May 7th, 1:30 PM - 3:00 PM

Comparing Tax Structures in Washington and Oregon: Tax Burden Impacts on Grocery Consumption

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Submitted for: Final Draft, Spring 2019.

Abstract: A 2018 study dubbed Washington's state tax system the most regressive in the United States. Conversely, the same study deemed Oregon's the forty-first least regressive. Washington and Oregon states rely on different tax systems. Washington collects sales tax but no personal income tax, while Oregon collects a personal income tax but no sales tax. These differences create an opportunity to measure the effects of differing tax policy on consumer spending. Previous literature has estimated the effect of border tax differences on aggregate spending patterns. This paper uses a two-stage regression simulation model to measure the effect of individual sales tax burden on individual-level spending. First, using data from the Consumer Expenditure survey, we estimate individual sales tax burden. Then, using these estimates in a second-stage regression simulation model, we find a significant negative relationship between higher sales tax burden and expenditure on groceries for households earning less than $40,000 annually.

JEL Classification Codes: D12, D63, H22, H71

Key Words: Consumption consolidation, Tax burden, Oregon State tax structure, Washington State tax structure.

Introduction

In 2018, a distributional analysis of state tax policy from the Institute on Taxation and Economic Policy found that of all 50 states, Washington has the most regressive tax system, meaning that the poor pay a higher percentage of their income in state taxes than the wealthy. The study also found that Oregon has one of the ten least regressive systems, with all income groups paying similar rates. When those earning the lowest incomes reside in areas with regressive tax systems, their budgets are further constrained creating undue economic burden. Policy makers in Washington have taken notice. 2019 House Bill 1527 proposes a, "sales tax refund" for working families earning less than $54,884 annually. Previous research finds that households tend to adjust their consumption in the short run when tax situations change. In the long run, the literature focuses primarily on aggregate economic measures like employment and average earnings, and find that growth can occur under both regressive and progressive tax systems. While existing research has examined county- or state-level tax effects of long-standing tax policies, we examine the effect of tax burden on grocery consumption at the household level. Moving from aggregate to household analysis helps to uncover who wins and who loses under different tax regimes.

We develop a sales tax incidence estimation method and exploit a natural experiment existing between Washington, which relies heavily on sales tax and has no state income tax, and Oregon, which has a relatively high-income tax and no sales tax. We find that a one percent increases in sales tax burden is associated with a 0.06% decrease in grocery consumption in Washington. In Oregon, we find that income tax incidence has no statistically significant relationship with grocery consumption. Our model predicts that a family of four earning $40,000 per year would have $8 more per week to spend on groceries in real terms living under Oregon's tax structure compared to living under Washington's.. This Oregon premium holds for most hypothetical households making less than $60,000 per year, suggesting that state tax structures have significant welfare implications.

The remainder of this paper unfolds in the following manner. First, we provide background information and a review of relevant literature. Next, we describe Consumer Expenditure Survey data. Then, we discuss the economic theory that guides our analyses. After that, we explain the two-stage model used to estimate individual sales tax incidence and ultimately the relationship between tax incidence and grocery consumption. Subsequently, we

present our results and present our hypothetical household analysis. In this section we also present various robustness checks performed throughout our process. Lastly, we present conclusions, discuss policy implications, and offer suggestion for future research on differing tax policies.

Background

Overview

Washington has no income tax and high sales tax while Oregon has no sales tax and high-income tax. Washington's base state sales tax of 6.5% is sixth highest in United States, and many local municipalities impose additional sales taxes up to 3.6%. Conversely, Oregon's top marginal income tax rate of 9.9% is the second highest in the country. Because Washington and Oregon are similar demographically and economically, this situation serves as a natural experiment to study the impact different tax structures have on household consumption. Taxes, like a per unit sales tax, that increase income inequality by creating a higher tax incidence—the proportion of income that goes to taxes— for those with lower incomes are considered regressive while those that decrease it are considered progressive[1]. Policymakers have and continue to question why governments create tax structures that place a higher burden on those with lower incomes.

State legislators in Washington currently debate the burden of sales tax on low income households. 2019 House Bill 1527 would provide households earning less than $54,884 annually with a sales tax refund (KUOW, 2019).[2] Legislators themselves list the economic security of low-income households as a primary concern in this bill. Without tax relief, such households must either find ways to make their money stretch further or decrease consumption. For households already constrained by lower incomes they may choose to consume less of goods or services that impact their physical or mental health and well-being.

The tax structures in both states are products of legislation, or lack thereof over the last century. In Washington, personal state income tax is illegal. Having originally been deemed unconstitutional by the State Supreme Court in 1932, multiple attempts, one as recently as 2010,

[1] Daniel Suit's 1977 paper "Measurement of Tax Progressivity" created a means to compare the relative progressiveness of various tax types. Suit's index concludes that personal income taxes are income progressive while sales and other use taxes are income regressive.

[2] HB 1527 makes the sales tax refund available to households learning less than $40,000 to $54,884 depending on family size.

to amend the state constitution or impose taxes similar to a graduated income tax have been voted down (Riding, 2010). In Oregon, the story is similar, but less definitive. While there is nothing strictly prohibiting the imposition of a sales tax, it requires a three-fifths majority of the state legislature to issue new taxes while it takes only a simple majority to cut taxes. Sales taxes have made it to the ballots in Oregon, but were defeated nine times between 1933 and 1993 (Hauser, 2018).

Tax Policy Literature

This section focuses on explaining the conversation around specific areas of tax policy, and how we fill the gaps between them. First, we look at research on how households typically change their consumption patterns under different tax circumstances. Second, we explore research on the aggregate efficiency and welfare outcomes of different tax structures. Third, we examine papers that use empirical methods to tie specific tax policy decisions directly to welfare outcomes. Through this review, consumption consolidation emerges as a recurring empirical complication in research using expenditure data, and thus the important literature on consumption consolidation is considered.

Consumer Response to Tax Policy

Most empirical literature agrees that, in the short run, households adjust consumption in response to tax policy changes, but disagree on whether the adjustment persists over time. In response to abrupt changes to tax policy, households behave according to classical economic theory; if taxes decrease, households buy more, and if taxes increase households buy less. Our model empirically measures consumption responses to a long standings tax policy difference. Three examples of short term situations are temporary tax holidays, legislated changes to tax structures in single municipalities, and border areas with differing tax policies. In each scenario, research finds that consumers changed their behavior to avoid taxes (Summit, Agarwal et al., 2017) (Cashin, 2017) (Baker et al., 2017). Each also notes that changes in consumption associated with policy changes are not offset by shifts in periods before or after the tax holiday or policy change. The one exception was an increase in expenditures on durable goods preceding an increase to a local sales tax (Cashin 2017) (Baker et al., 2017). While the literature consistently finds that consumers respond to tax policy changes in the short run, long run impacts

are less clear. Those who focused on changes to spatially broad sales taxes (national taxes opposed to local changes) and tax holidays find that consumption levels eventually returned to their pre policy change levels while research on spatially different tax policies suggest that new behaviors persist.

