Regional and Sectoral Varieties of VAT Pass Through in Japan[1]

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Abstract

This paper investigates the contemporaneous (short-run) and dynamic (long-run) responses of regional and sectoral price level change in consumption tax rate (VAT) hike (i.e. pass through of VAT) in Japanese monthly, 10 regional and 10 sectoral (commodity category) data. We show the effects not only contemporaneous but also pre-reform (from 12 month ago to one month) and post-reform (from one month ahead to 12 month) similar to Benedek et al.(2019). We obtain some remarkable results. First, aggregate pass through is incomplete, but case in 5% in 1997 and 8% in 2014 increase are complete (or overshifting) pass-through. Second, sectoral difference is large (e.g. the long-run pass through range from -0.25 to 1.42), while regional difference is small.

JEL classification: H20, H22, H23
Key Words: pass through of Value Added Tax (VAT), regional and sectoral price level.

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1. Introduction

Pass through to consumer prices is main topic in both policymakers (politicians and bureaucrats) and academic researchers. For example, the review in Bird and Gendon (2007), indirect tax changes are fully and exactly passed through to consumer prices. In addition, Japan Fair Trade Commission constructs and delegates the Act for Concerning Special Measure Correcting Prices Impeding Consumption Tax Pass-on to prevent some firms which have negotiation power making other firms remain their prices. On the other side, higher pass through which includes the price overshifting decreases the quantity and welfare (consumer surplus in partial equilibrium).

Economic theory of indirect taxation makes various cases of pass through on consumer prices. Case in incomplete pass through which elasticity of pass through is less than one can generate the standard partial equilibrium analysis of competitive market. That in price overshifting can generate under imperfect competition and/or with endogenous product quality[2]. In addition, sluggish price change may generate in anticipation of VAT change, and /or menu costs discussed by Kleven and Kreiner (2003). In fact, most of VAT change is not unanticipated policy change but anticipated by constructing law in advance.

This paper investigates the VAT (consumption tax) pass through in Japanese regional and sectoral data. We focus on not only the contemporaneous (short-run) effect, but also the total (long-run) which includes the pre- and post-VAT change (reform). We show the effects not only contemporaneous but also pre-reform (from 12 month ago to one month) and post-reform (from one month ahead to 12 month) similar to Benedek et al.(2019). We can predict the result theoretically as follows. If the Pre-reform impact is significant, this implies that anticipated effects work. If post-reform impact is significant, this implies that anticipated effects work. And if price overshifting causes, its goods market is imperfect competition.

Japanese government introduces a consumption tax, which was introduced at a rate of 3% consumption tax in 1989 instead of abolishing specified commodity taxes, such as cars and home electric appliances etc. In April 1997, it was increased to 5%[3]. In June 26, 2012, the lower house of the Japanese diet passed a bill to double the tax to 10%. The new bill increased the tax to 8% in April 2014 and 10% in October 2015. However, due to Japan's economic situation, the Abe government delayed the tax increase to 10% twice; initially until April 2017 and then October 2019.

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[2] See, for example, Stern (1987), Delipalla and Keen (1992), Weyl and Fabinger (2013), Häckner and Herzing (2016) and Adachi and Fabinger (2020).

[3] The 5% is made up of a 4% national consumption tax and a 1% local consumption tax.

We obtain some remarkable results. First, aggregate pass through is incomplete, but case in 5% in 1997 and 8% in 2014 increase are complete (or overshifting) pass-through. Second, sectoral difference is large (e.g. the long-run pass through range from -0.25 to 1.42), while regional difference is small (e.g. the long-run pass through range from 0.09 to 0.69).

There are some related literatures about our empirical research. Poterba (1996), Besley and Rosen (1999) and Benedek et al. (2019) estimate the reduced-form relationship between changes in consumer prices and in applicable VAT rates for the USA and Eurozone countries. Although this paper is closely related to Poterba (1996) and Besley and Rosen (1999) which focus on the sectoral (commodity) differences in each city, this paper also includes the estimation of regional differences. Carbonnier (2007,2008) estimate the effects of VAT changes in some commodities. Carbonnier (2007) focuses on housing repair services and new car sales, and Carbonnier (2008) on restaurant, coffee shops and selected services.

In another retail setting where price points may be important, Besanko, Dube and Gupta (2005) finds that 14% of wholesale price-promotions were passed on at more than 100% into retail prices. In fuels, where price increments are very small (often one cent) relative to tax changes, studies have found that gasoline and diesel taxes are fully passed through to consumers though prices may not fully adjust when supply is inelastic or inventories were high (Marion and Muehlegger(2011)) and that gas tax holidays are pass-though quickly but only partially to consumers (Doyle Jr. and Samphantharak(2008)). Harding, Leibtag and Lovenheim (2012) finds that cigarette taxes were less than fully passed through to consumers, while DeCicca, Kenkel and Liu (2013) cannot reject full pass through of cigarette taxes on average. Conlon and Rao (2020) examine the pass-through of recent increases in state excise taxes on distilled spirits considering about the discreteness of prices. Kosonen (2015), Harju, Kosonen and Skans (2018) and Benzarti et al.(2020) investigate the pass through on price of hairdressing service and some other commodities in Finland to VAT reform. Buettner and Medzharova (2020) studies the effects of consumption tax changes on prices and unit sales of durables utilizing micro-level product data and obtain the full pass through into prices.

Voigts (2016) explains the VAT pass through in a New Keynesian dynamic stochastic general equilibrium model with tax-excluded prices stickiness, which is well-used setting, such as Forni, Monteforte and Sessa.(2009), Correia et al.(2013) and Leeper, Traum and Walker. (2017). On the other hand, Karadi and Reiff (2019) constructs the model which presents a price-setting model with menu cost of tax-included price, trend-inflation and calibrate the VAT changes in Hungary.

As for the Japanese empirical research, Honma, Shigeno and Fukushige (1995), Kaneko and Puchit (2006), Yonezawa (2016) and Shiraishi (2019) estimate the pass through about VAT increase dummy in aggregate or some specific commodity categories. Shoji (2020) examines firms' price-setting behavior after Japan's consumption tax increase in 2014 using daily scanner data and find more than half of prices did not change on a tax-excluded basis after tax increase.

The remainder of the paper is organized as follows. Section 2 explains the empirical model and the dataset. Section 3 shows the results and their interpretations. Section 4 adds the robustness check and Section 5 concludes.

2. Empirical model and data

Following Poterba (1996), Besley and Rosen (1999), Benedek et al.(2019) and Buettner and Madzharova(2020), this paper estimates the reduced-form equation of monthly log change of the consumer prices $\Delta ln(CPI_{irt})$ on that of consumption tax rate $\Delta ln(1+\tau_{t+j})$:

$$\Delta ln(CPI_{irt}) = \sum_{j=-12}^{12} \gamma_j \Delta ln(1+\tau_{t+j}) + \alpha_{ir} + \rho \Delta ln(CPI_{irt-1}) + \varphi trend_t + \varepsilon_{irt}, \quad (1)$$

for consumption category *i* in region *r* and month *t*. The coefficient γ_j measures the impact on the consumer price of commodity (sector) i at time t of a change in month t+j in the VAT rate, with $j \in (-12,12)$. The first term of right-hand side of Eq.(1) shows that $\sum_{j=-12}^{-1} \gamma_j$ is coefficient of Pre-reform, γ_0 is contemporaneous, $\sum_{j=-1}^{12} \gamma_j$ is Post-reform and then $\sum_{j=-12}^{12} \gamma_j$ is total effect. α_{ir} is Fixed effects which we compare with two-type fixed effects (individual (9 sectoral and 9 regional variables) and interacted (99 dummy variables))). $trend_t$ is the trend and ε_{irt} is the disturbance term.

