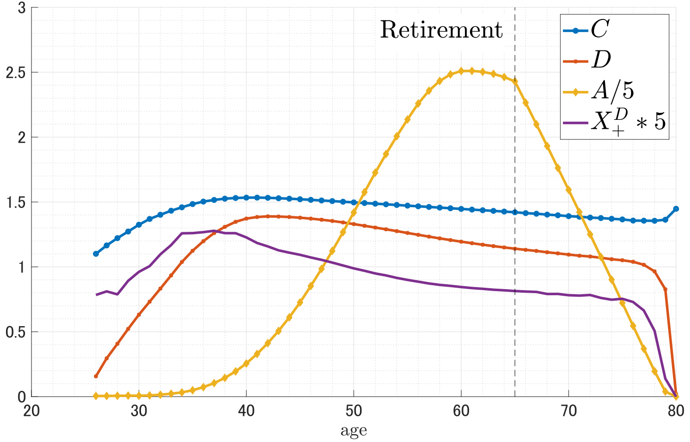
$$x_j^d = g_j^d(a_{-1}, d_{-1}, e) - (1 - \delta^d)d_{-1}$$



other ages

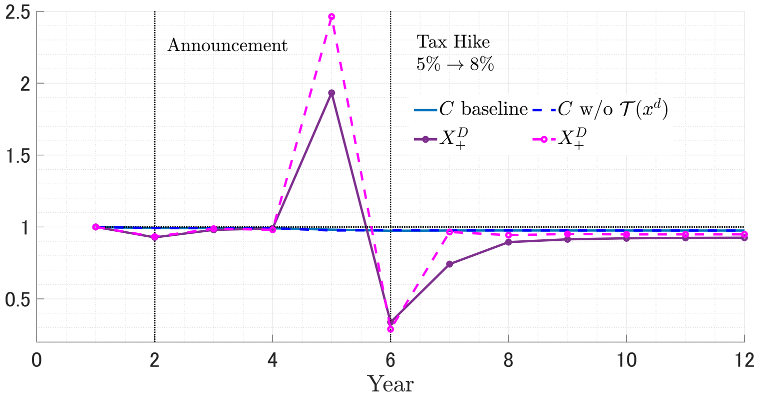
Life-cycle Profiles

Average Life-cycle (10,000 HHs per cohort ×55 cohorts)



Cobb-Douglas wealth dist

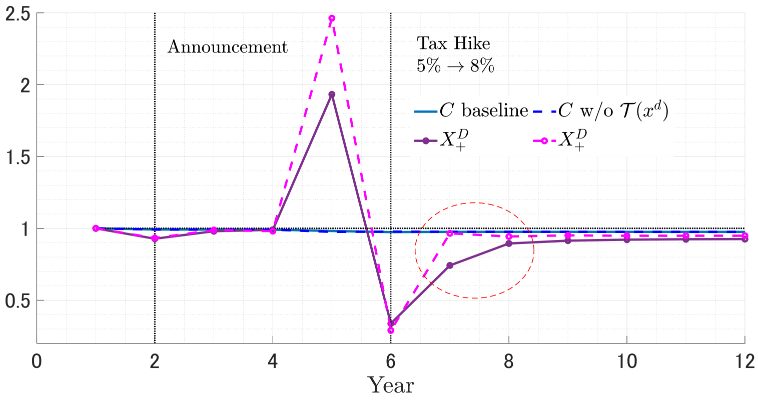
Roles of Tax Wedge: Comparison in IRF



- $X_+^D(t)/X_+^D(1)$ and $C(t)/C(1)$ are shown
- A model without the tax wedge $\mathcal{T}(x^d)$: $q = (1 + \tau^c)$

sensitivity:δ^d

Roles of Tax Wedge: Comparison in IRF

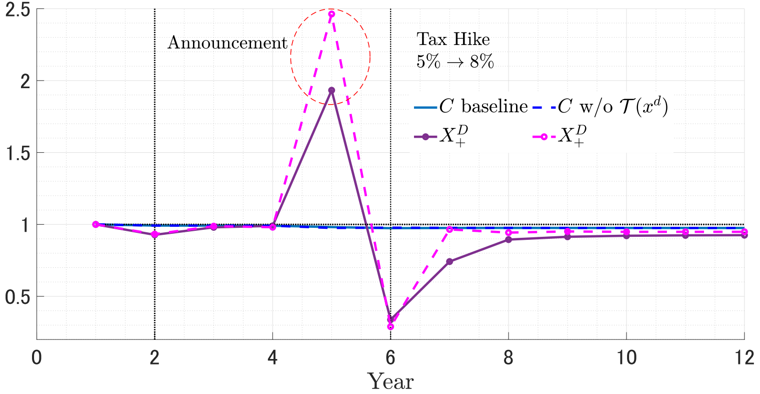


- After $\tau^c \uparrow$: ***slow*** convergence

consistent to BJK.

Sensitivity: other Inv't frictions, **un**anticipated $\tau^c \uparrow$.

Roles of Tax Wedge: Comparison in IRF



The model w/o tax wedge predicts X_+^D overly

Why a Model w/o Tax Wedge Predicts X_+^D Overly?

