Food Taxes and Their Impacts on Food Spending

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Abstract

Sales taxes on foods sold at grocery stores and/or restaurants exist in almost every county in the United States. By combining county-level sales tax data with U.S. Department of Agriculture's (USDA) 2012–13 National Household Food Acquisition and Purchase Survey (FoodAPS), we examine the association between both types of taxes and a household's spending on grocery and restaurant foods for three groups: USDA Supplemental Nutrition Assistance Program (SNAP) participants, households that are eligible for SNAP but do not participate in the program, and households that are not eligible for SNAP. We found that, among households that are eligible for SNAP but do not participate in the program, grocery taxes are associated with reduced spending on foods purchased for at-home consumption. No such association is found among the two other groups of households considered in this study, suggesting they are less sensitive to grocery taxes. SNAP households spend more money on foods purchased for at-home consumption in communities with higher restaurant taxes.

Keywords: Food tax, restaurant tax, grocery taxes, food expenditure, Supplemental Nutrition Assistance Program, SNAP, FoodAPS, food at home, FAH, food away from home, FAFH

Acknowledgments

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What Is the Issue?

State and local governments levy sales taxes to raise revenue for essential public services like schools and fire and police departments. These taxes typically apply to products bought at retail stores or online, such as clothes, computers, and automobiles. Most State and local governments exempt food purchases; some do not. Grocery taxes are more common in Southeast and Midwest States, such as Alabama, Arkansas, Kansas, Mississippi, Missouri, and South Dakota. The average grocery tax rate in counties that tax groceries is between 4 and 5 percent. Most State and local governments, by contrast, do not exempt restaurant meals and other types of food-away-from-home (FAFH). Indeed, restaurant taxes typically meet or exceed the general sales tax rate, which averages 6.6 percent across counties that impose a sales tax.

Food taxes can affect a household's relative costs for eating at home versus dining out, which can in turn affect diet quality. Restaurant meals are generally more calorie-dense and can be nutritionally poorer (often lower in fiber, calcium, and iron) than meals prepared at home. If such taxes were to encourage households to consume more FAFH and less food-at-home (FAH), they might have unintended implications for consumers' caloric intake and overall diet quality.

What Did the Study Find?

Restaurant and grocery taxes can affect a household's food spending. However, households are not homogeneous. How they respond to each type of tax may depend on income and if they participate in the U.S. Department of Agriculture's (USDA) Supplemental Nutrition Assistance Program (SNAP). Among the key results, we find that:

- Grocery taxes are negatively associated with FAH spending among households that are income eligible for SNAP but do not participate in the program. A 1-percentage-point increase in grocery taxes from 3 to 4 percent (a 33-percent increase), for example, is associated with spending 0.7 percent less on FAH.

- No clear relationship exists between grocery taxes and FAH spending among SNAP recipients, likely because these households' benefits are shielded from grocery taxes. Federal laws and USDA regulations exempt food purchases made with SNAP benefits from State and local sales taxes.

- No clear relationship is found between grocery taxes and food spending among higher-income households. Higher-income households may be less sensitive to such taxes because food represents a smaller portion of their total budgets.

- Restaurant taxes are positively associated with FAH spending among SNAP households, although no significant relationship was detected between restaurant taxes and FAH spending among the two other groups of households considered in this study. A 1-percentage-point increase in restaurant taxes from 7 to 8 percent (a 14-percent increase), for example, is associated with spending about 3.9 percent more on FAH among SNAP households.

How Was the Study Conducted?

This study combines county-level sales tax data with data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS) and estimated statistical models to isolate the relationship between food taxes and food spending while controlling for potentially confounding factors. The control factors in the models accounted for a household's income and demographic characteristics, geographic variation in food prices, and other aspects of the food environment. Moreover, because different types of households can react differently to tax and price changes, the researchers estimated separate models for three distinct household types: SNAP participants, households that are income-eligible for SNAP but do not participate in the program, and households that are not income-eligible for SNAP (mostly higher-income households).

Consumers in about one-third of U.S. counties face grocery taxes, 2019
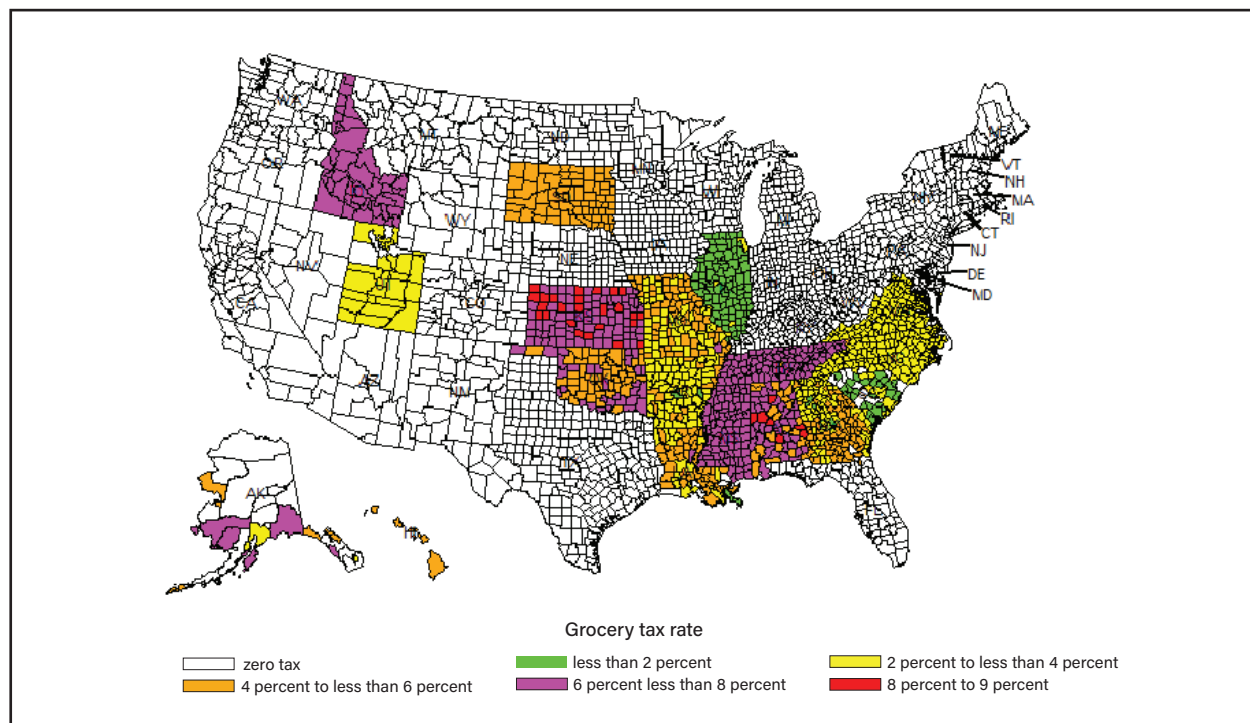
Source: USDA, Economic Research Service and collaborator calculation compilations from public sales tax sources and State and county departments of revenue. These are the combined State and county tax rates. They do not reflect that some cities may impose additional taxes in addition to State and county taxes.

