Cross-border Shopping and Use Tax Evasion: Theory and Evidence*

David R. Agrawal† Mohammed Mardan‡
University of Kentucky ETH Zurich and NoCeT

December 2015

Preliminary and incomplete

Abstract

Sales taxes are due at the point of sale for brick-and-mortar transactions, while use taxes are due on goods purchased in neighboring jurisdictions and on Internet sales. We develop a model where jurisdictions competitively set both sales and use taxes. When expected fines for tax evasion are sufficiently high, the optimal use tax rate is always equal to the sales tax rate. However, when expected fines are low, the optimal use tax rate does not necessarily equal the sales tax rate when asymmetric governments maximize social welfare. The divergence of the sales and use tax is likely when cross-state tax avoidance opportunities due to tax differentials are large. In most states, towns are allowed to levy local sales and use taxes. We assemble the first ever panel dataset of use tax rates for every town in the United States at the monthly frequency over the last eight years and merge this to previously assembled panel data on sales tax rates. We document that approximately 15% of towns have a use tax rate that is lower than the town's total sales tax rate. We then exploit changes in the sales and use tax rates over time to identify factors that induce a municipality to levy a use tax rate that is different than its sales tax rate. In response to exogenous increases in state-level policies that incentivize cross-border shopping, the results of the empirical model suggest that local sales tax rates are more likely to be equal to the local use tax rate.

Keywords: Use Tax, Sales Tax, Tax Evasion, Tax Enforcement

JEL classification: H21, H25, H77, R12

---

*The foundations for this project were laid while David Agrawal was a guest researcher at the CES in Munich. He wishes to thank CES and Ludwig Maximilian University of Munich along with the people associated with these institutions for their hospitality and support. We thank Sanjukta Das, Andrew Jonelis and Cole Rakow for excellent research assistance. The paper benefited from comments by William Fox, Odd Erik Nygård and participants at the 9th Norwegian-German Seminar on Public Economics. Any remaining errors are our own.

†University of Kentucky, Department of Economics and Martin School of Public Policy & Administration, 433 Patterson Office Tower, Lexington, KY 40506-0027; email: dragrawal@uky.edu; phone: 001-859-257-8608. Agrawal is also an affiliate member of CESifo.

‡Department of Management, Technology and Economics, Leonhardstrasse 21, CH-8092 Zürich, Switzerland; e-mail: mardan@kof.ethz.ch; phone +41 44 633 86 22.

1 Introduction

Tax evasion is ubiquitous. For this reason the tax authority must design a tax system that encourages dutiful compliance. The economics literature has focused on the optimal policy responses to tax evasion in the context of the individual income tax and the corporate income tax (Slemrod 2007). However, tax evasion on commodity taxes is also widespread. From the consumer's perspective, this tax evasion consists of buying goods in nearby low-tax jurisdictions or making purchases on websites where the obligation to remit the tax falls on the consumer. As such, tax evasion on commodities involves the hiding of taxable transactions from the tax authority, but it also involves behavioral choices concerning where to buy and whether or not to buy online. The tax evasion of sales taxes by the consumer typically involves the consumer shifting the location of purchase for a good in order to reduce tax liability without changing the set of goods being consumed. Even if firms are not party to tax evasion, firms may help facilitate the consumer's evasion by moving to a low-tax state or by establishing an online shopping center.[1] Despite the ubiquity of commodity tax evasion along these margins by consumers, few studies have analyzed how governments should optimally alter the commodity tax system in response to tax evasion by consumers. For the case of tax evasion due to cross-border shopping or online purchases, this issue is especially important given that one common solution in the case of the individual income tax – third party information reporting (Kopczuk and Slemrod (2006); Kleven, Kreiner and Saez (2015); Paramonova (2014)) – is not readily available to report taxable online or cross-border transactions in the United States.[2] Instead, consumers must report cross-border and Internet transactions to the tax authority. Indeed, even in the most compliant state, only 10 percent of tax returns declared a non-zero tax liability; in some states, less than 1 percent of tax returns report non-zero cross-border or online purchases.[3] Arguably, no other tax faces such dismally low compliance rates and commodity tax compliance remains one of the biggest tax enforcement issues facing state and local governments in the United States. In recent years many states have adopted policies that have attempted to increase compliance with

[1]The firm may also evade taxes by failing to report the correct amount of taxable sales to the tax authority (Pomeranz 2015; Naritomi 2015). For a discussion of enforcement issues with a Value Added Tax, please see Keen and Smith (2007). Our focus will be on tax evasion that occurs because consumers fail to report their tax liability to the state of residence as a result of cross-border and online transactions and not on business tax evasion of the sales tax.

[2]It is conceivable that credit card companies could be asked to report all online transactions to the tax authority, however, such a mechanism would likely not obtain much political support in the United States for consumer transactions. However, the use of information reporting on payments to small businesses by credit card companies under Form 1099-K increased reported receipts by up to 24 percent (Slemrod et al. 2015).

[3]Compliance rates for the individual income tax are higher. Even when there is "little or no" information reporting, compliance rates are approximately 44 percent (Slemrod et al. 2015).

the commodity tax system.[4] Given this void in the literature, our paper provides the first attempt to address optimal design of use taxes as a policy response to tax evasion on consumer sales.

In the United States, taxation of commodities falls under both sales and use taxes. Sales taxes are due at the point of sale, while use taxes are due on goods purchased in other jurisdictions and on remote online transactions. Both sales and use taxes are levied at the town level in approximately thirty-five states. With the exponential growth in online transactions in recent years, more and more consumers are legally required to remit use taxes each year. Despite this legal requirement to pay use taxes, the use tax continues to be notoriously evaded with consumers often reporting no online transactions or cross-border purchases to the tax authority. One important difference between sales and use taxes is that it is easier to collect sales taxes than use taxes because sellers can remit the sales tax to the tax authority, but according to the Supreme Court, businesses cannot be required to remit use taxes unless they have a physical presence (nexus) in a state from which they profit. The question thus arises: why even have a use tax? From a theoretical perspective, the use tax is designed to enforce taxation based on the destination of the sale rather than the origin of the purchase, which if enforced would reduce harmful tax competition (Slemrod and Wilson 2009) for highly mobile firms.[5] Keen and Wildasin (2004) note that the destination principle is usually viewed as preferred to the origin principle; however, this may not be true with non-cooperative tax setting and imperfect competition. Despite this, destination taxation remains strong because of production efficiency arguments (Keen and Hellerstein 2010).

The public finance literature concerning commodity taxation in the United States has focused on the response to sales taxes (Fox (1986); Braid (1987); Goolsbee (2000); Burge and Piper (2012); Agrawal (2015); etc.).[6] Notably absent has been an in depth analysis of its sister tax, the use tax; the one exception is Trandel (1992), which shows that use tax evasion can be welfare enhancing because it encourages firms near state border to price goods closer to marginal cost. Although compliance with use taxes is relatively low for consumers, compliance rates among firms are much higher. As a result, the use tax allows state and local governments to raise a non-trivial amount of revenue.[7]

[4]For example, in 2006, the state of Maine spent \$200,000 to advertise a tax amnesty and obtained over \$5 million of commodity tax revenue. Indeed, when evasion is common, social information can have a positive effect on compliance Fellner, Sausgruber and Traxler (2013).

[5]The public economics literature has an extensive discussion on the differences of destination and origin based taxation (Lockwood 1993; Lockwood 2001; Keen and Lahiri 1998; Keen, Lahiri and Raimondos-Möller 2002; Behrens et al. 2009).

[6]Issues of tax competition in a commodity tax setting are addressed in Mintz and Tulkens (1986), Kanbur and Keen (1993), Braid (1993), Trandel (1994), Haufler (1996), Nielsen (2001), and Devereux, Lockwood and Redoano (2007). For a survey, see Wilson (1999).

[7]Bruce, Fox and Luna (2009) note that approximately 13 percent of business to business transactions

For this reason, understanding the optimal use tax rate and why jurisdictions may lower their use tax rate represents an important contribution to be able to understand tax evasion with respect to commodity taxes.[8]

The conventional wisdom is that the use tax rate is levied at the same rate as the sales tax, which implies that if the use tax is effectively enforced, taxes will be based on the destination principle and effectively paid at the presiding sales and use tax rate in the place of residence. However, approximately 15 percent of towns in the United States set sales and use taxes at different rates; this percentage is even higher when considering only towns in states allowing for local sales taxes. None of these towns have a use tax rate at a higher rate than the sales tax; all of these differences are driven by towns that set lower use tax rates than sales tax rates. Some of these differences arise because localities are banned from levying local use taxes, however, the majority of these differences arise in states where localities have the flexibility to set both sales and use tax rates. The empirical divergence of tax rates suggests that municipalities potentially have two tax levers that can be set to help facilitate tax compliance – the sales tax rate and use tax rate.[9] What theoretical model yields this pattern of taxes? We develop a theoretical model where jurisdictions competitively set both sales and use tax rates. The divergence of use taxes from sales taxes cannot arise if the expected fines of being caught evading the tax are sufficiently high; high expected fines effectively yields destination taxation. With welfare maximizing governments, sales and use taxes can diverge if expected fines are sufficiently low. When fines are low, depending on the weight given to tax revenue and the size of exogenous policies set by the state, tax competition can occur by jurisdictions setting the sales tax rate; however, sometimes the use tax is the fiscal instrument used to engage in tax competition. Conditional on setting different sales and use tax rates, an increase in the state tax differentials will make the local sales and use tax differentials shrink as jurisdictions increase the use tax to achieve some tax compliance.

The goal of this paper is to analyze conditions under which governments optimally

are taxable. For example, an audit study conducted by the state of Washington (Guntmann 2008) indicates that approximately 25 percent of business to business online transactions escape the use tax. Bruce, Fox and Luna (2009) estimate the use tax losses from e-commerce (both business to business and business to consumer transactions) to be about 11 billion dollars in 2012 with an additional 6.8 billion dollars in losses from mail order transactions.

[8] Cross-border shopping is not simply a U.S. phenomenon. Indeed, it is problematic for cross-national transactions as well (for example, in the European Union context see Aasness and Nygård (2013) and Kessing and Koldert (2013)) and sub-state transactions in developing countries (Shanmugam and Sthanumoorthy (2004) and Sthanumoorthy (2006)). Cross-border issues also arise with respect to other taxes (Haufler and Mardan 2014).

[9] Given that states are usually responsible for collecting local tax revenue, audit rates and fines for tax evasion are likely policy instruments for the state government and not the locality. This means that the locality can only adjust the use tax rate as a means of encouraging or discouraging tax enforcement. Audits cannot be used as a strategic instrument by local governments as in Stöwhase and Traxler (2005).

choose to set the use tax rate below the sales tax rate. We derive conditions for various government objectives and for different assumptions on audit and fine probabilities. We then empirically test what explains why a jurisdiction may levy its use tax rate at a different rate than the sales tax rate and verify whether this is consistent with the theoretical predictions of the model. To do this, we use a novel data set of panel data on all local use tax rates in the United States and merge it with comprehensive panel data on all local sales tax rates. Previous studies have analyzed local sales tax rates, but this is the first study to analyze local use tax rates. In particular, we assemble data on the local use tax rate for every town, county and special district in the United States at the monthly frequency from September 2003 to December 2011 and then combine it with previously assembled panel data on local sales tax rates. This data assembly and cleaning process results in the most comprehensive data concerning the state and local commodity tax system in its entirety. The empirical model yields results consistent with the theoretical model: sales and use taxes are less likely to diverge when state sales tax rate differentials at borders increase. Using the difference between the sales and use tax, we also able to identify jurisdiction characteristics that are consistent with the government more likely to maximizing social welfare. We anticipate the empirical results in this study will spur further research on enforcement of commodity taxation.

2 Institutional details

Commodity taxation in the United States is highly decentralized. States, counties, localities and sub-municipal districts are allowed to levy local taxes on tangible products.[10] The average local sales tax rate in the United States contributes an additional 2 percentage points on top of the state sales tax rate in the thirty-five states allowing for local taxation of commodities. Sales taxes are remitted by the retailer and are levied at the time of transaction. Most localities that have sales tax authority also have use taxation authority.

The United States commodity tax system combines two related taxes: sales taxes and use taxes.[11] Every state that has enacted a non-zero sales tax rate has enacted a corresponding use tax and most of these states allow localities to levy a use tax as well. The use tax is necessary because under the Supreme Court ruling *Quill Corp v. North Dakota*, states can only require firms to remit sales taxes if the firm has nexus – or a

[10]Several studies of local sales taxes include Burge and Piper (2012), Burge and Rogers (2011), Burge and Rogers (2014), Sjoquist et al. (2007)and Luna (2004). Sjoquist and Stoycheva (2012) and Fox (2012) provide a survey of institutional details relating to these taxes.

[11]Much of the discussion of use tax institutions in this section comes from Agrawal and Fox (2015), which outlines recent policy reforms designed to enforce tax collection on a destination basis.

physical presence in the state from which it profits. Use taxes require the buyer to remit tax payments in cases where the seller does not remit the tax or remits the tax rate of the lower-tax jurisdiction, relative to where the good is intended to be used. The goal of the system of use taxes is to establish a commodity tax system that taxes on the basis of the destination of the sale; if this use tax system can be effectively enforced, then the consumer incentive for engaging in cross-border shopping is reduced. Use taxes apply to both taxable transactions made by consumers and by businesses.

In general, as noted in Section C of Agrawal and Fox (2015), the use tax is collected when (1) out-of-state purchases are within the taxable base of the destination state, (2) the items purchased will be used in the destination state and (3) the sales tax was not paid in the origin state or was paid at a lower rate in the other state. In cases where the sales tax rate was paid at a lower rate, individuals are usually responsible to remit only the difference between the sales tax paid and the use tax rate in the jurisdiction of residence (they receive a tax credit for sales taxes paid to other jurisdictions). In addition, online firms that establish a physical presence in the state will generally be required to collect use taxes rather than sales taxes on the online transactions.[12] The above three criteria suggest that consumer use taxes will be most applicable for cross-state transactions and for online transactions that occur at lower or zero tax rates. When a firm does not have a physical presence in the state, the consumer is generally required to remit state and local use taxes although compliance with these taxes is not at all guaranteed.

States also enact legal regulations on whether local use taxes are due on cross-border purchases that occur within states. States differ in how exactly use taxes are collected for the case of cross-locality purchases. For example, New York has different local sales tax rates across counties and municipalities. In New York, if the purchase of the taxable item occurs in a different locality than where the item will be used, local use taxes are owed if the purchasing jurisdiction has a lower local sales tax rate. For example, if you reside in Albany County (8% sales tax rate) but purchase an item in Saratoga County (7% sales tax rate), local uses taxes are due of the difference. In this example, 1% of the cost of the item is owed to the county of residence. Note, if the reverse were true and a resident of Saratoga County were to purchase a good in Albany County, the purchaser is not entitled to a refund of the difference.[13] These use taxes on within state transactions are often evaded on small purchases. However, within-state cross-border purchases do yield a non-trivial amount of local use tax revenue because of large purchases such as automobiles where enforcement is easy because of registration

[12] If the firm does not have nexus (a physical presence from which it profits), then the obligation to file a use tax return on the good rests with the consumer.

[13] See http://www.tax.ny.gov/pubs_and_bulls/tg_bulletins/st/use_tax_for_individuals.htm

requirements that are based on the resident's location.

When a firm has nexus within a state but delivers the taxable product to a another city within the state, how taxes are collected depends on whether the state is an origin-based or destination-based state. This paragraph specifically discusses transactions that occur between a buyer and a seller located within the *same* state when the product is shipped to a location different from the firm's city. Origin-based states have taxes remitted on the basis of where the product is being shipped from. Eleven states are origin-based states (including Tennessee and Missouri). In destination-based states, the product should be effectively taxed on the basis of where the product is shipped to and used. Thus, a seller that ships a product to a within state buyer will remit the taxes based on the buyer's location in these states. Thirty-four states are destination-based states. California operates a hybrid system where state, county, and city taxes are based on the origin of the sale but district taxes are based on the destination.[14] When sellers have established nexus in the state, use taxes can easily be collected because the seller remits them. When an online seller does not have a physical presence in the state, the obligation to pay these taxes falls on the consumer and the use tax is more easily avoided.

As noted in Manzi (2012), use tax compliance rates are often quite low, especially for consumer use taxes. The mechanisms for collecting state and local use taxes differ by states. In twenty-five states, use taxes are collected on the state's individual income tax forms while other states require individuals to file separate use tax forms; among the states that have filing occur on income tax returns, some require "zero" to be entered if truly no use tax liability is due. Seven states provide information on use taxes in the individual income tax instruction booklets. Five states have *de minimis* exemptions, which means that individuals do not need to file a use tax return until the exemption threshold is cleared. As a result of these institutions, use tax compliance rates differ by states. For example, the average use tax reported per return varies between \$12 and \$202; the fraction of returns reporting non-zero use tax liabilities range between 0.3% and 9.8%. The low compliance rates with the use tax suggest that governments may be able to implement other policies in an effort to stimulate use tax revenues or may account for this tax avoidance when setting sales tax rates. For example, Anderson (2015) notes that mailing post cards to a random set of taxpayers reminding them to pay use taxes on online transactions increases use tax revenue (but compliance rates remain relatively low). We explore the optimal setting of use tax rates when allowing municipalities to set different sales and use tax rates.

[14] See https://www.accuratetax.com/blog/destination-origin-sales-tax/

2.1 Survey of the states

In order to determine the importance of local use taxes and the ability of localities to to set municipal level use taxes, and because local use tax rates and regulations are not readily available online, we survey all of the states that allow for local option sales tax rates. To conduct the survey, we contact (either by phone or email) each one of the fifty state departments of revenues and ask the following questions.

1. Are local jurisdictions (counties, cities, municipalities) allowed to levy local use taxes?

2. If local jurisdictions are allowed to levy use taxes, can they differ from local sales tax rates and if so, why?

3. If local jurisdictions are allowed to levy use taxes, are consumer use taxes owed on cross-border purchases between local jurisdictions within the state?

In some cases, states did not respond to our emails or did not get back to us with a detailed response following a phone conversation. In these cases, after repeated inquiries, we best tried to determine the answers to these questions using online sources. Table 1 summarizes the results. We omit the answer to the third question for space reasons and because answers to this question were not thorough; however, we identify at least fifteen states where use taxes are legally due on within state cross-border purchases. Instead of reporting the answer to the third question we report whether the state is an origin or destination based sourcing state. Use taxes are always due on cross-state purchases and Internet purchases and although our model focuses on two jurisdictions and no state boundary, the model applies to two jurisdictions where some cross-border shopping occurs across state lines.

