Margins to Adjustment to Price and Sales Tax Changes: New Evidence from Retailer-Customer Linked Panel Data*

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Preliminary version: please do not cite or circulate

June 2016

Abstract

Using a retailer-customer linked panel, we perform a comprehensive analysis of adjustment margins to state and local sales tax changes. We find that households bring spending forward to the months leading up to a tax increase and spend significantly less in the months afterward. The intertemporal substitution is larger for more storable or durable goods, but is very short-lived, overall. There is little contemporaneous substitution to tax-exempt goods, which show similar dynamics as taxable items. Households also engage in substantial tax arbitrage by increasing trips to locations with a lower sales tax rates and shopping online. Part of the household response is muted by retailers lowering posted pre-tax prices. We benchmark our results by comparing the demand elasticities to tax changes and posted price changes using national wholesale price changes as an instrument for the latter. We find that that demand is significantly more elastic to posted prices than to sales taxes.

JEL Classification: D12, H31, E21

Keywords: sales taxes, consumer spending, intertemporal substitution, retail pricing

*We would like to thank Stephanie Georgina Johnson for outstanding research and technical assistance. We also thank seminar participants from Northwestern, Kellogg, the Minneapolis Federal Reserve, and the University of Minnesota for their comments. This research received financial support from the Alfred P. Sloan Foundation through the NBER Household Finance small grant program.

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Introduction

Sales tax revenue contributes 35% to all tax revenue of local and state governments, and indirect taxes have recently received increased attention due to large budget shortfalls during the Great Recession.[1] The incidence of the tax both in the short and long run is therefore of great interest to economists and policy makers alike: How do consumers and firms adjust to changes in local sales tax rates in the U.S.? We use detailed scanner panel data that links customers to retailers to identify the margins that consumers and firms use to adjust to changes in sales taxes. The households' margins include inter-temporal substitution of spending and consumption; increase in spatial tax arbitrage through shopping in neighboring tax districts or from online retailers based in other states; and substitution from taxable to tax-exempt goods. On the firm side we focus on the response of retail and wholesale prices and retailer margins to the sales tax changes.

Theory often looks favorably on consumption taxes for a number of reasons. Economically, sales or value added taxes are often less distortionary than other means of raising government revenue. Income taxes levied on corporate profits or personal income may deter productive behavior and taxes on capital gains and investment income disincentivize savings and investment. Politically, sales taxes have a broad base and are both simple and highly enforceable. For these reasons, sales taxes have been the subject of much academic research and are also critical components of state and local tax revenue.

In any model of optimal taxation, a key assumption is to what extent are households aware of the taxes. Often modelers assume that households or other actors are fully rational and carefully shift labor, spending, and other choices to maximize welfare given all available information on taxes. In contrast, if households are completely unaware, then taxes may act more as a non-distortionary 'surprise' lump sum tax. For sales taxes, in particular, there is reason to believe that households may not fully incorporate sales tax levels and changes in sales taxes into their everyday decision-making. Sales taxes in the United States have the notable characteristic that they are generally only observed upon purchase of an item. In contrast with nearly all other nations, stores in the United States publicly post only the pre-tax price of a good. Moreover, each state has its own set of goods that are exempt from sales taxes or that are subject to unique sales taxes, increasing the opacity of the overall tax system. Because of this, households may not treat sales tax levels or sales tax changes in the same way that they react to price levels and changes.

A large literature has theorized and demonstrated that consumers and households

[1] U.S. Census Annual Survey of State and Local Governments, 1977 to 2013.

often under-react to taxes and prices that are non-salient or 'shrouded', to use the terminology of (n.d.). In areas such as vehicle license fees, child tax credits, property taxes, and transit payments, researchers have shown large degrees of under-reaction by households.[2]

In particular, Chetty, Looney and Kroft (2009) test the degree of under-reaction of households to sales taxes. In both an experimental setting and in an annual cross-state panel, they find evidence that households exhibit approximately zero reaction to sales tax levels and sales tax changes. Given that sales taxes are paid by households nearly every day and may increase retail expenses by up to 10% (maximum combined state and local sales taxes are approximately 10% in some locations in the United States), it is quite surprising that households exhibit such strongly irrational behavior in optimizing retail expenditures.

In an international setting, where stores generally display post-tax prices, Cashin (Cashin (2014), Cashin (2015)) demonstrates that changes in sales taxes produce effects similar to changes in prices. This holds true in both Japan and New Zealand for multiple value added tax changes, showing that the salience of taxes may be a key component of household reaction.

A number of models have discussed this characteristic in general and as it applies to taxes, in particular. Sims, in a range of papers, has built on the idea of rational inattention, whereby consumers are 'aware' of information or the possibility to acquire it, but are constrained by some capacity to translate that knowledge, or knowledge about knowledge, into action. (n.d.) discuss goods with 'shrouded attributes' which households may not respond fully to. Perhaps most recently and most directly, Goldin (2014) discusses how policy-makers can improve welfare through the pointed application of high- and low-salience taxation. Left unsettled is the degree to which different taxes do engender a 'full' response by households.

This paper aims to contribute to this literature demonstrating the extent to which households and retailers respond to changes in sales taxes and along which margins. We use 36 sales tax changes at the state level between 2004 and 2014 and over a thousand additional changes at the local level starting in 2008. Since sales taxes change infrequently—especially relative to the frequency of the spending data—these quasi-natural experiments represent persistent changes to both inter-temporal (spending today vs. tomorrow) and intra-temporal relative prices (exempt vs.non-exempt items, differences in sales taxes across jurisdictions).

[2]See Feldman and Ruffle (2013), Finkelstein (2009), Jones (2010), Hayasi (2014), Cabral and Hoxby (2011), Ott and Andrus (2000), Gallagher and Muehlegger (2011), Goldin and Tatiana (2013), Goldin (2014), and others for demonstrations of under-reactions to 'non-salient' taxes or tax changes.

This paper examines this question with a new and more detailed dataset that allows for an analysis spanning more margins of adjustment for individual households. In contrast with Chetty et al. (2009), we find that households react strongly to changes in state and local taxes in the short-run. Looking at both inter-temporal and intra-temporal margins, households adjust spending patterns significantly. In the longer run, however, we find responses much more in line with Chetty, Looney, and Kroft, with overall household retail spending returning to its pre-tax-change trend.

First, in the short run households bring spending forward to the months leading up to a tax increase and then spend significantly less in the months after sales taxes have increased. The main mechanism driving these results is a change in shopping trips, which leads tax-exempt items to have a similar dynamic response as taxed items, although the inter-temporal elasticity of spending on taxable goods is slightly larger than for tax-exempt goods.

Second, we find that this large inter-temporal substitution elasticity is very short-lived. Spending reverts quickly to the levels prior to the tax changes (measured at pre-tax prices), suggesting that consumption patterns exhibit only minor changes in the short run (e.g. running down stored goods and shopping in other districts), but do not change significantly in the long run in response to sales tax changes. Hence, there is an important difference between the inter-temporal elasticity of *spending* and the inter-temporal elasticity of *consumption*. Both parameters are of interest: the latter enters specifications of consumer preferences in economic models while the former is informative for counter-cyclical policies.

We further document this important distinction of the two types of inter-temporal substitution elasticities by comparing the response of goods that are more durable (e.g., appliances) or storable (e.g., laundry supplies) to goods that are less durable and storable (e.g., fresh produce or prepared food). Consistent with the hypothesis that the short-term inter-temporal elasticity of spending is much larger than both the long-term elasticity and the inter-temporal elasticity of consumption, we find that durable goods purchases fall twice as much as non-durable goods in the month after a sales tax increase, and households spend twice as much on durables than non-durables in the two month leading up to the tax increase. Similarly, spending on storable goods, measured by the infrequency in which the household purchases them in a typical month, show similar dynamics as durable goods.

Third, consumers increase the amount of spending done in jurisdictions that allow them to avoid increases in sales taxes. For instance, the fraction of spending in neighboring tax districts in the months after the tax differential increases. Similarly, spending at online retail outlets increases, providing another way for households to avoid paying local sales

taxes. Both of these trends continue in the long-run, suggesting either a persistent change in shopping habits or at least some degree of continued recognition of the potential tax savings.

We also analyze various mechanisms that could contribute to our results such as salience and news. We find that changes in sales taxes prompt large increases in both news coverage of sales taxes and also more attention to sales taxes by households. We find that the ratio news articles containing the term 'sales tax' tends to spike in the months leading up to a new sales tax rate. We also find that Google searches for 'sales tax' tend to increase in the month that the change actually occurs and the following two months. That is, news coverage generally report on upcoming changes in sales taxes and households often search for current sales tax information following a change.

The change in spending by households is significantly impacted by these proxies for how 'salient' a given tax change is. For instance, sales tax changes that are accompanied by more news coverage about sales taxes (conditional on the size of the change), provoke larger spending declines among affected households. In addition, sales tax changes that are enacted through state-wide ballot propositions rather than by legislative decisions also see larger responses.

Retailers and wholesalers may also respond to anticipated changes in sales taxes. The extent to which these actors pass-through changes in sales taxes will greatly impact the degree to which households respond. We find that retail prices decline significantly after a sales tax increase. Wholesale prices are largely unaffected, causing retailer margins to decline by approximately 0.15 percentage points for every 1% increase in sales taxes.

Finally, we estimate the demand elasticity to posted price changes in order to benchmark our estimate of the demand elasticity to sales tax changes, and to compare it to estimates from the previous literature. We use national-level changes in wholesale prices as an instrument for changes in retail prices, which are endogenous due to retailers adjusting their price setting to local economic conditions. We find that the demand elasticity to posted retail price changes is even larger than the demand elasticity to sales tax changes. Consistent with customers being aware in advance of sales tax changes, we find that purchases strongly increase in the month prior to the sales tax increase, whereas we don't see any such anticipation effects to posted price changes, which are difficult to predict for consumers.

The remainder of the paper is organized as follows. Section 2 discusses the data utilized throughout the paper. Section 3 lays out our empirical results and Section 4 proffers a discussion of how our findings relate to previous literature and models of household consumption behavior. Section 5 concludes.

Data

We utilize a number of datasets to examine how sales taxes affect consumer spending and retailer pricing behavior.

Sales Tax Data

For our data on sales tax rates, we turn to Thomson Reuters OneSource sales tax service.[3] This source allows us to construct a database of zip-code level sales tax rates at a monthly frequency. The data cover the entirety of the United States. The data contain comprehensive information on all sales taxes imposed in a given zip code stemming from the state, county, city, or special tax rate district (eg. school districts or water districts) that the zip code is located in. Moreover, there is information on the combined sales tax in a zip code, which may differ from the sum of all of the aforementioned sales tax rates due to statutory maximum sales taxes imposed at a state level (eg. state sales tax is 4% and the state imposes a maximum total local sales tax rate of 5%). Our final sample includes 41,673 zip codes (we exclude all US territories, restricting to 50 states and Washington DC).

Overall, sales tax changes are highly asymmetrical. Over 80% of total observed changes in sales tax rates are positive, with average total sales taxes increasing from about 6.5% in 2008 to 6.9% in 2014. Restricting to changes in state sales taxes, we find that 70% of changes are positive, with state sales taxes increasing from 5% to 5.5% over the decade to 2014.

State sales taxes generally make up the majority of total local sales taxes in a given zip-code. State level changes also tend to be larger. For instance, the 25th and 75th percentiles of state level changes are 0.25% and 1%, while for all other sales tax changes, they are 0.1% and 0.5%. Local changes are driven overwhelmingly by changes in city and county level taxes, while other sales taxes covering metro areas, water districts, school districts, or other geographic groupings play a much smaller role. Summary statistics regarding all state and local tax changes each year are found in Table 1.

