Journal of Agricultural and Resource Economics 44(1):98–116 ISSN 1068-5502

Eat at Home or Away from Home? The Role of Grocery and Restaurant Food Sales Taxes

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Sales taxes on either grocery food or restaurant food exist in almost every U.S. county. By combining county-level sales tax data with the USDA's recent national household food acquisition and purchase survey, we examine how a food sales tax affects consumers' expenditures on grocery and restaurant food. We find that a grocery tax reduces consumers' grocery food expenditures and increases restaurant food expenditure and a restaurant food sales tax increases consumers' grocery food expenditures. We also find no differential impacts from food sales taxes based on consumers' income or participation status in the Supplemental Nutrition Assistance Program.

Key words: grocery tax, Supplemental Nutrition Assistance Program, tax salience

Introduction

The majority of states and counties in the United States exempt grocery food—but not restaurant food—from the general sales tax. For example, Fayette County, Kentucky, which has no county sales tax, exempts groceries but not restaurant food from the 6% state sales tax. As a result, consumers living in Fayette County face at least a 6% tax differential between eating at home versus away from home for a similar meal.[1] However, in Lee County, Alabama, groceries are subject to the same 4% state and 4% county sales taxes levied on restaurant food, providing no tax incentive for consumers to eat at home. Such myriad and often conflicting sales tax codes across and even within states can have direct public health implications, changing the relative prices of eating at home and dining out, since restaurant meals generally are more calorie-dense and could be nutritionally poorer (in many cases lower in fiber, calcium, and iron) than meals prepared at home (e.g., Guthrie, Lin, and Frazao, 2002; Lin and Guthrie, 2012).[2]

This research provides the first empirical examination of consumers' eating behaviors in response to both types of food sales taxes, defined as grocery taxes (sales taxes imposed on foods at retail outlets such as grocery stores, convenience stores, etc.) and restaurant taxes (sales taxes imposed on restaurant food). We address two important policy questions faced by local, state, and federal governments: i) do food sales taxes affect consumers' expenditures on grocery food and

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This work was funded by the USDA Economic Research Service through a cooperative agreement under federal grant number 58-5000-5-0096. The findings and conclusions in this article are those of the authors and do not represent the views of USDA. We thank the editor (Darren Hudson) and two anonymous reviewers for insightful comments.

Review coordinated by Darren Hudson.

[1] We state "at least" here because labor and overhead for meal production are taxed. Once this is considered, the aforementioned price differential for a similar meal is actually greater than 6%.

[2] Many studies have associated dining out with lower diet quality (e.g., Taveras and Skidmore, 2005; Beydoun, Powell, and Wang, 2009). However, the literature seems inconclusive on whether restaurant meals lead to obesity (e.g., Currie et al., 2010, report supporting evidence while Anderson and Matsa, 2011, find no causal link).

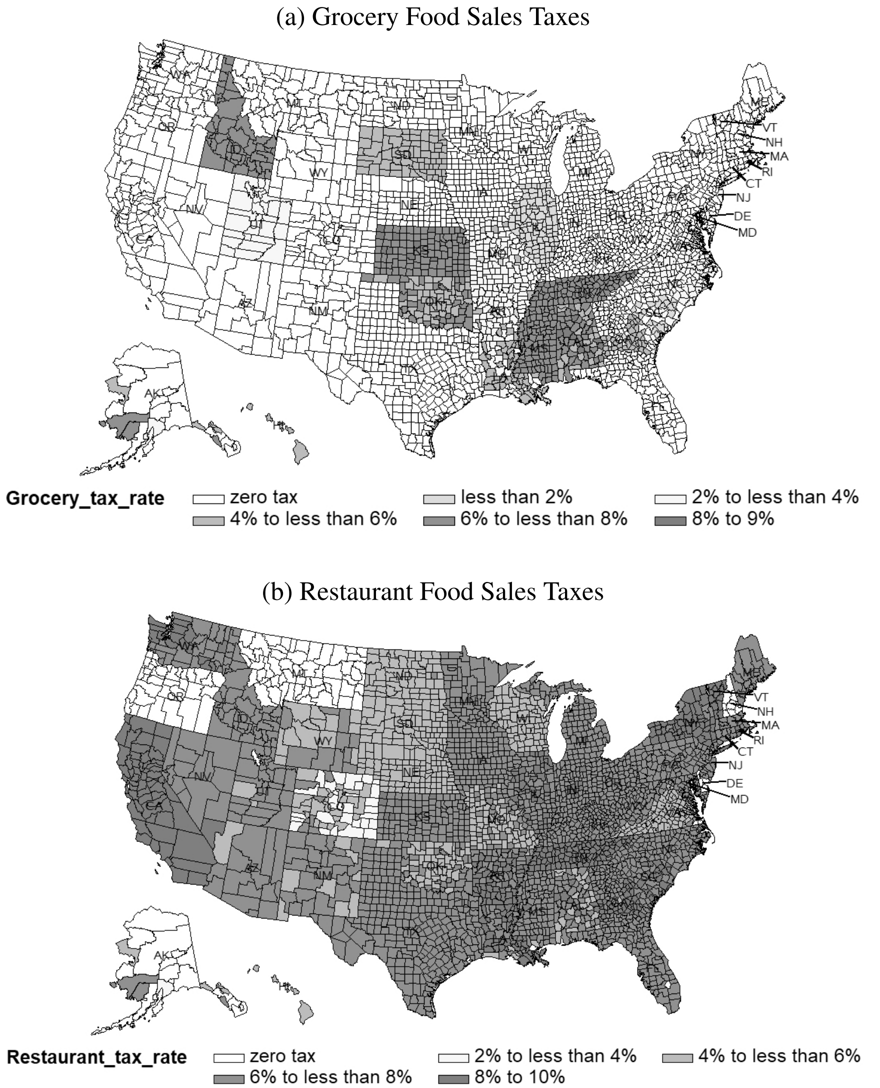

Figure 1. U.S. Food Sales Taxes, State and County Combined, 2014

restaurant food, and ii) are food expenditures of participants in government food assistance programs less sensitive to food sales taxes?

The first policy question is important for at least two reasons (in addition to the aforementioned public health implications). First, food sales taxes exist in almost every county in the United States. The two maps in Figure 1 show the rates of grocery taxes and restaurant taxes, respectively, for each U.S. county in 2014. These are the state and county combined tax rates. Our restaurant tax data reflect the fact that some counties impose an additional sales tax on top of the general sales tax on restaurant food.[3] Grocery taxes exist in 18 states. The average combined grocery tax rate for counties that tax groceries is 4.3%, and the highest rate is 9% (4% state plus 5% county) in Tuscaloosa County, Alabama, in 2014. Most of the counties with a grocery tax are located in the South (e.g., Alabama, Mississippi, and Arkansas). Restaurant taxes exist in all states except Delaware, New Hampshire, Montana, and Oregon; the highest is 10% (4% state plus 6% county) in Catahoula Parish

[3] Our sources for tax data are http://www.tax-rates.org, http://www.sale-tax.com, and state and various county departments of revenue. Our data are at the county level and do not reflect that some cities may impose additional restaurant taxes (not available to us).

