AN EXAMINATION OF THE SALES AND USE TAX GAP BASED ON MINNESOTA AUDIT EXPERIENCE

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CHAPTER 1. INTRODUCTION

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ABSTRACT

This paper examines the size and composition of the sales and use tax gap in Minnesota. The first segment of this thesis estimates the gap primarily attributed to business-to-consumer sales using data on remote sales collected by the U.S. Census Bureau. Business-to-consumer sales are primarily sales to individuals, while business-to-business sales are primarily sales to firms. We find…The second segment of the paper examines unremitted sales and use tax, primarily attributed to business-to-business sales, using data from audits conducted by the Minnesota Department of Revenue. It is important to note that while e-commerce does play a significant role in the underreporting of use tax, the sales tax gap is largely comprised of noncompliance unrelated to e-commerce. While capturing lost tax revenue to e-commerce will significantly decrease the size of the use tax gap, a sales tax gap will persist.

We find that, after controlling for audit selection, the estimated sales tax gap to be between $263 million to $1,039 million dollars each year. The use tax gap is somewhere between $261.3 million dollars and $400.3 million dollars. We also find that find larger firms are more likely to be audited, but that they are more likely to yield a no-change assessment, indicating that compliance increases as firm size increases. However, the size of audit assessments increase as tax liability increases, which likely explains why audit rates increase as firm size increases. We also find that firms with out of state addresses are less likely to be audited but are more likely to be noncompliant. Finally, from our analysis of the predicted magnitude of noncompliance, we can conclude that, after controlling for firm size and audit selection, the industries most likely to yield high use tax audit assessments are firms in the *Mining and Utilities* and *Finance & Insurance* industries. Firms most likely to yield high sales tax audit assessments are firms in the *Information* industry. Finally, we examine ways Minnesota may implement new tax policy to mitigate further erosion of the sales tax base.

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The retail sales tax represents an important revenue stream for the state of Minnesota, accounting for roughly one-third of the annual tax base in the state. The sales tax has been studied extensively, including the incidence, administration and its vulnerability to tax base erosion with the growth of internet commerce. However, firm compliance with the state retail sales tax has not been studied in great detail, with the exception of two notable studies, Murray (1995) and Alm, Blackwell and McKee (2004). We extend this literature by examining firms' sales and use tax compliance using a unique data set for Minnesota. This data set allows us to examine first, the likelihood that a firm will be selected for audit, and second, the firm characteristics correlated with noncompliance. This paper will address evasion of two different, but related, taxes: sales tax, under which sellers must remit tax on sales receipts, and use tax, under which purchasers must remit tax on purchases.

Minnesota statute defines the sales tax base as the sale at retail of tangible personal properties and some taxable services. Sale at retail requires that the purchaser is the end user of the product. Minnesota's use tax was created to capture lost tax revenue on purchases not subject to sales tax, such as purchases made in other states, by mail or online. Compliance with use tax has traditionally been quite poor as it puts the requirement to record, declare, calculate and remit use tax on the consumer. It is also difficult to enforce compliance or to detect noncompliance because of the nature of the use tax. It is very easy for taxpayers to conceal purchases subject to use tax from taxing authorities, making it difficult to detect noncompliance. The difficulty of enforcement of use tax for e-commerce in particular has led to the false, yet widely accepted notion, that online purchases are essentially tax free (Nehill, 2004). Many taxpayers are simply unaware of the obligation to remit use tax. The Minnesota use tax rate is the same as the sales tax rate which has been 6.875% since July 1, 2009; however municipalities may impose an additional local sales tax in addition to the state rate.[1]

The sales and use tax gap is the difference between estimated revenue from expected "full-compliance" tax collection and the actual revenue collected. The gap is generated by current taxpayers who underreport and those businesses and households that should file and remit tax, but do not. In recent history, the gap has grown with the increased use of internet commerce.

Internet commerce, or e-commerce, has represented a growing portion of total goods and services sold in the United States over the past decade. Goldman Sachs has estimated that over the next 10 years e-commerce retail (business-to-consumer) will continue to grow rapidly, five times faster than traditional retail at 15 percent per year (Ballard and Lee, 2008; Goolsbee ,2000). This poses a problem for state taxing authorities, as only businesses with a brick-and-mortar presence in the state are required to collect and remit sales tax. This creates a price advantage for e-retailers over in-state vendors,

[1] This paper does not examine the portion of the gap attributed to local sales tax.

which introduces a distortion into the market and results in an inefficient allocation of resources. This price differential also raises questions of marketplace equity, as the profitability and market share of Minnesota based businesses could be lower as a result. States' inability to enforce use tax compliance, or to force remote sellers from collecting tax, has led to erosion of the traditional sales tax base because remote sales and services represent a growing portion of economic activity. Businesses utilize the ease of the internet to purchase office supplies, inputs, services and other transactions. The US Census Bureau estimates that business-to-business transactions represent approximately 200 billion dollars in national sales. Business-to-business transactions made possible through internet sales increased by more than 200 percent from 1998 to 2008, while total business receipts grew only 50 percent over the same period (Strauss, 2012). Sales from businesses to consumers follow a similar pattern. Business-to-business e-commerce has grown from 11.4 percent of total activity in 1999 to 22.1 percent of total activity in 2008 while internet sales from businesses-to-consumers grew from less than 1 percent of total activity to 22.1 percent over the same period (Strauss, 2012).

The lost revenue attributed to the difficulty to enforce use tax, or to force remote sellers to collect and remit sales tax, has become a very important issue at the state level. Many states have introduced alternative reporting regimes to increase use tax compliance and capture lost revenue; however, the success of these programs has been very limited. Some states have allowed individuals to report use tax liability on individual income tax returns, eliminating the need for purchasers to file a separate use tax return. Ten states provide for reporting both state and local tax on income tax returns; however, compliance remains modest even in states that have made this allowance. The fraction of income tax returns reporting use tax in 2009 was 9.8 percent in Maine, 7.9 percent in Vermont, and 5 percent in New York. Some states had much more modest compliance. In Rhode Island, California and New Jersey, fewer than 0.3 percent of individual income tax returns reported use tax liability (Manzi, 2012).[2]

In 2012, Minnesota Governor Mark Dayton and Ohio Governor John Kasich proposed tax reforms that would tax business-to-business services, such as advertising, accounting and legal services. The principles of tax reform generally include broadening the base and lowering rates while maintaining simplicity and equity of the tax system. Unfortunately it is very difficult to broaden the base of the sales tax in such a way that does to include business-to-business transactions and services that will not distort consumption behavior. For example, firms with in-house legal services and advertising services would be able to avoid a tax on professional services, while smaller firms would be subject to the tax for all external professional services, giving an advantage to vertically integrated businesses.

Similarly, the erosion of the traditional sales tax base due to growth in e-commerce has triggered states to consider various alternatives to the retail sales tax entirely. One such alternative approach to the sales tax is the value added tax (VAT), a tax on the value added to a product at each stage of its manufacture or distribution. It is

[2] Manzi also reports that nine states provide tables with estimated use tax liabilities based on income and allow taxpayers to pay those amounts in lieu of their actual tax liability, except that use tax must still be paid on large purchases. She observes that, on average, more people report use tax liability in those states, partly offset by a slight reduction in average use tax paid by each reporting person.

similar to the sales tax in that the tax is ultimately passed on to the end consumer, however a value added tax is collected and remitted each time a business in the supply chain adds value to a product. The VAT has gained popularity over the more traditional sales tax because it eliminates the necessity of the seller to determine whether or not the buyer is an end consumer. Proponents of the VAT argue that it does not allow for the evasion of sales tax through buying products through a business or purchasing products as a false business, both of which are possible under sales tax reporting regimes. The VAT is the most common form of tax on goods and services in the world; however, in the United States only Michigan has used a form of the VAT known as the Single Business Tax (SBT). Michigan repealed the SBT in 2006 and now uses the Michigan Business Tax.

Another alternative to the sales tax is the Gross Receipts Tax (GRT); the structure of the GRT is simple: a uniform rate on nearly all in-state transactions, including services, goods and business-to-business transactions. Like the VAT, the primary argument in favor of a GRT is that it can lower the costs of administration for the taxation authorities and the costs of compliance for firms. A GRT also broadens the base, allowing for rate reduction. Under a GRT, the tax rate can be lower than under a traditional retail sales tax, as there are fewer opportunities for evasion and allows for a broader base. However, seemingly simple at the surface, a GRT introduces many complexities into the marketplace that make it less popular than a sales tax or a VAT.

Under a GRT, every item that passes between companies through the production phase is taxed; as a result, goods produced with multiple phases of production, from raw material to manufacturing, are taxed repeatedly through subsequent stages. This structure results in punitively higher effective tax rates on complex products, produced in multiple phases by multiple companies, than products with fewer production stages or that are produced entirely in-house. This provides a powerful incentive for companies to absorb suppliers and vertically integrate. A GRT also inherently favors goods imported from states without a GRT, putting in-stage companies at a tax disadvantage to out-of-state importers (Chamberlain and Fleenor, 2006).

