

Path Through in U.S. State Sale Tax Changes

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Abstract

This paper investigates the pass through of U.S. state and local sales tax on consumer price index (CPI). We focus on not only the contemporaneous (short-run) effects, but also the total (long-run) one, which include the pre- and post-sales tax change (reform). We show that the effects are not only contemporaneous but also pre-reform (from 4 quarters ago to one month) and post-reform (from one month ahead to 4 quarters), similar to Benedek et al. (2020). This paper obtained some remarkable results. First, aggregate CPI based analysis shows complete pass through (total effect is 1.2), and pre-reform pass through explains the most of impact (0.71). Second, Compared with pass through of tradable and non-tradable CPI, total effect of both pass through is similar while every effect of tradable CPI is significantly positive. Only pre-reform is significantly positive in the case of non-tradable.

JEL classification: H20, H22, H23, E60

Keywords: sales tax rate, pass through

1. Introduction

This paper investigates the pass through of U.S. state and local sales tax on consumer price index (CPI). We focus on not only the contemporaneous (short-run) effects, but also the total (long-run) one, which include the pre- and post-sales tax change (reform). We show that the effects are not only contemporaneous but also pre-reform (from 4 quarters ago to one month) and post-reform (from one month ahead to 4 quarters), similar to Benedek et al. (2020).

The economic theory of indirect taxation makes the case for pass through on consumer prices. Cases with incomplete pass through whose elasticity is less than one can generate standard partial equilibrium in a competitive market. On the other hand, Price overshifting can generate under imperfect competition and/or with endogenous product quality.¹ Moreover, sluggish price changes may appear in anticipation of the consumption (or sales) tax rate changes and/or menu costs, as discussed by Kleven and Kreiner (2003), Gagnon, López-Salido and N. Vincent (2013) and Karadi and Reiff (2019). In fact, most consumption tax rate changes are not unanticipated, as the related laws are created well in advance. Summarizing theoretical perspectives, the results are as follows. If the pre-

¹ See, for example, Stern (1987), Delipalla and Keen (1992), Weyl and Fabinger (2013), Häckner and Herzing (2016), and Adachi and Fabinger (2022).

reform impact is significant, anticipated effects work. If the post-reform impact is significant, anticipated effects work as well. For price overshifting, the goods market is under imperfect competition.

This paper obtained some remarkable results. First, aggregate CPI based analysis shows complete pass through (total effect is 1.2), and pre-reform pass through explains the most of impact (0.71). Second, Compared with pass through of tradable and non-tradable CPI, total effect of both pass through is similar while every effect of tradable CPI is significantly positive. Only pre-reform is significantly positive in the case of non-tradable. This implies that the announcement effect of sales tax changes works well before tax reforms implement. On the other hand, our findings that dynamic response of pass through tradable CPI is more persistent than that of non-tradable, because non-tradable CPI is more sticky than tradable one.

The remainder of the paper is organized as follows. Section 2 surveys the related literature. Section 3 presents the empirical model and the dataset. Section 4 shows the results and their interpretations, and Section 5 concludes the paper.

2. Related Literature

There are some empirical studies related to our research as follows. Poterba (1996),

Besley and Rosen (1999), Benedek et al. (2020), and Hiraga (2023) 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), who focus on the sectoral (commodity) differences in each city, we also include the estimation of regional differences. Carbonnier (2007, 2008) estimates the effects of VAT changes for some commodities. Specifically, Carbonnier (2007) focuses on housing repair services and new car sales, and Carbonnier (2008) on restaurant, coffee shop, and selected services.

In another retail setting where price points may be important, Besanko, Dubé, and Gupta (2005) find that 14% of wholesale price promotions were passed on at more than 100% to retail prices. Regarding 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 on through to consumers although prices may not fully adjust when supply is inelastic, or inventories are high (Marion and Muehlegger (2011)), and that gas tax holidays pass through quickly but only partially to consumers (Doyle and Samphantharak (2008)). Harding, Leibtag, and Lovenheim (2012) find that cigarette taxes are less than fully passed through to consumers, while DeCicca, Kenkel, and Liu (2013) cannot reject the 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 of the prices of hairdressing services and some other commodities in Finland in the context of the VAT reform. Buettner and Madzharova (2020) study the effects of consumption tax changes on the prices and unit sales of durables utilizing micro-level product data and obtain the full pass through onto prices.