- Budget in a model w/o tax wedge (i.e. assuming $q = 1 + \tau^c$)

  $$(1+\tau^c)(c + x^d) + a = (1+r)a_{-1} + y_j + b$$

- Why? ⇒A chance of (unrealistic) revenue **over the dynamics**
  - Example:
    - **Buy** the durables before the tax hike $(t = 5)$ $1 + \tau^c = 1.05$,

      $$1.05[c + \underbrace{x^d}_{>0}] + a = (1+r)a_{-1} + y_j + b$$

    - **Sell** them in tax hike $(t = 6)$ $1 + \tau^c = 1.08$,

      $$1.08c + a = (1+r)a_{-1} + y_j + b \underbrace{-1.08x^d}_{>0 \because x^d < 0}$$

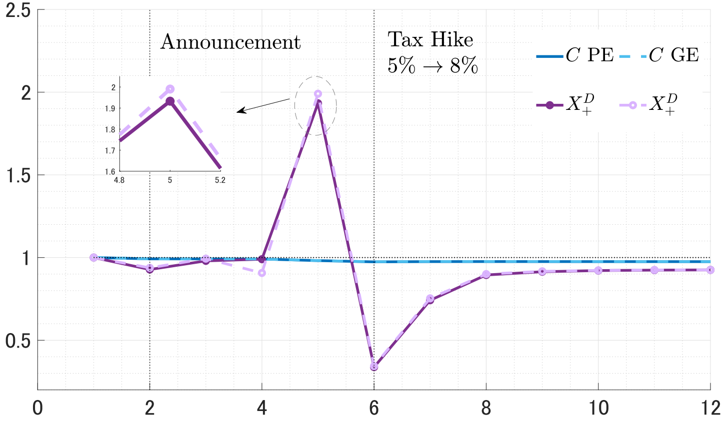
    - **Revenue** of stockpiling: $8 - 5 = 3\%$
    - Costs of stockpiling: δ^d and utility fluctuation

⇒ As *tax hike is larger scale* or δ^d *is sufficiently lower*, this **misspecification** problem becomes more critical. large tax hike bias in estimation

General Equilibrium :

How is it different from ***Partial Equilibrium*** *?*

PE & GE



- very **similar** : GE ≈ PE

Why so similar?

Koby and Wolf (2020): "interest rate elasticity is sufficient statistics for whether GE ≈ PE"

$$u'(c) \geq \beta \frac{1+\tau^c}{1+(\tau^c)'}(1+r')u'(c)$$

Tax elasticity ≈ Interest rate elasticity (c.f. Correia at al. 2008)

- **Puzzle**: Standard (S,s) models generate too high elasticity
  - Literature: Koby & Wolf ('20), McKay & Wieland ('19), Winberry ('20)
- My Model: *Low* **interest rate elasticity**
  (1) **Life-cycle**: mass of HHs who're less responsive
    - The young buy the durables, regardless of r.
    - The old do not buy the durables, regardless of r.

  (2) **Two assets**: (c.f. Berger and Vavra 2015, Bachmann and Ma 2013)
    - Khan and Thomas (2008): HHs smooths $C \Rightarrow$ smooth I.

  (3) **High depreciation rate δ^d** (c.f. House 2014)

Elasticity

Table: Interest Rate Elasticity of Durable: (from Mckay & Wieland '19)

Data	
Baker et al. ('19)	1.1
Mian and Sufi ('12)	4.3 – 5.0
Models	
Infinitely Lived + Fixed cost (Mckay & Wieland '19)	47.7
My baseline	4.1

Primary Appendix:

消費税制度 (English ver follows next page)

No.6105　課税の対象

[令和2年4月1日現在法令等]

消費税の課税対象は、国内において事業者が事業として対価を得て行う資産の譲渡等及び外国貨物の引取り（輸入取引）です(注)。

1　国内において事業者が事業として対価を得て行う資産の譲渡等

(1)　事業者が事業として行う取引

「事業者」とは、個人事業者(事業を行う個人)と法人をいいます。

「事業として」とは、対価を得て行われる資産の譲渡等を繰り返し、継続、かつ、独立して行うことをいいます。

したがって、個人の中古車販売業者が行う中古車の売買は事業として行う売買になりますが、給与所得者がたまたま自分の自家用車を手放す行為などは、事業として行う売買とはなりません。

なお、法人は事業を行う目的をもって設立されたものですから、その活動はすべて事業となります。

https://www.nta.go.jp/taxes/shiraberu/taxanswer/shohi/6105.htm back:RQ

Consumption Tax System: Japan

Consumption Tax

No.1 Taxable Sales

Consumption tax is levied on “Taxable Sales”. “Taxable sales” mean sales that satisfy all of the following four conditions.

(1) Effectuated in Japan

(2) Effectuated by a business for its business purposes

(3) Effectuated for a compensation

(4) Effectuated by the transfer or lease of assets or by the provision of services

(Referred to as “transfer of assets etc.”)

For example, machinery rental fees and proceeds from the sale of machinery, buildings and other business assets are included in taxable sales in addition to such things as proceeds from sales of products, contract work and services.

https://www.nta.go.jp/english/taxes/consumption_tax/01.htm back:RQ

VAT: UK

How VAT works

You can only charge VAT if your business is registered for VAT.

VAT is charged on things like:

- business sales - for example when you sell goods and services
- hiring or loaning goods to someone
- selling business assets
- commission
- items sold to staff - for example canteen meals
- business goods used for personal reasons
- ‘non-sales’ like bartering, part-exchange and gifts

Background: Japan's case

Why Japan?

- Japan's case in 2014 (5% → 8%) was relatively good environment:
  - A **single flat** rate
    - No **reduced** tax, unlike EU countries
  - **Full pass-through**: Gov't forced it

    in 1997 and 2014 but not in 2019. *See next page*
- The huge government debt necessitates large scale fiscal reform in Japan.

Back:roadmap, Back:VFs, Back:parameter

Detail on Full Pass-Through

- Gov't was mainly concerned about unfair pass-through *between firms* with unequal negotiation power.
- Ministry of Finance, FTC, Consumers Affairs Agency published an official guideline in cooperation to **prohibit non-full pass-through**.
  - Firms are **not** allowed to discount their product **because of the tax hike**.
    - × "Discount by the tax increase"
    - × "A special sale for tax hike"
    - ◯ "Seasonal sale"
    - ◯ "Clearance sale"
- Price-setting behavior is affected in other countries (e.g. Karadi and Reiff 2018)

`https://www.mof.go.jp/tax_policy/summary/consumption/250910tenka.htm` in Japanese (plz use translation in the browser)

back

Literature

- **Consumption Tax** including **Unconventional Fiscal Policy**
  - Theory
    Nishiyama and Smetters (2005), Correia (2010), Correia et al. (2013), Baker et al. (forthcoming), Parodi (2019a, 2019b), etc
  - Empirics
    Cashin and Unayama (2016a,b), Cashin (2017), D'Acunto, Hoang and Weber(2016,2018), Baker et al. (2019), etc