In this paper we will examine the remote sales tax gap at length. *Remote sales* include any sale involving a purchaser that has no physical contact with the seller's business location, an employee, or a representative of the seller. Remote sales include some sales for which the seller is required to collect and remit sales tax. If the seller is in the same state, the seller will have nexus. If the seller is from out of state but has nexus with the buyer's state, the seller is required to collect and remit sales tax. Nexus is created when a non-resident seller creates a substantial, frequent and continuous physical presence in a state. Physical presence may be exhibited in a number of ways, including but not limited to: the presence of employees or agents conducting business in a state, delivering products into a state using vehicles associated with you or your business, having an office, store of warehouse located in a state, participating in trade shows within a state, conducting bank business such as advertisement or purchasing insurance or owning, renting or leasing property in the state. Remote sales include business-to-business and business-to-consumer sales.

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The *remote sales tax gap* is the sum of all sales and use taxes owed on remote sales less any tax paid on those sales. The remote sales tax gap then, by definition, is the sum of unreported use tax owed by businesses, and unreported use tax owed by consumers, for remote sales. The *remote sales tax gap* is composed of two parts: i.) the filer use tax gap, estimated based on Minnesota audit experience, to the extent the unpaid use tax is from remote sales and ii.) the non-filer tax gap, or estimated use tax due on remote retail sales, both e-commerce and mail-order, as well as sales of selective services provided from remote locations. In this paper we will only estimate the filer use tax gap, as the non-filer tax gap is beyond the scope of this project.

The first segment of this thesis will estimate the gap primarily attributed to business-to-consumer sales, estimated using data on remote sales collected by the U.S. Census Bureau. Business-to-consumer sales are primarily sales to individuals, while business-to-business sales are primarily sales to firms. The second segment of the paper will examine unremitted sales and use tax, primarily attributed to business-to-business sales, using data from audits conducted by the Minnesota Department of Revenue. It is important to note that while e-commerce does play a significant role in the underreporting of use tax, the sales tax gap is largely comprised of noncompliance unrelated to e-commerce. While capturing lost tax revenue to e-commerce will significantly decrease the size of the use tax gap, a sales tax gap will persist. Finally, we will examine ways Minnesota may implement new tax policy to mitigate further erosion of the sales tax base.

Chapter 2

Minnesota Sales and Use Tax Gap Attributed to Remote Sales

Failure to collect sales and use tax from online retailers presents a problem that is fourfold. First, it inefficiently distorts consumer behavior by encouraging them to favor online retailers over brick-and-mortar retailers. Second, it inefficiently distorts vendor behavior by influencing where they should locate physical operations, like supply chain infrastructure, by the desire to avoid having a nexus in sales tax states. Third, the sales tax base has been significantly eroded; if an intervention is not taken to improve sales tax compliance for online sales, lost sales tax revenues are unlikely to be recovered, and could potentially further erode the traditional sales tax base. Internet retailing is growing at the expense of traditional retailing, diminishing revenue states have historically relied upon. Finally, failure to tax online sales may be regressive because individuals with limited income may not have the means to shop online; therefore, wealthier individuals can pay lower prices for the same goods online as those purchased by lower income individuals through traditional retailers. Figure 2.1 illustrates that while overall sales of retail goods and services have grown at a steady rate around 3%, e-commerce retail sales have grown at a much more rapid rate.

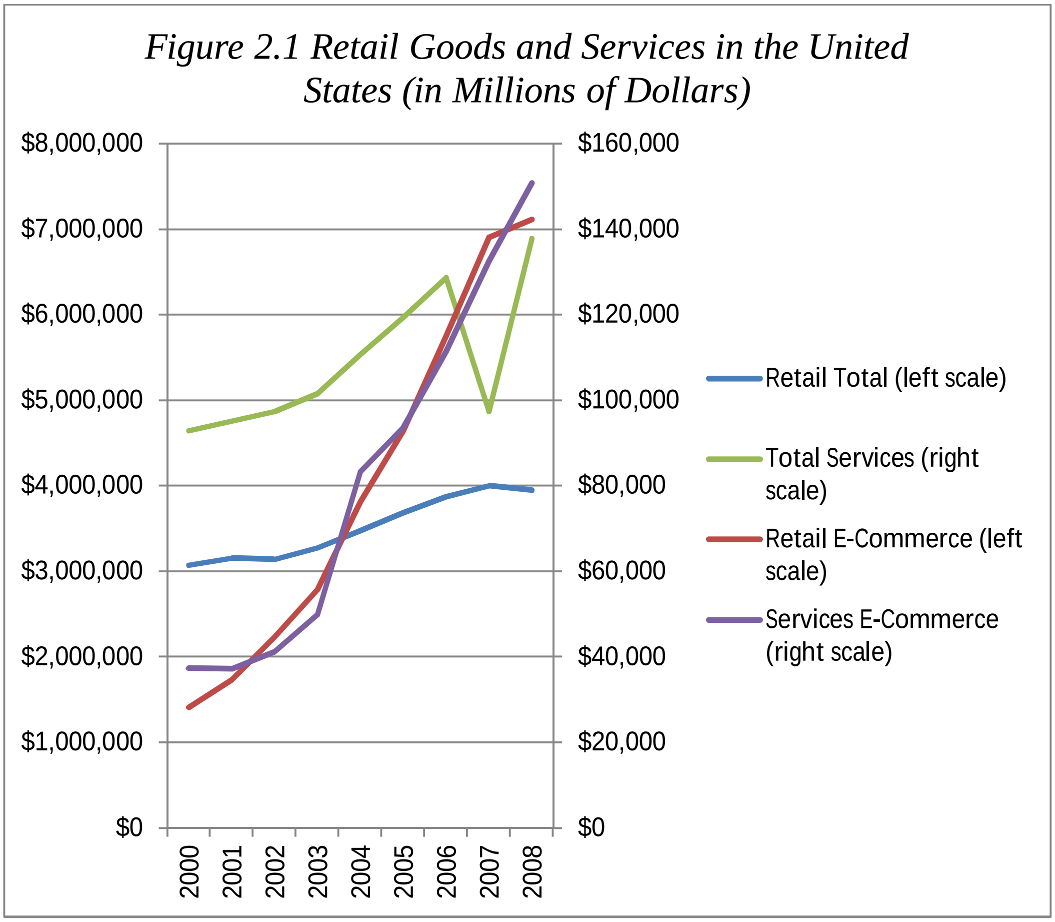


Figure 2.1 Data Calculated using figures from the U.S. Census Bureau
In 2009, the US Census Bureau altered the definitions to include additional services.

2.1 Background

The collection of tax on remote sales arises because states are unable to require remote vendors to remit the tax given the nexus restrictions as a result of the Supreme Court ruling in *Quill Corp. v. North Dakota ex rel Heitkamp (*504 U.S. 298, 317, 1992). Online companies have been the beneficiaries of this ruling as it established the requirement for “substantial nexus” as set forth in *National Bellas Hess, Inc. v. Dep’t of Revenue of Ill* (386 U.S. 753, 1967), which stated that a company must have a physical presence within a taxing jurisdiction before a state can require the collection of sales and use taxes. As a result, online companies have an advantage over their brick-and-mortar counterparts. Strauss (2012) conjectures that both profitability and market share are inherently lower for Minnesota businesses due to this price differential available to out-of-state vendors without a physical presence in Minnesota.

2.2 Preliminary Estimate of Remote Sales and Use Tax Gap

To estimate the size of the total remote sales tax gap for business-to-consumer sales, we use data from the U.S Census Bureau. Despite the growing significance of internet sales, a sufficient data source to track the size of e-commerce by state does not exist. Each year the U.S. Census Bureau estimates the volume of e-commerce for the retail sector (NAICS 44-45), the wholesale sector (NAICS 42), the manufacturing sector (NAICS 31-33) and selected services (NAICS 48-81).[3] The Census Bureau's e-stats are the most representative national level estimate of e-commerce data available. We exclude the manufacturing sector estimates from our calculations, because the manufacturing e-commerce activity reported by the Census Bureau reflects the value of shipments, rather than the value of sales, as in the cases of the retail and wholesale sectors. Our estimates do include online sales by the manufacturing sector because the Census estimates for the wholesale sector include the online sales of manufacturers' sales branches and offices.

The most recent annual e-commerce report, for calendar year 2010, estimates the volume of U.S. online retail sales for 2009 and 2010 at $145.26 billion $168.96 billion, respectively. The use tax due on remote retail sales and sales of selected services is estimated using the U.S. Census data for e-commerce and catalog sales. The Census Bureau assumes that retail and service e-commerce is entirely business-to-consumer. However; business-to-business sales represent a significant portion of e-commerce. To capture unpaid sales and use tax for business-to-business sales, estimates are calculated

[3] *2010 E-Commerce Multi Sector report.* U.S. Census Bureau, May 10, 2012, available at http://www.census.gov/econ/estats

based on Minnesota audit experience from May 2008 through August 2012 and will be estimated in the third chapter of this paper.

Federal data from the US Census Bureau database provides annual estimates of (1) remote retail sales by type of product and (2) electronic sales of services by service line. The percentage of e-commerce represented by Minnesota is assumed to be proportional to Minnesota's share of national sales by NAICS code. For example, we assume that if Minnesotans buy 1.8% of all women's clothing items sold in the U.S. from brick-and-mortar stores, then they also buy 1.8% of all women's clothing sold through online retailers. The value of national e-commerce shipments (by 13 retail sectors and 19 service sectors) was then scaled to Minnesota and the state general sales tax rate was applied. The Minnesota apportionment ratios can be found in Table I of the appendix.