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Introduction

State and local governments across the U.S. levy a general sales tax in order to raise revenue for essential public services like schools and fire and police departments. Sales taxes typically apply to products bought at retail stores or online, such as clothes, computers, and automobiles. Foods sold for at-home consumption are often exempted. Most of the State and local governments exempt food-at-home (FAH) from taxation because doing otherwise could disproportionately burden lower-income households (e.g., Figueroa and Waxman, 2017; Povich, 2016; Johnson and Lav, 1998). However, most State and local governments do not exempt restaurant meals and other types of food-away-from-home (FAFH) from taxation.

Overall, most U.S. consumers are subject to restaurant taxes while consumers in about one-third of U.S. counties are also subject to grocery taxes (Zheng et al., 2019). In 2019, grocery taxes existed in 18 of the 50 States, with the highest being 9 percent (4 percent State plus 5 percent county) in Alabama's Tuscaloosa and Cullman counties, while Florida has no grocery taxes.

Food tax rates not only vary across different States, counties, and cities, but they can change over time. For example, Kansas had a statewide grocery tax rate of 6.15 percent in 2014. Moreover, Johnson County imposed its own 1.23 percent tax on groceries, making the combined grocery tax rate in that county 7.38 percent. By 2020, it was 7.98 percent (9.1 percent in Overland Park, KS, where the city imposes an additional 1.13 percent tax on top of the State and county rates).

Food taxes can affect a household's relative costs for eating at home versus dining out, which can in turn affect diet quality. Restaurant meals are generally more calorie-dense and can be nutritionally poorer (in many cases, lower in fiber, calcium, and iron) than meals prepared at home (e.g., Guthrie et al., 2002; Lin and Guthrie, 2012). If, by raising a household's relative costs for eating at home, grocery taxes encourage households to consume more of their meals and snacks away from home, they may have unintended implications for consumers' caloric intake and overall diet quality.

Two recent studies by USDA, Economic Research Service (ERS) and collaborators funded by ERS, Zheng et al. (2019) and Dong et al. (2020), examined the relationship between food taxes and food spending by U.S. households. Dong et al. (2020) studied these relationships for three distinct population groups: participants in USDA's Supplemental Nutrition Assistance Program (SNAP), households that are eligible for SNAP but do not participate in the program, and other households that are ineligible for SNAP (mostly higher-income households). In this report, we synthesized and expanded on the findings in both studies and provided more recent food tax data.

Food Taxes Across the United States

Consumers across the United States face myriad tax codes that can change over time and vary across, as well as within, States. Building on Zheng et al. (2019), we provide two maps showing tax rates for each U.S. county in 2019 (figures 1a and 1b). These are the combined State and county tax rates. Our data do not reflect the fact that some cities may impose additional taxes as these data were not available to us. Several sources were used to compile these data, including the Tax Information Portal and Sale-Tax websites. We further augmented our food tax data from these sources with a comprehensive search of State and county departments of revenue.

Grocery taxes are sales taxes imposed on foods at retail outlets such as grocery stores, supercenters, and convenience stores regardless of whether those foods are fresh or processed. Grocery taxes are a result of a State and/or county taxing groceries at the full or a reduced rate. In 2019, grocery taxes existed in 18 of the 50 States. Most of these counties were in Southeast States, such as Alabama, Mississippi, and Arkansas, or in Midwest States, such as Kansas, Oklahoma, and South Dakota (figure 1a). In counties that taxed groceries, the average combined grocery tax rate was 4.3 percent.

Few State and local governments exempt restaurant meals and other types of FAFH from sales taxes, which average 6.6 percent across counties with a sales tax. Indeed, restaurant taxes typically meet or exceed the general sales tax rate. In Kansas City, MO, for example, the general sales tax is 8.6 percent, including a combined State tax of 4.23 percent, a county tax of 1.25 percent, a city tax of 3 percent, and a special district tax of 0.13 percent. However, when eating in restaurants, diners pay an 11.1 percent tax rate. Restaurant taxes exist in all States except Delaware, New Hampshire, Montana, and Oregon (figure 1b).