Table 1. Overview of U.S. State and County Grocery Food Sales Taxes, 2014

State Grocery Tax	County Grocery Tax	States (no. of counties if not all fall into this category)
State taxes grocery at full rate	**Counties tax at full rate**	AL (67), KS (90), OK (76)
	Counties have no sales tax	AL (1), HI, ID, KS (15), MS,[a] OK (1), SD
State taxes grocery at reduced rate	**Counties tax at full rate**	AR (73), IL (4),[a] MO (114), TN, VA
	Counties tax at reduced rate	IL (4),[a] MO (1)
	Counties exempt grocery (from county sales tax)	IL (55)[a]
	Counties have no sales tax	AR (2), IL (39)[a]
State exempts grocery from state sales tax	**Counties tax at full rate**	GA, LA (56), NC, SC (20), UT (18)[a]
	Counties tax at reduced rate	LA (4), SC (11), UT (11)[a]
	Counties exempt grocery (from county sales tax)	AZ, CA,[a] CO (52), DC, FL (56), IA (92), MN (17), NE (1), NV (12), NM, NY, ND (6), OH, PA (2), SC (7), TX (123), WA, WI (65),[a] WY (20)
	Counties have no sales tax	CO (12), CT, FL (11), IN,[a] IA (7), KY, LA (4), ME,[a] MD, MA,[a] MI, MN (70), NE (92), NV (5), NJ, ND (47), PA (65), RI,[a] SC (8), TX (131), VT,[a] WV, WI (7),[a] WY (3)
State has no sales tax	**Counties tax full rate**	AK (13)
	Counties have no sales tax	AK (15), DE, MT, NH, OR

Notes: Bold denotes the existence of a grocery tax.
[a]Indicates that some counties impose an additional sales tax on top of the general sales tax on restaurant food.
Sources: http://www.tax-rates.org, http://www.sale-tax.com, and state and county departments of revenue.

County, Louisiana. Overall, one-third of U.S. counties are affected by grocery taxes, and most U.S. counties are affected by restaurant taxes.

Second, many state and local governments have imposed or raised food sales taxes, particularly grocery taxes, as a way to raise additional governmental revenues. Table 1 presents an overview of many possible combinations of grocery tax policies, each of which depends on whether a state and a county tax grocery food at the full rate, tax grocery food at a reduced rate, exempt grocery food from sales tax, or have no sales tax. A grocery food tax is simply the result of a state and/or county taxing groceries at the full or reduced rate (e.g., South Dakota [full state tax], Georgia [full county tax], and Tennessee [reduced state tax coupled with full county tax]). In addition, many public health supporters advocate taxing fast food restaurants to curb the obesity epidemic. While recent literature provides some insights, there are still significant gaps in our knowledge about how food sales tax policies affect consumers' eating behaviors. If consumers allocate more of their budgets to eating away from home in response to a higher grocery tax rate, such a tax is beneficial to the local restaurant industry at the cost of grocery retailers.

The second policy question addresses how federal food assistance policies may interact with local tax policies. According to federal laws and U.S. Department of Agriculture (USDA) regulations, food purchases made with federal government food assistance benefits, such as those from the Supplemental Nutrition Assistance Program (SNAP), are exempt from both state and local sales taxes. Therefore, SNAP recipients might be less sensitive to grocery taxes because their program benefits are shielded from the taxes.

This paper empirically examines the impact of county-level grocery and restaurant taxes on consumers' food-at-home (FAH) and food-away-from-home (FAFH) expenditures using the USDA's new *National Household Food Acquisition and Purchase Survey* (FoodAPS), the first nationally representative survey of American households to collect unique and comprehensive data about household food purchases and acquisitions for FAH and FAFH consumption. We combine the FoodAPS data with newly collected county-level food sales tax data to address the two aforementioned policy questions. Our findings suggest that policy makers should consider consumers' food consumption responses when crafting or changing food tax policies.

Relevant Literature

Our study is closely related to a large literature on the impacts of food and beverage taxes (and subsidies) on consumptions and health outcomes. Most studies emphasize the importance of the price elasticity of demand for food, while assuming that a tax is perfectly passed on to consumers (e.g., Zheng and Kaiser, 2008; Zhen et al., 2014). A few studies analyze the impact of state food sales taxes on grocery sales for consumers living close to state borders by using tax-inclusive prices (e.g., Walsh and Jones, 1988; Tosun and Skidmore, 2007). Several researchers use a reduced-form approach to directly examine the impact of a tax on food and beverage consumption (e.g., Sturm et al., 2010) and health outcomes such as body mass index (e.g., Fletcher, Frisvold, and Tefft, 2010). Andreyeva, Long, and Brownell (2010) and Powell et al. (2013) conduct two subsequent, comprehensive reviews (published studies for 1938–2007 and 2007–2013, respectively) of hundreds of studies in the literature and find clear evidence of negative consumption responses to food and beverage taxes. However, Powell et al. (2013) show that the evidence for the effect of taxes on weight outcomes is mixed. Because the tax studies used primarily state-level sales taxes, Powell et al. (2013) attribute this mixed evidence to the small magnitude of state-level taxes. Following some of the previous studies, we adopt the reduced-form approach but use sales tax data with a much finer level of disaggregation. As displayed in Table 1, numerous counties have their own grocery taxes. Using county-level sales tax data therefore better captures reality and provides a greater source of variation.

Complicating the results from the above literature is the small but burgeoning collection of research on tax salience. In their seminal work, Chetty, Looney, and Kroft (2009) use a store experiment to show that consumers underreact to taxes that are not salient. These authors also show that for beer, consumers ignore state sales tax but not the excise tax imposed on manufacturers. Zheng, McLaughlin, and Kaiser (2013) further find that consumers' imperfect tax knowledge can attenuate or strengthen the degree of consumer underreaction to a sales tax. Their survey finds that about one-third of New York State consumers have an incorrect understanding of the tax status of some foods. Similarly, Chen, Kaiser, and Rickard (2015) use an economic experiment of 131 adult, nonstudent subjects and find that an inclusive tax (i.e., included in the menu price) has a significantly stronger effect on reducing the consumption of total calories, calories from fat, and the intake of carbohydrates, cholesterol, sugar, and sodium compared with an exclusive tax (added at the register). Goldin and Homonoff (2013) investigate income differences in attentiveness to cigarette sales taxes and find that only low-income consumers respond to the taxes. In contrast, Berck et al. (2016) show that a bottled-water sales tax in Washington decreased sales, and the effect is more pronounced in the lowest and highest quintile income areas. Our analysis relates to this literature because it provides a test of whether consumers ignore food sales taxes, which are generally added at the register. We also examine income differences in attentiveness to food sales taxes, providing some insights on whether food taxes place a higher burden on lower-income population.