Next, we exclude sales of exempt items. Sales of exempt items such as food, drugs, medical appliances, and clothing are not subject to sales or use tax, and are not included in our estimate. Some figures are scaled down by the estimated taxable percentage in the base. For example, books and magazines are subject to sales tax, but the exemption is rather narrow. Only textbooks and instructional materials required for a course of study at a public or private school, college, university or trade school are exempt. Additionally, subscriptions to magazines and journals are exempt, while sales of single copies are taxable.

We calculate the taxes due by applying the Minnesota sales tax rate; the rate of 6.5% was applied for years 2000-2008. On July 1, 2009 the sales tax rate changed to 6.875% so an average of the two rates was used for 2009 and the new rate was used for

2010.[4] This is the state general sales tax rate. Our estimates do not account for local sales tax rates that may apply.

We then find the difference between the taxes that are due and the taxes that were actually paid. We do this by adjusting the gap for actual sales tax collections from NAICS '4541' (Electronic Shopping and Mail-Order Houses) reported in Minnesota. Finally, we scale down the size of the gap to account for the *de minimis* use tax exemption for individuals. Minnesota Statutes, Section 297A.67, Subd. 21, provides an exemption for purchases that would otherwise be subject to use tax if they are made by an individual for personal use, and the total purchases do not exceed $770. If total purchases exceed $770, the full purchase amount is subject to tax. The $770 is an annual total, not a per-item or per-order amount.[5] The *de minimis* exemption adjustment is an estimate calculated by the Minnesota Department of Revenue in the Tax Expenditure Budget Report.[6] The figures used for the *de minimis* adjustment by year are included in Table 1 of the Appendix.

To calculate the percentage growth in e-commerce each year, we employ a series of calculations. For years 2000 through 2010, we use the actual growth rate as calculated by dividing the total e-commerce retail sales from the prior year by the total e-commerce sales for the current year and subtracting one. For years 2010-2013, we use the projected growth in sales tax revenue from the sales tax revenue forecast created by Minnesota

[4] It should be noted that the higher the sales tax rate, the more incentive exists for consumers to favor online shopping over traditional retail shopping. MN has the seventeenth highest sales tax rate in the nation, although we are one of only five states with a sales tax clothing exemption.

[5] There is no *de minimis* use tax exemption for businesses.

[6] Minnesota Department of Revenue, 2012. http://www.revenue.state.mn.us/research_stats/research_reports/2012/2012_tax_expenditure_links.pdf

Management and Budget.[7] We then multiply that rate by the expected growth rate in e-commerce, which we set at 5 percent based on the estimates calculated by Ballard and Lee (2008). For years 2014-2017, we assume an average growth rate of 3 percent for retail sales, and an expected growth rate of 5 percent for e-commerce.

Figure 2.1 summarizes the annual growth rates for U.S. online retail sales since 2000. The compound annual growth rate from 2000 to 2010 was 24.1 percent, so our estimates are conservative compared to past years. The sum of these two pieces yields a preliminary remote use tax gap estimate. Figure 2.2 shows only the portion of the gap attributed to the retail e-commerce sales tax gap. The business-to-business portion of this gap based on Minnesota audit experience is not accounted for in this estimate.

Figure 2.2 illustrates that Minnesota could collect an additional $200 million in tax revenue, should the requisite federal legislation pass; this assumes no small-seller exemption and full compliance after 2017. This estimate is similar to the oft-cited estimates of $149.6-253.3 million for years 2007-2012 produced by Bruce, Fox and Luna (2009). One attractive option for the state of Minnesota would be to simply repeal the *de minimis* use tax exemption for individuals. Manzi (2012) estimated that repealing the *de minimis* exemption for individuals would increase full-compliance revenues by $10.55 million in calendar year 2011. Minnesota is one of only five states with an individual *de minimis* use tax exemption.

[7] For the complete report see the Minnesota Management and Budget Forecast 2012. http://www.mmb.state.mn.us/doc/fu/13/complete-feb13.pdf

Figure 2.2: Remote Sales Tax Gap (Before Accounting for B-2-B Sales and De Minimus Exemption)

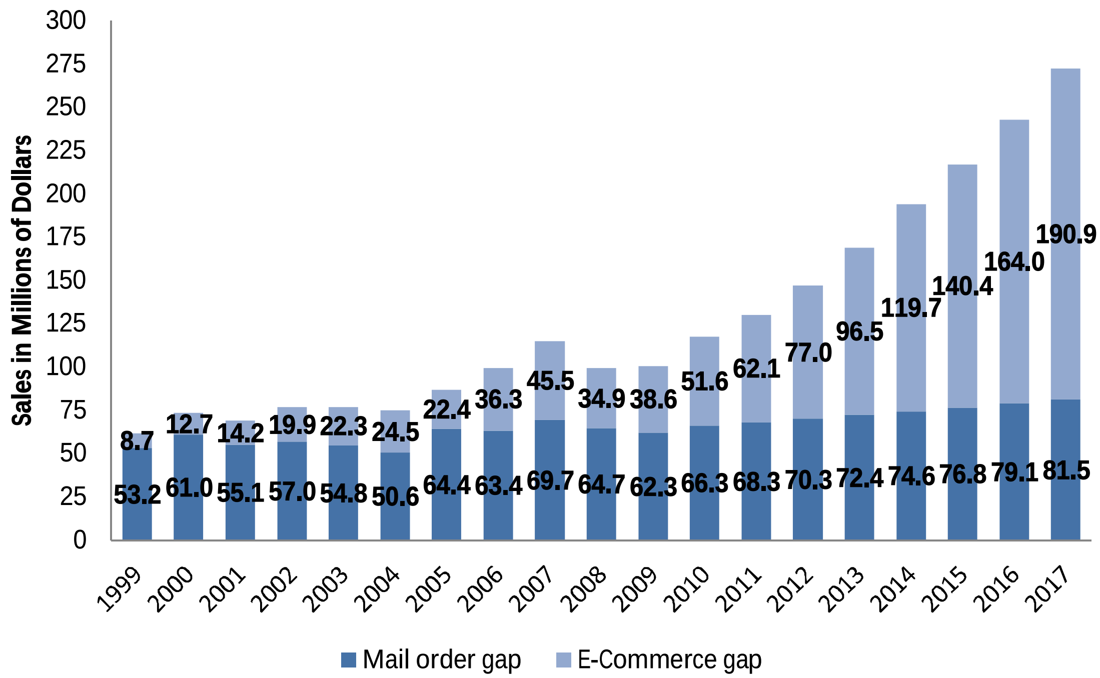
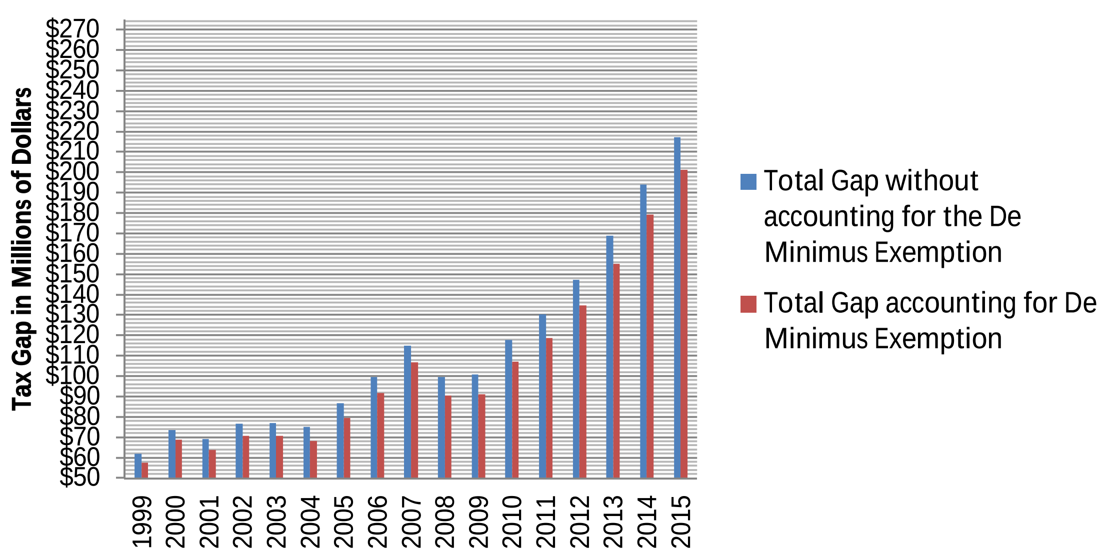


Figure 2.3 Remote Sales Tax Gap



Chapter Three

The Sales and Use Tax Gap estimated Using Minnesota Audit Experience

3.1 Literature Review

A number of studies have sought to estimate the amount of revenue lost due to the states' difficulty collecting use taxes. Most notably, Bruce, Fox and Luna estimated the nationwide revenue loss would reach $11.4 billion by 2012 (Bruce, Fox and Luna, 2009). However, this figure may be an overestimate, as many business-to-business sales made via the internet may be exempt from tax or for purchases on which tax has already been paid.[8]

In 2000 the Minnesota Department of Revenue issued an estimate of the state sales and use tax gap based on data arising from tax audits. The study was later updated, and the two studies provide gap estimates for years 2000 and 2004. The methodology used for both reports was the same. First, the population of audited firms was stratified by firm size and industry. Then the average ratio of noncompliance by industry and firm size was used to estimate total noncompliance. We seek to improve upon this method by controlling for additional factors that may be correlated with compliance behavior, such

[8] Both businesses and individual consumers are subject to use tax, although all business purchases should be exempt from sales tax, most states exempt only specific types of business purchases; *see* Noah Aldonas, ''Nebraska: DOR Disputes E-Commerce Sales Tax Loss Estimates,'' *State Tax Notes*, Aug. 27, 2012, p. 576, *Doc 2012-17681*, or *2012 STT 162-14*.

as whether a firm is located in another state. Additionally, we attempt to control for audit selection, as audit selection may not be random. It is possible the auditors have information beyond firm-size and industry when selecting audits. The earlier method assumes that all firms non-comply at the same rate as those selected for audit in the same industry and firm size category. Additionally under this method of estimation, it is not possible to control for variables that affect taxpayers' reporting decisions, including changes in tax laws and economic conditions.