In addition to our data from Thomson Reuters, we compare and extend our zip-code level Reuters sales tax data with hand-collected state level changes in sales tax rates from 2004-2015. Comparing with the Thompson Reuters data, we do not find any erroneous changes, leading us to believe that there are not any significant errors in our sales tax data.[4]

[3] https://tax.thomsonreuters.com/products/brands/onesource/indirect-tax/rates/

[4] We also test our zip code level sales tax data from Thomson Reuters using equivalent data from Zip2Tax. Data from Zip2Tax only covers December 2011 through December 2015. We find few mistakes

Newspaper Data

We employ data from the Access World News Newsbank database to measure news coverage of sales taxes at both a state and local level.[5] We query a set of over 3000 national, state, and local US newspapers at a monthly frequency from 2008 to 2016. Our query obtains the number of articles for each month and location that mention the term 'sales tax' or 'sales taxes'. We exclude classified ads and restrict our search to newspapers rather than newswires or magazines. Raw counts of articles may give a misleading measure of news coverage of sales taxes given changes in the number of newspapers at any given time. To better gauge relative news coverage, we normalize each monthly value by the total number of newspaper articles written in that month and location. We conduct searches at two levels of geographic aggregation. The first is at a state level (including Washington DC). The second is a city level, where we attribute newspapers to cities based on Access World News' categorization. Given that both our sales tax and retail spending are at a zip code level, we match states and cities to zip codes using the city-state-zip matches in the Thomson Reuters sales tax data. This method yields a good match, with only 77 out of 1468 cities with newspapers being unable to be matched to zip codes in our sample.

Google Search Data

Google search data is obtained from Google Trends. Google Trends is a Google application that gives a time series of the relative amount of local search activity for specific search terms on Google.com.[6] The values of Google Trends represent the number of searches on Google.com for the specified search term relative to the total number of searches on Google.com derived from a sample of all Google search data. Google Trends is normalized so that the highest value for the entire time period and term is set equal to 100. Its range of values is always between 0 and 100, where higher values correspond to total searches on Google.com for a given search term. A potential concern, discussed in detail by Stephens-Davidowitz (2013), is that Google imposes thresholds for reporting search data below which a 0 is displayed in Google Trends. For instance, too few searches were done for the search term 'econometrics' in July 2006 in Texas. Therefore, Google Trends displays a 0 rather than a low number, producing large swings in the time series data. For the term 'sales tax', there are a large number of zeroes in 2008-2010 in smaller

at a zip-code level in either database. The most common error is a one month deviation from the correct sales tax rate and a return to the correct value the following month. We utilize this overlap in the two databases to improve the quality of the Reuters data.

[5] http://www.newsbank.com/libraries/schools/solutions/us-international/access-world-news

[6] http://www.google.com/trends/

states. We treat these values as missing data rather than true zeroes, due to the censoring that Google employs. In the years after 2010, there are only a few zeroes per year. Our results are robust to excluding all data from the years prior to 2011.

State Ballot Propositions

Data regarding state ballot propositions that involve changes in state sales taxes are obtained from Ballotpedia.com. These data include propositions in Arizona, Arkansas, California, Colorado, Georgia, Maine, Massachusetts, Michigan, Minnesota, Missouri, South Dakota, and Washington during 2008-2015. In total, we observe 15 propositions with potential effects ranging from a decline in sales taxes of 3.25% to an increase in sales taxes of 1%. 7 of the 15 propositions were successful, 7 were unsuccessful, and one was partially successful (took effect in a subset of state counties). 9 of the 15 propositions took place in November with the remaining propositions spread across May, June, and August.

Nielsen Consumer Panel

The retail spending data in this paper is obtained from the Nielsen Consumer Panel (NCP) Database at the Kilts Center. The NCP consists of a long-run panel of American households aimed at measuring household demographic characteristics, household income, and spending on retail goods. Using barcode scanners and diary entries, participants are asked to report all spending on household goods following each shopping trip. Given the nature of the data collection, the spending consists primarily of trips to grocery stores, drugstores and pharmacies, as well as other mass-merchandise retailers. The types of goods purchased span groceries and drug products, small electronics and appliances, small home furnishings and garden equipment, kitchenware, and some soft goods. In total, there are 119 broad product groupings in the data. The NCP panel is constructed to be a representative sample of the US population. Demographic survey information about participants is obtained when they join the panel as well as each year thereafter. Nielsen attempts to maintain a high quality of data with regular reminders to participant households that prompt them to report fully, and will remove noncompliant households from their panel.[7] Monetary prizes and other drawings are utilized to incentivize higher levels of engagement.

Overall, there are 150,146 households in our sample period. However, we choose to exclude households that change zip codes at any point in their time with the NCP. This exclusion is done because we generally cannot tell the exact month of a move, so any

[7] Approximately 80% of households are retained from year to year.

change in sales taxes that accompany such a move may generate a spurious relationship with observed retail spending. Following this exclusions, 137,090 households remain, yielding 6,241,527 household-months of data.

The NCP tracks a sizable amount of a household's spending on material goods. On average, we observe over $350 of spending per month for each household. About half of this spending is on goods formally exempt from sales taxes while half is subject to sales taxes.

PromoData (Wholesale Prices)

We use PromoData to measure wholesale prices for grocery and retail goods. Promo obtains its information from one (confidential) major wholesaler in each market. One downside to this approach is that, since no single wholesaler carries every SKU in a given market, information about the universe of goods is not observed. Overall, Promo prices are available for 32 markets after removing redundant markets and combining overlapping markets.[8]

Data on wholesale prices are available from 2006 - 2012. However, during 2012 the data loses a significant amount of coverage. For this reason, we perform robustness tests excluding 2012 data from our sample. Data contains all changes in price or deals that are run by the wholesaler. Thus, we take prices as constant between observations, based on the last observed price data. We then are able to collapse prices to a monthly level for each product group. To arrive at consistent unit prices within type of product (eg. product groups), we scale the observed wholesale prices by the number of goods in a 'pack' and by the size of the unit (eg. number of ounces in a candy bar and number of candy bars in a box). To make meaningful unit price comparisons we need to know the units associated with each good. Unfortunately unit information is often not provided or is inconsistently coded (e.g. CT, PACK, EACH, OZ, O etc.). We use the modal unit within UPC to impute missing values. The intuition is that if a product is recorded as being measured in OZ most of the time units are reported, it is probably measured in OZ.

Nielsen Retail Scanner (Retailer Data)

With the Nielsen Retail Scanner (NRS) data, price and quantity information is available at the store level for each UPC carried by a covered retailer and span the years 2006-2014. Nielsen provides the following information about store location:

[8]Leveraging this regional information provides additional variation but introduces more measurement error given less complete coverage in any given market both with respect to corresponding Nielsen product groups in the cross-section and time-series coverage of specific products.

- ZIP3
- County
- DMA (Designated Market Area).

An average (quantity weighted) price is reported, by UPC, for each store every week. For a given store, coverage over time is stable and relatively complete across all years. For retailer unit prices, we use the following formula: [9]

$$\frac{price}{prmult \times size1_amt}$$

In the NRS data, units are consistently standardized and most products are measured in ounces (OZ, 51%), count (CT, 45%) or ml (ML, 2%). NRS covers 125 product groups with more than 3.2 million individual UPCs. Aside from grocery items, the NRS dataset also includes cosmetics, alcohol and general merchandise (homewares, office supplies, some electronics, garden supplies). The types of stores are detailed in Table 2.

Matching Wholesaler and Retailer Data

Given the large number of products in the retailer dataset we aggregate retail unit prices to the product group level before matching with wholesale prices. We assign products in the wholesaler data to Nielsen product groups by matching at the UPC level. The mapping is not 1-1 due to differences in end-digits when shifting to UPCs of different levels of granularity (eg. some are reported with retailer specific end-digits, etc.). This leads to multiple Nielsen UPCs corresponding to a single Promo UPC for some goods. However, this appears to have little effect when merging Nielsen product groups to their Promo equivalents.

As a consistency check we also match retail and wholesale prices by UPC at a single point in time. The implied markup distribution supports the accuracy of both the raw data and our unit price calculations, with 90 per cent of markups falling between -7 per cent and 135 per cent. We calculate Promo coverage of Nielsen product groups as the percentage of UPCs in each Nielsen product group that can be found in Promo. Overall, we see that about 4% of overall UPCs in Nielsen are also covered directly in the wholesale data for a given market. Aggregating across markets to the national level, this coverage increases somewhat.

The two datasets are merged based on the weekly date. That is, Promo prices are those associated with the week containing the Nielsen week-ending Saturday. For a Nielsen retailer using a 7-day period ending on Saturday the periods correspond closely. However,

[9] See Note E on p.15 of **Retail Scanner Dataset Manual 05.25.2015.pdf**

as mentioned above this is not the case for all retailers. For a retailer using a Thursday to Wednesday week, the Nielsen prices would pre-date the Promo prices by a few days.

Comparing unit prices is not completely straightforward as Promo units are missing for many products. As discussed above, we impute some missing units based on the modal unit reported in Promo for that UPC. When merging, we retain only UPCs for which the imputed Promo unit matches the Nielsen unit. A coarse attempt is made to standardize the more common Promo units before matching. In particular we assume O and Z refers to OZ and $C, CNT, PK, EA, EACH, STK, ROL, RL, PC, \#, CTN$ refer to CT.

Results

Our primary methodology is a difference-in-differences approach. For most of our examination of the impact of changes in sales taxes, we look at monthly changes in spending at a household level. By construction, the control groups are those households who did not experience a change in the sales tax that they face in that month. For most regressions, both period and household-level fixed effects are incorporated, thus controlling for seasonal effects, macro effects, and allowing for household-level trends over time.

Sales Taxes and Retail Spending

Table 3 shows how retail sales, as measured by the Nielsen Consumer Panel, changes following a change in the sales tax rate. Columns 1 and 2 look at the change in logged total monthly household retail spending following scaled changes in total or state sales tax rates. We see that following overall and state sales tax changes of one percentage point (eg. from 3% to 4%), household retail spending shifts by 1.6% and 1.8%, respectively. This change in spending is measured in the month that the tax change occurs in relative to the prior month.[10]

In order to categorize individual products into exempt or non-exempt goods, we first categorize products into one of several broad categories. We assign goods to one of the following categories: groceries, clothing, prepared food, medication, beer, liquor, wine, cigarettes, and non-exempt goods. We choose these categories to cover the range of categories that are treated differently on a state-by-state basis when it comes to determining whether a product is exempt from the sales tax. Groceries, for example, are almost always exempt from any state or local sales tax. However, the treatment of clothing or prepared food differs by state.

[10]Sales tax changes almost always go into effect on the first of the month, so the entire month is under the new sales tax rate. Our estimates are robust to excluding or weighting sales tax changes that occur on a different day of the month (the 15th is the second most common day).

Our categorization is done at the Product Group level, as defined by the Nielsen Consumer Panel. There are 119 total Product Groups in the Nielsen data that we then assign to these 9 categories. For instance, "Crackers", "Dough Products", "Fresh Meat", and "Fresh Produce" would be Product Groups categorized as 'grocery' purchases. "Prepared Food Ready to Serve" is assigned to the 'prepared food' category, while "Soft Goods" are treated as 'clothing'. A wide range of goods such as "Automotive" products, "Hardware and Tools", and "Toys and Sporting Goods" are categorized as 'non-exempt'.