Voigts (2017) explains the VAT pass through using a new Keynesian dynamic stochastic general equilibrium model with tax-excluded prices stickiness, which is a well-used setting by studies such as Feldstein (2002), Forni, Monteforte, and Sessa (2009), Correia et al. (2013), and Leeper, Traum, and Walker. (2017). On the other hand, Eggertsson and Woodford (2006), Gagnon, López-Salido, and Vincent (2013), and Karadi and Reiff (2019) construct a price-setting model with the menu cost of tax-included price and trend-inflation to calibrate the VAT changes in Hungary. Kato, Okuda, and Tsuruga (2021) show the negative correlation between inflation persistency and market concentration and construct the model which explains this empirical fact. Kato, Okuda, and Tsuruga (2021) also support the implications of our results, in that the sectoral differences of persistency may derive from market concentration. What we can see from the New Keynesian model is that higher price stickiness leads to higher persistence of the price variable after the

consumption tax hike.

The novelty of this study is to analyse the impact of U.S. state sales taxes on price shifting on a state-by-state CPI basis, and to test the findings against those obtained by economic theory.

3. Empirical model and data

3.1. Empirical model

Following Poterba (1996), Besley and Rosen (1999), Benedek et al. (2020), and Buettner and Madzharova (2020), this study estimates the reduced-form equation of a difference of quarterly inflation rate in the consumer prices $\Delta\pi_{it}$ on that in the consumption tax rate $\Delta\ln(1 + \tau_{t+j})$:

$$\Delta\pi_{it} = \sum_{j=-4}^4 \gamma_j \Delta\ln(1 + \tau_{t+j}) + \alpha_i + \alpha_t + \varepsilon_{it}, \quad (1)$$

for consumption quarter t in state i . Coefficient γ_j measures the impact on the consumer price of state i at time t of a change in quarter $t + j$ in the sale tax rate, with $j \in (-4, 4)$.

The first term on the right-hand side of Eq. (1) shows that $\sum_{j=-4}^{-1} \gamma_j$ is the coefficient for the pre-reform, γ_0 reflects contemporaneous effects, $\sum_{j=1}^4 \gamma_j$ represents the post-reform period, and $\sum_{j=-4}^4 \gamma_j$ is the total effect. α_i and α_t are state-and time-fixed effects, and ε_{irt} the disturbance term.

Before presenting the results, we make predictions on the estimation parameters. If the pre-reform impact is significant, anticipated effects work. If the post-reform impact is significant, anticipated effects work as well. Further, for price overshifting, the goods market is under imperfect competition.

3.2.Data

We use Hazell et al. (2022) 's state CPI-based inflation rate data, which includes not only aggregate CPI data but also decomposing datasets; Tradable and Non-Tradable ones². As for the data on sale tax, we use Baker, Johnson and Kueng (2021)'s state and local tax rate which turns to Thomson Reuters TDS Rate Files (2008–2015). Since Baker, Johnson and Kueng (2021) calculates the monthly state and local sales tax in the county, this paper uses state and quarterly averaged local sales tax data. Connecting the dataset of Hazell et al. (2022) and Baker, Johnson and Kueng (2021), we construct the panel data for 34 states from the first quarter of 2003 to the fourth quarter of 2015³. Table 1 shows the descriptive statistics of the dataset⁴.

4. Results

4.1.Case in State Sale Tax Changes

Table 2 shows the empirical results of dynamic pass through on state sales tax changes. Column (1) represents the dynamic effects of pass through of aggregate CPI, Column (2)

² Since the data in Hazell et al. (2022) were annualized value, I converted their data to quarterly.