The 2002 study yielded interesting results, and provides a foundation for this study. The 2002 study estimated the filer use tax gap to be $135 million, the filer sales tax gap to be $153 million and the non-filer gap to be $163 million, for a total gap of $451 million in 2000. To put this in perspective, the total voluntary compliance for sales tax in 2000 was $2.5 billion, while voluntary use tax compliance was $205 million. The 2008 update estimated the filer use tax gap to be $171 million, the filer sales tax gap to be $200 million and the non-filer gap to be $149 million, for a total gap of $520 million in 2004 (American Economics Group 2002; Hoheisel, 2008). In 2004, sales tax revenue represented nearly $4 billion in annual revenue, while use tax was approximately $271 million.

Murray (1995) investigated the determinants of audit selection and audit productivity for the Tennessee sales tax using a methodology that controls for audit selection, economic conditions, changes in tax laws and the compliance rate by firm size and industry before estimating the gap. Murray (1995)uses a three-stage selection procedure in which he first uses probit analysis to estimate the factors correlated with audit selection. He then determines the likelihood of firm noncompliance in the second stage. Finally, in the third stage, he uses linear regressions to estimate the level of noncompliance, using controls for selectivity bias from the first two stages.

Alm, Blackwell and McKee (2004) employ a methodology very similar to Murray (1995) to estimate audit selection rules and characteristics correlated with sales tax noncompliance in New Mexico. In this approach, they use a two-stage estimation procedure. In the first stage, again, they attempt to estimate factors correlated with audit selection, also referred to as the audit-selection rules. In the second stage, they estimate the rate of firm compliance for firms selected for audit in the first stage. To control for any bias generated by including only the audited firms, they control for audit selection using the Heckman sample selection procedure (Heckman, 1976, 1979).

3.2 Theoretical Framework

Sales tax compliance-tax enforcement is generally conceptualized as a strategic game between the revenue authority and the taxpayer (Graetz, Reinganum and Wilde, 1986). Subject to the uncertainty of audit, taxpayers seek to minimize reported liabilities, while revenue authorities select audits in order to maximize their return on investment[9]. Murray (1995) applies this framework empirically to the individual income tax, and Alm,

[9] This is only one objective of Revenue authorities; while return on investment is one component of audit selection, revenue authorities also seek to make sure taxpayers are paying their fair share, which might involve correcting firms that are overpaying and educating taxpayers to increase compliance rates .

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Blackwell and McKee (2004) follow the same approach for sales tax compliance. Our framework is similar.

In the sales and use tax compliance-enforcement framework there are two players, the risk averse firm owner/manager who seeks to maximize the expected utility of profits, and the auditor who seeks to select audits with the highest likely return on the state's investment in auditing resources.

Following the example of Murray (1995) and Alm, Blackwell and McKee (2004), we first consider the behavior of the risk averse firm. We assume the owner/manager has already chosen the levels of inputs and outputs necessary to maximize the firm's profits. The firm must then determine the fraction of total sales tax revenue collected that will not be remitted to the taxing authority. The firm's optimization can be determined by solving for the fraction of sales tax revenue π_C that the firm voluntarily remits to the taxing authority.

(1) $\pi_c{}^* = \pi_c(t, f, p, R, C, Z)$

Where *t* represents the sales tax rate, *f* represents the penalty rate, *p* represents the probability of audit, *R* represents the total revenue net-of-tax and *C* represents total production costs. Z represents the vector of characteristics that might make a firm more likely to be audited. For example, firms with multiple locations, an out-of-state address or firms that chronically late file may be more susceptible to audit.

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Second, we consider the behavior of the taxing authority. The taxing authority's audit selection approach will be a function of the characteristics they believe will yield the greatest return. The Minnesota Department of Revenue has no formal audit selection rules. This is perhaps to maintain taxpayer uncertainty regarding audits. Schotchmer and Slemrod (1989) and Alm, Jackson and McKee (1992) show that taxpayer uncertainty regarding audit selection policies can lead to greater compliance. The absence of selection rules may also be intended to maintain an equitable proportion of audits across industries and firms. Even without formal rules, however, it is possible that auditors do not randomly select audits, but in fact look for certain firm characteristics or behaviors that may make them more likely to be noncompliant.

This function leads the auditor to assign each potential audit some index of $Audit\ Assessment^*$, which reflects the auditor's anticipated return on the audit based upon a vector of firm characteristics. The taxing authority's objective function, $Audit\ Assessment^*$, is then is a linear function of firm characteristics X and Minnesota Department of Revenue budget resources $\emptyset$. The error term ε is assumed to be normally distributed with a mean of zero, reflecting the fact that the taxing authority cannot determine audit productivity perfectly prior to audit.

(2) $Audit\ Assessment^* = \beta X + \beta\emptyset + \varepsilon$

Because we do not observe the audit selection rules, we must evaluate the characteristics we do observe: those of audited firms. Audit selection can be viewed as a probability of audit, where p^*_{audit} represents the probability that a firm will be selected for audit based upon observable firm characteristics and department resources.

$$(3)\quad p^*_{audit} = p_{audit}(Audit\ Assessment^*)$$

This equation reflects the potential endogeneity of the audit selection process; the probability of audit is not in fact, perfectly random, but instead depends upon certain observable factors. To analyze the firm characteristics associated with compliance, we must first control for the audit selection process. We do this two ways: first, we control for audit selection using the Heckman (1979) correction for sample selection, the inverse Mills ratio; second, we use propensity score weighting to control for audit selection.

3.3 Econometric Approach

Our econometric approach consists of a two-stage estimation procedure. In the first stage, we estimate the likelihood of audit, pooling both audited and non-audited firms. In the second stage, we estimate non-compliance in two ways. First, we estimate a probit model to examine factors that predict whether firms are noncompliant or compliant. Second, we estimate a Tobit model to evaluate the factors predicting the magnitude of noncompliance. To correct for the endogeneity of audit selection, we employ two alternative econometric approaches. First, we use the Heckman sample selection correction. Second, we use propensity score weights to control for audit selection. Using two alternative approaches to control for audit selection allows us to compare the results of both second-stage regressions.

There are several advantages to this approach. The first stage investigates factors that might make a firm more likely to be selected for audit; more importantly however, the first stage estimation is necessary to generate unbiased estimates in the second stage of the analysis. If the firms selected for audit were in fact selected based on certain firm characteristics, these firms will differ from the firms not selected for audit and must be isolated to discern the firm characteristics correlated with rates of noncompliance.

3.3.1 The Probit Model

The equation for the first-stage audit selection, equation (2), allows us to examine whether certain firm characteristics or auditing resources have an impact on audit selection. Although we do not yet observe $Audit\ Assessment^*$ for every firm, we do observe firms that are audited ($p_{audit} = 1$) and those who are not audited ($p_{audit} = 0$), which generates the indicator variable $Audit\ Assessment$ for each firm. Using equation (3), we observe the following for audited firms:

(4) $Audit\ Assessment = 1\ if\ Audit\ Assessment^* > 0,\ 0\ otherwise$

We estimate this equation by probit analysis, which estimates the probability that a firm is audited as a linear function of firm characteristics X and Minnesota Department of Revenue budget resources $\emptyset$. This equation includes variables indicating industry, firm size, firms located out-of-state and dummy variables indicating the year to correct for variations in the budget of the Department of Revenue.

Second, we observe compliance of audited firms ($p_{audit\ assessment} = 1$). In this regression the compliance rate is either 0 or 1, with some audits resulting in no change, indicating full compliance, and some firms with audit assessments, indicating noncompliance. We indicate no-change audits and refund audits with a 0, indicating full compliance, and audit assessments with 1, indicating noncompliance. This regression equation includes the same variables as first regression, but eliminates variables associated with taxing authority resources such as the year variables and the out of state indicator. This is based on the assumption that those variables are correlated with auditing resources, but not necessarily with firm compliance.

The probit model allows us to evaluate the response probability of an event. This relationship is represented in the following equation:

(5) $P\left(y = 1 \middle| x\right) = P(y = 1 | x_1, x_2.., x_k)$

Where we use *x* to denote the full set of explanatory variables, in this case, x represents firm characteristics.

