The Incidence of Grocery Taxes in U.S. Food and Factor Markets

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Abstract: We study the incidence of county-level grocery sales taxes across the United States from 2010-2019. We find substantial grocery tax over-shifting to consumers. On average, a grocery tax that generates $1 in government revenue leads to a $1.25 rise in tax-inclusive consumer food prices. This tax over-shifting is even higher for lower-income households and shoppers at discount and dollar stores. The grocery tax incidence varies significantly among foods, with over-shifting highest for perishable staples. The windfall revenue arising from grocery tax over-shifting does not translate into increased earnings for food retail workers nor higher prices received by farmers.

Key words: Food Sales Taxes, Tax Incidence, Retail Food Prices, Demand Analysis

JEL codes: H22, L81, Q11, D12

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Approximately one-third of all United States (U.S.) counties assess a state, county, or combined sales tax on food purchased at a retail outlet. Such grocery taxes are widely considered distributionally regressive because, per Engel's Law, low-income households spend a larger proportion of their income on food than do higher income families.

The distributional effects also turn, however, on the incidence of grocery taxes.[1] Standard welfare theory predicts that the tax incidence between consumers and retailers under perfect competition depends on the relative price elasticities of demand and supply; whichever party is less price responsive bears more of the tax burden (Jenkin 1872; Harberger 1962). Conversely, grocery taxes might be especially regressive if firms with market power face convex demand curves, enabling them to raise (tax-exclusive) product prices so that consumers not only shoulder the full tax burden but also pay extra for the same foods, despite no change in food retailers' marginal cost (Anderson et al. 2001; Bonnet and Réquillart 2013; Weyl and Fabinger 2013; Pless and van Benthem 2019). Given widespread unease about grocery tax regressivity, rising concerns about market power in a range of U.S. industries (Berry et al. 2019), and the paucity of current evidence on this topic (Besley and Rosen 1999), the incidence of U.S. grocery taxes seems a timely, policy-relevant topic for study.

The first contribution of this paper is a comprehensive examination of grocery tax pass-through across all food categories in the U.S. We constructed a panel dataset of U.S. grocery food tax rates at the county level, which we merge with NielsenIQ Homescan household food purchase data at the product (UPC)-level for 2010 through 2019. These data enable us to estimate grocery tax pass-through rates using individual household-level observations on specific

[1] Grocery taxes could also have indirect effects through induced changes in food consumption patterns that affect health and food security outcomes (Allcott et al. 2019; Zheng et al. 2021; Cawley and Frisvold 2023; Wang et al. 2023) or through general equilibrium effects. We abstract from those mechanisms in this paper.

food products. Our results show considerable over-shifting of grocery taxes to consumers. Specifically, a one dollar increase in grocery tax revenues to state or local government leads to a $1.25 increase in the tax-inclusive price, on average. Grocery taxes thereby generate windfall revenue gains for food retailers.

Our second contribution is to identify important heterogeneity in grocery tax over-shifting by household and store types and by product groups. Lower-income, White, Hispanic or Asian households, and shoppers at discount, drug, warehouse stores, or especially dollar stores, face greater grocery tax over-shifting than do higher-income or Black or Native American consumers at conventional grocery or convenience stores. Highly perishable staple products like fluid milk exhibit the highest rates of tax over-shifting.

Our third contribution links grocery taxes with underlying factor markets, namely retail worker earnings and farm-level product prices, to gain a more complete understanding of who benefits from grocery tax over-shifting. Grocery tax over-shifting to consumers implies an increase in food retail workers' marginal revenue product without any corresponding increase in fixed or marginal costs. In 2022, almost 45% of consumer expenditures on food for home consumption accrued to agri-food value chain workers and half of the gross revenue that accrued to food retailers passed through to workers (USDAERS, 2023). In competitive labor markets, this should translate into greater food retail worker earnings, whether through increased wage rates, hours worked, or both. We nonetheless find no impact of grocery taxes on county-level grocery store workers' earnings; indeed, the point estimates are negative but statistically insignificant. These results are consistent with others' recent findings that employers exercise market power (De Loecker et al. 2020; Azar et al. 2022; Berger et al., 2022; Card 2022; Yeh et al. 2022). Further, since our product-level estimates identified fluid milk as the product with the highest rate of grocery tax over-shifting, one might expect that to translate into higher farmgate prices for dairy farmers in counties with grocery taxes. In 2022, 51 percent of the consumer price of fresh milk purchased for consumption at home accrued to farmers.[2] We find no significant impact, however, of grocery taxes on the county-level Class I minimum milk price received by farmers.

Some state and local governments rely on grocery taxes for an important part of their revenues. But the incidence of those taxes appears quite regressive. The main finding of this research is that grocery tax over-shifting leads to substantial revenue windfalls for food retailers, while the magnified tax burden falls disproportionately on consumers, especially lower-income households and patrons of dollar stores, with no discernible gains flowing to workers or farmers.

Data

Our analysis relies on two data sets for the estimation of grocery tax pass-through rates, and then two other data sets to explore whether grocery taxes impact grocery workers' earnings or the price farmers get from milk sales.

A. State and County Food Sales Taxes

We assembled data on U.S. county-level food sales tax rates 2010 through 2019. The total grocery tax rate in each county is the combination of the state and county-level tax rates, obtained from *Tax-Rates.org* and various websites of state and county Departments of Revenue. The data contain all the historical rates and the dates of tax rate changes.

Over our study period, 19 different states had at least one county with a positive grocery tax rate in at least one year. The highest combined state and county rate was 9% in some counties

[2] Per USDA ERS at https://www.ers.usda.gov/data-products/price-spreads-from-farm-to-consumer/highlights-and-interactive-charts/, accessed 15 May 2024.

of Alabama (Table A1). The average combined grocery tax rate was 4.3% in 2019. Eight states impose taxes on food with the same rate as the general sales tax: Alabama (8%), Mississippi (7%), Kansas (6.5%), Idaho (6%), Tennessee (5%), Oklahoma (4.5%), South Dakota (4.5%), and Hawaii (4%).[3] Six states collected food sales taxes at a reduced rate compared to general sales taxes: Utah (3%), Virginia (2.5%), North Carolina (2%), Arkansas (1.5%), Missouri (1.225%), and Illinois (1%). Four states do not impose grocery taxes at the state level but have specific counties that do: Alaska, Georgia, Louisiana, and South Carolina. West Virginia had grocery taxes during this period but abolished them in 2013.

Because we use a county-level fixed effects estimator, we identify grocery tax incidence estimates using county-level changes in grocery sales tax rates (Appendix Table A2). Over this period, the largest state-level tax change occurred in 2013 when over 30 counties in Georgia increased their food sales taxes by 3%. The smallest change occurred in Kansas, when the state reduced the food sales tax by 0.15% in early 2014. No changes occurred in Hawaii, Idaho, Mississippi, North Carolina, South Dakota, and Utah during this period.