$\Rightarrow$ Incorporate **durables &tax wedge** into GE to study **anticipated VAT changes**

- **Lumpy Durables** or **Life-cycle Durables**
  - Lumpy Durables
    Lam (1989, 1991), Berger and Vavra (2014,2015), Guerrieri and Lorenzoni (2017), McKay and Wieland (2020), Zorzi (2020), etc
  - Life-cycle Durables
    Attanasio (1999), Fernández-Villaverde and Krueger (2007, 2011), etc

$\Rightarrow$ **Life-cycle** and **tax wedge** are key components to match the elasticity back

Choice-Specific Value Functions

$$v_j^{up}(a_{-1}, d_{-1}, e) = \max_{c,a \geq 0, x^d \geq 0} u(c, d) + \beta \mathbb{E}[v_{j+1}(a, d, e')|e]$$

$$\text{s.t. } (1+\tau^c)[c + x^d] + a = (1+r)a_{-1} + y_j(e) + b$$

$$x^d = d - (1-\delta^d)d_{-1}$$

$$v_j^{down}(a_{-1}, d_{-1}, e) = \max_{c,a \geq 0, x^d < 0} u(c, d) + \beta \mathbb{E}[v_{j+1}(a, d, e')|e]$$

$$\text{s.t. } (1+\tau^c)c + q x^d + a = (1+r)a_{-1} + y_j(e) + b$$

$$x^d = d - (1-\delta^d)d_{-1}$$

Back:VFs

Equilibrium: Market Clearing and Dealers

Factors and goods markets clear

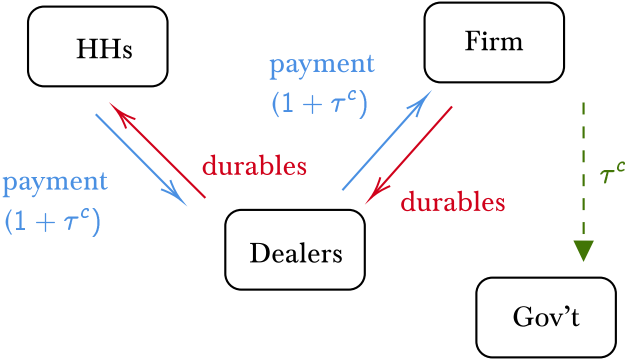
$$\text{(i)}\ K = \sum_{j=0}^{J} \int a d\mu_j, \quad \text{(ii)}\ N = \sum_{j=0}^{J^R-1} \int \kappa_j e d\mu_j$$

$$\text{(iii)}\ C + X^D + G + K' = K^\alpha N^{1-\alpha} + (1-\delta)K.$$

where $X^D \equiv X_+^D + qX_-^D$.

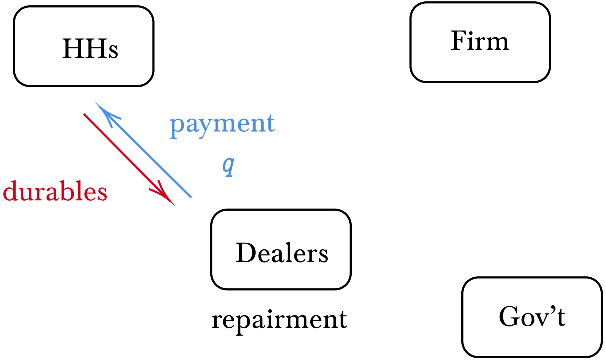
Back:Model

Flow Chart: Buying New Durables



Back:Model

Flow Chart: Selling Durables



Back:Model

Non-Homothetic Utility

Problem: Standard homothetic utility functions do not generate hump shape in x^d profile.
$\Rightarrow$**Stone Geary**:

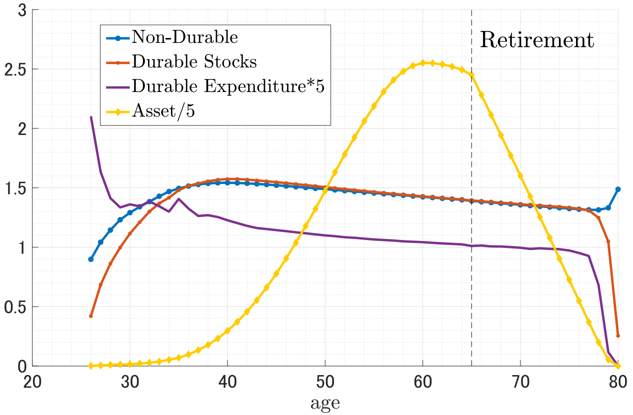
$$u(c,d) = \frac{\left(c^{\theta}(d+\epsilon^{d})^{1-\theta}\right)^{1-\sigma}}{1-\sigma}$$

With $\epsilon^d > 0$, d is luxury$\Rightarrow$ *The rich buy more durables*

- Helps generate hump-shaped x^d profile
  - because the middle-age are rich in both asset and earnings

Calibration: θ and ϵ^d are calibrated matching (i) X^D/C share and (ii) peak and initial x^d profile ratio. back

Life-cycle Profiles: Cobb-Douglas Case



- Roughly, durable expenditure is decreasing in age
- Share btw c&d are constant once borrowing const becomes slack.
- some durable stocks at the end of life

Back:profile

Wealth Distributions: Untargeted

Table: Wealth Share owned by each quintile

	1st	2nd	3rd	4th	5th	top10%	top1%
Data	0.3%	3.7%	9.8%	21.3%	64.9%	45%	10.2%
Baseline	0.1%	2.4%	12.6%	27.3%	57.6%	35.8%	5.7%

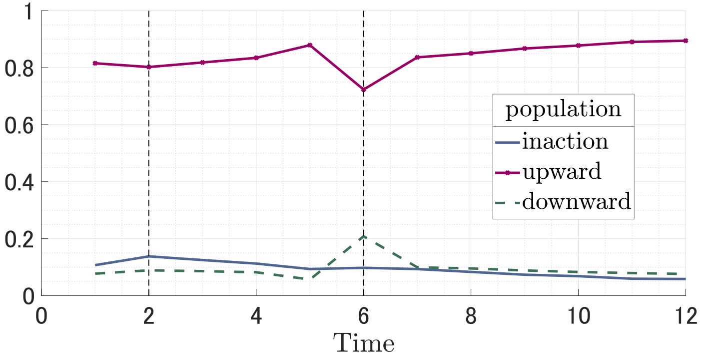
Data: National Survey of Family Income and Expenditure in 2014 by Kitao and Yamada (2019)

Why is asset distribution important here?

