CAN TAXES SHAPE AN INDUSTRY? EVIDENCE FROM THE IMPLEMENTATION
OF THE "AMAZON TAX"

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<u>ABSTRACT</u>

For years, online retailers have maintained a price advantage over brick-and-mortar retailers by not collecting sales tax at the time of sale. Recently, several states have required that online retailer Amazon collect sales tax during checkout. Using transaction-level data, we document that households living in these states reduced Amazon purchases by 9.4% after sales tax laws were implemented, implying elasticities ranging from –1.2 to –1.4. The effect is more pronounced for large purchases, for which we estimate a reduction of 29.1% in purchases, corresponding to an elasticity of –3.9. Studying competitors in the electronics field, we detect some evidence of substitution toward competing retailers.

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1 Introduction

Over the past decade, online retail transactions have increased dramatically in volume. According to the U.S. Census, online sales constituted 2.5% of retail sales in 2006 and 7.7% of retail sales in 2016 (corresponding to $354 billion over the four quarters from 2015Q2 to 2016Q1).[1] Many factors have contributed to the growth in online sales, one of which is that out-of-state online retailers do not charge sales tax, which has generally given them a price advantage over retailers with a presence in the state. This sales tax collection loophole has not gone unnoticed by state governments or by competing retailers. State governments are concerned that these online sales depress local employment and erode tax revenues. Over the last decade, many states responded by requiring that Amazon, the largest online retailer, begin to collect sales tax at checkout. Collectively, these laws are called the "Amazon Tax." Despite the importance of understanding the effects of imposing sales tax on online commerce, only a few studies have explored how the imposition of sales tax affects consumer behavior and online and brick-and-mortar retailers. In addition, no previous systematic study has looked at the Amazon Tax.

This study fills this gap in the literature by examining how collecting sales taxes on online transactions affects consumers' purchasing decisions. Online retailers that are not required to collect sales tax, including Amazon, enjoy a price advantage. Thus, we hypothesize that the introduction of the Amazon Tax will lead to a decline in Amazon's sales and substitution to alternative retailers. With effective sales tax rates as high as 10% in some jurisdictions (after accounting for state, county, and city taxes), this price advantage can be sizable. Gene DeFelice, vice president of Barnes and Noble, the largest book retailer in the United States, summarized the issue succinctly: "We are at a serious competitive disadvantage against out-of-state, online

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[1] www.census.gov/retail/index.html#ecommerce

retailers who pay no taxes."[2] An additional factor that is likely to facilitate customer migration from Amazon to alternative outlets is the low search cost of online shopping.

State governments have begun paying increased attention to the issue of sales tax collection in light of the Great Recession and the recent growth in online retail volume. General sales taxes represent an important part of state revenue: For example, in 2011, general sales tax constituted 10.4% of revenues. Figure 1 shows that the importance of this tax varies considerably by state, ranging from 0% of revenues in states without sales tax (such as Oregon and Alaska) to as high as 21.0% of state revenues for Washington.[3] Recently, the issue has also received federal attention. The Marketplace Fairness Acts of 2013 and 2015 were attempts by lawmakers to enable all states to force retailers to collect sales tax on purchases made by out-of-state customers, but neither act has been adopted into law.[4] Proponents of such online sales tax collection bills often tout the elimination of the Internet retailer sales tax advantage as "leveling the playing field" and helping to restore business and jobs to local economies.

A recent trend in state legislatures is to enforce the collection of sales tax on Internet retailers, particularly on Amazon, the largest online retailer. To date, there has been little evaluation of far-reaching and permanent sales tax policies on retail, competition, and consumers. Between 2012 and 2015, 19 states began implementing laws requiring Amazon.com to collect sales tax from its customers. These laws provide an ideal setting for examining the effects of sales tax collection on consumer behavior and the consequences to related firms.

Our analysis of the effects of the Amazon Tax on purchasing behavior uses data from an online financial account aggregator. This financial service enables subscribers to concentrate all

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[2] http://articles.latimes.com/2011/jan/20/business/la-fi-internet-tax-20110120
[3] 2011 US Census Annual Survey of State & Local Government Finance: www.census.gov/govs/local/
[4] The text and status of the bill are found here: www.govtrack.us/congress/bills/113/s743, www.govtrack.us/congress/bills/114/s698

of their accounts in one place for viewing and monitoring purposes. Our base dataset includes information on 2.7 million households and contains transaction-level entries similar to what is found on bank and credit card statements. Due to the nature of this dataset, our sample contains households that are likely to be younger and more urban than the general population. Though this limits the external validity of our results, the sample represents a subset of the population that is growing rapidly and are relevant to the overall economy.

We begin our analysis by using a traditional difference-in-differences (diff-in-diff) methodology to test whether households decreased their Amazon purchases following the introduction of the law. Each state that adopted the Amazon Tax during our sample period is considered "treated" following the adoption, and other states are considered "controls." Our results show that the introduction of the Amazon Tax resulted in a persistent decline of 9.4% in the amount spent on products (net of sales tax, which we hereafter refer to as the tax-exclusive price) through Amazon, corresponding to an average elasticity of –1.2. In an alternative specification, we find that a one percentage point increase in sales tax leads to a $0.54 reduction in tax-exclusive Amazon spending, corresponding to an elasticity of –1.4. We also test whether these effects are more sensitive to households in high-tax jurisdictions and find that indeed these consumers have higher elasticities.

We find that low-income households reduced their tax-exclusive spending on Amazon more than high-income households (9.9% versus 7.0%, respectively). Further, the percent reduction in spending on Amazon was slightly higher among heavy Amazon customers. The highest tercile of Amazon spending in 2011 reduced Amazon purchases by $6.22, corresponding to a 9.4% reduction, whereas the lowest tercile of Amazon shoppers reduced expenditures by $1.65, corresponding to an 8.0% reduction.

Consistent with the idea that consumers trade off sales tax with search costs, we find that the decline in Amazon purchases is more pronounced for larger purchases, as consumers would receive the greatest savings by avoiding tax on such purchases. We document strong evidence that the effect of the Amazon Tax increases with the size of the purchase, suggesting that households are particularly likely to engage in Internet shopping to avoid sales tax for large purchases. Consumers decrease their spending by 29.1% on transactions of at least $250, implying an elasticity of –3.9. In a more refined analysis into smaller transaction amount bins, we show that the elasticity is increasing in the transaction amount.

Finally, we study substitution effects. Because many of Amazon's large competitors are companies with a larger scope of products than that of Amazon (e.g., groceries at Walmart, Costco), we focus on a particular industry: electronics retailers. We find that Newegg, one of Amazon's direct competitors, experienced an increase in sales thanks to the implementation of the Amazon Tax. On average, Newegg's sales increased by 13.0%. We also observe that the share of retail purchases coming from Amazon decreased for treated households and that this effect was primarily driven by heavy Amazon shoppers.

Our work relates to two recent strands of the literature. First, several empirical studies have documented that consumers are price and tax sensitive, and thus attempt to avoid sales taxes. Poterba (1996) and Besley and Rosen (1998) find that price levels in locations with high sales tax are lower than those in locations with lower sales tax. Agarwal, Chomsisengphet, Ho, and Qian (2013) find that consumers who live near state borders often shop in the neighboring state when there are positive sales tax differences. Agarwal, Marwell, and McGranahan (2017) show that consumers increase their purchases during sales tax holidays. Chetty, Looney, and

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Kroft (2009) use an experimental setting to show that when sales tax is salient to consumers, the demand for the product declines.

Second, several studies explore the sensitivity to sales tax in the specific context of online retail. The closest study to ours in this body of work is Einav, Knoepfle, Levin, and Sundaresan (2014, EKLS). These researchers document a strong preference among eBay customers for out-of-state sellers, for whom sales taxes do not apply. They observe eBay shoppers' reactions when they discover that the seller is from the same state, which requires them to pay sales tax. EKLS document that eBay shoppers are indeed sensitive to sales tax and thus less likely to buy from sellers who reside in the same state. In this setting, they estimate an elasticity –1.7.

Our research contributes to the literature beyond EKLS on multiple accounts. First, our paper directly studies the effects of a permanent change in sales tax for the largest Internet retailer in the world. We rely on state-level implementation of laws; consequently, our results directly measure the effect of these laws on Amazon and on Amazon's competitors. While the results of EKLS indicate that online shoppers are sensitive to taxes, their evidence does not translate directly to the effect of the tax implementation and thus is less conducive to measuring the policy impact. Second, we are able to study how the imposition of the Amazon Tax affects the sales of competitors. Third, our empirical setting is different from that of EKLS, validating both sets of results. The EKLS study is based on a limited sample of transactions (about 270,000). Conversely, our analysis is based on millions of transactions made by a sample of more than 460,000 households in our broadest regressions. In addition, Amazon is larger than eBay: As of 2014, Amazon's revenues were five times larger. Finally, the time periods of the studies are distinct, although chronologically close. EKLS use a sample from 2010; our data are

from 2011–2015. Given the speed at which online commerce is evolving, it important to monitor the persistence of effects over time.

Several additional studies examine the intersection of online sales and sales tax. Goolsbee (2000a, 2000b) uses survey data to estimate that the number of online shoppers would drop by 24% if the tax-advantaged status of Internet retailers were removed. Alm and Melnik (2005), Ballard and Lee (2007), and Scanlan (2007) address this question as well, though they find smaller magnitudes for the effect. Goolsbee, Lovenheim, and Slemrod (2010) ascertain that the penetration of the Internet is correlated with lower sensitivity of cigarette sales to local taxes, suggesting that smokers use the Internet to purchase tax-free cigarettes. Ellison and Ellison (2009) explore the price elasticity of memory modules sold by a particular retailer and determine that consumers are price sensitive both to tax-exclusive prices and to state taxes. Anderson, Fong, Simester, and Tucker (2010) show that when retail chains open their first store in a new state, they experience a decline in their Internet sales shipped to that state because of the sales tax, but the researchers find no similar effect on catalog sales. Finally, Hoopes, Thornock, and Williams (2016) find that Internet retailers exhibit negative stock market returns following legislative proposals to collect sales tax from customers, such as the Marketplace Fairness Act of 2013.

2   Background and Empirical Setting

Sales tax is not collected on purchases from online retailers due to the Commerce Clause in the U.S. Constitution. Current interpretation of the law, which has been consistently upheld by the U.S. Supreme Court, is that online retailers must only collect sales tax on out-of-state purchases if the retailer has a nexus (or a substantial physical presence) in the state. Due to the

nature of their business structure, online retailers have a physical presence in very few states. Ten years ago, Amazon was only required to collect sales taxes in states in which it had a nexus (for example, where it was headquartered or had fulfillment centers).