³ As for total sale tax data, the available period is from the first quarter of 2008.

⁴ Under the restriction of data availability, this paper does not include the data of Alaska, Arizona, Delaware, Hawaii, Kentucky, Maine, Montana, North Dakota, Nebraska, New Hampshire, New Mexico, Nevada, Rhode Island, South Dakota, Vermont, West Virginia, and Wyoming states.

represents that of tradable CPI and Column (3) represents that of non-tradable CPI. Total effects of every model are approximately 1.2 and complete pass through⁵. On the other hand, transition dynamics of pass through among tradable and non-tradable are different. This result is inconsistent with the price stickier goods (non-tradable goods) are more sluggish response in post-reform⁶. One possible interpretation is that price stickier goods firms prepare to anticipated sale tax changes in advance. Figure 1,2 and 3 show the cumulative impulse responses of state sale tax changes and confirm significant positive complete pass through in these figures.

4.2. Case in Total Sale Tax Change

Table 3 shows the empirical results of dynamic pass through on state sales tax changes and columns are the same definition in Table 2. Main result is consistent with the case in tradable CPI, but aggregate and non-tradable ones are some of different with respect to post-reform. Especially, negative pass through of non-tradable CPI causes in post-reform and cancel out the total effect. This counter-intuitive result may be still puzzling.

5. Conclusion

This paper investigates the pass through of U.S. state and local sales tax on consumer price index (CPI). We focus on not only the contemporaneous (short-run) effects, but also the total (long-run) one, which include the pre- and post-sales tax change (reform). We show that the effects are not only contemporaneous but also pre-reform (from 4 quarters ago to one month) and post-reform (from one month ahead to 4 quarters), similar to Benedek et al. (2020). This paper obtained some remarkable results. First, aggregate CPI based analysis shows complete pass through (total effect is 1.2), and pre-reform pass

⁵ We confirm the null hypothesis that total effect is one is not rejected.

⁶ Bils and Klenow (2004) and Hazell et al.(2022) show the service (non-tradable CPI) is stickier than goods (tradable CPI).

through explains the most of impact (0.71). Second, Compared with pass through of tradable and non-tradable CPI, total effect of both pass through is similar while every effect of tradable CPI is significantly positive. Only pre-reform is significantly positive in the case of non-tradable.

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Table 1. Descriptive Statistics (Unit: %)

	Aggregate CPI Inflation rate	Tradable CPI Inflation Rate	Non-Tradable CPI Inflation Rate	State Sales Tax Rate	Total Sales Tax Rate
Mean	0.555	0.289	0.699	5.366	6.811
Median	0.580	0.303	0.711	6.000	7.000
Maximum	1.924	1.953	3.135	8.250	9.768
Minimum	-0.950	-1.276	-1.297	0.000	0.000
Standard Deviation	0.374	0.486	0.418	1.459	1.616
Observations	1768	1768	1768	1768	1088

Table 2. Cumulative Pass Through of State Sales Tax Changes

	(1) Aggregate CPI			(2) Tradable CPI			(3) Non-Tradable CPI		
	Coefficient	Standard Error		Coefficient	Standard Error		Coefficient	Standard Error	
Pre-Tax Change	0.713	0.120	***	0.473	0.160	***	0.834	0.139	***
Contemporaneous	0.219	0.116	*	0.313	0.096	***	0.151	0.141	
Post-Tax Change	0.275	0.193		0.362	0.099	***	0.211	0.284	
Total	1.206	0.196	***	1.148	0.190	***	1.197	0.302	***
R Squared	0.562			0.718			0.35		
Observations	1496			1496			1496		

(Note) Standard errors of the cumulative sums are between parentheses⁷. Standard errors are robust in all specifications and clustered by region and sector. *** is 1%, ** is 5% and * is 1% statistically significant.