Consumers will consistently "shop" for lower sales and use taxes by crossing borders. Wooster and Lehner (2009) examine the border effects of differing sales tax policies between Washington state and neighboring states. This study is of particular interest as it examines the same geographic region as our paper. Wooster and Lehner estimate that over their fourteen-year study period, interstate sales tax differences resulted in $160 million in lost tax revenues for Washington state from consumers crossing borders to make purchases on taxable items. Others find similar results; research on cigarette taxes finds that the closer an individual lives to a lower tax jurisdiction, the more likely they were to cross borders to buy cigarettes (Harding et al., 2012).

This literature suggests that households adjust their short run expenditures in response to most tax policies. While that behavior typically fades in the long run, if the tax can be consistently avoided, the behavior will likely persist. Outside of Wooster and Lehner, all of these papers focused on a change to a sales or use tax, while we look to compare two different tax structures. Wooster and Lehner compare tax structures, but focus their attention on revenue generation at the county level. This compares the effects of disparate tax structures at the household level, and leverages the natural experiment provided by Washington and Oregon to examine whether consumer behavior is affected by longstanding tax policies as opposed to short term treatments like tax holidays or adjustments to sales tax rates. Thus, we explore literature comparing various tax structures.

Income and Sales Taxes: Theoretical Comparison

A central assumption of our model is that different tax structures create disparate impacts across households earning different incomes. We find very little rigorous research that compares income and sales taxes using household level data. Economists take various approaches to compare tax types. Some argue that sales taxes are more efficient and stimulating for an economy than income taxes while others find that the inequality and inequity of sales taxes place an undue burden on households with lower incomes. Daniel Suit's seminal (1977) paper

"Measurement of Tax Progressivity" gave economists and policymakers a tool to understand the progressivity of various tax types. In response, theoretical models were developed to explore the economic impacts of different tax types.

Nearly all economic research that compares tax structures focuses on aggregate measures including: state level income growth, marginal excess burden, and state tax revenue (Holcombe & Lacombe., 2004) (Dye & McGuire., 1991) (Ballard et al., 1985). Within this literature the results are mixed. Some find that more progressive taxes put more burden on aggregate economies and reduce efficiency resulting in slower wage growth (Holcombe & Lacombe., 2004) (Ballard et al., 1985). Others conclude that more progressive taxes do not inhibit wage growth, and in the case of an income tax, can provide a more stable revenue source to governments (Dye & McGuire., 1991). While these studies focus on aggregate outcomes, none consider how different tax policies impact individuals.

While most use aggregate measures, some have taken different approaches. A behavioral economics study seeking to understand individual preference between progressive and regressive tax policies find that participants tend to decrease their concern for others as deadweight loss grows; suggesting that a balance exists when legislating tax policy (Ackert et al., 2007). While Ackert et al., shift their focus toward individuals, they fail to empirically measure changes in any economic measurements. We focus on household grocery consumption to measure how households earning different levels of income are impacted by sales and income taxes respectively. Additionally, we build a counterfactual model to compare grocery expenditures for hypothetical households under the two tax scenarios. As such, we are the first to employ empirical methods to examine the impacts of long-standing policies with theoretically differing impacts across income brackets.

Welfare Impacts and Progressive Policies

Implicit in our hypthesis that differing tax structures will result in varying outcomes is the assumption that one structure will leave households better off than the other. While research directly comparing tax structures tends to focus on aggregate outcomes, research on other types of policies have used household outcomes. Some compare and contrast regressive and progressive policies and find that both can improve individual welfare. A study on the U.S. social security program concludes that while the current, flat rate, social security tax improves

long term welfare for individuals, the improvement is reduced, or in some cases eliminated, when accounting for realistic borrowing conditions (Hubbard & Judd, 1987).[3] However, the same study also finds that replacing the current social security tax with a more progressive version could improve welfare under realistic borrowing conditions. Other research finds the regressive policies improve welfare more than similar progressive counterparts, but conclude that welfare gains can occur in both scenarios (Jeske & Kitao, 2009).

Both papers find that both progressive and regressive policies can improve welfare. We ask a similar question—do households see tangible gains in the consumption of a good that likely increases well-being under different policy scenarios?—but take a new approach by directly empirically comparing general tax structures at the state level. Our measure of welfare also differs from the two papers discussed. Instead of income, we look at how household level grocery consumptions responds to different policies.

Consumption Consolidation

As this study uses expenditures on groceries as the key indicator of the effects of varying tax structures, it was pertinent for us to examine literature on consumption and expenditure. An important observation in the literature is that expenditure is not the same as consumption. With some goods, households can purchase them and consume them at a later date. As income inequality has grown in the U.S. it is likely, but not necessarily certain, that consumption inequality has as well. Some suggest that as income inequality has grown, those with relatively less income smooth their consumption by bulk shopping or stocking up on storable goods. This is referred to as *consumption consolidation*. Economists disagree on the extent to which consumption consolidation occurs.

Two key papers illustrate the dissent. Aguir and Bils (2015) use a two-stage econometric model and find that CES data underestimates consumption inequality as high-income households shift toward luxuries while low income households have to focus more on necessities. They find that changes in consumption mirror changes in income and expenditure. Conversely, Coibion et al. (2017) conclude that consumption inequality can almost exclusively be accounted for via

[3] Hubbard and Jones find that while social security allows households to maintain pre retirement consumption levels after retirement, the increased utility from this consumption is offset by a decrease in liquidity associated with paying the into social security.

consolidation. The literature is not conclusive. Both findings are supported by results of other research (Pistiaferri & Attanasio, 2016) (Krueger & Perri, 2005). We address this concern by developing a consolidation index that appears as a covariate in our regression model.

This paper explores a gap in the literature on the impacts of tax policy on household consumption. The natural experiment created by Washington and Oregon states allows us to estimate the effects of progressive and regressive state tax structures on consumer behavior. Additionally, we focus on low income households as they are most likely to be impacted by regressive taxes. Beyond contributing an original empirical study of differing tax structures, we also add to the literature on consumption inequality and tax incidence forecasting by applying a new method for estimating individual sales tax incidence and controlling for consumption consolidation.

Data

We primarily use public use microdata (PUMD) from the US Bureau of Labor Statistics' (BLS) Consumer Expenditure Survey (CE). The CE consists of an interview survey and a diary survey. The interview survey records major and recurring expenditures by individual households or "consumer units" (CUs) quarterly for one year. The diary survey records minor and more frequent CU expenditures over a two-week period. The interview survey provides a broad look at consumption over the course of a year while the diary survey offers a more granular look at purchasing behavior. In addition to expenditure data, The CE provides demographic and income data for all respondents. The diary and interview surveys sample different groups; there is no overlap in respondents between the two surveys. Within each survey there are multiple PUMD sets which present information at different levels of resolution. This study uses datasets from both the interview and diary surveys.

Interview Survey

From the interview survey, we use the "family characteristics and income" (FMLI) files from 2008Q2 through 2018Q1 from Washington state. Participating households are surveyed once per quarter for four quarters. Observations in a given FMLI file correspond to a first, second, third, or fourth interview. The survey can begin in any quarter, and thus many FMLI observations fall in two different years over four quarters.