In recent years, states have attempted to collect sales taxes by broadening the definition of a nexus. Legislation by these states has defined the presence of affiliate programs or subsidiaries as constituting a nexus.[5] Even when this legislation has been ruled constitutional by state courts, the effectiveness of this method of tax collection has been mixed. Overstock.com, for example, has responded to these laws by simply dropping its affiliates in these states. Amazon has acted similarly in some states but in other states has chosen to accede to the Amazon Tax laws due to various political and operational issues.

As of February 2015, Amazon was collecting sales tax in 24 states, comprising more than half of the U.S. population. Over our sample period, 19 states implemented Amazon Tax laws, resulting in the beginning of sales tax collection on well-defined dates for each of these states.[6] Our diff-in-diff study relies on this change in tax policy over time for these states, relative to a control group of other states that did not change their tax policy contemporaneously.

Our study investigates the impact of the Amazon Tax in 19 states in which Amazon started collecting sales taxes between 2012 and 2014. These states are Texas (7/1/2012), Pennsylvania (9/1/2012), California (9/16/2012), Arizona (2/1/2013), New Jersey (7/1/2013), Virginia (9/1/2013), Georgia (9/1/2013), West Virginia (10/1/2013), Connecticut (11/1/2013), Massachusetts (11/1/2013), Wisconsin (11/1/2013), Indiana (1/1/2014), Nevada (1/1/2014),

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[5] Online retailers such as Amazon and Overstock will often advertise on websites such as blogs. If a website reader clicks on the advertisement and subsequently purchases the Amazon product, the website owner will receive a commission on the sale. These website owners who allow Amazon to advertise on their websites are referred to as affiliates.

[6] Before our sample period begins, five states collected sales tax from Amazon, including Washington where Amazon is headquartered. After our sample period ends, more states already have or will shortly begin collecting sales tax on Amazon purchases.

Tennessee (1/1/2014), North Carolina (2/1/2014), Florida (5/1/2014), Maryland (10/1/2014), Minnesota (10/1/2014), and Illinois (2/1/2015).

One concern with our setting is that many states require that households pay sales taxes that are not collected at the time of purchase. These taxes are referred to as "use taxes" and are collected by states annually at the time of tax filing. However, compliance with this use tax has been abysmal. Manzi (2012) finds that only 22 states have "use tax" provisions in their state income tax forms and that the vast majority of households residing in these states do not report any "use tax" liability. For example, only 0.2% of households in Rhode Island report any use taxes, and only 0.3% of households in California and New Jersey report use taxes. However, some states have higher participation rates, such as Vermont and Maine, with 7.9% and 9.8% of households in each state reporting use taxes, respectively. Unlike income tax reporting, systems for tracking and enforcing collection of these sales taxes are weak.[7] Note that these figures do not necessarily represent the percentage of compliance with the law. In particular, the quoted numbers do not account for underreporting of use taxes conditional on reporting a use tax liability.

3   Data

The data we use were provided by an online account aggregator. This service allows subscribers to pool their various financial information in one place, enabling households to view spending by category, monitor investments, etc. Households join the service for free and provide

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[7] For example, Colorado's version of the Amazon Tax legislation tried to force online retailers to report to both customers and the state tax authority summaries of use tax incurred, but it was later declared unconstitutional by the District Court. However, Amazon makes annual spending reports available to residents of South Carolina and Tennessee to aid households in tax filing, though this information is not reported to state tax authorities by Amazon.

their username and passwords to various financial institutions so that the service can automatically extract relevant bank and credit card information.

The information we use consists of daily transactions for 2.7 million households from January 2011 to May 2015, and includes both banking (i.e., checking, savings, and debit card) and credit card transactions. We observe the date, amount, and description of each transaction. Thus, our dataset contains transaction-level data similar to those typically found on monthly bank or credit card statements. Because each household is assigned a unique identifier, we are able to follow each household through time.

Identifying the state of residence of the household is integral to our analysis, because this allows us to determine whether the household lived in one of the 19 treatment states affected by an Amazon Tax. We use the fact that for most purchase-related transactions in the data, there are geographic identifiers at the end of the transaction description that show where the transaction took place.

For each household, we collect the transactions with geographic identifiers and identify the state of residence for that household by requiring that at least 75% of the transactions occur within a single state. Next, for each household we assign the most commonly observed city in the state of residence identified in the prior step as the city of residence of the household. Our results are also robust to alternative methods of identifying the city of residence of the household as described in Section A1 of the Appendix.

Because we are primarily interested in how Amazon customers respond after the implementation of the Amazon Tax, we focus our analysis on households who made some purchases on Amazon prior to implementation. We include households that spent more than $200 on Amazon during 2011, though the results are robust to using alternative spending

thresholds, as demonstrated in Section A2 of the Appendix. After applying these two filters, our sample size is reduced to 275,437 households, 180,330 of which live in one of the 19 states that implemented the Amazon Tax during our sample period.

The unit of observation in our analyses is the household-month. For each household-month, we sum all Amazon expenditures. For all transactions in our database, we adjust by the households' sales tax to determine the tax-exclusive amount spent on goods purchased. For Amazon purchases by households in the 19 states that implemented an Amazon Tax, we only adjust transactions after the law has been implemented.[8] All variables are winsorized at the 99th percentile.

Table 1 shows the geographic distribution of households in our sample relative to the 2010 U.S. Census. Our sample is quite geographically diverse and maps fairly well to the U.S. Census data. Our sample does contain more California and New York residents than the general population, potentially raising the concern that our results are attenuated to reflect the behavior of households in these states. However, New York implemented an Amazon Tax law prior to the study data period (2008), and thus is always in the control sample. California implemented the law during the study period. To ensure that the results are not driven by California-specific behavior, we rerun our main analyses excluding California, and find that the results remain virtually unchanged.

Figure 2 shows annual income of households in our sample and in U.S. Census data. Our dataset maps fairly well to the U.S. Census, with a few caveats. The income we observe flows through to a household's checking or savings account. Thus, it will be equal to gross income minus the sum of withholdings (payroll tax, state tax, federal tax, healthcare contributions,

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[8] For two states (Pennsylvania and California), the implementation of the Amazon tax took place at the middle of the month. In these cases, we removed the household-month observations from the transition month.

retirement contributions, etc.). Consequently, a household's gross income will be higher than what we directly observe. Nonetheless, the data are well dispersed across income groups and seem to be reasonably representative of the U.S. income distribution. A notable difference between our dataset and the Census are households with incomes lower than $10,000. These households are over-represented in our sample compared to the population. Aside from the possibility that our sample may contain a larger fraction of households that have lower incomes than the population, it may also be attributed to households that did not link their income-related bank accounts to the data provider.

Compared to the Census, households in our sample are likely to be younger and more urban. Though this limits the external validity of the results, our sample still represents an important and growing share of the U.S. population. According to some estimates, Amazon's direct and indirect involvement in U.S. e-commerce reached over 30% in 2016.[9] The results of our paper are relevant for understanding the online purchasing behavior of these households.

Table 2 shows the average tax-exclusive Amazon spending three months before and three months after the Amazon Tax implementation of each state. In this table, the tax-exclusive spending for a particular state is reported along with that of the control states. We find that treated states reduce tax-exclusive spending at Amazon relative to control states. We analyze this formally in the subsequent sections.

4   States Implementing the Amazon Tax

States that decide to implement the Amazon Tax are, of course, not drawn randomly. This fact raises the concern that the decline in Amazon sales that we document occurs due to an

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[9] www.usatoday.com/story/tech/news/2016/10/20/amazon-online-sales-bigger-larger/92419572/

unobservable confounding factor that pushes states to embrace the Amazon Tax and at the same time causes a decline in Amazon sales. Perhaps the most obvious potential latent factor is a state-level economic weakness that leads states to adopt the Amazon Tax in order to increase revenues, and that at the same time causes a decline in consumption.

We address this concern in four ways. First, we explore whether states that implement the Amazon Tax during our sample period experience significantly different gross domestic product (GDP) growth around the implementation of the tax than states that did not implement the tax. We collect five-year GDP growth data around the implementation year and test whether the average GDP growth is different for state-quarters following the implementation of the Amazon Tax. We present the results in Table 3, Columns (1) and (2). The regressions indicate no significant difference in state-level GDP following the Amazon Tax implementation.

Second, we test whether households' income changed around the implementation of the tax using household-month data. To test whether this is the case, we extract household income from the transaction data and regress household income on dummies surrounding the implementation of the Amazon Tax. The results, found in Columns (3) and (4) of Table 3, show that households did not experience a meaningful change in income around the implementation of the tax. Hence, it is not likely that our main results are due to changes in the purchasing power of households.

Third, because a state-level slowdown typically is accompanied by a general decline in consumption, we examine whether the pattern of purchasing at electronics retailers changed after the tax's implementation (Section 5.4). We find no such decline in consumption.

Fourth, we conduct an event study in which we examine the change in Amazon sales month by month around the implementation of the law. Figure 4, which is discussed later in

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Section 5.1, shows a sharp decline in Amazon sales around the month of implementation of the law, leaving little doubt that the Amazon law is behind the reduction in sales.

In sum, we conclude that our results are not likely to be driven by a state-level economic weakness that caused states to implement the Amazon Tax and that at the same time caused a slowdown in consumption.

5   The Effect of the Amazon Tax on Amazon Sales

In this section, we examine how Amazon's sales in the treated states changed after implementation of the tax and compare these results to Amazon's sales in states that did not change their laws. We perform this analysis using the tax-exclusive price. Then, we explore how different types of households might react to the new tax differently. Thus, we repeat our analysis but split our sample into terciles based first on household income and then on Amazon historical spending intensity. Finally, we examine the tax's effect on large purchases exclusively.

We use a diff-in-diff methodology in which we measure the consumption effects after states started imposing sales tax on Amazon purchases. Our basic empirical specification is

$$Y_{h,t} = \beta_0 + \beta_1 \times Treated\ State_h \times I(t \geq Q)_{h,t} + \beta_2 \times Cost\ of\ Living\ Index_{c,t}$$
$$+ Month\ Fixed\ Effects_t + Household\ Fixed\ Effects_h + \varepsilon_{h,t},$$

where $Y_{h,t}$ is the dependent variable of interest and takes on the value of Amazon expenditures of household h in month t (tax-exclusive spending on Amazon). $Treated\ State_h \times I(t \geq Q)_{h,t}$ is an indicator variable that takes a value of 1 for treated households after implementation of the Amazon Tax, and 0 otherwise. In a slightly modified empirical specification, we split the $Treated\ State_h \times I(t \geq Q)_{h,t}$ term into a more granular interactive term to investigate short-versus long-term responses to the treatment at a quarterly frequency. To account for regional

differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted $Cost\ of\ Living\ Index_{c,t}$. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month.