Several recent studies have analyzed the determinants of FAH and FAFH spending using longitudinal survey data. These studies share a common objective of identifying consumption responses to the SNAP program, and all ignore food sales taxes. For example, Wilde, Troy, and Rogers (2009) analyze this issue by splitting samples into SNAP participants and nonparticipants. Burney (2018) exploits state variation in SNAP caseloads arising from the early 2000s recession, Hoynes and Schanzenbach (2009) utilize the original introduction of the program across counties as the source of variation, and Beatty and Tuttle (2015) utilize the large increases in SNAP benefits in 2009. The last three studies adopt a difference-in-differences research design. That the FoodAPS data are only 1 week in duration prevents us from using the panel data techniques used by the last three related studies to get around the endogeneity of SNAP participation. Instead, following a broader literature of examining SNAP impacts on food security (e.g., Ratcliffe, McKernan, and Zhang, 2011) we use cross-sectional data and rely on instrumental variables to address this well-known issue. Because historical county food sales tax information is unavailable, our source of variation to identify the impact of tax on household food consumption comes from the vast tax differences among U.S. counties (Figure 1). This is a reasonable approach considering that food sales taxes generally do not change over short periods of time. We also make use of the detailed and unique consumer characteristics (e.g., traveling time to primary food store, food access) provided by FoodAPS to better control for factors that could influence food purchasing decisions.

Overall, we attempt to make three contributions. First, we examine both the own- and cross-price effects of grocery and restaurant taxes on FAH and FAFH and explore potential tax policy interactions between state/local and federal levels. The estimates presented here are directly relevant to policies such as a fat tax on fast food restaurants. Second, our conceptual framework illustrates how the sales tax affects market equilibrium in the presence of tax inattentiveness and various degrees of tax pass-through. Our empirical model provides a test of tax attentiveness, contributing to the growing tax salience literature. Third, the use of county-level food sales tax data is an improvement over previous tax studies. The rich household information in FoodAPS also provides insight into how food access affects consumption.

Conceptual and Empirical Frameworks

Conceptual Framework

Our conceptual framework builds on the framework introduced by Fletcher, Frisvold, and Tefft (2010) and incorporates the salience component developed by Chetty, Looney, and Kroft (2009). We conceptualize the food consumption quantity (Q, which can be FAH or FAFH consumption) of individual i living in county c as a function of the tax-exclusive food price (P) and food sales tax rate (T) in county c as well as other variables such as demographics and income. Suppressing the other variables for exposition purpose leads to a general functional form

$$Q_{ic} = f\left[P_c, (1+T_c)\right]. \tag{1}$$

Total differentiation of equation (1) yields

$$dQ_{ic} = \frac{\partial Q_{ic}}{\partial P_c} dP_c + \frac{\partial Q_{ic}}{\partial (1+T_c)} d(1+T_c). \tag{2}$$

Dividing equation (2) by $d(1+T_c)$ and expressing it in logarithm, we have

$$\frac{d \ln Q_{ic}}{d \ln(1+T_c)} = \frac{\partial \ln Q_{ic}}{\partial \ln P_c} \frac{d \ln P_c}{d \ln(1+T_c)} + \frac{\partial \ln Q_{ic}}{\partial \ln(1+T_c)}, \tag{3}$$

where $\frac{\partial \ln Q_{ic}}{\partial \ln P_c}$ is the price elasticity of demand, $\frac{d \ln P_c}{d \ln(1+T_c)}$ is the degree of tax pass-through, and $\frac{\partial \ln Q_{ic}}{\partial \ln(1+T_c)}$ is the tax elasticity of demand. Equation (3) can be expressed equivalently as

$$\frac{d \ln Q_{ic}}{d \ln(1+T_c)} = \underbrace{\frac{\partial \ln Q_{ic}}{\partial \ln P_c}}_{\text{price elasticity}} \left[\underbrace{\frac{d \ln P_c}{d \ln(1+T_c)}}_{\text{tax pass-through}} + \underbrace{\theta}_{\text{tax attentiveness}} \right], \tag{4}$$

where the θ term, defined as $\theta = \frac{\partial \ln Q_{ic}}{\partial \ln(1+T_c)} / \frac{\partial \ln Q_{ic}}{\partial \ln P_c}$, measures the ratio of tax elasticity to price elasticity of demand and bears further discussion. If $\theta = 0$, the consumer completely ignores the

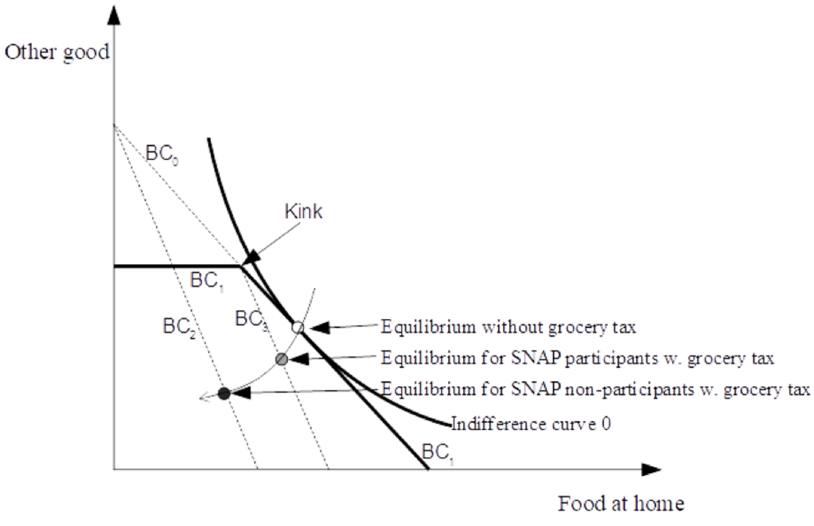

Figure 2. Illustration of Grocery Tax on Food-at-Home Consumption

sales tax when shopping; if $\theta = 1$, then the consumer is fully attentive of sales taxes when shopping; $0 < \theta < 1$ is the case between the two extremes in which the consumer partially responds to the sales tax.

The effect of the tax on equilibrium food consumption depends on three factors: i) price elasticity of demand, ii) degree of tax pass-through to consumers, and iii) degree of tax attentiveness. The conventional thought is that retail price rises by approximately the amount of a sales tax in a standard competitive market (i.e., full pass-through, $\frac{d\ln Price_c}{d\ln(1+Tax_c)} = 0$, because the price here excludes tax). On the other hand, the tax can over-shift in a noncompetitive market (i.e., price increases more than the increase in tax, or $\frac{d\ln Price_c}{d\ln(1+Tax_c)} > 0\}$. Empirical studies estimating tax pass-through for food sales taxes are very limited. Besley and Rosen (1999) report full tax pass-through for Big Macs, Crisco, and eggs and over-shifting for bananas, bread, milk, and soda. Therefore, our reduced-form estimates of tax impact subsume the net effect of tax pass-through and tax attentiveness, assuming a negative price elasticity of demand.