Figure 1
(1a) U.S. food sales taxes, State and county combined, 2019
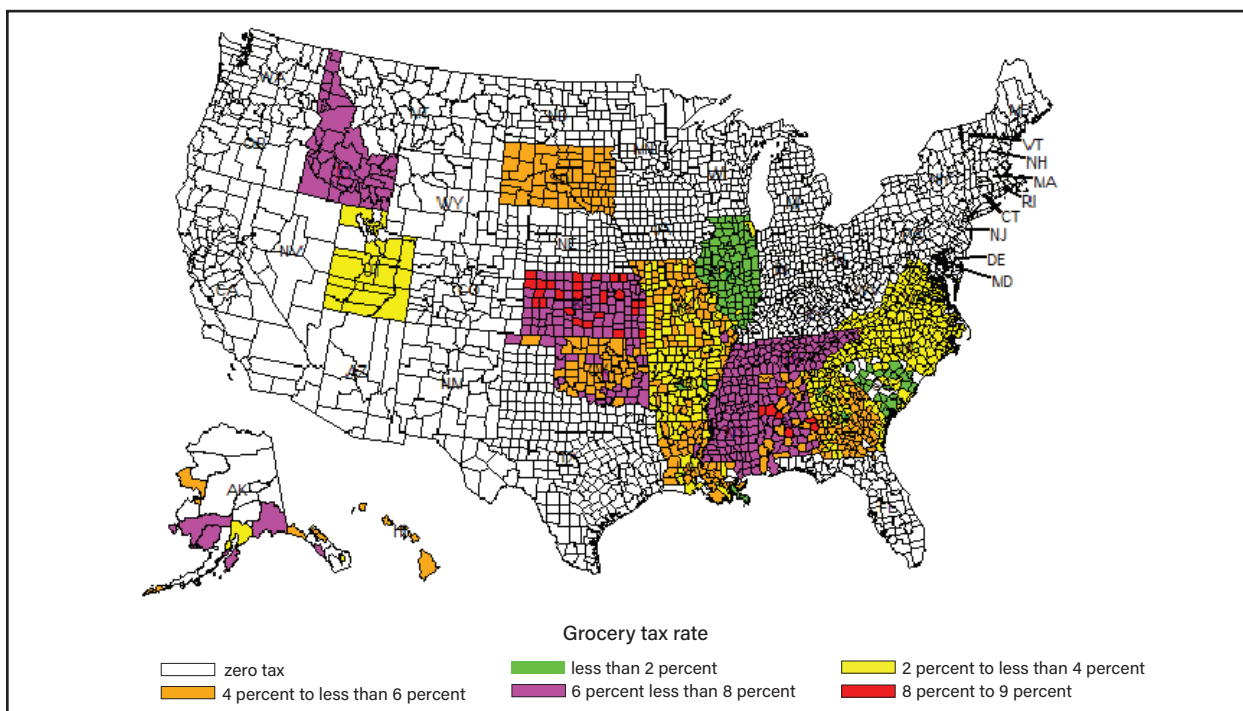
Source: USDA, Economic Research Service and collaborator calculations compiled by the authors from public tax and sales tax sources and State and county departments of revenue. These are the combined State and county tax rates. They do not reflect that some cities may impose additional taxes on top of any State and county taxes.

(1b) Restaurant food sales taxes
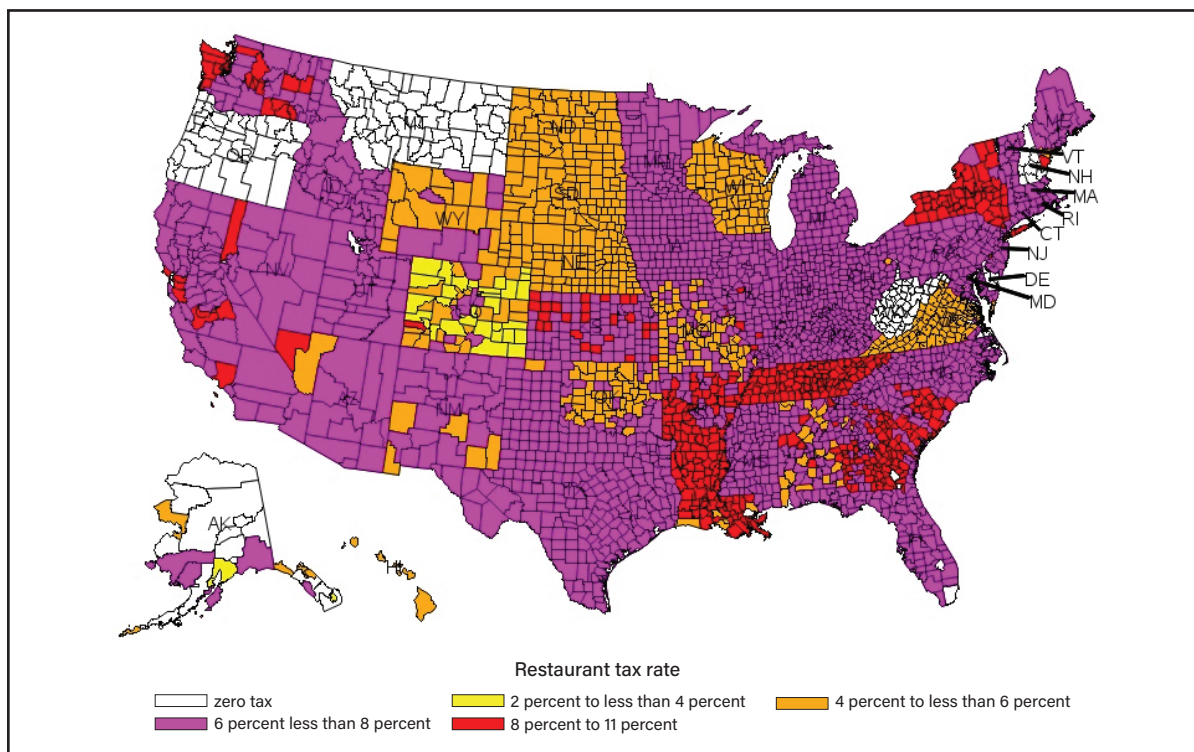
Restaurant tax rate

☐ zero tax	☐ 2 percent to less than 4 percent	☐ 4 percent to less than 6 percent
☐ 6 percent less than 8 percent	☐ 8 percent to 11 percent	

Source: USDA, Economic Research Service and collaborator calculations compiled by the authors from public tax and sales tax sources and State and county departments of revenue. These are the combined State and county tax rates. They do not reflect that some cities may impose additional taxes on top of any State and county taxes.

Food tax rates can change over time. To investigate how grocery taxes have evolved over a recent 5-year period, we compared data from 2019 with data from 2014. No States that taxed groceries in 2014 were found to have completely abolished those taxes by 2019, and we did not identify any States without a grocery tax in 2014 that introduced one. However, a few States and many counties did adjust their grocery tax rates. For example, Tennessee cut its State grocery tax rate by 1 percentage point from 5 to 4 percent. In Georgia, Clayton County reduced its grocery tax rate from 4 to 1 percent while Douglas County cut its tax from 3 to 1 percent. Other counties in Georgia, including Decatur and Lumpkin, raised their grocery tax rates by 1 percentage point. Randolph County in Alabama raised its grocery tax rate by 1.5 percentage points.

Food taxes and changes to them over time can lead to differences in households' relative costs for eating at home versus dining out. For example, in Kentucky's Fayette County, there is no county sales tax, and groceries are exempt from the 6 percent State sales tax, but restaurant food is not exempt. As a result, consumers living in Fayette County face at least a 6-percent tax differential between eating at home and having a similar meal away from home. But in Lee County in Alabama, groceries are subject to the same 4 percent State and 4 percent county sales taxes levied on restaurant food, providing no tax incentive for consumers to eat at home.