Wooldridge (2009) shows that in the probit model, G represents the standard normal distribution function, which is expressed as the integral:

(6) $G(z) = \Phi(z) \int_{-\infty}^{z} \Phi(v) dv$

where Φ(z) is the standard normal density. This choice of G ensures that (5) is strictly between one and zero for all values of the parameter x_j (Wooldridge, 2009). The probit model can be derived from an underlying latent variable. Let y^* represent an unobserved, or latent variable, determined by

(7) $y^* = \beta_0 + x\beta + \varepsilon$,

(8) $y = 1\{y^* > 0\}$,

where y^* takes the value of one if the event in brackets is true, and zero if otherwise. We assume that the error term ε is independent of *x* and that ε is symmetrically distributed about zero.

Because the independent variables are all binary, we must omit one variable from firm size and one variable from industries to avoid multicollinearity. We omit *De Minimis* industries from the industries included in the regression and firms with annual tax liability less than or equal to zero from our firm size categories. As a result, we interpret our coefficients as the rate the independent variable (x) relates to the dependent variable (y) in relation to the omitted variable. We follow the same methodology for the Tobit model.

3.3.2 The Tobit Model

Finally, we conduct the second-stage regression analysis for all audited firms ($p = 1$). We estimate this equation using Tobit maximum likelihood estimation. Because we have a significant number of observations with assessments equal to zero, a linear model would likely lead to negative predictions for some observations (Wooldridge, 2009).

To overcome the nonlinear nature of this model, we rely on maximum likelihood methods. The theory of maximum likelihood estimation for random samples implies that the maximum likelihood estimation is consistent, asymptotically normal and asymptotically efficient (Wooldridge, 2009). This equation again includes variables indicating various firm characteristics; however the year binary variables and the out of state binary variable are no longer included in the second-stage regressions. We exclude these variables following the example of Alm, Blackwell and McKee (2004), based on the assumption that these variables serve as a representation of Revenue resource availability that affects the audit rate in the first-stage but not the compliance rate in the second stage.

In summary, the Tobit model assumes the following relationship:

(9) $y^* = \beta_0 + x\beta + u, u \mid x \; Normal(0, \sigma^2)$

(10) $y = max(0, y^*),$

where the observed y equals y^* when $y^* \geq 0$ but equals 0 when $y^* < 0$. Therefore, we can see that the relationship between the expected value, $E(y \mid x)$, of all observations is dependent upon the expected value when above the limit, $E(y \mid y > 0, x)$, as well as the probability of being over the limit (McDonald and Moffitt, 1980).

Wooldridge (2009) shows that

(11) $$E(y \mid x) = \Phi\left(\frac{x\beta}{\sigma}\right) * E(y \mid y > 0, x)$$

Where $\Phi\left(\frac{x\beta}{\sigma}\right)$ is the cumulative normal distribution, x is a vector of independent variables (firm characteristics), β is a vector of unknown coefficients and

(12) $$E(y \mid y > 0, x) = x\beta + \sigma\lambda(\frac{x\beta}{\sigma})$$

Where λ represents the *inverse Mills ratio*. Substituting equation (7) into equation (6) we find the following:

(13) $$E(y \mid x) = \Phi\left(\frac{x\beta}{\sigma}\right) x\beta * \sigma\varphi(\left(\frac{x\beta}{\sigma}\right)$$

Where Φ represents the cumulative distribution function and φ represents the probability distribution function, where both Φ and φ are evaluated at $(\frac{x\beta}{\sigma})$.

There are two primary limitations associated with the Tobit model. First, the Tobit model assumes that for each firm the probability of audit is the same. This decreases the accuracy of the model; however, we do include λ, the inverse Mills ratio from the first-stage regression to mitigate this problem. Second, the $E(y \mid x)$=is not a linear function of x and β (Wooldridge, 2009).

3.3.3 Second-Stage Sample Selection Corrections

Auditors may know something about the firms selected for audit that we cannot accurately control for in the regression, so we must control for this non-random selection bias using statistical methods. We attempt to correct for the non-random audit selection two ways: first, using Heckman's selection correction (1979); second, using propensity score weighting (Angrist and Pischke, 2008).

The Heckman Correction

Heckman (1976, 1979) proposed a solution for non-random sample selection. Recall that we want to estimate the audit outcome equation of the following model:

(14) $$y_{1i}^{*} = x'_{1i}\beta_1 + u_{1i}$$

(15) $$y_{2i}^{*} = x'_{2i}\beta_1 + u_{2i}$$

Where the rate of non-compliance, y_{1i}^{*}, is only observed for audited firms, where y_1 is observed.

(16) $$y_{1i} = y_{1i}^{*} \; if \; y_{1i}^{*} > 0$$

(17) $$y_{1i} = 0 \; if \; y_{2i} \leq 0.$$

Model (13) is estimated using a probit selection equation that describes the probability of audit. Heckman (1979) proposed a two-step method to estimate likelihood. For the subsample with a positive $y_{1i}{}^*$, firms that were audited, the conditional expectation of $y_{1i}{}^*$ is given by the following equation:

(18) $$\mathrm{E}(y_{1i}{}^* \mid x_{1i}, y_{2i}{}^* > 0) = x'_{1i}\beta_1 + E(u_{1i} \mid u_{2i} > -x'_{2i}\beta_2)$$

Heckman (1979) shows that the conditional expectation of the error term is:

(19) $$\mathrm{E}(u_{1i} \mid u_{2i} > -x'_{2i}\beta_1) = \frac{\sigma_1}{\sigma_2}\frac{\sigma\left(\frac{-x'_{2i}\beta_2}{\sigma_2}\right)}{1-\Phi\left(\frac{-x'_{2i}\beta_2}{\sigma_2}\right)}$$

Where σ and Φ represent the cumulative density function and standard normal distribution respectively; as such, we can rewrite formula (18), the conditional expectation of $y_{1i}{}^*$, as

(20) $$\mathrm{E}(y_{1i}{}^* \mid x_{1i}, y_{2i}{}^* > 0) = x_{2i}\beta_1 + \frac{\sigma_1}{\sigma_2}\frac{\sigma(\frac{-x'_{2i}\beta_2}{\sigma_2})}{1-\Phi(\frac{-x'_{2i}\beta_2}{\sigma_2})}$$

Then, we introduce Heckman's inverse mills ratio, equation (21), using a probit regression.

(21) $$\lambda\left(\frac{-x'_{2i}\beta_2}{\sigma_2}\right) = \frac{\sigma_1}{\sigma_2}\frac{\sigma(\frac{-x'_{2i}\beta_2}{\sigma_2})}{1-\Phi(\frac{-x'_{2i}\beta_2}{\sigma_2})}$$

Finally, we estimate equation (22) as the second-step of the selection equation. Heckman (1979) characterized the sample selection problem as a special instance of the omitted variable problem, where λ represents the omitted variable if ordinary least squares (OLS) regression were used when ${y_{1i}}^*$ is greater than zero. As long as u_2 has a normal distribution, and the error term is independent of λ, the two-step estimator is consistent (Puhani 2002).

$$(22) \qquad y_{1i} = x'_{1i}\beta_1 + \frac{\sigma_1}{\sigma_2}\frac{\sigma(\frac{-x'_{2i}\beta_2}{\sigma_2})}{1-\Phi(\frac{-x'_{2i}\beta_2}{\sigma_2})} + \varepsilon_1$$

Heckman's inverse Mills ratio has been criticized when used with small sample sets; however, this method is consistent under large samples (Wooldridge 2009).

Propensity Score Weighting

Propensity score weighting provides an alternative approach to control for the audit selection bias. The propensity score is the probability of treatment assignment dependent upon conditional observed baseline characteristics. The propensity score exists in both randomized experiments and observational studies. In randomized experiments the propensity score is known and defined by the study design. In observational studies, the propensity score is not known but can be estimated using the study data. The propensity score is derived from the first-stage probit audit selection equation and represents the predicted probability of treatment (audit selection) based upon the fitted regression model (Austin 2012).

There are several methods for calculating propensity scores. For this project we use the inverse probability of treatment weighting (IPTW) as the propensity score. This approach uses the propensity score as a weight to create a sample in which the distribution of baseline covariates is independent of treatment assignments. IPTW was first proposed by Rosenbaum (1987). The propensity score weights are calculated by taking the inverse of the probability that the observation was treated (audited) from the first-stage probit equation. This method is sensitive to extreme values of the weights and may be inaccurate for subjects with a very low or high probability of treatment; however, only 8.2% of our observations had a predicted probability of audit below .05 or greater than .95. These observations were set equal to .05 or .95 to mitigate the sensitivity of the IPTW approach.

3.4 Data

We begin with a data set containing information from the returns voluntarily remitted to the Department of Revenue at least once between the years 2006 and 2011. This data consists of 730,572 monthly observations of Minnesota businesses who filed Minnesota returns. This data set includes the sales and use tax voluntarily remitted to the Department of Revenue for each month, address information and the type of business as defined by the North American Industrial Classification System (NAICS) codes. The original data set contains one observation for each filing made by a firm to the Department of Revenue. Sales tax can be filed monthly, quarterly, semi-annually or annually. Additionally, firms may submit amended returns. So some taxpayers may have only a single annual observation, while others could have many observations each year, depending upon their filing period and submissions of amended returns. To create a uniform standard of the data, we divide the sales tax liability (including any additional liability submitted on amended returns) by the number of months in the filing period. This creates one observation for each month included in any period for which the firm remitted sales tax or use tax.