After merging files, we retained observations that had four complete interviews. If participants dropped out of the study without finishing the interview cycle, or their data was incomplete at our 2018Q1 cutoff they were omitted from the sample. The interview survey provides extensive demographic and financial information including income, household size and general location as well as the race, education level, marital status and age of the head of household for each CU.

Our interest in the FMLI files is to calculate sales tax incidence for each CU and model it based on demographic characteristics. Most expenditure values do not include sales tax, with the exception of restaurant meals and other select categories that the BLS adjusts. For expenditure categories that are subject to sales tax, we sum the amount going to sales tax to calculate an annual value. Then, the amount paid toward tax is divided by income, creating a sales tax proportion value for each CU.

Diary Survey

From the diary survey, two different file sets are used. The first, "detailed expenditure" (EXPD) files are employed to construct a purchase consolidation index, and the second, "family characteristics and income" (FMLD) files are used for our primary regression analysis. The diary survey asks households to keep a detailed record of all expenditures for a two week period. The primary expenditure category considered in this study is groceries, defined as all food and nonalcoholic beverages purchased at grocery stores.[4] Examples of subcategories are dairy, bakery products and seafood. The FMLD files provide the same income and demographic data as the FMLI files and report expenditures by category, while the EXPD files present detailed expenditure information down to individual purchases. For example, the FMLD files present expenditure categories such as, "dairy," while the expd presents more precise categories like, "milk," "cheese" and "cream." Specifically, our analysis uses all fmld and expd files from 2008Q1 to 2017Q4. Similar to the interview survey, all files in the diary portion include information on family size and general location as well as the race, education level, marital status and age of the head of household for each CU. The sample includes 1090 unique Washington CUs and 1017 unique Oregon CUs. Summary statistics for the diary survey can be found in Figure 1.

Aggregate Data

[4] All expenditure data is discounted using the Bureau of Labor Statistics' West Region CPI.

The final dataset includes data from the diary survey, consolidation index values generated from the interview survey, property tax estimates from ITEP, income tax values generated by the National Bureau of Economic Research's (NBER) TAXSIM model, and sales tax incidence values generated using our method as described in section 3C. EXPD files are used to create a purchase consolidation index for each CU. Those values are matched to their households in the FMLD files. After step one of the hierarchical model is complete using FMLI data, estimated sales tax incidence values are generated for each CU in the FMLD data. All year and state specific dollar values are deflated using the BLS west region consumer price index (CPI) and the U.S. Bureau of Economic Research's state level purchasing power parity index.

Methodology

Microeconomic Theory

Our analysis begins with an assessment of the consumer theory faced by grocery shoppers. Households face a choice between grocery expenditures and all other uses of income. The first observation is that even low-income households require a certain level of grocery expenditure. Households in the bottom income decile receive an average of $6,059 in pre-tax income, but spend an average of $2,449 on groceries, supporting the necessity status of groceries (Figure 2). At higher incomes, the national-level CE data shows that while grocery expenditures increase as income increases, the proportion of income spent on groceries decreases, suggesting that non-grocery uses of income are a relative luxury. This is illustrated by the upward-bending income expansion path (Figure 3).

We are interested in the effects of different tax policies on grocery expenditures. An important feature of the two-good utility maximization model is the effect of income versus sales taxes. For an individual consumer faced with the option between an income tax raising a certain amount of revenue, and a per-unit tax on one good that raises the same amount of revenue, it can be shown (refer to appendix) that the consumer will prefer the income tax to the per-unit tax. This result is relevant to our study because of Oregon and Washington's contrasting tax policies. While the income tax preference would hold under revenue-neutral alternatives, the alternatives in Washington and Oregon are not revenue-neutral. The bottom 80% of households pay more on

average under Washington's system than they do under Oregon's, which amplifies the consumer preference for income tax[5].

In this model, households facing taxes will modify their grocery expenditures due to price and income effects. In Oregon, we expect expenditures to be reduced by the budget constraint imposed by income tax. In Washington, we expect three primary effects:

1. An income effect, as cumulative sales tax expenditures reduce the household's budget;
2. A price effect, as the price of goods subject to sales tax is raised;
3. A secondary price effect, as pre-tax product prices will be higher than they would be absent the sales tax due to businesses passing their own sales tax burdens on to consumers.

Our model isolates the income effect (1) by controlling for the two price effects. We address the direct price effect by analyzing grocery expenditures, which are exempt from sales tax. We address the secondary price effect by controlling for purchasing power parity between Washington and Oregon, which normalizes overall prices between states.

Covariate Selection

One approach to estimate the effects of taxes on grocery expenditures is to treat the different tax systems as binary treatments. Another is to use statutory tax rates as covariates in estimating expenditures. The limitation of these methods is that they do not account for the different effective tax rates paid by households of different income levels and with different purchasing patterns. In Washington, although all households in the same area face the same sales tax rate, low income households spend a higher percentage of their income on goods that are subject to sales tax (figure 4), which results in a higher sales tax rate. For this reason, we express our tax covariates as the percent of pre-tax income spent on sales tax.

Unlike income tax, which is easy to track and report, sales tax is paid on individual purchases, and is more difficult to estimate. To estimate sales tax rates, we use a two-step procedure. First, we use spending data from the CE Interview survey to calculate household-level effective sales tax rates, and regress these values on the demographic characteristics of the

[5] The preference for households in the top 20% of households would depend on their individual characteristics.

households. Second, we apply the function from this regression to observations in the CE Diary survey to create an estimated effective sales tax rate.

The Interview survey asks respondents to report quarterly expenditures on major spending categories for four consecutive quarters. All spending categories that Washington state sales tax applies to are included in the Interview data. The sales tax in a particular location in Washington is the sum of state, county, and local sales tax rates. Because of limited geographic information in the CE data, we only know whether an observation is inside or outside the Seattle metropolitan statistical area (MSA). For observations in the Seattle MSA, we apply the lowest sales tax rate from that region. For those outside the Seattle MSA, we do the same. We then calculate the dollar value spent on sales tax by the household over the course of the year, and express this as a proportion of pre-tax income.

Next, we regress sales tax rates on household characteristics and transfer this function to the Diary survey. The Interview and Diary surveys both report pre-tax income and other demographic characteristics, making this transfer possible. After testing multiple models, the model with the closest fit was a nonlinear function of income, age, marital status, household size, education level, and racial indicators. The functional form (Equation 1) is

$$salestax = \big(1 + \beta_1(income) + \beta_2(age) + \beta_3(married) + \beta_4(famsize) + \beta_5(education) + \beta_6(Seattle) + \beta_7(black) + \beta_8(asian) + \beta_9(hispanic)\big)^{-1} + u$$

This function places some restraints on estimated sales tax rates, as the effective rate will approach 0% as income becomes large for nonnegative values of β_1. By offsetting the vertical asymptote, it also avoids returning sales tax values above 100%. This model has a number of benefits. First, it closely fits the data. Second, by constraining predicted sales tax rates to nonnegative values, it allows us to use log transformations in the second stage. Third, by including demographic information, it partially accounts for factors affecting spending habits. Figure 5 shows observed sales tax incidence values with our baseline estimation, and figure 6 shows the effect of the bootstrap method by overlaying 100 bootstrap draws of a one-parameter model for illustration purposes. Our final estimation used 1,000 bootstrap simulations.