⁷ Similar to Benedek et al.(2020), this paper reports $\sum_{j=-4}^{-1} \gamma_j$ and $SE(\sum_{j=-4}^{-1} \gamma_j)$ for the pre-reform period impact; γ_0 and $SE(\gamma_0)$ for the contemporaneous impact; $\sum_{j=1}^4 \gamma_j$ and $SE(\sum_{j=1}^4 \gamma_j)$ for the post-reform period impact; and $\sum_{j=-4}^4 \gamma_j$ and $SE(\sum_{j=-4}^4 \gamma_j)$ for the total period impact.

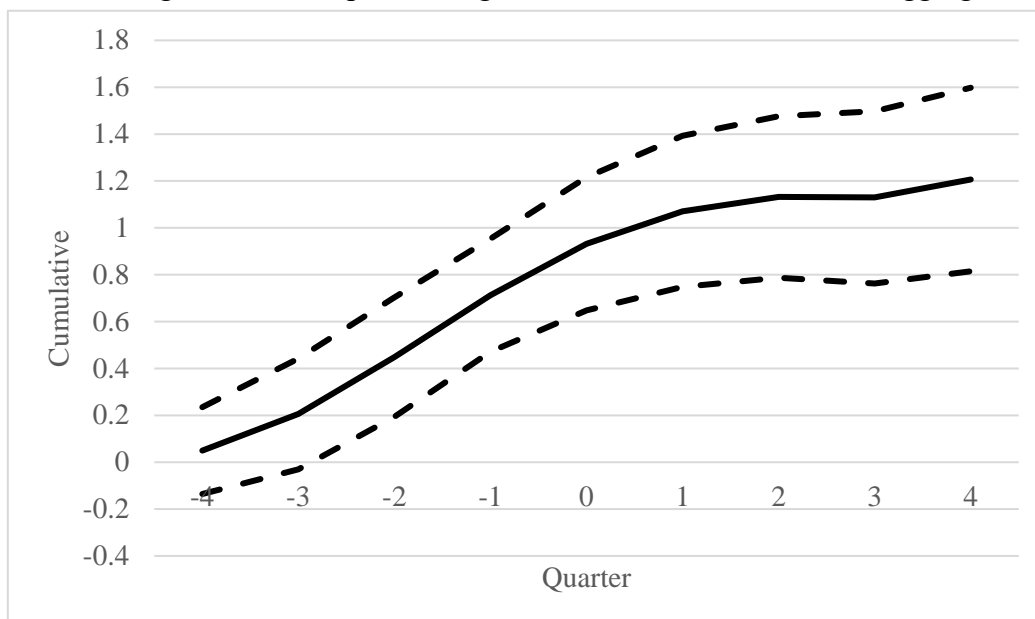
Table 3. Cumulative Pass Through of Total (State + Local) Sales Tax Changes

	(1) Aggregate CPI			(2) Tradable CPI			(3) Non-Tradable CPI		
	Coefficient	Standard Error		Coefficient	Standard Error		Coefficient	Standard Error	
Pre-Tax Change	0.866	0.142	***	0.561	0.208	***	0.925	0.213	***
Contemporaneous	0.156	0.090	*	0.247	0.110	**	0.059	0.092	
Post-Tax Change	-0.148	0.191		0.495	0.147	***	-0.625	0.308	**
Total	0.874	0.256	***	1.302	0.308	***	0.360	0.468	
R Squared	0.558			0.771			0.287		
Observations	806			806			806		

(Note) Standard errors of the cumulative sums are between parentheses⁸. Standard errors are robust in all specifications and clustered by region and sector. *** is 1%, ** is 5% and * is 1% statistically significant.