Figure 2 illustrates our conceptual framework for the differential impact of grocery tax on SNAP recipients; the kinked budget constraint (BC_1) is the standard textbook treatment of SNAP recipients (e.g., Hoynes and Schanzenbach, 2009; Beatty and Tuttle, 2015). Imagine another consumer who attains the same consumption bundle of FAH and the other good but does not participate in the SNAP. The budget constraint for this consumer is the straight line BC_0. When the grocery tax increases, the budget constraint for the nonparticipant rotates clockwise around the y-axis intercept and becomes BC_2. However, the budget constraint for the SNAP participant rotates clockwise around the kink and becomes BC_3 (proof available upon request). As a result, the reduction in FAH consumption becomes more pronounced for the nonrecipient (the black dot versus the gray dot). The fundamental cause for this difference is the exemption of SNAP benefits from the tax, providing SNAP benefits with higher purchasing power than cash in the presence of a tax.

Empirical Model

Our empirical model consists of a separate equation for household weekly FAH and FAFH expenditures. We hypothesize that the out-of-pocket or cash FAH expenditures (that is, total FAH expenditures minus SNAP purchases) of household *i* living in county *c* are a function of the following core variables: grocery tax rate (*Grtax*) and restaurant food tax rate (*Resttax*) in county *c*, household SNAP participation status (dummy variable), basket food price index constructed from retail scanner data for the county to control for price effect, household size, income, and additional control variables:

$$
\begin{aligned}
CashFAH_{ic} = & \beta_0 + \beta_1 Grtax_c + \beta_2 Resttax_c + \beta_3 SNAP_i + \beta_4 Basketprice_c + \beta_5 Size_i \\
& + \beta_6 Income_i + \beta_7 \boldsymbol{Demog}_i + \beta_8 \boldsymbol{Access}_i + \beta_9 \boldsymbol{Other}_i + \varepsilon_i,
\end{aligned} \tag{5}
$$

where β are parameters to be estimated and ε_i is the error term. Equation (5) uses expenditures instead of quantities (as in equation 1) for FAH and FAFH since that information is both better recorded in FoodAPS than information on physical quantities and easy to aggregate from all food consumptions. With the rich information provided by the FoodAPS data, we add three additional sets of control variables: The demographic variable vector (***Demog***) includes the primary survey respondent's age, education level, marital status, and race. The primary respondent is the person in the household most responsible for grocery shopping. Food access variable vector (***Access***) includes one-way travel time to the household primary food stores measured in minutes, numbers of SNAP–authorized retailers, fast food restaurants, and non–fast food restaurants all within 5 miles of the household. The last vector includes whether any household member is on any kind of food diet, whether the household received USDA foods from local program or distribution site, meals at home from community program, or meals at a community center in past month, respectively. The FAFH equation is similarly specified by replacing the dependent variable in equation (5) with FAFH expenditures.

The National Household Food Acquisition and Purchase Survey (FoodAPS)

The USDA's new FoodAPS offers unique data on 4,826 American households' food choices. For FoodAPS, households, including SNAP participants, living throughout the continental United States 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's primary respondent participated in two in-person interviews and up to three telephone interviews. Collected data include information on food and beverage items purchased or otherwise acquired, including location, price, brand, package size, flavor, and payment method (e.g., whether it was purchased with SNAP benefits). Collected data also include detailed factors expected to affect food acquisition decisions, such as household size, demographic characteristics, income, participation in federal food assistance programs, and food access information (also known as the food environment). The basket prices were constructed by the University of Illinois using weekly IRI store-level sales and costs at the universal product code (UPC) level for a group of foods based on the food basket defined by the Thrifty Food Plan for Feeding America's the Meal Gap Project (Gundersen et al., 2015).[4] The basket prices were calculated for each of the 50 FoodAPS's primary sampling units and captured both time and store variation in food basket cost. Since different stores may offer different quality foods, one major limitation of the basket prices is that they "cannot guarantee the goods compared over time and over stores are identical." Detailed survey information, including variable lists and code books, is available on the USDA's website.[5]

Our unit of analysis is the household. We aggregated all household members' FAH and FAFH expenditures over the week for each household. FAH and FAFH expenditures include sales taxes paid. Since payments made using SNAP Electronic Benefit Transfer (EBT) cards are exempt from grocery taxes, we subtracted this amount from total FAH expenditures and use the net amount as the dependent variable in equation (5). That is, we use the cash FAH expenditures (similar to Hoynes and Schanzenbach, 2009), including sales taxes paid, to better estimate the tax impact. About 60% of the SNAP recipients in the data reported a positive EBT transaction amount for the week. Similarly,

[4] The detailed construction of basket price is available at https://www.ers.usda.gov/media/8582/priceindexdata.pdf.
[5] http://www.ers.usda.gov/data-products/foodaps-national-household-food-acquisition-and-purchase-survey.aspx.

we use household members' total FAFH expenditures over the week, including taxes and tips paid, as the dependent variable for the FAFH equation. About 5%, 6%, and 1% of households reported zero (cash) FAH expenditures, zero FAFH expenditures, and zero FAH and FAFH expenditures, respectively (a handful of households with negative cash FAH expenditures were found in the data, likely due to reporting errors, and thus dropped from our sample). Since zero expenditures represent only a very small fraction of the dependent variables and are more likely attributable to factors such as shopping frequency rather than food taxes, we restrict our study samples to households with positive FAH expenditures and households with positive FAFH expenditures during the week, resulting in sample sizes of 3,995 and 3,596, respectively, for the two equations. Our tax data came from several sources. We augment sales tax data available from www.tax-rates.org and www.sale-tax.com with a comprehensive search on state and county departments of revenue. Because we started collecting the tax data at the end of 2014 and the sources only provide county tax data for the current year, our tax data are for 2014 and therefore do not align perfectly with the FoodAPS data. However, the historical state-level grocery tax rates reported by Bridging the Gap (2015), a research program funded by the Robert Wood Johnson Foundation, show that only Kansas changed its rate (from 6.3% to 6.15%) from 2013 to 2014. Our data adjusted for this change accordingly, but results should be interpreted with the caveat that county-level taxes may have changed during this period.

Table 2 shows summary statistics for FAH and FAFH expenditures, taxes, and other control variables based on households with positive FAH and FAFH expenditures, respectively. On average, households spent $98.36 for FAH net of SNAP benefits and $60.31 for FAFH in the week. When broken down by SNAP participation status, SNAP recipients spent $63.51 cash for FAH, $93.81 SNAP benefits, and $45.6 for FAFH, while nonparticipants spent $112.64 in cash for FAH and $66.72 for FAFH. Such numbers fit squarely into the textbook illustration of the SNAP effect on recipients: an increase of total FAH expenditure and a decrease in cash FAH expenditure (Hoynes and Schanzenbach, 2009, p. 119). Table 2 shows that 29% of households received SNAP benefits, which is higher than the national participation rate of 19%.[6] This reflects the fact that the FoodAPS oversampled low-income households because of special interest in the food acquisition patterns of households participating in government food assistance programs.