Once we have categorized all of the goods that a household purchases, we are in a position to separately examine exempt and non-exempt purchases for each household. Columns 4-6 in Table 3 split retail spending into exempt and non-exempt totals. For both overall sales tax rates as well as state sales tax rates, we find that changes tend to affect households' non-exempt spending to a greater degree than their exempt spending. However, for both exempt and non-exempt goods, we see a strong negative relationship between sales taxes and retail spending.

In theory, we might expect that the effect on exempt spending would be zero, but there are a few reasons why we might still see a negative elasticity even for goods that are unaffected by sales tax rate changes. For one, households may be unaware of the fact that some goods are exempt from sales taxes or may simply mis-attribute an exempt product to a non-exempt category. In practice, the laws defining which goods are exempt and non-exempt are quite detailed and technical, so it would not be surprising to have a significantly level of this sort of error on the part of households.

A second reason we might not expect a zero relationship between sales tax rate changes and exempt goods purchases is that purchases are often highly correlated within trips. For instance, on a typical trip to a grocery store, a household may purchase both exempt and non-exempt goods (fresh produce, cookware, and a deli sandwich, for example). If households adjust purchasing responses to sales tax changes at a trip level, then we may expect that behavior of exempt and non-exempt goods would be correlated. We discuss this more in Section 3.3 where we show that much of the observed decline in spending after a sales tax increase is driven by adjusting the timing of trips and purchases.

We test that these results are robust to a number of alternative specifications and additional control variables. Looking at dollars of spending rather than logged spending yields similar results. Results are also little changed when also controlling for indicators of local economic conditions like average income and local unemployment rates.

Table 4 more explicitly examines some of the dynamics in household spending surrounding changes in the sales tax rate. Here we look at the evolution of logged spending levels for households in the three months prior to and the five months following any change

in state level sales taxes. We find elevated (depressed) levels of spending in the period preceding a sales tax increase (decrease) that quickly disappear once the change takes effect. For a sales tax increase of 1%, we see a dramatic fall in spending from the one month prior to the change to the month of the change, equivalent to a decline in spending of about 2.5%.

Columns 2 and 3 show that this decline is steeper for non-exempt goods. This suggests some level of substitution between exempt and non-exempt goods. These results are also displayed in Figure 5

Importantly, we find that any significant deviation of levels of spending from their long-run averages tends to disappear after only a few months. That is, the short term response of household spending is significantly different than, and greater than, any long term response.

Durability and Inter-temporal Substitution

We note that a large component of the change in retail sales in response to changes in sales taxes comes from inter-temporal substitution within the household. When faced with an imminent sales tax increase, households bring forward purchases and spending to the lower-taxed period. Given this revealed desire to shift spending forwards in time, we would expect to see this substitution manifest itself to a larger degree for goods that are more durable and more storable. That is, it would not be feasible to purchase a several-month supply of milk given that it would go bad before it could all be used.

To examine whether this pattern holds true empirically, we must first categorize all products in the Nielsen Consumer Panel data by their durability and storability. We do so in two ways.

First, we manually categorize the 118 product groups contained in the Nielsen data. We construct three broad bins from this data, non-durable, semi-durable, and durable. These measures are meant to both capture how durable but also how storable a product is. For instance, a product like laundry detergent is not durable in the sense that it is consumed after use. However, it is highly storable and can be purchased well in advance of the use date.

Our rule of thumb is to categorize goods that need to be used within 6 months as non-durable, those that can be kept up to 1 year as semi-durable, and those that can be kept or used for over 1 year as durable. We look at sources including Nielsen documentation, nutritional data on average shelf life, and data about average expiration dates for products to get a better idea of how durable and storable a given product group is. For instance, items like “Gum”, “Milk”, “Fresh Produce”, “Ice Cream”, and “Candy” are categorized

as non-durable. "Beer", canned food, and "Coffee" are semi-durable, and "Soft Goods, "Automotive", "Laundry Supplies", and "Toys" are labeled as durable.

Second, we categorize each product group with a continuous measure of how frequently products in a given group were purchased. For instance, milk, purchased weekly by an average household, would have a value of approximately 4 (average purchases per month), while light bulbs may have a value of less than 0.5 (purchased less than once every two months).

This measure corresponds fairly well with our hand-coded categorization, with durable or storable goods, on average, having significantly lower purchases per month than non-durable or nonstorable goods. In the durable category, the average purchases per month of a given product group is 0.38, for semi-durables, it is 0.8, and for non-durables, the average number of purchases per month is 1.5.

We first conduct our analysis of heterogeneous behavior across categories of goods at a state-month level. This minimizes problems that arise from households having large numbers of zeroes for their monthly spending on particular fine categories. Table 5 shows results from these regressions.

In Column 1, we show the baseline spending response to a change in sales taxes. On average, across categories, we see a decline in spending of approximately 2.7% in the month of a sales tax increase of 1%. Column 2 adds an interaction with whether the product was in the 'durable' category. This interaction term is negative and significant at a 10% level, consistent with households acting shifting spending of durables more than nondurables.

In Column 3, we explicitly test for changes in purchasing behavior prior to the change in sales tax. We find that there are significant increases in durables in the months leading up to decrease in sales tax but no significant changes in purchases of other types of goods. Finally, in Column 4, we interact the change in sales tax with our product group level data on logged purchase frequency. We find that products purchased more frequently tend to be less affected by a change in sales taxes while infrequently purchased products see a larger than average response in the month of the tax change.

Cashin (2014) also finds that this pattern was seen around changes in the sales tax rate in New Zealand. Using data regarding three large changes in the national sales tax (Goods and Services Tax) rate, he finds strong evidence for inter-temporal substitution among both durables and non-durables. However, the magnitude of the substitution from the month of the change to the month prior to the change is 3-5 times larger for durable goods than for non-durables.

Shopping Trip Adjustment

Another benefit of the Nielsen Consumer Panel is the ability to observe details of the shopping trips that households took and where they shopped. We test how households shopping trips were affected by changes in sales taxes in Table 6. We do this both at a store level and based on the geographic location of a retailer.

Our data identifies stores by their three-digit zip code. Given our sales taxes can vary at a five digit zip-code level, this significantly reduces our ability to test smaller shifts in the location of spending. In general, it is difficult for most households to switch to shopping in a different three digit zip-code. One exception is the set of households that live near state borders which feature differences in zip-code at a one or two digit level. For this reason, we focus on changes in state sales taxes in Table 6.

We find that both the number of unique retailers and stores declines in the month following a sales tax increase. This may be driven both by a decline in overall spending and a consolidation to particular types of stores.

Columns 3 and 4 test whether the geographical location of shopping trips changed, as well. For these columns, we observe the fraction of spending that a household conducts in a three digit zip code different than his own. We find little increase in "alternative zip code" spending for households in general. However, Column 4 notes that we see a significant increase in this type of spending for households who had already been conducting some of their shopping in alternative three digit zip codes. This signals that, for households who could conceivably substitute spending into a different three digit zip-code, an increase in the sales tax made them shift additional spending to that zip-code.

Another potential way for households to avoid increases in sales taxes is to shop online. Online retailers are generally not required to collect sales taxes for sales to purchasers if the retailer does not maintain a physical presence in the same state as the purchaser. For most of our sample period, a majority of online purchases were done without purchasers paying sales tax.

Instead, households are required to pay a 'use tax' to their home state when completing their annual taxes. However, compliance with the use tax is estimated to be extremely low (eg. 0.3% of California tax returns reported any use tax related purchases in 2009). Because of this, households may shift purchases online where possible when local sales taxes increase.

Fortunately, the Nielsen Homescan data categorizes purchases made from online merchants separately from brick-and-mortar retailers. In Table 7, we separately examine the impact of changes in sales taxes on these online purchases. We find that household seem to shift spending online in the month following a sales tax increase. We measure this

looking at changes in logged online spending as well as the fraction of total measured retail spending done online. We find strong effects on online sales volumes, and positive but marginally significant effects when looking at the fraction of spending done online. These coefficients suggest that online spending in an affected household increased 1.5% following an increase in the sales tax rate of 1%.

Davis, Knoepfle, Sun and Yannelis (2016) look at the geographical substitution patterns surrounding sales taxes in much more detail. They use credit card spending data to examine how zip-code level spending is impacted by changes in sales taxes on both sides of borders, finding an elasticity of approximately 4.2 in zip-codes that are located on state borders. Our results here align with their own. They also note persistent substitution to online retailers following sales tax increases.

Again, similarly to our results that suggest strong inter-temporal substitution of durables purchases, this pattern of behavior is evidence that while spending patterns are significantly affected by sales tax increases in the short-run, consumption patterns may be less affected.

Sales Tax Changes, Newspapers, and Google Search

Table 8 examines the relationship between sales taxes and news coverage. We look at average local tax rates across all zip codes in a state as well as state sales tax rates. Columns 1 and 2 simply regress the fraction of all newspaper articles that contain the term 'sales tax' on indicators for any change in any local sales tax or any change in state sales tax rates. The indicators are timed such that they are one month ahead of the actual change, such that an effect on news for a sales tax change taking place on August 1st is measured in July. We find that changes in sales taxes induce a large increase in coverage about sales taxes in the month before they go into effect. The effect is larger for state sales taxes, which may be due to their larger range of coverage or because of their larger size, on average. The mean value of the dependent variable is 0.53 and the standard deviation is approximately 0.4 (that is, the average fraction of articles in a newspaper that mention sales taxes is about 0.5%), so a change in the state sales tax, for example, is associated with an increase in news coverage of about 60% of one standard deviation. Columns 3 and 4 scale the change in sales tax rates by the absolute value of the size of the change (averaged across the state). Here we find that, indeed, larger changes in sales tax rates drive much wider coverage of sales taxes, in general. A change in the state sales tax rate of 1% is associated with an increase of news coverage about sales taxes of 1.25 standard deviations.

Columns 5 and 6 look at the evolution of news coverage and searches on Google.com

that contain the term 'sales tax' in the quarters surrounding a change in state sales tax rates. We find that news only spikes in the quarter prior to the change, while Google searches spike in the quarter that the change actually takes place in. This suggests that the news media reports about imminent changes in sales taxes, while individuals are more interested in the change after it actually occurs (and when it will affect their buying behavior.

Sales Tax Salience

In Table 9, we include measures of news coverage of sales taxes in an attempt to measure the awareness or salience of each individual sales tax change. Our measure of salience is based on the amount of news coverage that discusses sales taxes in the month prior to the change. The assumption is that the more that sales taxes are written about, the more likely it is that a given household will be aware of the upcoming change in sales taxes and that they will react to the change.

As shown in Table 8, this measure is sensitive to the presence and the size of changes in sales taxes. So, a large amount of variation in news coverage will be driven by the size of the sales tax change, itself. We attempt to recover the more exogenous portion of coverage in sales taxes (eg. driven by other competing stories in the news) by removing a cubic function of the change in the sales tax rate, as well as time and location fixed effects, from our measure of news coverage.

Table 9 looks at the change in household spending that is associated with changes in sales taxes, this orthogonalized measure of sales tax news coverage, and an interaction of these two variables. We again find that, in general, sales tax changes have a negative relationship with spending. Moreover, while not always statistically significant, changes that had more news coverage (conditional on the size of the change) also had larger declines, and this effect of news coverage strengthened as the sales tax change got larger.