B. NielsenIQ Consumer Panel

We use food purchases and household demographic data from NielsenIQ Homescan Consumer Panel (NHCP) from January 1, 2010, to December 31, 2019. NielsenIQ data offer a nationally representative longitudinal panel of 40,000 to 60,000 U.S. households annually (Harding et al., 2012). Though households may rotate in and out of the panel over time, over 80% of the households remain in the sample each year. NHCP provides a wealth of information on grocery food transactions such as product brand, size, store type, coupon

[3] Five of these states (KS, ID, TN, OK, and HI) offer a tax credit to low-income households to offset the tax costs, although it is unclear how much redemption occurs.

usage, zip code, price, and other product and store characteristics. In addition, it includes household socioeconomic characteristics such as income. Appendix Table A3 describes these data.

The transaction-level, decade-long NHCP data take up over 700 GB. To keep estimation computationally manageable, we employed a supervised machine learning algorithm using 5% bootstrapped samples, with 500 replicates. We report mean parameter estimates from the empirical distribution of bootstrapped parameter estimates and report the standard deviations of the bootstrapped distribution as the standard errors of those estimates. As shown in Table A3 for a sample generated by bootstrap, we include 15,825,274 transactions made by 145,794 households in all the 50 states plus the District of Columbia. This includes 329,678 distinct product universal product codes (UPCs). The distribution of food categories is shown in Appendix Figure A1. Around one-half of the observed transactions are dry grocery products (e.g., cereal, breakfast food, crackers, cookies). The next two major categories are dairy products (fluid milk, cheese, etc.), and fresh produce (fruits and vegetables).

C. Grocery Store Workers' Earnings

We obtain county-level average earnings data for food retail workers, by store type, from the Quarterly Workforce Indicators (QWI) dataset for 2010-2019, from the United States Census Bureau's Longitudinal Employer-Household Dynamics program. We follow the North American Industry Classification System (NAICS) codes, using categories for Grocery and Related Product Merchant Wholesalers (4244), Grocery and Convenience Retailers (4451), Specialty Food

Retailers (4452), and Warehouse Clubs, Supercenters, and Other General Merchandise Retailers (4552).

D. Class I Farmgate Milk Prices

The Class I milk price is the minimum price U.S. dairy farmers receive each month. It varies across U.S. counties based on the federal milk marketing order system authorized by the Agricultural Marketing Agreement Act of 1937. The Class I milk price thus provides a lower bound indicator of a key input cost for milk retailers. We obtained county-month-level Class I milk price data from USDA Agricultural Marketing Service.[4]

Estimation Strategy

Our regressions follow a straightforward estimation strategy. We treat grocery tax rates as exogenous, which is almost surely true for the UPC-level, individual consumer purchase data that underpin our tax pass-through estimates. The reduced-form regression of pre-tax (i.e., tax-exclusive) unit prices on the grocery sales taxes is:

$$(1)\ \ln(p_{uijm}) = \beta_0 + \beta_1 \tau_{jm} + \eta C_{jm} + \theta X_{im} + \delta_j + \varphi_m + \alpha_u + \varepsilon_{uijm}$$

where $\ln(p_{uijm})$ is the natural logarithm of the pre-tax (i.e., tax-exclusive) price paid for food product (UPC code) u by household i in county j in month (and year) m. The ad-valorem tax for food groceries in county j and in month m, τ_{jm}, expressed in percentage terms is our key variable of interest. Per Besley and Rosen (1999), the semi-log specification allows us to assess the degree of tax pass-through; a positive β_1 indicates over-shifting.[5] We include the vector C_{jm}

[4] https://www.ams.usda.gov/resources/price-formulas

[5] Note that we do not include any measure of market power – like the Herfindahl index – due to endogeneity to the same conditions that might cause grocery taxes and because the relationship between market concentration and prices is fundamentally ambiguous even in the presence of market power (Berry et al. 2019).

to account for measurable cost-of-living differences, including median apartment rent, average commercial electricity rate, and state minimum wage (Leung 2021). X_{im} is a vector of household characteristics, including income, and household head race and educational attainment. We also include fixed effects to control for time-invariant mean differences in prices across county (δ_j), UPC (α_u), and month-year (φ_m). The error term is ε_{uijm} has the usual properties. Standard errors are clustered at the county level to alleviate concerns about residual serial correlation. Using product and county fixed effects, our identification comes from within-product price changes in response to within-county tax changes over time.

We also estimate a version that includes household fixed effects as a robustness check; most household characteristics necessarily drop out because they do not change over time. Since those characteristics – e.g., race, income category – hold considerable interest, our preferred specification does not include household fixed effects. We also interact household characteristics and store-specific retail channel information with grocery taxes so as to test for potentially heterogenous price responses across customers (where White, low-income households are the baseline category) or store channels, with grocery stores as the benchmark to compare against discount stores, Warehouse Clubs, convenience stores, dollar stores, and drug stores.

Grocery Tax Pass-Through Estimates

The first column of Table 1 displays the main baseline results. The estimated β_1 coefficient is 0.338, significant at the one percent level. Food retailers significantly over-shift grocery taxes to retail consumers through price markups, on average. Following Besley and Rosen (1999) we can estimate how much the tax-exclusive retail price increases per dollar of added government tax revenue. For our baseline model (Table 1, column 1), one dollar of grocery tax revenue to government increases the retail tax-inclusive price paid by consumers by $1.25, on average, across all grocery foods.

Across robustness checks (Table A4) with (1) no household fixed effect nor household-level control variables, (2) household fixed effects with no other household-level controls, and (3) demographic and other control variables with household fixed effects, the β_1 estimated coefficient remains positive, statistically significant, and quite similar in magnitude, ranging from 0.265 to 0.396, none significantly different from our baseline estimates.

We test for heterogeneous grocery tax over-shifting by interacting the grocery tax variable with household characteristics, store characteristics, or both (Table 1, columns 2-5). The highest income levels experience a statistically significant 23 percent lower grocery tax pass through than the lowest income households (column 2). This result may seem counter-intuitive since the price elasticity of food demand typically declines (in absolute value) with income. This may reflect lower income households having less flexibility to travel to alternative food retail outlets, as compared to higher income households, although we cannot test this hypothesis with these data. That conjecture is consistent, however, with the striking heterogeneity we see in grocery tax over-shifting by store type. We find that drug stores, discount stores, warehouse club stores, and especially dollar stores – all disproportionately frequented by lower-income consumers – all over-shift grocery taxes significantly more than do grocery stores or convenience stores. The estimated tax coefficient for discount stores (column 3) is one-third higher than grocery stores, that for warehouse stores is 62 percent higher, and that for dollar stores is 126 percent more.

The store categories that have the highest rates of grocery tax over-shifting are frequented disproportionately by White households. Indeed, we find that households with Black heads experience only half the pass-through rate of those with White heads, and those with Other Race (mainly Native American) heads face no statistically significant grocery tax pass through at all (column 4). Once we control for income, race and store type, the heterogeneity by income shrinks in magnitude and becomes statistically insignificant while the racial differences increase both in magnitude and proportional to the baseline white, lower-income households (column 5).