We identify ten states in which local use and local sales tax rates may differ. Of these states, four states prohibit localities from setting local use tax rates. In the remaining states, the rationale given for why the rates differ include "the locality sets the rate", "the state constitution allows them to differ", and "sales tax legislations were enacted before use tax legislation". One state did not provide a response on why the tax rates differ, but noted that use taxes are only due in certain cities at the same rate as the sales tax, but is not due in other places. The differences in sales and use tax rates in these states are indeed confirmed in our data.[15]

[15]Our data, which contains millions of observations (approximately 22,000 towns by 100 periods) also has a few data points where use taxes differ from sales taxes in states other than the ones listed in the table. To the best of our knowledge, these represent errors in the data set where the use tax rate was possibly incorrectly typed. When the data differs from the survey in trivial manners, we correct these data points to be consistent with our survey evidence.

The survey indicates that for many localities in these states, the local use tax rate is a policy instrument that is distinct from the local sales tax rate.

3 A model of sales and use taxes

3.1 Basic framework

The model has two municipalities located in the interval of [-1; 1] each in a different state. To analyze asymmetries, we suppose that one municipality is larger than the other. For convenience, and inspired by Nielsen (2001), the larger municipality ranges from -1 to b, with $b > 0$, while the smaller municipality range from b to 1. Population density is unity in both municipality, resulting in population sizes of the large and the small municipality of $1 + b$ and $1 - b$ respectively.

As an additional source of heterogeneity designed to capture cross-border shopping due to factors outside the control of the municipality, we assume that the border between the two municipalities is a state border. Each state levies a sales tax rate T_i and municipalities levy an additional tax rate t_i, $i = \{H, L\}$, on the purchase of consumption goods within their borders. We assume that the large municipality resides in the high-tax state, i.e. $T_H > T_L$.[16] To mitigate cross-border shopping just due to differences in the sales tax rates the high-tax state and its municipality also impose a use tax, Γ_H and τ_H, respectively. Given cross-border shopping can occur in only one direction, the use tax is irrelevant for the low-tax jurisdiction and thus need not be modeled. In contrast to the sales tax which has to be remitted by the local seller, individuals have to declare whether they purchased the good in another jurisdiction and remit the use tax on this purchase themselves. Already paid sales taxes can be credited against the due tax payments if the use tax in the resident jurisdiction is higher than the sales tax of the jurisdiction of purchase. However, individuals can also decide not to declare the purchase at all. Opportunity costs of filing the use tax form may cause an individual to skip filing and to evade the use tax payments.[17] We model this argument in a stylized way, by assuming idiosyncratic costs $m_i \in [0; \infty)$ of filing the use tax form. A higher value of m_i indicates higher opportunity costs and in turn a lower willingness to comply with the tax law. Individuals draw their idiosyncratic cost parameter from a cumulative distribution function

[16] In all of the subsequent analysis, we assume that $t_H \geq t_L$, which will be true if b is sufficiently large. We make this assumption to avoid irrelevant cases where the use tax rate is smaller than the sales tax rate of the neighboring jurisdiction and hence ineffective. Note that in a two jurisdiction setting, given tax credits against sales taxes already paid, a jurisdiction setting its use tax to zero is equivalent to setting the use tax at the sales tax rate of the neighborging jurisdiction.

[17] See Manzi (2012) for a discussion of some state level characteristics that may make compliance more difficult.

$G(m_i)$ with density $g(m_i)$.[18] We assume that $\mathcal{G}(0) = G(0) = g(0) = 0$ where $\mathcal{G}(m_i)$ is the primitive of $G(m_i)$. If an individual does not declare the purchase, she gets caught by the domestic tax authority with an exogenously given probability of p and has to pay an additional exogenous fine f.[19]

Let us assume there is only one consumption good produced by homogeneous firms. These firms find themselves in a perfectly competitive environment and hence set their prices to marginal costs which we normalize to one. As a consequence the pre-tax price of the consumption good is also equal to one and the same across the two jurisdictions. Individuals' maximum willingness to pay, denoted by V, is uniform across jurisdictions and is large enough meaning all individuals wish to purchase one unit of the good.

To help the reader, we summarize the model's notation that will subsequently be introduced in table 2.

3.2 Optimal behavior of individuals

Individuals can decide whether to purchase the good in their jurisdiction of residence or abroad. Given that firms locate possibly anywhere along the line segment, if they purchase the good in the home jurisdiction, they have to pay the combined local sales tax rate $T_H + t_H$ but do not incur any transportation costs. Total surplus of purchasing at home will be $V - 1 - T_H - t_H$. As an alternative, some of these individuals may cross-border shop. In the absence of any possibility to evade the use tax or if individuals are honest, individuals from the jurisdiction in the high-tax state have to pay the combined local sales tax rate of the neighboring jurisdiction $T_L + t_L$ as well as the difference between their jurisdiction's combined local use tax rate and the neighboring jurisdiction's combined local sales tax rate $\Gamma_H + \tau_H - T_L - t_L$ if they decide to purchase the good abroad. Total tax payments then amount to $\Gamma_H + \tau_H$, which is the destination principle use tax rate. Additionally, when cross-border shopping they incur the cost of traveling to the border (and back) in the amount of δ per unit of travel S_i and the cost of filing the use tax form m_i. Hence, without the opportunity to evade the use tax, individuals from the high-tax state will purchase the good abroad if their surplus of doing so is greater than buying the good at home, i.e.

$$\begin{aligned} V - 1 - \Gamma_H - \tau_H - \delta S_i - m_i &\geq V - 1 - T_H - t_H, \\ m_i \leq T_H + t_H - \Gamma_H - \tau_H - \delta S_i &= \psi - \delta S_i \equiv m_i^D. \end{aligned} \tag{1}$$

[18] For a similar approach, see Berger et al. (2015).

[19] The exogeneity of p and f is a plausible assumption when municipalities have little control on setting p or f. Usually p and f are state level policies that the municipality must take as given that use tax audits are often conducted by the state.

Let us define the distance to the border of the individual which is indifferent between purchasing the good at home or abroad as S^D if her cost m_i is exactly zero. Thus, $S^D = \frac{\psi}{\delta}$. Only individuals with a distance of at most S^D units to the border will opt for a purchase of the good abroad if tax evasion is ruled out. The trade-off contains two kinds of costs which are both idiosyncratic. This means that although an individual is close to [far away from] the border, i.e. S_i is small [large], she could prefer to purchase the good at home [abroad] because her cost of filing the use tax form m_i is too high [sufficiently low]. Thus, individuals have their specific threshold for the level of compliance cost m_i^D below which they will purchase the good abroad.

With the opportunity to evade the use tax, individuals can decide whether to shop abroad without paying the use tax. With probability $1-p$ individuals can evade the use tax and only have to pay the additional combined local sales tax T_L+t_L. With probability p they get caught and have to file their use tax form which causes costs m_i as well as pay the full amount of the combined use tax $\Gamma_H + \tau_H$ plus an additional fine f. When evasion is possible, instead of purchasing the good at home an individual from the large jurisdiction will shop abroad (and possibly evade the use tax) if

$$\begin{aligned}(1-p)(V-1-T_L-t_L-\delta S_i)+p(V-1-\Gamma_H-\tau_H-f-m_i-\delta S_i) \quad &\geq \quad V-1-T_H-t_H,\\ m_i \leq \frac{m_i^D+(1-p)(\Gamma_H+\tau_H-T_L-t_L)-pf}{p} \quad &\equiv \quad m_i^N. \end{aligned} \tag{2}$$

Let us define the distance to the border of that individual which is indifferent between purchasing the good at home or purchasing abroad and evade the use tax S^N if its cost m_i is exactly zero. Thus, $S^N = \frac{\psi+(1-p)(\Gamma_H+\tau_H-T_L-t_L)-pf}{\delta}$. Only individuals with a distance of at most S^N units to the border will opt for a purchase of the good abroad if tax evasion is feasible.[20]

Conditional that an individual decided to purchase the good abroad, it is only optimal for her to evade the use tax if

$$(1-p)(V-1-T_L-t_L-\delta S_i)+p(V-1-\Gamma_H-\tau_H-f-m_i-\delta S_i) \geq V-1-\Gamma_H-\tau_H-m_i-\delta S_i, \tag{3}$$

which simplifies to

$$m_i \geq \frac{p}{1-p}\, f - (\Gamma_H+\tau_H-T_L-t_L) \equiv m^E. \tag{4}$$

Hence, whether evading the use tax is beneficial depends on the level of the expected fine the individual has to pay if caught. It becomes clear from equation (4) that we

[20]Note that if $p=0$, the government does not audit and individuals will never pay the use tax. In this case, our model simplifies to the standard model of commodity taxation like in Nielsen (2001).

must consider several possible cases on the parameter values on the right hand side of the inequality: when expected fines are low, when expected fines are high, and when expected fines are bounded above and below.

3.2.1 Low expected fine

In this subsection, we analyze individuals' shopping and evading decision if the expected fine is low, i.e.

$$\frac{p}{1-p} f < \Gamma_H + \tau_H - T_L - t_L. \tag{5}$$

From our assumption in (5) we know that the threshold above which evading is beneficial for individuals is negative, i.e. $m^E < 0$. This means that whenever individuals decide to purchase the good abroad, they will evade the use tax. The question now is which individuals are purchasing abroad. Inequality (2) delivers the answer to that. All individuals for which $m_i \leq m_i^N$ will purchase abroad. Hence, only individuals with $S_i \leq S^N$ will opt for a purchase abroad. Figure 1 summarizes individuals' shopping and evading decision for a low level of the expected fine.

Because we will display a series of figures in the same format for each case, we spend some time describing this figure in detail. Each axis represents the two possible idiosyncratic components characterizing an individual: the distance to the border on the vertical axis and the person-specific cost of filing the use tax return on the horizontal. Individuals above m_i^N shop at home and in this figure, m_i^D is irrelevant because fines are sufficiently low. The intersection of the lines m_i^N and m_i^D gives the critical value of m^E, which is less than zero and thus irrelevant in this case. Thus, everyone below m_i^N cross-border shops and evades.

Finally, we can calculate the expected number of individuals, π^N which purchase the good abroad and evade the use tax. This is given by

$$\pi^N = \int_0^{S^N} \int_0^{m_i^N} g(m_i) \mathrm{d}m_i \mathrm{d}S_i = \int_0^{S^N} G(m_i^N) \mathrm{d}S_i. \tag{6}$$

3.2.2 High expected fine

In this subsection, we analyze individuals' shopping and evading decision if the expected fine is high, i.e.

$$\frac{p}{1-p} f > T_H + t_H - T_L - t_L. \tag{7}$$

With this assumption it is still true that only individuals with $S_i \leq S^D$ will opt for a purchase abroad. However, the threshold m^E will now be so high that even the consumer which is located at the border ($S_i = 0$) will not evade the use tax. Consequently, all cross-border shoppers will be non-evaders.

Figure 2 summarizes the discussion of this subsection. Notice in this case that fines are sufficiently high such that m_i^N is now irrelevant. Because m_i^N and m_i^D intersect sufficiently far to the right, all cross-border shoppers are compliant with the use tax.

Also in this case we can calculate the expected number of cross-border shoppers all of whom are compliant with the use tax. This is given by

$$\pi^H = \int_0^{S^D} \int_0^{m_i^D} g(m_i) \mathrm{d}m_i \mathrm{d}S_i = \int_0^{S^D} G(m_i^D) \mathrm{d}S_i. \tag{8}$$

3.2.3 Medium expected fine

In this subsection, we analyze individuals' shopping and evading decision if the expected fine is of medium size, i.e.

$$T_H + t_H - T_L - t_L \geq \frac{p}{1-p} f \geq \Gamma_H + \tau_H - T_L - t_L. \tag{9}$$

The first thing that we note is that the expected fine is now so high that for individual with $S_i > S^D$ the benefit from purchasing abroad will never be higher than if they purchase at home even if they can evade the use tax.[21] Hence, only individuals in the range of $[0, S^D]$ can decide whether to shop abroad without paying the use tax.

From our assumption in (9) we know that the threshold above which evading is beneficial for individuals is positive, i.e. $m^E > 0$. Hence, we know that, conditional on purchasing abroad, some individuals will evade the use tax while others won't. Let us define the distance to the border of that individual which is indifferent between evading and truthfully reporting the use tax payments (conditional on purchasing abroad) as S^E if her cost m_i is exactly m^E. This distance is determined by the intersection of the m_i^D and the m_i^N thresholds. Thus, $S^E = S^D - m^E/\delta$. Individuals for which $S_i \leq S^E$ will evade the use tax if $m_i > m^E$ so that m_i^N is the decisive threshold for these individuals. But for $m_i < m^E$, individuals will not evade the use tax conditional on purchasing abroad. Furthermore, individuals for which $S_i > S^E$, the m_i^D threshold is decisive for the decision to shop abroad. Figure 3 summarizes individuals' shopping and evading decision for medium sized expected fines. Notice that the space is now partitioned into three types of individuals: cross-border shoppers who comply, cross-border shoppers who do not comply, and individuals that shop at home.

[21] Plugging in the value of S^D into the (2), we can see that an individual needs to have a compliance cost $m_i < 0$ in order to benefit from a purchase abroad even if the use tax can be evaded.

Finally, we can calculate the expected number of individuals which will choose to purchase the good abroad whether or not they evade the use tax. This is given by

$$\pi^D = \int_{S^E}^{S^D}\int_0^{m_i^D} g(m_i)\mathrm{d}m_i\mathrm{d}S_i + \int_0^{S^E}\int_0^{m_i^N} g(m_i)\mathrm{d}m_i\mathrm{d}S_i = \int_{S^E}^{S^D} G(m_i^D)\mathrm{d}S_i + \int_0^{S^E} G(m_i^N)\mathrm{d}S_i. \quad (10)$$

This expected number can be decomposed into use tax evaders and non-evaders. The expected number of evaders amounts to

$$\pi^N = \int_0^{S^E}\int_{m^E}^{m_i^N} g(m_i)\mathrm{d}m_i\mathrm{d}S_i = \int_0^{S^E} G(m_i^N) - G(m^E)\mathrm{d}S_i, \quad (11)$$

whereas the expected number of non-evaders reads

$$\pi^H = \int_{S^E}^{S^D}\int_0^{m_i^D} g(m_i)\mathrm{d}m_i\mathrm{d}S_i + \int_0^{S^E}\int_0^{m^E} g(m_i)\mathrm{d}m_i\mathrm{d}S_i = \pi^D - \pi^N. \quad (12)$$

3.3 Optimal tax policy

We assume that the objective of both local governments is to maximize own-jurisdiction welfare that is defined as the weighted average of tax revenues and consumer surplus where the weight given to revenue is λ.[22] Using standard terminology, λ is interpreted as the marginal cost of public funds (Dahlby 2008). Welfare of the jurisdictions in the high-tax and low-tax state is respectively given by

$$W_i = \lambda R_i + CS_i, \quad i = \{H, L\} \quad (13)$$

Sales tax revenues of a jurisdiction are defined as the total number of consumers buying the good at home adjusted for individuals who shop abroad multiplied by the local sales tax t_i. On top of that, the municipality in the high-tax state collects the use tax (net of local sales taxes already paid) from non-evading cross-border shoppers and the use tax (net of local sales taxes already paid)[23] plus a fine from caught evaders.[24]

[22]This welfare function is common in the tax competition literature (see Nielsen 2002 as one example).

[23]Note that because a caught cross-border shopper has to pay the sales tax in the small jurisdiction, the small jurisdiction obtains some revenue from cross-border shoppers.

[24]We assume, for simplicity, that all of the fine is given to the local government even though the state government likely conducts the audit. As an alternative, we could have the local government obtain αf where $\alpha > 0$ is the fraction of the fine transfered to the local government by the state. All propositions are robust to this modification. Thus, this component of local tax revenue can also be interpreted as an inter-governmental grant where the state transfers some of the fine revenue to the locality.

We proceed allowing for local sales and use tax rates to be endogenously determined and not necessarily equal to each other. We assume that all taxes are set in a simultaneous Nash game. The optimal local sales taxes are given by

$$\frac{\partial W_i}{\partial t_i} = \lambda \frac{\partial R_i}{\partial t_i} + \frac{\partial CS_i}{\partial t_i}. \tag{14}$$

The optimal use tax in the municipality of the high-tax state is determined by

$$\frac{\partial W_H}{\partial \tau_H} = \lambda \frac{\partial R_H}{\partial \tau_H} + \frac{\partial CS_H}{\partial \tau_H}. \tag{15}$$

3.3.1 Low expected fine

Total tax revenues in the high-tax and the low-tax jurisdictions when the expected fine is low amount to

$$R_H = t_H[1 + b - \pi^N] + p(\tau_H - t_L + f)\pi^N, \tag{16}$$

$$R_L = t_L[1 - b + \pi^N]. \tag{17}$$

Note that for low expected fines case all consumers which decide to shop abroad evade the use tax. Consumer surplus in the respective municipalities is given by[25]

$$CS_H = (1 + b)(V - 1 - T_H - t_H) + p \int_0^{S^N} \int_0^{m_i^N} G(m_i)\, \mathrm{d}m_i \mathrm{d}S_i, \tag{18}$$

$$CS_L = (1 - b)(V - 1 - T_L - t_L). \tag{19}$$

Consumer surplus in the large jurisdiction is composed of two terms. First, individuals in the high-tax jurisdiction can at least get a surplus that is as high as $V - 1 - T_H - t_H$ if they purchases in the large jurisdiction an accordingly pay the combined local sales tax rate $T_H + t_H$. Second, individuals with with a distance to the border between 0 and S_N will opt for a purchase abroad and evade the use tax if their compliance cost is lower than m_i^N. Consumer surplus in the low-tax jurisdiction is just the surplus of all $1 - b$ resident individuals buying the good and paying the low-tax jurisdiction's combined local sales tax rate $T_L + t_L$ as residents of the low-tax jurisdiction do not engage in cross-border shopping.