- HHs cannot afford stockpiling of durables w/o assets.
- Heterogeneous welfare costs depend on assets.

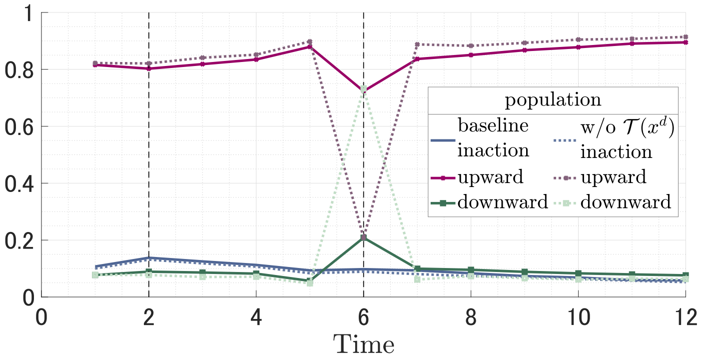
Back:profile

Baseline Results: Extensive Margin

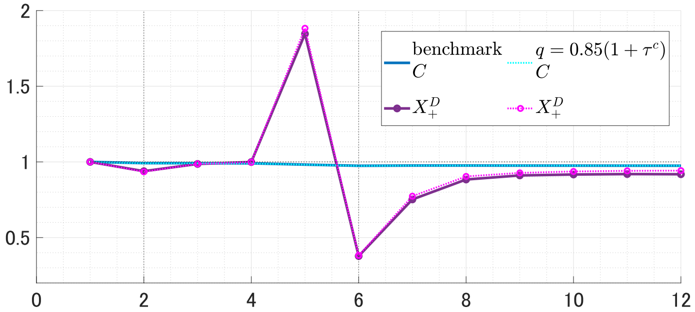


- Extensive margin does not change much

Baseline Results: Extensive Margin



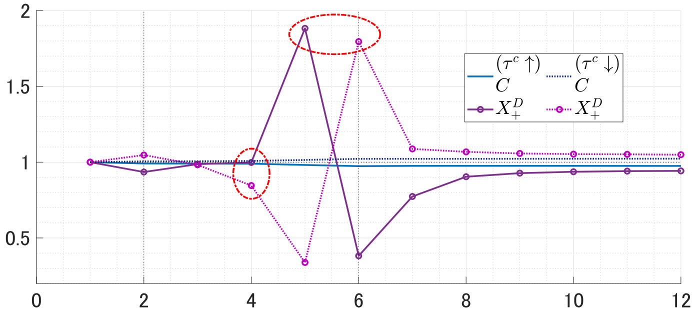
Tax Wedge & Partial Irreversibility



$$\mathcal{T}(x^d) = \begin{cases} (1+\tau^c)x^d & \text{if } x^d \geq 0 \\ 0.85(1+\tau^c)x^d & \text{if } x^d < 0, \end{cases}$$

Benchmark (Tax Wedge) $\approx$ Traditional partial irreversibility.

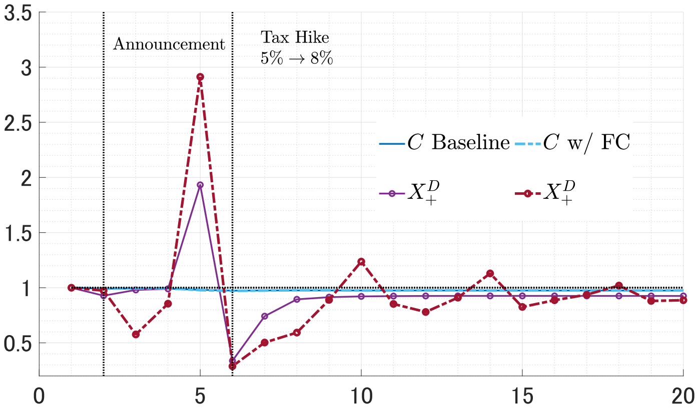
Partial Irreversibility: Asymmetricity Result



$$\mathcal{T}(x^d) = \begin{cases} (1+\tau^c)x^d & \text{if } x^d \geq 0 \\ 0.85(1+\tau^c)x^d & \text{if } x^d < 0, \end{cases}$$

Asymmetric Result arises in the (traditional) partial irreversibility.

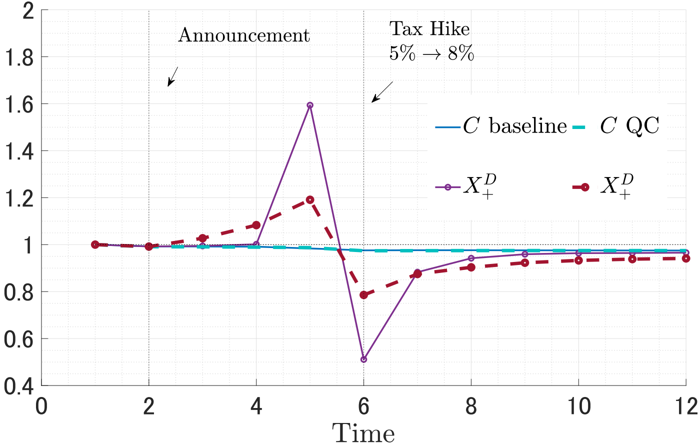
Other Costs: Fixed Cost



Fixed costs: $F(d, d_{-1}) = \mathbb{I}_{x^d \neq 0} F^d (1 - \delta^d) d_{-1}$

- bigger spike
- negative persistence ⇒ overshooting in period 10, 14, 18.