Before the section of the result, we confirm the prediction of the estimating parameters. If the Pre-reform impact is significant, this implies that anticipated effects work. If the Post-reform impact is significant, this implies that anticipated effects work. And if the price overshifting causes, its goods market is imperfect competition.

We use the Japanese Monthly Consumer Price Index (from 1970 to 2019, Seasonally adjusted) which includes 10 regions (i.e. Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, Kyushu and Okinawa (from 1975) and 10 sectors (i.e. consumption

categories) (Foods, Residence, Utility, Furniture, Clothing and Shoes (Clothing), Health and Medical (Medical), Education, Leisure, Miscellaneous)[4].

Table 1 shows the descriptive statistics of full-sample (10 regions and 10 commodities) consumer price index and consumption tax rate. Table 2 shows the descriptive statistics of (a) sectoral and (b) regional CPI. In addition, we check the stationarity of the CPI and most of them obtain the I(0) shown in Table 3 and 4[5]. To adjust the seasonality, we use the season trend decomposition. Figure 1 and 2 show the histograms of logarithm change in CPI with respect to sectoral (Figure 1) and regional (Figure2). As you can see in Table 2 and Figure 1 and 2, sectoral differences are larger than regional ones and the shapes of distribution are different in sectoral but quite similar in regional.

Table 1. Descriptive Statistics of Full-sample CPI and consumption tax rate.

	CPI	⊿log(CPI)	Tax Rate
Mean	88.7	0.002	0.031
Median	93.6	0	0.03
Maximum	169.6	0.333	0.1
Minimum	12.3	-0.181	0
Standard Deviation	25.7	0.015	0.028
Number of Observations	59,400	59,300	600

[4] This data is available from the Ministry of Internal Affairs and Communications (URL: https://www.stat.go.jp/data/cpi/historic.html#chihou (in Japanese)).

[5] Although CPI of furniture is I(1), we estimate the log difference of CPI data and then we support the stationarity of the estimation.

Table 2. Descriptive Statistics of $\Delta \log CPI$ in each sector or region

(a) Sectoral stats

	General	Food	Residence	Utility	Furniture	Clothing
Mean	0.002	0.002	0.002	0.004	0.000	0.002
Median	0.001	0.001	0.001	0.000	0.000	0.002
Maximum	0.046	0.076	0.066	0.239	0.085	0.171
Minimum	-0.017	-0.041	-0.034	-0.072	-0.028	-0.136
Standard Deviation	0.006	0.012	0.005	0.013	0.008	0.033
Num of Observations	5930	5930	5930	5930	5930	5930
	Medical	Transportation	Education	Leisure	Miscellaneous	
Mean	0.002	0.002	0.003	0.002	0.002	
Median	0.000	0.000	0.000	0.001	0.001	
Maximum	0.124	0.102	0.333	0.085	0.173	
Minimum	-0.123	-0.046	-0.181	-0.031	-0.101	
Standard Deviation	0.011	0.009	0.018	0.009	0.008	
Num of Observations	5930	5930	5930	5930	5930	

Table 2. Descriptive Statistics of $\Delta \log CPI$ in each sector or region (continued.)
(b) Regional stats

	Hokkaido	Tohoku	Kanto	Hokuriku	Chubu
Mean	0.001	0.001	0.001	0.001	0.001
Median	0.000	0.000	0.000	0.000	0.000
Maximum	0.173	0.190	0.203	0.168	0.196
Minimum	-0.169	-0.151	-0.095	-0.181	-0.116
Standard Deviation	0.016	0.014	0.013	0.014	0.014
Num of Observations	5,990	5,990	5,990	5,990	5,990
	Kinki	Chugoku	Shikoku	Kyushu	Okinawa
Mean	0.001	0.001	0.001	0.001	0.001
Median	0.000	0.000	0.000	0.000	0.000
Maximum	0.238	0.239	0.171	0.175	0.333
Minimum	-0.098	-0.149	-0.140	-0.109	-0.156
Standard Deviation	0.014	0.014	0.014	0.014	0.013
Num of Observations	5,990	5,990	5,990	5,990	5390

Table 3. Panel Unit root test of Full and Sectoral CPI

	Full		General		Food	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-44.61	0.00	-28.09	0.00	-18.05	0.00
Im, Pesaran and Shin	-26.54	0.00	-18.99	0.00	-10.60	0.00
ADF - Fisher Chi-square	1347.76	0.00	396.17	0.00	171.21	0.00
PP - Fisher Chi-square	1474.66	0.00	401.15	0.00	120.19	0.00
	Residence		Utility		Furniture	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-25.96	0.00	-5.57	0.00	-3.97	0.00
Im, Pesaran and Shin	-17.84	0.00	-7.63	0.00	-0.77	0.22
ADF - Fisher Chi-square	361.26	0.00	161.83	0.00	22.43	0.32
PP - Fisher Chi-square	564.74	0.00	152.00	0.00	23.57	0.26
	Clothing		Medical		Education	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-16.28	0.00	-12.61	0.00	-15.39	0.00
Im, Pesaran and Shin	-9.97	0.00	-6.49	0.00	-9.88	0.00
ADF - Fisher Chi-square	152.35	0.00	83.61	0.00	148.13	0.00
PP - Fisher Chi-square	60.76	0.00	91.54	0.00	162.57	0.00
	Transportation		Leisure		Miscellaneous	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-15.39	0.00	-17.49	0.00	-16.12	0.00
Im, Pesaran and Shin	-9.88	0.00	-10.69	0.00	-9.20	0.00
ADF - Fisher Chi-square	148.13	0.00	167.30	0.00	133.82	0.00
PP - Fisher Chi-square	162.57	0.00	184.42	0.00	153.03	0.00

(Note) CPI of furniture is I(1) to test the first differentiated panel unit root. ADF means the augmented Dickey-Fuller test and PP means the Phillips-Perron test.

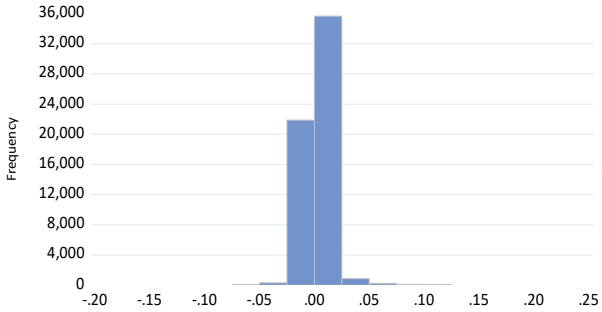
Table 4. Panel Unit root test of Full and Regional CPI