For income tax rates in Oregon, we use the predicted values from the TAXSIM model created by the National Bureau of Economic Research. This model outputs estimated federal and

state income tax values based on 27 income and demographic characteristics available in the Diary survey. For property tax rates, we use values from the non-profit Institute on Taxation and Economic Policy, which provides estimates of income and property tax rates by income quintile for each state. This method does not provide unique values for all observations, so they function in our model as a first approximation.

Simulation Regression Model

The second stage regression for each state has the following form (equation 2):

$$\ln(groceries_i) = \beta_0 + \beta_1 \ln(salestax_i) + \beta_2 \ln(inctax_i) + \beta_3 \ln(proptax_i) + \boldsymbol{\gamma X}_i + u_i$$

Where the log of average weekly grocery expenditures is a function of individual log tax rates, and a set of control variables $\boldsymbol{X}$. In order to transfer the sales tax rate estimates to the Diary survey, one procedure would be to input each household's covariate values into equation 1. There are two limitations of this method. First, it does not reflect the fact that households with similar observable characteristics often exhibit different spending patterns that result in different sales tax rates. Second, because the sales tax rate would be a function of variables that are also used in the second stage regression, it would introduce multicollinearity into the data. To address these issues, we draw bootstrap samples from the Interview survey and perform the first stage regression on each one [refer to appendix for discussion of assumption that CE data are a representative sample of the underlying population]. Each regression returns one coefficient vector estimate drawn from the joint sampling distribution of the estimator. We save the matrix of coefficient estimates from these bootstrap samples. Turning to the Diary survey, we assign a randomly drawn coefficient vector estimate from the above matrix to each observation, with replacement. We then calculate each observation's estimated sales tax rate using equation 1. This allows observations with similar characteristics to receive different estimated sales tax values since they are assigned different coefficient vectors. With the sales tax covariate estimated, we perform the second stage regression and obtain coefficient estimates. We repeatedly perform this procedure in the Diary survey, saving the second stage coefficient estimates from each simulation. The coefficient vector from each simulation is drawn from the joint sampling distribution of the estimator. We then use the sample means of coefficients and variances to obtain coefficient magnitudes and perform tests of statistical significance.

Control Variables

As described in section A, our analysis attempts to isolate the income effect on grocery expenditures due to facing a higher effective sales tax rate. To do this, we need to control for other income and substitution effects. First, we control for pre-tax income. Second, as described in the Data section, because we are using expenditure, rather than consumption, data, we need to control for changes in the type of groceries purchased by consumers. Literature has shown that consumers may choose to buy in bulk to obtain lower unit prices. Our data does not include information on whether consumers buy in bulk, so we construct a measure of grocery purchase consolidation that attempts to control for this effect. We calculate an index similar to the Herfindahl-Hirschman Index used to measure market concentration. For each household, the index value is (equation 3)

$$HHI_i = \sum_{j=1}^{N} \left(\frac{s_{ij}}{T_i}\right)^2$$

Where s_{ij} are the dollar values of individual grocery line items for a household i item j, and T_i is the household's total grocery expenditures. This formula returns values between zero and one, with lower values associated with smaller more frequent purchases, and values close to one associated with larger less frequent purchases. Our expectation is that households that buy in bulk will have larger index values, which will partially control for purchasing behavior effects. In addition to including the index value as a control variable in the primary regression, we also regress the index values on other demographic variables to obtain a secondary result.

Another effect to control for among Washington residents' concerns restaurant expenditures. Because grocery purchases are exempt from sales tax, but restaurant purchases are not, we would expect a substitution away from restaurant purchases and toward grocery purchases. To account for this effect, we include the dollar value of restaurant purchases in the primary regression.

Results

Simulation Regression Analysis

Using the bootstrap simulation regression model outlined in section 3, we find that a one percent increase in sales tax incidence is associated with a 0.12 percent decrease in grocery

expenditures for Washingtonians.[6] For a Washingtonian with a sales tax rate of 5% and weekly grocery expenditures of $100, a sales tax rate increase to 5.05% would result in a grocery expenditure decrease to $99.84. Conversely, we find no statistically significant relationship between income tax incidence and grocery expenditure for Oregonians. Figure 7 displays the empirical results of equation 2 using data from Washington and Oregon respectively.

These results provide additional insight into other factors affecting grocery consumption across states, and help identify potential differences between the two. Most notably, our consolidation index estimates are statistically significant in both states, indicating that increased consumption consolidation is associated with decreased grocery expenditure. We find that consolidation behavior is more prevalent in households with lower incomes, and more common in Washington than in Oregon. Lower income households, facing a tighter budget constraints under Washington's tax structure, consolidate more than lower income households living under Oregon's tax structure. This result is consistent with previous literature. People with tighter budgets use consolidation as a way to smooth consumption. By including the index in our specification we control for the effect of consolidation on expenditure, and can be more confident that the coefficients associated with sales and income tax show the impacts of the tax structures and not of consolidation behavior. The index is discussed further in section 4C.

Living in Seattle has a statistically significant, positive effect on grocery expenditure. While state level prices are controlled for using BEA's purchasing power parity index and by running separate regressions for each state, Seattle is the only metro area in the sample area large enough to register as a separate statistical area. As prices tend to be higher in large metro areas, this resulted is expected.[7]

The only variable present in both states with differing statistical significance is pre-tax income. In Oregon, pre-tax income is statistically significant while in Washington, it is not. Both have modest positive coefficients, and a joint t-test concludes that the coefficients are not statistically different from one another. One explanation for this difference is the nature of the sales tax covariate in the Washington regression. Because sales tax incidence was calculated as a decreasing function of income (among other variables), its presence in the regression might

[6] All dollar values are reported in terms of Washington dollars. Oregon values are adjusted using BEA's purchasing power index. This index is only available up to 2016. 2017 and 2018 values were generated using Stata's -epolate- command.

[7] Statista: CPI of all urban consumers for select cities and metro areas in the U.S.

reduce the statistical significance of income itself. Because the Oregon model does not have a tax value calculated as a decreasing function of income, it does not feature the same attenuation as Washington.

Other variables of note in Figure 7 are marital status, age, age^2 and family size, all of which have similar levels of significance and similar magnitudes in both states. Marital status has a negative and significant effect on grocery expenditure while family size has a positive and significant effect. While the direction of these coefficients appears counterintuitive—marriage typically increases the household size—but the inclusion of both variables in the specification controls for their individual effects. For families of the same size, where the head of household is married, less groceries are consumed, but generally, larger household sizes mean more grocery expenditure. This suggests that not all families in the sample fit the traditional American mold of two parents plus children which is consistent with household summary statistics available in appendix A. In both states age and age^2 are statistically significant with modest coefficients. In both cases the magnitude of the impact is nearly zero, suggesting that any changes in grocery consumption associated with age are negligible.