Other Costs: Quadratic Adjustment Cost



Quadratic Adjustment Costs: $QC(d, d_{-1}) = \frac{F^{qc}}{2}[d - (1 - \delta^d)d_{-1}]^2$ Back:IRF

- smaller spike
- slow adjustment before $\tau^c \uparrow$

IES estimation: Cashin and Unayama (2016)

Empirics: Cashin and Unayama (2016 REStat) and Cashin (2018)

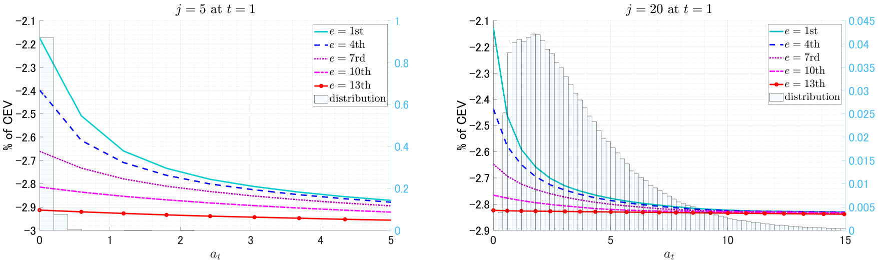
- Both estimated IES with Rep. HH model of durables and VAT **w/o tax wedge**.
- **Their result**: $IES(= 1/\sigma) = 0.21$

My Result: overshoot in a model w/o tax wedge .

- To compromise with observed *small* stockpiling behavior, they must have low IES.
- $\Rightarrow$ *their estimation result underestimates the IES.*

Back:overly prediction

Welfare (CEV) over dynamics

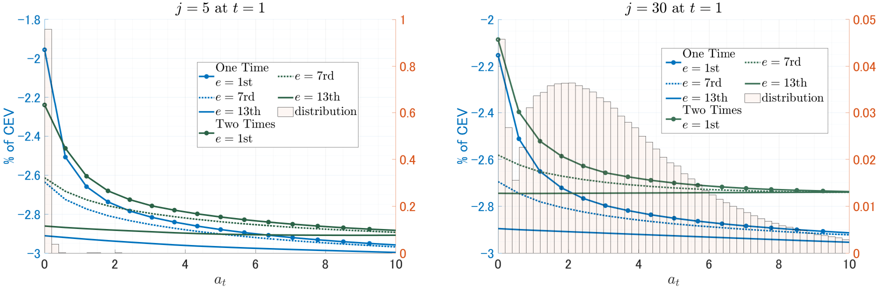


Tax-induced inflation ⇒ ↓ real value of (i) Asset (ii) Durable (iii) Labor Earning

⇒ **Progressive**

back

Welfare Comparison: once or 2 times



- Two-times-hikes scheme **mostly welfare dominates** one-time-hike scheme
  - **exception**: young poor both in asset and earnings

back

Solution Method:
Nested EGM

Two Main Difficulties:

1. **Multi-dimensions**: asset, non-durable and durable.
2. **Discrete choices**: non-concave value function
   - non-differentiable regions ⇒ derivative based method ✗
   - extremely smoothing interpolation ✗
   - possibly many local maxima (c.f. Iskhakov et al. (2017))

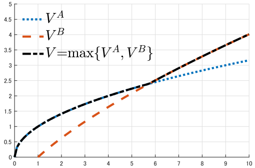


Figure: An image of 1D value function w/ discrete choice

Byproduct: Numerical Solution

Two Main difficulties :

1. **Multi-dimension**: durable, non-durable and asset
2. **Discrete choice**: non-concave value function
    - non-differentiable regions ⇒ derivative based method ✗
    - extremely smoothing interpolation ✗(c.f. Chebyshev)
    - possibly many local maxima (c.f. Iskhakov et al. (2017))

Nested EGM (Druedahl 2019) solves this class of models fast.

1. **Nesting the timing**: Converting the multidimensional problem to *unidimensional*.
2. **Upper Envelope Algorithm**: to identify the global maximum

NEGM

Advantage of NEGM: How fast?

Table 1: Speed and Accuracy

	VFI	NVFI	NEGM	NVFI+	NEGM+
			relative Euler errors		
All (average)	−4.245	−4.173	−4.268	−4.173	−4.268
5th percentile	−5.811	−5.691	−5.908	−5.691	−5.908
95th percentile	−2.689	−2.708	−2.715	−2.708	−2.715
Adjusters (average)	−4.232	−4.352	−4.502	−4.352	−4.502
Keepers (average)	−4.247	−4.140	−4.225	−4.140	−4.225
			timings (in minutes, best of 5)		
Total	63.54	5.96	4.12	4.71	1.45
Post-decision functions	0.00	1.75	3.53	0.49	0.82
Keeper problem	62.26	4.19	0.57	4.20	0.61
Adjuster problem	1.28	0.02	0.02	0.02	0.02
Speed-up relative to VFI		10.66	15.42	13.49	43.85

Druedahl (2019) uses Berger and Vavra (2015) as a benchmark model:

- NEGM is **15 times faster** than traditional VFI.
- Speed gain is mostly from **nesting** (but not EGM).
- As accurate as VFI

Nesting: Overview of Algorithm

- Beginning: HH know states.
- **1st decision**: Solve inaction problem first, and get $c^{inact}(m, d, e)$ using **EGM** with **Upper Envelope Algorithm** to find *global optim*.
- **2nd decision**: HH solves optimal adjusting ($i \in \{\text{up}, \text{down}\}$) problem

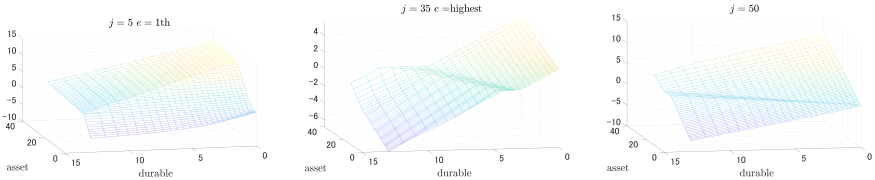
$$v_j^i(\cdot) = \max_{d} \; u(c, d) + \beta \mathbb{E} v_{j+1}(\cdot)$$
$$\text{s.t. } (1 + \tau^c)c + Q^i d + a = m^i$$
$$c = c^{inact}(m^i - Q^i d, d, e)$$
$$x^d \lesseqgtr 0, \qquad a \geq 0$$

where m^i is choice-specific COH, $Q^i \in \{(1 + \tau^c), q\}$.