Impact of Food Taxes on Food Spending

If grocery taxes encourage households to dine out instead of eating at home, there may be unintended consequences for Americans' caloric intake and overall diet quality. Restaurant meals are generally more calorie-dense and can be nutritionally poorer—in many cases, lower in fiber, calcium, and iron—than meals prepared at home (e.g., Lin et al., 1999; Lin and Guthrie, 2012). McCrory et al. (1999) found a positive association between the frequency of consuming restaurant food and body fat levels in adults. Chou et al. (2004) found a positive association between the number of restaurants per capita and obesity. Replacing one at-home meal with one away-from-home meal increases average daily caloric intake by 134 calories for adults (Todd et al., 2010) and 108 calories for teenagers (Mancino et al., 2010).

Imposing a grocery tax can effectively increase the cost of eating at home relative to dining out. However, some empirical research on tax salience and pass-through suggests the effects of a grocery tax on consumer behavior could also be somewhat less pronounced than the effects of a pure price increase. In a fully salient tax system, individuals are aware of actual taxes as they make economic decisions. In a less salient tax system, individuals are not aware of the actual tax but instead have a perception of the tax (Finkelstein, 2009). In a seminal study, Chetty et al. (2009) showed that consumers underreact to taxes that are not salient or readily noticeable. Chen et al. (2015) further found that an inclusive tax (included in the menu price) has a significantly stronger effect on consumer behavior than an exclusive tax (added at the register). Furthermore, food retailers or restaurants may choose to absorb part of any taxes imposed on food by only partially passing those taxes on to consumers for selected food products as a part of a marketing strategy designed to minimize the effect on sales.

An individual household's response to food taxes may also be tempered by several factors. Participation in Supplemental Nutrition Assistance Program, or SNAP (formerly the Food Stamp Program) is one of these factors. SNAP is the Nation's largest domestic food and nutrition assistance program for low-income households. Participants receive benefits they can use at retail food stores to purchase FAH. Moreover, according to Federal laws and U.S. Department of Agriculture regulations, food purchases made with these benefits are exempt from both State and local sales taxes. Therefore, program beneficiaries face food taxes only when they purchase FAFH or pay for FAH out of pocket, not when they buy FAH with their SNAP benefits.

Income is another factor that may influence how particular households respond to food taxes. All else being equal, it is likely that higher-income households are less sensitive to these taxes because food tends to represent a smaller portion of their total budget.

Overall, food taxes may affect household behavior much as price changes do, but the size of these effects may also depend on the saliency of food taxes and household-specific factors, including SNAP participation and income that vary across the Nation. It is likewise necessary to measure the effects of food taxes as distinct from price effects in a framework that also accounts for these potential interactions.

New Research Sheds Light on Food Tax Effects

Recent studies by Zheng et al. (2019) and Dong et al. (2020) used USDA's National Household Food Acquisition and Purchase Survey (FoodAPS) to explore the association between food taxes and FAH and FAFH expenditures in the United States. A total of 4,826 households that were economically and demographically representative of the contiguous United States participated in the survey between April 2012 and January 2013. Survey participants reported their income, household size, and other key characteristics (table 1). For one week, each participating household also reported all food items they purchased, where they bought those items, and how much they paid (table 1).

Table 1

Summary statistics of the FoodAPS and tax data

Variable	Description	Total households		SNAP households		SNAP eligible, non-participants		SNAP ineligible households	
	Observations	4,826		1,581		1,117		2,128	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
FAH	Value of food spending at retail food stores ($)	81.74	2.042	80.87	4.26	67.93	6.287	85.56	2.99
TOTAL-FOOD	Value of food spending at all food establishments ($)	131.9	2.84	107.6	4.48	105.7	6.53	140.2	4.43
GRTAX	Grocery food sales tax rate, county and State combined (percent)	0.8	0.3	0.7	0.3	0.7	0.3	0.8	0.2
RESTTAX	Restaurant food sales tax rate, county and State combined (percent)	7.0	0.1	7.1	0.2	7.0	0.1	6.9	0.1
COLI	Cost-of-Living-Index for household's county	104.9	1.723	102.0	1.803	106.1	2.212	105.0	1.775
Income	Household average monthly income, in $1,000	5.234	0.222	2.052	0.106	3.061	0.186	6.565	0.264
HHSIZE	Number of people at residence, excluding guests	2.422	0.044	2.901	0.075	2.208	0.077	2.389	0.043
Age	Individual's age in years	49.78	0.5	45.91	1.005	53.42	1.117	49.47	0.494
Employed	Equals 1 if employed; 0 otherwise	0.523	0.011	0.288	0.020	0.384	0.027	0.614	0.014
Married	Equals 1 if married; 0 otherwise	0.442	0.015	0.220	0.021	0.326	0.025	0.524	0.019
College	Equals 1 if college; 0 otherwise	0.323	0.020	0.083	0.012	0.249	0.028	0.396	0.023
Black	Equals 1 if Black or African American; 0 otherwise	0.126	0.017	0.280	0.044	0.135	0.023	0.092	0.015
Hispanic	Equals 1 if Spanish, Hispanic, or Latino; 0 otherwise	0.128	0.024	0.240	0.052	0.176	0.031	0.089	0.018
Asian	Equals 1 if Asian; 0 otherwise	0.038	0.007	0.008	0.003	0.038	0.014	0.044	0.008

SNAP = Supplemental Nutrition Assistance Program.

Std.Dev. = standard deviation.

Note: Mean is weighted, and the standard deviation is calculated using sample designed structure. GRTAX and RESTTAX are the average State and county taxes across the three household groups. These are State and county taxes faced by households. They are not the taxes actually paid by households. Household variables except INCOME and HHSIZE are those of the household head aged 18 and above.

Source: USDA, Economic Research Service calculations using the 2012-13 National Household Food Acquisition and Purchase Survey (FoodAPS).

During their week of participation in the survey, FoodAPS households spent $131.90 on food, including $81.74 on FAH, on average (table 1). FAH spending is defined as the sum of a household's spending at retail food stores, including purchases financed out of pocket and with food assistance benefits (e.g., SNAP benefits). The value of any nonfood items (e.g., paper towels bought at a grocery store) was subtracted from that total. Total food spending is defined as spending on FAH plus any additional spending on food at restaurants, cafeterias, movie theatres, and other FAFH establishments.