Figure 7: Simulation Regression Results by State

Log Grocery Expenditures and Covariates

Washington			**Oregon**		
Variable	Coefficient	Standard Error		Coefficient	Standard Error
Sales Tax	-0.122***	0.038	Income Tax	-0.010	0.009
Property tax	-0.044	0.146	Property tax	-0.061	0.110
Consolidation	-0.384*	0.180	Consolidation	-0.743***	0.191
Seattle	0.107*	0.049			
Income ($,000s)	0.00032	0.00043	Income ($,000s)	0.00092**	0.00038
Married	0.110*	0.044	Married	0.138**	0.045
Black	0.012	0.097	Black	-0.231	0.139
Native American	-0.410	0.293	Native American	-0.457	0.262
Asian	0.044	0.056	Asian	-0.019	0.086
Pacific Islander	-0.076	0.173	Pacific Islander	-0.005	0.153
Hispanic	0.051	0.070	Hispanic	0.090	0.072
Education	0.009	0.013	Education	0.029*	0.013
Age	0.024***	0.006	Age	0.026***	0.007
Age Squared	-0.00019**	0.00006	Age Squared	-0.00026***	0.00006
Family Size	0.184***	0.016	Family Size	0.179***	0.020
Food Stamp Recipient	-0.015	0.070	Food Stamp Recipient	-0.065	0.064
Grocery Proportion	0.049	0.079	Grocery Proportion	0.133	0.085
Constant	2.316***	0.494	Constant	2.552***	0.414
R^2 0.39			R^2 0.35		

*Significant at the 95% level

**Significant at the 99% level

*** Significant at the 99.9% level

Pre- Tax Income Coefficients and Standard Errors multiplied by 100,000

All tax variables are log of ta incidence

Marriage and Race are dummy variables given by status of head of household

Grocery Proportion is proportion of food consumed in the home

Education level measured in years of education completed by head of household

Grocery Consolidation follows HH Index explained in Methods Section

Results displayed for all statistics are averages of method described in Methods Section.

Consolidation Index

The consolidation index described in Methods, and included in each regression specification, suggests that households in lower income quintiles consolidate purchases more than those in higher quintiles. Figure 8 shows our consumption consolidation index values by income quintile. The negative and significant coefficient on the consolidation index suggests that increases in consolidation is correlated with decreases in grocery expenditure. This is consistent with previous literature (Coibion et al., 2017) (Pistiaferri & Attanasio, 2016). While we do find consolidation to be strongly correlated with grocery expenditure, our full regression model finds that increases in sales tax incidence are still correlated with decreases in grocery consumption even when controlling for consolidation.

Substitution Effect: Food Ratio

As incomes rise we suspect people will pivot away from grocery toward eating out. Figure 9 shows groceries as a percentage of total food expenditure by income quintile. We see that the relationship is not linear. The simulation regression results in section 4A present regression results with and without this food ratio as a covariate. When included, its coefficient is not significant. However, we still expect some substitution toward food away from home to account for some of the decrease in grocery expenditure. Moving forward, a separate regression analysis with food ratio as the dependent variable would allow for a more precise look at this substitution effect. The raw data suggest that while households tend to substitute food outside the home for groceries as income grows, the substitution is relatively, and is not a major concern for our analysis. The inclusion of 'food ratio' in our preferred specification provides more conservative estimates than when omitted.

Hypothetical Households Analysis

To provide an illustrative example of the above results, we construct a simple model to compare predicted grocery expenditure values for several hypothetical households in each state. Based on our model, how much would grocery consumption change for the same household

living under the two different tax structures. Using hypothetical values, opposed to real observations from the data, we plug values for each covariate into the models for each state and produce two separate grocery expenditure values. A summary of this exercise can be seen in figure 10. This exercise comes with caveats, and should be taken as a simple, back of the napkin type calculation. It is likely that similar households would not earn the same income living in the two different states. Given the limited data given on household employment, estimating industry specific wage penalties for workers in the state where they would earn less, likely Oregon, was outside the scope of this project. However, we find this exercise succinctly explains the results of our model—comparable low-income families, living under a more regressive state tax structure, spend less per week on groceries—and illustrates the disparate impacts created by the two tax structures.

Conclusion

The paper has sought to discover if any quantifiable differences exist in grocery consumption for similar residents living under different tax structures in Washington and Oregon. Throughout this inquiry, we have developed a novel estimation for individual sales tax incidence estimates for Washington residence, applied a Herfindahl-Hirschman style Index to test for purchase consolidation and account for it in our regression model and conducted a simple counterfactual exercise using our final regression estimates to directly compare hypothetical grocery expenditure values for the same resident living under both tax structures. Our results indicate that for most households, especially those earning less than <$30,000>, similar households in Washington spend less per week on groceries than those living in Oregon. Specifically, we find that, in Washington, sales tax incidence has a statistically significant and negative relationship with grocery consumption while the tax structure in Oregon has no statistically significant relationship with grocery consumption. Our results suggest that between the two states, Washington's tax policies reduce grocery consumption for most hypothetical households when compared to Oregon's.

While this conclusion is consistent with both our hypothesis and many previous pieces of research our method has limitations.[8] First, The diary portion of the Consumer Expenditure Survey has been frequently criticized for it's limited time frame leading to inappropriate

[8] Our conclusions align with those of Suits, Aguiar & Bills, and Wooster & Lehner

conclusions about expenditure consolidation. We take multiple steps to ensure we overcome this limitation including the use of yearlong interview survey results in estimating sales tax incidence values and the development and inclusion of our consolidation index. However, more refined expenditure data that spans a longer time period for each household could improve our estimates. Next, we exogenously assign property tax values by income bracket from ITEP. We do not suspect property tax incidence varies significantly within income groups, nor do we suspect property tax payments directly impact grocery consumption, but it remains the only tax value we fail to estimate in the model. Finally, the hypothetical household analysis displayed in the Results portion of this paper assumes exogenous income for hypothetical households, an assumption that requires further analysis or guidance from previous research which, if it exists, we failed to encounter. Despite these limitations, we believe the results presented provide an accurate look into the impacts of state level tax policies on grocery consumption.

Future research would benefit from increased data granularity and should focus on the quality of purchases in addition to the monetary value. Access to specific purchase information for increased periods of time for all observed households would both improve the accuracy of our model and increase the validity of conclusions offered in our paper and any future inquiries into the impacts of tax policies on expenditure. While we find that increased sales tax incidence does lead to lower grocery expenditure values compared to increased income tax incidence, future research looking to understand household level welfare impacts should consider the quality of goods purchased. With data on the quality of groceries purchased, an inquiry could come to more nuanced conclusions about the the gap in expenditure, and subsequently consumption inequality in instances of varying tax structures or other areas of differing policy.