5.1 Consumer Response to Tax Implementation

We begin our analysis by examining whether the average monthly amount that households spend on Amazon purchases changes as a result of the new sales tax. For each household in the sample, we aggregate the dollar amount spent on Amazon products within each month. Because we are interested in the impact of the sales tax on Amazon's sales and the value of items purchased by households, we create the tax-exclusive price by dividing by one plus the local tax rate.

Table 4 presents the results of this analysis. Column (1) shows the change in average monthly Amazon spending after the tax was implemented. The results indicate that consumers in affected states reduced their average monthly purchases on Amazon by \$3.65, a 9.4% (–3.65/39.00) reduction in purchases relative to mean monthly spending among the treated states before the tax was implemented.[10] This result is statistically and economically significant and corresponds to an elasticity of –1.2.[11] Because these values are tax-exclusive, the drop in spending reflects a drop in Amazon's revenues in the affected states.

In Column (2), we examine the timing of the Amazon purchases in the quarter preceding and in the quarters following the tax implementation. $I(t = Q_{-1})_{h,t}$, $I(t = Q_0)_{h,t}$, and $I(t =$

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[10] Note that the mean of spending by the pre-event treatment is different than what is reported in Table 2 since here we restrict the sample window around the Amazon Tax event.
[11] (–\$3.65 / \$39.00) / 7.5% = –1.24.

$Q_{+1})_{h,t}$ are indicator variables for the quarter(s) before, quarter after, and quarters following the tax implementation, respectively. We find some evidence of a buildup in purchases before the Amazon Tax was implemented, corresponding to an increase of 3.6% (1.42/39.00).

In the quarter immediately following the sales tax implementation, consumers in the affected states reduced their monthly Amazon purchases by $3.29, corresponding to an 8.4% (–3.29/39.00) reduction from the mean. In subsequent quarters, the reduction of Amazon purchases is $3.21, corresponding to an 8.2% (–3.21/39.00) reduction from the mean. The results are highly statistically significant.

In Column (3), we interact our $Treated\ State_h \times I(t \geq Q)_{h,t}$ term with the local tax rate of each household to examine whether the households that lived in localities with a high sales tax were more sensitive to the implementation of an Amazon Tax. Indeed, we find that a 1% increase in sales taxes leads to a $0.54 reduction in monthly Amazon spending, corresponding to an elasticity of –1.4.[12]

In Section A3 of the Appendix, we repeat the above analysis using the tax-inclusive Amazon expenditures as the dependent variable instead of the tax-exclusive Amazon expenditures. We find a reduction in the tax-inclusive spending at Amazon, but we present the results in the Appendix for two reasons. First, our main analysis is consistent with the standard approach used in the literature to calculate tax-exclusive elasticities. Second, the relationship between tax-inclusive and tax-exclusive elasticities is largely mechanical and can largely be inferred from the tax-exclusive elasticities.

We also provide an alternative measure of elasticity in Appendix A4. In a nutshell, we log the dependent variable and rerun the main specification. The resultant elasticity of–0.83 is

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[12] (–$54.32 / $39.00) = –1.39.

lower than that in our main analysis. The reason for a lower elasticity is that log specification compresses large values and gives more weight to smaller purchase values. As discussed later in Section 5.3, Amazon customers exhibit higher elasticity for large purchases, and hence a log-specification tones down that end of the spectrum.

To better understand the persistence of these effects, we plot the coefficients for the regression in Figure 4, Panel A, using month dummies instead of quarter dummies. We see a slight buildup in purchases in the quarter prior to the Amazon Tax taking effect, after which there is a large and persistent reduction in Amazon purchases.

5.2   The Cross-Section of Households

Different households may react to the inclusion of sales tax differently. For example, households with low income may be closer to their budget constraint and thus change their tax-exclusive Amazon spending due to the implementation of sales taxes. Households with high income may also change their tax-exclusive Amazon spending, but at a proportionally smaller rate relative to their average spending at Amazon. Similarly, households that purchase large amounts at Amazon may find that they can no longer buy the same quantity of goods as before after the implementation of sales taxes. The following analysis explores these dimensions.

We first split the sample into terciles based on observable household income and perform our main specification for each tercile. The results are presented in Table 5. Columns (1) to (3) indicate that low-income households are the most sensitive to the Amazon Tax, reducing Amazon purchases by $3.04 per month, corresponding to a 9.9% reduction in spending relative to mean and an elasticity of –1.3. High-income households reduce their purchases by $3.76, corresponding to a 7.0% reduction in spending and an elasticity of –1.0. These results are

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consistent with low-income households being more price sensitive than high-income households. Further, the results are also consistent with lower income households having lower opportunity costs and being willing to bear search costs to substitute to alternative retailers.

We also split households into terciles by the total amount of Amazon purchases in 2011 to explore how past Amazon shopping intensity might affect a household's response to the new tax. Columns (4) through (6) of Table 5 present the results. We find that households with high Amazon spending in 2011 exhibited the biggest dollar decline in spending. Such households reduced Amazon purchases by $6.22, corresponding to a 9.4% reduction in Amazon purchases and an elasticity of –1.3. This coefficient is highly statistically significant. In contrast, households with low Amazon spending in 2011 exhibited the lowest decline in spending. Such households reduced Amazon purchases by $1.65, which corresponds to an 8.0% reduction and an elasticity of –1.1.

5.3   Large Purchases

Given that the amount of sales tax charged on an item is proportional to its price, we expect households to be more sensitive to sales taxes as the size of the purchase increases, especially when assuming some sort of fixed search costs. For example, assume a household has a sales tax rate of 10%. If the household were to purchase a $10 item at a local brick-and-mortar retailer, it would result in a $1 sales tax charge. However, for a purchase of $1,000, the sales tax due would amount to $100. When there is a fixed search cost associated with finding the tax savings, this household would be more likely to purchase the $1,000 item online as opposed to the $10 item. However, after implementation of the Amazon Tax, the tax avoidance incentive to

make large purchases through Amazon is removed, and any observed change in behavior surrounding this event could be attributed to the Amazon Tax.

We test this prediction in Table 6, which repeats the base regressions (from Table 4) with a new dependent variable consisting of transactions of at least $250. Specifically, for each household in the sample, we include only Amazon transactions of at least $250 using tax-exclusive prices. Transactions below these amounts are set to zero. Then, we aggregate the large transactions at the household-month level.

The results show that the effects are substantially stronger for large purchases. Column (1) shows the average decline in Amazon sales is 29.1% (–2.25/7.73), corresponding to an elasticity of –3.9. In the more granular specification, Column (2) shows that there was some buildup in purchases before the tax took effect and that the decline in purchases following the tax implementation is persistent at a rate of –27.6% (–2.13/7.73). Column (3) shows that the reduction in large purchases increases with the tax rate of the household: A 1% increase in sales tax results in a $0.32 reduction in large purchases, corresponding to an elasticity of –4.1 for large purchases.

In Table 7, we expand on the analysis performed in Table 6. We create more refined bins of Amazon purchases in $100 intervals. Column (1) in Table 7 corresponds to Amazon purchase sizes of $0.01-$99.99, Column (2) corresponds to Amazon purchase sizes of $100.00-$199.99, and so forth. Elasticities are computed in the bottom row and also plotted in Figure 3. Overall, the results in Table 7 and Figure 3 convincingly illustrate that consumers are sensitive to the amount of taxes owed, not just the tax rate. For relatively small purchases, consumers are relatively inelastic. However, for large purchases, consumers are highly elastic. For the last category that we consider (purchase ≥ $700), the elasticity is as large as –6.8.

We repeat the month-by-month graphical analysis for the subset of large purchases and present it in Figure 4, Panel B. The chart shows that the conclusion about the permanency of the decline in Amazon sales documented earlier in Figure 4, Panel A, is applicable also to the subset of large purchases.

We also conduct an additional analysis that assesses the probability of purchasing from Amazon in a given month. The analysis is presented in detail in Appendix A5. Consistent with the analysis above, we find a 15.5% reduction in the likelihood of spending at least $250 (tax-exclusive) at Amazon in a given month. This result is statistically insignificant for purchases less than $250.

In Table 8, we further examine the relation between large purchases and the tax increase, by subpopulations. As before, we split the sample by income and by historical Amazon purchases in 2011. We detect similar patterns to those found in Table 5. Column (3) shows that low-income households reduce their large purchases at Amazon by 34.3% after implementation of the Amazon Tax, corresponding to an elasticity of –4.5. In contrast, Column (1) shows that high-income households reduce their large purchases only by 24.8%, corresponding to an elasticity of –3.3.

Column (4) shows that those with high past Amazon expenditures reduce tax-exclusive spending by 30.1% (implying an elasticity of –4.0), while Column (6) shows that those with low past Amazon expenditures reduce spending by 26.0% (implying an elasticity of –3.5).

5.4   Substitution to Competing Retailers and Income Effect

We are interested in whether the forgone sales of Amazon went to competing firms and whether these firms are brick-and-mortar stores or other online retailers. Previous studies have

found that the imposition of sales tax pushes consumers to look for alternative sellers who do not collect sales tax. For example, evidence of cross-border shopping (e.g., Ballard, and Lee, 2007; Agarwal, Chomsisengphet, Ho, and Qian, 2013) indicates substitution in the physical sphere. In the online arena, EKLS find that eBay customers back out of transactions once they find that they need to pay sales tax and that they are more likely to instead buy another item from an out-of-state seller who does not collect sales tax. Ellison and Ellison (2009) use Pricewatch data to document that buyers of memory modules choose to purchase from sellers who do not collect sales tax. The substitution observed in these studies of online retailers is performed on the same platform (either eBay or Pricewatch, respectively), making it is easy for the consumer to substitute within the platform and for researchers to identify the effect. In the case of Amazon, substitution may be costlier for customers and is more difficult for researchers to detect.

In our tests of substitution, we face a data issue. While we observe transaction amounts at Amazon and the competing firms, we do not know what products were purchased. Furthermore, if there is substitution to other retailers, it is likely spread among several competitors rather than one retailer. Finally, it is empirically difficult to detect an increase in sales in giant competitors like Walmart, Costco, or Target that sell a wide array of products including some that are not usually offered by Amazon (e.g., groceries).