	Hokkaido		Tohoku		Kanto	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-13.88	0.00	-14.13	0.00	-14.31	0.00
Im, Pesaran and Shin	-7.38	0.00	-8.20	0.00	-9.01	0.00
ADF - Fisher Chi-square	116.63	0.00	128.52	0.00	144.47	0.00
PP - Fisher Chi-square	122.23	0.00	130.94	0.00	157.09	0.00
	Hokuriku		Chubu		Kinki	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-13.50	0.00	-14.86	0.00	-15.00	0.00
Im, Pesaran and Shin	-17.84	0.00	-8.81	0.00	-9.36	0.00
ADF - Fisher Chi-square	115.68	0.00	141.67	0.00	151.69	0.00
PP - Fisher Chi-square	111.20	0.00	147.05	0.00	149.21	0.00
	Chugoku		Shikoku		Kyushu	
	Statistics	p-value	Statistics	p-value	Statistics	p-value
Levin, Lin & Chu	-14.92	0.00	-16.29	0.00	-14.39	0.00
Im, Pesaran and Shin	-8.45	0.00	-9.36	0.00	-8.83	0.00
ADF - Fisher Chi-square	135.11	0.00	156.49	0.00	141.38	0.00
PP - Fisher Chi-square	153.96	0.00	176.81	0.00	149.82	0.00
	Okinawa					
	Statistics	p-value				
Levin, Lin & Chu	-11.21	0.00				
Im, Pesaran and Shin	-6.79	0.00				
ADF - Fisher Chi-square	116.12	0.00				
PP - Fisher Chi-square	176.32	0.00				

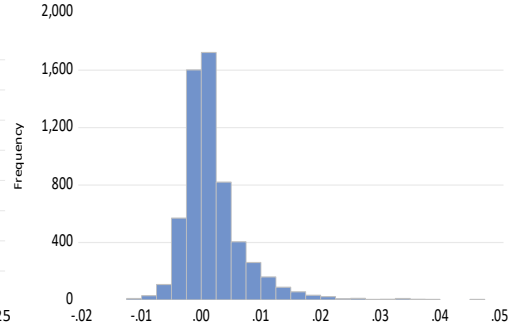
(Note) ADF means the augmented Dickey-Fuller test and PP means the Phillips-Perron test.

Figure 1. Histograms of Full-sample and sectoral ⊿logCPI

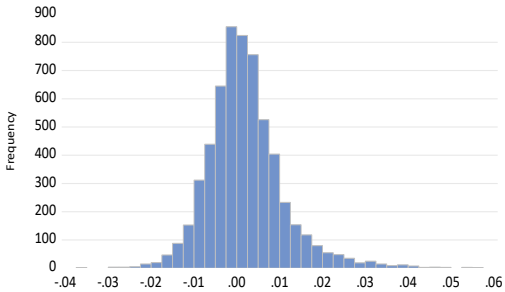
(a)Full Sample



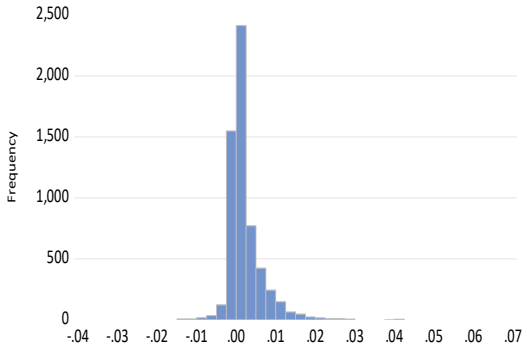
(b)General



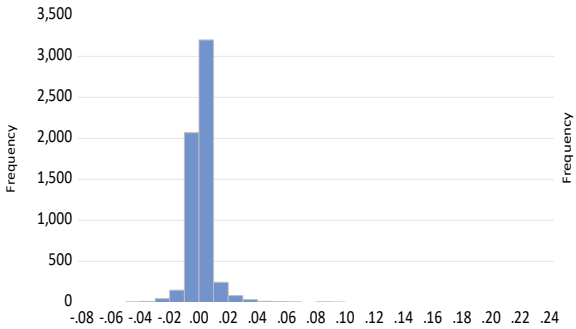
(c)Food



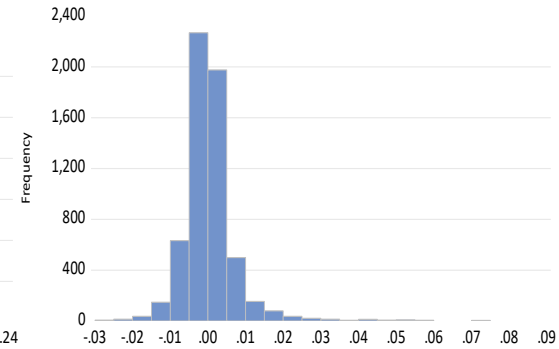
(d)Residence



(e)Utility



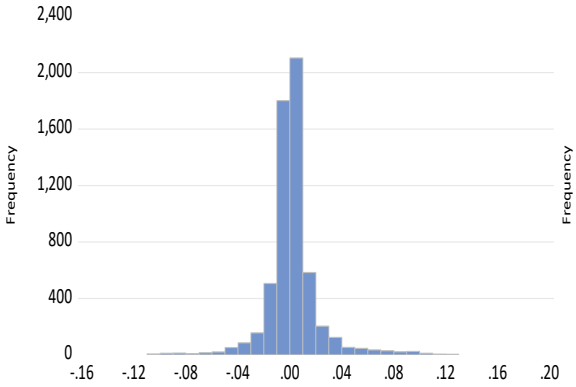
(f)Furniture



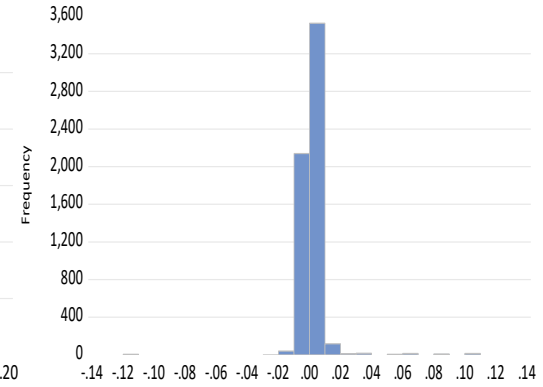
(Note) We use season trend decomposition

Figure 1. Histograms of Full-sample and sectoral ⊿logCPI (continues.)