The impact of news coverage that we see is significantly larger for changes in the sales tax rate that are not driven by the state sales tax rate. This may be because changes in state sales taxes are highly salient in general (eg. workplace discussions, TV coverage, voting on statewide propositions), so changes in news coverage do relatively little to increase awareness about the upcoming change. Local sales taxes, on the other hand, may have larger increases in salience driven by a corresponding increase in news coverage.

If households generally act as though the sales tax does not exist, one might expect a large impact on spending when reminded that there is a sales tax. We test for this possibility by utilizing data regarding all state ballot propositions that would affect state sales tax rates from 2004-2014.

Table 10 displays results looking at how household retail sales immediately respond to 15 ballot propositions in 12 states from 2008-2015. Column 1 shows that there is no significant systematic relationship between one of these ballot propositions being on the ballot and any changes in retail spending in a given month, regardless of whether the proposition failed or not. Column 2 controls of the size (and direction) of the proposed tax changes, as well as an interaction of the size with whether the proposition passed.

In Column 3, we test whether the ballot propositions have differential impacts depending on what the **current** sales tax is in the state. If we think that, in general, households do not pay attention to sales taxes and a ballot proposition about sales taxes would make the current tax rate more salient, we would expect states with high sales taxes to see declines in retail spending when a sales tax proposition is on the ballot. We do not see any such effect, with the only significant coefficient being on the level of the current state sales tax.

Finally, Columns 4-5 look not only at the date of the ballot proposition but also the actual dates that the propositions changed the sales taxes. We see no effect on retail sales surrounding the date of the ballot, but a significant decline following the actual change in sales taxes. Column 5 highlights the fact that, while the ballot propositions themselves induce no changes in retail spending, changes in sales taxes that were driven by ballot propositions seem to have larger effects on household spending than those done by the legislature. This would suggest that there is a salience effect of the ballot propositions, but it is targeted on the actual sales tax changes rather than the current sales tax rate.

Long-Run Reactions

While we find household responses that are both statistically and economically significant in the short-run, a natural question is if there are any long-run impacts of sales tax changes.

Table 11 tests our main specifications at an annual frequency, mirroring the empirical tests performed in Chetty et al. (2009). We test for effects on exempt, non-exempt, and overall spending as well as looking at both state and overall tax changes. We find no significant effects. This sharply contrasts with our results in the short-run where we found significant responses along numerous margins.

Tables 12 and 13 examine two of the previous margins that we found households adjust along. Here we see a continuation of the trends we observed in Tables 6 and 7. Despite no change in overall retail spending, even at an annual level, households continue to spend more outside their three-digit ZIP code and more online than the year prior to a sales tax increase. This suggests that households have acquired new habits of retail shopping that

persist long after sales tax changes.

We also investigate the possibility that the reason overall household spending does not react significantly in the long-run to sales tax changes it that other state and local taxes may offset any change in sales taxes. For instance, under a range of utility functions in a standard permanent income model, instituting a sales tax increase (assuming the sales tax effected all goods and services) alongside a compensating income tax decrease will produce no change in pre-tax retail expenditures. This effect is seen in Cashin (2014), where New Zealand institutes a change in sales taxes while also adjusting income taxes in the opposite direction. Therefore, omitting compensating changes in income tax rates from any analysis of long run sales tax rate changes may dramatically understate any true impact of sales tax changes.

We collect state income tax data at an annual level for all states in the United States from 2004-2014. Using TAXSIM software, we derive the tax burden for each Nielsen household adjusted for all available demographic and financial information such as income and number of dependents. We find significant evidence that state income taxes and sales taxes are negatively correlated. Table 14 lists a selection of instances where there are explicit political links between tax changes. Many states, under new political leadership, enact compensated changes in their tax system involving all three primary sources of state tax revenue: income taxes, sales taxes, and property taxes. It is often the case that a state will, in the same year, adjust the sales tax upwards and the income tax rate downwards, for example.

Table 15 tests this in regression form at an annual level for all households in our sample. We find that an increase in sales tax of 1% is, on average, accompanied by a decrease in the state income tax rate of approximately 0.15%. We find no such evidence that this link exists for federal income tax rates.

Table 16 then incorporates these changes in income tax rates into our baseline specifications. Column 1 shows that we see no impact of sales taxes on retail sales at an annual level. Columns 2 and 3 add in changes in household income and the state income tax rate into the analysis. While both of these variables have significant impacts on changes in overall, exempt, and non-exempt retail spending, the null effect for changes in sales taxes at an annual level holds true.

Retailer Margins and Price Elasticity

We combine data from the Nielsen Retailer Survey with PromoData to study how retailer margins responded to changes in sales taxes. Given that we observe inter-temporal substitution patterns and overall declines in sales following an increase in sales taxes that

act as large shifts in demand for retail goods, we might expect retailers to anticipate and react to these shifts.

We proceed in this analysis at a monthly, product group level for each three-digit zip-code that the data cover. We measure changes in both retailer and wholesaler logged prices. In Table 17, we observe that while wholesale prices are largely unaffected, retailer prices decline significantly in the month following an increase in sales taxes. We find an elasticity of about 0.15-0.2 for changes in state and local taxes. That is, for a 1% increase in the sales tax rate, retailer prices tend to decline by 0.15-0.2%.

The non-response of the wholesale prices may be driven by the fact that wholesalers are less geographically concentrated and so do not price to local conditions to the extent that retailers do. Another reason may be that wholesale prices tend to be more stable and feature fewer short-term sales than do retailers, leading to somewhat higher menu costs and a reduction in desire to change prices at high frequency.

Columns 5 and 6 in Table 17 perform the same analysis for retail prices at an annual level. In contrast to the muted long-run response of household spending, here we find that prices remain relatively depressed in the year following a change in the sales tax rate. This suggests that sales taxes are not fully passed through to consumers, but that they are partially incident on retailers, as well. It also may help to explain the lower elasticity of household spending with respect to sales taxes at an annual level that we observed. If, for example, retailers reduced prices by 1% for each 1% increase in the sales tax rate, then post-tax prices would be essentially unchanged and we might expect even fully rational households to leave retail spending levels and distributions unchanged.

This linked data also gives us an avenue to examine how household responses to changes in sales taxes differ from their responses to price changes. Since local retail prices are highly endogenous and vary with local demand, we use changes in wholesale prices to instrument for changes in retail prices. Moreover, wholesale prices are less directly linked to demand at a local level, interacting more tightly with global commodity prices. The implicit assumption of our instrument is that changes in wholesale prices only affect household spending on a given type of good through changes in retail prices.

While retailers' and wholesalers' responses to sales tax changes differ significantly, in general they exhibit strong amounts of co-movement over time. Changes in wholesale prices are generally translated into changes in retail prices, keeping margins relatively consistent over time for a given good. Figure 6 shows this correlation over time for a number of product groups.

Table 18 displays both OLS and IV versions of this specification, examining how changes in household spending co-vary with changes in both retail prices and state sales

taxes.. Here, our data is at a month-product group-ZIP3 level, as this is the granularity with which we observe the store and wholesaler locations. Moreover, using product group data with households tends to yield a large amount of zeroes and increase concerns about measurement error.

In column 1, we see that spending tends to decrease following increases in sales taxes or increases in retail prices. However, we retain significant concerns about the relationship between retailer prices and local demand. To remedy this concern, we utilize our wholesale price instrument in column 3. Here we find a much larger response (around -3.7) to retailer prices. Column 4 utilizes a number of lags of wholesale prices in addition to a contemporaneous wholesale price change in the first stage, increasing first stage power and somewhat reducing the elasticity of spending with respect to retail prices. Overall, we find a similar magnitude of household response to both prices and taxes, suggesting that households are well aware of changes in sales taxes.

Columns 2 and 5 look at changes in spending in the month prior to changes in retail prices or state sales taxes. Here we find a significant difference between the two sources of product post-tax price variation. In our IV specification in column 5, we find no response of current spending with respect to future retail price changes. However, we see a significant increase in spending when there will be an increase in sales taxes in the following month. This is likely because changes in sales taxes are almost always foreseen at least one month in advance while changes in future retail prices may be relatively opaque.

As discussed previously, much of the change in spending around sales tax changes is driven by inter-temporal substitution. When a price change is unforeseen, it isn't possible to bring forward future spending into the present. Thus, while we see similar responses to changes in prices and changes in sales taxes in the short run, the long run effect of sales taxes on prices is much smaller once households run down stocks of durable and storable items purchased in the period before any increase.

Discussion

Despite the fact that, for most retail shopping sales taxes are unobserved prior to checkout and have been termed as a non-salient tax by other researchers, we find that household retail spending does respond significantly to changes in sales taxes. At least in some regards, households do seem to be well aware of sales taxes and the means by which to avoid them. By far the largest effect is in intertemporal substitution, requiring households to not only be aware of sales taxes but also to correctly foresee the predictable changes that are soon-to-be enacted.

These results imply that, while local sales taxes may be avoided by households shopping in neighboring jurisdictions or online. This result mirrors that found by Davis et al. (2016) using different data on household spending. They find that for border areas, cross-border shopping effects are significant, though quickly decline to zero when further than 50 miles from a relevant border. Moreover, they also find that households are quick to shift spending to online retailers when local sales taxes increase.

To the extent that sales taxes converge across states and loopholes for online sales are closed, this avenue of adjustment may be closed and drive effects on consumption. In a number of papers (Agrawal (2015b), Agrawal (2015a), Agrawal (2016)), Agrawal shows that local jurisdictions will act to take advantage of changes in sales taxes in neighboring jurisdictions. For instance, when Illinois raises sales taxes across the state, cities in Indiana near the border with Illinois tend to raise their taxes by 50% as much as Illinois did to take advantage of the increase in cross-border shopping.

However, even in the short-run, there seems to be little substitution or differential reaction between exempt and non-exempt goods. While our point estimates of the impact on non-exempt goods is generally larger than that for exempt goods, the difference is not statistically significant. Unless there is an extreme degree of complementarity between exempt and non-exempt goods, this result is implausible for fully-informed consumers. So, while households exhibit some types of awareness of sales tax changes, their understanding of which goods are subject to sales taxes may be limited.

To the extent we can measure changes in the amount of information presented to households about sales taxes, we can test whether households' reactions correlate with the amount of information about sales taxes they have. Changes in sales tax rates not only have impacts on the post-tax prices of retail goods, but also generate large amounts of news coverage of both current and future tax rates. Our finding that higher levels of news coverage surrounding sales tax changes tend to generate larger spending responses implies that the salience of the tax may indeed play a large role. In addition, changes in salience driven by news-coverage about sales taxes may also be able to explain the similar responses in spending on exempt and non-exempt goods. Through manual inspection of a number of articles written about impending sales taxes, both the upcoming change in sales taxes as well as the current sales tax were nearly always mentioned, while the distinction between exempt and non-exempt goods was only present in a small fraction of articles.

Whereas previous literature regarding salience or (n.d.) 'shrouded attributes' allows for different levels of attention paid to different taxes, our results suggest that not only is the salience of taxes important, but salience or attention may change over time. This

decline in salience over time may be one explanation for the fact that, in the longer run, we find much less evidence of any persistent response of overall household spending to a change in sales taxes. In the year after a change in sales taxes, consistent with the findings in Chetty et al. (2009), we find no detectable impact on overall retail spending by households, nor separately for non-exempt goods.

This finding merits further study, given it produces a result counter to what most models of learning would predict. If we expected households to slowly obtain knowledge about changes in sales taxes, we should expect that long-run elasticities are significantly larger than short-run elasticities.