Nevertheless, we can provide some evidence about substitution in specific areas. In this section, we investigate electronics retailers as well as broad Internet merchants. We focus on electronics products for several reasons. First, these are often large purchases, making it worth the shopper's time to find a good deal. Second, these products are easily identifiable by brand and model; hence, shoppers can easily compare prices across outlets. Third, competing retailers in the electronics space specialize in electronics only, sharpening the empirical test. We,

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therefore, look at the largest competing electronics stores: Best Buy and Newegg. Best Buy is the largest electronics retailer in the United States, and Newegg is the second largest online-only retailer after Amazon. Best Buy has a physical presence in most states and thus collects sales tax both for physical and online sales. Newegg, however, is headquartered in California and has limited operations in two other states, so it is only required to collect sales tax from purchases in three states.[13] To gain more insight into household behavior, we split Best Buy transactions into brick-and-mortar and online purchases.

Next, we identify transactions through eBay, which is a viable competitor to Amazon, selling a wide variety of products in its online marketplace. Unfortunately, there is no easy way to identify eBay transactions in our dataset because the majority of these transactions occur through PayPal payments directly to eBay sellers.[14] The portion of these transactions that contain the keyword "eBay" we unambiguously classify as eBay transactions. All other PayPal transactions we leave in their own PayPal category, with the understanding that this is an imperfect proxy for eBay transactions. Next, in an attempt to capture a wide breadth of online retailers, we identify all other Internet merchants by searching for the keyword ".com" for all retail transactions not previously classified into the other categories.

To test for the possibility that competing electronics retailers benefited from some of Amazon's forgone sales, we regress total spending of the competing retailer's sales on the $Treated\ State_h \times I(t \geq Q)_{h,t}$ variable introduced earlier. As with the previous regressions, we also include household and month fixed effects. The results of the substitution analysis are presented in Panel A of Table 9. We find no significant results for Best Buy in Columns (1) and (2). However, we find evidence of substitution toward Newegg in Column (3). On average,

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[13] https://kb.newegg.com/search/getsearch/12/3?text=*&catid=1011

[14] Paypal, owned by eBay, is the primary payment system on the eBay platform.

households increase their purchases at Newegg by $0.25 per month, corresponding to a 13.0% increase in expenditures. The result is highly statistically significant and could be attributable to the fact that it retains its tax advantage over Amazon and Best Buy. In Columns (4) and (5), we find no significant results for eBay or PayPal, respectively. Likewise, Column (6) indicates no evidence of substitution toward other retailers captured with the ".com" retail query.

In Panel B of Table 9, we look at substitution using an alternative approach. In this panel, we explore whether the ratio of Amazon purchases to total retail purchases (including Amazon) changes as a result of the Amazon Tax. In Column (1), we find that treated households reduce the share of Amazon purchases by 0.5 percentage points. In Columns (2) to (4), we divide the sample into terciles based on Amazon spending as in Table 5 and Table 8. We find that this substitution to other retailers is larger for heavy Amazon shoppers, who reduce the share of Amazon purchases by 0.7 percentage points. In comparison, light Amazon shoppers only reduced their share of Amazon purchases by 0.3 percentage points.

We also examine whether households altered their consumption package in other domains as the Amazon Tax effectively lowers their disposable income. In the analysis presented in Appendix A6, we test whether the spending on restaurants, groceries, and entertainment, where households are grouped by their Amazon shopping intensity. The results show no meaningful effect, suggesting that households decreased their spending in other consumption categories.

5.5   Substitution to Amazon Marketplace

We also analyze potential substitution of Amazon customers to Amazon Marketplace. Amazon Marketplace is a platform that allows third-party sellers to sell products directly on

Amazon's website. Many products on Amazon are sold by both Amazon.com and Amazon Marketplace within a single product page. Amazon handles the billing and often the shipping of these orders, so Amazon Marketplace sellers are an almost perfect substitute for Amazon. Because these third-party Amazon Marketplace sellers have limited geographical footprints and are not subject to the Amazon Tax laws, products sold by these sellers are not generally taxed. However, the sales tax advantage of these Marketplace sellers may not be immediately evident to the casual shopper who mistakenly assumes that the Amazon Tax laws apply to both Amazon and Amazon Marketplace transactions.

We test the effect of the Amazon Tax on Marketplace sales in Column (7) of Table 9, Panel A, and find a marginally significant negative coefficient on the variable, corresponding to a 2.3% reduction in Amazon Marketplace expenditures among treated households. This surprising result could stem from treated Amazon shoppers not knowing that Amazon Marketplace transactions allow them to avoid paying sales tax. Thus, any positive effects from the more attractive treatment of sales tax of Marketplace transactions appear to be offset by the negative effects of the perceived increases in taxes by the casual Amazon shopper.

6   Conclusion

Taxes affect not only business decisions by managers, but also purchasing decisions by customers. In the aggregate, purchasing decisions have significant effects on corporations. In this study, we analyze the effects of implementing the Amazon Tax law in various states. The law requires Amazon to collect sales tax, which in turn makes Amazon's products less competitive.

Using transaction-level data of 275,437 households in our main specifications, we examine the effects of the Amazon Tax on the purchasing behavior of residents living in 19

states that adopted such laws during the 2012–2015 period. We find that Amazon sales fall by 9.4% after implementation of an Amazon Tax, corresponding to an elasticity of –1.2. We further find that a one percentage point increase in the tax rate of the household leads to a $0.54 reduction in tax-exclusive Amazon spending, corresponding to an elasticity of –1.4. We find the effect to be concentrated among large purchases of at least $250. For this subset of purchases, we find that Amazon sales fall by 29.1% after implementation of the Amazon Tax, corresponding to an elasticity of –3.9.

To understand whether Amazon's competitors benefit from the law, we examine the sales of the online retailer's competitors in the electronics industry. We find no evidence of substitution toward Best Buy, Amazon's largest competitor in the electronics space, but our results indicate some substitution to Newegg, an online electronics retailer.

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Table 1. Geographic Distribution of the Sample

This table shows the geographic distribution of the households in the sample relative to the 2010 U.S. Census.

State	% Households Residing			State	% Households Residing		
	Data	US Census	Data - US Census		Data	US Census	Data - US Census
Alabama	0.6%	1.5%	-1.0%	Montana	0.1%	0.3%	-0.2%
Alaska	0.3%	0.2%	0.0%	Nebraska	0.3%	0.6%	-0.3%
Arizona	1.8%	2.1%	-0.2%	Nevada	0.9%	0.9%	0.0%
Arkansas	0.3%	0.9%	-0.6%	New Hampshire	0.2%	0.4%	-0.2%
California	21.5%	12.1%	9.5%	New Jersey	2.1%	2.8%	-0.8%
Colorado	1.1%	1.6%	-0.5%	New Mexico	0.4%	0.7%	-0.2%
Connecticut	1.2%	1.2%	0.1%	New York	19.2%	6.3%	13.0%
Delaware	0.1%	0.3%	-0.1%	North Carolina	2.5%	3.1%	-0.6%
District of Columbia	0.4%	0.2%	0.2%	North Dakota	0.1%	0.2%	-0.1%
Florida	6.2%	6.1%	0.1%	Ohio	0.7%	3.7%	-3.0%
Georgia	2.6%	3.1%	-0.5%	Oklahoma	0.6%	1.2%	-0.6%
Hawaii	0.4%	0.4%	-0.1%	Oregon	0.7%	1.2%	-0.5%
Idaho	0.2%	0.5%	-0.3%	Pennsylvania	1.2%	4.1%	-2.9%
Illinois	5.4%	4.2%	1.3%	Rhode Island	0.2%	0.3%	-0.2%
Indiana	0.4%	2.1%	-1.7%	South Carolina	0.9%	1.5%	-0.6%
Iowa	0.2%	1.0%	-0.8%	South Dakota	0.1%	0.3%	-0.2%
Kansas	0.4%	0.9%	-0.5%	Tennessee	1.0%	2.1%	-1.0%
Kentucky	0.3%	1.4%	-1.1%	Texas	10.9%	8.1%	2.8%
Louisiana	0.4%	1.5%	-1.0%	Utah	0.3%	0.9%	-0.6%
Maine	0.2%	0.4%	-0.3%	Vermont	0.1%	0.2%	-0.1%
Maryland	2.4%	1.9%	0.5%	Virginia	4.1%	2.6%	1.5%
Massachusetts	2.8%	2.1%	0.6%	Washington	1.7%	2.2%	-0.4%
Michigan	0.7%	3.2%	-2.5%	West Virginia	0.1%	0.6%	-0.5%
Minnesota	0.4%	1.7%	-1.3%	Wisconsin	0.3%	1.8%	-1.5%
Mississippi	0.2%	1.0%	-0.8%	Wyoming	0.1%	0.2%	-0.1%
Missouri	0.8%	1.9%	-1.1%				

Table 2. Average Monthly Tax-Exclusive Expenditures Before and After Sales Tax Change

This summary table presents average tax-exclusive spending at Amazon in the ±3-month window before and after implementation of Amazon Tax laws. We include only households that spent over $200 on Amazon during 2011. If an Amazon transaction occurs after the tax law changes and the household resides in one of the 19 affected states, we adjust the post-implementation transactions by dividing by one plus the local sales tax rate to create the tax-exclusive amount. Control states are the 31 states that do not change their Amazon tax status during our sample period.