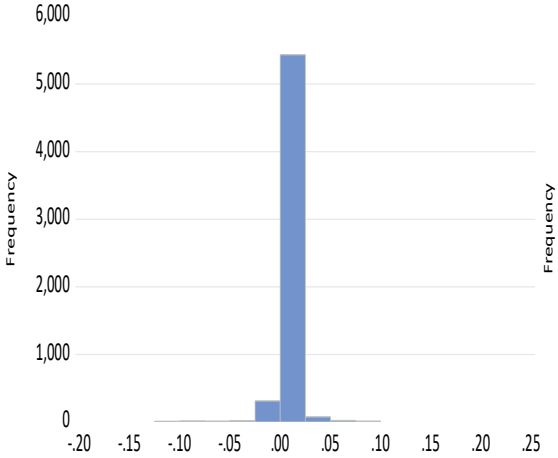
(f)Clothing



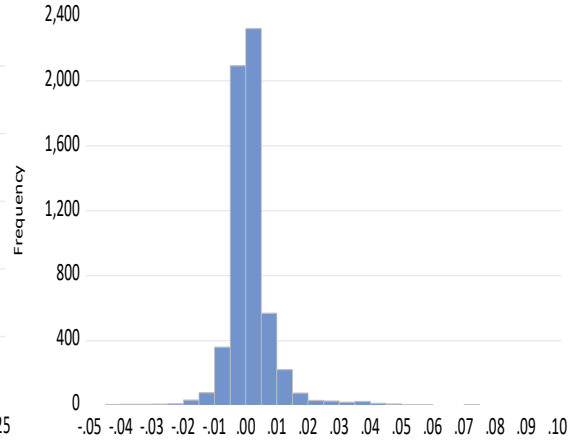
(g)Medical and Health



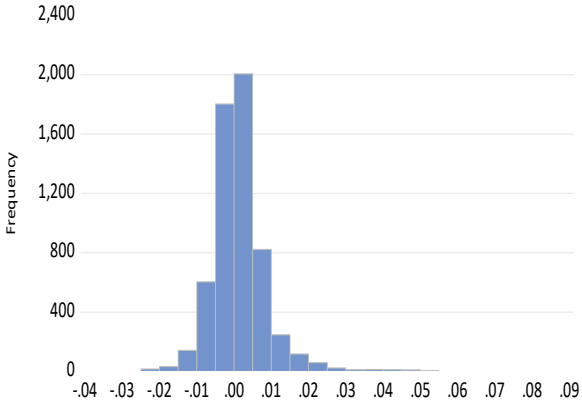
(h)Education



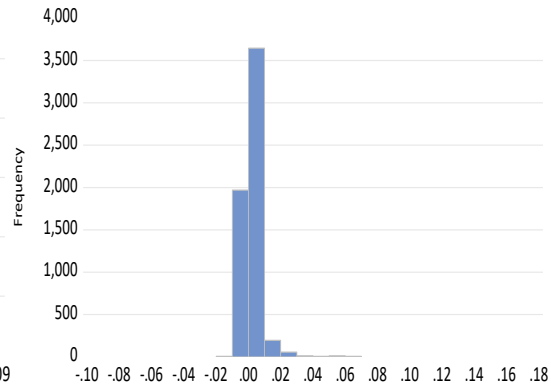
(i)Transportation



(j)Leisure



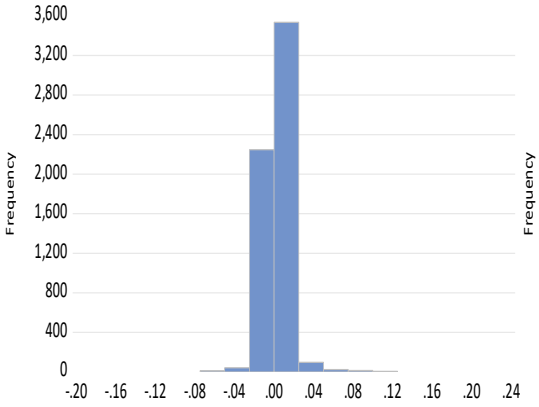
(k)Miscellaneous



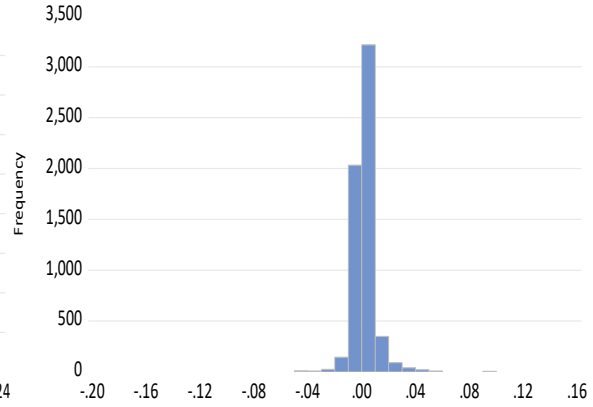
(Note) We use season trend decomposition

Figure 2. Histograms of Regional⊿logCPI

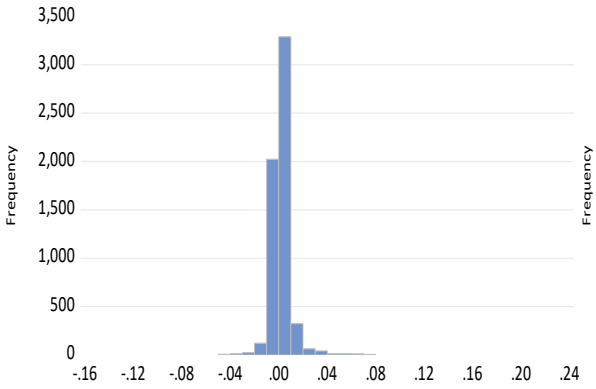
(a)Hokkaido



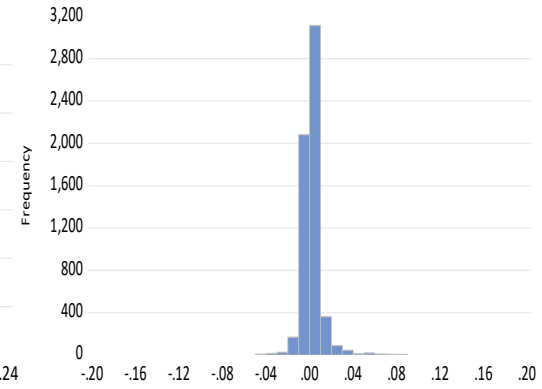
(b)Tohoku



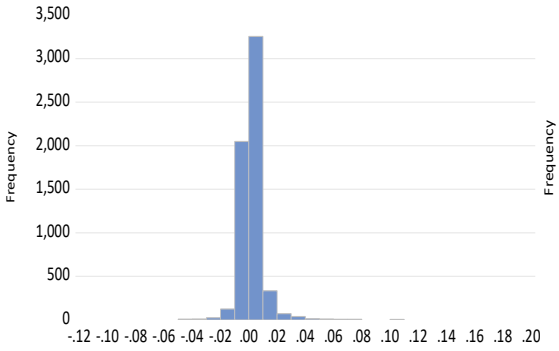
(c)Kanto



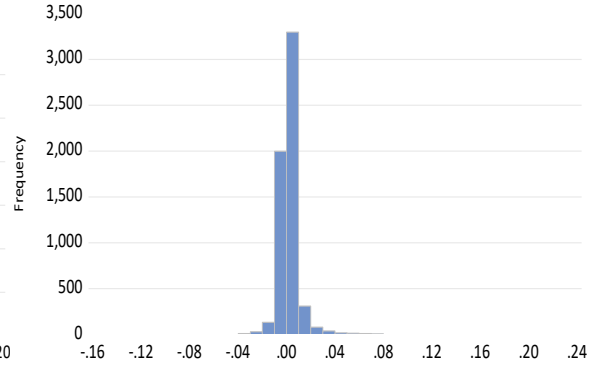
(d)Hokuriku



(e)Chubu



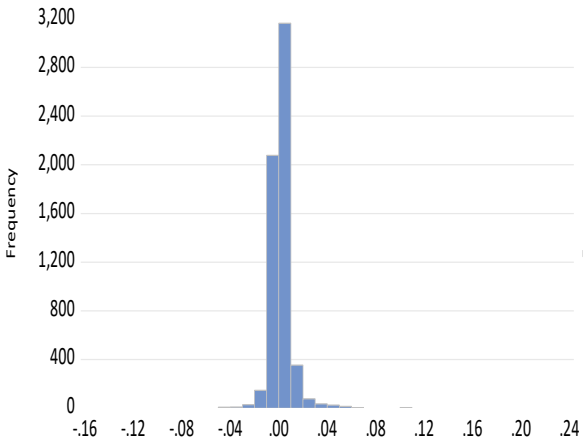
(f)Kinki



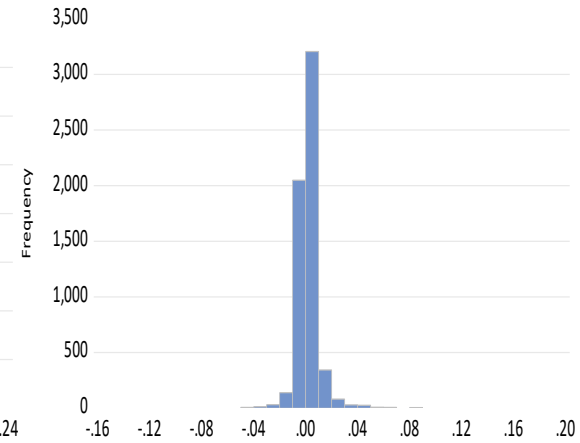
(Note) We use season trend decomposition

Figure 2. Histograms of Regional⊿logCPI (continues.)