Considerable variation in tax shifting exists among major product categories. Table A5 and Figure 1 show the estimates that come from interacting the grocery tax with various product categories (spreads, jellies, and jams are the baseline product group). Fresh milk products have the highest over-shifting. This is not surprising because fresh milk products are perishable staples and tend to be among the most price inelastic of all grocery items, with estimated price elasticities of -0.045 (Kaiser, Streeter, and Liu, 1988), -0.039 (Schmit and Kaiser, 2004), and -0.154 (Zheng and Kaiser, 2008). For milk products, an increase in the ad valorem tax rate equivalent to one dollar of tax revenue increases the retail tax-inclusive milk price by $1.59.

At the opposite extreme, frozen unprepared meat and seafood have the lowest tax incidence for consumers. For that product category, a tax increase equivalent to one dollar raises the tax-inclusive price by only $0.70; retailers absorb a non-trivial portion of the tax burden. A similar result holds for salads and deli, where one dollar of tax revenue raises the tax-inclusive price by $0.77. These latter two results reflect product categories with significantly greater price elastic demand; for example, recent estimates for deli ham range from –1.3 to -1.6 (Lusk and Tonsor, 2016).

Of the 40 different food product categories we study (Table A5), only two – deli salads and prepared foods, and unprepared frozen meat – exhibit evidence of incomplete grocery tax pass-through to consumers. Taxes pass through fully on baking mix products, i.e., there is no over-shifting but the full grocery tax incidence falls on consumers. We find statistically significant evidence of grocery tax over-shifting for the other 37 product categories. The magnitudes vary, but the breadth of the grocery tax over-shifting effect is striking.

Model Diagnostic Checks

We subject these estimates to a range of robustness checks, reported in the Online Appendix. First, we assumed that grocery taxes are exogeneous, following prior studies on sales taxes (Rohlin and Thompson, 2018; Zheng et al., 2021; Zhao et al., 2021). We exploit the panel nature of the data to conduct a placebo test in which we add future tax rates, τ_{jm+1} , to equation (1):

$$(2)\ \ln(p_{uijm}) = \beta_0 + \beta_1\tau_{jm} + \beta_2\tau_{jm+1} + \eta C_{jm} + \theta X_i + \delta_j + \varphi_m + \alpha_u + \varepsilon_{uijm}.$$

If the grocery tax is strictly exogeneous, then prices should not respond to future tax changes, i.e., β_2 should equal zero. As shown in Table A6, the β_2 estimate is indeed statistically insignificantly different from zero, while the β_1 remains substantially unchanged and statistically significant at the 1% level.

Second, our model requires parallel trends across counties since in essence it is a differences-in-differences estimator. So, we include county-specific time trends:

$$(3)\ \ln(p_{uijm}) = \beta_0 + \beta_1\tau_{jm} + \eta C_{jm} + \theta X_i + \beta_j(\delta_j * trend) + \delta_j + \varphi_m + \alpha_u + \varepsilon_{uijm}$$

where $\delta_j * trend$ is the county-specific, monthly linear trend. We also try county-specific quarterly and annual linear trends. If the estimated tax impact is not sensitive to the inclusion of county-specific trends, that reinforces the credibility of our findings. Appendix Table A7 shows our tax coefficients change little in magnitude, and not at all in statistical significance, from the version that does not include county-specific trends.

We also estimate an event study model. During our study period, several counties and states changed grocery sales tax rates multiple times. These multiple treatments could confound inference, so we restrict analysis to only the 144 counties that increased their grocery tax only once in our study period and compare these to a control group of counties with no grocery tax. The event study plots of the post-treatment effects (up to six months after) are consistent with our main results (Figure A2). After a county observed its only tax increase over the decade, tax-exclusive food prices increased, significantly so in two out of six months, even with the low power of this small subsample. No statistically significant pre-trend exists. We also find that the post-change tax increase estimates are equal to or higher than the corresponding tax decrease estimates (Figure A3). While this suggests the possibility of asymmetry consistent with the exercise of market power, the difference is not statistically significant, possibly due to insufficient power to detect such asymmetries given only 144 positive counties and 181 negative changes in the data.

Finally, we conduct a placebo test in which we randomize the assignment of grocery taxes among counties, keeping the other independent variables unchanged. This mechanically breaks the hypothesized causal correlation between grocery taxes and pre-tax prices in each county, generating a randomized pseudo-treatment that should have no impact on pre-tax food prices unless some spurious correlation exists (Christian and Barrett 2024). We bootstrap the grocery tax variable 500 times and plot the kernel densities of the resulting coefficient estimates and their *p*-values in Figure A4, and report results in Table A8. In only 4% of the 500 regression instances (20 times), did we observe p-values under 0.05. This exercise suggests that the estimated impact of grocery taxes on pre-tax food prices is not spurious. All in all, our core results stand up well to all the robustness checks we tried.

Who Captures the Tax Over-Shifting Revenue Windfall?

Our main finding is that food retailers significantly over-shift grocery taxes to consumers. For all food items, on average, the results indicate that an ad valorem tax sufficient to raise one dollar of revenue increases the retail tax-inclusive price by $1.25. Grocery food taxes create a significant revenue windfall for food retailers. For instance, in Alabama, grocery food taxes raised $500 million in 2021.[6] That implies an estimated windfall of $140 million to grocery retailers in the state that year. In Mississippi, the 7% tax on food generates between $267 million and $315 million annually in tax revenue for the state, but also an extra $75-88 million for grocery retailers due to over-shifting.[7] Other states' estimated tax revenue yield and grocery retailers' windfall revenue increases net of tax payments are shown in Table 5.

These estimates raise an important question. Do food retailers keep all this windfall? Or does some of it pass on to their workers and/or to farmers upstream in the marketing chain?

A. Earnings of Grocery Store Workers

To answer the first part of that question, we regress earnings by food retail outlet employees on the grocery food tax and a similar set of country-level covariates used as control variables in the prior regressions:

$$(4)\ \ln\left(Earnings_{ijq}\right) = \beta_0 + \beta_1 \tau_{jq} + \eta C_{jq} + \delta_j + \alpha_i + \gamma_q + \varepsilon_{ijq}$$

where the dependent variable is the logarithm of the average earnings of employees in food stores in industry i in county j in quarter (and year) q. The variable τ_{jq} is the ad-valorem grocery

[6] https://wbhm.org/2021/why-alabama-lawmakers-just-wont-give-up-the-grocery-tax/
[7] https://mississippitoday.org/2021/01/21/key-house-leader-says-mississippi-should-cut-highest-in-nation-grocery-tax/)

tax, C_{jq} is again a vector of measurable cost-of-living differences, and we include county, industry, and quarter-year fixed effects. The standard errors are clustered at the county level.

The main finding is that the grocery food taxes have no impact on food retail worker earnings (Table 3). We also run this regression separately by food store types, including grocery and merchant wholesalers, conventional grocery stores, specialty food stores, and warehouse clubs. We find no significant impact of the grocery food tax on average worker earnings in any type of retail food outlet (Table A9). Although half of the revenue accruing to food retailers is accounted for by labor costs (USDAERS, 2023), none of the significant revenue windfall food retailers enjoy for grocery tax over-shifting accrues to their workers.