The lack of a long-run response may also be driven by the persistence of substitution into cross-border shopping and to online retailers, allowing households to continue to avoid the change in sales taxes. Larcom, Rauch and Willems (2016) demonstrate that a strike by subway workers in London produced persistent changes in commuting patterns. Once a shock to their transit options occurred, workers re-optimized their routes, causing positive changes that lasted longer than the strike itself. Some of the persistence of online and cross-border shopping that we observe may be driven by a similar cause. Increases in sales taxes may induce more experimentation between shopping options and some of those options may be more convenient or desirable even if households no longer consider the tax savings they incur.

We also investigate the role that prices play in affecting household spending decisions following sales tax changes. We find that pre-tax prices tend to drop (increase) persistently following an increase (decrease) in sales taxes, providing another channel through which effects on household spending may be muted. This effect is still detectable, and, in fact, strengthens somewhat over the year following a sales tax change, reaching approximately 20-30% the size of the change in sales taxes. The limited pass-through that we find joins a somewhat conflicted literature on to what degree retailers respond to sales taxes.[11]

Conclusions

From 2004 to 2014, there were more than a thousand changes in state and local tax rates. This paper evaluates the impact of the tax changes on household retail spending through a number of different channels and potential margins of adjustment. Understanding how households respond differently to post-tax price changes driven by taxes rather than pre-tax price changes has important implications both for tax incidence but also more generally in structural models of household consumption.

[11] See Poterba (1996), Sidhu (1971), Besley and Rosen (1994), Due (1954), Haig and Shoup (1934), Brownlee and Perry (1967), Harris (1987), and others for tests of sales tax and excise tax pass-through.

In general, we find that households bring spending forward to the months leading up to a tax increase and spend significantly less in the months afterward. This strong inter-temporal substitution of spending is very short-lived despite the persistent change in the inter-temporal price, suggesting that actual consumption behavior does not change significantly.

Consistent with this hypothesis, we find the inter-temporal substitution of spending is larger for more storable or durable goods and there is little substitution to tax-exempt goods. Instead, tax-exempt items follow a similar pattern as non-exempt items driven by the strong complementarity of purchases of exempt goods and the number of shopping trips. Households also engage in geographical arbitrage by increasing trips to locations with a lower sales tax rate after a tax increase in their home ZIP code.

Part of the household response is muted by retailers lowering posted before-tax prices. Retail prices decrease more than wholesale prices causing a significant decrease in retailer profit margins. We benchmark our results by comparing the demand elasticities to tax changes and posted price changes using national wholesale price changes as an instrument for the latter. We find that that demand is substantially more elastic to posted prices than to sales taxes.

Across several specifications, we find that increases in the amount of information presented to households about current sales taxes and upcoming changes to sales taxes induce larger responses of household spending. Our results imply that the salience of taxes is an important determinant of how households respond to taxes and may vary significantly over time.

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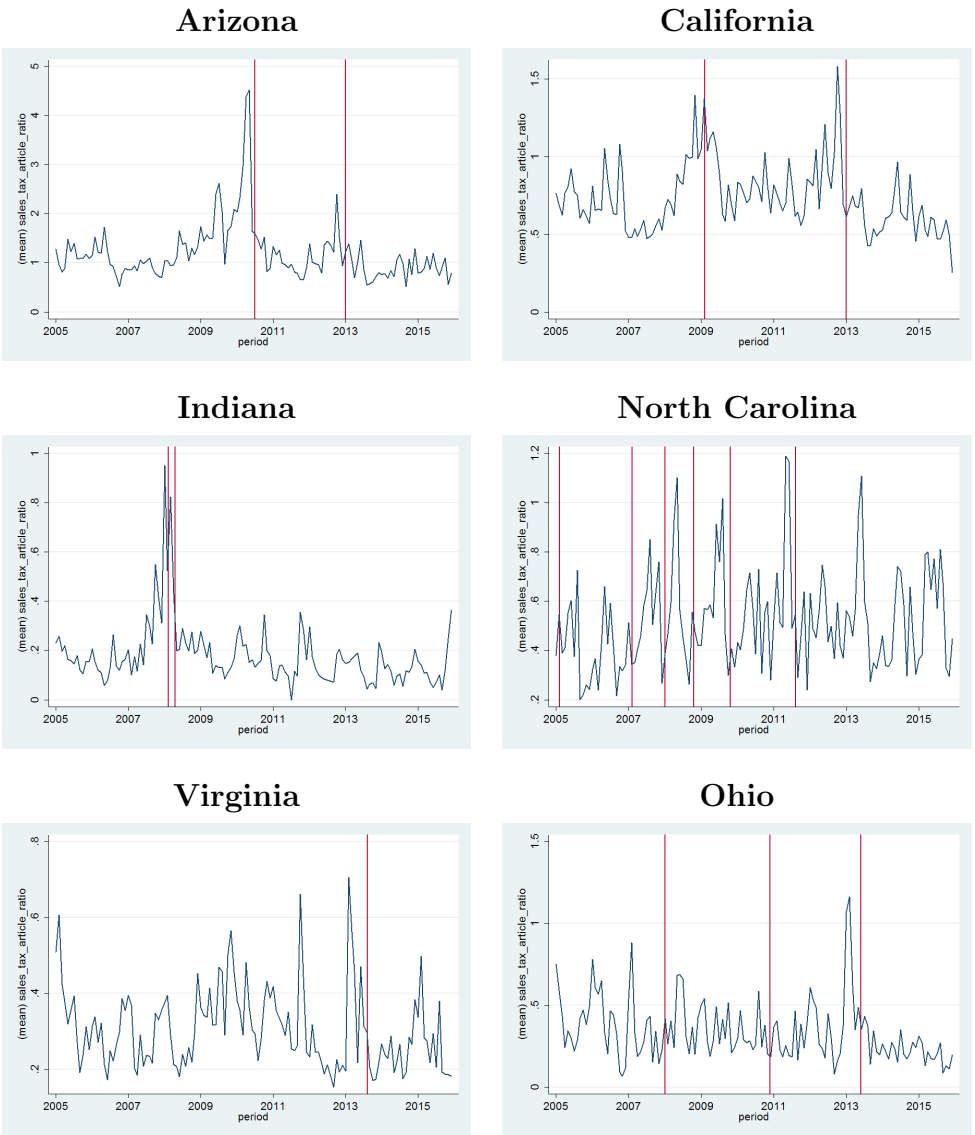
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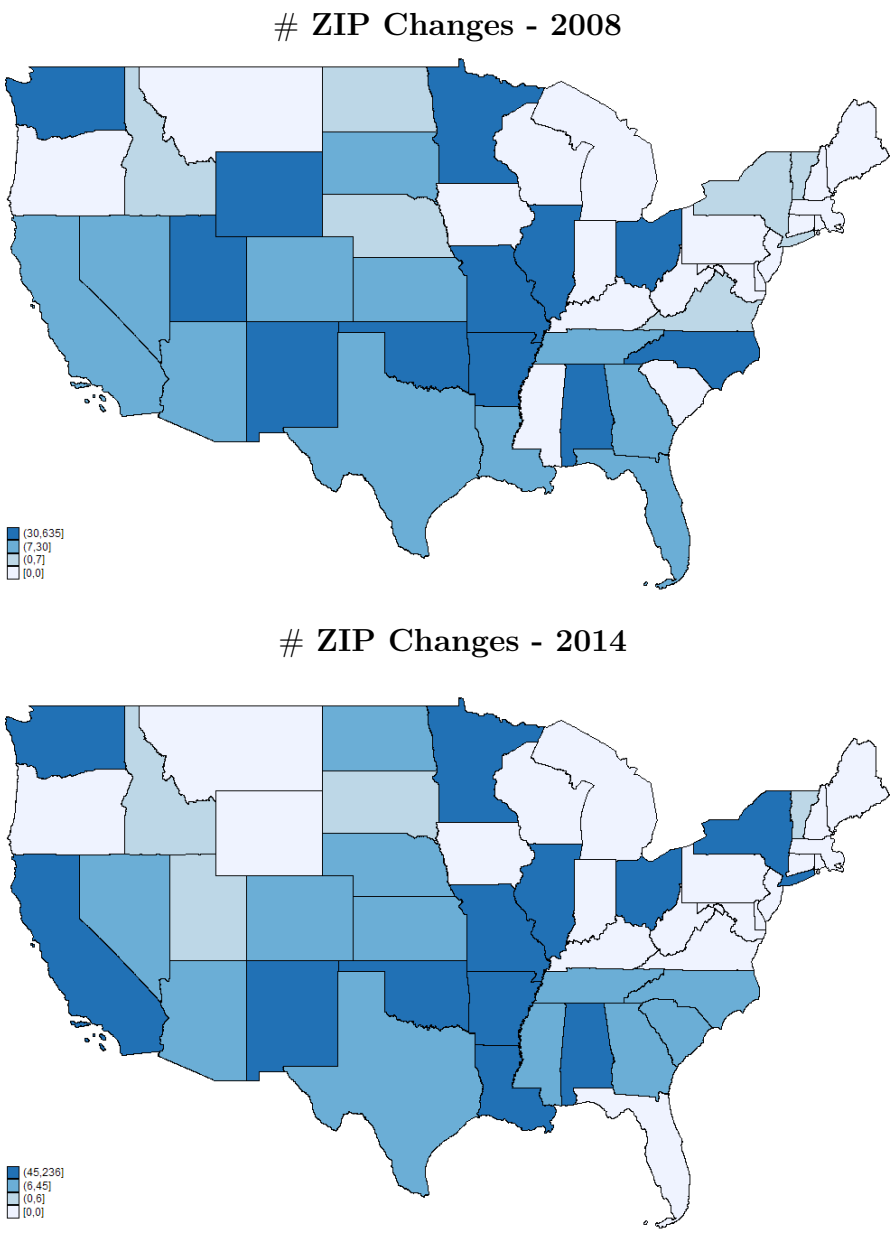
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Figure 1 – Newspaper Coverage and Sales Tax Changes



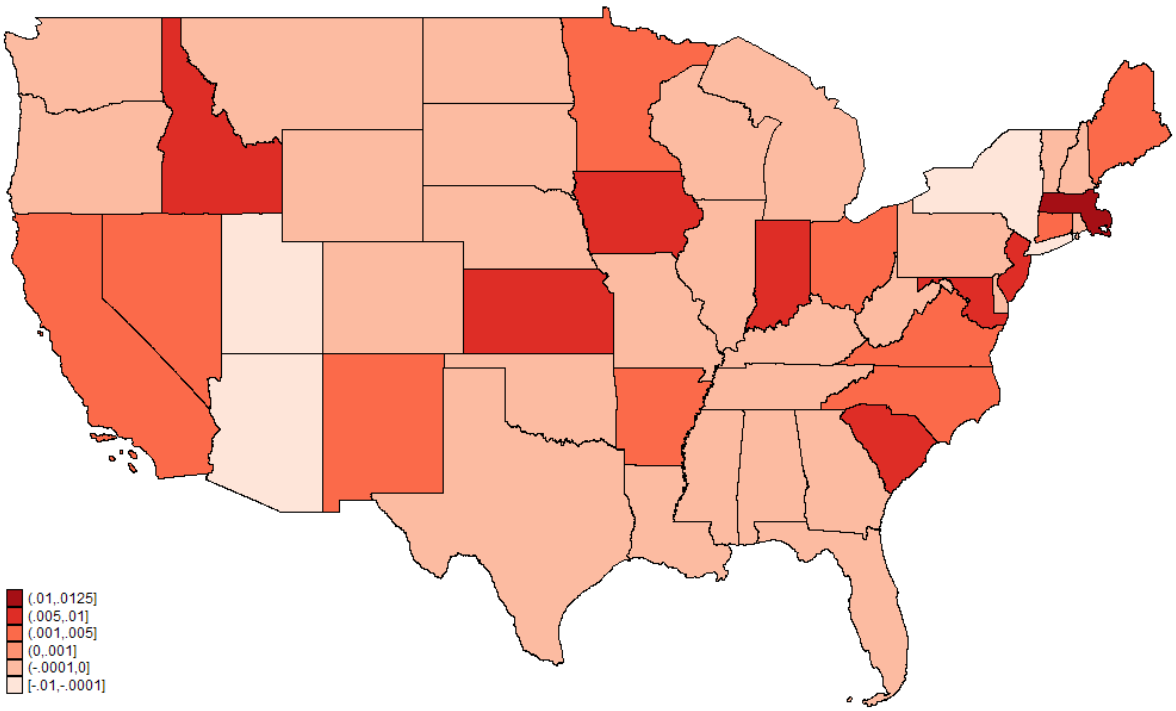
Notes: Figures plot news articles that contain the term 'sales tax' or 'sales taxes' as a fraction of all newspaper articles in a given month across newspapers in that state. Y-axis units are percentage points (eg. 0.2 = 0.2% of articles contain 'sales tax'). Selected states shown. News articles taken from Access World News and cover approximately 3,000 US newspapers ranging from large national papers to local papers. Red vertical lines denote the dates of state-wide sales tax changes.