We now analyze how a changes in the local tax rates affect welfare in the jurisdictions to study the equilibrium pattern of tax rates. The effects of sales tax rates on

[25] A full derivation of consumer surplus be found in Appendix A.1.

welfare are given by[26]

$$\frac{\partial W_H}{\partial t_H} = (\lambda - 1)(1 + b - \pi^N) - \lambda \, \frac{1}{\delta} \left[t_H - p(\tau_H - t_L + f)\right] G\left(\frac{x}{p}\right), \tag{20}$$

$$\frac{\partial W_L}{\partial t_L} = (\lambda - 1)(1 - b) + \lambda \pi^N - \lambda t_L \, \frac{1 - p}{\delta} \, G\left(\frac{x}{p}\right). \tag{21}$$

The effects of the use tax rate on welfare in municipality H are given by

$$\frac{\partial W_H}{\partial \tau_H} = (\lambda - 1) p \pi^N + \lambda \, \frac{p}{\delta} \left[t_H - p(\tau_H - t_L + f)\right] G\left(\frac{x}{p}\right). \tag{22}$$

where $x = m_i^D|_{S_i=0} - (1 - p)m^E$. Through equations (20) - (22), the first term captures the effects on the tax base and consumer surplus upon a change in the respective tax rate. The second term displays behavioral adjustments of evading individuals and the effect on either sales tax revenues or use tax revenues and fines collected.

We proceed by partitioning this case into two sub-cases. As noted in the survey of states, some states allow localities to set a use tax rate different from the sales tax rate and some some states ban localities from setting a local use tax rate. We analyze each of these sets of states separately. Of course, in some states the use tax rate is constrained to equal the sales tax rate by state law. This case is not discussed because it simplifies to a model similar to the standard commodity tax competition model where the difference in the sales and use tax rate is always zero and our model is focused on explaining variation in the difference.

Use tax ban for municipalities If municipalities are not allowed to set a use tax rate (22) can be neglected. What are the optimal sales tax rates in equilibrium? Let us introduce the short-hand notation $\phi = t_H - p(\tau_H - t_L + f)$. This term is the lost revenue because of sales tax avoidance corrected for expected revenue and fines from use tax audits.

Optimal sales tax rates will be positive if at $t_i = 0$, $i = H, L$, the first-order condition for t_i is positive. For (a) $\phi > 0$ and $\lambda < 1$, the first-order condition for t_H is unambiguously negative so that in this case the optimal sales tax rate in municipality H is $t_H = 0$, which implies that $t_L = 0$ by the assumption that $t_H \geq t_L$.

Suppose we are in a case in which $t_H > 0$, which occurs if (b) $\phi < 0$ and $\lambda > 1$, (c) $\phi > 0$ and $\lambda < 1$ and (d) $\phi < 0$ and $\lambda < 1$. In this case, the sales tax rates are positive and the use tax rate is at its lower bound because it is banned. Note that the optimal t_L can be positive if $\lambda > 1$ and $\phi < 0$ because there are still some individuals which shop

[26] A comprehensive derivation of the first-order conditions is relegated to Appendix A.2.

in L due to the positive sales tax rate differential at the state level. Figure 4 summarizes the equilibrium as a function of the parameters. It is clear that the use tax is not used as an instrument because it is banned, which implies that all tax competition occurs by jurisdictions adjusting the sales tax rate.

When $t_H > 0$, we are able to analyze how a change in the state sales tax rate differential $T_H - T_L$ affects municipalities H's sales and use tax rate differential $\Delta^B \equiv t_H^B - \tau_H^B$, where the B superscript corresponds to towns banning local use taxes. We analyze the response to these state tax rate differentials because they are likely empirically exogenous to the municipality's decision. Because of the use tax ban, the use tax rate is set as if it was not binding, i.e. $\tau_H = t_L$, so we only need to analyze how the optimal sales tax rate of municipality H is affected to understand the effect on Δ^B. Applying the implicit function theorem on (20) yields[27]

$$\frac{\mathrm{d}\Delta^B}{\mathrm{d}T_L} = \frac{(1-p)\left[(\lambda-1)pG(x/p) + \lambda\phi g(x/p)\right]}{(2\lambda-1)pG(x/p) + \lambda\phi g(x/p)} > 0. \tag{23}$$

A reduction in the state level sales tax differential increases Δ^B. The reason is that a lower sales tax differential at the state level reduces the expected number of cross-border shoppers. Hence, the government of municipality H has some leeway to raise its sales tax rate to increase sales tax revenues from home shoppers as the number of cross-border shoppers will then not increase dramatically. Put differently, a smaller state tax differential makes the tax base in the high-tax jurisdiction less elastic. Following an inverse elasticity rule, this jurisdiction can then mark up its local sales tax rate.

Next, we analyze how Δ^B is affected by a change in the weight given to tax revenues λ when $t_H > 0$. This effect is given by

$$\frac{\partial\Delta^B}{\partial\lambda} = \frac{\delta(1+b-\pi^N) + \phi G\left(\frac{x}{p}\right)}{(2\lambda-1)pG\left(\frac{x}{p}\right) + \lambda\phi g\left(\frac{x}{p}\right)} = \frac{\delta(1+b-\pi^N)/\lambda}{(2\lambda-1)pG\left(\frac{x}{p}\right) + \lambda\phi g\left(\frac{x}{p}\right)} > 0. \tag{24}$$

If municipalities are not allowed to set their own use tax rate, a higher weight on tax revenues increases Δ^B. Again, this effect can only be driven by an increase in the sales tax rate of the municipality t_H. Intuitively, an increase in the weight on tax revenue raises the sales tax rate because the government cares less about consumer surplus.

No use tax ban In the second case, municipalities have the flexibility set a use tax $\tau_H \leq t_H$. When municipality H can optimally set its use tax rate τ_H, we have to take (22)

[27] Doing the analysis with respect to T_H delivers the very same result. Note that since we assume $\Gamma_H = T_H$ one has to take into account the effect of the change in use tax rate at the state level Γ_H.

into consideration. We will as above analyze the the solution subject to the parameter values ϕ and λ. Figure 5 summarizes the equilibrium as a function of the parameters.

Consider first the solution for $\phi > 0$. Again, if $\phi > 0$, the first-order condition for municipality H's sales tax rate rate (20) is negative when $\lambda \leq 1$ and hence $t_H = \tau_H = 0$. Given our assumption, $t_L = 0$, however, we should note that if the state sales tax differential is sufficiently small then $t_L = 0$. If $\lambda > 1$ the first-order condition (22) is positive and only the first-order condition of the sales tax rate can be zero in equilibrium. Plugging (20) in (22) we get

$$\frac{\partial W_H}{\partial \tau_H} = (\lambda - 1)p(1 + b) > 0, \tag{25}$$

which is unambiguously positive and independent of any tax rate. In the optimum, the use tax rate will therefore be set at the level of the sales tax rate and tax competition will be in sales tax rates. Here the sales tax is set competitively, but the use tax is not.

Thus, whenever $\phi > 0$, a use tax rate smaller than the sales tax rate can never be optimal. This is a useful result given that many jurisdictions are observed setting equal sales and use tax rates.

Suppose now we are in the case in which $\phi < 0$. For $\lambda \leq 1$, the first-order condition for the optimal use tax is unambiguously negative. Thus, the government sets the use tax as if it was not binding for the consumer, i.e. $\tau_H = t_L$. However, there will still be cross-border shopping in equilibrium because of the positive tax rate differential at the state level so that t_H and t_L can be positive and by assumption $t_H > t_L$ if b is sufficiently large. Thus, in this case, use and sales tax rates may be different from each other. For $\lambda > 1$, the first-order condition for the optimal sales tax rate in H, given in (20), is positive. Hence, only the first-order condition for the use tax (22) can be zero in the optimum. Plugging (22) in (20), we get

$$\frac{\partial W_H}{\partial t_H} = (\lambda - 1)(1 + b) > 0, \tag{26}$$

which is unambiguously positive and independent of any tax rate. In the optimum, the sales tax rate will therefore be set at the highest possible level, but the use tax is used as a policy instrument and the use tax is given by $t_H \geq \tau_H \geq t_L$. Thus, municipality H will use the use tax rate to compete with municipality L and fiscal competition occurs via the use tax – not the sales tax.

Based on our analysis, there is only one case in which the use tax rate differs from the sales tax rate and is used as a policy instrument. This is the case if $\lambda > 1$ and $\phi < 0$, the second of which will occur when the state sales tax differential is sufficiently large.[28] Indeed, it is also empirically likely that this case is relevant because use tax fines are indeed low, but non-zero. Here the use tax is used to engage in tax competition by jurisdiction H; the sales tax rate is not used as a competitive instrument and instead is used to raise revenue from the loyal base of residents sufficiently far from the border. We summarize in:

Proposition 1. *A sufficient condition for the use tax rate to be set at a lower level than the sales tax rate is a sufficiently large state sales tax rate differential ($\phi < 0$).*

We analyze now how the state sales tax rate differential affects $\Delta^{NB} = t_H^{NB} - \tau_H^{NB}$ when $\lambda > 1$ and $\phi < 0$. Applying the implicit function theorem on (22), we get

$$\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L} = \frac{(1-p)\left[(\lambda-1)pG\left(\frac{x}{p}\right) + \lambda\phi g\left(\frac{x}{p}\right)\right]}{p\left[(2\lambda-1)pG\left(\frac{x}{p}\right) + \lambda\phi g\left(\frac{x}{p}\right)\right]} > 0, \tag{27}$$

which means that a higher sales tax rate differential at the state level decreases Δ^{NB}. The intuition is the same as given after (23).

Comparing (23) with (27), we can see that $\frac{\mathrm{d}\Delta^B}{\mathrm{d}T_L} = p\,\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L}$ which means that the effect of a change in the state sales tax differential is stronger when municipalities are allowed to set their own use tax rate (and the particular parameter values are $\lambda > 1$ and $\phi < 0$). This difference in the magnitudes is only comparable for the particular values of phi and lambda. For values (c) $\phi > 0$ and $\lambda < 1$ and (d) $\phi < 0$ and $\lambda < 1$, equation 23 applies in the ban case. However, in the no ban case $\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L} = 0$ for a marginal change in the differential because the use tax rate is not used as an instrument under these parameter values. Thus, empirically, although the effect is larger in absolute value for towns falling in the bottom right quadrant of figure 5, compared to the ban case it is likely that there are more jurisdictions that will realize no change in response to the state tax shock. Put differently, in the ban case, jurisdictions in three different quadrants of figure 4 respond to the state tax shocks, but only jurisdictions in one quadrant of figure 5 respond to to the state shock (albeit more intensely) when use taxes are allowed. Thus, it remains an empirical question whether the effects are more salient in the ban and no ban case.

Noting that $\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_H} = -\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L} < 0$, we summarize this discussion in:

Proposition 2. *An increase in the sales tax rate differential at the state level decreases Δ.*

[28]Note that $\phi < 0$ means that $t_H - p(\tau_H - t_L + f) < 0$. As ϕ decreases with pf, it is sufficient to substitute the lower bound of pf (cf. (9)), to get the sufficient condition under which $\phi < 0$. Doing this, we get $T_H - T_L > (t_H - \tau_H + t_L)/(1-p)$ where we made use of $\Gamma_H = T_H$. This means that for ϕ to be smaller than zero, the state sales tax rate differential must be sufficiently large.

Next, we analyze how Δ^{NB} is affected by a change in the weight assigned to tax revenues λ when $\lambda > 1$ and $\phi < 0$. This effect is given by

$$\frac{\partial \Delta^{NB}}{\partial \lambda} = -\frac{\delta \pi^N + \phi G\left(\frac{x}{p}\right)}{(2\lambda - 1)pG\left(\frac{x}{p}\right) + \lambda \phi g\left(\frac{x}{p}\right)} = -\frac{\delta \pi^N / \lambda}{(2\lambda - 1)pG\left(\frac{x}{p}\right) + \lambda \phi g\left(\frac{x}{p}\right)} < 0. \tag{28}$$

As the sales tax rate of municipality H is set at the highest possible value, the effect of λ on Δ^{NB} is totally driven by a change in the use tax rate τ_H. The sign of (28) is composed of two effects. The direct tax base effect and the behavioral effect of consumers. In the optimum, the first-effect dominates so that a government which is more interested in tax revenues will set a higher use tax rate. This highlights the role of the use tax as a revenue raising instrument in addition to its role of reducing tax avoidance. We summarize in:

Proposition 3. *If municipalities are [not] allowed to set their own use tax rate, a higher weight on tax revenues λ decreases [increases] Δ.*

Irrespective of the ban on the use tax, the intuition for the effect of λ on Δ is the same. The reason for the opposite sign is that in the case of a use tax ban the strategic instrument is the sales tax t_H, whereas in the case without ban governments rather use the use tax τ_H as a strategic instrument. In both cases, the government wants to increase the respective tax rate to obtain additional revenue.

3.3.2 High expected fine

Next, we consider the case where fines are sufficiently high. Although this may not be the case in the United States today, it is conceivable this case could arise if states devoted additional resources to tax enforcement. Total tax revenues in the large and the small jurisdiction when the expected fine is high amount to

$$R_H = t_H[1 + b - \pi^H] + (\tau_H - t_L)\pi^H, \tag{29}$$

$$R_L = t_L[1 - b + \pi^H]. \tag{30}$$

Consumer surplus in the large and the small jurisdiction are respectively given by

$$CS_H = (1 + b)(V - 1 - T_H - t_H) + \int_0^{S^D} \int_0^{m_i^D} G(m_i) \, \mathrm{d}m_i \mathrm{d}S_i, \tag{31}$$

$$CS_L = (1 - b)(V - 1 - T_L - t_L). \tag{32}$$

On top of the surplus that consumers of the large jurisdiction get when they purchase at home, an individual which purchases abroad saves the difference of its jurisdiction's sales and use tax rate but has to incur costs of traveling and filing the use tax form.

We now analyze how changes in the taxes affect welfare in the large and the small jurisdiction. The optimal use tax rate is given by

$$\frac{\partial W_H}{\partial \tau_H} = \lambda \, \frac{1}{\delta} \, G\left(\psi\right)\left[t_H - \tau_H + t_L\right] + (\lambda - 1)\pi^H. \tag{33}$$

The optimal sales taxes are given by

$$\frac{\partial W_H}{\partial t_H} = (\lambda - 1)(1 + b - \pi^H) - \lambda \, \frac{1}{\delta} \, G\left(\psi\right)\left[t_H - \tau_H + t_L\right], \tag{34}$$

$$\frac{\partial W_L}{\partial t_L} = \lambda(1 - b + \pi^H) - (1 - b). \tag{35}$$

From (8) and (1) we know that π^H is independent of t_L. Hence, depending on the value of λ the first-order condition for the small jurisdiction's sales tax rate is either globally positive or negative.[29] In the former case $t_L = \tau_H$ and in the latter case $t_L = 0$.

It needs to be determined whether (33) or (34) is binding. Suppose $\lambda < 1$, then for sure the first-order condition for the optimal t_H is globally negative so that $t_H = 0$. As a consequence $\tau_H = 0$ and also $t_L = 0$.

If $\lambda > 1$, municipality L will set its sales tax rate at a level $t_L = \tau_H$.[30] Because of this, there is no tax competition effect that drives tax rates down. A joint increase the use and the sales tax rate in municipality H raises welfare by $(\lambda - 1)(1 + b)$ which is unambiguously greater than zero. Hence, in the case of high expected fines, municipalities will set all of their tax rates as high as possible and in equilibrium they will be equalized, i.e. $t_H = \tau_H = t_L$. An artifact of this case, in which all consumers are honest, is that the use tax rate effectively implements taxation based on the destination principle and removes the harmful effects of mobility in the tax base.[31] Figure 6 summarizes the equilibrium as a function of the parameters.

Proposition 4. *When expected fines are sufficiently high, the presence of a use tax results taxation based on the destination principle and eliminates tax competition for cross-border shoppers.*

Although proposition 4 is attractive on theoretical grounds and on policy grounds whereby destination taxation is preferred (Keen and Hellerstein 2010), it has little practical application in the United States system as currently enforced because the use tax

[29]Note that ϕ does not matter for high expected fines.

[30]We assume for simplicity that at $t_L = \tau_L$ consumers that are indifferent between shopping at home and abroad will purchase abroad.

[31]For a discussion of destination versus origin taxation, please see Lockwood (1993), Lockwood (2001), Keen and Lahiri (1998), Keen and Wildasin (2004) and Keen and Hellerstein (2010).

remains effectively under-enforced. However, it does suggest that destination taxation can be achieved with more intense auditing of consumers.

3.3.3 Medium expected fine

For reasons of space, we relegate the analysis of the medium expected fine case to Appendix (A.3). Note, however, that similar results to the low expected fine case can be derived in this case. In this case the results become more realistic in that we obtain interior solutions where the sales tax is not at its upper bound and the use tax is not at its lower bound. More specifically, the results are a convex combination of the low and high expected fine case supplemented by the additional margin that individuals can switch from truthfully reporting their use tax payments to evading the use tax (and vice versa) depending on the level of m^E. In this case, the value of $G\left(m^E\right)$ determines the weight given to the low and high expected fine case (see (A.23)). If $G\left(m^E\right)$ approaches the upper bound $G\left(\frac{x}{p}\right)$, then we are in the high expected fine case in which there are only honest consumers. Likewise if $G\left(m^E\right)$ equals zero, we are in the low expected fine case. Thus, we expect proposition 2 and proposition 3 to apply in the medium expected fines case.

4 Data

We assemble the first ever comprehensive database of all local option use taxes in the United States. That data has complete geographic coverage of states, towns, counties, and special taxing districts in the United States including Alaska, Hawaii, and the District of Columbia.[32] This includes just under 22,000 towns and approximately 3100 counties in the United States. The data covers the period from September 2003 to December 2011 at the monthly frequency (for a total of 100 time periods). The high-frequency nature of the data allow us to observe precise sales and use tax changes over time. This database complements the panel data on local sales tax rates assembled in Agrawal (2014) and we merge the use tax rates to the sales tax rates assembled in Agrawal (2014). To our knowledge, no other study has ever assembled even a cross-section local option use tax rates for a single state. Thus, this data assembly provides an important effort to inform the economics literature on the relationship between sales and use tax rates and why the two tax rates may diverge when they do. This study marks a major accomplishment simply from a data perspective because it represents the first time that comprehensive panel data on both sales and use tax rates have been studied. Appendix A.5 describes how we clean the data.

[32] Although Alaska has no state sales tax rate, it gives localities substantial authority to set local taxes and allows sales and use taxes to be set, at possibly different rates.

After assembling this panel, we have, for all towns in the country, its tax rate history for both sales and use tax rates over the last decade. We observe the tax rates at dis-aggregated levels (state, city, county, and district) and we also calculate a total sales and use tax rate in each town. To these data we merge control variables from the American Community Survey (ACS). At the town level, this requires using the five year estimates of the ACS. We assign the ACS five year estimates to our tax data by assigning it to December of the midpoint of the years spanned.[33] It is important to keep in mind that these control variables in the five year estimates are useful for showing broad trends over time and not the precise timing of population or demographic shocks. No other dis-aggregated demographic and population variables are available at this level of geography at high frequency.