B. Farmer Milk Prices

Food price changes induced by grocery taxes might impact the prices farmers in that county receive for commodities, perhaps especially for relatively lightly processed products like fresh, fluid milk, the food with the highest estimated grocery tax pass-through rate. We therefore estimate the pass-through of grocery taxes to the Class I milk prices as follows:

(5) $\ln(PI_{jm}) = \beta_0 + \beta_1 \tau_{jm} + \eta C_{jm} + \delta_j + \varphi_m + \varepsilon_{jm}$

where the dependent variable is the logarithm of the Class I milk price in county *j* and month (and year) *m*, constructed by combining the national minimum monthly price and the county price differential. The rest remains the same as in the earnings model.

The results of the milk price model show that grocery food taxes have no impact on Class I milk prices (Table 4). Indeed, the point estimates are consistently negative and insignificant. Despite the tax-inclusive price of milk rising an estimated \$1.59 for every dollar of grocery tax revenue raised, and more than half of retail fluid milk prices flowing back to farmers, on average, dairy farmers do not seem to receive a higher price due to grocery taxes.

Discussion

We find that food retailers significantly over-shift grocery taxes onto consumers. We also find evidence of heterogeneous tax pass through based on consumer income and race, as well as by type of retail outlet. Specifically, African American and Other Race (i.e., Native American) households face significantly lower tax over-shifting than low-income White households do, while retailers that generally offer lower prices– i.e., warehouse, discount, and dollar stores – more substantially over-shift grocery taxes onto customers than grocery or convenience stores do. Tax pass-through rates also vary among food product categories. Highly price inelastic demand product categories like milk exhibit the greatest over-shifting while more price elastic products like frozen, unprepared meat and seafood had the lowest tax pass through.

Finally, although food retailers enjoy considerable windfall revenue from grocery tax over-shifting, food retail workers and dairy farmers do not share any of this incremental revenue. By process of elimination, it appears that food retailers accrue all the windfall gains from the grocery tax.

The major implication of these results is that sales taxes on foods appear even more regressive than previously thought. Not only does the flat, ad valorem rate feature of grocery sales taxes harm lower income relative to higher income households because the poor spend a larger share of their income on food, but we show that grocery taxes also increase tax-exclusive foods prices, and disproportionately so for lower-income households, especially those shopping at discount, dollar and warehouse format food retail outlets.

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Figure 1. Grocery Tax Pass-Through Rates by Food Categories

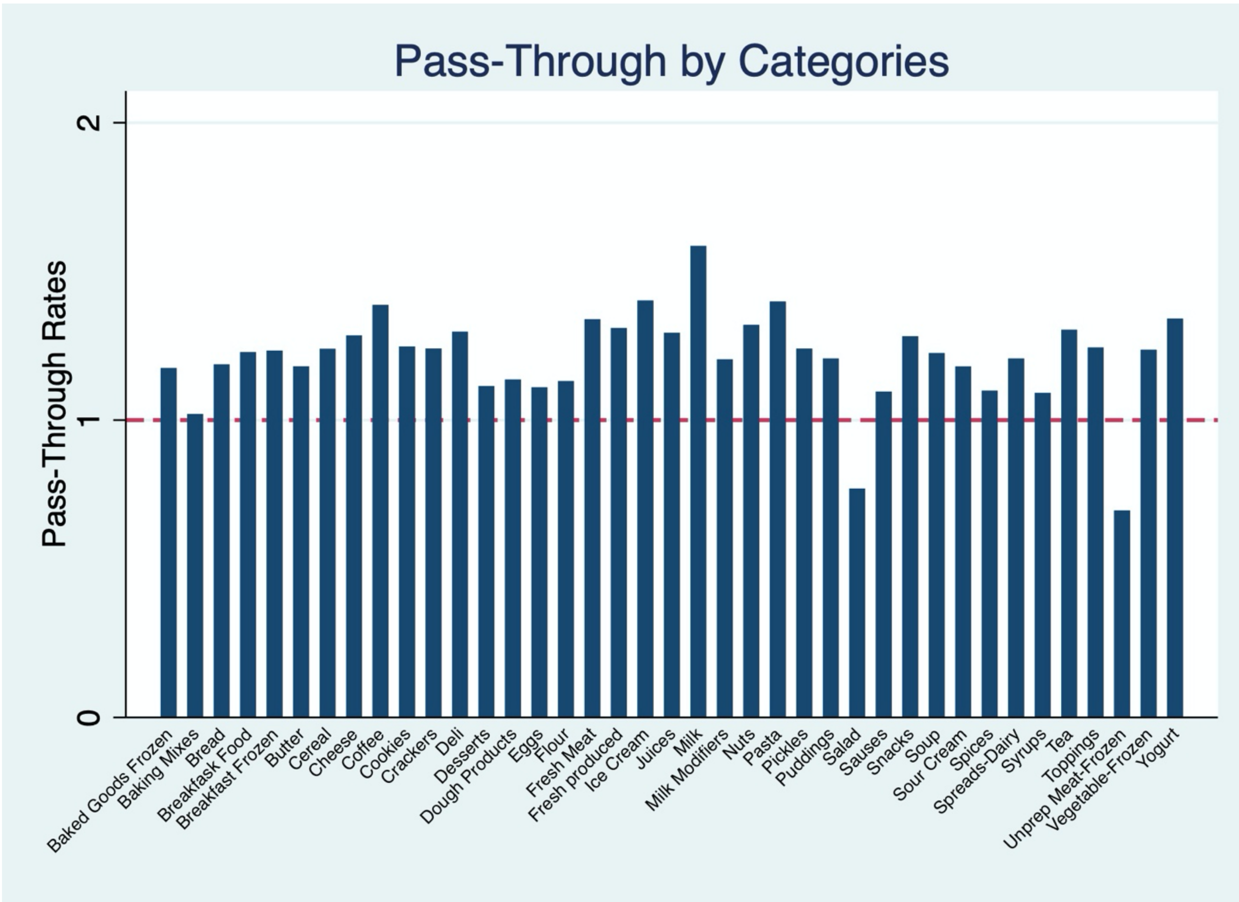

Table 1. Regression Results on Tax Pass-through, by Household Demographics and Store Channels

Dependent Variable: ln (Pre-tax Unit Price)	(1) Baseline Result	(2) By Income	(3) By Store Types	(4) By Race	(5) All Interaction Terms
Grocery Tax	0.338***	0.381***	0.189	0.372***	0.265**
	(0.124)	(0.131)	(0.125)	(0.124)	(0.129)
Grocery Tax * Median Income		-0.041			-0.029
		(0.047)			(0.046)
Grocery Tax * High Income		-0.086*			-0.071
		(0.052)			(0.051)
Grocery Tax * Discount Stores			0.336***		0.337***
			(0.052)		(0.051)
Grocery Tax * Warehouse Club			0.620***		0.627***
			(0.108)		(0.108)
Grocery Tax * Convenience Store			-0.056		-0.04
			(0.421)		(0.421)
Grocery Tax * Dollar Store			1.257***		1.265***
			(0.197)		(0.196)
Grocery Tax * Drug Store			0.312*		0.324***
			(0.157)		(0.324)
Grocery Tax * Black				-0.181***	-0.215***
				(0.067)	(0.065)
Grocery Tax * Hispanics				0.055	0.038
				(0.088)	(0.088)
Grocery Tax * Asians				-0.077	-0.069
				(0.171)	(0.171)
Grocery Tax * Other Races				-0.282**	-0.303***
				(0.113)	(0.112)
Month Fixed Effects	Y	Y	Y	Y	Y
County Fixed Effects	Y	Y	Y	Y	Y
UPC Fixed Effects	Y	Y	Y	Y	Y
Household Fixed Effects	N	N	N	N	N
Household Characteristics	Y	Y	Y	Y	Y
Country-Level Economic Controls	Y	Y	Y	Y	Y
Number of Clusters	2,894	2,894	2,894	2,894	2,881

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. N=14,383,111.