Figure 2 – Number of Changes in ZIP Code Level Sales Taxes



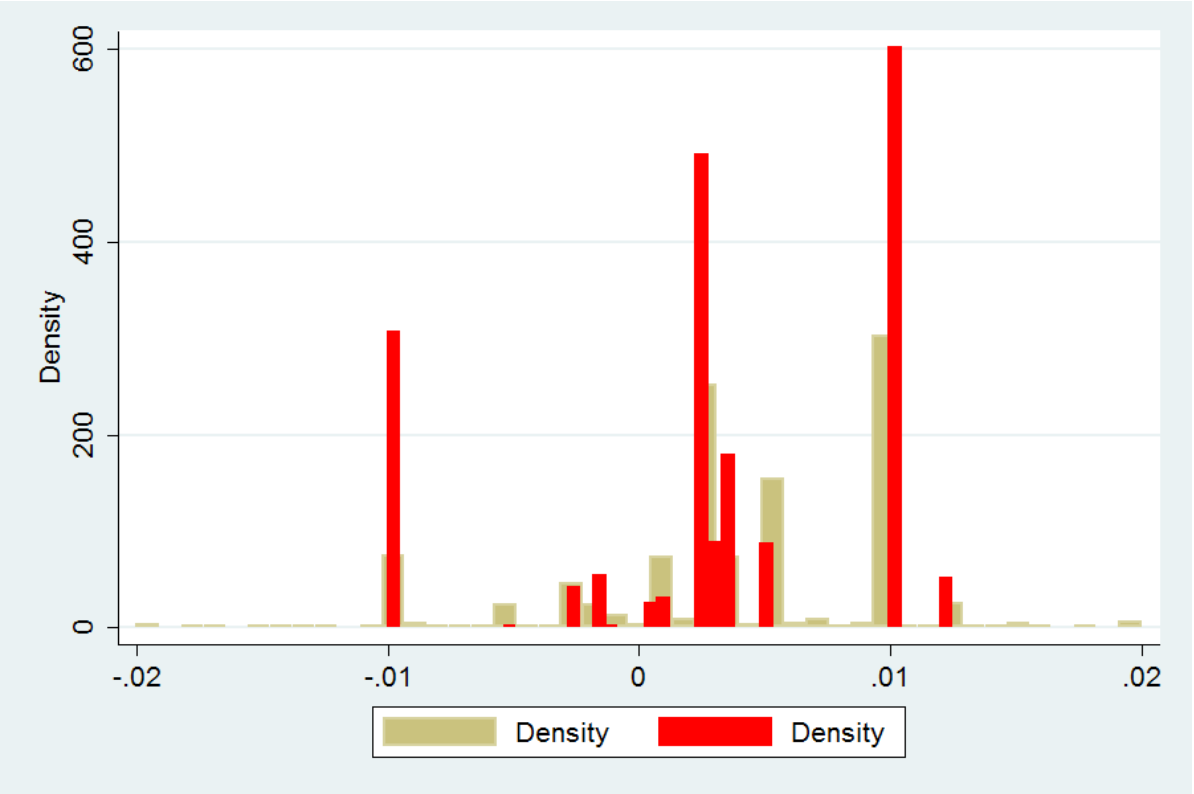
Notes: Maps plot the number of zip-codes that experience changes in local sales tax rates in each state for the listed years. If a zip-code is subject to two different changes in local sales tax rate in a year, it is counted twice. Local sales tax rate changes may be driven by changes in state, city, county, or other sales tax levels.

Figure 3 – Change in State Tax Rate, 2005-2014



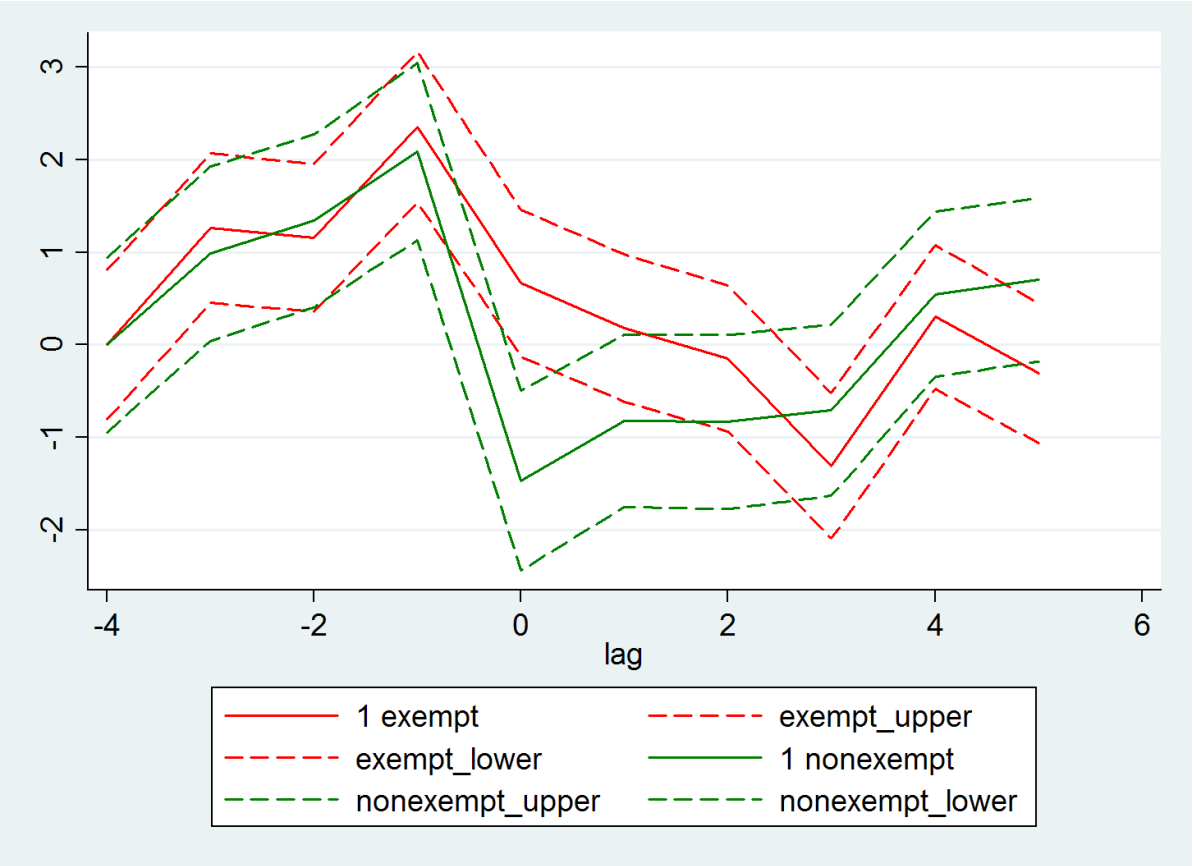
Notes: Map shows the overall change in the state-level sales tax rate for each state from January 2005 to January 2014.

Figure 4 – Distribution of State and Local Tax Changes, 2005-2014



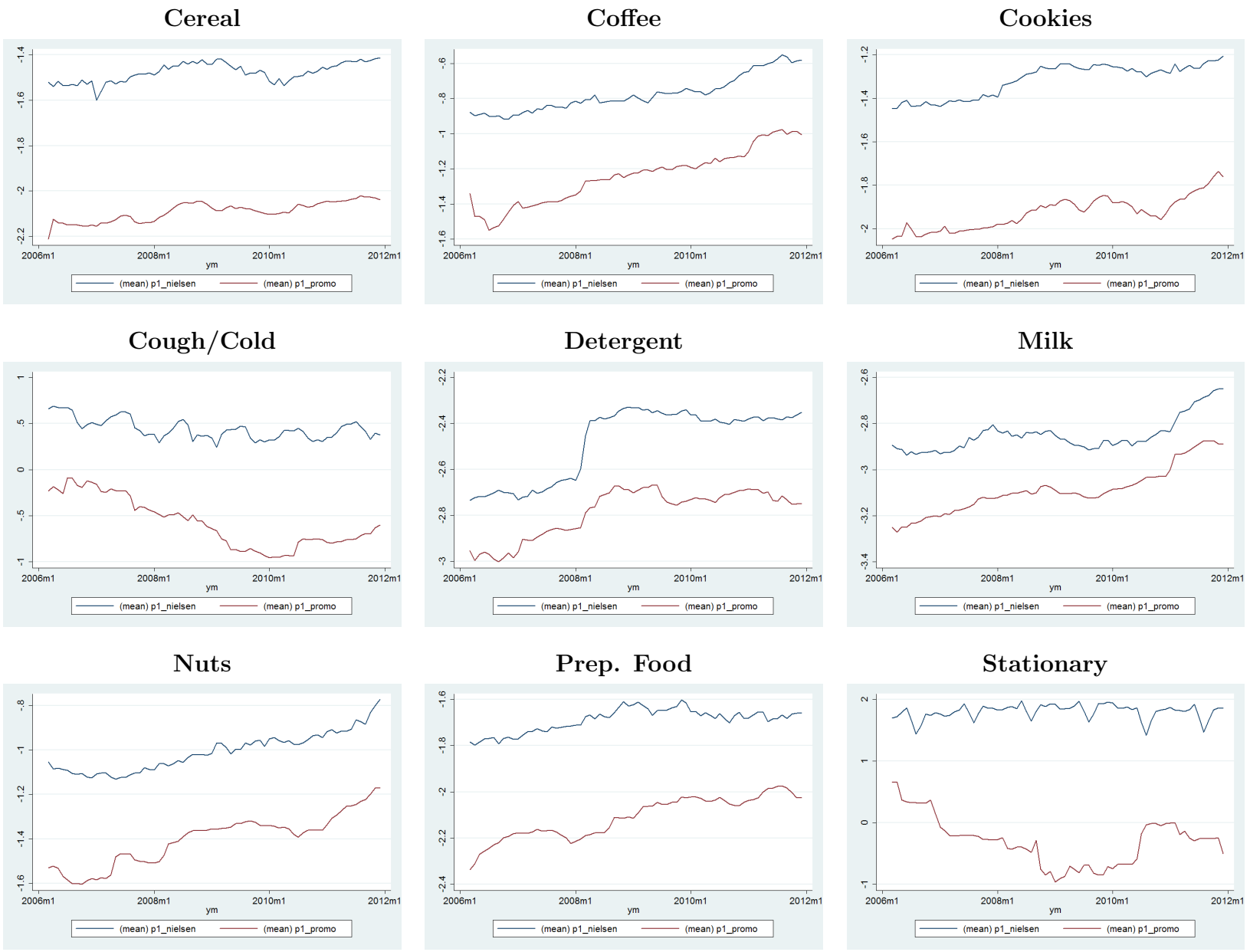
Notes: This histogram plots the relative density of various sizes of state and local tax changes at a zip code level. The red bars denote state sales tax changes while the tan bars represent local (eg. city, county, metropolitan, school district, etc.) taxes. There are over 1,700 local tax changes and 40 state tax changes over 2006-2014 that each may affect multiple zip code level tax rates.