Table 3 breaks down average FAH and FAFH expenditures by food sales tax rate. Overall, counties that exempt groceries have the highest average FAH expenditures. It is striking to observe that FAH expenditures are lowest not in areas with the highest tax rates but in counties with a grocery tax rate that positive but less than 2%. On the other hand, areas with higher restaurant taxes seem to have higher average FAFH expenditures. This ambiguity necessitates a multivariate statistical analysis.

For several reasons, the FoodAPS data are a far better source than other large datasets such as the Current Population Survey Food Security Supplement (CPS-FSS) to study the impact of food sales taxes. First, while SNAP enrollment is self-reported in the CPS-FSS and most large datasets, the FoodAPS data verifies enrollment through administrative records, which significantly reduces bias arising from measurement error. Second, FAH and FAFH expenditures are measured with better precision because households were asked to scan barcodes on packaged foods and calculate FAFH expenditures based on saved receipts from restaurants. Third, the FoodAPS data allows for better control of the local food environment by including variables that measure food prices, food access, ease of SNAP benefit use, and type of grocery stores available.

[6] The USDA reports that 23 million households participated in SNAP in 2013 (U.S. Department of Agriculture, SNAP Participation and Costs, 1969–2015, https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap) out of 122 million households in that year (U.S. Census Bureau, Households by Type and Tenure of Householder for Selected Characteristics, 2013, https://www.census.gov/data/tables/time-series/demo/families/households.html).

Table 2. Summary Statistics of the FoodAPS and Tax Data

Variable	Description	*N*	Mean	Std. Dev.	Min.	Max.
FAH	Total cash food-at-home expenditures during the week	3,995	\$98.36	\$97.41	\$0.03	\$1,847.50
FAH for SNAP = 1	. . . for SNAP recipients	1,161	\$63.51	\$74.02	\$0.03	\$567.19
FAH for SNAP = 0	. . . for SNAP nonrecipients	2,834	\$112.64	\$102.14	\$0.99	\$1,847.50
FAFH	Total food-away-from-home expenditures during the week	3,596	\$60.31	\$73.35	\$0.35	\$1,816.97
FAFH for SNAP = 1	. . . for SNAP recipients	1,091	\$45.60	\$56.42	\$0.89	\$1,073,36
FAFH for SNAP = 0	. . . for SNAP nonrecipients	2,505	\$66.72	\$78.77	\$0.35	\$1,816.97
Grocery tax	Grocery food sales tax rate, county and state combined	3,995	0.04[a]	0.02	0.01	0.08
Restaurant tax	Restaurant food sales tax rate, county and state combined	3,995	0.07	0.01	0.04	0.10
SNAP participation	= 1 if household reports SNAP current participation, 0 otherwise	3,995	0.29	0.45	0.00	1.00
SNAP EBT	SNAP EBT payment	3,995	\$93.81[a]	\$95.48	\$0.50	\$856.72
Basket price	Basket food price index constructed from IRI scanner data	3,995	347.41	56.33	235.80	518.24
Household size	Number of people at residence, excluding guests	3,995	2.99	1.73	1.00	–[b]
Household income	Household average monthly income, in \$1,000	3,995	\$3.58	\$4.04	\$0.00	>\$60[b]
Age	Individual's age in years (for the primary respondent)	3,995	46.29	16.36	16.00	>90[b]
Education	Highest level of school completed	3,995	20.21	2.80	11.00	24.00
Married	= 1 if married, 0 otherwise	3,995	0.45	0.50	0.00	1.00
Black	= 1 if race is black or African American, 0 otherwise	3,995	0.14	0.35	0.00	1.00
Native American	= 1 if race is American Indian or Alaska Native, 0 otherwise	3,995	0.02	0.14	0.00	1.00
Asian	= 1 if race is Asian, 0 otherwise	3,995	0.05	0.21	0.00	1.00
Hispanic	= 1 if individual is Spanish, Hispanic, or Latino; 0 otherwise	3,995	0.01	0.07	0.00	1.00
Travel time	One-way travel time to primary food store, in minutes	3,995	10.50	8.22	1.00	90.00
No. SNAP retailers	No. of SNAP–authorized retailers within 5 miles of household	3,995	184.14	423.69	0.00	3,812.00
No. fast food rest.	No. of fast food restaurants within 5 miles of household	3,995	73.81	79.00	0.00	429.00
No. non-fast food rest.	No. of non–fast food restaurants within 5 miles of household	3,995	337.90	547.17	0.00	3,639.00
Shop convenience	= 1 if household shopped for food at a convenience store during past 30 days, 0 otherwise	3,995	0.34	0.47	0.00	1.00

Continued on next page. . .

Table 2. – continued from previous page

Variable	Description	*N*	Mean	Std. Dev.	Min.	Max.
Shop big box	= 1 if household shopped for food at a discount or big box store during past 30 days, 0 otherwise	3,995	0.42	0.49	0.00	1.00
Shop clubs	= 1 if household shopped for food at a wholesale club during past 30 days, 0 otherwise	3,995	0.22	0.42	0.00	1.00
Nutrition facts	How often use nutrition facts panel (1 = always, 6 = never seen)	3,995	3.01	1.34	1.00	6.00
Any dieting	= 1 if any household member is on any kind of food diet, 0 otherwise	3,995	0.32	0.47	0.00	1.00
Food pantry	= 1 if household went to a food bank or food pantry in past 30 days for groceries, 0 otherwise	3,995	0.06	0.24	0.00	1.00
USDA foods	= 1 if anyone receiving USDA foods from local program or distribution site, 0 otherwise	3,995	0.04	0.19	0.00	1.00
Meal delivery	= 1 if anyone receiving meals at home from community programs, 0 otherwise	3,995	0.01	0.10	0.00	1.00
Meal facility	= 1 if anyone received meals at a community center in past month, 0 otherwise	3,995	0.02	0.15	0.00	1.00
Fingerprint	= 1 if SNAP requires fingerprinting of applicants, 0 otherwise	3,995	0.33	0.47	0.00	1.00
Report simple	= 1 if SNAP uses simplified reporting option for households with earnings, 0 otherwise	3,995	0.87	0.33	0.00	1.00
Outreach	Outreach spending (federal, state, and grant), in $1,000	3,995	$150.19	$166.63	$0.00	$452.80

Notes: [a]Summary statistics for the observations that are not 0. Mean is not weighted. The grand mean for grocery tax rate is 0.0076.
[b]Maximum household size, income, and age are suppressed protect respondent confidentiality.

Estimation and Results

Strategy to Address Endogeneity Issue

The primary econometric issue for the empirical model is the well-known endogeneity issue related to SNAP participation. People may self-select into SNAP for reasons such as a stronger taste for food consumption (Hoynes and Schanzenbach, 2009). In our case, the error term of the model subsumes such unobservable taste factor and is potentially correlated with SNAP participation. Our empirical strategy is to use instruments to control for SNAP endogeneity.