Table 2. Estimated Pass-through to Average Worker Earnings

	(1)	(2)	(3)	(4)
Dependent Variable: ln (Earnings)				
Grocery Tax	-0.668	-0.557	-0.223	0.107
	(1.022)	(0.643)	(0.638)	(0.682)
Commercial Electricity Price			-0.007**	-0.001
			(0.003)	(0.003)
Median Rent			0.0005***	0.0009***
			(0.00005)	(0.00005)
Minimum Wage			0.004	0.008**
			(0.003)	(0.004)
Year FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
County Trend	N	Y	Y	N
Economic Controls	N	N	Y	Y
Number of Clusters	2,693	2,693	2,693	2,693
N	149,328	149,328	134,279	134,279

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table 3. Estimated Pass-through to Class 1 Milk Prices

	(1)	(2)	(3)	(4)
Dependent Variable: ln (Class 1 Milk Price)				
Grocery Tax	-0.299	-0.290	-0.271	-0.290
	(0.320)	(0.329)	(0.413)	(0.398)
Commercial Electricity Price			0.0003	0.0003
			(0.003)	(0.0003)
Median Rent			-0.00003	-0.00002
			(0.00003)	(0.00003)
Minimum Wage			0.002	0.002
			(0.002)	(0.002)
Year FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
County Trend	N	Y	Y	N
Economic Controls	N	N	Y	Y
Number of Clusters	2,893	2,893	2,893	2,893
N	373,320	373,320	373,311	373,311

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table 4. Grocery Revenue for Stores Located in State-Wide Positive Grocery Taxes in 2019

States	Tax Revenue (Million USD)	Revenue Windfall (Million USD)	Does the State Tax Food at the Full Rate?	Proposed to Lift Food Sales Taxes in 5 Years?
AL	500	665	YES	NO
AR	450	598	NO	NO
HI	270	359	YES	NO
ID	79	105	YES	NO
IL	400	532	NO	YES
KS	450	598.5	YES	YES
MO	70	93.1	NO	NO
MS	315	418.9	YES	NO
NC	400	532	YES	NO
OK	300	399	YES	NO
SD	104	138.3	YES	NO
TN	272	361.7	NO	NO
UT	200	266	NO	VOTE PENDING
VA	600	798	NO	YES

*Alaska, Georgia, Louisiana, and South Carolina exempt food sales taxes at the state level, but groceries can still be subject to local (city- or county-level) sales taxes.

*Sources: State Departments of Revenue, tax.org, and taxfoundation.org.