Figure 5 – Exempt and NonExempt Spending Around a State Sales Tax Change



Notes: Maps plot the number of zip-codes that experience changes in local sales tax rates in each state for the listed years. If a zip-code is subject to two different changes in local sales tax rate in a year, it is counted twice. Local sales tax rate changes may be driven by changes in state, city, county, or other sales tax levels.

Figure 6 – Wholesale and Retail Prices



Notes: All plotted data is for the 606 three-digit zip code (Chicago) for selected product groups. The blue (lower) line denotes average logged retail unit prices for the given product group derived from Nielsen Retail Scanner data. The red (upper) line denotes average logged wholesale unit prices for the given product group derived from PromoData. Plots span 2006-2011.

Table 1. State and Local Changes in Sales Taxes by Year

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
State Sales Tax Changes	3	2	3	3	1	5	8	3	3	0	8	0	1
County Sales Tax Changes	-	-	-	-	-	259	201	65	56	64	92	85	111
City Sales Tax Changes	-	-	-	-	-	211	318	207	247	1109	271	255	291
Other Local Sales Tax Changes	-	-	-	-	-	74	90	42	34	89	215	38	68
Total Sales Tax Changes	-	-	-	-	-	549	617	317	340	1262	586	378	471

Notes: These represent all state and local changes in sales tax rates in a given year and are mutually exclusive. A tax change and revision later the same year would be counted separately. In addition, expirations of sales tax changes are counted as a change, as well. 'Other Local Sales Tax Changes' include changes in administrative areas such as water districts, school districts, and other areas.

Table 2. Nielsen coverage statistics – 2011

Type of store	% of Nielsen stores	% of sales covered for stores of this type
Convenience	6	2
Drug	35	55
Food	29	53
Liquor	1	1
Mass Merchandise	30	32

Notes: Data taken from Nielsen Homescan data documentation for 2011. Data used spans 2004-2014. Nielsen retailer coverage remained consistent across years though household sample size increased from under 40,000 to over 60,000.

Table 3. Sales Tax Changes and Retail Spending

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Δ ln(Total)	Δ ln(NonExempt)	Δ ln(Exempt)	Δ ln(Total)	Δ ln(NonExempt)	Δ ln(Exempt)
Δ Total Sales Tax	-1.636***	-1.978***	-1.441***			
	(0.415)	(0.516)	(0.440)			
Δ State Sales Tax				-1.764***	-2.140***	-1.622***
				(0.449)	(0.556)	(0.482)
Observations	4,622,701	4,622,061	4,555,224	6,598,934	6,598,925	6,509,614
R^2	0.000	0.013	0.013	0.013	0.012	0.012
Period FE	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 'Total Sales Tax' refers to the total sales tax within a zip-code (includes state, city, county, etc. taxes). 'State Sales Tax' is the state level sales tax. Dependent variables are monthly changes in logged household spending as measured by Nielsen Consumer Panel data. NonExempt and Exempt spending is defined at a state level depending on what categories of goods are exempt from sales taxes (eg. groceries, clothing, medication). Regressions span 2006-2014 for state sales tax changes and 2008-2014 for total sales tax changes. Results clustered at a household level.

Table 4. Spending Around Sales Tax Changes

	(1)	(2)	(3)
VARIABLES	ln(Total)	ln(NonExempt)	ln(Exempt)
Δ State Sales Tax = F,	0.507	0.637	0.547
	(0.371)	(0.465)	(0.406)
Δ State Sales Tax = F,	0.201	0.458	0.264
	(0.370)	(0.461)	(0.407)
Δ State Sales Tax = F,	1.389***	1.637***	1.624***
	(0.370)	(0.461)	(0.407)
Δ State Sales Tax	-1.155**	-1.446**	-0.931*
	(0.451)	(0.564)	(0.492)
Δ State Sales Tax = L,	0.731**	1.026**	0.203
	(0.359)	(0.444)	(0.399)
Δ State Sales Tax = L,	-0.213	-0.0550	-0.487
	(0.368)	(0.454)	(0.406)
Δ State Sales Tax = L,	-0.748**	-0.298	-1.367***
	(0.360)	(0.448)	(0.392)
Δ State Sales Tax = L,	0.671*	0.499	0.255
	(0.357)	(0.444)	(0.398)
Δ State Sales Tax = L,	0.558	0.732	0.259
	(0.369)	(0.459)	(0.404)
Δ State Sales Tax = L,	-0.651*	-1.416***	-0.498
	(0.356)	(0.451)	(0.390)
Observations	4,959,652	4,959,652	4,933,379
R^2	0.607	0.607	0.869
Period FE	YES	YES	YES
Household FE	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 'State Sales Tax' is the state level sales tax. Dependent variables are changes in logged household spending as measured by Nielsen Consumer Panel data. NonExempt and Exempt spending is defined at a state level depending on what categories of goods are exempt from sales taxes (eg. groceries, clothing, medication). Regressions span 2006-2014 and are run at a household-month level. Results clustered at a household level.

Table 5. Product Durability

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Δ l(Spend)	Δ l(Spend)	Δ l(Spend)	Δ l(Spend)	Δ l(Spend)
Δ State Sales Tax	-2.392***	-1.827**	-1.712**	-1.369**	-1.267*
	(0.636)	(0.715)	(0.703)	(0.683)	(0.671)
F1.Δ State Sales Tax			-1.169*		-1.018
			(0.703)		(0.671)
F2.Δ State Sales Tax			-0.533		-0.452
			(0.703)		(0.671)
Δ State Sales Tax*Dur.		-2.666*	-2.834*		
		(1.545)	(1.521)		
F1.Δ St. Sales Tax*Dur.			1.544		
			(1.519)		
F2.Δ St. Sales Tax*Dur.			3.337**		
			(1.519)		
Δ State Sales Tax*Purch.				3.090***	3.162***
				(0.751)	(0.739)
F1.Δ St. Sales Tax*Purch.					-0.532
					(0.738)
F2.Δ St. Sales Tax*Purch.					-1.890**
					(0.738)
Observations	381,959	381,959	365,552	381,959	365,552
R^2	0.045	0.045	0.049	0.045	0.049
Period FE	YES	YES	YES	YES	YES
State and Product FE	YES	YES	YES	YES	YES

Notes: Dependent variables are changes in logged household spending as measured by Nielsen Consumer Panel data. "Δ State Sales Tax*Dur." refers to the change in the state sales tax interacted with a hand-coded indicator for whether the product is durable or storable in the sense of it being possible to store or continue using for a minimum of approximately one year. "Δ State Sales Tax*Purch." refers to the change in the state sales tax interacted with a continuous measure of the average number of times per month a good from that product group is purchased by a household (eg. if milk is purchased once a week on average, it would have a value of 4.3). Regressions run at a state-month-product group level for 119 product groups in the Nielsen Consumer Panel data. Regressions span 2006-2014. Results clustered at a state level.

Table 6. Sales Tax Changes and Trips

VARIABLES	(1) # Retailers	(2) # Stores	(3) Alt ZIP Spending	(4) Alt ZIP Spending
Δ State Sales Tax	-7.858***	-2.626***	-0.0483	-0.155*
	(2.292)	(0.980)	(0.0812)	(0.0923)
Δ State Sales Tax * Avg. Alt ZIP Fraction				1.540**
				(0.634)
Observations	6,117,097	6,117,097	6,117,045	6,117,045
R^2	0.017	0.005	0.005	0.005
Period FE	YES	YES	YES	YES
Household FE	YES	YES	YES	YES

Notes: Columns 1 and 2 dependent variables are the number of unique retailers (eg. locations) and unique stores (eg. chains) that a household visits in a given month. Columns 3 and 4 dependent variable is the fraction of household spending that is conducted in a known three digit zipcode other than the three digit zipcode that the household resides in. "Δ State Sales Tax*Avg. Alt ZIP" is an interaction between a change in the state sales tax rate and the average fraction of spending done outside a household's home three digit zip. Regressions run at a household-month level and span 2006-2014. Results clustered at a household level.

Table 7. Sales Tax Changes and Online Retail Spending

	(1)	(2)	(3)	(4)
VARIABLES	Δ ln(Online)	Δ Frac. Online	Δ ln(Online)	Δ Frac. Online
Δ Total Sales Tax	1.602**	0.103*	1.562*	0.0764
	(0.695)	(0.0567)	(0.802)	(0.0829)
Δ Total Sales Tax * Avg Online Spend			0.00521	0.00349
			(0.0284)	(0.00306)
Observations	6,865,213	6,873,381	6,865,213	6,873,381
Period FE	YES	YES	YES	YES
Household FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable in columns 1 and 3 is the change in logged online spending at a household-month level. The dependent variable in columns 2 and 4 is the fraction of household spending done online in a given month. In columns 3 and 4, we include a term interacting changes in state sales tax rates with the average amount of household spending done online by each household. Household and period fixed effects are included in all regressions. Results clustered at a household level.

Table 8. Sales Tax Changes and News

	(1)	(2)	(3)	(4)
VARIABLES	Sales Tax News	Sales Tax News	Sales Tax News	Google Search
Change in Sales Tax	54.79***			
	(7.802)			
Change in State Sales Tax		48.54***		
		(7.670)		
3 Quarters Prior to Tax Change			-3.556	-13.10
			(7.924)	(9.092)
2 Quarters Prior to Tax Change			12.88	-11.93
			(11.37)	(9.291)
Quarter Prior to Tax Change			28.60***	0.682
			(9.577)	(10.12)
Quarter of Tax Change			4.643	44.51**
			(11.05)	(17.16)
Quarter after Tax Change			-10.44	12.04
			(11.28)	(14.68)
Observations	4,182	4,182	2,938	2,646
R^2	0.650	0.649	0.696	0.760
Period & State FE	YES	YES	YES	YES

Notes: All specifications run at a state-month level. Columns 1-3 dependent variable is the ratio of newspaper articles that contain the term 'sales tax' or 'sales taxes' as a fraction of all newspaper articles in a given month across newspapers in that state. News articles taken from Access World News and cover approximately 3,000 US newspapers ranging from large national papers to local papers. 'Sales Tax' is change in average zip-code level sales tax rate across the state. 'Quarter of Tax Change' refers to the month of the tax change and two months following the tax change. Other 'Quarter' variables are relative to that three month period. Regressions span 2008-2014.