The secondary data set, the audit data set, contains information regarding 20,082 audits. Of those, 83.4 % were registered taxpayers with the Department of Revenue and the remaining audits were of non-filing firms, at any time for the period 2006-2011. Of the firms audited, 13.7% were fully compliant, meaning the audit resulted in no change or a net refund. We examined audits completed in the years 2008, 2009, 2010 and 2011. Audits completed in 2008 often contain records from 2006 and 2007 as well, which necessitates using return data for years 2006-2011. At the time the data was pulled, many 2011 audits were not yet complete and as such, only a limited number of audits are available for 2011.

Our data set originally includes audit assessments for non-filing firms, or firms that were not voluntarily remitting tax to the Department of Revenue at the time of audit. We omit these observations from our data set, because we do not have enough information about the firm characteristics of non-filing firms to accurately draw conclusions regarding the compliance behavior of these firms. The Department of Revenue collects approximately 6 to 10 million dollars in revenue from non-filing firms each year. [10]

The data available from the audit data set includes information regarding the sales tax assessment, use tax assessment, net penalties, addresses and NAICS codes. The audit data set originally contained one observation for each audit. Audit periods typically cover three years; however, some audits may only cover one month. Again, we created a single observation for each firm for each month of the audit period by dividing the audit assessment by the number of months in the audit period. Unfortunately, this limits our ability to observe whether a firm's compliance behavior varies throughout the year.

Alm, Blackwell and McKee (2004) include control variables for the average deductions reported, the age of the firm and the number of years in which the firm failed to file a return. Unfortunately, this information is not available in our data set. Murray (1995) also includes variables for the age of the firm and the average number of late returns filed. He also accounts for the number of affiliated outlets with the firm, the average hours spent on the audit and the number of auditors available to conduct audits. Murray controls for the average gross sales reported over a period, as well as the magnitude of variations in reported gross sales. Ideally, we would include the age of the firm in future studies, as newer firms may be less compliant than their older counterparts.

[10] This estimate is subject to change depending on the resources of the Department of Revenue.

Another ideal variable would be a discrete variable indicating the number of affiliated outlets, as the number of audit leads may increase if leads are generated through the detection of noncompliance in affiliated outlets.

We do include a discrete variable to indicate whether the firm is located out-of-state, as it is likely auditors have different audit selection rules for out-of-state firms. We also include several variables for industry, indicated by NAICS code, and firm size, based on annual tax liability. Both Murray (1995) and Alm, Blackwell and McKee (2004) include variables indicating firm size; however, only Alm, Blackwell and McKee include information regarding the industry type. Our study includes a more detailed list of industries, as well as income tiers indicating firm size indicated by dummy variables rather than a continuous variable to indicate firm size based on average gross receipts.

The combined dataset matched each monthly observation from the audit data set to the return dataset, yielding our pooled dataset. From the pooled dataset, we created variables to represent the firm-size and industry of each firm in the dataset. Looking at the raw data, we can observe audit rates without controlling for any of the factors that may be correlated with audit selection. We observe that as firm sizes increase, the likelihood of audit increases. Firms with liability greater than $500,000 are nearly four times more likely to be audited than firms with liability of $1-1,000. Firms in the *Mining & Utilities, Information, Transportation & Warehousing* and *Construction* face the highest likelihood of audit. Firms in *Retail Trade* and *Other Services* face the lowest audit rates.[11]

Variable definitions and descriptive statistics for both data sets, audited and unaudited, are reported in Table 4 of the appendix. The compliance rate measure for firms was calculated by taking the ratio of voluntary compliance of the taxpayer to the "true" tax liability, or post-audit findings.[12] Firms were considered "audited" if they were audited at any time during calendar years 2006-2011.[13] Noncompliance includes both firms that purposefully avoided paying their full tax liability as well as firms that underpaid their liability due to malfeasance, misfeasance or nonfeasance[14]. The audit data does not include any indication of whether the taxpayer was purposely avoiding payment of the tax, or whether the noncompliance was accidental, as is often the case with use tax.

The *monthly voluntary compliance* field is unique to each taxpayer for each month the taxpayer filed a return. This amount is the actual tax paid to the Department of Revenue. The *monthly audit assessment* field is also unique to each taxpayer for each month of the audited period and reflects the amount of tax that was not remitted to the Department of Revenue, but was deemed as a liability by the auditor. The *compliance rate* was determined by taking the sum of audit assessments divided by the sum of total

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[11] We are prevented from releasing exact audit frequencies by a non-disclosure agreement with Minnesota Department of Revenue.
[12] This compliance rate assumes the auditor is able to determine 100% of the firm's noncompliant behavior.
[13] The Department of Revenue asked us not to disclose actual audit rate information.
[14] Malfeasance, misfeasance and nonfeasance are legal terms used to describe the type of behavior associated with noncompliance with the law. Malfeasance describes purposeful, even aggressive, behavior; misfeasance describes accidental noncompliance and nonfeasance describes total noncompliance.

compliance, voluntarily remitted revenue and assessments. We calculate *monthly voluntary compliance, monthly audit assessment and compliance rate* for both sales tax and use tax.

Figure 3.1 shows the average of *Compliance Rate* by NAICS code, estimated from our audited firm data set. The average compliance rate across all firms was 71%, with sales tax compliance averaging 89% compliance and use tax compliance at only 52%. Sales tax compliance ranges from highs of 98% compliance in the *Mining & Utilities* industries and 96% in *Finance & Insurance*, to a low of 79% in the *Administration & Waste Industries*. Use tax compliance ranges from a high of 98% in *De Minimis* Industries to a low of 24% in *Other Services*. The industries included in *De Minimis* include: Forestry, Hunting, Fishing, Agriculture Support, Unclassified, Education and Healthcare.

Figure 3.2 shows the average of *Compliance Rate* by firm size. Both Figure 3.1 and 3.2 clearly illustrate the lower rates of use tax compliance than sales tax compliance across industries and firms. Sales tax compliance rates increase as firm size increases; the largest firms, firms with annual tax liability greater than $500,000 have the highest use tax compliance rate of 80%. Use tax compliance appears quite poor in this chart, but it is important to keep in mind that all outliers are included in this figure, and that only audited firms are included in these calculations. Use tax by firm size ranges from a low of

13% among audited firms with tax liability of $1-$1,000 and a high of 30% among firms with tax liability greater than $500,000.

Figure 3.1 Total Rate of Compliance by Industry for Audited Firms

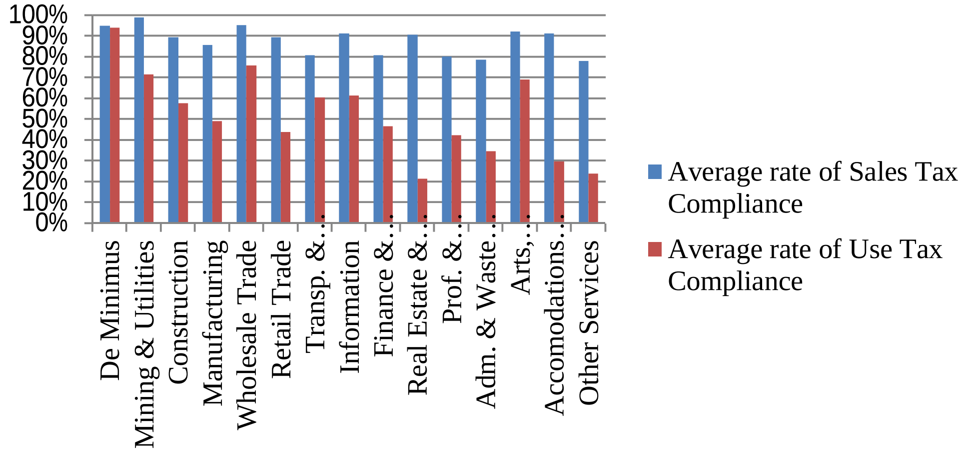
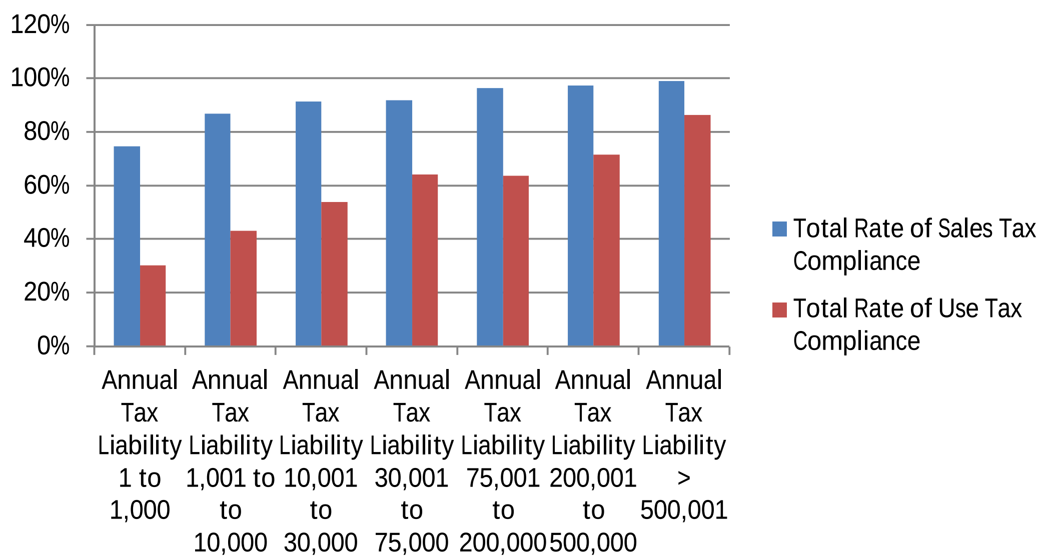


Figure 3.2 Total Rate of Compliance by Firm Size for Audited Firms



3.5 Estimation Results

The first-stage audit selection equation estimates the factors that may affect the likelihood of audit selection and combines the audited and non-audited firm samples for years 2006-2011. This data set includes 748,400 observations, 39,878 of which were audited at least once during the time period. Firms that were audited multiple times during this period include one observation for each audit. The dependent variable is the observed variable *audit*, equal to 1 if the firm is selected for audit and 0 otherwise. Independent binary variables indicating the firm size, industry, year and whether the firm was located outside the state. A detailed list of the binary variables used to indicate firm size and industry can be found in Table 2 of the Appendix.