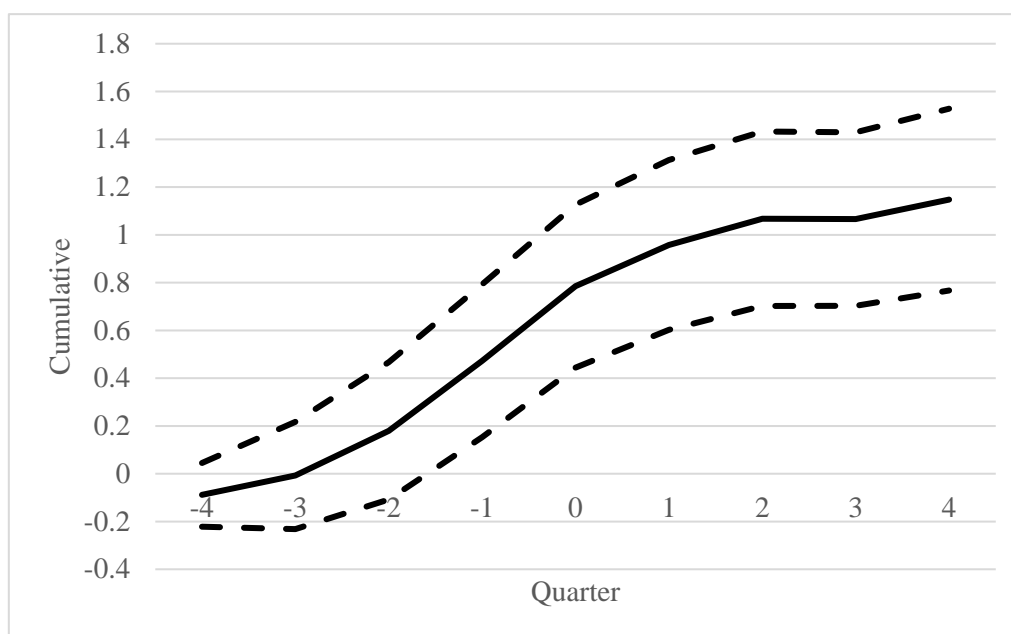
⁸ Similar to Benedek et al.(2020), this paper reports $\sum_{j=-4}^{-1} \gamma_j$ and $SE(\sum_{j=-4}^{-1} \gamma_j)$ for the pre-reform period impact; γ_0 and $SE(\gamma_0)$ for the contemporaneous impact; $\sum_{j=1}^4 \gamma_j$ and $SE(\sum_{j=1}^4 \gamma_j)$ for the post-reform period impact; and $\sum_{j=-4}^4 \gamma_j$ and $SE(\sum_{j=-4}^4 \gamma_j)$ for the total period impact.

Figure 1. Average cumulative pass through of State Sales Tax in for the Aggregate CPI



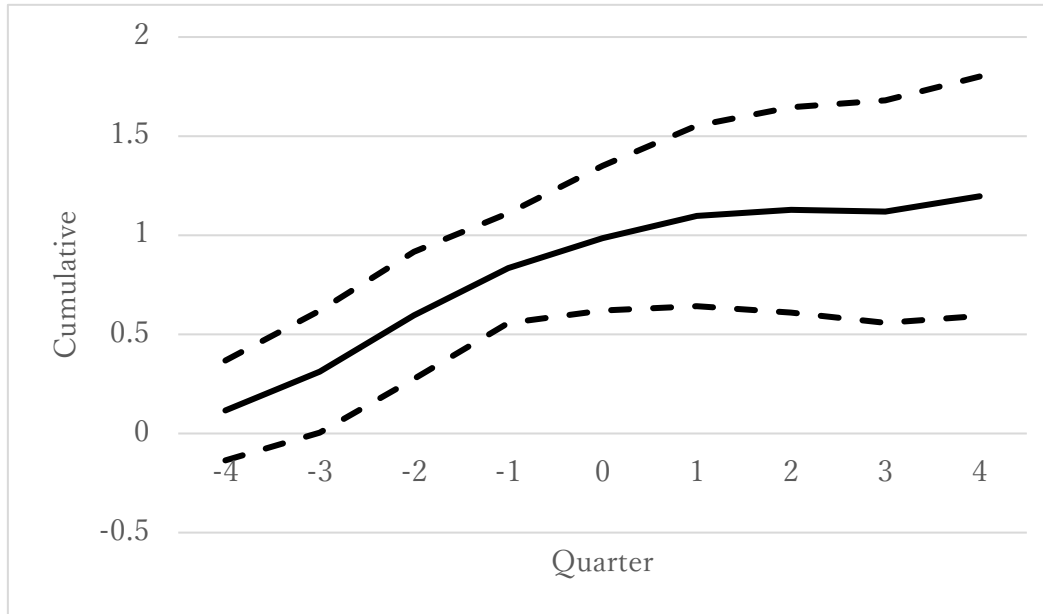
(Note) Broken lines are 95% confidence interval.