Appendix

Figure A1. Transactions by NielsenIQ Department

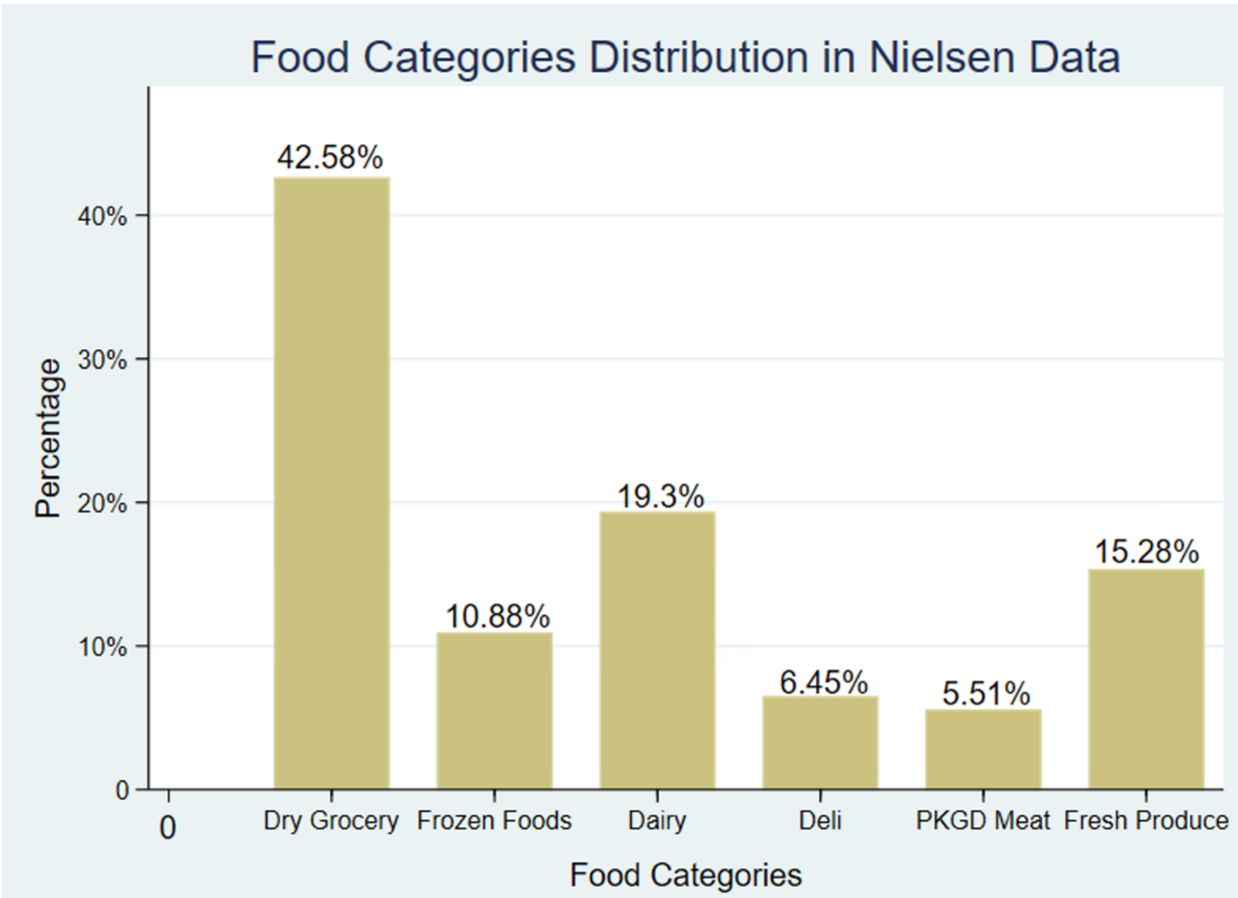

Figure A2. Event Study of Single Tax Increase

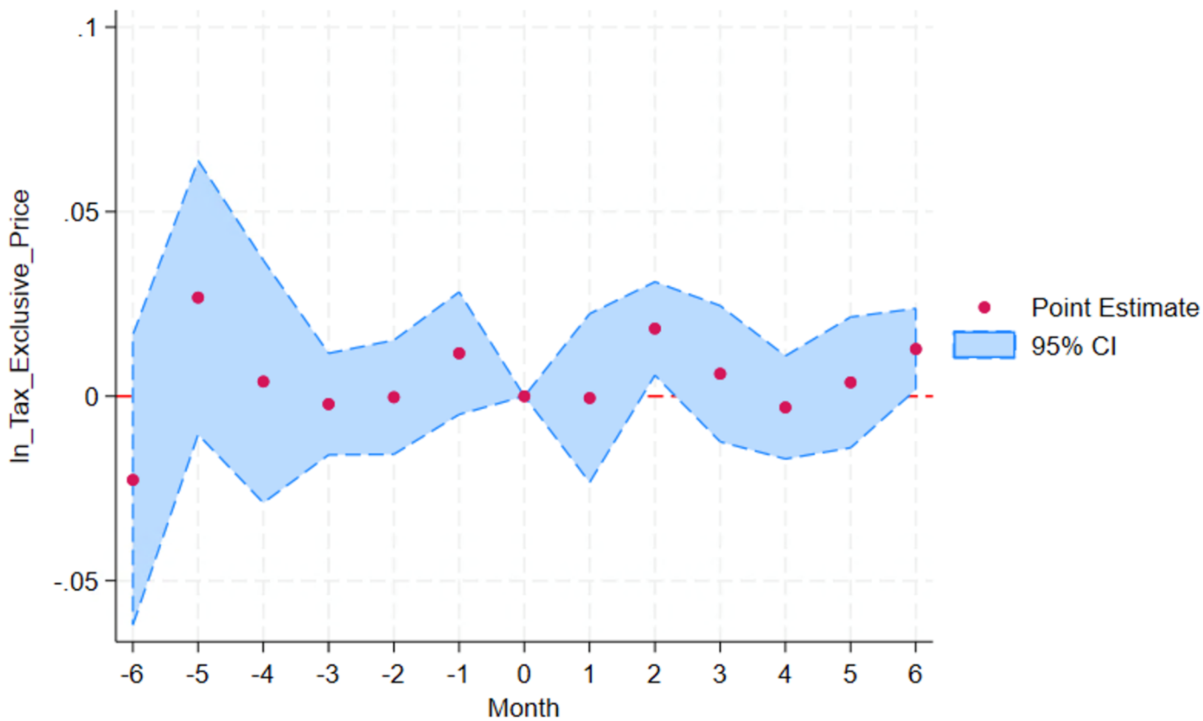

Figure A3. Event Study of Grocery Tax Increase vs Decrease

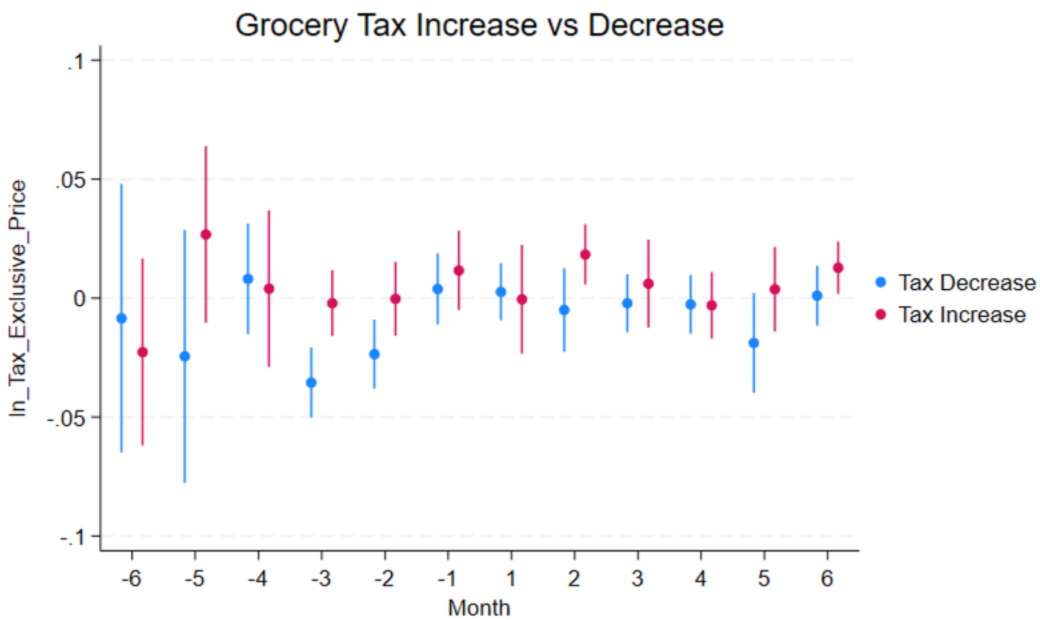

Figure A4. Distribution of Placebo Test Coefficient Estimates

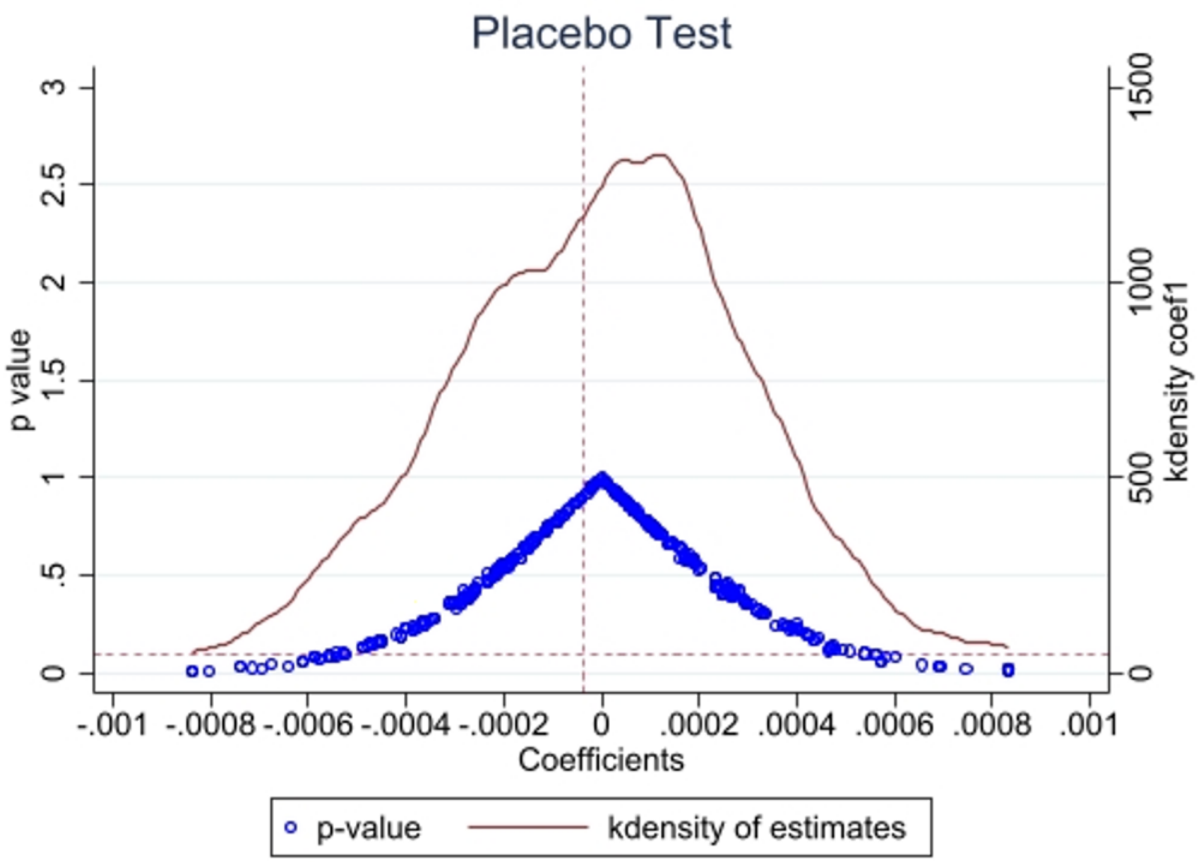

Table A1. States With Food Sales Taxes in 2019

State	Min Food Tax Rate	Max Food Tax Rate	Mean Food Tax Rate	# Counties with Food Sales Tax	# Counties with NO Food Sales Tax	Mean General Sales Tax Rate	Tax Food at Reduced Rate	Counties Follow Home Rule
AL	4%	9%	6.19%	67	0	6.19%	N	Y
AK	2.5%	7%	5.4%	16	13	5.4%	N	Y
AR	1.5%	4.75%	3.2%	75	0	8.21%	Y	Y
GA	1%	4%	3.4%	158	0	7.39%	Y	Y
HI	4%	4.5%	4.25%	5	0	4.25%	N	Y
ID	6%	6%	6%	44	0	6%	N	N
IL	1%	2.25%	1.09%	102	0	6.9%	Y	Y
KS	6.5%	8.73%	7.54%	105	0	7.54%	N	Y
LA	1%	6%	4.3%	60	4	9.41%	Y	Y
MS	7%	7%	7%	82	0	7%	N	N
MO	1.725%	4.91%	2.95%	114	0	5.94%	Y	Y
NC	2%	2%	2%	100	0	6.85%	Y	Y
OK	4.5%	7%	5.7%	77	0	5.7%	N	Y
SC	1%	3%	1.35%	34	12	7.91%	Y	Y
SD	4%	4%	4%	66	0	4%	N	N
TN	5.5%	6.75%	6.51%	95	0	9.51%	Y	Y
UT	3%	3%	3%	25	0	6.46%	Y	Y
VA	2.5%	2.5%	2.5%	95	0	5.35%	Y	Y

Note: The other states did not collect food sales taxes from 2010 to 2019.

Table A2. States with Food Sales Tax Changes from 2010 to 2019

State	Min Change	Max Change	# Counties Changed Tax	# Times Tax Changes in State	# Counties Did NOT Change Tax
AL	-2%	1%	19	24	48
AK	0	1%	3	3	15
AR	-1%	2%	75	137	0
GA	0	3%	185	257	1
IL	0	1.25%	6	6	96
KS	-0.15%	2%	105	327	0
LA	-1.55%	1%	11	11	49
MO	0	2.5%	87	148	27
OK	0	1.25%	44	60	33
SC	0	1%	3	3	31
TN	-1%	0.5%	95	284	0
WV	-1%	0	55	110	0

Note: The other states did not change food sales tax rates from 2010 to 2019.

Table A3. Descriptive Statistics of Analysis Variables

Variable	# Observations	Mean	SD
Total Grocery Taxes		0.009	0.019
Household Income			
< $30,000		0.175	0.379
$30,000-$69,999		0.422	0.494
≥ $70,000		0.403	0.491
Race			
White		0.807	0.394
Hispanic		0.060	0.238
Black		0.084	0.277
Asian		0.026	0.160
Other Race		0.023	0.022
Head Education			
Less than HS		0.021	0.142
HS Graduate		0.246	0.431
Some College		0.305	0.460
Bachelor and plus		0.429	0.495
Store Channels			
Grocery Store		0.626	0.484
Discount Store		0.190	0.392
Warehouse Club		0.044	0.205

Convenience Store		0.004	0.060
Dollar Store		0.017	0.128
Drug Store		0.009	0.091
Market Consentration			
HHI_sales		0.548	0.345
Monthly Ave. Wages			
Food Retails Total		2366.628	1964.817
Grocery Stores		2342.740	536.806
General Merchandise		2340.491	522.744