The estimation results for the first-stage model of sales tax audit selection are presented in Table 4. Several explanatory variables have a statistically significant impact on the likelihood of audit selection by the Department of Revenue, supporting the theory that audit selection is not entirely random.

Table 4 provides the marginal effects from the first-stage equation for both the probit and logit regressions. Only the probit results will be discussed in detail; however, the logit results are similar in sign and magnitude to those of the probit regression. Industries are compared to the baseline of firms categorized as *De Minimis*; similarly, the baseline comparison for firm-size are firms that had liability less than or equal to zero. This complicates our interpretation of marginal effects a bit, because rather than comparing the marginal effects to the baseline comparison, we will compare the marginal effects to the industry and firm size that are least likely to be audited. Similarly, the results of these regressions are the results after controlling for firm characteristics included in the model such as firm size and industry, as such, our probabilities will not perfectly correlate to the frequencies when looking at the raw data and as described in chapter 3.4.

The industries with the lowest probability of audit are firms in the following industries: *Other Services, Accommodations & Food Services,* and *Retail Trade*. The firms most likely to be selected for audit are firms in the *Finance & Insurance* industry, firms in the *Mining & Utilities* industry and firms in the *Construction* industry. Firms in the *Finance & Insurance* industry are most likely to be audited, with a predicted audit rate 1.63 percentage points higher than *De Minimis* firms, and 4.6 percentage points higher than the least likely to be audited industry, *Other Services*. Firms categorized as *Mining & Utilities* are second most likely to be selected for audit, as these firms have a 1.14 percentage point higher rate of being audited than *De Minimis* firms and a 4.11 percentage point higher rate of being audited than the least likely industry.

These results also indicate that as tax liability increases, firms are more likely to be selected for audit. Firms with annual tax liability of $1-$1,000 have a predicted probability of being audited that is 24.27 percentage points lower than firms with tax liability exceeding $500,000. Firms with zero liability are the least likely to be audited.

After controlling for industry and firm size, firms located out-of-state are less likely to be audited than firms in state, these firms face a predicted audit rate 2.89 percentage points lower than their in-state counterparts, after controlling for firm size and industry. Our results also show that the lowest likelihood of audit selection for the study period occurred during 2006 and 2007, with audit rates being 0.63 percentage points higher in 2008-2009 and 1.63 percentage points higher in 2008 and 2009. This may be the result of increased resources allocated to the Department of Revenue; however, neither of the year variables are statistically significant.

The selection power for both models is detailed in Table 5. We test the predictive power of the model using a method proposed by Park and Capps (1997). Typically, if the estimated probability is greater than .5 and the first alternative is selected (in this case, the firm is audited), we assume the decision is correctly classified. Alternatively, if the estimated probability is less than .5 and the second alternative is selected (the firm is not audited), the decision is correctly classified. We seek maximum proportion of classifications in our model. But in many cases, the appropriate cutoff may not be .5. Rather, we select a cutoff proportional to the number of audited firms in our data set. Using this approach, we accurately predict the outcome 83% of the time. The predictive power of the model can be found in Table 2. The Chi-square statistic provides a goodness-of fit measure; for the probit model the Chi-square statistic is 312, which is quite strong. We also observe McFadden’s Likelihood Ratio of .056, which further suggests the strength of the model. These results suggest that auditors do employ some audit selection rules, with some industries and firm sizes facing a greater likelihood of audit selection than others.

These results are not strictly comparable to those of Alm, Blackwell and McKee (2004) or Murray (1995), as our data, variable definitions and specifications vary slightly as discussed previously. We found that audit probability increased as firm size increased, which is contrary to the findings of Murray (1995) who found that firms with greater annual tax liability, and as such greater gross sales, had a lower probability of audit. However, this finding is in line with those of Alm, Blackwell and McKee (2004) and may be attributed to the fact that larger firms, ceteris paribus, have higher tax liabilities and as such, may prove to be more productive targets. Larger firms also may have more resources available to support noncompliant behavior such as legal resources and accountants. Our findings show that firms located outside the state are less likely to be audited than firms with in-state addresses, which is in line with the findings of Murray(1995), as well as Alm, Blackwell and McKee (2004). This finding may be a result of more resources located within the state.

CHAPTER 3. THE SALES AND USE TAX GAP ESTIMATED USING MINNESOTA AUDIT EXPERIENCE

TABLE 1

FIRST-STAGE AUDIT SELECTION EQUATION

Independent Variable	**Probit Marginal Effects**		**Logit Marginal Effects**	
Mining & Utilities	1.14%	***	-0.20%	***
Construction	0.94%	***	0.17%	***
Manufacturing	0.10%	***	-0.09%	***
Wholesale Trade	-0.11%	***	-0.24%	***
Retail Trade	-2.19%	***	-0.64%	***
Transp. & Warehousing	-1.12%	***	-0.24%	***
Information	0.39%	**	-0.06%	**
Finance & Insurance	1.63%	***	0.34%	***
Real Estate & Leasing	-1.39%	***	-0.47%	***
Prof. & Technical Services	-0.40%	***	-0.10%	***
Adm. & Waste Management	-1.43%	***	-0.33%	***
Arts, Entertainment & Recreation	-1.45%	***	-0.36%	***
Accomodations & Food Services	-2.20%	***	-0.85%	***
Other Services	-2.97%	***	-0.74%	***
Annual Tax Liability 1 to 1,000	2.68%	***	0.69%	***
Annual Tax Liability 1,000 to 10,000	7.01%	***	1.52%	***
Annual Tax Liability 10,001 to 30,000	14.63%	***	1.90%	***
Annual Tax Liability 30,001 to 75,000	19.44%	***	2.24%	***
Annual Tax Liability 75,001 to 200,000	22.97%	***	2.53%	***
Annual Tax Liability 200,000 to 500,000	25.20%	***	2.85%	***
Annual Tax Liability > 500,001	26.95%	***	2.81%	***
Outstate	-2.89%		-0.51%	
Year 2008-2009	0.63%		1.88%	
Year 2009-2010	1.60%		-0.56%	
Number of Observations	*730,572*		*######*	
Log-likelihood	*70366*		*14,650*	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

Table 2			
Predictive Power			
PROBIT	**Predicted Outcome**		
Actual Outcome	*Not Selected*	*Selected*	*Total*
Not Selected	*594,235*	*398,214*	*708,522*
Selected	*7,828*	*14,222*	*22,050*
Total	*602,063*	*128,509*	*730,572*
Percentage Correct	*84%*	*64%*	*83%*
LOGIT	**Predicted Outcome**		
Actual Outcome	*Not Selected*	*Selected*	*Total*
Not Selected	*310,308*	*398,214*	*708,522*
Selected	*3,043*	*19,007*	*22,050*
Total	*313,351*	*417,221*	*730,572*
Percentage Correct	*44%*	*86%*	*45%*

In our second set of estimation results, we first examine the probability of noncompliance for audited firms. Any firm with an audit assessment greater than zero is considered noncompliant, whereas firms with an assessment of zero or a net refund are considered compliant. Again, we use the probit model to determine the probability of whether or not the audit yields an assessment. The dependent variable is a binary variable equal to zero for no-change audits and refund audits, and 1 for audits with an assessment. We run the equations separately for sales tax and use tax, to observe whether some firms are more likely to non-comply with use tax than sales tax or vice-versa. We estimate this model two ways: first, we run the probit model without controlling for audit selection from the first regression; second, we run the probit model controlling for audit selection in the first equation. The results of these regressions are reported in Tables 3a and 3b respectively. This regression was run for audited firms with sales tax liability (16,525 firms), and firms with use tax liability (11,919 firms). This regression allows us to compare the difference in sales and use tax compliance rates across industries.

First, we examine the marginal effects of audit outcomes with respect to use tax. We observe that firms in the following industries are most compliant: *Construction, Professional & Technical Services* and *Finance & Insurance. Retail Trade* firms are most likely to be noncompliant, with marginal effects suggesting that have a predicted probability that is .22 percentage point higher than that for *De Minimis* firms. Firms located outside the state have a slightly higher rate of noncompliance than their in-state counterparts; they have a .19 percentage point increase in the predicted probability rate. Finally, we observe that firms are increasingly compliant as tax liability increases.