In addition, we calculate the population weighted centroid of every municipality using Census Block points within each town. Letting i index municipalities and t index time, we then calculate the spatial lag of a variable y using this centroid as:

$$\bar{y}_{i,t} = \sum_{k \neq i} \omega_i^k y_{k,t} \tag{36}$$

where ω_i^k are exogenous weights that are row normalized such that $\sum_k \omega_i^k = 1$ and where no weight is ever given to town i's own tax rate: $\omega_i^i = 0$. Then, $\bar{y}_{i,t}$ denotes the spatial lag of y for town i in period t. First, define the set of towns within fifty miles of the population centroid of a town as $S_{i,t}$ where $s_{i,t}$ is the number of towns in this set.[34] Then spatial weights that give equal weight to all towns within fifty miles are given by:

$$\omega_i^k = \begin{cases} \frac{1}{s_{i,t}} & \text{if } k \in S_{i,t} \\ 0 & \text{if } k \notin S_{i,t} \end{cases}. \tag{37}$$

This is the baseline spatial lag that we use. As a robustness exercise, we consider inverse distance weights where proximate towns are given more weight. All results are robust to this change. The main variable that we calculate the spatial lag of is population. We do this because we wish to compare the population of a particular town with the average population of its nearby competitor towns. This provides us with a relative size metric as to if the jurisdiction is "large". This yields an exogenous way to partition the sample: based on jurisdiction size, which should be correlated with endogenous high tax rates.

[33]For example, the ACS five year estimates from 2007 to 2011 would be assigned to December 2009.

[34]We select fifty miles, because this has been estimated as the extreme limit of tax competition in commodity tax competition models.

4.1 Summary statistics

Table 3 shows the average sales and use tax rates at various points in time. The average sales tax rate is approximately 1.30 percentage points (which in turn can be added to the state sales tax rate). But, the average local use tax rate is just over one percentage point. This suggests to us that local use tax rates have a tendency to be below the sales tax rate. Indeed, this is confirmed as no towns in the dataset have a use tax rate higher than the sales tax rate. It is also noticeable that sales tax rates have increased by more than local use tax rates have over the sample.

Table 4 focuses on the ten states where local use taxes differ from local sales taxes. We present the percent of towns in our sample that set different local sales and use taxes (note the towns in our sample represent only the towns we were able to successful match to Census data using the procedure in Appendix A.5). Notice from the table that no towns in these states set local use taxes that are higher than local sales taxes; however, a significant majority of the towns set local use tax rates that are lower. For the majority of states the gap between local sales and use tax rates has been widening.[35] This is consistent with these towns raising the sales tax rate more rapidly than the local use tax rates. This increase in the gap is not due to the fact that sales tax rates alone are rising over this time period. As noted in the prior table, local use tax rates are also increasing over this time period and this pattern holds true for the sub-sample of states in this table that allow localities to set local use taxes.

5 Empirical evidence the model

We develop two possible tests to explain when local use tax rates may differ from local sales tax rate.

5.1 Who sets different rates?

One interesting question is, what types of places set local sales tax rates, $t_{i,t}$ that are different from the local use tax rate $\tau_{i,t}$? The theoretical model suggests that conditional on use and sales taxes diverging, an increase in the weight on revenue decreases the difference in these rates when use taxes are allowed; but the effect is opposite in sign when use taxes are banned. In places allowed to set use taxes, as $\lambda \to \infty$ (revenue maximization), the two tax rates should converge at the upper bound. Thus, when allowed to set use taxes, places with larger differences between the sales and use tax rate are more likely to be behaving

[35] One interesting exception is the state of Iowa, where the differential shrank over time, but the percentage setting different rates increased. This unusual pattern is driven by a state tax reform.

in a manner consistent with welfare maximization compared to revenue maximization than places that simply impose equality of these two tax rates. We do not have any single variable to empirically measure whether a municipality is benevolent or Leviathan. Thus, we must look at what governments set different sales and use tax rates on the basis of time varying observable characteristics (demographic variables from the Census). In doing so, we can identify characteristics that are more closely related to revenue versus welfare maximization.[36] This provides a useful exercise because theoretical models of tax competition differ on the basis of the objective of governments (for example, consider the varying objectives in Keen and Kotsogiannis (2002); Keen and Kotsogiannis (2003); Keen and Kotsogiannis (2004)), yet we have very few empirical tests of whether governments are benevolent or Leviathan.[37] Although we cannot directly test our theoretical model, we can use the prediction from our theoretical model to identify characteristics that are associated with a larger difference in sales and use tax rates, which implies the government has a lower λ when allowed to set use taxes. This question is of first order importance, because as noted in Agrawal, Fox and Slemrod (2015), we have very little empirical tests of revenue versus welfare maximization.[38] Indeed, the fact that not all governments set the use tax equal to the sales tax suggests that different governments may have different objectives. We can determine what drives this possible heterogeneity in governments objectives. Some informative evidence on this question could help determine when various theoretical modeling strategies are more appropriate. Thus, although we cannot determine which governments maximize welfare, we can identify the characteristics that are correlated with a lower weight on tax revenue.

As in the theoretical model, define the difference in the sales tax rate minus the use tax rate as $\Delta_{i,t} = t_{i,t} - \tau_{i,t}$. We estimate a panel data model:

$$\Delta_{i,t} = \alpha + X_{i,t}\beta + \nu_t + \zeta_i + \varepsilon_{i,t} \tag{38}$$

where ζ_i are town fixed effects, ν_t are time fixed effects, and $X_{i,t}$ is a vector of controls available from the ACS at the Census Place level. Unfortunately, the ACS was first made available in 2007 and our tax data runs from 2003 to 2011. Because we wish to have sufficient changes in tax rates, we focus on the first and last time period that we have tax

[36]Ideally we would want to focus on jurisdictions with a large enough state tax rate differential to isolate the effects in the particular sub-case with $\phi < 0$, however, we lack the ability to do this and thus pool all observations in each group of states irregardless of the level of ϕ. We believe this biases us against finding an effect because it includes some observation with a smaller or no effect.

[37]Wildasin (1979), Brueckner (1983), and Hoyt (1993) focus on the maximization of the property values of landowners.

[38]Epple, Romer and Sieg (2001) and Calabrese et al. (2006) provide some evidence on the motives of governments.

data on (September 2003 and December 2011). Thus, we interpolate earlier ACS data.[39] To our knowledge, this represents one of the first tests of the weight given to tax revenue in the welfare function for the commodity tax competition literature. We estimate the model in its fixed effects form noted above, but the results are very similar if estimated in first differences. To account for possible correlations in errors, we cluster the standard errors at the county level.

The results are summarized in table 5. Before proceeding, please note our sample restrictions in each column. Every subsequent table will follow the same convention. Column (1) includes towns across all states. Column (2) restricts the sample to the states listed in table 4: states where the local sales and use tax can differ. Note this sub-sample includes both states that ban local use taxes and states that allow the locality to set the local use tax. Column (3) narrows the sample further to states that allow local use tax rates to be set by the municipality and where at least one municipality chooses a different use tax rate than the sales tax rate. This sub-sample removes the states that ban local use tax rates. Column (4) looks at states that ban local use taxes.

When looking at the sample of all towns, population, percent white, income, percent of households on public assistance and the ratio of public to private school students have some significant explanatory power. Given the definition of Δ, a positive coefficient indicates that sales taxes diverge from use taxes by more and a negative coefficient indicates that the differential pushes closer to zero. Put differently, in states allowing local use taxes, a positive coefficient indicates that a government gives less weight to tax revenue (and more likely a social welfare rather than revenue maximizer). A negative coefficient indicates that an increase in the variable makes the government more likely a revenue maximizer. The signs should be the opposite in states banning use taxes if similar factors matter in these states. To interpret the magnitudes, consider the income variable in column (3). A one percent increase in income lowers the differential by 0.24 percentage points. Consider a variable in percentage points such as the percent of households in public assistance: a one percentage point increase in this variable increases the differential by 0.01 percentage points. In the second set of columns, we focus on jurisdictions that have a population that is greater than the spatial lag of neighboring populations. These columns are designed to focus on relatively large jurisdictions, which are likely to set non-zero sales tax rates because of their size advantage. The results are similar, but generally stronger in absolute value.

[39] We have ACS data available for 2011, however, the ACS was not available in 2003. To determine the values of the controls in 2003, we linearly interpolate between the 2000 Census and the first year the ACS was available (2007). While this approach induces some measurement error in the data, we prefer using the earlier year of tax data because starting in 2007 substantially reduces the number of changes in tax rates. In addition, this approach avoids starting in the middle of the Great Recession. We also run results starting the data in 2007 and find similar signs, but lose some statistical significance.

In column (3'), we conclude that governments that set $\Delta_{i,t}$ further from zero and thus give less weight to tax revenue are most likely jurisdictions with a large population, a higher fraction of white people, and generally lower income and less educated. If the theoretical model were strictly true and the same sets of covariates mattered in states with bans, the signs on these covariates should flip in column (4'). Unfortunately, although some of these covariates do indeed flip signs, we lack statistical power to identify such an effect.

We do not intend to interpret this as a causal exercise to identify the effect of each particular characteristic; rather, this exercise is descriptive and informs the researcher of characteristics that are less likely consistent with revenue maximization. However, we do wish to demonstrate that the effects we identify are driven by changes in the use tax rate and not just changes in the sales tax rate. In table 6, we reestimate equation 6 with $\tau_{i,t}$ as the dependent variable. Notice that most variables are opposite in sign to the previous table; this is entirely consistent – if the differential falls, the use tax must rise. More noticeable is that the magnitudes are only slightly smaller in absolute value. We take this as evidence that the use tax is an important component that drives changes in the differential Δ.

5.2 The role of tax shocks

The theoretical model makes it clear that jurisdictions will respond to shocks and adjust the use tax rates accordingly. We focus on two arguably exogenous variables that changed dramatically over the last decade: the state tax rates and the difference in state tax rates at the border.

The state tax rate, $T_{i,t}$, is an important factor that determines cross-border shopping across borders. An increase in the state tax rate is likely to increase the state sales tax differential at the state border. Towns that are located in high-tax states are more likely to have cross-border shopping out of their jurisdiction. Towns in low-tax states are more likely to have cross-border shopping into their jurisdiction. Thus, increases in the state sales tax rate – all else equal – will trigger an increase in cross-border shopping, which may induce municipalities to alter $\Delta_{i,t}$. Although the state sales tax rate may be high, not all towns in the state may face cross-border shopping out of their jurisdiction. In particular, what matters is the state sales tax rate relative to a nearby neighboring state. To get at this, we use data on the driving time from the population weighted centroid of the municipality to the nearest state border intersection with a major road.[40] We then define $\Lambda_{i,t} = T_{i,t} - T^n_{i,t}$ where $T^n_{i,t}$ is the state tax rate in the nearest neighboring state.

[40]Distance to the border is common factor in studies of tax evasion. For example, see Lovenheim (2008).

We exploit changes in $\Lambda_{i,t}$ to study the effect of the state tax rate differential. We then further code a dummy variable $H_{i,t}$ that equals one if a town is in a relatively high-tax state; this occurs if the state it is located in sets a higher sales tax rate than the nearest neighboring state based on the distance criteria defined. The dummy variable equals zero otherwise; a town-is in a relatively low-tax state if the nearest neighboring state sets a higher tax rate than its own state. We then exploit changes in this dummy variable that occur over the course of our panel. In particular, we exploit towns that flip from being located on the relatively high-tax side to the relatively low-tax side and vice-versa. We argue that state sales tax rates are exogenous because the vast majority of municipalities are small and because states are likely to act as leaders in a tax competition game. Parchet (2014) argues that cantonal tax rates in Switzerland are exogenous in the tax local tax competition game and provides evidence of this. When studying these variables, we use data from December of every year in our panel so we exploit many annual changes across our sample.

Using these variables, we estimate a model of the form:

$$\Delta_{i,t} = \alpha + X_{i,t}\beta + \gamma z_{i,t} + \nu_t + \zeta_i + \varepsilon_{i,t} \tag{39}$$

where $z_{i,t}$ is one of the three possible shocks ($T_{i,t}$, $H_{i,t}$ or $\Lambda_{i,t}$). The variables provide exogenous shocks to which we can study how Δ responds. We always cluster standard errors at the county level and we verify that the estimates are similar if we use a first-differences methodology.

Tables 7 and 8 present the results of the effect of $T_{i,t}$; in this section, we focus on the "A" panels. The column numbers remain the same as the prior section and again we present results for all towns and big jurisdictions. .

Notice across all columns (1) to (4) of table 7, an increase in the state sales tax rate shrinks the size of $\Delta_{i,t}$. This means that, in the case of column (1), a one percentage point increase in the state tax rate shrinks the differential by 0.16 percentage points. More interesting is the comparison across columns (1) to (4). To make this point, focus on the sample of large jurisdictions. When using all states, an increase in the state sales tax rate reduces the differential by 0.15 percentage points. When using all states where sales and use taxes diverge, we estimate an effect of -.84. However, focusing on states without use tax bans, we identify no significant effect. But we find large significant effect in states that ban local use tax rates. Given these jurisdictions in column (4) cannot raise their use tax, all of this reduction is coming from the jurisdiction lowering its sales tax rate in response to an increase in the state sales tax rate. However, the effects are not evident when looking at states that allow for separate sales and use taxes to be set by the locality.

This suggests to us that tax competition on sales tax rates is more intense in states that ban local use tax rates. It appears that in these states with a ban, given that localities in this state cannot obtain any revenue on cross-border purchases (even from the sale of items such as cars where the use tax can easily be enforced), these municipalities adjust downward their sales tax rate in response. Thus, the lack of a use tax seems to heighten sales tax competition.

Of course, the theoretical model predicts that the sign should be negative in columns (3) and (4), but it also predicts the absolute magnitude should be larger in column (3) *when the use tax is used as an instrument.* To get at this, we run two alternative models. First, we estimate a linear probability model where the dependent variable is equal to one if the use tax rate does not equal the sales tax rate and is zero otherwise. Then, we separately estimate equation 39 restricting the sample to the towns that have a $\Delta_{i,t} \neq 0$. In doing this, we are attempting to study the effects in jurisdictions that seeming use the use tax as a separate instrument. Table 8 presents the results. Notice that in states without a ban, the linear probability model estimates a positive effect inconsistent with the model. This provides some reason for the smaller effects in the previous table. When dropping the observations with a zero difference in sales and use taxes, the effects become negative suggesting that the choice to use the instrument separately (perhaps due to administrative features) may play an important role. However, the effects remain smaller in absolute value in column (3) compared to column (4). Again, this is not a rejection of the model. First, note that the magnitude of equation 27 is only larger in the no ban case for $\phi < 0$ and $\lambda > 1$. The effects are larger in the ban case for $\phi < 0$ and $\lambda < 1$ and for $\phi > 0$ and $\lambda > 1$. Thus, larger effects in the ban case suggest that this last two sets of parameter values may be important and many towns may fall in these ranges in our sample. Second, we should note that the state tax rate changes that we observe in the sample of states used in column (3) are much smaller than the state tax rate changes in the sample of states in column (4). In addition, there are fewer towns on the high-tax side of borders in the first sample than the second sample. The smaller effects could simply be driven by the different degrees of variation in the exogenous variables. We further note that the empirical model confirms the expected signs on these variables.

Table 9 and 10 present the results using $\Lambda_{i,t}$ and $H_{i,t}$. For the first panels we exploit changes in the state tax rate differential at the state border, which could be driven by changes in a town's own state or the neighboring state. The vast majority of the specifications have the same sign as the previous results but are smaller in absolute value. This is consistent own-state tax rates bing more salient and is also consistent with horizontal competition where increases in own-state tax rates are accompanied by similar increase in nearby states. If horizontal competition occurs, the differential should have a smaller effect in absolute value because the simultaneous neighboring state tax rate increase has an opposite signed effect on $\Delta_{i,t}$ compared to the own-state tax rate. Furthermore, notice that when a town switches from being on the low-tax side of the border ($H = 0$) to the high-tax side of the border ($H = 1$), the difference in sales and use taxes also shrink.[41] Indeed the effects are larger for the large towns and for the towns that have a non-zero Δ.

5.3 Border tests and heterogeneity

An alternative specification exploits how the differential $\Delta_{i,t}$ varies across space in response to exogenous shocks. Define Φ_i as the log of driving time from the population weighted centroid to the nearest major road crossing of that state border. Lovenheim (2008) provides a justification for the log parameterization of the distance function. Using panel data, then we test how the differentials vary across space following changes in the variables $z_{i,t}$:

$$\Delta_{i,t} = \alpha + X_{i,t}\beta + \gamma z_{i,t} + \lambda z_{i,t} \times \Phi_i + \nu_t + \zeta_i + \varepsilon_{i,t}. \tag{40}$$

Panels "B" of tables 7 to 10 present the results. To summarize, we notice that state tax shocks have stronger effects on border municipalities that on municipalities away from the border. This is exactly where cross-border shopping is most intense. The coefficient on the interaction term is generally positive suggesting that the effect of changes in state tax policy diminish across space. This result is entirely consistent with our theoretical model, which suggests that the use tax rate should be used as a policy instrument when the state tax rate differential is sufficiently large. Although towns far away from the border may have the same sized differential as a border town, it is as if this differential is small for the interior town because transportation costs erode the benefit of cross-border shopping.

5.4 The Internet

In addition to tax evasion occurring on cross-border transactions, tax evasion also occurs on online purchases. Our theoretical model tells us little about online shopping and formally modeling the use of the Internet presents many complexities that could be the subject of its own paper. However, we would note that a tax-free Internet is similar to the small jurisdiction having no sales tax rate (such that $T_L + t_L = 0$). Given the importance of online shopping, we present some results concerning the effect of the Internet to help guide future advances on this subject.

[41] Columns (3) have no switchers in this sample, so we cannot estimate this effect for that sub-sample.