Grocery Wholesales		2424.327	3945.604
Specialty Food Stores		2364.096	462.077
Milk			
Regulated Milk Price		19.922	2.525
# Transactions	15,825,274		
# Households	145,794		
# UPC Codes	329,678		

Table A4. Baseline Regression Results with Different Specifications

Dependent Variable: ln (Pre-tax Unit Price)	(1) No Household or Demographics	(2) Household FE	(3) Household FE + Demographics
Grocery Tax	0.396***	0.283**	0.265**
	(0.114)	(0.112)	(0.117)
Year FE	Y	Y	Y
Month FE	Y	Y	Y
County FE	Y	Y	Y
UPC FE	Y	Y	Y
Household FE	N	Y	Y
Demographics	N	N	Y
Store Channels	N	N	Y
Number of Clusters	2,894	2,894	2,894
N	15,825,274	15,824,881	14,382,738

Table A5. Interactions by Product Categories

Dependent Variable: Ln (Pre-Tax Unit Price)	(1) No Trend or Controls	(2) County Trend	(3) Controls	(4) Trend + Controls
Total Grocery Tax	0.321**	0.319***	0.314**	0.307**
	(0.126)	(0.129)	(0.148)	(0.139)
Grocery Tax * Product Category (Baseline Product = Jams, Jellies, Spreads)				
1. Dry Grocery				
1.2 Soup	0.007	0.007	-0.023	-0.027
	(0.071)	(0.071)	(0.076)	(0.077)
1.3 Baking Mixes	-0.213***	-0.209***	-0.293***	-0.290***
	(0.071)	(0.071)	(0.075)	(0.075)
1.4 Breakfast Food	0.045	0.044	-0.018	-0.022
	(0.085)	(0.085)	(0.094)	(0.094)
1.5 Cereal	0.048	0.047	0.001	0.0008
	(0.077)	(0.077)	(0.087)	(0.088)
1.6 Coffee	0.293**	0.312**	0.318**	0.336**
	(0.124)	(0.123)	(0.147)	(0.144)
1.7 Condiments, Gravies, and Sauces	-0.183***	-0.176**	-0.208***	-0.205***
	(0.069)	(0.070)	(0.076)	(0.077)
1.8 Desserts, Gelatins, Syrup	-0.147**	-0.142**	-0.185**	-0.181**
	(0.073)	(0.074)	(0.082)	(0.083)
1.9 Flour	-0.165*	-0.163*	-0.163	-0.168*
	(0.092)	(0.093)	(0.100)	(0.101)
1.10 Nuts	0.180**	0.193**	0.157*	0.163**
	(0.078)	(0.078)	(0.082)	(0.081)
1.11 Packaged Milk and Modifiers	0.034	0.025	-0.057	-0.066
	(0.075)	(0.074)	(0.078)	(0.077)
1.12 Pasta	0.374***	0.371***	0.349***	0.340***
	(0.086)	(0.086)	(0.102)	(0.103)
1.13 Pickles, Olives, and Relish	0.041	0.046	0.002	0.002
	(0.077)	(0.077)	(0.078)	(0.080)
1.14 Spices, Seasoning, Extracts	-0.168**	-0.165**	-0.204***	-0.210***
	(0.073)	(0.074)	(0.079)	(0.079)
1.15 Table Syrups, Molasses	-0.132	-0.136	-0.213**	-0.219**
	(0.089)	(0.090)	(0.093)	(0.094)
1.16 Tea	0.137*	0.139*	0.122	0.120
	(0.072)	(0.072)	(0.082)	(0.081)
1.17 Bread and Baked Goods	-0.053	-0.044	-0.084	-0.080
	(0.077)	(0.077)	(0.086)	(0.084)
1.18 Cookies	0.042	0.040	0.015	0.007
	(0.076)	(0.075)	(0.081)	(0.079)
1.19 Crackers	0.017	0.018	0.003	-0.003
	(0.008)	(0.081)	(0.091)	(0.089)
1.20 Snacks	0.131*	0.137*	0.079	0.082
	(0074)	(0.072)	(0.081)	(0.078)
2. Frozen Foods				