	States (3-month window)									
	All	TX	PA	CA	AZ	NJ	VA	GA	WV	CT
Before implementation										
Treated state(s)	$40.51	$32.45	$37.56	$37.21	$51.00	$36.31	$44.05	$36.75	$38.30	$42.75
Control states	$35.71	$30.72	$31.09	$31.19	$46.83	$33.66	$34.38	$34.38	$34.45	$34.66
After implementation										
Treated state(s)	$39.93	$29.98	$37.64	$44.06	$31.90	$35.10	$45.63	$37.58	$58.65	$59.82
Control states	$39.68	$31.32	$35.27	$45.52	$32.06	$34.45	$37.74	$37.74	$51.13	$51.89

	MA	WI	IN	NV	TN	NC	FL	MD	MN	IL
Before implementation										
Treated state	$41.14	$44.75	$60.87	$54.06	$61.45	$58.11	$38.91	$42.83	$44.97	$49.18
Control states	$34.66	$34.66	$51.13	$51.13	$51.13	$51.88	$35.23	$36.68	$36.68	$46.66
After implementation										
Treated state	$56.07	$60.42	$39.43	$33.69	$35.95	$35.65	$36.02	$54.73	$52.59	$31.42
Control states	$51.89	$51.89	$35.50	$35.50	$35.50	$35.23	$36.98	$47.85	$47.89	$33.41

Table 3. State GDP Growth and Household Income Around Amazon Tax Implementation

This table explores whether states that implemented the Amazon Tax experienced a different GDP growth (Columns (1) and (2)) or a change in household income (Columns (3) and (4)) than states that did not implement the tax. All regressions are ordinary least squares (OLS) regressions and include time and state fixed effects. The unit of observation in Columns (1) and (2) is the state- quarter. The regression in Column (1) is weighted by the GDP of the each state. The regression in Column (2) is weighted by the relative number of households in each state in the sample. The unit of observation in Columns (3) and (4) is the household month. Column (3) looks at household income after the tax implementation in the treated states. Column (4) looks at the short-term and long-term changes in household income after the tax implementation in the treated states. Standard errors are clustered by state and time. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$ and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	State-level GDP growth (%)		Income	
	(1)	(2)	(3)	(4)
Treated state $\times$ I(t $\geq$ Q)	0.184	-0.104	58.224	
	(0.42)	(-0.22)	(1.68)	
Treated state $\times$ I(t = Q$_{-1}$)				-3.130
				(-0.09)
Treated state $\times$ I(t = Q$_0$)				36.061
				(1.11)
Treated state $\times$ I(t $\geq$ Q$_{+1}$)				65.934
				(1.41)
State fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Weighting	GDP	#Households		
Obs	757	757	10,436,160	10,436,160
R^2	48%	52%	73%	73%

Table 4. Effect of Amazon Tax on Tax-Exclusive Monthly Amazon Expenditures

This table explores the effect of the Amazon Tax on tax-exclusive Amazon expenditures. The unit of observation is the household month, and the dependent variable is the sum of monthly Amazon transactions per household. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of an Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$, and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-exclusive)		
	(1)	(2)	(3)
Treated state × I(t ≥ Q)	-3.648***		
	(-5.07)		
Treated state × I(t = Q-1)		1.421***	
		(2.87)	
Treated state × I(t = Q0)		-3.289***	
		(-3.82)	
Treated state × I(t ≥ Q+1)		-3.208***	
		(-4.47)	
Treated state × I(t ≥ Q) × Tax rate			-54.328***
			(-7.05)
Household fixed effect	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160
R^2	28%	28%	28%
Mean spending of treated	$39.00	$39.00	$39.00
Mean tax rate of treated	7.5%	7.5%	7.5%
Implied elasticity (Treated state × I(t ≥ Q))	-1.24		
Implied elasticity (Treated state × I(t = Q-1))		0.48	
Implied elasticity (Treated state × I(t = Q0))		-1.12	
Implied elasticity (Treated state × I(t = Q+1))		-1.09	
Implied elasticity (Treated state × I(t ≥ Q) × Tax rate)			-1.39

Table 5. Effect of Amazon Tax on Different Types of Households

This table explores the effect of the Amazon Tax on different types of households. The unit of observation is the household month, and the dependent variable is the tax-exclusive sum of monthly Amazon transactions per household. Households are divided into three groups depending on their monthly income and total Amazon spending in 2011. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. *I(t ≥ Q)* is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-exclusive)					
	Income terciles			Amazon spending terciles		
	High	Mid	Low	High	Mid	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Treated state × I(t ≥ Q)	-3.755***	-3.675***	-3.038***	-6.224***	-2.830***	-1.649***
	(-3.53)	(-4.85)	(-5.81)	(-5.37)	(-4.82)	(-2.89)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2,501,723	2,501,759	2,501,788	3,478,700	3,478,723	3,478,737
R^2	30%	26%	24%	30%	20%	17%
Mean spending of treated	$53.34	$38.72	$30.57	$65.97	$29.86	$20.53
Mean tax rate of treated	7.4%	7.5%	7.6%	7.5%	7.5%	7.5%
Implied elasticity	-0.95	-1.27	-1.31	-1.25	-1.26	-1.07
Treated state × I(t ≥ Q) / Mean spending	-7.0%	-9.5%	-9.9%	-9.4%	-9.5%	-8.0%

Table 6. Effect of Amazon Tax on Large Amazon Expenditures

This table explores the effect of the Amazon Tax on tax-exclusive large Amazon expenditures. The unit of observation is the household month, and the dependent variable is the sum of monthly Amazon transactions per household that are at least $250. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$, and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index* This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending $\geq$ \$250 (tax-exclusive)		
	(1)	(2)	(3)
Treated state $\times$ I(t $\geq$ Q)	-2.249***		
	(-7.92)		
Treated state $\times$ I(t = Q-1)		0.471**	
		(2.16)	
Treated state $\times$ I(t = Q0)		-2.128***	
		(-6.78)	
Treated state $\times$ I(t $\geq$ Q+1)		-2.103***	
		(-7.04)	
Treated state $\times$ I(t $\geq$ Q) $\times$ Tax rate			-31.923***
			(-11.31)
Household fixed effect	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160
R^2	8%	8%	8%
Mean spending of treated	\$7.73	\$7.73	\$7.73
Mean tax rate of treated	7.5%	7.5%	7.5%
Implied elasticity (Treated state $\times$ I(t $\geq$ Q))	-3.87		
Implied elasticity (Treated state $\times$ I(t = Q-1))		0.81	
Implied elasticity (Treated state $\times$ I(t = Q0))		-3.66	
Implied elasticity (Treated state $\times$ I(t = Q+1))		-3.61	
Implied elasticity (Treated state $\times$ I(t $\geq$ Q) $\times$ Tax rate)			-4.13

Table 7. Elasticities as a Function of Purchase Size

This table explores how elasticity varies with purchase size. The dependent variable in Column (1) is the tax-exclusive sum of monthly Amazon transactions per household. The dependent variable in Columns (1) through (8) is the sum of tax-exclusive monthly Amazon transactions for various sized bins. Column (1) corresponds to purchases with tax-exclusive prices of $0.01-$99.99, Column (2) corresponds to purchases with tax-exclusive prices of $100.00-$199.99, and so on. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. *I(t ≥ Q)* is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Tax-Exclusive Amazon Purchase Size in bracket…							
	$0.01 - $99.99	$100.00 - $199.99	$200.00 - $299.99	$300.00 - $399.99	$400.00 - $499.99	$500.00 - $599.99	$600.00 - $699.99	$700 and up
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated state × I(t ≥ Q)	-1.245***	-0.832***	-0.533***	-0.381***	-0.183***	-0.172***	-0.157***	-1.269***
	(-3.03)	(-6.13)	(-7.73)	(-6.66)	(-4.70)	(-3.44)	(-7.08)	(-7.07)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160
R^2	38%	11%	6%	5%	5%	4%	3%	6%
Mean spending of treated	$24.22	$7.46	$3.30	$1.76	$1.10	$0.70	$0.47	$2.48
Mean tax rate of treated	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Implied elasticity	-0.68	-1.48	-2.15	-2.88	-2.22	-3.28	-4.43	-6.79
Treated state × I(t ≥ Q) / Mean spending	-5.1%	-11.2%	-16.2%	-21.7%	-16.7%	-24.7%	-33.3%	-51.1%

Table 8. Effect of Amazon Tax on Different Types of Households for Large Purchases

This table explores the effect of the Amazon Tax on different types of households for large purchases. The unit of observation is the household month, and the dependent variable is the tax-exclusive sum of monthly Amazon transactions per household that are at least $250. Households are divided into three groups depending on their monthly income and total Amazon spending in 2011. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. *I(t ≥ Q)* is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending ≥ $250 (tax-exclusive)					
	Income terciles			Amazon spending terciles		
	High	Mid	Low	High	Mid	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Treated state × I(t ≥ Q)	-2.601***	-2.157***	-1.879***	-4.250***	-1.467***	-0.935***
	(-5.56)	(-6.12)	(-9.45)	(-7.59)	(-7.53)	(-4.51)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2,501,723	2,501,759	2,501,788	3,478,700	3,478,723	3,478,737
R^2	7%	6%	6%	9%	5%	5%
Mean spending of treated	$10.50	$6.83	$5.48	$14.12	$5.33	$3.59
Mean tax rate of treated	7.4%	7.5%	7.6%	7.5%	7.5%	7.5%
Implied elasticity	-3.34	-4.21	-4.53	-3.99	-3.66	-3.45
Treated state × I(t ≥ Q) / Mean spending	-24.8%	-31.6%	-34.3%	-30.1%	-27.5%	-26.0%

Table 9. Substitution Effects from the Amazon Tax

This table explores the effect of the Amazon Tax on other retailers. Panel A investigates the dollar value spent at Best Buy, Newegg, eBay, PayPal, generic online merchants, and Amazon Marketplace. Panel B investigates the percentage of retail spending occurring at Amazon. In both panels, the unit of observation is the household month. In Panel A, the dependent variable is the tax-inclusive sum of monthly retail transactions for a given retailer. Best Buy sales are categorized as either brick-and-mortar or online transactions. *DotCom* corresponds to a generic query intended to capture all other online merchants using the term ".com" in the description that are not otherwise classified in the other columns. We include households that spent at least $200 on Amazon during 2011. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. *I(t ≥ Q)* is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Dollar value substitution to other retailers

Dependent variable:	Best Buy (Brick)	Best Buy (Online)	Newegg	eBay	PayPal	DotCom	Amazon Marketplace
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treated state × I(t ≥ Q)	-0.018	-0.066	0.247***	0.030	-1.698	-0.271	-0.948*
	(-0.07)	(-0.53)	(2.99)	(1.22)	(-1.15)	(-0.19)	(-1.77)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160
R^2	8%	5%	12%	27%	26%	21%	27%
Mean spending of treated	$11.63	$2.28	$1.89	$0.51	$36.31	$58.89	$41.51
Mean tax rate of treated	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Treated state × I(t ≥ Q) / Mean spending	-0.2%	-2.9%	13.0%	5.9%	-4.7%	-0.5%	-2.3%

Table 9. Substitution Effects from the Amazon Tax (Cont.)