We use data on Internet penetration, $I_{i,t}$, at the town level to proxy for tax evasion that occurs online. We use the fraction of households with access to multiple Internet service providers as a proxy of Internet usage. The key is that we focus on the supply of the Internet to the market as an exogenous shock whereby technology providers invested more in certain markets. These data come from the National Broadband Map and are described in detail in Agrawal (2013). One issue in the panel context is that Internet usage is only observed in 2011; Internet usage at the local level are not available for earlier years in our data. We address this by focusing on two years within the panel – 2003 and 2011. For 2011, we use the observed data from the National Broadband Map. For 2003, we impose that Internet penetration in all towns is equal to zero. Although extreme, this assumption is consistent with actual tax evasion in 2003: approximately 1.5% of all business to consumer sales occurred online in 2003. At that point in our panel, mail order transactions were arguably more important from an evasion perspective. Thus, although strong, the imposition of zero amounts to us assuming that the size of the changes in Internet usage from to 2003 to 2011 are proportional to the levels of usage in 2011. We then estimate equation (39) where $z_{i,t}$ is given by $I_{i,t}$.

In terms of the Internet penetration shock, we hypothesize that there should be little heterogeneity across space. Instead, we should notice differences depending on the state sales tax rates. In places where sales taxes are high, localities are constrained in the pre-Internet era and thus should respond deferentially. To get at this, we estimate:

$$\Delta_{i,t} = \alpha + X_{i,t}\beta + \gamma I_{i,t} + \lambda I_{i,t} \times H_{i,t} + \nu_t + \zeta_i + \varepsilon_{i,t}. \tag{41}$$

Table 11 present the results of an increase in Internet penetration. Here, we notice almost no effect of an increase in Internet technologies across all states on $\Delta_{i,t}$ (columns 1). This makes intuitive sense given that in most of these states, towns must change the sales tax rate and use tax rate at the same time; therefore, the differential remains unchanged. We notice significant effects in columns (2), but these results are driven by much larger effects in the sample of states where localities set both sales and use tax rates independently (column 3). We take this positive coefficient as evidence that jurisdictions are lowering their use tax rate when Internet penetration increases. This would be a rational response given that use taxes are collected on online purchases. Thus, if individuals try to evade the use tax by buying from online firms without nexus, the jurisdiction seeks to reduce this by lowering its use tax which increases $\Delta_{i,t}$. In states where use taxes are banned, this is not possible, which explains the smaller coefficients in that sample.

We notice that the effects of the Internet are most salient in relatively low-tax states, which are the states where the local use tax is likely to be a significantly larger portion of the online tax burden to consumers.

6 Conclusion

We have shown that the use tax acts as an important instrument for local governments. Depending on the objectives of government and exogenously given state policies, the local use tax can be actively used by local governments to engage in tax competition although in other circumstances the use tax will not be used and tax competition will occur through sales taxes. We then assemble the first ever comprehensive panel data set on local use tax rates. We provide descriptive evidence that large jurisdictions and low-income jurisdiction behave in a manner more consistent with welfare maximization than with revenue maximization. Exploiting plausibly exogenous shocks to state fiscal policies and Internet penetration, we show that the differences between sales and use tax rates is responsive to these shocks in a manner generally consistent with our theoretical model.

Many future extensions abound. For example, future work may also analyze a model with endogenous audit probabilities and may include Internet usage which would seeming require authors to tackle the issue of nexus.

References

Aasness, Jörgen, and Odd Erik Nygård. 2013. "Revenue Functions and Dupuit Curves for Indirect Taxes with Cross-border Shopping." *International Tax and Public Finance*, 21(2): 272–297.

Agrawal, David R. 2013. "The Internet as a Tax Haven? The Effect of the Internet on Tax Competition." SSRN Working Paper #2328479.

Agrawal, David R. 2014. "LOST in America: Evidence on Local Sales Taxes from National Panel Data." *Regional Science and Urban Economics*, 49: 147–163.

Agrawal, David R. 2015. "The Tax Gradient: Spatial Aspects of Fiscal Competition." *American Economic Journal: Economic Policy*, 7(2): 1–30.

Agrawal, David R., and William F. Fox. 2015. "Sales Taxes in an E-Commerce Generation." University of Georgia Working Paper.

Agrawal, David R., William F. Fox, and Joel Slemrod. 2015. "Competition and Subnational Governments: Tax Competition, Competition in Urban Areas, and Education Competition." *National Tax Journal.*

Anderson, John. 2015. “Paying the State Use Tax: Is a ’Nudge’ Enough?” NTA Working Paper.

Behrens, Kristian, Jonathan Hamilton, Gianmarco Ottaviano, and Jaques-Francois Thisse. 2009. “Commodity Tax Competition and Industry Location Under the Destination and Origin Principle.” *Regional Science and Urban Economics*, 39: 422–433.

Berger, Melissa, Gerlinde Fellner-Röhling, Rupert Sausgruber, and Christian Traxler. 2015. “Higher Taxes, More Evasion? Evidence from Border Differentials in TV License Fees.” ZEW Discussion Paper No. 15-008.

Braid, Ralph M. 1987. “The Spatial Incidence of Local Retail Taxation.” *Quarterly Journal of Economics*, 102(4): 881–892.

Braid, Ralph M. 1993. “Spatial Competition Between Jurisdictions Which Tax Perfectly Competetive Retail (or Production) Centers.” *Journal of Urban Economics*, 34(1): 75–95.

Bruce, Donald, William F. Fox, and LeAnn Luna. 2009. “State and Local Government Sales Tax Revenue Losses from Electronic Commerce.” *State Tax Notes*, 52(7): 537–557.

Brueckner, Jan. 1983. “Property Value Maximization and Public Sector Efficiency.” *Journal of Urban Economics*, 14(1): 1–15.

Burge, Gregory, and Cynthia Rogers. 2011. “Local Option Sales Taxes and Consumer Spending Patterns: Fiscal Interdependence under Multi-tiered Local Taxation.” *Regional Science and Urban Economics*, 41: 46–58.

Burge, Gregory S., and Brian Piper. 2012. “Strategic Fiscal Interdependence: County and Municipal Adoptions of Local Option Sales Taxes.” *National Tax Journal*, 65(2): 387–416.

Burge, Gregory S., and Cynthia L. Rogers. 2014. “Leaders, Followers and Asymmetric Local Tax Policy Diffusion.” University of Oklahoma Working Paper.

Calabrese, Stephen, Dennis Epple, Thomas Romer, and Holger Sieg. 2006. “Local Public Good Provision: Voting, Peer Effects, and Mobility.” *Journal of Public Economics*, 90(6-7): 959–981.

Dahlby, Bev. 2008. *The Marginal Cost of Public Funds.* Cambridge, MA:The MIT Press.

Devereux, Michael P., Ben Lockwood, and Michela Redoano. 2007. "Horizontal and Vertical Indirect Tax Competition: Theory and Some Evidence from the USA." *Journal of Public Economics*, 91: 451–479.

Epple, Dennis, Thomas Romer, and Holger Sieg. 2001. "Interjurisdictional Sorting and Majority Rule: An Empirical Analysis." *Econometrica*, 69(6): 1437–1465.

Fellner, Gerlinde, Rupert Sausgruber, and Christian Traxler. 2013. "Testing Enforcement Strategies in the Field: Threat, Moral Appeal and Social Information." *Journal of the European Economic Association*, 11(3): 634–660.

Fox, William F. 1986. "Tax Structure and the Location of Economic Activity Along State Borders." *National Tax Journal*, 39(4): 387–401.

Fox, William F. 2012. "Retail Sales and Use Taxation." In *The Oxford Handbook of State and Local Government Finance.* , ed. Robert D. Ebel and John E. Petersen, Chapter Retail Sales and Use Taxation, 406–428. Oxford University Press.

Goolsbee, Austan D. 2000. "In a World Without Borders: The Impact of Taxes on Internet Commerce." *Quarterly Journal of Economics*, 115(2): 561–576.

Guntmann, Donald. 2008. "Deapartment of Revenue Compliance Study." State of Washington Department of Revenue.

Haufler, Andreas. 1996. "Tax Coordination with Different Preferences for Public Goods: Conflict or Harmony of Interest." *International Tax and Public Finance*, 3(1): 5–28.

Haufler, Andreas, and Mohammed Mardan. 2014. "Cross-border Loss Offset Can Fuel Tax Competition." *Journal of Economic Behavior & Organization*, 106: 42–61.

Hoyt, William H. 1993. "Tax Competition, Nash Equilibria, and Residential Mobility." *Journal of Urban Economics*, 34(3): 358–379.

Kanbur, Ravi, and Michael Keen. 1993. "Jeux Sans Frontières: Tax Competition and Tax Coordination When Countries Differ in Size." *American Economic Review*, 83(4): 877–892.

Keen, Michael, and Christos Kotsogiannis. 2002. "Does Federalism Lead to Excessively High Taxes?" *American Economic Review*, 92(1): 363–370.

Keen, Michael, and Christos Kotsogiannis. 2003. "Leviathan and Capital Tax Competition in Federations." *Journal of Public Economic Theory*, 5(2): 177–199.

Keen, Michael, and Christos Kotsogiannis. 2004. "Tax Competition in Federations and the Welfare Consequences of Decentralization." *Journal of Urban Economics*, 56: 397–407.

Keen, Michael, and David Wildasin. 2004. "Pareto-Efficient International Taxation." *American Economic Review*, 94(1): 259–275.

Keen, Michael, and Sajal Lahiri. 1998. "The Comparison Between Destination and Origin Principles Under Imperfect Competition." *Journal of International Economics*, 45: 323–350.

Keen, Michael, and Stephen Smith. 2007. "VAT Fraud and Evasion: What Do We Know, and What Can Be Done?" IMF Working Paper WP-07-31.

Keen, Michael, and Walter Hellerstein. 2010. "Interjurisdictional Issues in the Design of VAT." *Tax Law Review*, 63(2): 359–408.

Keen, Michael, Sajal Lahiri, and Pascalis Raimondos-Möller. 2002. "Tax Principles and Tax Harmonization Under Imperfect Competition: A Cautionary Example." *European Economic Review*, 46: 1559–1568.

Kessing, Sebastian G., and Bernhard Koldert. 2013. "Cross-border Shopping and the Atkinson-Stiglitz Theorem." *International Tax and Public Finance*, 20(4): 618–630.

Kleven, Henrik Jacobsen, Clau Thustrup Kreiner, and Emmanuel Saez. 2015. "Why Can MoMode Governments Tax So Much? An Agency Model of Firms as Fiscal Intermediaries." UC Berkeley Working Paper.

Kopczuk, Wojciech, and Joel Slemrod. 2006. "Putting Firms Into Optimal Tax Theory." *American Economic Review: Papers and Proceedings*, 96(2).

Lockwood, Ben. 1993. "Commodity Tax Competition Under Destination and Origin Principles." *Journal of Public Economics*, 52(2): 141–162.

Lockwood, Ben. 2001. "Tax Competition and Tax Coordination Under Destination and Origin Principles: A Synthesis." *Journal of Public Economics*, 81: 279–319.

Lovenheim, Michael F. 2008. "How Far to the Border?: The Extent and Impact of Cross-Border Casual Cigarette Smuggling." *National Tax Journal*, 61(1): 7–33.

Luna, LeAnn. 2004. "Local Sales Tax Competition and the Effect on County Governments' Tax Rates and Tax Bases." *The Journal of the American Taxation Association*, 26(1): 43–67.

Manzi, Nina. 2012. “Use Tax collection on Income Tax Returns in Other States.” Policy Brief for the Minnesota House of Representatives.

Mintz, Jack, and Henry Tulkens. 1986. “Commodity Tax Competition Between Member States of a Federation: Equilibrium and Efficiency.” *Journal of Public Economics*, 29(2): 132–172.

Naritomi, Joana. 2015. “Consumers as Tax Audiors.” LSE Working Paper.

Nielsen, Søren Bo. 2001. “A Simple Model of Commodity Taxation and Cross-Border Shopping.” *The Scandinavian Journal of Economics*, 103(4): 599–623.

Nielsen, Søren Bo. 2002. “Cross-border Shopping from Small to Large Countries.” *Economics Letters*, 77(3): 309–313.

Paramonova, Yulia. 2014. “The Optimal Deterrence of Tax Evasion: The Trade-off Between Information RepReport and Audits.” University of Michigan Working Paper.

Parchet, Raphaël. 2014. “Are Local Tax Rates Strategic Complements or Strategic Substitutes?” Working Paper.

Pomeranz, Dina. 2015. “No Taxation Without Enforcement: Deterrence and Self-Enforcement in the Value Added Tax.” *American Economic Review*, 105(8): 2539–2569.

Shanmugam, K. R., and R. Sthanumoorthy. 2004. “Sales Tax Policy Interaction Among the State Governments in India.” *Journal of Quantitative Economics: Journal of the Indian Econometric Society*, 2: 147–163.

Sjoquist, David L., and Rayna Stoycheva. 2012. “Local Revenue Diversification: User Charges, Sales Taxes, and Income Taxes.” In *The Oxford Handbook of State and Local Government Finance.* , ed. Robert D. Ebel and John E. Petersen, 429–462. Oxford University Press.

Sjoquist, David L., William J. Smith, Mary Beth Walker, and Sally Wallace. 2007. “An Analysis of the Time to Adoption of Local Sales Taxes: A Duration Model Approach.” *Public Budgeting & Public Finance*, 27(1): 20–40.

Slemrod, Joel. 2007. “Cheating Ourselves: The Economics of Tax Evasion.” *The Journal of Economic Perspectives*, 21(1): 25–48.

Slemrod, Joel, and John D. Wilson. 2009. “Tax Competition with Parasitic Tax Havens.” *Journal of Public Economics*, 93(11-12): 1261–1270.

Slemrod, Joel, Brett Collins, Jeffrey Hoopes, Daniel Reck, and Michael Sebastiani. 2015. "Does Credt-Card Information RepReport Improve Small-Business Tax Compliance?" University of Michigan Working Paper.

Sthanumoorthy, R. 2006. "Rate War, Race to the Bottom and Uniform State VAT Rates: An Empirical Foundation for a Difficult Policy Issue." *Economic and Political Weekly*, 41(24): 2460–2469.

Stöwhase, Sven, and Christian Traxler. 2005. "Tax Evasion and Auditing in a Federal Economy." *International Tax and Public Finance*, 12(4): 515–531.

Trandel, Gregory. 1994. "Interstate Commodity Tax Differentials and the Distribution of Residents." *Journal of Public Economics*, 53(3): 435–457.

Trandel, Gregory A. 1992. "Evading the Use Tax on Cross-Border Sales: Pricing and Welfare Effects." *Journal of Public Economics*, 49(3): 313–331.

Wildasin, David E. 1979. "Local Public Goods, Property Values, and Local Public Choice." *Journal of Urban Economics*, 6(4): 521–534.

Wilson, John D. 1999. "Theories of Tax Competition." *National Tax Journal*, 52(2): 268–304.