Appendix

Figure 1: Key Summary Stats

Variable	Oregon (1017 Observations)		Wasington (1090 Observations)	
	Mean	Std. Dev.	Mean	Std. Dev.
Highest Education Level in Family	13.91	1.55	14.07	1.58
Age of Reference Person	49.75	16.56	48.17	17.36
Children Under 18	0.56	0.97	0.55	0.98
Family Size	2.36	1.35	2.4	1.39
Pre-Tax Income	$70,682.00	$67,087.00	$80,991.00	$72,243.00
Groceries	92.21	66.15	99.06	70.49

Figure 2: Avg Pre-Tax Income and Grocery Expenditure by Income Quintile

Figure 3: Expansion path by income decile

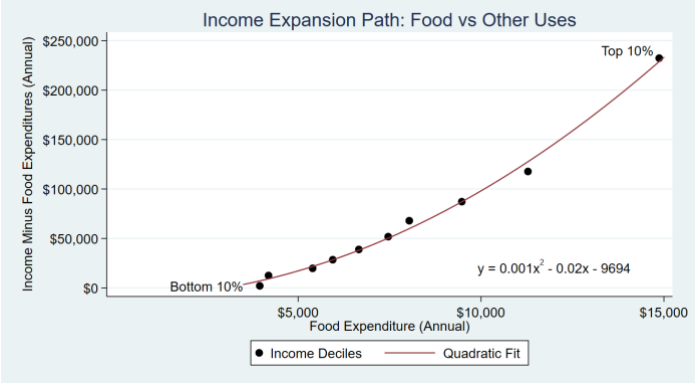


Figure 4:

ITEP Total State Tax Burden: Washington

ITEP Total State Tax Burden: Oregon

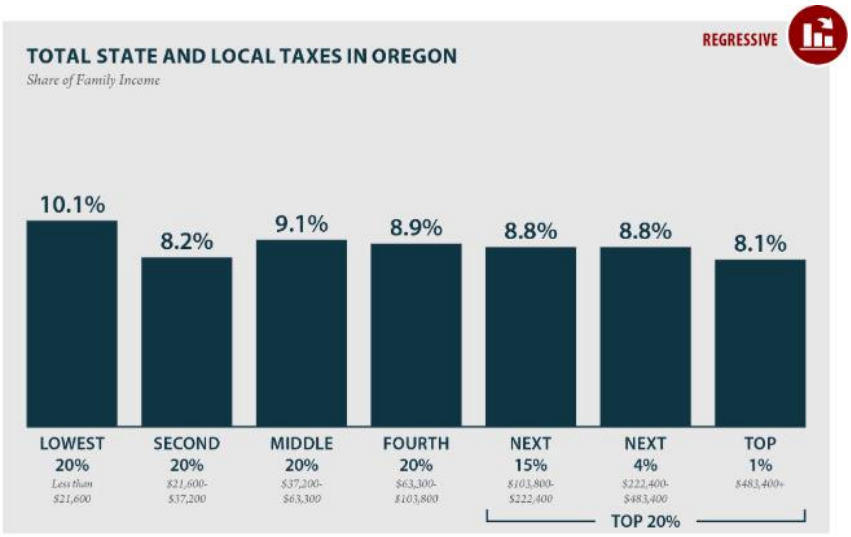


Figure 5: Sales tax burden vs income with functional form and smoothed values

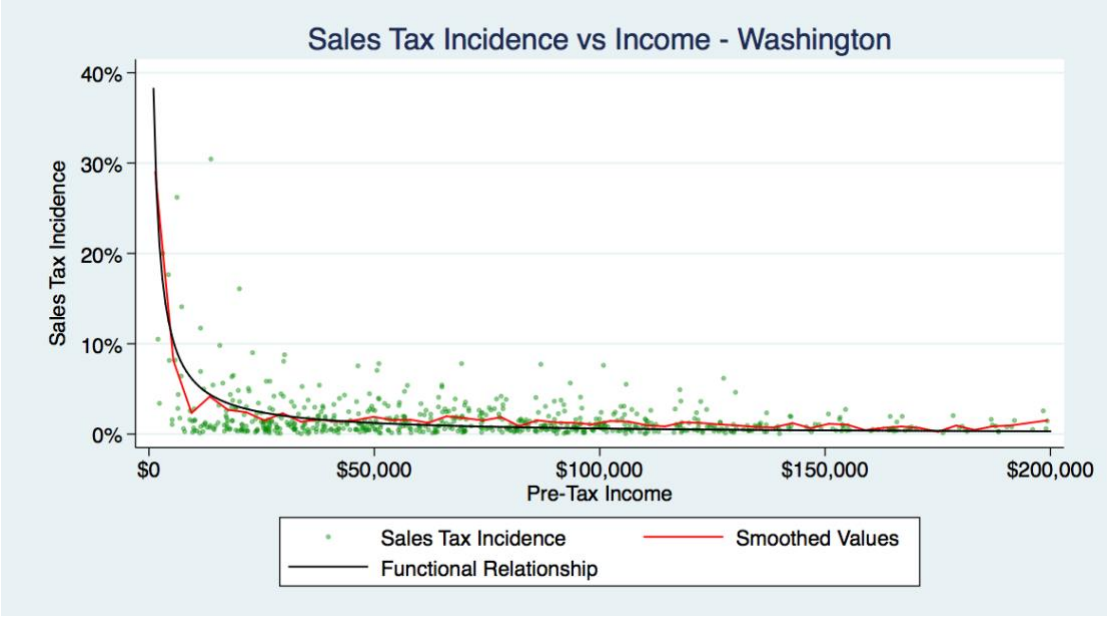


Figure 6: Estimated sales tax values, 100 bootstrap parameter values with confidence intervals.

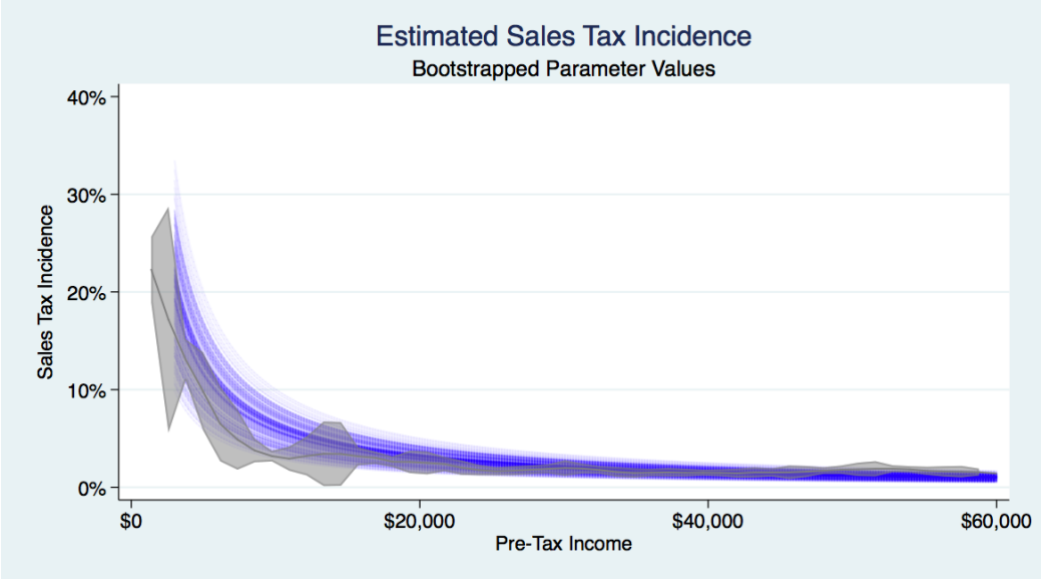


Figure 8: Consolidation Index by State and Income Quintile

Consolidation Index by Income Quintile

	Oregon	Washington
Lowest 20%	0.092	0.143
20% - 40%	0.083	0.075
Middle 20%	0.074	0.082
60% - 80%	0.059	0.075
Top 20%	0.064	0.057
Total	0.074	0.084