Economic theory predicts that grocery and restaurant taxes may affect a household's purchasing decisions by changing the relative prices depending on the taxes and their amounts. Zheng et al. (2019) and Dong et al. (2020) noted above used statistical models to identify the association between FoodAPS households' FAH spending, FAFH spending, and each type of food tax while controlling for potentially confounding factors (see appendix for a detailed description of the method used) in order to estimate the effect of taxes on food purchase decisions. Control variables in the models account for a household's income and demographic characteristics, geographic variation in food prices, and other aspects of the food environment. This information was then matched with estimates of the grocery and restaurant tax rates in 2014 each FoodAPS household faced in its county of residence. To better match the year of the food purchase data, we included our 2014 food tax data in the model instead of our 2019 data. Finally, because different types of households can react differently to tax and price changes, we estimated separate models for each of three distinct population groups—SNAP participants, households that are income-eligible for SNAP but do not participate in the program, and households that are not income-eligible for SNAP (mostly higher-income households).

All study results were reported in elasticities, which are a measure of sensitivity (table 2). For a continuous variable, such as tax rates, elasticities measure the expected percentage change in food spending given a 1-percent change in the explanatory variable, or tax, in this study. For a categorical variable, such as those for race and ethnicity, they represent the percentage difference in spending between households that do and do not exhibit the characteristic.

Table 2
Elasticity estimates

Variable	SNAP households			SNAP eligible but not participating			Other households (mostly high income)		
	Elasticity	Std. error	T-ratio	Elasticity	Std. error	T-ratio	Elasticity	Std. error	T-ratio
Total spending (TOTAL FOOD)									
Income	0.1181*	0.0196	6.0247	0.3582*	0.0501	7.1451	0.3378*	0.0361	9.3629
HHSIZE	1.5974*	0.1834	8.7110	1.2145*	0.1921	6.3216	1.0055*	0.1326	7.5821
Age	0.3751	0.2067	1.8148	0.2081	0.1464	1.4219	0.1023	0.1629	0.6278
Employed	-0.0153	0.0357	-0.4286	0.0846	0.0548	1.5447	-0.0795	0.0624	-1.2750
Married	0.0183	0.0296	0.6182	0.1986*	0.0430	4.6207	0.0976	0.0536	1.8211
College	0.011	0.0398	0.2764	0.1324*	0.0287	4.6172	0.1284*	0.0515	2.4930
Black	-0.1223*	0.0557	-2.1959	-0.1979*	0.0454	-4.3625	-0.1069*	0.0227	-4.7135
Hispanic	-0.021	0.0306	-0.6864	-0.0865*	0.0350	-2.4691	-0.0381*	0.0169	-2.2594
Asian	-0.0024	0.0090	-0.2665	-0.0472*	0.0194	-2.4325	-0.03*	0.0113	-2.6532
Coli	0.9603	0.4979	1.9288	1.9174*	0.2620	7.3187	0.9545*	0.4677	2.0408
FAH spending (FAH)									
HHSIZE	-0.1077	0.1515	-0.7108	0.0786	0.0977	0.8047	0.1301	0.0837	1.5551
Age	-0.0322	0.0834	-0.3859	0.2586*	0.0753	3.4344	0.1505*	0.0662	2.2731
College	0.0042	0.0131	0.3203	-0.0178	0.0144	-1.2386	-0.0017	0.0222	-0.0765
Employed	-0.0414*	0.0183	-2.2568	-0.0747*	0.0199	-3.7599	-0.0494	0.0392	-1.2597
Black	-0.0096	0.0200	-0.4800	-0.0303*	0.0132	-2.2877	-0.0193	0.0150	-1.2839
Hispanic	-0.0179*	0.0088	-2.0323	-0.0111	0.0109	-1.0220	-0.0233*	0.0075	-3.0999
Asian	-0.0026	0.0032	-0.8179	-0.0026	0.0112	-0.2323	-0.0033	0.0044	-0.7425
GRTAX	-0.009	0.0089	-1.0142	-0.0243*	0.0113	-2.1584	-0.0107	0.0056	-1.9036
RESTTAX	0.3297*	0.0997	3.3058	-0.0104	0.0854	-0.1218	0.0254	0.0850	0.2987
Total food	1.0607*	0.2160	4.9100	1.0105*	0.0711	14.2205	0.792*	0.1032	7.6742

Note: Numbers for binary variables are the percentage changes in total spending or FAH spending with or without the variable. These elasticities are the mean values over all households and across all clusters. The standard errors of the elasticities were derived from the Delta method proposed by Fuller (1987).
* indicates statistically significant at the 5-percent level.
SNAP = Supplemental Nutrition Assistance Program.

Source: USDA, Economic Research Service calculations using a censored cluster model and the 2012-13 FoodAPS.

Study results confirmed that grocery taxes are associated with spending less on FAH and more on FAFH. The opposite is true for restaurant taxes. However, these are average responses, and they differ by household type. Specifically, as shown in table 2, results show:

- Grocery taxes have a significant and negative association with the purchase of FAH among households that are income eligible for SNAP but do not participate in the program. A 1-percentage-point increase in grocery taxes from 3 to 4 percent (a 33-percent increase), for example, is associated with spending about 0.7 percent less on FAH.

- Grocery taxes have no significant association with FAH spending among SNAP recipients. As hypothesized, SNAP recipients appear to be less sensitive to grocery taxes, likely because their program benefits are shielded from those taxes.

- Grocery taxes also have no significant association with FAH spending among higher income households. Higher income households are less sensitive to such taxes, likely because food represents a smaller portion of their total budgets.

- Taxes on restaurant foods have a positive and significant association with at-home food spending among SNAP households. SNAP households may shift their food dollars toward at-home foods when they face restaurant taxes that raise the relative cost of such foods. A 1-percentage-point increase in restaurant taxes from 7 to 8 percent (a 14-percent increase), for example, is associated with spending about 3.9 percent more on FAH among SNAP households.

What If Governments Raise or Lower Food Taxes?