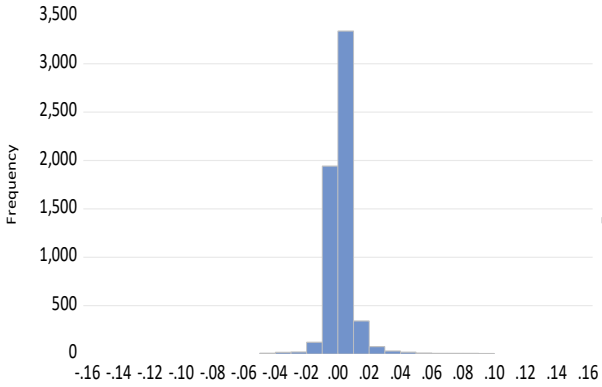
(g)Chugoku



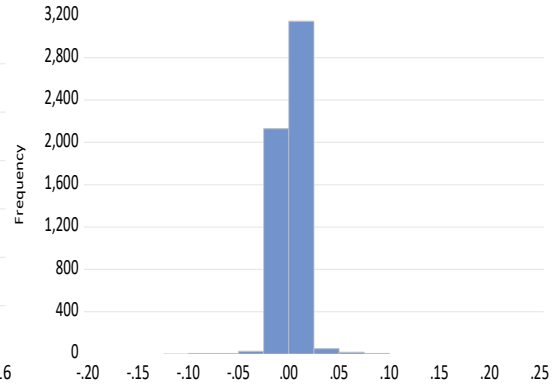
(h)Shikoku



(i)Kyushu



(j)Okinawa



(Note) We use season trend decomposition

3. Result

3.1. Average VAT change in Full-sample CPI

First, we estimate the cumulative price impact of consumption tax rate changes for three variants of the estimating Eq. (1) shown in Table 5. 'Pre-reform' refers to the sum of coefficients from 12 months to 1 month before the VAT rate change; the 'Contemporaneous' elasticity is the pass through in the month of the rate change; and 'Post-reform' refers to the sum of the coefficients from 1 to 12 months after the tax change. The cumulative effect for the entire 2-year window is shown in the fourth line. In column (1), estimation is without controls and fixed effects; column (2) adds region and sectoral (commodity category) fixed effects, but without interactions; column (3) adds the fully interacted fixed effects as in Eq. (1). We report also Wald tests for the null hypotheses of both zero pass through and full pass through.

The cumulative total pass through in column (1) is -44%, significant at 1%. Though the 'Contemporaneous' effect is positive (46%), Pre- and Post-reform are negative (-41% and -50%, respectively) and this is not intuitive result and interprets it as the result of the lack of fixed effects. On the other hand, the cumulative total pass through in column (2) and (3) is 50%, which most of them can explain the 'Contemporaneous' impact, and no significant impact on Pre- and Post-reforms.

Figure 3 shows the implied pattern of pass through in more detail, based on the regression in column (2) of Table 5. It shows the cumulative sums of the estimated coefficients at every month in the two-year window around reform. The monthly pass through estimates are typically low—being greatest, as one might expect, at the time of implementation. Figure 1 also shows the 95% confidence interval of the cumulative effect. Its growth over time reflects the increase in the standard error of the cumulative effect when starting measurement at 12 months before the reform.

Two aspects of these results stand out. First, similar to Benedek et al. (2019), the total pass through is statistically different from unity (and from zero) at 99% confidence. The null of full pass through—the standard presumption in policy work—is firmly rejected, with the point estimates implying that only around one-quarter of a VAT change is passed forward to consumer prices. Simply assuming full pass through of all VAT reforms is, it seems, a significant mistake. Second, only contemporaneous effects in the month of implementation matter: effects before or after the reform are negligible and insignificant.

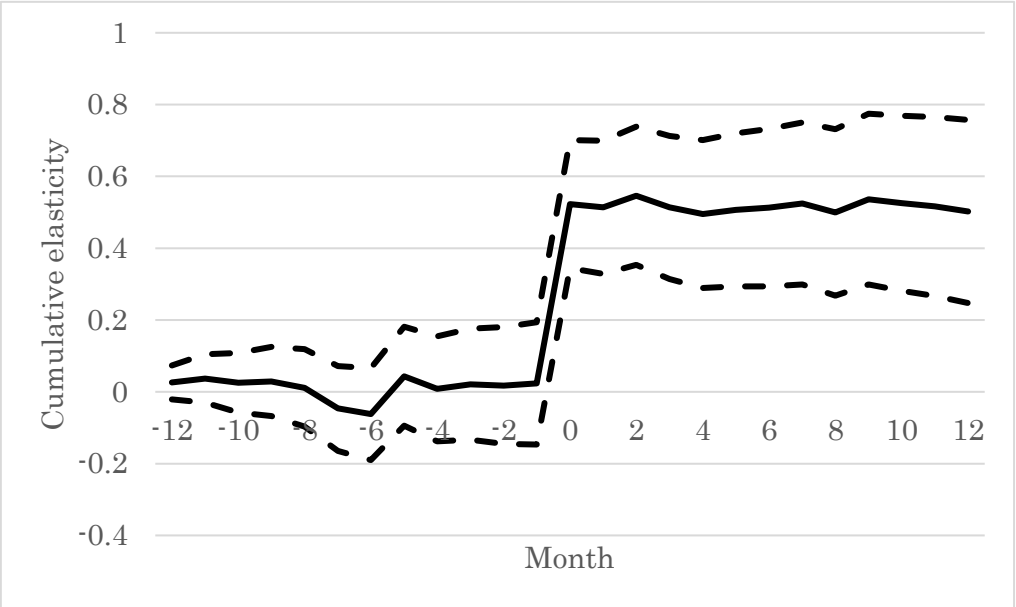
Table 5. Cumulative pass through for the Full-sample CPI.

	(1)	(2)	(3)
VAT pass through			
Pre-reform	-0.41***	0.02	0.02
	(0.08)	(0.09)	(0.09)
Contemporaneous	0.46***	0.50***	0.50***
	(0.02)	(0.02)	(0.02)
Post-reform	-0.50***	-0.02	-0.02
	(0.08)	(0.08)	(0.08)
Total	-0.44***	0.50***	0.50***
	(0.12)	(0.13)	(0.13)
Total=0(p value)	0.00	0.00	0.00
Total=1(p value)	0.00	0.00	0.00
Fixed Effect	Pool	Interacted	Individual
AR(1)&Trend	No	Yes	Yes
Observations	57,020	57,010	57,010
R-squared	0.007	0.06	0.05

(Note)Standard errors of the cumulative sums in parentheses[6].