Figure 2. Average cumulative pass through of State Sales Tax in for the Tradable Goods CPI



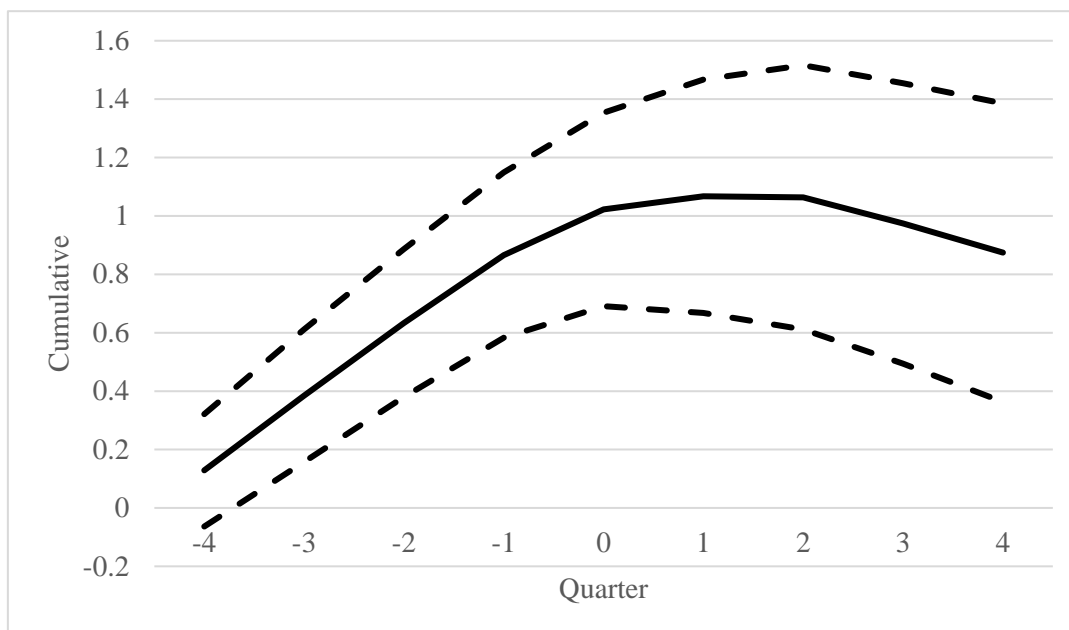
(Note) Broken lines are 95% confidence interval.

Figure 3. Average cumulative pass through of State Sales Tax in for the Non-Tradable Goods CPI