State and local governments impose sales taxes, including grocery and restaurant taxes, to raise revenue for public programs like schools and fire and police departments. However, food taxes can be controversial. KC Healthy Kids (2020), a nonprofit organization that is leading an effort to reduce grocery taxes in Kansas, alleges that the State's relatively high grocery tax rate burdens lower-income households and damages local food retailers.

Between 2014 and 2019, grocery taxes were reduced in some U.S. counties and increased in others. No State eliminated grocery taxes altogether. To illustrate the impact of marginal changes in grocery and restaurant tax rates on FAH spending for different types of households, we performed simulations (tables 3 and 4) by assuming the estimated relationships hold. The approach involved inserting different food tax rates into the estimated statistical models and observing how the predicted value of FAH spending changed for each of the three household types under study. For an initial (base) scenario, the grocery tax rate was set to 4 percent, and the restaurant tax rate was set to 7 percent. The two tax values were chosen to match the combined grocery tax rate for counties that taxed FAH (averaged 4.3 percent in 2014 and 2019) and the combined restaurant tax rate for counties that taxed FAFH (averaged 7.1 percent in 2014 and 6.6 percent in 2019). All household characteristic variables—such as those for income, education, household size, and age—were set equal to their sample means in table 1 and remained unchanged throughout the simulation. Given these mean values, expected FAH expenditures in the base scenario were $87.70 among SNAP households, $60.50 among eligible non-SNAP households, and $88.40 among other, mostly higher-income households.

The grocery tax rate was next manipulated both upwards and downwards to observe predicted changes in FAH spending for each type of household. Specifically, for scenarios 1 and 2, the grocery tax rate faced by each household type was lowered from 4 to 2 percent and raised from 4 to 6 percent, respectively. As the grocery tax rate rose from 4 to 6 percent, we found that FAH spending fell about 1.16 percent to $59.80 among eligible, non-SNAP households (scenario 2 in table 3). And FAH spending fell by less than 1 percent among SNAP and other households. However, these decreases are statistically insignificant based on the model estimation results.

Decreasing grocery taxes raises FAH spending by the same amount as increasing grocery taxes lowers it. As the grocery tax rate fell from 4 to 2 percent, eligible non-SNAP households were predicted to increase their FAH spending by about 1.16 percent to $61.20 (scenario 1 in table 3). However, changes in FAH spending among SNAP and other household types were again insignificant.

The restaurant tax rate was similarly manipulated both upwards and downwards to determine any changes in predicted FAH spending for each type of household. For scenarios 3 and 4 of the restaurant tax simulation, that tax rate was lowered from 7 to 5 percent and raised from 7 to 9 percent. All other variables were kept the same as in the base scenario, including the grocery tax rate. FAH spending increased by about 9.5 percent from $87.70 to $96 among SNAP households as the restaurant tax rate rose from 7 to 9 percent (scenario 4 of table 4). However, changes for other household types were statistically insignificant.

Table 3
Food at home (FAH) spending by household groups at different grocery tax rates

	SNAP households		SNAP eligible but not participating		Other households (mostly high income)	
	FAH spending (dollars)	Change to base (percent)	FAH spending (dollars)	Change to base (percent)	FAH spending (dollars)	Change to base (percent)
Scenario 1 (Grocery tax: 2 percent; Restaurant tax: 7 percent)	88.1	0.46	**61.2**	**1.16**	88.9	0.57
Base Scenario (Grocery tax:4 percent; Restaurant tax: 7 percent)	87.7	0	**60.5**	0	88.4	0
Scenario 2 (Grocery tax: 6 percent; Restaurant tax: 7 percent)	87.3	-0.46	**59.8**	**-1.16**	87.9	-0.57

Notes: Simulation results of grocery tax are statistically significant for only eligible, non-SNAP households. Simulation results of restaurant tax are statistically significant for only SNAP households. Numbers in bold are statistically significant at the 5-percent level. SNAP = Supplemental Nutrition Assistance Program.

Source: USDA, Economic Research Service calculations using a censored cluster model and the 2012-13 FoodAPS.

Table 4
Food at home (FAH) spending by household groups at different restaurant tax rates

	SNAP households		SNAP eligible but not participating		Other households (mostly high income)	
	FAH spending (dollars)	Change to base (percent)	FAH spending (dollars)	Change to base (percent)	FAH spending (dollars)	Change to base (percent)
Scenario 3 (Grocery tax: 4 percent; Restaurant tax: 5 percent)	**79.4**	**-9.46**	60.7	0.33	87.8	-0.68
Base Scenario (Grocery tax:4 percent; Restaurant tax: 7 percent)	**87.7**	0	60.5	0	88.4	0
Scenario 4 (Grocery tax: 4 percent; Restaurant tax: 9 percent)	**96.0**	**9.46**	60.3	-0.33	89.0	0.68

Notes: Simulation results of grocery tax are statistically significant for only eligible, non-SNAP households. Simulation results of restaurant tax are statistically significant for only SNAP households. Numbers in bold are statistically significant at the 5-percent level. SNAP = Supplemental Nutrition Assistance Program.

Source: USDA, Economic Research Service calculations using a censored cluster model and the 2012-13 FoodAPS.

Conclusion

As researchers and other members of the public health community seek strategies to tackle America's obesity problem, some have suggested that relative prices could be manipulated via taxes to incentivize healthy food choices. Indeed, interest has grown among health policy advocates and researchers in taxing "unhealthy" foods, such as sugar-sweetened beverages and fast food, while also subsidizing "healthy" foods (e.g., Powell and Chaloupka, 2009; Smith et al., 2010; Dharmasena and Capps, 2012; Thow et al., 2014; Jithitikulchai and Andreyeva, 2018).

This study investigates the association between food taxes and households' food expenditures. Food taxes may have unintended public health consequences that work against efforts to promote a healthy and well-nourished population by encouraging households to eat out more often. FAFH is generally considered to be less healthy than FAH. While most States and counties exempt groceries from sales taxes, some do not.

Better understanding how different types of households respond to grocery and restaurant taxes could inform policies to better promote a healthy and well-nourished population while still raising needed revenue. In a pair of studies, ERS and collaborators used data from USDA's FoodAPS in coordination with newly collected data on food tax rates for U.S. counties to investigate the association between food taxes and food spending for SNAP participants, households eligible for SNAP but not participating in the program, and mostly higher-income households who are not eligible for SNAP.