Following a study by Ratcliffe, McKernan, and Zhang (2011) on how SNAP participation affects food security, we use three instrumental variables for SNAP participation. These are three state-level dummy variables that capture variation in SNAP eligibility requirements and administrative options, including the use of biometric technology (fingerprint scan) for identity verification, adoption of simplified reporting, and SNAP outreach spending (federal, state, and grant combined). Biometric testing is negatively correlated with SNAP participation because it imposes a transaction cost on the

Table 3. Average (Food-at-Home) FAH and Food-Away-from-Home (FAFH) Expenditures by Food Sales Tax Rates

	Sort by Grocery Tax			Sort by Restaurant Tax	
Tax Rates	***N***	**Cash FAH Expenditures**	**Total FAH Expenditures**	***N***	**FAFH Expenditures**
0	3,307	\$100.29	\$117.02		
		(99.95)	(107.06)		
>0 to < 2%	53	\$72.30	\$86.34		
		(67.82)	(73.75)		
2% to < 4%	232	\$93.05	\$107.16		
		(97.10)	(103.16)		
4% to < 6%	174	\$89.81	\$102.57	405	\$57.22
		(80.17)	(82.02)		(60.03)
6% to < 8%	229	\$88.55	\$103.01	2,135	\$58.34
		(74.24)	(86.13)		(65.20)
8% to < 10%				1,056	\$65.50
					(91.21)

Notes: Numbers in parentheses are standard deviations.

Table 4. Tests on Instrument Validity

	Null Hypothesis	**Test Statistics**
F-test of excluded instruments (Cragg–Donald F-statistic)	Parameters for excluded instruments are 0	15.87 ($p < 0.01$)
Stock–Yogo weak identification test critical value[a]	Excluded instruments are weak	13.91
Kleibergen–Paap rk LM statistic	Underidentification	46.34 ($p < 0.01$)
Hansen J statistic	Instruments are valid	4.80 ($p = 0.09$)
Hall–Peixe redundancy test on fingerprint	Instrument is redundant	9.21 ($p < 0.01$)
Report simple	Instrument is redundant	28.67 ($p < 0.01$)
Outreach	Instrument is redundant	3.01 ($p = 0.08$)
Durbin–Wu–Hausman endogeneity test on SNAP participation	SNAP participation is endogenous	2.85 ($p = 0.09$)

application and reduces the probability of cheating the system. Simplified reporting eliminates the requirement that participants regularly report changes in income and living conditions, and outreach spending measures the amount of money spent spreading awareness about the program. Both policies encourage participation and are therefore positively correlated with SNAP participation. In addition, they satisfy the exclusion restriction assumption because, while they affect participation, they do not impact FAH or FAFH expenditure. These variables are obtained from the USDA's SNAP Policy Database and are for the year of 2010, which is the most recent year of data available. Since these policy changes do not vary much over time, we do not expect it to be an issue combining it with the more recent FoodAPS data.

Table 4 presents a battery of tests on the instrument validity based on our primary FAH equation. While we also run these tests for the FAFH equation, we suppress the results here since they are almost identical to those for the FAH equation. The *F*-test in the first-stage regression on the excluded three instruments yields a test statistic of 15.87, which exceeds the critical value of the Stock–Yogo test statistic (13.91 for 5% maximal relative bias), suggesting the instruments are not weak. The Kleibergen–Paap test on under-identification rejects the null hypothesis of under-identification.[7] We further conduct Hall–Peixe redundancy tests on the three instruments and reject the null hypothesis that any instrument is redundant at the 10% significance level or better. Finally, a Durbin–Wu–Hausman endogeneity test on SNAP participation shows that we cannot reject the null hypothesis of endogeneity at the 10% level. We focus our discussion on the results using instruments while presenting the results using the ordinary least squares (OLS) as well.

FAH Equation

Table 5 presents the estimated results for the FAH equation. We use robust standard errors for all specifications in this paper.[8] Column 1 presents the OLS (noninstrumented) results, where all the core variables have the expected signs (note that SNAP participation is expected to decrease cash FAH expenditures) and are statistically significant at the 10% level or better. Column 2 shows OLS results for the model with full control variables. Column 3 reports two-stage-least-square (2SLS) estimates for both stages. Because program participation is a dummy variable, column 4 differs from column 3 in that the first stage is estimated using the logit model following the method suggested by Wooldridge (2010, p. 622) for treating a dummy endogenous variable. Therefore, column 4 becomes our preferred specification. In the first stage, all instruments have the correct signs and are statistically significant at the 10% level or better.

Focusing on the preferred specification in column 4 of Table 5, we find that a 1-percentage-point increase (e.g., the tax rate changes from 5% to 6%) in grocery tax leads to a \$2.06 decrease in household weekly (cash) FAH expenditures (a 2.1% decrease) and a 1-percentage-point change in the restaurant tax leads to a \$3.31 increase in weekly FAH spending (a 5.5% increase). Such numbers, though small at first glance, can easily aggregate to around \$40 a month for a 5% tax imposition (i.e., \$2.06 $\times$ 5 $\times$ 4).

SNAP participation reduces FAH cash spending by \$65.10, consistent with the summary statistics presented in Table 2. As shown in Table 2, the average SNAP EBT payment is \$93.81. Therefore, the net impact of SNAP participation is an increase of \$28.71 (i.e., 93.81 – 65.10) in total FAH expenditure. The basket food price has a negative effect, consistent with Gregory and Coleman-Jensen's (2013) finding that food prices reduce food security. Both household size and income positively affect FAH expenditures.

[7] While the Hansen J statistic shows that the *p*-value for overidentification restrictions here is 0.09, the *p*-value for overidentification restrictions when including a few additional control variables later (last specification in Table 7) is 0.17.

[8] We did not include state dummy variables because all the instruments used are at the state level; including state dummies will lead to collinearity problem between the instruments and the state dummies.