Both 1st and 2nd problem is **unidimensional**. $\Rightarrow$ unidimensional techniques (interpolation, optimization, etc.). $\Rightarrow$ curse of dim $\downarrow$.

Further Extra Appendix:

Age-dependence in Policy Functions



Some Caveats

- In life-cycle model, almost everywhere can be thresholds of (S,s) over (a_{-1}, d_{-1}).

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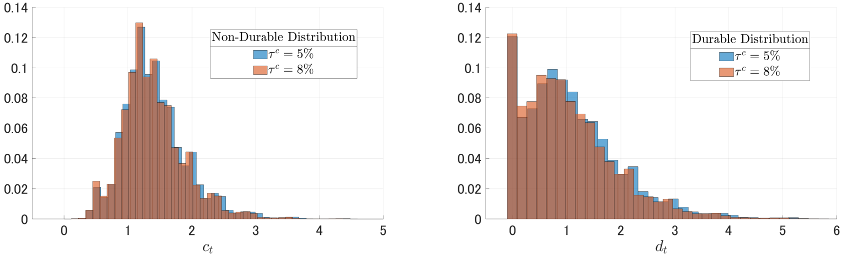
Cross-Sectional Effect: Stationary Eq



- **Non-Durable**: Left skewed for all
- **Durable**: Left skewed and higher concentration around center.

Elasticity: Yearly ⇔ Monthly

Issue: Model is annual but Baker et al. (forthcoming) is monthly.

1. Solve the perfect foresight with $\tau^c \uparrow$ by 12%
2. Get a sequence of $\{X_+^D(t)\}_{t=1}^T$ where $X_+^D(1)$ is stationary eq value.
3. Compute elasticity $\epsilon^D|_{12\%}$:

$$\epsilon^D|_{12\%} = \log X_+^D(t) - \log X_+^D(1)$$

4. This is elasticity when tax change is by 12%. Thus, divide by 12:

$$\epsilon^D|_{1\%} = \frac{\epsilon^D|_{12\%}}{12}$$

5. I report this $\epsilon^D|_{1\%}$

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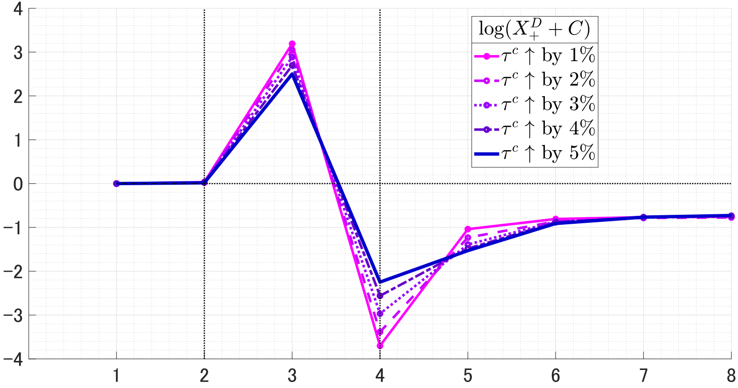
Tax Elasticity with Different $\tau^c \uparrow$

The model-implied Tax Elasticity with different $\tau^c \uparrow$



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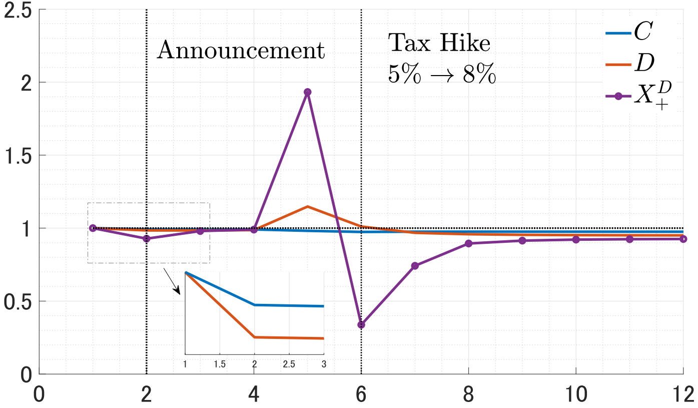
Baseline Results: 5% → 8%



- $X_+^D(t)/X_+^D(1)$ and $C(t)/C(1)$ are shown

Negative income effect in announcement.

Welfare Computation: CEV

Consumption Equivalent Variation: ω

- Economy A: tax hike
- Economy B: no policy change (i.e. stay stationary eq)

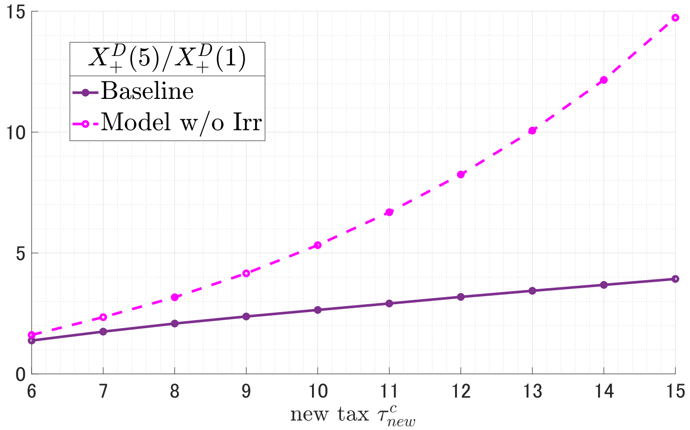
$$\int \mathbb{E}_t \tilde{v}(\{(1+\omega)c^A, d^A\}_{j\geq t}^J)\mathrm{d}\mu = \int \mathbb{E}_t \tilde{v}(\{c^B, d^B\}_{j\geq t}^J)\mathrm{d}\mu$$

$$\text{where} \quad \tilde{v}(\{c,d\}_{j\geq t}^J) = \sum_{j\geq t}^{J} \beta^j u(c,d)$$