Panel B: Ratio of retail spending at Amazon

Dependent variable:	Amazon / (Amazon + Other Retail)			
		Amazon spending terciles		
	Overall	High	Mid	Low
	(1)	(2)	(3)	(4)
Treated state × I(t ≥ Q)	-0.005***	-0.007***	-0.004***	-0.003***
	(-4.68)	(-4.48)	(-4.69)	(-4.44)
Household fixed effect	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes
Obs	9,592,627	3,214,499	3,197,020	3,181,108
R^2	28%	32%	24%	21%

Figure 1. Histogram of (Sales Tax Revenue / Total State Revenue) for the 50 States in 2011

This figure illustrates the importance of sales tax revenues as a percentage of total state revenues. The data come from 2011 U.S. Census Annual Survey of State and Local Government Finance: www.census.gov/govs/local/. This figure shows that the importance of this tax varies considerably across states, ranging from 0% of state revenues in states without a sales tax (such as Oregon and Alaska) to as high as 21.0% of state revenues for Washington.
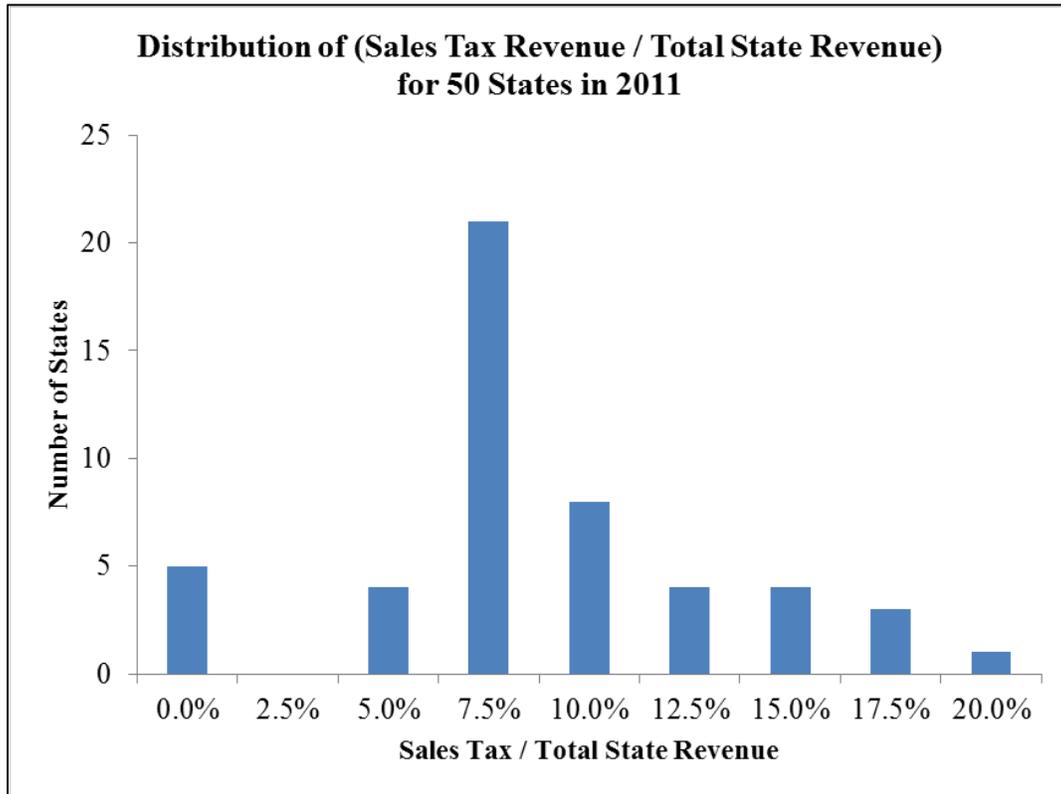
Figure 2. Distribution of Annual Income

This figure illustrates the differences in the distribution of annual income between our sample and the U.S. Census. The income observed in our data is that which arrives in households' checking and savings accounts. Therefore, it equals gross income minus the sum of withholdings (payroll tax, state tax, federal tax, healthcare contributions, retirement contributions, etc.). These omissions will result in a gross income that is higher than what we directly observe.
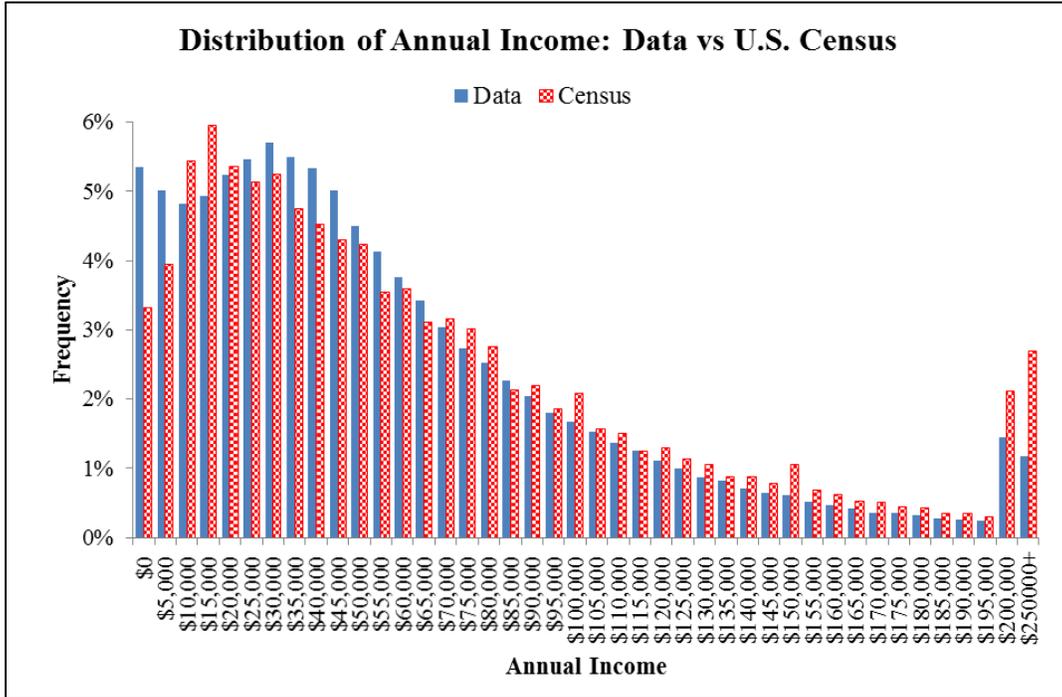
Figure 3. Elasticities as a Function of Purchase Size

This figure presents the elasticities of Amazon shoppers as a function of tax-exclusive purchase size. The elasticities are coefficients of regressions of Amazon purchase amounts on an indicator of treatment state and post-tax. The dependent variable equals the purchase amount if it falls within the bracket being investigated (e.g., $200 to $299.99), and zero otherwise. The dashed lines indicate the 95% confidence interval, and standard errors are clustered by state and time. The last bucket ($700+) includes all of the tax-exclusive transactions that are greater than $700. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month.
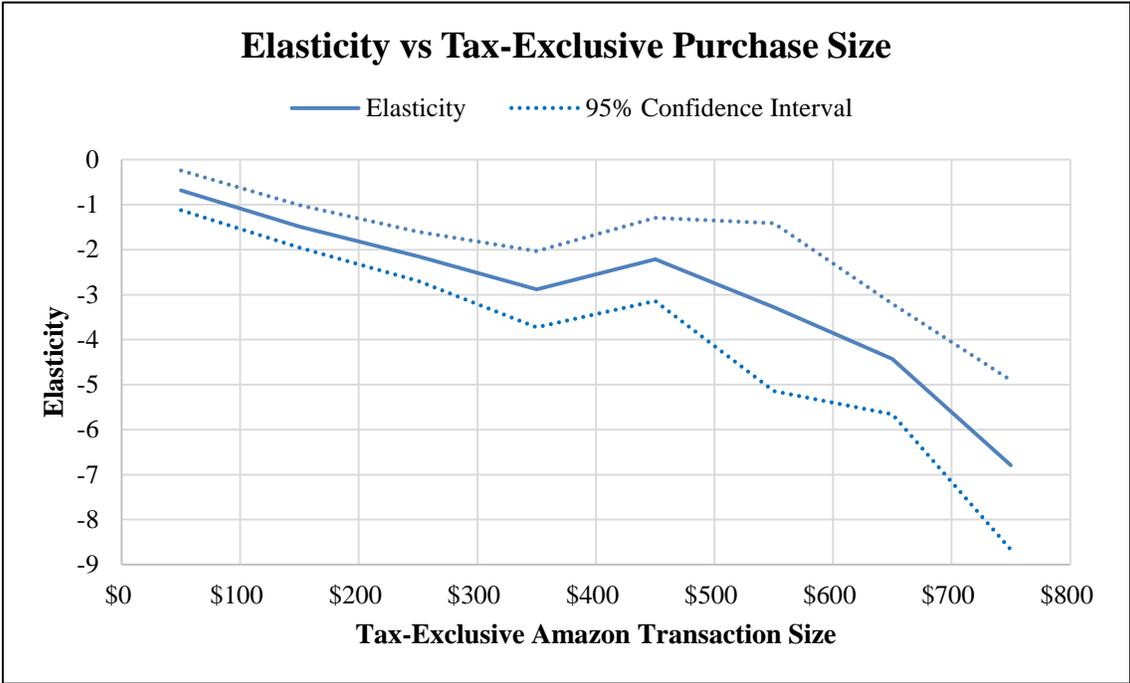
Figure 4. Amazon Spending Before and After the Amazon Tax

This figure illustrates the trend of the regression coefficients of monthly Amazon spending in the –12 to end-of-sample window surrounding implementation of Amazon Tax laws. The specification is similar to the base specification described previously but with a series of months-after-treatment indicator variables rather than quarters-after-treatment indicators. We run two different regressions. In Panel A, the dependent variable for the first regression is the sum of all tax-exclusive Amazon purchases. In Panel B, the dependent variable for the second regression is the sum of all tax-exclusive Amazon purchases that are at least $250 in size. Regression coefficients for the two regressions are plotted. The dashed lines indicate the 95% confidence interval, and standard errors are clustered by state and time. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month.