Consolidation Index calculated using Equation 3
Itemized expenditures from BLS EXPD files, 2008 - 2017
Values close to 0 indicate less consolidation
Values close to 1 indicate more consolidation

Figure 9: Grocery Share of Total Food Expenditures

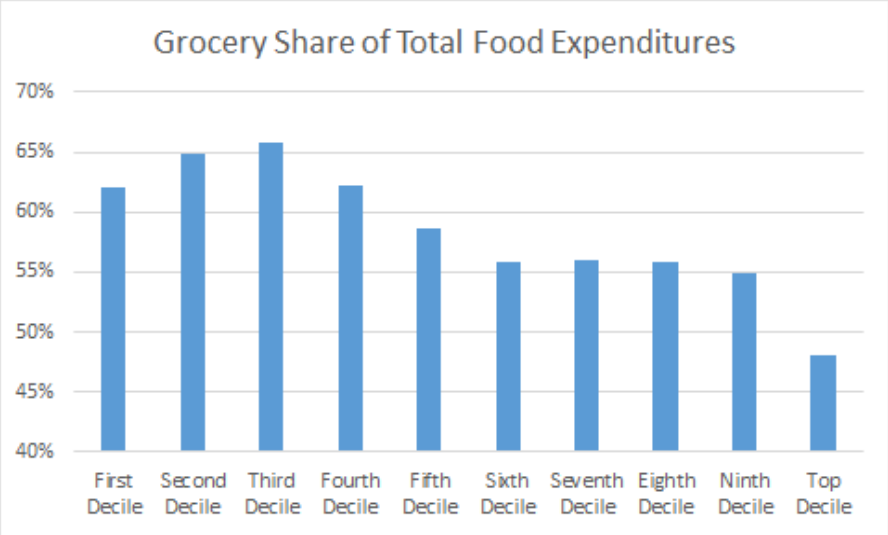
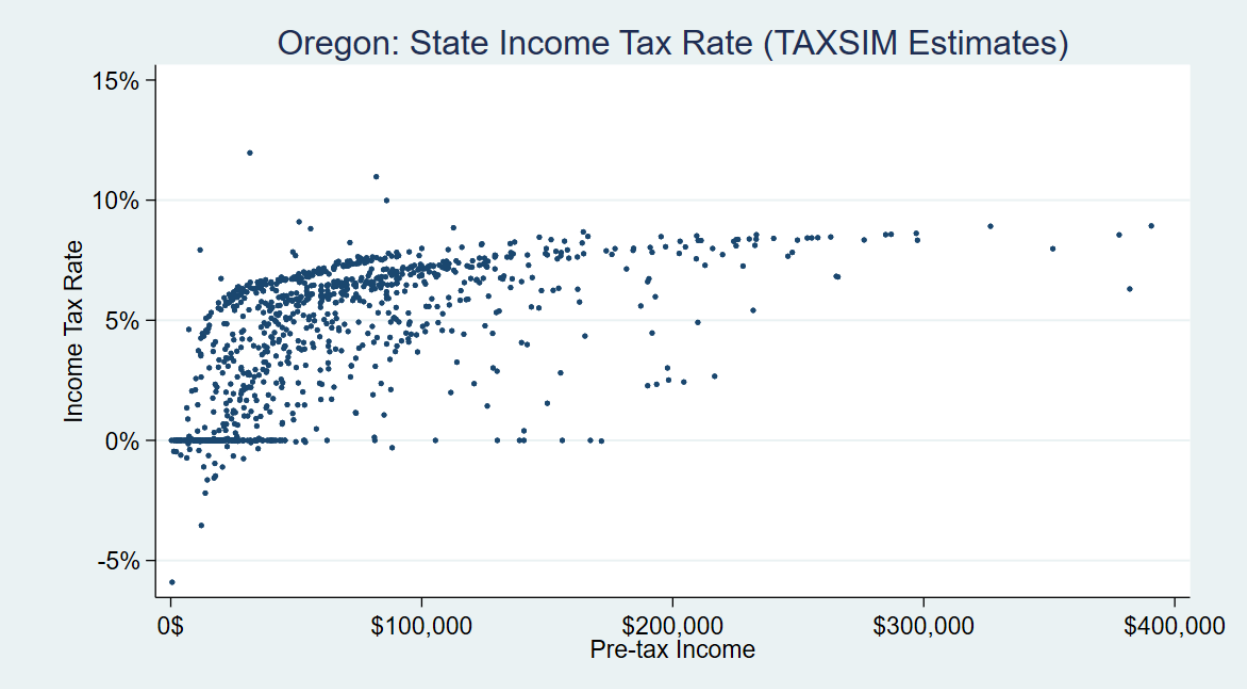


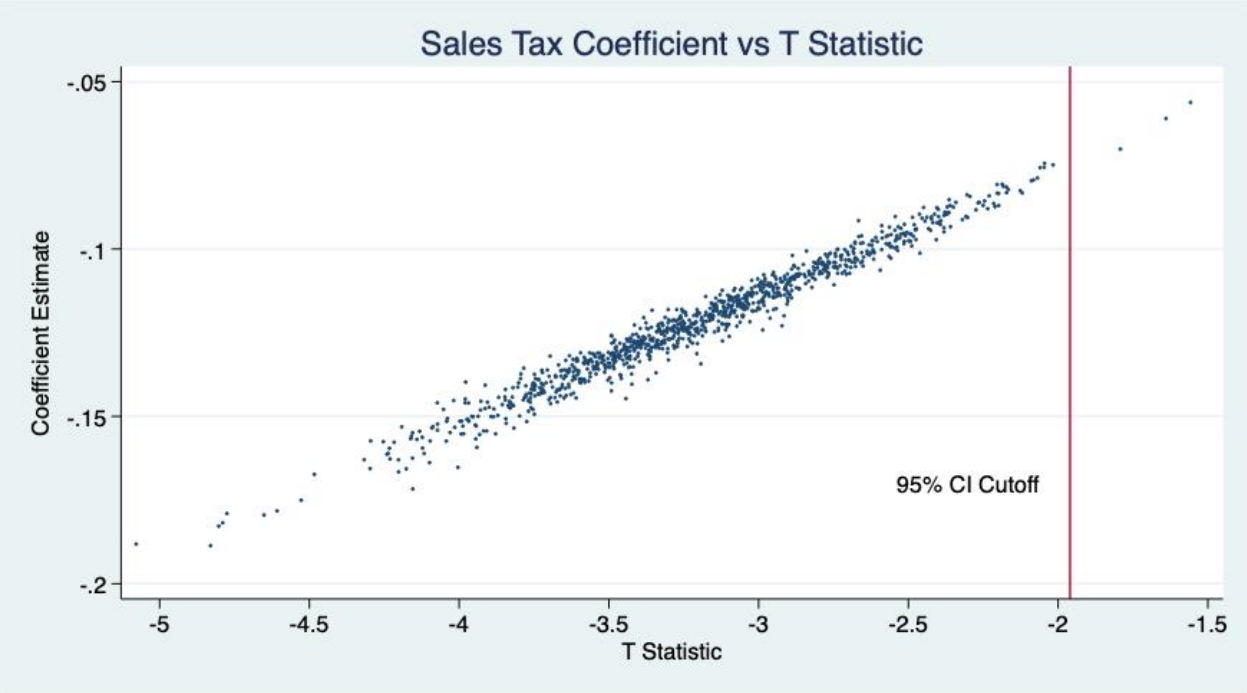
Figure 10: Hypothetical Household Analysis Summary