Figure 1: Individuals' Shopping and Evading Decision With Low Expected Fines

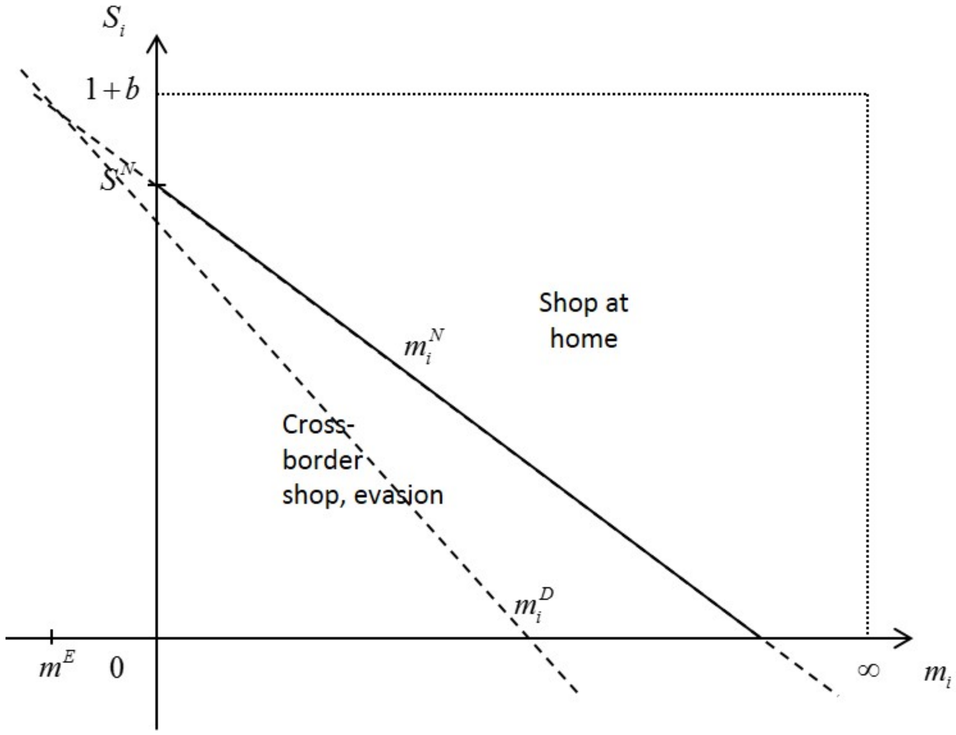

Figure 2: Individuals' Shopping and Evading Decision With High Expected Fines

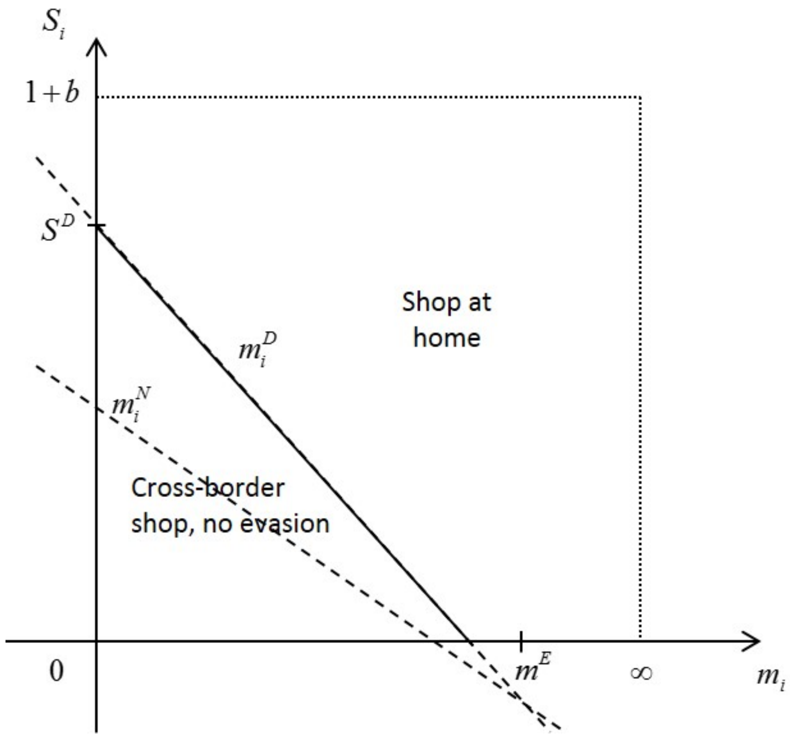

Figure 3: Individuals' Shopping and Evading Decision With Medium Expected Fines

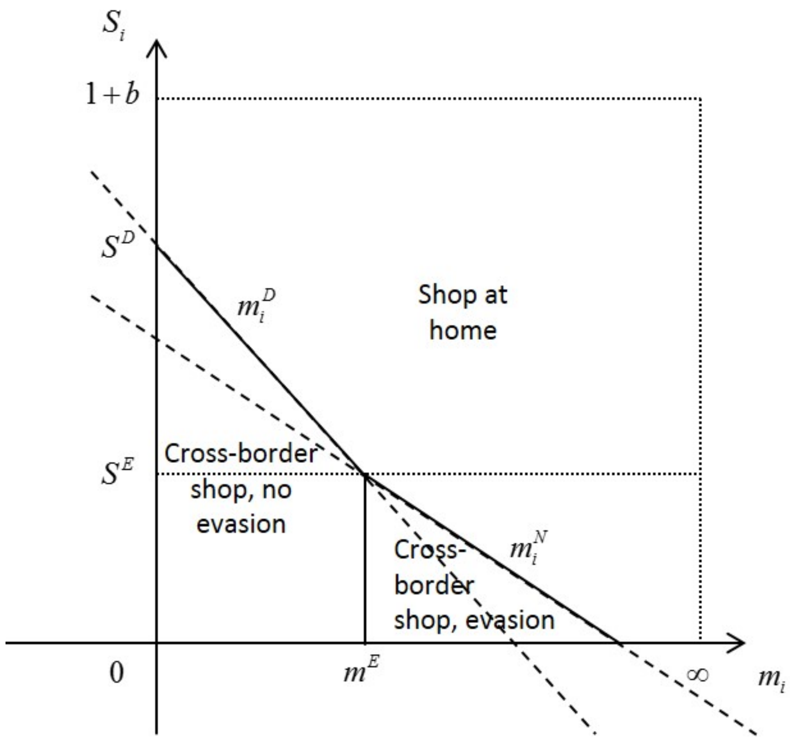

Figure 4: Solution Summary: Low Expected Fines and Use Tax Ban

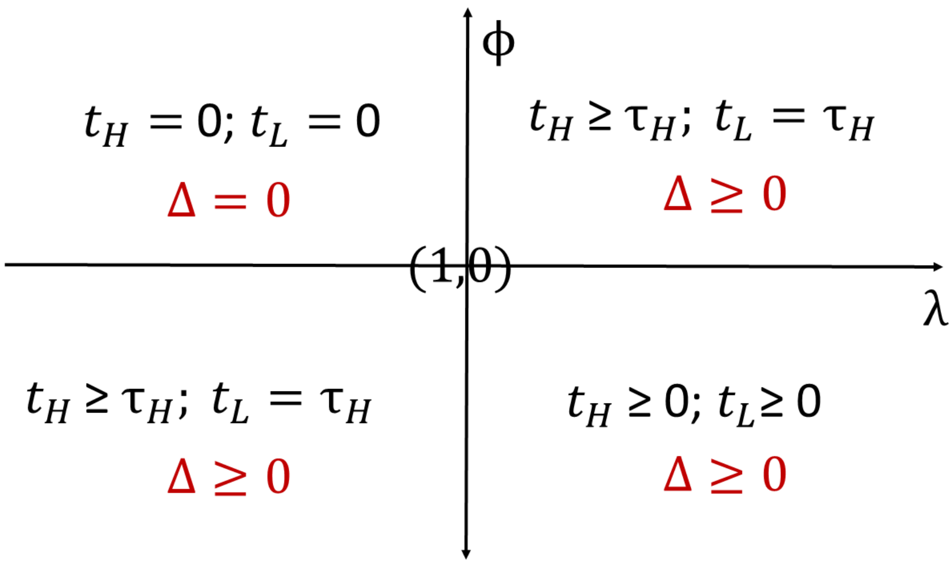

Figure 5: Solution Summary: Low Expected Fines and Use Tax Not Banned

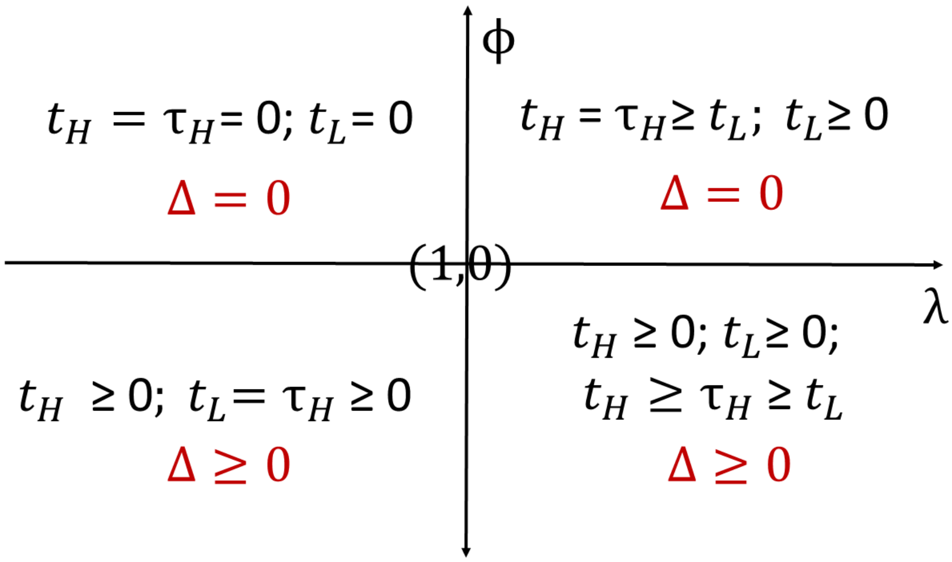

Figure 6: Solution Summary: High Expected Fines

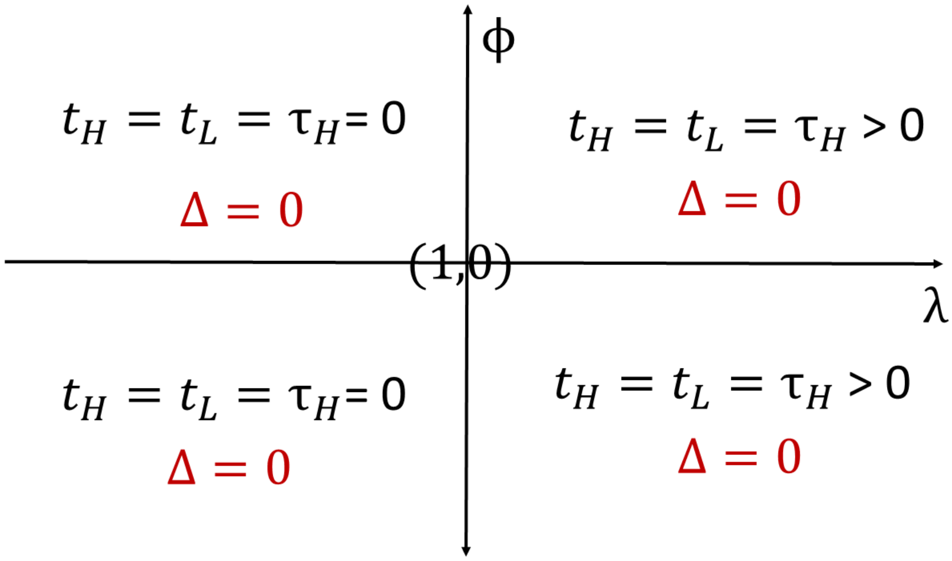

Table 1: Survey of States Regarding Use Taxes

	State Sales and Use Tax?	Local Sales Tax?	Local Use Tax Allowed?	Rates May Differ?	Destination or Origin?
Alabama	Yes	Yes	Yes	Yes	D
Alaska	No	Yes	Yes	Yes	D
Arizona	Yes	Yes	Yes	Yes	O
Arkansas	Yes	Yes	Yes	No	D
California	Yes	Yes	Yes	No	Hybrid
Colorado	Yes	Yes	Yes	Yes	D
Connecticut	Yes	No	-	-	D
Delaware	No	No	-	-	-
D.C.	Yes	No	-	-	D
Florida	Yes	Yes	Yes	No	D
Georgia	Yes	Yes	Yes	No	D
Hawaii	Yes	Yes	Yes	No	D
Idaho	Yes	Yes	Yes	No	D
Illinois	Yes	Yes	No	Yes	O
Indiana	Yes	No	-	-	D
Iowa	Yes	Yes	No	Yes	D
Kansas	Yes	Yes	Yes	No	D
Kentucky	Yes	No	-	-	D
Louisiana	Yes	Yes	Yes	No	D
Maine	Yes	No	-	-	D
Maryland	Yes	No	-	-	D
Massachusetts	Yes	No	-	-	D
Michigan	Yes	No	-	-	D
Minnesota	Yes	Yes	Yes	No	D
Mississippi	Yes	Yes	No	Yes	O
Missouri	Yes	Yes	Yes	Yes	O
Montana	No	No	-	-	-
Nebraska	Yes	Yes	Yes	No	D
Nevada	Yes	Yes	Yes	No	D
New Hampshire	No	No	-	-	D
New Jersey	Yes	No	-	-	D
New Mexico	Yes	Yes	No	Yes	O
New York	Yes	Yes	Yes	No	D
North Carolina	Yes	Yes	Yes	No	D
North Dakota	Yes	Yes	Yes	No	D
Ohio	Yes	Yes	Yes	No	O
Oklahoma	Yes	Yes	Yes	Yes	D
Oregon	Yes	No	-	-	D
Pennsylvania	Yes	Yes	Yes	No	O
Rhode Island	Yes	No	-	-	D
South Carolina	Yes	Yes	Yes	No	D
South Dakota	Yes	Yes	Yes	No	D
Tennessee	Yes	Yes	Yes	No	O
Texas	Yes	Yes	Yes	No	O
Utah	Yes	Yes	Yes	No	O
Vermont	Yes	Yes	Yes	No	D
Virginia	Yes	Yes	Yes	No	O
Washington	Yes	Yes	Yes	No	D
West Virginia	Yes	Yes	Yes	No	D
Wisconsin	Yes	Yes	Yes	No	D
Wyoming	Yes	Yes	Yes	No	D

The answers to these questions come from our survey of state governments.

Table 2: Notation for Theoretical Model

Variable	Definition
t_i	Local sales tax rate
τ_i	Local use tax rate
T_i	State sales tax rate
Γ_i	State use tax rate
b	Jurisdiction size parameter
p	Probability of audit
f	Fine
δ	Transportation cost
m_i	Idiosyncratic use tax filing cost
S^D	Distance of individual indifferent between purchasing at home or abroad if $m_i = 0$ (Evasion not possible.)
m_i^D	Individual specific threshold below which buy abroad (Evasion not possible.)
S^N	Distance of individual indifferent between purchasing at home or abroad if $m_i = 0$ and evasion possible.
m_i^N	Individual specific threshold below which buy abroad if evasion possible.
m^E	Individual specific threshold above which the use tax is evaded.
π^N	The expected number of individuals that purchase abroad and evade.
π^H	The expected number of individuals that purchase abroad and do not evade.
S^E	Distance of individual indifferent between evading and truthfully reporting when $m_i = m^E$.
π^D	$\pi^N + \pi^H$ or the total number of cross-border shoppers.
λ	The weight given to revenue in the welfare function.
ϕ	$t_H - p(\tau_H - t_L + f)$
Δ	The local sales tax minus the local use tax.

All variables are listed in the order that they appear in the text.

Table 3: Summary Statistics for Tax Rates

	Tax	Unweighted full sample	Unweighted 9/2003	Unweighted 12/2011	Population Weighted full sample	Population Weighted 9/2003	Population Weighted 12/2011
All States	Total Local Sales Tax	1.30	1.18	1.35	1.58	1.46	1.68
		(1.43)	(1.35)	(1.47)	(1.49)	(1.41)	(1.54)
	Total Local Use Tax	1.01	.94	1.06	1.32	1.26	1.35
		(1.36)	(1.29)	(1.40)	(1.45)	(1.40)	(1.49)
	Number Where Local Sales Tax $\neq$ Local Use Tax	341,541	3,172	3,444	341,541	3,172	3,444
	Total Number Observations	2,149,604	21,435	21,547	2,149,604	21,435	21,547
With Local Taxes	Total Local Sales Tax	1.53	1.37	1.58	1.58	1.46	1.68
		(1.43)	(1.38)	(1.49)	(1.49)	(1.41)	(1.54)
	Total Local Use Tax	1.19	1.09	1.24	1.32	1.26	1.35
		(1.40)	(1.32)	(1.44)	(.145)	(1.40)	(1.48)
	Number Where Local Sales Tax $\neq$ Local Use Tax	341,541	3,172	3,444	341,541	3,172	3,444
	Total Number Observations	1,826,232	18,401	18,429	1,826,232	18,401	18,429

The table shows the average local sales and use tax rate (county + town + district) for the full sample (over all one-hundred months) and for the first and last month of the sample. The first panel includes states that do not allow for local sales taxation. The second panel restricts each time period to the set of states that allows for local sales taxation at at least one level of local government. Note, the total number of observations in the sample are different in 2011 and 2003 because of missing values. Standard deviations are given in parenthesis. The weighted results are weighted by the town population in the 2010 Census. Note that all calculation are based off our sample of matched towns to Census places.

Table 4: Fraction of Towns with Sales Taxes Not Equal to Use Taxes by State

State	9/2003 Percent with Sales Tax > Use Tax	9/2003 Percent with Sales Tax < Use Tax	9/2003 Average Differential (including zeros)	12/2011 Percent with Sales Tax > Use Tax	12/2011 Percent with Sales Tax < Use Tax	12/2011 Average Differential (including zeros)
Alabama	24.34	0	.41	15.50	0	.28
Alaska	39.65	0	1.16	40.56	0	1.41
Arizona	95.45	0	1.46	100	0	1.60
Colorado	91.67	0	2.56	94.20	0	3.18
Illinois	47.36	0	.35	61.97	0	.73
Iowa	79.20	0	1.10	94.93	0	.94
Missouri	88.39	0	1.69	89.91	0	2.09
Mississippi	.003	0	≈ 0	.003	0	≈ 0
New Mexico	98.64	0	1.20	100	0	1.98
Oklahoma	39.59	0	1.02	25.46	0	.66

The table shows the percent of towns in our sample with a total sales tax rate (county + town + district) greater than and less than the local use tax rate. The unaccounted percent of towns in the table has a local use tax rate equal to the local sales tax rate. The average differential is the total sales tax rate minus the total use tax rate. When calculating the average differential, we include those towns with equal sales and use taxes in the sample. Note that all calculation are based off our sample of matched towns to Census places.

Table 5: Empirical Test of Revenue Versus Welfare Maximizing Governments: Difference

	All Towns				Jurisdictions Bigger Than Neighbor			
Characteristics	(1)	(2)	(3)	(4)	(1')	(2')	(3')	(4')
ln(population)	0.027*	0.132**	0.098	0.182**	0.033	0.429*	0.629**	-0.248
	(0.015)	(0.055)	(0.081)	(0.082)	(0.050)	(0.235)	(0.281)	(0.393)
% male	0.001	0.002	0.005*	-0.000	0.002	0.002	-0.005	0.009
	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.010)	(0.014)	(0.016)
% senior	0.001	0.004	0.004	0.005	0.003	-0.003	-0.011	0.017
	(0.001)	(0.003)	(0.004)	(0.003)	(0.004)	(0.012)	(0.015)	(0.021)
median age	-0.000	0.000	-0.001	0.002	-0.001	0.003	0.003	-0.004
	(0.001)	(0.002)	(0.004)	(0.003)	(0.003)	(0.010)	(0.013)	(0.016)
% white	0.001	0.005*	0.007*	0.003	0.003	0.017**	0.027**	0.003
	(0.001)	(0.003)	(0.004)	(0.004)	(0.002)	(0.008)	(0.014)	(0.006)
% education	-0.000	-0.002	-0.002	-0.002	-0.004	-0.021**	-0.028**	-0.011
	(0.001)	(0.003)	(0.004)	(0.004)	(0.003)	(0.010)	(0.014)	(0.013)
ln(income)	-0.054**	-0.222**	-0.241**	-0.193	-0.069	-0.638**	-0.919**	-0.230
	(0.026)	(0.095)	(0.121)	(0.150)	(0.081)	(0.325)	(0.454)	(0.409)
% public asst.	0.001	0.006**	0.008**	-0.000	-0.002	0.013*	0.019**	-0.005
	(0.001)	(0.003)	(0.003)	(0.005)	(0.004)	(0.007)	(0.009)	(0.024)
% non-citizen	-0.000	-0.002	-0.007	0.006	-0.005	-0.007	-0.027	0.031
	(0.001)	(0.004)	(0.005)	(0.006)	(0.005)	(0.016)	(0.020)	(0.020)
% work in	-0.001	-0.004	-0.007	-0.000	0.003	0.004	0.029*	-0.017
state	(0.001)	(0.003)	(0.004)	(0.002)	(0.004)	(0.013)	(0.017)	(0.014)
rooms	-0.002	-0.018	-0.001	-0.036	-0.056*	-0.208	-0.176	-0.162
	(0.009)	(0.035)	(0.056)	(0.042)	(0.030)	(0.127)	(0.157)	(0.217)
age house	0.001	0.003	0.005*	0.000	0.001	0.013	0.013	0.013
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.011)	(0.016)	(0.014)
% agriculture	-0.001	-0.002	-0.001	-0.003	-0.000	-0.011	-0.008	-0.024
	(0.001)	(0.002)	(0.003)	(0.002)	(0.004)	(0.010)	(0.013)	(0.020)
public-private	-0.008	-0.053**	-0.096**	-0.017	-0.051	-0.074	-0.083	0.059
ratio	(0.005)	(0.023)	(0.038)	(0.024)	(0.046)	(0.055)	(0.053)	(0.689)
Observations	41,872	10,264	5,014	5,250	8,248	1,982	1,080	902
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y