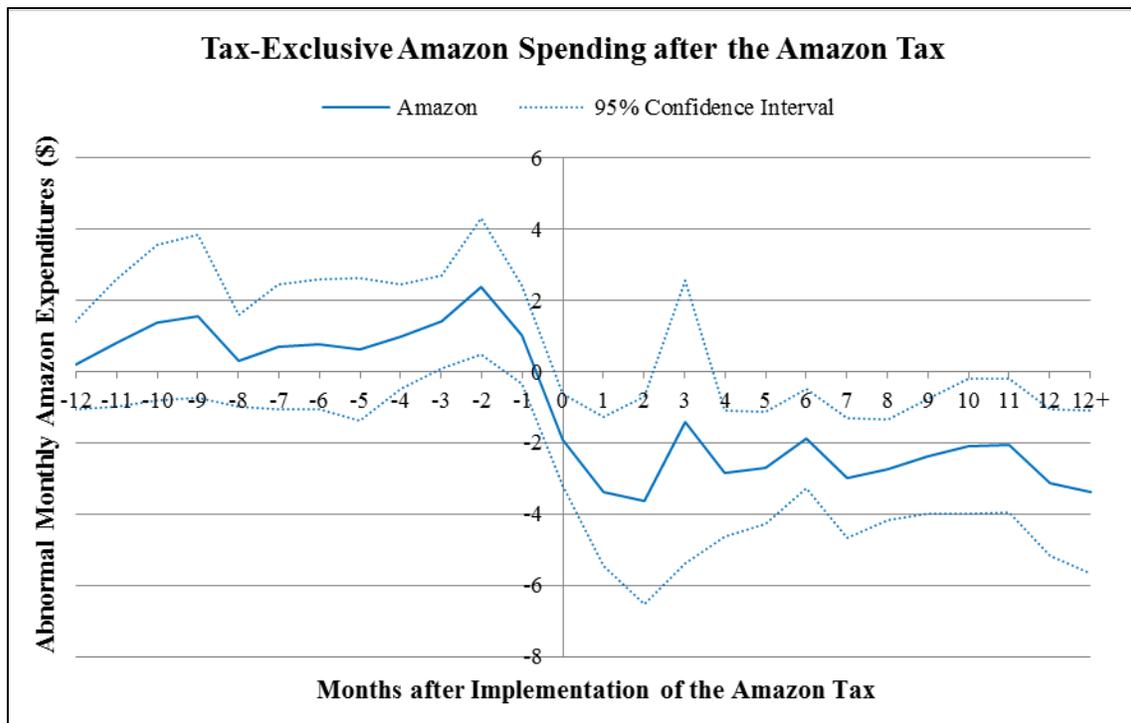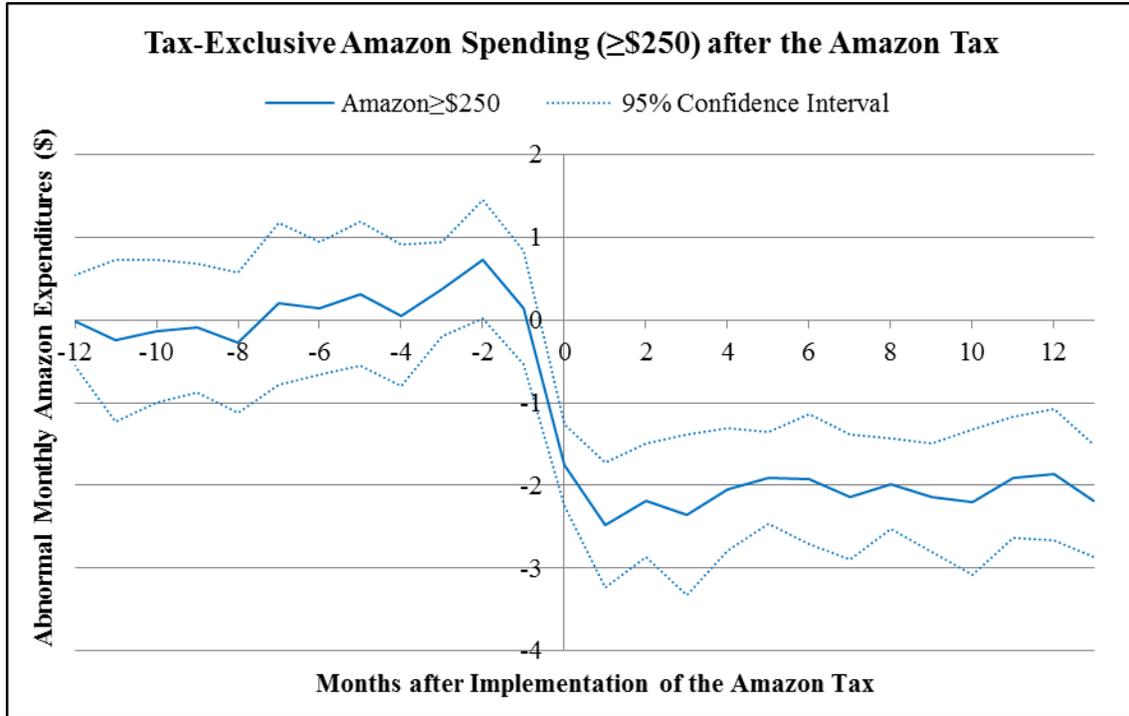## Panel A: The Effect of Amazon Tax on Amazon Spending

Figure 4. Amazon Spending Before and After the Amazon Tax (Cont.)

Panel B: The Effect of Amazon Tax on Large Amazon Spending

Appendix

A1 Alternative Methods of Identifying City of Residence

Because the observed reduction in Amazon demand is dependent on the correct calculation of tax-exclusive Amazon expenditures, it is important that the correct sales tax value is used. If we use an incorrect sales tax rate, then the inferred tax-exclusive Amazon expenditures will be incorrect, leading to a potential overstatement (understatement) of the results in the event that the actual sales tax of the household is lower (higher) than the sales tax we assign to the household.

As mentioned in the Section 3, we identify the state of residence of households in our dataset by requiring that 75% of transactions occur within a given state. We then assign the most common city as the city of residence of the household.

In this section, we provide results for two alternative methods of identifying city of residence, both of which are straightforward. The first method simply takes the second-most common city where transactions occur and assigns the corresponding tax rate to this household. If, for example, an individual works in downtown Chicago and frequently gets coffee or lunch, we will mistakenly assign the city of residence of the household as Chicago, IL, rather than its actual hometown of Naperville, IL. Because Chicago has a higher sales tax rate than Naperville (10.25% vs. 7.25% at the time of this writing), this would lead to an overstatement of our results.

The second method is the most conservative. It takes the minimum sales tax of the first- and second-most common cities observed. Continuing from the example above, we would conservatively assume that the household resided in Naperville, IL and assign the more conservative 7.25% sales tax rate to the household. This lower sales tax rate would lead to a

higher value for tax-exclusive Amazon purchases, and would thus reduce the magnitude of our main results.

The results from these alternative methods are presented in Table A1. The results are statistically indistinguishable from those in the Table 4. The main coefficient in Column (1) is –3.735 and is highly statistically significant, corresponding to an elasticity of –1.3. The coefficient is larger in magnitude than the coefficient of –3.648 found in Column (1) of Table 4. Similar results hold in Columns (2) through (3). When we repeat the activity using the second alternative method, the observed magnitude is –3.617 in Column (4) (corresponding to an elasticity of –1.2), which is only slightly lower in magnitude than the initial value. Similar results hold for Columns (5) and (6).

As a result, it does not appear that misclassification of city of residence is driving the results. Even when using the most conservative of the three methods, the results are still highly statistically and economically significant.

A2   Removal of the $200 Amazon Spending Filter in 2011

As explained in Section 3, we are primarily interested in how Amazon customers respond after the implementation of the Amazon Tax. As a result, our main results focus on households that spent at least $200 on Amazon during 2011, prior to any of the tax law changes exploited in the paper. In this section, we relax this filter and instead include any household that had non-zero spending on Amazon during 2011. Doing so increases our sample size from 275,437 households (180,330 of which are in the treatment group) to 460,983 households (301,830 of which are in the sample group).

The results hold for this broader group as shown in Table A2. The main coefficient in Column (1) indicates a $2.67 per month reduction in spending at Amazon and is highly significant. Note that this sample has lower mean monthly spending on Amazon of $28.78 per month as opposed to $39.00 in the main body of the paper. This reduction in mean spending is a natural result of the entry of households who spent less than $200 in 2011 and thus are likely less frequent Amazon shoppers. When our main coefficient in Table A2 is normalized by the mean spending, it shows a reduction in spending of 9.3% (–2.67/28.78), which is very close to that found in the main body of the paper of 9.4%. As a result, the implied elasticities are nearly equivalent with either method (–1.23 using the whole sample vs. –1.24 using the restricted sample).

A3 The Effect of Amazon Tax on Amazon Sales (Tax-Inclusive Price)

In this section, we assess whether households changed their overall expenditure on Amazon (tax-inclusive price, which includes the effect of sales tax on price). We rerun our analysis from the previous section but use the tax-inclusive price. This analysis examines whether households spend less money overall on Amazon when the Amazon Tax is in effect. It is difficult to predict ex-ante the direction of the results in this analysis because households may increase their overall expenditure, keep it the same, or even decrease it in the wake of the new sales tax.

In Table A3, we replicate Table 4 with tax-inclusive Amazon expenditures as the dependent variable. The coefficient in Column (1) is –1.21, corresponding to a 3.0% (–1.21/40.73) reduction in tax-inclusive Amazon expenditures after implementation of the Amazon Tax. However, this coefficient is only marginally significant. Column (2) confirms a run-up in

spending in the quarter prior to treatment but shows no significant change in tax-inclusive Amazon spending in subsequent quarters. Finally, Column (3) confirms that tax-inclusive Amazon spending is sensitive to the sales tax rate of the household. Treated households reduce Amazon spending, inclusive of tax, by $0.21 per month for every 1% increase in sales tax, corresponding to an elasticity of –0.5.

A4   Alternative Calculation of Elasticity

In the main body of the text, we estimate elasticity in two straightforward ways. First, we use our difference-in-difference framework to estimate the change in the level of tax-exclusive Amazon spending among treated households. We then divide the level change by the mean Amazon spending of treated households to arrive at the percent reduction in tax-exclusive spending. We next divide by the sales tax rate to arrive at the elasticity.

The second way we estimate elasticities is by using the same difference-in-difference framework to estimate the dollar change in tax-exclusive Amazon spending for a one percentage point increase in the sales tax. We then normalize by the mean spending to arrive at the elasticity. For comparison purposes, our main estimations of elasticity shown in Table 4 are reproduced in Columns (1) and (2) of Table A4.

An alternative approach is to log the dependent variable and directly observe the elasticity from the regression coefficient. We do so in Column (3) of Table A4. In this regression, the dependent variable is the log of (1 + tax-exclusive Amazon spending). The regression coefficient, and elasticity, is –0.834 and highly statistically significant. However, the magnitude of the coefficient is smaller than that estimated in the main specifications as reproduced in Columns (1) and (2).

Taking into account the results in Table 7 and Figure 3, it is easy to understand why the estimated elasticity in Column (3) of Table A4 is smaller in magnitude than the elasticity estimates elsewhere in the paper, as the higher elasticities resulting from the bigger purchases are muted from the log transformation.

A5   Probability of Amazon Purchases

In the main body of the text, we estimate the dollar reduction in tax-exclusive Amazon spending following the introduction of the Amazon Tax. In this section, we explore how the probability of shopping at Amazon changes after implementation of the Amazon Tax. The results of our logit specification are found in Table A5. Columns (1) and (2) show that households do not reduce the likelihood of shopping at Amazon during a given month after implementation of the Amazon Tax for all purchases and purchases under $250, respectively. Finally, Column (3) shows that households reduce the likelihood of making purchases over $250. The coefficient of – 0.0023 corresponds to a 16% reduction in the probability of making a purchase of at least $250 after implementation of the Amazon Tax.