Table 5. Impacts of Food Sales Taxes on Food-at-Home (FAH) Expenditures ($N = 3,995$)

	OLS Core	OLS Full	2SLS, First-Stage Linear: Second Stage	2SLS, First-Stage Linear: First Stage	2SLS, First-Stage Logit: Second Stage	2SLS, First-Stage Logit: First Stage
	1	2	3		4	
Grocery tax	−187.68***	−185.03***	−224.48***	−0.87**	−205.82***	−6.10**
	(67.91)	(68.58)	(77.28)	(0.38)	(69.93)	(2.58)
Restaurant tax	214.42*	341.89***	321.09***	1.79**	330.93***	11.36**
	(123.08)	(122.80)	(123.20)	(0.82)	(123.49)	(5.25)
SNAP participation	−48.71***	−37.95***	−89.46***		−65.10***	
	(3.07)	(3.02)	(33.70)		(12.58)	
Basket price	−0.06**	−0.06*	−0.07**	−0.0002	−0.06**	−0.002*
	(0.03)	(0.03)	(0.03)	(0.00)	(0.03)	(0.001)
Household size	13.72***	13.72***	17.02***	0.07***	15.46***	0.46***
	(1.01)	(1.17)	(2.48)	(0.005)	(1.48)	(0.03)
Household income	4.50***	3.41***	2.35***	−0.02***	2.85***	−0.37***
	(0.62)	(0.59)	(0.83)	(0.002)	(0.63)	(0.02)
(Head) age		0.31***	0.23**	−0.002***	0.27***	−0.01***
		(0.08)	(0.10)	(0.0004)	(0.09)	(0.003)
Education		2.85***	1.83**	−0.02***	2.31***	−0.11***
		(0.51)	(0.83)	(0.003)	(0.56)	(0.02)
Married		20.78***	11.18	−0.19***	15.72***	−1.06***
		(3.21)	(6.81)	(0.01)	(4.04)	(0.10)
Black		−27.96***	−22.62***	0.09***	−25.15***	0.41***
		(3.26)	(4.86)	(0.02)	(3.54)	(0.11)
Native American		−5.37	0.28	0.11**	−2.39	0.50*
		(6.32)	(7.54)	(0.05)	(6.48)	(0.26)
Asian		−21.26***	−26.54***	−0.09***	−24.04***	−1.21***
		(6.71)	(7.89)	(0.03)	(6.86)	(0.30)
Hispanic		−9.97	−10.73	0.00	−10.37	0.12
		(18.03)	(16.95)	(0.08)	(17.32)	(0.56)
Travel time		0.52***	0.64***	0.002***	0.58***	0.01***
		(0.16)	(0.19)	(0.001)	(0.17)	(0.005)
No. SNAP retailers		−0.01*	−0.01	−0.00002	−0.01	−0.0001
		(0.01)	(0.01)	(0.00003)	(0.01)	(0.0002)
No. fast food rest.		−0.12***	−0.13***	0.0003	−0.13***	0.003**
		(0.04)	(0.04)	(0.0002)	(0.04)	(0.001)
No. non-fast food rest.		0.02***	0.02***	−0.00001	0.02***	−0.0002
		(0.01)	(0.01)	(0.00003)	(0.01)	(0.0003)
Any dieting		8.30***	9.40***	0.02	8.88***	0.20**
		(3.10)	(3.21)	(0.01)	(3.14)	(0.09)
Food pantry		−5.21	4.67	0.19***	0.00	0.79***
		(5.65)	(8.83)	(0.03)	(6.27)	(0.17)
USDA foods		−4.20	3.41	0.14***	−0.19	0.67***
		(6.66)	(8.89)	(0.05)	(7.07)	(0.23)
Meal delivery		−13.45	−11.41	0.04	−12.38	0.13
		(8.44)	(9.79)	(0.07)	(8.93)	(0.35)
Meal facility		−19.57***	−20.68***	−0.02	−20.15***	−0.13
		(6.85)	(7.40)	(0.04)	(7.03)	(0.27)
Fingerprint				−0.08***		−0.58***
				(0.03)		(0.15)
Report simple				0.17***		1.24***
				(0.03)		(0.22)
Outreach				0.0001*		0.001**
				(0.0001)		(0.0005)
R^2	0.16	0.20	0.16	0.23	0.19	0.25

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 6. Impacts of Food Sales Taxes on Food-Away-from-Home (FAFH) Expenditures ($N = 3,596$)

	OLS Core	OLS Full	Second Stage of 2SLS (First-Stage Linear)	Second Stage of 2SLS (First-Stage Logit)
	1	2	3	4
Grocery tax	102.37	162.94**	125.54	145.85*
	(70.59)	(74.07)	(78.41)	(75.83)
Restaurant tax	133.78	−62.95	−80.70	−71.07
	(101.08)	(100.05)	(102.64)	(100.37)
SNAP participation	−16.34***	−12.24***	−51.48**	−30.18**
	(2.72)	(2.55)	(25.19)	(12.48)
Basket price	0.03	0.02	0.01	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Household size	5.93***	6.02***	8.62***	7.21***
	(0.80)	(0.90)	(1.95)	(1.38)
Household income	3.66***	3.25***	2.43***	2.88***
	(0.55)	(0.56)	(0.75)	(0.68)
R^2	0.09	0.11	0.06	0.10

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level. Standard errors are in parentheses. Effects of demographics, etc., are suppressed.

Regarding demographic effects, we find that older age, higher education, and being married lead to higher FAH expenditure, while African Americans and Asians have lower FAH expenditures compared with Caucasians. As to food access, longer travel time to the primary food store increases FAH spending, possibly because shoppers with a longer distance shop less frequently and spend more for each trip. The number of fast food restaurants within 5 miles of a household decreases FAH expenditure, while the opposite is found to be true for the number of non–fast food restaurant within the same radius. The availability of fast food restaurants might induce households to allocate a smaller proportion of their food budgets to FAH.

FAFH Equation

Table 6 displays results for the FAFH equation. The first-stage results and results for the noncore variables are suppressed to conserve space. The preferred specification in column 4 shows that a 1-percentage-point increase in the grocery tax leads to a $1.46 increase in weekly FAFH spending, but the restaurant tax does not have a statistically significant effect on FAFH spending (though the coefficient has the correct negative sign). Consistent with Wilde, Troy, and Rogers (2009), SNAP participation is found to reduce FAFH expenditures. Though not presented in Table 6, other noteworthy findings include the fact that African Americans and Asians have lower FAFH expenditures compared with Caucasians, the number of non–fast food restaurants increases FAFH expenditure, and—surprisingly—a household member on any kind of food diet leads to higher FAH and FAFH expenditures. This may be due to healthier food, which often costs more than less healthy food.