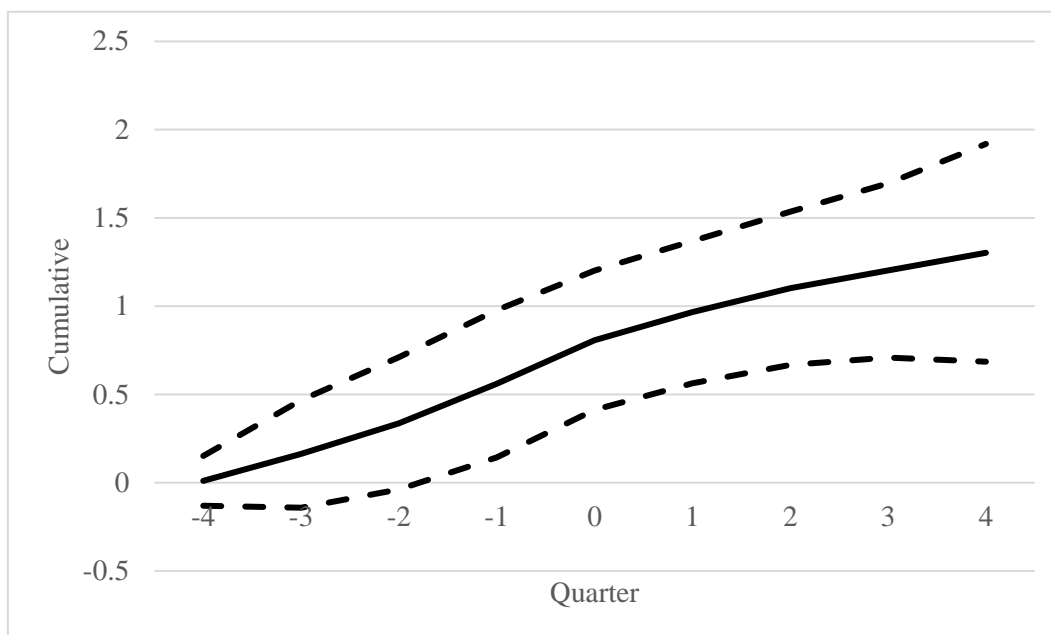
(Note) Broken lines are 95% confidence interval.

Figure 4. Average cumulative pass through of Total (State+(Average)Local) Sales Tax in for the Aggregate CPI



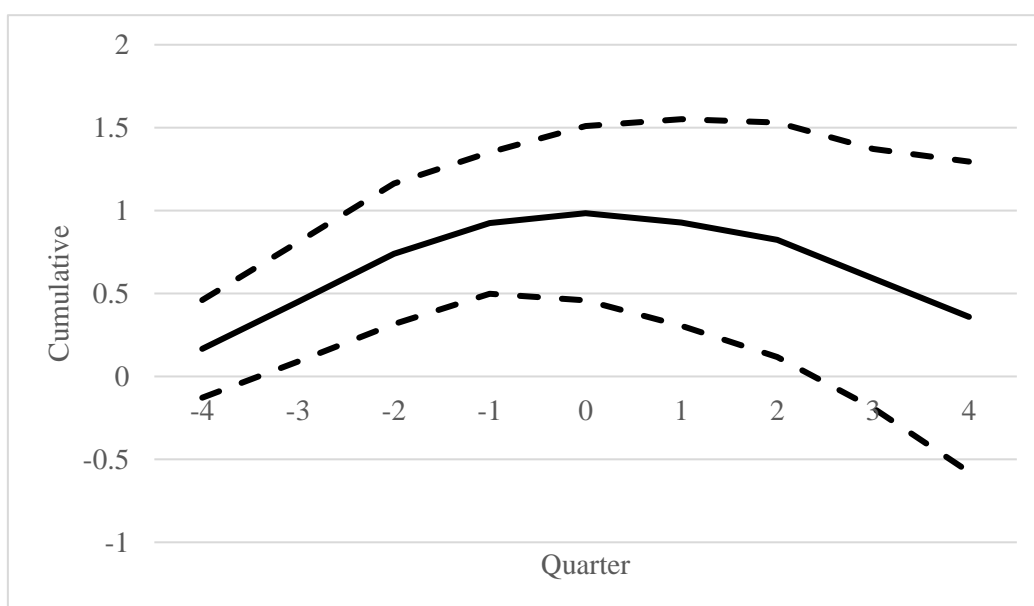
(Note) Broken lines are 95% confidence interval.

Figure 5. Average cumulative pass through of Total (State+(Average) Local) Sales Tax in for the Tradable Goods CPI



(Note) Broken lines are 95% confidence interval.

Figure 6. Average cumulative pass through of Total (State+(Average)Local) Sales Tax in for the Non-Tradable Goods CPI



(Note) Broken lines are 95% confidence interval.