Our results show that food sales taxes are associated with reduced spending on FAH. Grocery taxes have a significant and negative association with at-home food purchases of households that are eligible for SNAP but do not participate in the program, meaning these households may allocate less of their food dollars to at-home foods when they face such a tax.

SNAP households are less sensitive to grocery taxes than similar households that do not participate in the program. Grocery taxes have no significant association with these households' food spending, likely because Federal law and USDA regulations stipulate that any foods purchased with SNAP benefits are exempt from both State and local sales taxes.

Restaurant taxes were found to have a positive and significant association with FAH spending by SNAP households, meaning SNAP households may shift their food dollars toward at-home foods when they face restaurant taxes that raise the relative cost of such foods.

Food expenditures are associated with food consumption, but imperfectly so. When households shift their food dollars from FAH to FAFH, they are likely adjusting the quantities of each type of food purchased, but they may also be purchasing less expensive at-home foods as well as more expensive FAFH. Still, studies show that FAFH expenditures, especially for fast food, are negatively associated with diet quality (Monsivais et al., 2014; You and Nayga, 2005). By contrast, spending on FAH is positively associated with diet quality among lower-income households (Sanjeevi et al., 2018). In a study of 217 lower-income households, Sanjeevi et al. (2018) found that households with larger FAH budgets have higher-quality diets, primarily because they purchase larger amounts of fruits and vegetables. Additional research is needed on how food taxes affect the quantity of foods consumed since an individual's diet quality depends on what they eat.

The National Household Food Acquisition and Purchase Survey (FoodAPS)

To better understand households' food shopping behavior, the U.S. Department of Agriculture (USDA) developed the National Household Food Acquisition and Purchase Survey (FoodAPS). This survey was developed by USDA in cooperation with Mathematica Policy Research, which designed and fielded the survey, and Westat, which independently assessed the quality and accuracy of the data through a contract with USDA. A form of cluster sampling was used to select households into the survey. The continental United States was divided into 948 counties or groups of contiguous counties that served as primary sampling units (PSUs). Fifty of those PSUs were then selected. A sample of 4,826 households was drawn from the selected PSUs. FoodAPS over-sampled low-income households because of USDA's special interest in those households.

Key to FoodAPS was a food acquisition diary. Participating households recorded all the foods they acquired for both at home and away from home consumption over 7 consecutive days between April 2012 and mid-January 2013. Each household reported data for only one 7-day period, and each household's primary respondent also participated in two in-person interviews and up to three telephone interviews. Detailed information was collected about each occasion during which a household purchased or otherwise acquired (e.g., receiving food at no cost from a food pantry, relatives, or friends) food and beverage items, including the location, expenditures, and any payment methods used (e.g., cash, Supplemental Nutrition Assistance Program (SNAP) benefits).

After designing and fielding FoodAPS, USDA and its contractors further processed and prepared the data for use by researchers. As a part of that effort, each participating household was assigned a sample weight based on the survey design and its own economic and demographic characteristics. When analyzed using these weights, FoodAPS is economically and demographically representative of noninstitutionalized households living in the contiguous United States.[1] Efforts were also made to confirm a household's SNAP status and determine if any non-participants were eligible to receive benefits through the program. While participating in the survey, each household's primary respondent was asked whether they or anyone in their household received benefits from the SNAP program. To confirm respondents' answers, records of households that had given consent were matched against SNAP administrative data.[2] To further distinguish between eligible non-participants and households that are not eligible for SNAP, USDA and its contractors developed a SNAP eligibility indicator based on each household's income, assets, and expenses, along with State-level eligibility guidelines.[3]

Additional details on FoodAPS, including published research that outlines best practices for working with the data, are available online (USDA-ERS, 2019). Tiehen et al. (2017) and Ver Ploeg et al. (2015), for example, examined the food spending and shopping behavior of food assistance recipients and other U.S. households. Those studies also discussed procedures for identifying both household types along with procedures for best calculating their food expenditures. A thorough overview of studies using FoodAPS, including research findings and insights on diet quality and food assistance programs in the United States in general, is available in Page et al. (2019).

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[1]FoodAPS did not cover all segments of the U.S. population equally. To improve the relation between the sample and the U.S. population, USDA and its contractors calculated base weights equal to the inverse of a household's overall probability of selection. A series of adjustments were later made. Final sample weights are based on a ranking and trimming procedure. Weights were calibrated to population control totals for race/ethnicity of respondent, income, receipt of SNAP, household size, number of children in the household, and presence of a member aged 60 or older. Additional details are available in Krenzke and Kali (2016). Noninstitutionalized households exclude the residents of institutions such as elder care, penal, and mental facilities.

[2]Two types of SNAP administrative data were used: State-level caseload data with SNAP households' case identification numbers, the names of SNAP-unit heads, addresses, and other information; and records from SNAP's electronic benefit transfer (EBT) Anti-fraud Location using EBT Retailer Transactions (ALERT) database. ALERT data contain one record for each swipe of an EBT card and include information on State, a store identification code, EBT account number, and other information. Additional details are available in the FoodAPS household codebook (FoodAPS, 2016).

[3]Additional details are available in the FoodAPS household codebook (FoodAPS, 2016).

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Appendix: Methodology

Empirical model

Grocery and restaurant taxes may affect a household's purchasing decisions. An economic and statistical model was developed to identify the association between FoodAPS households' food at home (FAH) spending, food away from home (FAFH) spending, and each type of food tax while controlling for potentially confounding factors. Below is a description of that model based on Dong et al. (2020).

Following classic economic theory, we assumed households engage in a multistage budgeting process. The amount of money a household allocates to total food purchases depends on its income level, prices, and tastes and preferences. In this study, we further assumed that households next allocate these food dollars between FAH and FAFH depending on their characteristics as well as food taxes in their county of residence. Likewise, we included one equation in our model to explain a household's total food spending (combined FAH and FAFH spending) and a second equation to capture the amount of that money it allocates to FAH.

Because the survey design underlying FoodAPS involved cluster sampling, it is likely that parameters estimated in the traditional manner will be biased. To account for survey design and obtain unbiased estimates, we incorporated a cluster-specific error term into our model.