[6] Similar to Benedek et al.(2019), this paper reports $\sum_{j=-12}^{-1}\gamma_j$ and SE($\sum_{j=-12}^{-1}\gamma_j$) for the Pre-Reform period impact; γ_0 and SE(γ_0) for the Contemporaneous impact; $\sum_{j=1}^{12}\gamma_j$ and SE($\sum_{j=1}^{12}\gamma_j$) for the Post-Reform period impact; and $\sum_{j=-12}^{12}\gamma_j$ and SE($\sum_{j=-12}^{12}\gamma_j$) for the Total period impact.

Figure 2. Average cumulative pass through in Full-sampling CPI (Case in Interacted fixed effect)



(Note) Broken lines are 95% confidence interval.

3.2.VAT change in sectoral CPI data

Next, we re-estimate the following equations in each sector (consumption category);

$$\Delta ln(CPI_{rt}) = \sum_{j=-12}^{12} \gamma_j \Delta ln\left(1 + \tau_{t+j}\right) + \alpha_r + \rho \Delta ln(CPI_{rt-1}) + \varphi trend_t + \varepsilon_{rt}, \qquad (2)$$

where α_r is the fixed effect of regional dummy.

Table 6 shows the cumulative pass through for each sectoral CPI. We obtain the several remarkable results. First, total and contemporaneous pass through in each sector is quite different. For example, total pass through of leisure is 1.47 which means the price overshifting, while that of residence is -0.25 (not significant). Finally, 'Post-reform' does not have a significant effect in any sector.

Figure 4 shows the estimated cumulative dynamic effects in each sector. We can classify four groups; no pass through (Residence, Utility, Transportation and Miscellaneous), incomplete pass through (Medical and Education), complete pass through (Food, Clothing and Furniture) and price overshifting (Leisure). These differences imply that there are demand and supply elasticity and (or) the degree of market imperfection (oligopoly).

Table 6. Cumulative pass through for each sectoral CPI

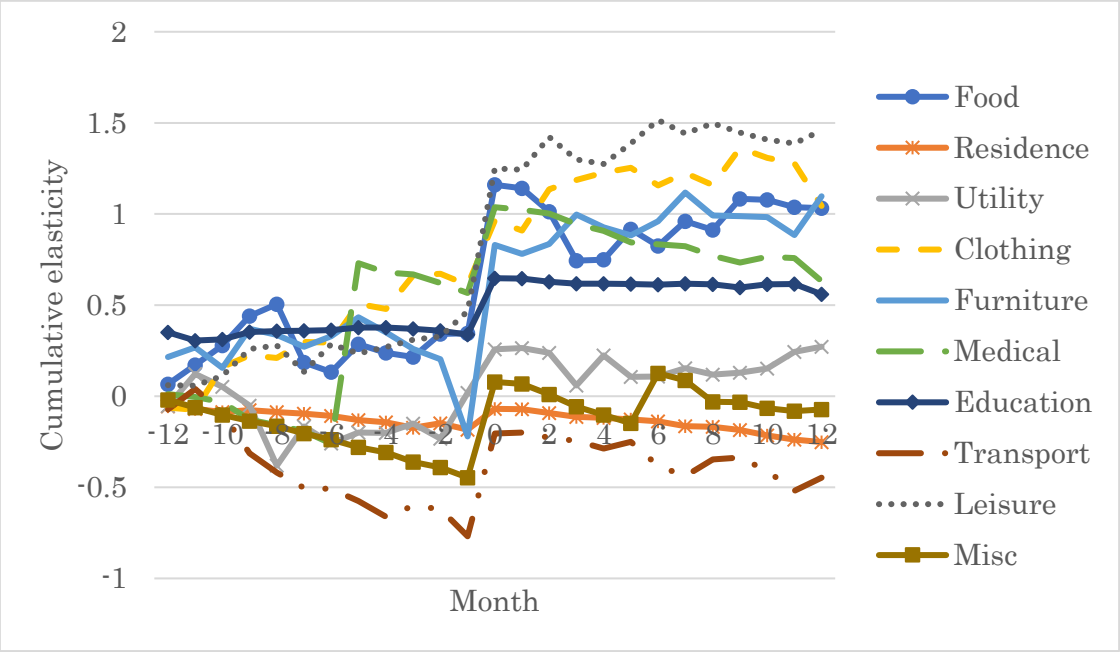
	(1)	(2)	(3)	(4)	(5)
Sector	Food	Residence	Utility	Clothing	Furniture
Pre-reform	0.34	-0.18*	0.02	0.61	-0.29*
	(0.22)	(0.11)	(1.51)	(0.49)	(0.17)
Contemporaneous	0.81***	0.11***	0.24	0.35**	1.05***
	(0.06)	(0.03)	(0.42)	(0.22)	(0.05)
Post-reform	-0.13	-0.18*	0.01	0.08	0.23
	(0.22)	(0.11)	(1.49)	(0.48)	(0.17)
Total	1.03**	-0.25	0.27	1.04	0.87***
	(0.33)	(0.17)	(2.25)	(0.73)	(0.26)
Total=0(p value)	0.00	0.12	0.90	0.15	0.00
Total=1(p value)	0.92	0.00	0.74	0.95	0.60
Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	5,701	5,701	5,701	5,701	5,701
R-squared	0.08	0.25	0.0001	0.01	0.23

Table 6. Cumulative pass through for each sectoral CPI (continued).

	(6)	(7)	(8)	(9)	(10)
Sector	Medical	Education	Transportation	Leisure	Miscellaneous
Pre-reform	0.57**	0.34	-0.76***	0.47**	-0.45**
	(0.27)	(0.30)	(0.19)	(0.18)	(0.20)
Contemporaneous	0.47***	0.31***	0.56***	0.78***	0.52***
	(0.08)	(0.08)	(0.05)	(0.05)	(0.05)
Post-reform	-0.40	-0.08	-0.24	0.20	-0.15
	(0.26)	(0.29)	(0.20)	(0.17)	(0.19)
Total	0.63	0.56	-0.44	1.46***	-0.07
	(0.41)	(0.45)	(0.30)	(0.27)	(0.29)
Total=0(p value)	0.12	0.21	0.13	0.00	0.80
Total=1(p value)	0.37	0.32	0.00	0.09	0.00
Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	5,701	5,701	5,701	5,701	5,701
R-squared	0.05	0.06	0.13	0.13	0.07

(Note) Standard errors of the cumulative sums in parentheses. We set interacted fixed effect in Table 5, since the results of individual fixed effect obtains almost same results.

Figure 4. Average Cumulative pass through for each sector



3.3.VAT change in regional CPI data

In this subsection, we estimate the sectoral panel CPI equation in each region:

$$\Delta ln(CPI_{it}) = \sum_{j=-12}^{12} \gamma_j \Delta ln\left(1+\tau_{t+j}\right) + \alpha_i + \rho \Delta ln(CPI_{it-1}) + \varphi trend_t + \varepsilon_{it}, \qquad (2)$$

where α_i is the fixed effect of sectoral dummy.

Table 6 shows the cumulative pass through for each regional CPI and Figure 5 shows the estimated cumulative dynamic effects in each sector. Regional difference is smaller than sectoral one and there only exists the 'Contemporaneous' impact which is imperfect pass through in every region. Quantitative difference of the 'Contemporaneous' effect may interpret the demand elasticity in each region[7].