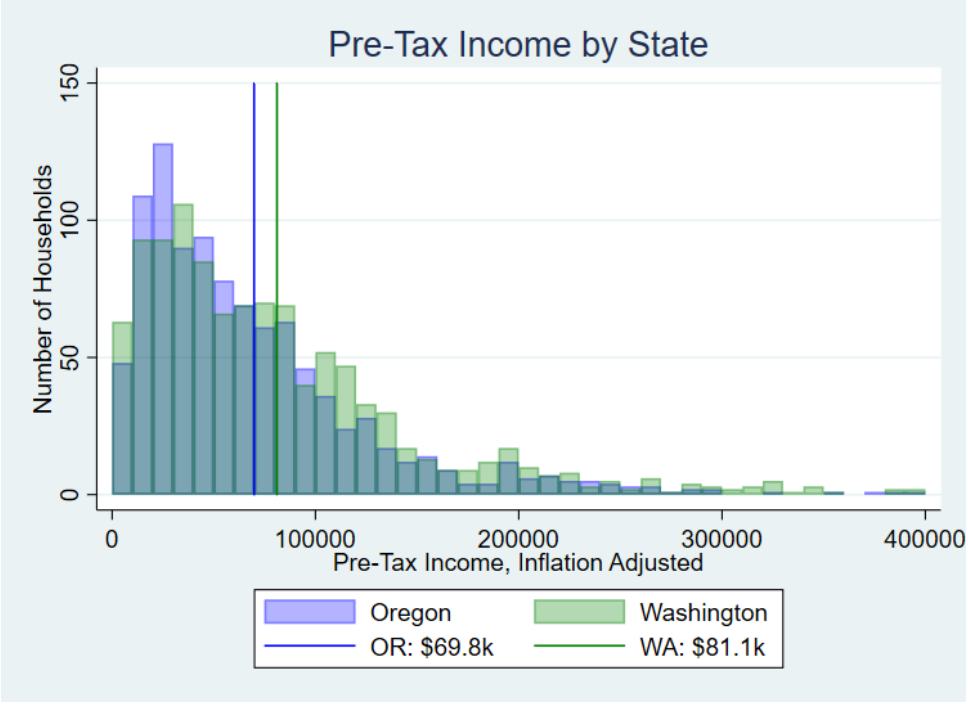
Estimated Weekly Grocery Expenditures for Hypothetical Households

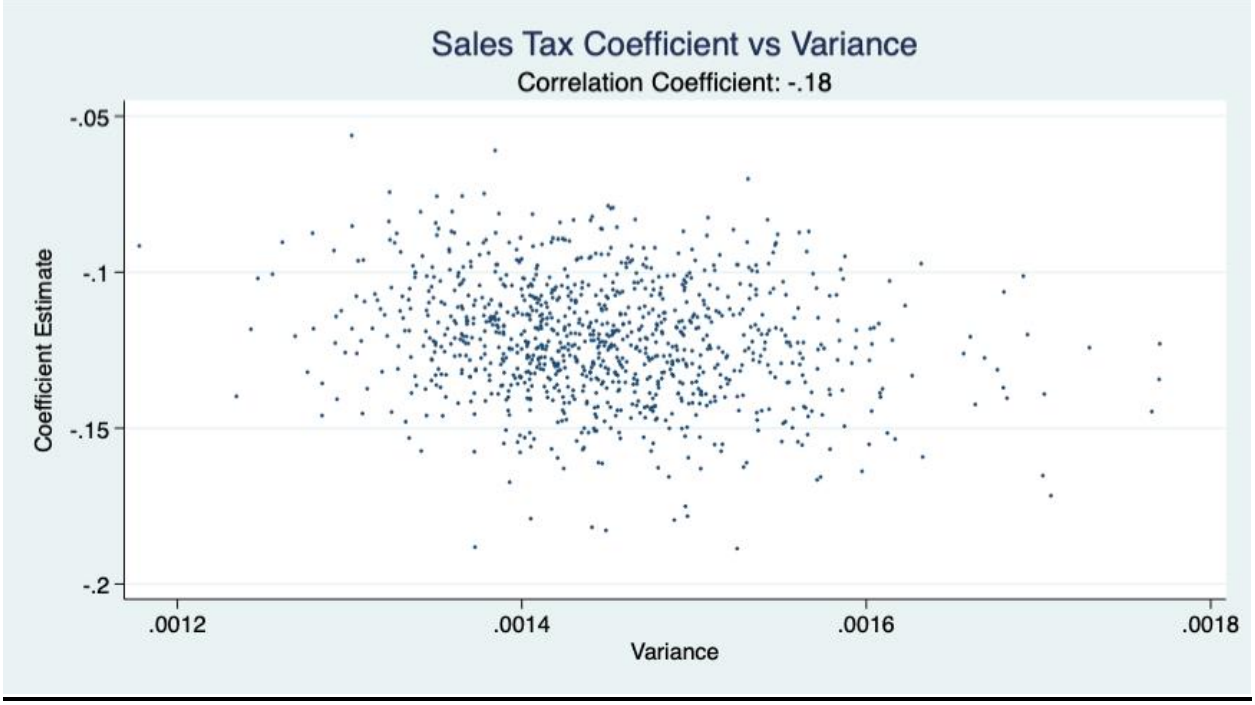
Household	Income	OR	WA	Difference
College Educated, 40-year-old married couple with two kids	$ 25,000	$ 119.06	$ 105.15	$ 13.91
	$ 40,000	$ 122.64	$ 115.63	$ 7.01
	$ 65,000	$ 126.10	$ 123.39	$ 2.71
High School Educated, 25-year-old single mother of one	$ 15,000	$ 55.33	$ 45.36	$ 9.97
	$ 25,000	$ 57.50	$ 49.44	$ 8.06
	$ 35,000	$ 58.02	$ 51.63	$ 6.39
Single 70-year-old retiree	$ 6,000	$ 54.26	$ 44.59	$ 9.67
	$ 15,000	$ 54.71	$ 49.65	$ 5.06

Additional Figures




Sales Tax Coefficient vs T Statistic
Coefficient Estimate
-.05
-.1
-.15
-.2
-5
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
T Statistic
95% CI Cutoff


Pre-Tax Income by State
Number of Households
0
50
100
150
0
100000
200000
300000
400000
Pre-Tax Income, Inflation Adjusted
Oregon
OR: $69.8k
Washington
WA: $81.1k


Sales Tax Coefficient vs Variance
Correlation Coefficient: -.18
Coefficient Estimate
-.05
-.1
-.15
-.2
.0012
.0014
.0016
.0018
Variance

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