The dependent variable is the total local sales tax rate minus the total local use tax rate. All models are estimated using panel data from September 2003 and December 2011. The model contains time fixed effects and town fixed effects. Columns (1) to (4) contain the variables listed in the table. Column (1) is the full sample of all towns in the United States. Column (2) uses only states where the use tax and sales tax rate may differ. Column (3) focus on states where towns are explicitly allowed to set different tax rates. Column (4) only uses states with use tax bans. Columns with a prime restrict the sample to towns that have a larger population than their average neighboring jurisdictions. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 6: Empirical Test of Revenue Versus Welfare Maximizing Governments: Use Tax Rates

	All Towns				Jurisdictions Bigger Than Neighbor			
Characteristics	(1)	(2)	(3)	(4)	(1')	(2')	(3')	(4')
ln(population)	-0.029	-0.006	-0.113	n/a	-0.087	-0.290	-0.441	n/a
	(0.019)	(0.049)	(0.082)		(0.058)	(0.197)	(0.275)	
% male	-0.000	-0.001	-0.003	use tax	0.003	-0.007	-0.006	use tax
	(0.001)	(0.002)	(0.003)	always 0	(0.003)	(0.008)	(0.014)	always 0
% senior	-0.000	-0.001	-0.008**		0.000	-0.004	-0.009	
	(0.001)	(0.002)	(0.004)		(0.004)	(0.009)	(0.015)	
median age	0.000	0.000	0.001		0.000	0.003	0.013	
	(0.001)	(0.002)	(0.004)		(0.004)	(0.009)	(0.014)	
% white	-0.002**	-0.008***	-0.015***		-0.005**	-0.023***	-0.048***	
	(0.001)	(0.002)	(0.004)		(0.002)	(0.008)	(0.016)	
% education	0.001	-0.001	-0.005		0.002	0.004	-0.001	
	(0.001)	(0.002)	(0.003)		(0.003)	(0.008)	(0.014)	
ln(income)	0.111***	0.121**	0.218**		0.164*	0.554*	0.887*	
	(0.023)	(0.059)	(0.103)		(0.093)	(0.304)	(0.479)	
% public asst.	-0.002	-0.004	0.001		-0.004	-0.006	-0.003	
	(0.001)	(0.003)	(0.004)		(0.004)	(0.008)	(0.010)	
% non-citizen	-0.001	-0.002	-0.004		0.012**	0.025*	0.042*	
	(0.001)	(0.004)	(0.007)		(0.006)	(0.014)	(0.025)	
% work in	0.003***	0.004*	0.005		-0.004	-0.013	-0.028	
state	(0.001)	(0.002)	(0.004)		(0.005)	(0.012)	(0.021)	
rooms	0.008	-0.022	0.002		0.053	0.177*	0.382**	
	(0.009)	(0.026)	(0.053)		(0.039)	(0.099)	(0.162)	
age house	-0.000	-0.003**	-0.004*		0.002	0.001	0.001	
		(0.001)	(0.003)		(0.002)	(0.008)	(0.014)	
% agriculture	-0.001	-0.000	-0.001		0.002	0.003	0.002	
	(0.001)	(0.001)	(0.002)		(0.005)	(0.010)	(0.014)	
public-private	-0.002	0.014	0.015		-0.013	0.019	0.037	
ratio	(0.004)	(0.014)	(0.031)		(0.023)	(0.031)	(0.042)	
Observations	41,872	10,264	5,014	5,250	8,248	1,982	1,080	902
Time FE?	Y	Y	Y		Y	Y	Y	
Town FE?	Y	Y	Y		Y	Y	Y	

The dependent variable is the total local use tax rate. All models are estimated using panel data from September 2003 and December 2011. The model contains time fixed effects and town fixed effects. Columns (1) to (3) contain the variables listed in the table. Column (1) is the full sample of all towns in the United States. Column (2) uses only states where the use tax and sales tax rate may differ. Column (3) focus on states where towns are explicitly allowed to set different tax rates. Column (4) only uses states with use tax bans, but given this leaves no variation, this column is excluded. Columns with a prime restrict the sample to towns that have a larger population than their average neighboring jurisdiction. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 7: Effect of State Tax Shock on Difference in Local Sales and Use Tax

	All Towns				Jurisdictions Bigger Than Neighbor			
Characteristics	(1)	(2)	(3)	(4)	(1')	(2')	(3')	(4')
Panel I.A: State Sales Tax Rate								
State Sales Tax Rate	-.156***	-.774***	-.008	-.947***	-.153***	-.840***	.071	-1.054***
	(.016)	(.053)	(.059)	(.076)	(.020)	(.091)	(.186)	(.084)
Panel I.B: State Sales Tax Rate By Distance								
State Sales Tax Rate	-.174***	-1.291***	-.060	-1.318***	-.268***	-1.617***	-.534	-1.515***
	(.046)	(.142)	(.187)	(.135)	(.063)	(.207)	(.448)	(.124)
State Sales Tax Rate × ln(distance)	.004	.129***	.011	.094***	.030	.198***	.132	.123***
	(.010)	(.037)	(.041)	(.031)	(.016)	(.062)	(.108)	(.038)
Observations	190,572	46,852	23,020	23,832	37,424	9029	4959	4070
Controls?	Y	Y	Y	Y	Y	Y	Y	Y
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y

The dependent variable is the total local sales tax rate minus the total local use tax rate. All models are estimated using data from December of each year from 2003 to 2011. The model contains time fixed effects and town fixed effects and the controls used in the previous table. Each panel represents a separate regression. Panel IA use the state sales tax rate. Panel IB also uses the state sales tax rate but allows the effect of it to vary with distance to the border. Column (1) utilizes towns in all states in the United States regardless of local use tax rules. Column (2) uses only towns in states where the use tax and sales tax rate differ. Column (3) focus on towns in states where towns are explicitly allowed to set different tax rates. Column (4) only uses towns in states with use tax bans. Within each of these sets, columns with a prime restrict the sample to towns that have a larger population than their average neighboring jurisdiction. The number of observations corresponds to Panel IA; generally they are quite similar except for a couple missing observations on the distance variable. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 8: Effect of State Tax Shock on Difference in Local Sales and Use Tax: By Margin of Response

	Linear Probability Model				Exclude Observations With $\Delta = 0$			
Characteristics	(1)	(2)	(3)	(4)	(1')	(2')	(3')	(4')
				PANEL I.A: STATE SALES TAX RATE				
State Sales Tax Rate	-.005	-.020	.042*	-.079**	-.986***	-.986***	-.179***	-1.201***
	(.004)	(.023)	(.022)	(.031)	(.061)	(.061)	(.062)	(.111)
				PANEL I.B: STATE SALES TAX RATE BY DISTANCE				
State Sales Tax Rate	.000	.010	.054*	-.033	-1.473***	-1.473***	-.246	-1.499***
	(.007)	(.041)	(.031)	(.057)	(.143)	(.143)	(.177)	(.145)
State Sales Tax Rate $\times$ ln(distance)	-.001	-.007	-.002	-.011	.122***	.122***	.013	.077***
	(.003)	(.015)	(.004)	(.019)	(.036)	(.036)	(.038)	(.026)
Observations	190,572	46,852	23,020	23,832	29,927	29,927	14,355	15,572
Controls?	Y	Y	Y	Y	Y	Y	Y	Y
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y

In columns without a prime, the dependent variable is equal to one if the use tax and sales tax are not equal and zero otherwise. In columns with a prime, the dependent variable is the total local sales tax rate minus the total local use tax rate, restricted to observations a non-zero differential in the sales and use tax. All models are estimated using data from December of each year from 2003 to 2011. The model contains time fixed effects and town fixed effects and the controls used in the previous table. Each panel represents a separate regression. Panel IA use the state sales tax rate. Panel IB also uses the state sales tax rate but allows the effect of it to vary with distance to the border. Column (1) utilizes towns in all states in the United States regardless of local use tax rules. Column (2) uses only towns in states where the use tax and sales tax rate differ. Column (3) focus on towns in states where towns are explicitly allowed to set different tax rates. Column (4) only uses towns in states with use tax bans. The number of observations corresponds to Panel IA; generally they are quite similar except for a couple missing observations on the distance variable. Note that in the columns with a prime, the sample in (1') and (2') are identical given the restriction. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 9: Effect of State Tax Differential Shock on Difference in Local Sales and Use Tax

	All Towns				Jurisdictions Bigger Than Neighbor			
Characteristics	(1)	(2)	(3)	(4)	(1')	(2')	(3')	(4')
Panel I.A: State Sales Tax Rate Differential								
State Differential	-.026***	-.289***	.109**	-.521***	-.020***	-.266***	.097*	-.576***
	(.006)	(.053)	(.042)	(.058)	(.007)	(.067)	(.057)	(.061)
Panel I.B: State Sales Tax Rate Differential By Distance								
State Differential	-.098***	-.872***	.101	-.960***	-.083**	-.882***	.161	-.923***
	(.033)	(.149)	(.125)	(.211)	(.035)	(.142)	(.157)	(.182)
State Differential × ln(distance)	.017**	.135***	.001	.113**	.015*	.135***	-.011	.093*
	(.007)	(.031)	(.026)	(.041)	(.008)	(.030)	(.030)	(.045)
Panel II.A: High-Tax State Dummy								
High Dummy	-.190***	-.491***	n/a	-.564***	-.225***	-.455***	n/a	-.618***
	(.067)	(.118)		(.120)	(.080)	(.109)		(.117)
Panel II.B: High-Tax State Dummy By Distance								
High Dummy	-.444*	-1.279***	n/a	-1.415***	-.392*	-1.031***	n/a	-1.197***
	(.256)	(.422)		(.437)	(.201)	(.273)		(.276)
High Dummy× ln(distance)	.066	.206**	n/a	.223**	.045	.155***	n/a	.156**
	(.051)	(.089)		(.091)	(.036)	(.059)		(.060)
Observations	188,741	45,594	21,762	23,832	36,708	8475	4405	4070
Controls?	Y	Y	Y	Y	Y	Y	Y	Y
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y

The dependent variable is the total local sales tax rate minus the total local use tax rate. All models are estimated using data from December of each year from 2003 to 2011. The model contains time fixed effects and town fixed effects and the controls used in the previous table. Each panel represents a separate regression with. Panel IA use the state sales tax rate differential defined as your state tax rate minus the nearest neighboring state sales tax rate. Panel IB also uses the state sales tax rate differential but allows the effect of it to vary with distance to the border. Panel IIA uses a dummy variable that equals 1 if the town is located on the relatively high-state sales tax side of the state border. Panel IIB allows the effect of the dummy variable to vary with distance. Column (1) utilizes towns in all states in the United States regardless of local use tax rules. Column (2) uses only towns in states where the use tax and sales tax rate differ. Column (3) focus on towns in states where towns are explicitly allowed to set different tax rates. Column (4) only uses towns in states with use tax bans. Within each of these sets, columns with a prime restrict the sample to towns that have a larger population than their average neighboring jurisdiction. The number of observations corresponds to Panel IA; generally they are quite similar except for a couple missing observations on the distance variable. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 10: Effect of State Tax Differential Shock on Difference in Local Sales and Use Tax: By Margin of Response

	All Towns				Exclude Observations With $\Delta = 0$			
Characteristics	(1)	(2)	(3)	(4)	(1")	(2")	(3")	(4")
PANEL I.A: STATE SALES TAX RATE DIFFERENTIAL								
State Differential	-.003**	-.023*	.012	-.055**	-.429***	-.429***	.126**	-.666***
	(.001)	(.0137)	(.008)	(.022)	(.067)	(.067)	(.048)	(.074)
PANEL I.B: STATE SALES TAX RATE DIFFERENTIAL BY DISTANCE								
State Differential	-.003	-.029	-.003	.020	-1.105***	-1.105***	.139	-1.173***
	(.002)	(.020)	(.031)	(.052)	(.174)	(.174)	(.129)	(.189)
State Differential × ln(distance)	.001	.002	.003	-.019	.162***	.162***	-.002	.132
	(.001)	(.003)	(.005)	(.016)	(.041)	(.041)	(.027)	(.039)
PANEL II.A: HIGH-TAX STATE DUMMY								
High Dummy	-.019**	-.044**	n/a	-.030	-.666***	-.666***	n/a	-.750***
	(.007)	(.020)		(.021)	(.117)	(.117)		(.145)
PANEL II.B: HIGH-TAX STATE DUMMY BY DISTANCE								
High Dummy	.010	.069	n/a	.098	-1.609***	-1.609***	n/a	-1.921***
	(.016)	(.061)		(.062)	(.315)	(.315)		(.381)
High Dummy× ln(distance)	-.007	-.030	n/a	-.033*	.250***	.250***	n/a	.311***
	(.005)	(.019)		(.018)	(.069)	(.069)		(.079)
Observations	188,741	45,594	21,762	23,832	29,439	29,927	13,772	15,572
Controls?	Y	Y	Y	Y	Y	Y	Y	Y
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y

In columns without a prime, the dependent variable is equal to one if the use tax and sales tax are not equal and zero otherwise. In columns with a prime, the dependent variable is the total local sales tax rate minus the total local use tax rate, restricted to observations a non-zero differential in the sales and use tax. All models are estimated using data from December of each year from 2003 to 2011. The model contains time fixed effects and town fixed effects and the controls used in the previous table. Each panel represents a separate regression. Panel IA use the state sales tax rate differential defined as your state tax rate minus the nearest neighboring state sales tax rate. Panel IB also uses the state sales tax rate differential but allows the effect of it to vary with distance to the border. Panel IIA uses a dummy variable that equals 1 if the town is located on the relatively high-state sales tax side of the state border. Panel IIB allows the effect of the dummy variable to vary with distance. Column (1) utilizes towns in all states in the United States regardless of local use tax rules. Column (2) uses only towns in states where the use tax and sales tax rate differ. Column (3) focus on towns in states where towns are explicitly allowed to set different tax rates. Column (4) only uses towns in states with use tax bans. The number of observations corresponds to Panel IA; generally they are quite similar except for a couple missing observations on the distance variable. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

Table 11: Effect of Internet Shock on Difference

Characteristics	All Towns (1)	(2)	(3)	Jurisdictions Bigger Than Neighbor (1')	(2')	(3')	Exclude Observations With $\Delta = 0$ (1")	(2")	(3")
Panel I.A: Internet Penetration									
Internet Penetration	.032**	.152***	.248***	.023	.091	.291**	.112*	.112*	.251***
	(.014)	(.051)	(.075)	(.027)	(.088)	(.117)	(.068)	(.068)	(.074)
Panel I.B: Internet Penetration By High-Tax State									
Internet Penetration	.067**	.178***	.260***	.095**	.176*	.360***	.161**	.161**	.257***
	(.027)	(.067)	(.078)	(.042)	(.102)	(.119)	(.078)	(.078)	(.076)
Internet Penetration× High Dummy	-.060**	-.079	-.156	-.129***	-.175	-.114	-.219**	-.219**	-.332***
	(.027)	(.078)	(.116)	(.038)	(.108)	(.376)	(.109)	(.109)	(.124)
Observations	41,872	10,264	5014	8248	1982	1080	5812	5812	2896
Controls?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time FE?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Town FE?	Y	Y	Y	Y	Y	Y	Y	Y	Y

The dependent variable is the total local sales tax rate minus the total local use tax rate. All models are estimated using data of each year from December of 2003 and 2011. The model contains time fixed effects and town fixed effects and the controls used in the previous table. Each panel represents a separate regression with a different right-hand side variable of interest. Panel IA use a proxy for Internet penetration. Panel IB also uses the Internet penetration rate but allows the effect of it to vary with whether the town is located on a relatively high-tax side of the state border. The high-tax dummy variable that equals 1 if the town is located on the relatively high-state sales tax side of the state border. The proxy for Internet usage is the percent of households in the town with access to multiple providers. Column (1) utilizes towns in all states in the United States regardless of local use tax rules. Column (2) uses towns in only states where the use tax and sales tax rate differ. Column (3) focus on towns in states where towns are explicitly allowed to set different tax rates. Within each of these sets, columns with a prime restrict the sample to towns that have a larger population than their average neighboring jurisdiction. Columns with a double prime restrict the sample to towns where the differential in the sales and use tax is non-zero. Note that in this last case, the sample in (1") and (2") are identical. The number of observations corresponds to Panel IA; generally they are quite similar except for a couple missing observations on the distance variable. All standard errors are clustered at the county level. ***99%, **95%, and *90%.