For cluster, or primary sampling unit (PSU) j, we assumed the food at home spending FAH of household i is a function of total food spending Y, which is the sum of FAH and FAFH, and food sales tax rates $\mathbf{T}$, which the household faces. We first modeled the total food spending equation as below:

$$Y_{ji} = \mathbf{Z_{ji}}\boldsymbol{\alpha}_1 + P_j\alpha_2 + u_j + e_{ji} \tag{1}$$

where $\mathbf{Z_{ji}}$ is a vector of household variables that influences its total food spending. P_j is a food price index for cluster j. $\boldsymbol{\alpha}_1$ and α_2 are parameters where $\boldsymbol{\alpha}_1$ is a vector conformable with $\mathbf{Z_{ji}}$. Both u_j and e_{ji} are error terms. However, whereas e_{ji} is an idiosyncratic error term specific to household i in cluster j, u_j is a cluster-specific error term that captures unobserved aspects of cluster j, such as the economic environment or regional factors that can influence food spending and are invariant across households within the same-cluster.

As described above, FAH can be defined as:

$$FAH_{ji} = \mathbf{X_{ji}}\boldsymbol{\beta}_1 + Y_{ji}\beta_2 + \mathbf{T_j}\boldsymbol{\beta}_3 + v_j + \varepsilon_{ji} \tag{2}$$

where $\mathbf{T}_j$ is a vector of food tax rates in cluster j,[4] and $\mathbf{X_{ji}}$ is a vector of observed household economic and demographic variables to capture i's tastes and preferences and may contain some of the same variables in $\mathbf{Z_{ji}}$. The remaining model components are as follows: $\boldsymbol{\beta}_1$, β_2, and $\boldsymbol{\beta}_3$ are parameters where $\boldsymbol{\beta}_1$ is a vector conformable with $\mathbf{X_{ji}}$, v_j is an unobserved cluster-specific error term that captures unobserved effects of cluster j on FAH spending, and ε_{ji} is an idiosyncratic error term.

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[4]State and county authorities are likely to impose or raise grocery taxes where income and property taxes are politically less feasible. Thus, the tax variable $\mathbf{T}_j$ here may be endogenous and suffer endogeneity bias. To completely rule out endogeneity bias, researchers must identify instrumental variables (IVs) and perform a Hausman or similar test. In this study, reasonable IVs might be measures of State and local political situations. Unfortunately, we have data on a very limited number of State and local areas. It is unlikely that we would have significant enough variation in those IVs to conduct such a procedure. A possible alternative is to use Lewbel's (2012) instrumental variables approach, which does not require instruments that are excluded from the main equation. That approach relies on sufficient heteroscedasticity in the first stage regressions to identify the causal impact of an endogenous explanatory variable and is often beset by the problem of weak instruments. To keep the model practically tractable, we did not apply this procedure given our cluster data issue and censoring data problem.

Theoretically, equation 2 can be viewed as a linear Engel curve reduced from the linear expenditure system (Howe, 1977) by dropping the FAFH equation because of the adding-up condition. We extended the model to incorporate the clustered structure of the data and data censoring. Equations (1) and (2) are estimated simultaneously by assuming their error terms jointly normal distributed.

A Maximum Likelihood Estimation (MLE) procedure was used to obtain parameter estimates in the above model. The detailed procedure of estimation can be found in Dong et al. (2020).

Marginal effects and elasticities

The expected values of total food expenditure (Y_{ji}) and food at home expenditure (FAH_{ji}) can be calculated as:

$$E(Y_{ji}) = \mathbf{Z_{ji}}\boldsymbol{\alpha}_1 + P_j \alpha_2 \tag{3}$$

$$E(FAH_{ji}|Y_{ji}) = \mathbf{X_{ji}}\boldsymbol{\beta}_1 + Y_{ji}\beta_2 + \mathbf{T_j}\boldsymbol{\beta}_3 + E\left((v_j + \varepsilon_{ji})|(u_j + e_{ji})\right) \tag{4}$$

For uncensored data, (4) becomes:

$$E(FAH_{ji}|Y_{ji}) = \mathbf{X_{ji}}\boldsymbol{\beta}_1 + Y_{ji}\beta_2 + \mathbf{T_j}\boldsymbol{\beta}_3 \tag{5}$$

For censored data, (4) becomes (Greene, 2000):

$$E(FAH_{ji}|Y_{ji}) = \mathbf{X_{ji}}\boldsymbol{\beta}_1 + Y_{ji}\beta_2 + \mathbf{T_j}\boldsymbol{\beta}_3 + \sigma_{\psi|\omega}\frac{\phi(\theta_{ij})}{\Phi(\theta_{ij})} \tag{6}$$

where $\sigma_{\psi|\omega} = \left(\sigma_v^2 + \sigma_\varepsilon^2 - \rho_{\varepsilon e}^2 \frac{\sigma_\varepsilon^2 \sigma_e^2}{\sigma_u^2 + \sigma_e^2}\right)^{1/2}$ and $\theta_{ij} = (\mathbf{X_{ji}}\boldsymbol{\beta}_1 + Y_{ji}\beta_2 + \mathbf{T_j}\boldsymbol{\beta}_3)/\sigma_{\psi|\omega}$

Marginal effects and elasticities can be calculated based on (3), (5), and (6). For example, the marginal effects and elasticities of the grocery tax (T_j) for censored data can be derived from (6) as:

$$Marginal\ effect\ =\ \frac{\partial E(FAH_{ji}|Y_{ji})}{\partial \mathbf{T_j}} = \boldsymbol{\beta}_3(1 - \theta_{ij}\frac{\phi(\theta_{ij})}{\Phi(\theta_{ij})} - [\frac{\phi(\theta_{ij})}{\Phi(\theta_{ij})}]^2) \tag{7}$$

$$Elasticity = \frac{\partial E(FAH_{ji}|Y_{ji})}{\partial \mathbf{T_j}}\frac{\mathbf{T_j}}{E(FAH_{ji}|Y_{ji})} = \boldsymbol{\beta}_3\frac{\mathbf{T_j}}{E(FAH_{ji}|Y_{ji})}(1 - \theta_{ij}\frac{\phi(\theta_{ij})}{\Phi(\theta_{ij})} - [\frac{\phi(\theta_{ij})}{\Phi(\theta_{ij})}]^2) \tag{8}$$

where $E(FAH_{ji}|Y_{ji})$ is given by (6). Similar formulas can be obtained for other variables.