A6   Income Effects

We explore the income effects resulting from implementation of the Amazon Tax. It is reasonable to assume that those who were the heaviest Amazon spenders would be most impacted by the implementation of the Amazon Tax. We formally test this assumption in Table A6.

We divide households into terciles based on their Amazon spending in 2011, then perform separate regressions of expenditure on different consumption categories on the main

variable of interest: $Treated\ State_h \times I(t \geq Q)_{h,t}$. The categories of consumption we analyze constitute a large share of a typical household's spending: restaurants ($253/month), groceries ($315/month), and entertainment ($35/month).

Regression results are shown in Columns (1) through (9) of Table A6. We do not find evidence supporting an income effect from the implementation of the Amazon Tax. It is possible that the data limitations discussed in Section 5.4 (i.e., the signal to noise ratio being too low) also apply to the income analysis.

Table A1. Effect of Amazon Tax on Monthly Amazon Expenditures Using Alternative Methods of Identifying City of Residence (Replication of Table 4)

This table explores the effect of the Amazon Tax on Amazon expenditures for any household that shopped at Amazon at any point in our sample. (The tables in the main body require that the household spent at least $200 at Amazon in 2011.) The unit of observation is the household month, and the dependent variable is the sum of monthly Amazon transactions per household. Columns (1) through (3) evaluate tax-exclusive expenditures using the sales tax rate from the second-most common city, as described in Appendix A1, and Columns (4) through (6) evaluate tax-exclusive expenditures using the minimum sales tax rate of the first two most-common cities, as described in Appendix A1. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$, and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-exclusive using second-most common city's tax rate)			Amazon spending (tax-exclusive using minimum of first- and second-most common city's tax rates)		
	(1)	(2)	(3)	(4)	(5)	(6)
Treated state × I(t ≥ Q)	-3.735***			-3.617***		
	(-5.22)			(-5.03)		
Treated state × I(t = Q-1)		1.418***			1.416***	
		(2.85)			(2.85)	
Treated state × I(t = Q0)		-3.383***			-3.255***	
		(-3.93)			(-3.79)	
Treated state × I(t ≥ Q+1)		-3.293***			-3.180***	
		(-4.61)			(-4.44)	
Treated state × I(t ≥ Q) × Tax rate			-55.338***			-53.825***
			(-7.27)			(-6.96)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160	10,436,160
R^2	28%	28%	28%	28%	28%	28%
Mean spending of treated	$38.95	$38.95	$38.95	$39.02	$39.02	$39.02
Mean tax rate of treated	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Implied elasticity (Treated state × I(t ≥ Q))	-1.27			-1.23		
Implied elasticity (Treated state × I(t = Q-1))		0.48			0.48	
Implied elasticity (Treated state × I(t = Q0))		-1.15			-1.11	
Implied elasticity (Treated state × I(t = Q+1))		-1.12			-1.08	
Implied elasticity (Treated state × I(t ≥ Q) × Tax rate)			-1.42			-1.38

Table A2. Effect of Amazon Tax on Monthly Amazon Expenditures for unrestricted sample (Replication of Table 4)

This table explores the effect of the Amazon Tax on Amazon expenditures for any household who spent any non-zero amount at Amazon during 2011. The tables in the main body require that the household spent at least $200 at Amazon in 2011. The unit of observation is the household month, and the dependent variable is the sum of monthly Amazon transactions per household. Columns (1) through (3) evaluate tax-exclusive expenditures. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$, and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-exclusive)		
	(1)	(2)	(3)
Treated state × I(t ≥ Q)	-2.665***		
	(-4.83)		
Treated state × I(t = Q-1)		1.101***	
		(2.72)	
Treated state × I(t = Q0)		-2.381***	
		(-3.61)	
Treated state × I(t ≥ Q+1)		-2.326***	
		(-4.18)	
Treated state × I(t ≥ Q) × Tax rate			-39.668***
			(-6.58)
Household fixed effect	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes
Obs	17,483,777	17,483,777	17,483,777
R^2	28%	28%	28%
Mean spending of treated	$28.78	$28.78	$28.78
Mean tax rate of treated	7.5%	7.5%	7.5%
Implied elasticity (Treated state × I(t ≥ Q))	-1.23		
Implied elasticity (Treated state × I(t = Q-1))		0.51	
Implied elasticity (Treated state × I(t = Q0))		-1.10	
Implied elasticity (Treated state × I(t = Q+1))		-1.07	
Implied elasticity (Treated state × I(t ≥ Q) × Tax rate)			-1.38

Table A3. Effect of Amazon Tax on Tax-Inclusive Monthly Amazon Expenditures (Reproduction of Table 4, Columns (1) to (3), with tax-inclusive Amazon spending as dependent variable)

This table explores the effect of the Amazon Tax on tax-inclusive Amazon expenditures. The unit of observation is the household month, and the dependent variable is the sum of monthly Amazon transactions per household. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of an Amazon Tax. $I(t = Q_{-1})$, $I(t = Q_0)$, and $I(t \geq Q_{+1})$ are indicator variables for the quarter(s) before, quarter after, and subsequent quarters following the tax implementation, respectively. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-inclusive)		
	(1)	(2)	(3)
Treated state × I(t ≥ Q)	-1.205*		
	(-1.76)		
Treated state × I(t = Q-1)		1.324***	
		(2.71)	
Treated state × I(t = Q0)		-0.850	
		(-1.08)	
Treated state × I(t ≥ Q+1)		-0.803	
		(-1.16)	
Treated state × I(t ≥ Q) × Tax rate			-21.210**
			(-2.63)
Household fixed effect	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160
R²	28%	28%	28%
Mean spending of treated	$40.73	$40.73	$40.73
Mean tax rate of treated	7.5%	7.5%	7.5%
Implied elasticity (Treated state × I(t ≥ Q))	-0.39		
Implied elasticity (Treated state × I(t = Q-1))		0.43	
Implied elasticity (Treated state × I(t = Q0))		-0.28	
Implied elasticity (Treated state × I(t = Q+1))		-0.26	
Implied elasticity (Treated state × I(t ≥ Q) × Tax rate)			-0.52

Table A4. Alternative Method of Calculating Elasticities

This table explores an alternative method of estimating the elasticities driven by the Amazon Tax. The unit of observation is the household month. The dependent variable in Columns (1) and (2) is the tax-exclusive sum of monthly Amazon transactions per household. The dependent variable in Column (3) is the log of 1 plus the tax-exclusive sum of monthly Amazon transactions. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. *I(t ≥ Q)* is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. *Tax Rate* is the household's sales tax rate. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are OLS regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Amazon spending (tax-exclusive)		log (1+tax-exclusive Amazon spending)
	(1)	(2)	(3)
Treated state × I(t ≥ Q)	-3.648***		
	(-5.07)		
Treated state × I(t ≥ Q) × Tax Rate		-54.328***	-0.834***
		(-7.05)	(-3.49)
Household fixed effect	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes
Obs	10,436,160	10,436,160	10,436,160
R^2	28%	28%	34%
Mean spending of treated	$39.00	$39.00	$39.00
Mean tax rate of treated	7.5%	7.5%	7.5%
Implied elasticity	-1.24	-1.39	-0.83

Table A5. Effect of the Amazon Tax on the Probability of Amazon Expenditures

This table explores the effect of the Amazon Tax on the probability of Amazon expenditures. The unit of observation is the household month, and the dependent variable is an indicator variable that takes a value of 1 if the household has purchased from Amazon in a given month. Column (1) explores the probability of any Amazon expenditure. Column (2) explores the probability of any Amazon expenditure less than $250. Column (3) explores the probability of any Amazon expenditure of at least $250. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. The regression is a logit specification, and standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Tax-Exclusive Amazon > $0	Tax-Exclusive Amazon < $250	Tax-Exclusive Amazon ≥ $250
	(1)	(2)	(3)
Treated state × I(t ≥ Q)	-0.0038	-0.0015	-0.0023***
	(-0.51)	(-0.22)	(-3.03)
Obs	10,436,160	10,436,160	10,436,160
Mean probability of treated	0.3437	0.3289	0.0148
Treated state × I(t ≥ Q) / Mean probability	-1.1%	-0.5%	-15.5%

Table A6. Income Effects from the Amazon Tax

This table investigates the income effects following implementation of the Amazon Tax by exploring expenditures in the categories of restaurants, groceries, and entertainment. The unit of observation is the household month, and the dependent variable is the tax-inclusive expenditures for the given spending category. We include households that spent at least $200 on Amazon during 2011. *Treated State* is an indicator variable that takes a value of 1 for states that implemented an Amazon Tax during our sample period. $I(t \geq Q)$ is an indicator variable that takes a value of 1 for all months after implementation of the Amazon Tax. Households are divided into three groups depending on their total Amazon spending in 2011. To account for regional differences in cost of living that vary over time, we introduce a time-varying cost of living index at the city-month level, denoted *Cost of Living Index*. This index is computed by calculating the mean expenditures in the categories of gas, restaurants, groceries, and retail (excluding Amazon purchases) for each city-month. All regressions are ordinary least squares (OLS) regressions and include household and year-month fixed effects. Standard errors are clustered by state and time. *t*-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Restaurants			Groceries			Entertainment		
	Amazon spending terciles			Amazon spending terciles			Amazon spending terciles		
	High	Mid	Low	High	Mid	Low	High	Mid	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated state $\times$ I(t $\geq$ Q)	-0.730	-1.011**	0.330	-1.200	-1.263	-0.589	1.342	0.162	0.027
	(-0.87)	(-2.20)	(0.54)	(-1.09)	(-1.57)	(-0.62)	(1.48)	(0.19)	(0.04)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YYYYMM fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost of living index (city-month)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	3,478,700	3,478,723	3,478,737	3,478,700	3,478,723	3,478,737	3,478,700	3,478,723	3,478,737
R^2	61%	60%	60%	69%	68%	67%	31%	28%	27%
Mean spending of treated	$274.96	$247.10	$231.12	$351.62	$304.72	$280.14	$75.99	$62.71	$55.96
Mean tax rate of treated	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Implied elasticity	-0.04	-0.05	0.02	-0.05	-0.06	-0.03	0.23	0.03	0.01
Treated state $\times$ I(t $\geq$ Q) / Mean spending	-0.3%	-0.4%	0.1%	-0.3%	-0.4%	-0.2%	1.8%	0.3%	0.0%