Table 6. Cumulative pass through for each region

	(1)	(2)	(3)	(4)	(5)
Region	Hokkaido	Tohoku	Kanto	Hokuriku	Chubu
Pre-reform	-0.17	-0.03	0.08	0.04	0.14
	(0.20)	(0.26)	(0.25)	(0.27)	(0.26)
Contemporaneous	0.41***	0.53***	0.48***	0.56***	0.51***
	(0.05)	(0.07)	(0.08)	(0.07)	(0.10)
Post-reform	-0.14	-0.05	0.02	-0.03	0.03
	(0.19)	(0.25)	(0.25)	(0.26)	(0.25)
Total	0.09	0.44	0.59	0.57	0.69*
	(0.30)	(0.39)	(0.38)	(0.40)	(0.38)
Total=0(p value)	0.76	0.25	0.12	0.15	0.09
Total=1(p value)	0.00	0.15	0.29	0.28	0.41
Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	5,750	5,750	5,750	5,750	5,750
R-squared	0.09	0.06	0.06	0.05	0.06

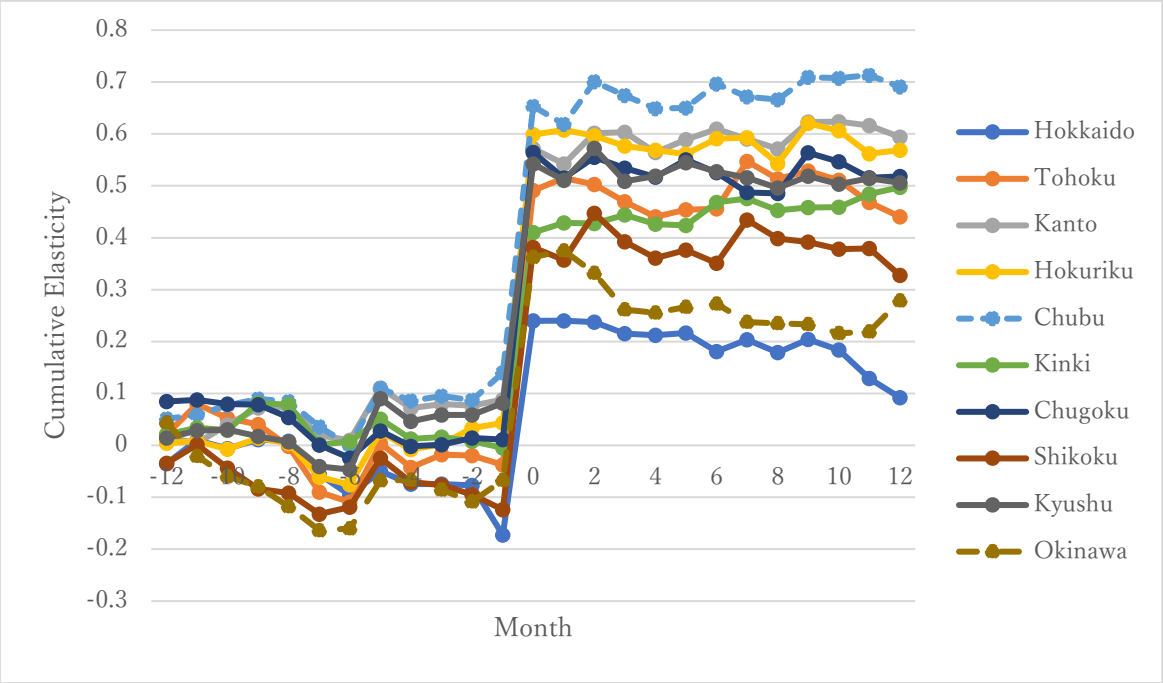
[7] We check the regional differences among parameters of contemporaneous and total effect using Tukey-Kremer test, and there is no significant difference.

Table 6. Cumulative pass through for each region (continued).

	(6)	(7)	(8)	(9)	(10)
Region	Kinki	Chugoku	Shikoku	Kyushu	Okinawa
Pre-reform	-0.00	0.01	-0.12	0.08	-0.06
	(0.19)	(0.28)	(0.27)	(0.27)	(0.27)
Contemporaneous	0.41***	0.55***	0.51***	0.46***	0.43***
	(0.05)	(0.08)	(0.08)	(0.08)	(0.07)
Post-reform	0.08	-0.05	-0.05	-0.03	-0.08
	(0.19)	(0.28)	(0.27)	(0.26)	(0.26)
Total	0.50*	0.52	0.32	0.51	0.28
	(0.28)	(0.42)	(0.40)	(0.41)	(0.40)
Total=0(p value)	0.08	0.21	0.42	0.21	0.49
Total=1(p value)	0.08	0.25	0.09	0.22	0.07
Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	5,750	5,750	5,750	5,750	5,260
R-squared	0.11	0.05	0.05	0.05	0.03

(Note) Standard errors of the cumulative sums in parentheses. We set interacted fixed effect in Table 5, since the results of individual fixed effect obtains almost same results.

Figure 5. Average Cumulative pass through for each region



4. Robustness

In this section, we add the validity of our main finding to re-estimate the following three trials; dividing each VAT increase scenario, using General CPI index of regional panel, and adding control variables.

4.1. Sub-sampling in each VAT increase

Table 7 shows the dividing the sample-period as three cases; Column (1) and (2) (period 1970-1993) focus on 0 to 3% VAT rate increase, Column (3) and (4) (1994-2011) on 3 to 5%, Column (5) and (6) (2012-2019) on 5 to 8% and 8 to 10% (with reduced tax). Figure 6 shows the estimated cumulative dynamic effects in each VAT increase scenario. Column (1) and (2) in Table 7 show that 'Contemporaneous' pass through rate of the case in 3% VAT is 28%, which is imperfect pass through, and total is also. This is because the abolishment of commodity tax some of cancel out the CPI increasing. On the other hand, both 'Contemporaneous' and 'Total' impact on Column (3)-(6) are larger than Column (1) and (2). Especially, both 5% and 8% VAT increases face on the price overshifting in viewpoint of 'Total' impact[8]. Qualitative difference among 5% and 8% increases is the timing of not 'Contemporaneous.' That is, case in 5% increase works 'Pre-reform' impact, while case in 8% works 'Post-reform,' which imply the announcement of VAT increase play a role in 5% increase case, while menu cost may work on the case in 8% (and 10%) increase.