Table 9. Sales Tax Salience and Spending

	(1)	(2)	(3)	(4)
VARIABLES	Δ l(Total)	Δ l(NonExempt)	Δ l(Total)	Δ l(NonExempt)
Δ State Sales Tax	-1.767***	-2.153***		
	(0.448)	(0.555)		
Δ State Sales Tax * News	-40.67	-50.19		
	(44.80)	(53.44)		
Sales Tax News Index	-0.176**	-0.338***		
	(0.0800)	(0.0986)		
Δ Total Sales Tax			-1.665***	-2.037***
			(0.414)	(0.515)
Δ Total Sales Tax * News			-1.401	9.517
			(48.25)	(57.43)
Sales Tax News Index			-0.157	-0.324***
			(0.101)	(0.124)
Observations	6,598,934	6,598,925	4,622,672	4,622,061
R^2	0.013	0.012	0.014	0.013
Period FE	YES	YES	YES	YES
Household FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 'Total Sales Tax' refers to the total sales tax within a zip-code (includes state, city, county, etc. taxes). 'State Sales Tax' is the state level sales tax. Dependent variables are changes in logged household spending as measured by Nielsen Consumer Panel data. NonExempt and Exempt spending is defined at a state level depending on what categories of goods are exempt from sales taxes (eg. groceries, clothing, medication). 'News' refers to the ratio of newspaper articles that contain the term 'sales tax' or 'sales taxes' as a fraction of all newspaper articles in the month prior to the sales tax change in that zip-code. News articles taken from Access World News and cover approximately 3,000 US newspapers ranging from large national papers to local papers. For these regressions, we use residuals of the raw 'News' ratio on a quadratic of the size of the sales tax change and the square of the size of the tax change. Regressions span 2006-2014 for state sales tax changes and 2008-2014 for total sales tax changes. Results clustered at a household level.

Table 10. State Ballot Propositions

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Δ l(NonExempt)	Δ l(NonExempt)	Δ l(NonExempt)	Δ l(NonExempt)	Δ l(NonExempt)
Any Ballot Prop	-0.0126*	-0.00592	-0.0144	-0.00861	
	(0.00668)	(0.0113)	(0.0163)	(0.0113)	
Failed Ballot Prop	0.00678	0.00244		0.00500	
	(0.00937)	(0.0133)		(0.0133)	
Proposed Sales Tax Change		-1.509		-0.464	
		(2.035)		(2.051)	
Failed Ballot*Size of Change		0.919		-0.127	
		(2.113)		(2.127)	
Current State Sales Tax			-0.117**		
			(0.0524)		
Ballot*Current Sales Tax Rate			0.104		
			(0.261)		
Δ State Sales Tax			-1.830***	-1.857***	-1.939***
			(0.454)	(0.458)	(0.471)
Ballot Driven Change					0.0459***
					(0.0163)
Ballot Driven Change*Size of Change					-7.215**
					(3.119)
Observations	6,613,475	6,613,475	6,613,475	6,613,475	6,613,475
R^2	0.012	0.012	0.012	0.012	0.012
Period FE	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables are changes in logged household spending as measured by Nielsen Consumer Panel data. NonExempt spending is defined at a state level depending on what categories of goods are exempt from sales taxes (eg. groceries, clothing, medication). Ballot Proposition data hand-collected, mainly from Ballotopedia.com. 'Any Ballot Prop' is an indicator for the month that a sales tax ballot proposition was on the ballot. 'Failed Ballot Prop' is an indicator for that ballot proposition failing. 'Proposed Sales Tax Change' is the size of the proposed sales tax change while

Table 11. Sales Tax Changes and Retail Spending (Annual)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Δ ln(Total)	Δ ln(NonExempt)	Δ ln(Exempt)	Δ ln(Total)	Δ ln(NonExempt)	Δ ln(Exempt)
Δ Total Sales Tax	-0.111	-0.461	0.138			
	(0.243)	(0.306)	(0.268)			
Δ State Sales Tax				0.142	-0.0658	-0.293
				(0.237)	(0.302)	(0.268)
Observations	228,833	228,751	228,398	347,196	347,151	347,033
R^2	0.211	0.209	0.239	0.178	0.172	0.196
Year FE	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 'Total Sales Tax' refers to the total sales tax within a zip-code (includes state, city, county, etc. taxes). 'State Sales Tax' is the state level sales tax. Dependent variables are annual changes in logged household spending as measured by Nielsen Consumer Panel data. NonExempt and Exempt spending is defined at a state level depending on what categories of goods are exempt from sales taxes (eg. groceries, clothing, medication). Regressions span 2006-2014 for state sales tax changes and 2008-2014 for total sales tax changes. Results clustered at a household level.

Table 12. Online Spending (Annual)

	(1)	(2)	(3)	(4)
VARIABLES	Δ ln(Online)	Δ Frac. Online	Δ ln(Online)	Δ Frac. Online
Δ Total Sales Tax	1.414**	0.134**	-1.199	-0.161**
	(0.620)	(0.048)	(1.754)	(0.0675)
Δ Total Sales Tax * Avg Online Spend			11.96**	1.266***
			(5.958)	(0.260)
Observations	268,441	264,154	268,347	264,154
Year FE	YES	YES	YES	YES
Household FE	YES	YES	YES	YES

Notes: The dependent variable in columns 1 and 3 is the change in logged online spending at a household-year level. The dependent variable in columns 2 and 4 is the fraction of household spending done online in a given year. In columns 3 and 4, we include a term interacting changes in state sales tax rates with the average amount of household spending done online by each household. Household and year fixed effects are included in all regressions. Results clustered at a household level.

Table 13. Changes in Shopping Trips and Spending Outsize Own ZIP (Annual)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	# Trips	# Retailers	# Stores	Alt ZIP Spending	Alt ZIP Spending
Δ State Sales Tax	-14.54	-2.333	-6.104***	-0.0354	-0.739***
	(66.21)	(2.177)	(1.050)	(0.123)	(0.141)
Δ State Sales Tax * Avg. Alt ZIP Fraction					10.07***
					(0.972)
Observations	357,703	357,703	357,703	357,703	357,703
Year FE	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Columns 2 and 3 dependent variables are the number of unique retailers (eg. locations) and unique stores (eg. chains) that a household visits in a given month. Columns 4 and 5 dependent variable is the fraction of household spending that is conducted in a known three digit zipcode other than the three digit zipcode that the household resides in. "Δ State Sales Tax*Avg. Alt ZIP" is an interaction between a change in the state sales tax rate and the average fraction of spending done outside a household's home three digit zip. Regressions run at a household-year level and span 2006-2014. Results clustered at a household level.

Table 14. Selected Offsetting State Tax Changes

State	Year(s)	Sales Tax	Property Tax	Income Tax
Idaho	2006	>	<	-
South Carolina	2006	>	<	-
New Jersey	2006	>	<	-
Maryland	2007-2011	>	-	<
Indiana	2008	>	<	<
North Carolina	2009	>	-	<
Kansas	2012	>	>	<
Ohio	2012-2013	>	-	<
Georgia	2015	>	-	<
Pennsylvania	2015	>	<	>
Maine	2015	>	<	<
North Carolina	2016	>	-	<

Notes: Changes in sales taxes are only considering changes in overall or exempt rates, not changes in exemption status. Income tax changes are only considered when rates change, not simply income bracket thresholds. Property tax changes may consider both rates and tax basis.

Table 15. Offsetting Income Tax Changes

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Δ Fed. Inc Tax Rate	Δ St. Inc Tax Rate	Δ Fed. Inc Tax Rate	Δ St. Inc Tax Rate	Δ St. Inc Taxes	Δ St. Inc Taxes
Δ State Sales Tax	0.0212	-0.161***			-12.51***	
	(0.0337)	(0.00828)			(0.445)	
Δ Total Sales Tax			0.0207	-0.198***		-15.42***
			(0.0319)	(0.00671)		(0.421)
Observations	310,296	312,861	204,661	206,492	312,861	206,492
R^2	0.022	0.007	0.001	0.010	0.015	0.023
Year FE	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Changes in federal and state income tax rates calculated at a household level using the TAXSIM calculator using household income and demographic characteristics. State income taxes (Columns 5 and 6) are estimated dollars of taxes to be paid at a household level. Household and period fixed effects are included in all regressions. Standard errors clustered at a household level.

Table 16. Offsetting Income Tax Changes and Retail Spending

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Δ ln(Spend)	Δln(Spend)	Δln(Spend)	Δln(Nonexempt)	Δln(Exempt)
Δ State Sales Tax	-0.0181	-0.00415	-0.0323	-0.161	-0.0323
	(0.381)	(0.385)	(0.385)	(0.448)	(0.487)
Δ ln(Income)		0.474*	0.460*	0.647**	0.430
		(0.247)	(0.247)	(0.291)	(0.308)
Δ Income Tax			-0.373***	-0.354**	-0.396**
			(0.134)	(0.155)	(0.167)
Observations	274,937	270,126	269,042	250,159	268,618
R^2	0.175	0.177	0.177	0.192	0.171
Year FE	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Changes in state income tax rates calculated at a household level using the TAXSIM calculator using household income and demographic characteristics. Columns 1-3 utilize changes in logged total retail spending while columns 4 and 5 restrict to non-exempt and exempt spending, respectively. Household and period fixed effects are included in all regressions. Standard errors clustered at a household level.

Table 17. Sales Tax Changes and Retailer Prices

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Δ l(Retailer)	Δ l(Wholesale)	Δ l(Retailer)	Δ l(Wholesale)	Δ l(Retailer)	Δ l(Retailer)
Δ State Sales Tax	-0.161***	-0.00326			-0.362***	
	(0.0297)	(0.00240)			(0.111)	
Δ Total Sales Tax			-0.222***	0.00340		-0.277**
			(0.0326)	(0.00509)		(0.110)
Observations	6,160,287	6,160,287	4,407,753	4,407,753	477,437	319,783
R^2	0.013	0.052	0.012	0.050	0.055	0.159
Period FE	YES	YES	YES	YES	YES	YES
Product and Location FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables are changes in logged retailer margins, logged retailer prices, and logged wholesale prices. Columns 3, 4, and 6 span 2008-2012 while columns 1, 2, and 5 span 2006-2012. Columns 1-4 run at a month-product group-three digit ZIP level while Columns 5-6 are done with the identical panel structure but at an annual level. Regressions clustered at a three digit ZIP level.

Table 18. Retail Prices, Sales Taxes, and Spending

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Δ l(Spend)-OLS	Δ l(Spend)-OLS	Δ l(Spend)-IV	Δ l(Spend)-IV	Δ l(Spend)-IV
Δ State Sales Tax	-1.380***		-2.233***	-2.039***	
	(0.249)		(0.274)	(0.275)	
Δ Retailer Price	-0.226***		-3.721***	-2.317***	
	(0.00632)		(0.215)	(0.169)	
Δ State Sales Tax = F1,		0.997***			1.035***
		(0.249)			(0.260)
Δ Retailer Price = F1,		-0.153***			-0.110
		(0.00643)			(0.189)
Observations	1,950,463	1,950,463	1,950,463	1,950,463	1,950,463
Period FE	YES	YES	YES	YES	YES
Product and Location FE	YES	YES	YES	YES	YES

Notes: Columns 1-2 are run in OLS. Columns 3 and 5 are instrumental variables specifications where changes in retail prices are instrumented for by changes in wholesale prices. Column 4 instead instruments for changes in retail prices with changes in wholesale prices and 3 monthly lags of wholesale price changes. "= F" refers to one month prior to a given change in state sales tax rates or retailer prices. Regressions run at a month-product group-three digit ZIP level and span 2008-2012. Regressions clustered at a three digit ZIP level.