Table 7. Additional Specifications

	Food at Home					Food Away from Home			
	Interaction w/ Income	Interaction w/ Border	Interaction w/ SNAP	SNAP Eligible	County Income	Interaction w/ Income	Interaction w/ SNAP	SNAP Eligible	County Income
	1	2	3	4	5	6	7	8	9
Grocery tax	−137.24	−269.56**	−194.20***	−181.88	−142.89**	166.59	51.44	−32.65	171.03**
	(90.08)	(106.93)	(70.93)	(182.94)	(69.05)	(102.99)	(91.14)	(155.89)	(76.38)
Restaurant tax	326.70***	324.33***	342.30***	306.89**	301.12**	−72.01	−79.86	−17.61	−74.25
	(123.14)	(123.54)	(125.89)	(134.75)	(124.79)	(100.96)	(101.94)	(114.99)	(99.94)
SNAP participation	−65.22***	−66.60***	−64.51***	−56.57***	−57.21***	−29.32**	−31.19**	−29.45**	−27.56**
	(12.63)	(12.95)	(12.48)	(20.98)	(12.82)	(12.42)	(12.64)	(14.48)	(12.51)
Basket price	−0.06**	−0.06**	−0.07**	−0.06*	−0.07**	0.02	0.02	−0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
Household size	15.47***	15.44***	15.41***	13.90***	14.74***	7.16***	7.11***	6.29***	6.88***
	(1.48)	(1.48)	(1.47)	(1.99)	(1.47)	(1.38)	(1.37)	(1.31)	(1.38)
Household income	2.97***	2.85***	2.86***	−3.33	2.59***	2.93***	2.90***	−1.59	2.83***
	(0.68)	(0.63)	(0.63)	(2.61)	(0.61)	(0.72)	(0.68)	(1.71)	(0.67)
Grocery tax × income	−19.55					−5.37			
	(20.96)					(18.54)			
Grocery tax × border		−139.45							
		(185.94)							
Grocery tax × SNAP			236.07	64.40			349.96	425.79	
			(266.90)	(370.02)			(299.59)	(356.39)	
County income					0.0001***				0.0003
					(0.0003)				(0.0002)
No. of obs.	3,995	3,995	3,995	2,257	3,995	3,596	3,596	1,997	3,596
R^2	0.19	0.19	0.19	0.18	0.21	0.10	0.10	0.04	0.10

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level. Standard errors are in parentheses. Effects of demographics, etc., are suppressed.

Additional Specifications

This subsection describes a few additional specifications that explore whether taxes have differential impacts with income, SNAP participation, and others, and how robust the results are when additional control variables are included. Table 7 reports the results. The first specification stems from the consideration that food sales taxes could be regressive by disproportionately affecting lower-income households. Columns 1 and 6 show the results with an interaction term between grocery tax and income, based on the preferred specifications in Tables 5 and 6. The interaction effect is not statistically significant. Hence, our results do not support the contention that food sales taxes disproportionately impact those with lower incomes.

Second, previous studies show some evidence that consumers might cross a state border to shop for food (e.g., Walsh and Jones, 1988; Tosun and Skidmore, 2007) and cigarettes (Harding, Leibtag, and Lovenheim, 2012) when there is a sizeable tax difference. We therefore create a dummy variable, *Border*, to indicate counties that tax groceries (a positive combined state and county tax rate) and share borders with counties that exempt groceries. The interaction of grocery taxes and the border effect again is not significant (column 2 of Table 7), possibly because only 148 households fit this category.

Third, based on the conceptual framework, we test whether grocery taxes have a less pronounced effect on SNAP recipients by adding an interaction between SNAP participation and grocery taxes. We find an insignificant interaction effect (columns 3 and 7 of Table 7). Several things could possibly explain this finding: First, the tax impact depends on where a consumer is located on the initial budget constraint (different locations of the white dot in Figure 2). The tax impact will be larger for consumers with higher preferences for FAH. Second, each consumer's degree of substitution between FAH and the other good could be different (i.e., different gray or different black dots in Figure 2). Third, current tax rates might be too small to make a discernable difference (i.e., difference between the black and gray dots may be too small). Fourth, even SNAP recipients generally still need to cover most of their FAH need with their cash. It is possible that SNAP recipients are aware of the grocery tax on their cash receipts but do not notice the missing sales tax from their receipts for SNAP purchases.[9] To explore the first two reasons further, we reduce consumer heterogeneity by restricting the analysis to only households that are eligible to receive SNAP benefits using the 185% poverty rate as the threshold. Results (columns 4 and 8) still show an insignificant grocery tax effect, providing more support for the other reasons.

Finally, we present the results obtained from including several additional controls in columns 5 and 9 of Table 7. One is county-level per capita income. We already include household income. However, one potential concern is that if county-level taxes are correlated with county-level income, then leaving out county income could result in a biased estimate of tax effect. Second, we include how often the household uses nutrition facts panel and three other dummy variables related to shopping behavior, indicating whether in the past 30 days the household shopped for food at i) a convenience store, ii) a discount (big box) store, or iii) a wholesale club. Our results remain robust, with the tax impacts becoming somewhat smaller for the FAH equation and larger for the FAFH equation. For shopping behavior, we find that consumers who shopped for food at a wholesale club recently or consumers with more frequent use of nutrition facts panel have higher FAH expenditures.

Conclusions

This study provides the first empirical examination of consumers' eating behaviors in response to grocery and restaurant taxes. The focus of the research is on two important policy questions, namely i) Do food sales taxes affect consumers' expenditures on grocery food and restaurant food? and ii) Are food expenditures of government food assistance program participants less sensitive to

[9] We thank an anonymous reviewer for suggesting this explanation.

food sales taxes? The analysis is based on food sales tax data at the county level combined with the USDA's new National Household Food Acquisition and Purchase Survey (FoodAPS), the first nationally representative survey of American households on food purchases and acquisitions, which provides a rich dataset on consumer behavior.

The results indicate that a 1-percentage-point increase in grocery tax leads to a $2.06 decrease in weekly (cash) FAH spending and a $1.46 increase in weekly FAFH spending. This suggests that consumers respond to grocery taxes even though this tax is added at the register and therefore not reflected in the shelf price. We also find that a 1-percentage-point increase in restaurant tax leads to a $3.31 increase in weekly FAH spending but does not affect FAFH spending.

Several findings may have important policy implications. First, the grocery tax changes consumers' allocation of food dollars between FAH and FAFH because it changes their relative prices. Considering that many state and local governments use grocery taxes as a means of generating revenue, we find an unintended consequence of the grocery tax, which might have further health implications considering that restaurant meals may be nutritionally poorer than meals prepared at home. Furthermore, we find that a restaurant tax increases consumers' FAH spending, suggesting that a tax on fast food might effectively encourage consumers to eat more at home.

Second, we do not find any differential impacts of food sales taxes by consumers' income or SNAP participation status. These two results suggest that, overall, food sales taxes are not regressive. However, this result may be due to the fact that FoodAPS oversampled low-income households; the under-representation of wealthier households may have caused the lack of significance in the grocery tax–income interaction term. Third, we do not find evidence that consumers might cross a state border to shop for food when there is sizeable food tax difference. However, this result may be due to the fact that only 148 households in the survey fit this category.

Our findings that consumers respond to food sales taxes also contribute to the growing literature of tax salience. Although both grocery taxes and restaurant taxes are generally not posted on the shelf or on menus and are only added after checking out, our results show that many consumers are still attentive to food sales taxes (under the conventional assumption of one-to-one tax pass-through). This result is consistent with other sales tax studies on specific products, such as bottled water (Berck et al., 2016).

Finally, these results should be interpreted with some caution since only 1 year of data were used due to the unavailability of historical county-level food sales tax data. Powell et al. (2013) point out that cross-sectional studies tend to overestimate the association between fast food prices and weight outcomes by about 25% compared with longitudinal estimates. In this respect, our results likely should be properly interpreted as an upper bound on food sales tax impacts.

[Received January 2018; final revision received April 2018.]

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