A Appendices

A.1 Deriving consumer surplus in municipality H

As a guide, we will derive consumer surplus in the large jurisdiction when expected fines are low. Consumer surplus is given by

$$\begin{aligned}
CS_H &= (1+b-S^N)(V-1-T_H-t_H) \\
&+ \int_0^{S^N}\int_0^{m_i^N} \left[(1-p)(V-1-T_L-t_L-\delta S_i)+p(V-1-\Gamma_H-\tau_H-f-m_i-\delta S_i)\right] g(m_i)\mathrm{d}m_i\mathrm{d}S_i \\
&+ \int_0^{S^N}\int_{m_i^N}^{\infty}(V-1-T_H-t_H)\, g(m_i)\mathrm{d}m_i\mathrm{d}S_i. \qquad \text{(A.1)}
\end{aligned}$$

The first term is the consumer surplus of all individuals that are located more than S^N units from the border. These individuals will always purchase the good at home and thus pay municipality H's combined sales tax rate $T_H + t_H$. The second term captures individuals which purchase the good abroad and evade the use tax. These individuals are located within the interval $[0; S^N]$ and have sufficiently low compliance costs $m_i \leq m_i^N$. The third term comprises again individuals which shop at home because their compliance cost is too high ($m_i > m_i^N$). We can rewrite the consumer surplus of municipality H to

$$\begin{aligned}
CS_H &= (1+b-S^N)(V-1-T_H-t_H) + \int_0^{S^N}\int_0^{\infty}(V-1-T_H-t_H)\, g(m_i)\mathrm{d}m_i\mathrm{d}S_i \\
&+ \int_0^{S^N}\int_0^{m_i^N}\left[m_i^D-(1-p)m^E-pm_i\right] g(m_i)\mathrm{d}m_i\mathrm{d}S_i, \qquad \text{(A.2)}
\end{aligned}$$

Simplifying the first integral by using integration by parts and making use of $G(\infty) = 1$ and $G(0) = 0$ yields

$$\begin{aligned}
CS_H &= (1+b-S^N)(V-1-T_H-t_H) + \int_0^{S^N}(V-1-T_H-t_H)\mathrm{d}S_i \\
&+ \int_0^{S^N}\int_0^{m_i^N}\left[m_i^D-(1-p)m^E-pm_i\right] g(m_i)\mathrm{d}m_i\mathrm{d}S_i, \qquad \text{(A.3)}
\end{aligned}$$

which simplifies to

$$CS_H \quad = \quad (1+b)(V-1-T) + \int_0^{S^N}\int_0^{m_i^N} [x - \delta S_i - pm_i]\; g(m_i)\mathrm{d}m_i\mathrm{d}S_i. \qquad \text{(A.4)}$$

Partially integrating the remaining double integral leads to

$$\begin{aligned} CS_H \quad &= \quad (1+b)(V-1-T_H-t_H) + \int_0^{S^N} G(m_i^N)[m_i^D - (1-p)m^E - pm_i^N]\mathrm{d}S_i \\ &+ \quad p\int_0^{S^N}\int_0^{m_i^N} G(m_i)\mathrm{d}m_i\mathrm{d}S_i. \end{aligned} \qquad \text{(A.5)}$$

As the value of the first integral is zero, consumer surplus reduces to

$$CS_H = (1+b)(V-1-T_H-t_H) + p\int_0^{S^N}\int_0^{m_i^N} G(m_i)\mathrm{d}m_i\mathrm{d}S_i. \qquad \text{(A.6)}$$

A.2 Derivation of the first-order conditions for low expected fines

We analyze how changes in the own tax rates affect welfare in both municipalities when expected fines are low. The first-order conditions are given by

$$\frac{\partial W_H}{\partial t_H} \quad = \quad \lambda(1+b-\pi^N) - \lambda[t_H - p(\tau_H - t_L + f)]\frac{\partial \pi^N}{\partial t_H} + \frac{\partial CS_H}{\partial t_H}, \qquad \text{(A.7)}$$

$$\frac{\partial W_H}{\partial \tau_H} \quad = \quad \lambda p \pi^N - \lambda[t_H - p(\tau_H - t_L + f)]\frac{\partial \pi^N}{\partial \tau_H} + \frac{\partial CS_H}{\partial \tau_H}, \qquad \text{(A.8)}$$

$$\frac{\partial W_L}{\partial t_L} \quad = \quad \lambda(1-b+\pi^N) + \lambda t_L\,\frac{\partial \pi^N}{\partial t_L} + \frac{\partial CS_L}{\partial t_L}. \qquad \text{(A.9)}$$

In order to arrive at the first-order conditions in given in (20) - (22), we need the following derivations for π^N:

$$\begin{aligned} \frac{\partial \pi^N}{\partial t_H} \quad &= \quad \int_0^{S_N} g\left(m_i^N\right)\;\mathrm{d}S_i + G(m_i^N(S^N))\,\frac{\partial S^N}{\partial t_H} = -\frac{1}{\delta}\left[G(m_i^N)\right]_0^{S^N} \\ &= \quad \frac{1}{\delta}\,G\left(\frac{x}{p}\right), \end{aligned} \qquad \text{(A.10)}$$

$$\frac{\partial \pi^N}{\partial \tau_H} \quad = \quad -\frac{1}{\delta}\,G\left(\frac{x}{p}\right), \qquad \text{(A.11)}$$

$$\frac{\partial \pi^N}{\partial t_L} \quad = \quad -\frac{1-p}{\delta}\,G\left(\frac{x}{p}\right). \qquad \text{(A.12)}$$

In order to derive the effects on consumer surplus in municipality H, we first rewrite CS_H as

$$CS_H = (1+b)(V-1-T_H-t_H) + p\int_0^{S_N} \mathcal{G}\left(m_i^N\right)\, \mathrm{d}S_i, \tag{A.13}$$

where $\mathcal{G}(m)$ is the primitive of $G(m)$. Taking derivations we get

$$\begin{aligned}
\frac{\partial CS_H}{\partial t_H} &= -(1+b) + \int_0^{S_N} G\left(m_i^N\right)\, \mathrm{d}S_i + p\mathcal{G}(m_i^N(S^N))\,\frac{\partial S^N}{\partial t_H} \\
&= -(1+b-\pi^N), && \text{(A.14)}\\
\frac{\partial CS_H}{\partial \tau_H} &= -p\pi^N && \text{(A.15)}\\
\frac{\partial CS_L}{\partial t_L} &= -(1-b), && \text{(A.16)}
\end{aligned}$$

as $m_i^N(S^N) = 0$ and $\mathcal{G}(0) = 0$. Plugging (A.10) - (A.16) into the first-order conditions given above yields the first-order conditions (20) - (22).

A.3 Medium expected fine

Total tax revenues in municipalities H and L when expected fines are high amount to

$$R_H = t_H[1+b-\pi^D] + (\tau_H - t_L)\pi^H + p(\tau_H - t_L + f)\pi^N, \tag{A.17}$$

$$R_L = t_L[1-b+\pi^D]. \tag{A.18}$$

Consumer surplus in municipalities H and L are respectively given by

$$\begin{aligned}
CS_H = {} & (1+b)(V-1-T_H-t_H) + \int_{S^E}^{S^D}\int_0^{m_i^D} G(m_i)\, \mathrm{d}m_i \mathrm{d}S_i + \int_0^{S^E}\int_0^{m_i^N} G(m_i)\, \mathrm{d}m_i \mathrm{d}S_i \\
& - (1-p)\int_0^{S^E}\int_{m^E}^{m_i^N} G(m_i)\, \mathrm{d}m_i \mathrm{d}S_i, && \text{(A.19)}\\
CS_L = {} & (1-b)(V-1-T_L-t_L). && \text{(A.20)}
\end{aligned}$$

We now analyze how a changes in the local tax rates affect welfare in the municipalities. The effects of sales tax rates on welfare are given by

$$\frac{\partial W_H}{\partial t_H} = (\lambda - 1)(1 + b - \pi^D) - \lambda\,\frac{1}{\delta}\,\left(t_H - \tau_H + t_L\right) G\left(m^E\right) - \lambda\,\frac{1}{\delta}\phi\left[G\left(\frac{x}{p}\right) - G\left(m^E\right)\right], \tag{A.21}$$

$$\frac{\partial W_L}{\partial t_L} = (\lambda - 1)(1 - b) + \lambda\pi^D - \lambda t_L\,\frac{1-p}{\delta}\left[G\left(\frac{x}{p}\right) - G\left(m^E\right)\right]. \tag{A.22}$$

The effects of the use tax rate on welfare in municipality H are given by

$$\begin{aligned}\frac{\partial W_H}{\partial \tau_H} = {} & (\lambda - 1)(\pi^H + p\pi^N) + \lambda\,\frac{1}{\delta}\,\left(t_H - \tau_H + t_L\right) G\left(m^E\right) + \lambda\,\frac{p}{\delta}\phi\left[G\left(\frac{x}{p}\right) - G\left(m^E\right)\right] \\ & + \lambda\theta S^E g\left(m^E\right),\end{aligned} \tag{A.23}$$

where $\theta = pf - (1-p)(\tau_H - t_L)$. Again we ask ourselves how the optimal tax rates look like in equilibrium when municipalities are allowed to set their own use tax and when there is a ban.

Use tax ban for municipalities Like in the low expected fines case, we can neglect the first-order condition for the optimal use tax (A.23) if municipality H is not allowed to set its own use tax. If $\phi > 0$, the first-order condition for municipality H's sales tax rate rate is negative when $\lambda < 1$ and hence $t_H = 0$. Because of the assumption on $pf/(1-p)$ we made for the case of medium expected fines, π^D will be non-positive when $t_H = 0$. Accordingly, also municipality L sets its sales tax rate equal to zero so that in equilibrium we get $t_H = \tau_H = t_L = 0$. For all the other cases it depends on the other parameters whether $t_H > 0$.

Suppose we are in a case in which $t_H > 0$. We will analyze how the state level sales tax rate differential affects Δ^B. Again, this effect will only come from a change in municipality H's sales tax rate t_H because use taxes are banned. The effect is given by[42]

$$\frac{\mathrm{d}\Delta^B}{\mathrm{d}T_L} = \frac{(\lambda - 1)p(1-p)[G(x/p) - G(m^E)] + \lambda(1-p)\phi g(x/p) - \lambda p\theta g(m^E)}{(2\lambda - 1)pG(x/p) + \lambda\phi g(x/p)}. \tag{A.24}$$

The effect of a change in T_L is ambiguous because an increase in the sales tax rate t_H would not only increase cross-border shopping but also induce some individuals to switch from truthfully reporting their use tax payments to evasion. In order to sign the effect we make two simplifying assumptions. First, we assume $\lambda > 1$ because for $\lambda < 1$, $t_H = 0$

[42] Again, the very same effect can be derived when we inspect a change in the state sales tax rate T_H while considering the subsequent change in Γ_H.

when $\phi > 0$. Second, we assume m to be uniformly distributed. Since $m \in [0; \infty)$, the density is zero for any value of m, i.e. $g(m) = 0 \; \forall m$. If we do that, the effect simplifies to

$$\frac{\mathrm{d}\Delta^B}{\mathrm{d}T_L} = \frac{(\lambda - 1)p(1-p)[G(x/p) - G(m^E)]}{(2\lambda - 1)pG(x/p)} > 0, \tag{A.25}$$

which is unambiguously greater than zero. Hence, a reduction in the sales tax rate differential at the state level increases Δ^B as in the case of low expected fines.

The effect of a change in λ on Δ^B is given by

$$\frac{\mathrm{d}\Delta^B}{\mathrm{d}\lambda} = \frac{\delta(1 + b - \pi^D)/\lambda}{(2\lambda - 1)pG(x/p) + \lambda\phi g(x/p)} > 0. \tag{A.26}$$

The intuition for this is similar to the one we gave when we discussed the effect given in (24).

No use tax ban If municipality H is allowed to set its own use tax rate, we have to take (A.23) into consideration. As argued for the case of a use tax ban, if $\phi > 0$ and $\lambda < 1$, $t_H = t_L = 0$ and hence $\tau_H = 0$. For all other cases of ϕ and λ, we have to ask under which circumstances it is most likely that in equilibrium $t_H > \tau_H$. We answer this question in two steps. First, we analyze the first-order conditions for t_H and τ_H at the point $t_H = \tau_H$ to find necessary conditions under which $t_H > \tau_H$. Then, we ask what are the sufficient conditions under which $t_H > \tau_H$ in the more general case.

Inspecting (2), consumers will never choose to evade the use tax if $t_H = \tau_H$ as $m_i^N \leq 0$. Hence $\pi^N = 0$. The first-order conditions for t_H and τ_H simplify to

$$\frac{\partial W_H}{\partial t_H}|_{t_H = \tau_H} = (\lambda - 1)(1 + b - \pi^D) - \lambda \, \frac{1}{\delta} \, (t_H - \tau_H + t_L) \, G\left(m^E\right), \tag{A.27}$$

$$\frac{\partial W_H}{\partial \tau_H}|_{\tau_H = t_H} = (\lambda - 1)\pi^D - (\lambda - 1)(1-p)\pi^N + \lambda \, \frac{1}{\delta} \, (t_H - \tau_H + t_L) \, G\left(m^E\right) + \lambda\theta S^E g\left(m^E\right). \tag{A.28}$$

The question is which of the two first-order condition is equal to zero first. Suppose (A.27) is zero at $t_H = \tau_H$ while (A.28) is not. Then we can substitute (A.27) in (A.28) and get

$$\frac{\partial W_H}{\partial \tau_H}|_{\tau_H = t_H} = (\lambda - 1)[1 + b - (1-p)\pi^N] + \lambda\theta S^E g\left(m^E\right) > 0. \tag{A.29}$$

This means that at the point $\tau_H = t_H$ the first-order condition for τ_H is positive and hence the government ideally wants to increase τ_H. Since this is not possible, the government remains at setting $\tau_H = t_H$ so that $\tau_H < t_H$ is not possible when (A.27) is zero.

Suppose that (A.28) is zero and (A.27) is not. Substituting (A.28) in (A.27) yields

$$\frac{\partial W_H}{\partial t_H}|_{t_H=\tau_H} = (\lambda-1)[1+b-(1-p)\pi^N] + \lambda\theta S^E g\left(m^E\right) > 0, \tag{A.30}$$

which means that the government wants to increase t_H starting from $t_H = \tau_H$. Thus, for $t_H > \tau_H$ in equilibrium, it is necessary that the first-order condition for τ_H is binding.

Let us now inspect the first-order conditions (A.21) and (A.23) again. If $\phi < 0$, the third term in (A.21) is positive making the first-order condition for t_H *ceteris paribus* more positive whereas the third term in (A.23) is negative making the first-order condition for τ_H more negative. Moreover, to make sure that $\tau_H > 0$ at the lower threshold for $pf/(1-p)$ (cf. (9)), we need to have $\lambda > 1$. At the lower threshold $m^E = 0$. If we assume $\lambda < 1$, the first-order condition for τ_H is negative and the use tax would not be a binding policy instrument. Thus, a use tax rate which is smaller that the sales tax rate in equilibrium and where the use tax is used as a policy instrument is most likely to be the case if $\lambda > 1$ and $\phi < 0$.

Given that we are in a situation in which $t_H > \tau_H > 0$, we will now analyze how a change in the state sales tax rate differential affects Δ^{NB}. We will do this by applying the implicit function theorem to (A.21) and (A.23) with respect to T_L and get

$$\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L} = \frac{\mathrm{d}t_H}{\mathrm{d}T_L} - \frac{\mathrm{d}\tau_H}{\mathrm{d}T_L}, \tag{A.31}$$

where

$$\frac{\mathrm{d}t_H}{\mathrm{d}T_L} = \frac{(\lambda-1)p(1-p)[G(x/p)-G(m^E)] - \lambda(1-p)\phi g(x/p) - \lambda p\theta g(m^E)}{\Omega}, \tag{A.32}$$

$$\frac{\mathrm{d}\tau_H}{\mathrm{d}T_L} = \frac{-(\lambda-1)p(1-p)[G(x/p)-G(m^E)] + [\lambda\theta + \delta(\lambda-1)(1-p)S^E]g(m^E) + \lambda p\phi[g(x/p)-g(m^E)]}{\Sigma} \tag{A.33}$$

where $\Omega = (2\lambda-1)pG(x/p) + \lambda\phi g(x/p) > 0$ and $\Sigma = (2\lambda-1)p^2[G(x/p)-G(m^E)] + (\lambda-1)G(m^E) + \lambda(t_H-\tau_H+t_L)g(m^E) + \lambda p\phi[g(x/p)-g(m^E)] + \delta(\lambda-1)(1-p)S^E g(m^E) > 0$ are the modified second-order conditions for t_H and τ_H. The sing of both (A.32) and (A.33) are ambiguous and hence we cannot say anything about the change in Δ^{NB}. Hence, as before, we make the simplifying assumption of a uniform distribution for which $g(\cdot) = 0$. Equations (A.32) and (A.33) simplify to

$$\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}T_L} = \frac{(\lambda-1)p(1-p)[G(x/p)-G(m^E)]}{(2\lambda-1)pG(x/p)} + \frac{(\lambda-1)p(1-p)[G(x/p)-G(m^E)]}{(2\lambda-1)p^2[G(x/p)-G(m^E)] + (\lambda-1)G(m^E)} > 0, \tag{A.34}$$

Comparing (A.25) to (A.34) we see that the first effect in (A.34) is the same as in (A.25). Hence, a change in the state sales tax rate differential must have a stronger effect on Δ if municipalities are allowed to set their own use tax rate.

Finally, we are able to analyze how a change in the weighting factor λ affects Δ^{NB} which is given by

$$\frac{\mathrm{d}\Delta^{NB}}{\mathrm{d}\lambda} = \frac{\delta}{\lambda}\left[\frac{p(1+b-\pi^{D})}{\Omega} - \frac{(\pi^{H}+p\pi^{N})}{\Sigma}\right] \tag{A.35}$$

The sign is ambiguous as both the sales tax rate t_H and the use tax rate τ_H increase. If p is sufficiently small, which is very likely in the case of medium sized expected fines, the second effect dominates and an increase in λ will decrease Δ^{NB}.

A.4 High expected fine

The derivation of the first order conditions follows a similar process to the derivations in the prior two cases.

A.5 Data Cleaning

The initial data on local use tax rates is provided to us by a proprietary firm, which collects the data from states and assembles it into a single usable file. The firm then sells these data to companies that need to remit taxes across multiple states. Although these data are provided to use, they need substantial cleaning to be used for research purposes. The panel data are assembled in a similar manner as the raw data in Agrawal (2014). The raw data that we obtain contain no geographic identification numbers. The data contains only the town name, county name, and the zip code that the tax rate prevails within. In order to match this to observable demographic data and to determine the position of each town in geographic space, we name match the tax data to the names of Census Places in the most recent American Community Survey (ACS). When doing this, we require the town name, county name, and state name to match. In general, town tax rates are constant within a town as are county tax rates. However, given that special districts may be sub-municipal, district taxes may vary within a town. To calculate the district tax in the town, we select the district tax rate that is most common in the town at the given year. As a robustness exercise, we exclude all district taxes from the analysis. Matching the data to Census Places means that some towns (mainly small towns) with taxing authority are not in our final data set, however, in order to proceed with the analysis we need to know about the municipalities. Unfortunately, no map files exist for all towns in the United States; the closest approximation is Census Places. We do not account for

Native American Reservations.

In the case where Census Places cross county lines, we assign the town to be within the county where the majority of the population lives. In order to determine this, we take a map of Census Block points and intersect this map with a map of Census Places and Census counties. We then sum the total population of the block points within each intersection of the place and the several counties it may span. We then assign the town to the county that contains the majority of its population.

After cleaning the use tax data, we are able to match the use tax rates to local sales tax data assembled in Agrawal (2014) using the Census Place identification number.

In assembling the data, we noticed that occasionally, sales and use taxes are different from each other even in states where the survey results indicate that there are no differences in the sales and use tax rate. We randomly check these discrepancies with published data on sales and use tax rates (if available). To the best of our knowledge these represent data entry errors. For example, in one jurisdiction, a rate of 6.5 was entered instead of .65. In all states where we know local use and local sales tax rates are available, we correct these errors by changing the local use tax rate to be equal to the local sales tax rate.[43] In states where local sales and use taxes are allowed to differ, we verify that there are no unusually large differences in these tax rates and we correct observations where the difference in the sales and use tax arises for only a single month (we view this as a likely typographical error given that tax rates do not usually change two months in a row). Unfortunately, given that many states do not publish historical local use tax rates, we cannot clean all observations. However, after the two data cleaning procedures noted above – taken in conjunction with the survey evidence – we are confident the data are capturing true differentials.

[43]In general, we notice that there are relatively few errors in the sales tax data base.