2.1 Baked Goods-Frozen	-0.006	0.0009	-0.102	-0.100
	(0.079)	(0.080)	(0.091)	(0.092)
2.2 Breakfast Foods-Frozen	-0.019	-0.007	-0.009	-0.002
	(0.075)	(0.076)	(0.084)	(0.085)
2.3 Desserts/Fruits/Toppings-Frozen	0.042	0.048	0.009	0.009
	(0.083)	(0.084)	(0.092)	(0.093)
2.4 Ice Cream, Novelties	0.389***	0.397***	0.359***	0.365***
	(0.078)	(0.079)	(0.086)	(0.087)
2.5 Juices, Drinks-Frozen	0.073	0.098	0.102	0.145
	(0.129)	(0.130)	(0.152)	(0.153)
2.6 Unprep Meat/Poultry/Seafood-Frzn	-0.543***	-0.518***	-0.547***	-0.529***
	(0.114)	(0.112)	(0.128)	(0.124)
2.7 Vegetables-Frozen	0.001	0.004	-0.004	-0.004
	(0.065)	(0.066)	(0.072)	(0.073)
3. Dairy				
3.1 Butter And Margarine	-0.062	-0.050	-0.093	-0.085
	(0.070)	(0.073)	(0.079)	(0.082)
3.2 Cheese	0.073	0.087	0.084	0.100
	(0.068)	(0.068)	(0.078)	(0.075)
3.3 Cot Cheese, Sour Cream, Toppings	-0.048	-0.051	-0.094	-0.094
	(0.071)	(0.072)	(0.074)	(0.074)
3.4 Dough Products	-0.107	-0.106	-0.156*	-0.161*
	(0.085)	(0.087)	(0.095)	(0.096)
3.5 Eggs	-0.113	-0.104	-0.190*	-0.182*
	(0.099)	(0.098)	(0.111)	(0.109)
3.6 Milk	1.102***	1.106***	1.100***	1.107***
	(0.130)	(0.123)	(0.142)	(0.130)
3.7 Pudding, Desserts-Dairy	-0.071	-0.074	-0.053	-0.055
	(0.139)	(0.139)	(0.171)	(0.171)
3.8 Snacks, Spreads, Dips-Dairy	0.110	0.117	-0.053	-0.044
	(0.107)	(0.109)	(0.115)	(0.117)
3.9 Yogurt	0.207***	0.211***	0.204**	0.208***
	(0.072)	(0.071)	(0.080)	(0.079)
4. Deli				
4.1 Dressings/Salads/Prep Foods-Deli	-0.417***	-0.389***	-0.501***	-0.476***
	(0.135)	(0.137)	(0.154)	(0.157)
5. Packaged Meat				
5.1 Packaged Meats-Deli	0.111	0.126	0.109	0.123
	(0.076)	(0.073)	(0.086)	(0.080)
5.2 Fresh Meat	0.220***	0.239***	0.199***	0.214***
	(0.066)	(0.066)	(0.075)	(0.074)
6. Fresh Produce				
6.1 Fresh Produce	0.199	0.203	0.135	0.139
	(0.157)	(0.133)	(0.178)	(0.139)

Year FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
UPC FE	Y	Y	Y	Y
Demographics	Y	Y	Y	Y
County Trends	N	Y	N	Y
Economic Controls	N	N	Y	Y
Number Of Clusters	2,894	2,894	2,693	2,693
N	15,822,571	15,820,365	13,239,830	13,236,650

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table A6. Strict Exogeneity Test

	(1)
Dependent Variable: ln (Pre-tax Unit Price)	
Grocery Tax in the current year	0.387***
	(0.113)
Grocery Tax in one year later	0.176
	(0.110)
Year FE	Y
Month FE	Y
County FE	Y
UPC FE	Y
Household FE	N
Demographics	Y
Store Channels	Y
Number of Clusters	2,894
N	12,341,097

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table A7. County Group Specific Trends

Dependent Variable: ln (Pre-tax Unit Price)	(1) County Linear Trend by Year	(2) County Linear Trend by quarter	(3) County Linear Trend by month
Grocery Tax	0.420**	0.402**	0.404**
	(0.178)	(0.179)	(0.179)
Year FE	Y	Y	Y
Month FE	Y	Y	Y
County FE	Y	Y	Y
UPC FE	Y	Y	Y
Household FE	N	N	N
Demographics	Y	Y	Y
Store Channels	Y	Y	Y
Number of Clusters	2,894	2,894	2,894
N	15,822,571	15,822,571	15,822,571

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table A8. Placebo Test based on Shuffling Taxes

	(1)
Dependent Variable: ln (pre-tax prices)	
Grocery Tax	-0.000000375
	(0.00033)
Year FE	Y
Month FE	Y
County FE	Y
County Trend	N
Economic Controls	Y
Number of Clusters	2,894
N	14,382,738

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.

Table A9. The Average Earnings Model by Industry

Dependent Variable: ln (Earnings)	(1) Grocery and Merchant Wholesalers	(2) Grocery Stores	(3) Specialty Food Stores	(4) Warehouse Clubs
Grocery Tax	-0.759	-0.215	1.115	0.748
	(1.551)	(0.798)	(0.978)	(1.063)
Commercial Electricity Price	-0.0003	-0.007	0.003	0.004
	(0.008)	(0.005)	(0.007)	(0.005)
Median Rent	0.0001	0.00003	0.00008	0.0001
	(0.00009)	(0.00007)	(0.00006)	(0.00008)
Minimum Wage	0.004	0.002	-0.001	-0.004
	(0.006)	(0.005)	(0.006)	(0.004)
Year FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
County Trend	N	N	N	N
Economic Controls	Y	Y	Y	Y
Number of Clusters	2,180	2,664	1,998	2,615
N	31,612	35,825	33,103	33,739

Note: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the county level. FE stands for fixed effects.