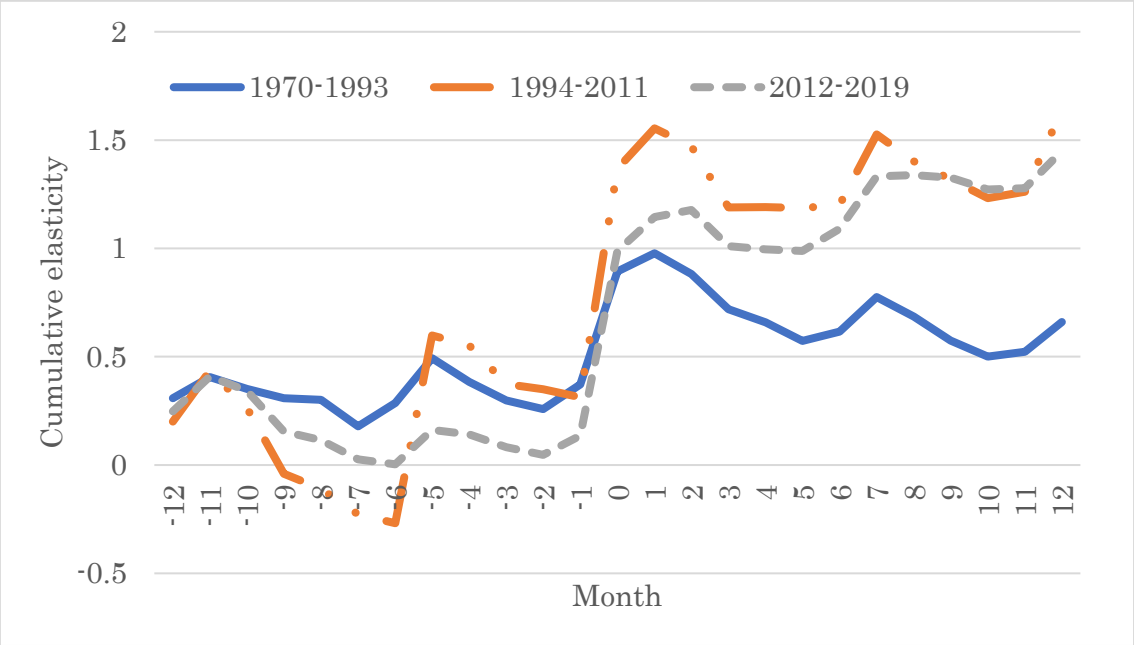
[8] We need to pay attention to the null hypotheses which 'Total' impact of Column (5) and (6) are one are not rejected at 5%; that is, the case in 8% (and 10%) VAT increase may be complete pass through, not price overshifting.

Table 7. Cumulative pass through for each VAT increase case

	(1)	(2)	(3)	(4)	(5)	(6)
VAT pass through						
Period	1970-1993		1994-2011		2012-2019	
Pre-reform	0.31*	0.31*	0.41***	0.41***	0.11	0.11
	(0.17)	(0.17)	(0.13)	(0.13)	(0.09)	(0.09)
Contemporaneous	0.28***	0.28***	0.77***	0.77***	0.66***	0.66***
	(0.05)	(0.05)	(0.04)	(0.04)	(0.02)	(0.02)
Post-reform	-0.25	-0.25	0.24*	0.24*	0.50***	0.50***
	(0.17)	(0.17)	(0.13)	(0.14)	(0.09)	(0.09)
Total	0.33	0.33	1.42***	1.42***	1.26***	1.26***
	(0.25)	(0.25)	(0.20)	(0.20)	(0.14)	(0.14)
Total=0(p value)	0.25	0.25	0.00	0.00	0.00	0.00
Total=1(p value)	0.00	0.00	0.02	0.02	0.06	0.06
Fixed Effect	Individual	Interacted	Individual	Interacted	Individual	Interacted
Observations	27,010	27,010	21,600	21,600	8,400	8,400
R-squared	0.05	0.05	0.05	0.05	0.09	0.09

(Note) (1) and (2) focus on 0 to 3% VAT rate increase, (3) and (4) on 3 to 5%, (5) and (6) on 5 to 8% and 8 to 10% (with reduced tax).

Figure 6. Average Cumulative pass through for each VAT increase scenario



4.2.General Index CPI pass through

To confirm the validity of the full sample estimation, we re-estimate the general index of regional CPI data and compare with the result in Table 7. Although the results in Column (3)-(6) may not cause the price overshifting, qualitative tendencies of Table 8 are almost consistent with Table 7.

Table 8. Cumulative pass through for each general VAT increase case

	(1)	(2)	(3)	(4)	(5)	(6)
VAT pass through						
Period	1970-1993		1994-2011		2012-2019	
Pre-reform	0.37	0.37	0.09	0.09	-0.06	-0.06
	(0.23)	(0.23)	(0.15)	(0.14)	(0.09)	(0.09)
Contemporaneous	0.37***	0.37***	0.73***	0.73***	0.66***	0.66***
	(0.06)	(0.06)	(0.04)	(0.04)	(0.02)	(0.02)
Post-reform	-0.17	-0.17	0.27*	0.27*	0.33***	0.33***
	(0.23)	(0.23)	(0.15)	(0.15)	(0.09)	(0.09)
Total	0.57	0.57	1.24***	1.24***	0.93***	0.93***
	(0.35)	(0.35)	(0.23)	(0.23)	(0.14)	(0.14)
Total=0(p value)	0.10	0.10	0.00	0.00	0.00	0.00
Total=1(p value)	0.21	0.21	0.30	0.29	0.66	0.66
Fixed Effect	Individual	Interacted	Individual	Interacted	Individual	Interacted
Observations	2,701	2,701	2,160	21,600	840	840
R-squared	0.20	0.20	0.22	0.22	0.53	0.53

(Note) (1) and (2) focus on 0 to 3% VAT rate increase, (3) and (4) on 3 to 5%, (5) and (6) on 5 to 8% and 8 to 10% (with reduced tax).

4.3.Adding control variables

Eq. (1) does not consider about the other factors; such as business cycle index, other price index, and labor market condition etc. Then, this paper adds (Log change of) Input-Output Price Index, Unemployment rate, Economic Policy Uncertainty Index, Monetary base, as the control variables[9]. To compare with the effects of the control variables, we report the estimation result without control variables.

Table 9 shows the cumulative pass through for VAT increase with and without control variables (sample period is from January 1987 to December 2018). The result with control variables is almost consistent with that without control variables.

Table 9. Cumulative pass through for VAT increase with and without control variables (Period: January 1987 to December 2018).

	Without Control Variable	With Control Variables
VAT pass through		
Pre-reform	0.36***	0.39***
	(0.05)	(0.05)
Contemporaneous	0.50***	0.51***
	(0.14)	(0.14)
Post-reform	0.30***	0.27***
	(0.05)	(0.05)
Total	1.18***	1.17***
	(0.08)	(0.08)
Total=0(p value)	0.00	0.00
Total=1(p value)	0.02	0.03
AR(1)&Trand	Yes	Yes
Observations	38,300	38,300
R-squared	0.047	0.050

[9] Note that the data of the economic policy uncertainty index is available from 1987 and unemployment rate uses until 2018, and then sample period changes. We use the Input-output price index and Monetary base by the Bank of Japan, regional unemployment by Labor Force Survey in the Ministry of Internal Affairs and Communications. We consider The Input-Output price index and Monetary base as macroeconomic factor, and regional unemployment rate as regional specific factor.

5. Conclusion

This paper investigates the VAT (consumption tax) pass through in Japanese regional and sectoral data. We focus on not only the contemporaneous (short-run) effect, but also the total (long-run) which includes the pre- and post-VAT change (reform). We show the effects not only contemporaneous but also pre-reform (from 12 month ago to one month) and post-reform (from one month ahead to 12 month) similar to Benedek et al.(2019). We can predict the result theoretically as follows. If the Pre-reform impact is significant, this implies that anticipated effects work. If the Post-reform impact is significant, this implies that anticipated effects work. And if the price overshifting causes, its goods market is imperfect competition.

There are two policy implications of our results. First, Regional difference is quite small because the low of one price may be satisfied in each commodity. Second, recent VAT reform may be more harmful because the consumer prices overshifting decreases the consumption quantity and consumer surplus.

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