- The premium ω can be thought of as *the percent of life-time non-durables* HHs in economy A lose in welfare term due to the tax hike.
- Computing ω

$$\omega(j, a_{-1}, d_{-1}, e) = \left(\frac{v_j^B(a_{-1}, d_{-1}, e)}{v_j^A(a_{-1}, d_{-1}, e)}\right)^{\frac{1-\sigma}{\theta}}$$

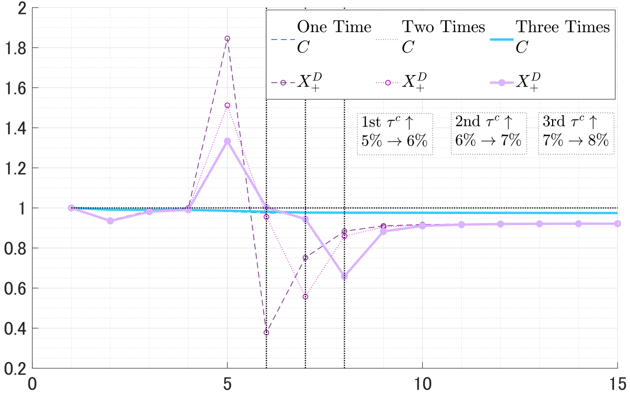
How Stockpiling differ with different new tax?



Misspecification becomes critical as tax differential $\tau^c_{\text{new}} - \tau^c_{\text{old}}$ increases

(Note 10 in y-axis means 10 times more $X_+^D(5)$ than $X_+^D(1)$, but not $10\% \uparrow$)

Consecutive Multiple Tax Hikes: Three Times



- Weaker intertemporal shifting.
- Put off the plummet

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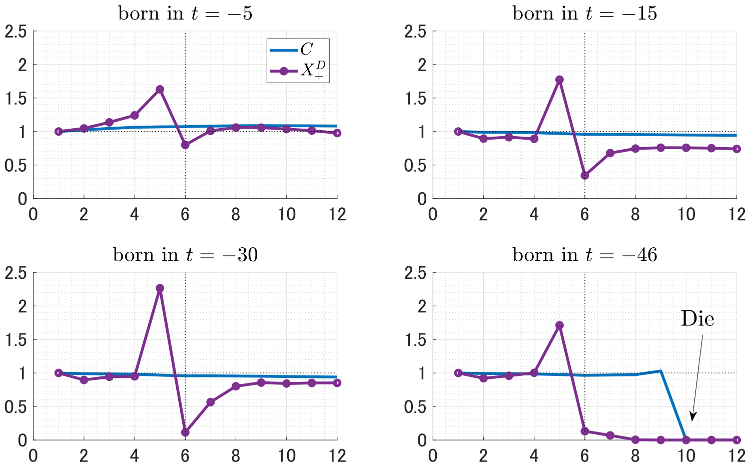
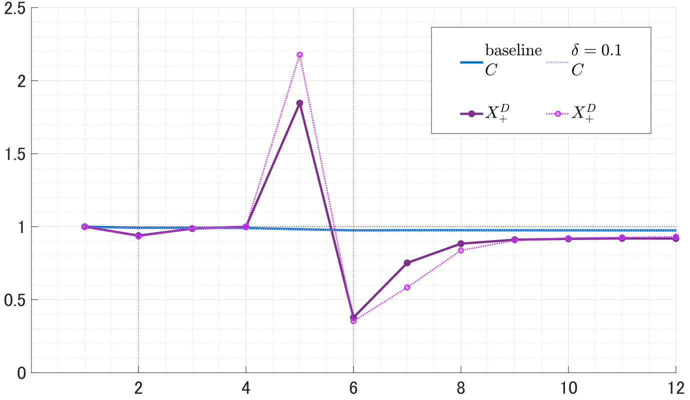
Age-Dependent Stockpilings



Choice of δ^d:

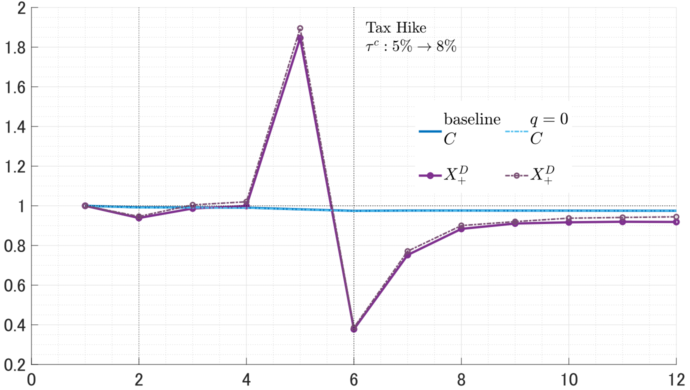
baseline $\delta^d = 0.15$



Both are baseline models (w/ tax wedge). back

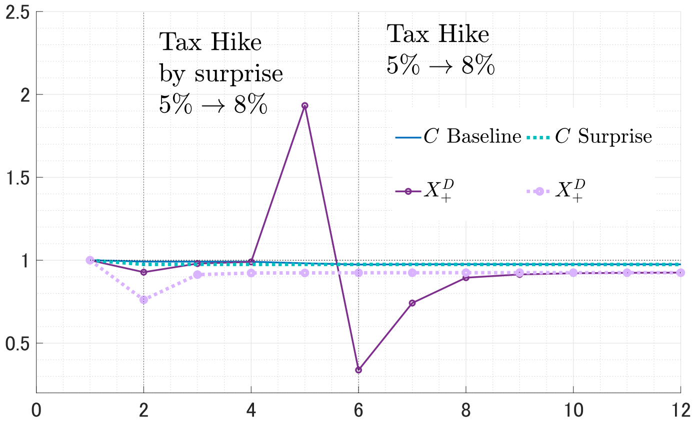
Choice of q

baseline $q = 1$



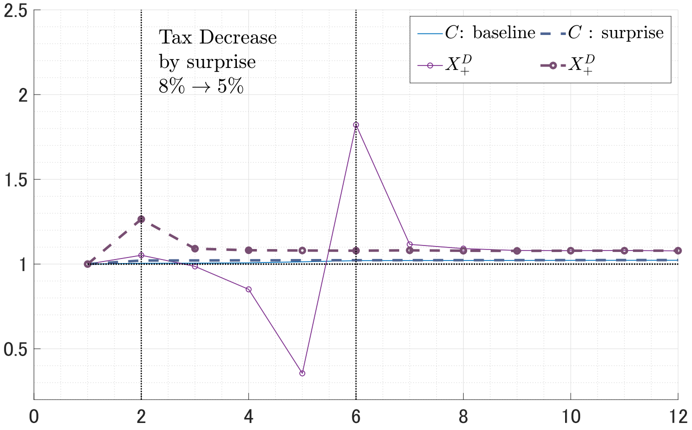
Choice of value of q does not change the quantitative result almost at all back

No Announcement: Tax Hike



Negative Income Effect only when $\tau^c \uparrow$ is surprise

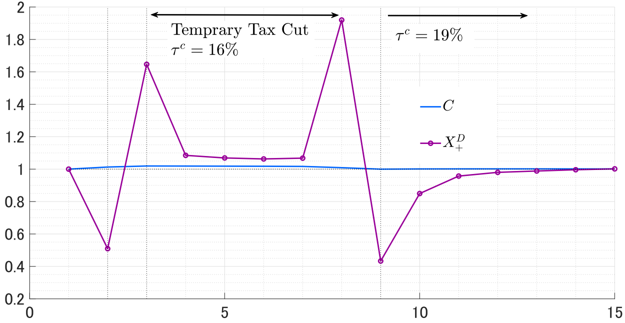
No Announcement: Tax Decrease



Almost symmetric to tax hike by surprise. (see previous page)

Temporary Tax Cut: Germany

$19\% \rightarrow 16\%$ for a half year



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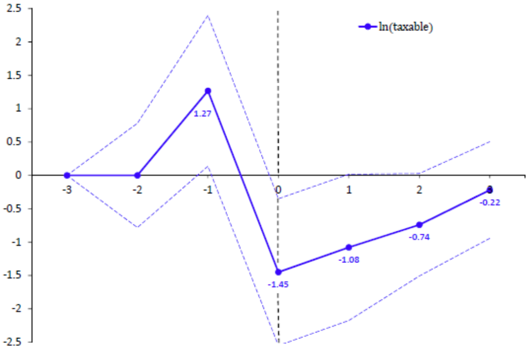
Some Complementary Data:

Empirical Tax Elasticity: BJK

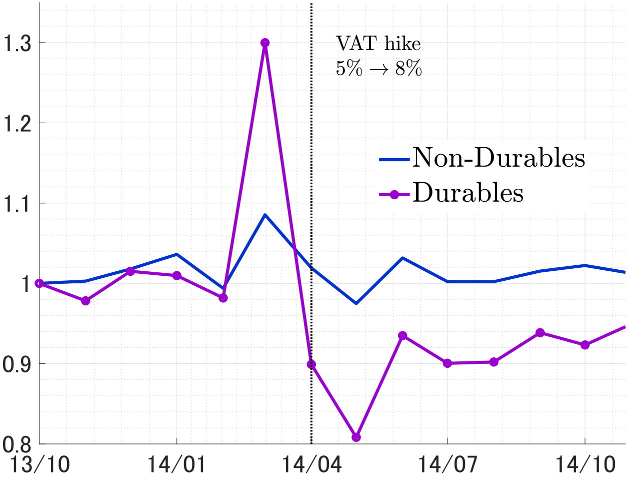
Key patterns

- before $\tau^c \uparrow$: sharp response
- after $\tau^c \uparrow$: *gradual* response



from **Baker Johnson Kueng** (forthcoming in AEJ Ma)
(also observed in Baker et al 2019; Mian & Sufi 2012) back Japan

Japan: VAT 5% → 8%



Seasonally Adjusted. Non-Durable and Durable Spendings

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Relative Price btw ND and D

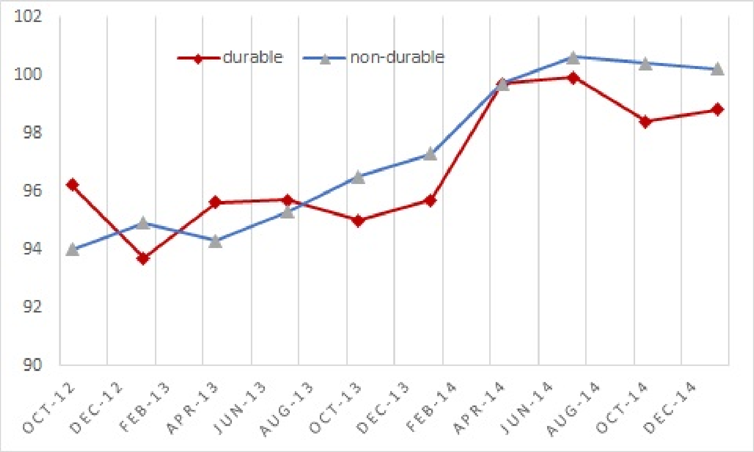

Figure: Consumer Price Indices for both Durable and Non-Durable Goods. Announcement is in October 2012 and Implementation is in April 2014.

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