Next, we examine the marginal effects with respect to sales tax audit outcomes. The firms most likely to be compliant with sales tax are firms in the following industries: *Retail Trade, Accommodations and Food Services,* and *Wholesale Trade.* Firms in the *Finance & Insurance* industry have the lowest compliance rate. With respect to firm size, again we notice that the probability of having an assessment decreases as tax liability increases, suggesting that larger firms are more compliant.

For both sales and use tax, firms located out-of-state are slightly more likely to be noncompliant than firms located in-state; however this variable is only statistically significant for firms with sales tax liability.

TABLE 3a				
PROBIT ESTIMATES: PROBABILITY OF NONCOMPLIANCE FOR AUDITED FIRMS				
Independent Variable	**Probit Sales Tax Audit OutcomeMarginal Effects**		**Probit Use OutcomeMarginal Effects**	
Mining & Utilities	0.07	***	(0.08)	
Construction	(0.05)	***	0.05	
Manufacturing	0.09	*	(0.04)	***
Wholesale Trade	0.15	*	(0.14)	
Retail Trade	0.16	0	(0.22)	***
Transp. & Warehousing	(0.07)	***	(0.08)	***
Information	0.10	***	(0.10)	***
Finance & Insurance	(0.28)	0	(0.03)	***
Real Estate & Leasing	0.01	***	(0.17)	0
Prof. & Technical Services	0.05	0	(0.03)	
Adm. & Waste Management	0.08	***	(0.17)	***
Arts, Entertainment & Recreation	0.08	***	(0.06)	***
Accomodations & Food Services	0.15	***	(0.17)	***
Other Services	0.13	***	(0.15)	***
Annual Tax Liability 1 to 1,000	0.45	***	0.60	***
Annual Tax Liability 1,000 to 10,000	0.63	***	0.65	***

Annual Tax Liability 10,001 to 30,000	0.64	***	0.69	***
Annual Tax Liability 30,001 to 75,000	0.69	***	0.74	***
Annual Tax Liability 75,001 to 200,000	0.65	***	0.76	***
Annual Tax Liability 200,000 to 500,000	0.65	***	0.80	***
Annual Tax Liability > 500,001	0.71	***	0.83	***
Outstate	(0.19)	***	(0.25)	
Number of Observations	*16,525*		*11,919*	
Log-likelihood	*-10,188.56*		*-13,030*	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

We run the probit equation again with the additional inverse Mills ratio variable from the audit selection equation to control for audit selection. We observe that the percentage point differences are smaller when we include the inverse Mills ratio. However, the inverse Mills ratio is only statistically significant for use tax. The results from this regression are very similar to those in the probit regression estimating noncompliance behavior without controlling for audit selection. Again, we observe that firms are generally more likely to be compliant as tax liability increases, and that out of state firms are more likely to be noncompliant than their counterparts for both sales and use tax. After controlling for audit selection, we find that the industries least likely to yield an assessment for use tax include the following: *Construction, Finance & Insurance* and *Professional and Technical Services*. The firms most likely to yield an audit assessment for use tax are industries in the *Retail Trade, Accommodations & Food*

Services and *Real Estate & Leasing*. The firms most likely to be compliant with sales tax are firms in the following industries: *Accommodations and Food Services, Retail Trade* and *Wholesale Trade.* Firms in the *Finance & Insurance* industry have the lowest compliance rate.

Although the inverse Mills ratio is only significant for use tax, it appears that controlling for audit selection yields more consistent marginal effects. The coefficient on the inverse Mills ratio is positive and significant, indicating that the unobservables associated with audit selection are positively correlated with the unobservables associated with the rate of compliance. Both models yield very low log-likelihood ratios, so both models fit the data well.

TABLE 3b

PROBIT ESTIMATES: PROBABILITY OF NONCOMPLIANCE CONTROLLING FOR AUDIT SELECTION

Independent Variable	**Probit Use Tax Audit Outcome Marginal Effects**		**Probit Sales Tax Outcome Marginal Effects**	
Mining & Utilities	(0.04)	**	0.03	
Construction	0.04	***	(0.02)	***
Manufacturing	(0.02)	***	0.04	***
Wholesale Trade	(0.09)	***	0.07	***
Retail Trade	(0.14)	***	0.07	***
Transp. & Warehousing	(0.05)	***	(0.03)	***
Information	(0.06)	***	0.05	***

Finance & Insurance	(0.01)		(0.13)	***
Real Estate & Leasing	(0.11)	***	0.01	
Prof. & Technical Services	(0.02)	*	0.02	***
Adm. & Waste Management	(0.11)	***	0.04	***
Arts, Entertainment & Recreation	(0.04)	***	0.04	***
Accomodations & Food Services	(0.12)	***	0.07	***
Other Services	(0.10)	***	0.06	***
Annual Tax Liability 1 to 1,000	0.36	***	0.20	***
Annual Tax Liability 1,000 to 10,000	0.40	***	0.28	***
Annual Tax Liability 10,001 to 30,000	0.43	***	0.28	***
Annual Tax Liability 30,001 to 75,000	0.47	***	0.30	***
Annual Tax Liability 75,001 to 200,000	0.49	***	0.28	***
Annual Tax Liability 200,000 to 500,000	0.53	***	0.28	***
Annual Tax Liability > 500,001	0.54	***	0.30	***
Outstate	0.00		-	
Lambda	(0.61)	***	0.12	
Number of Observations	*16,525*		*11,919*	
Log-likelihood	*-10,184.95*		*-13,030*	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

Finally, we observe the rate of non-compliance among firms that were audited. In the second-stage regression, we estimate the noncompliance rates of audited firms. Using a Tobit model, we regress firm characteristics against the monthly sales and use tax assessments. We examine the coefficients from the Tobit regression as these coefficients actually represent assessment values in dollar terms.

Let us first examine the results from second-stage regression using Heckman's inverse Mills ratio. As tax liability increases for both sales and use tax, the size of the audit assessment increases. The firms with greatest monthly use tax audit assessments are in *Accommodations & Food Services, Mining & Utilities,* and *Other Services* industries with monthly assessments of $510, $468 and $456 respectively. Again, these assessment figures are with respect to the omitted industries in the *De Minimis* category. The firms with the greatest use tax assessments are in the following sectors: *Construction, Information and Wholesale Trade*. These firms have monthly assessment rates of $238, $87 and $34 respectively. The coefficient on the inverse Mills ratio is negative and significant, indicating that the unobservables associated with audit selection are negatively correlated with the unobservables associated with the rate of compliance.

Next, we examine the results from the second-stage regression using the IPTW approach. Similar to the findings from the Heckman second-stage regression, we find that as tax liability increases for both sales and use tax, the size of the audit assessment increases. The firms with greatest monthly use tax audit assessments are in the *Finance & Insurance, Manufacturing* and *Mining and Utilities* industries with monthly assessments of $912, $416 and $407 respectively. The firms with the greatest sales tax assessments are in the following sectors: *Information, Mining & Utilities* and *Real Estate & Insurance*. These firms have assessment rates of $657, $172 and $106 respectively.

The regression results in tables 4a and 4b illustrate that as firm size increases, their compliance rate increases. Our estimates from both the Heckman and IPTW secondary regression suggest that the larger the scale of a firm's operation as measured by their annual tax liability, the greater the size of the assessment. So while many audits of large firms may yield no assessment, those that do yield large assessments, which likely explains the increased audit probability of larger firms.

Finally, for the sake of comparison, we regress firm characteristics on the sales and use tax audit assessment value using OLS regression. The results of this regression can be found in Table 4c. Again, we find that as tax liability increases for both sales and use tax, the size of the audit assessment increases. The firms with greatest monthly use tax audit assessments are in *Mining and Utilities, Construction* and *Manufacturing* industries with assessments of $3,437, $1,012 and $922 respectively. The firms with the greatest monthly sales tax assessments are in the following sectors: *Information, Administrative & Waste* and *Real Estate & Insurance.* These firms have assessment rates of $651, $93 and $88 respectively. However, the R-squared for both of these regressions is extremely low, suggesting that this model is not a suitable fit for the data.

TABLE 4a						
TOBIT ESTIMATES: PROBABILITY OF NONCOMPLIANCE CONTROLLING FOR AUDIT SELECTION USING THE HECKMAN SAMPLE SELECTION CORRECTION						
Independent Variable	**Sales Tax Audit Outcome Coefficients**			**Use Tax Audit Outcome Coefficients**		
Intercept	$	12,582	***	$	7,387	***
Mining & Utilities	$	468	***	$	(440)	***
Construction	$	(217)	***	$	238	***
Manufacturing	$	416	***	$	(407)	***
Wholesale Trade	$	(37)		$	34	
Retail Trade	$	309	***	$	(344)	***
Transp. & Warehousing	$	106		$	(113)	
Information	$	(75)		$	87	
Finance & Insurance	$	211	*	$	(158)	*
Real Estate & Leasing	$	279	***	$	(301)	***
Prof. & Technical Services	$	9		$	(10)	
Adm. & Waste Management	$	181	***	$	(192)	***
Arts, Entertainment & Recreation	$	(27)		$	15	
Accomodations & Food Services	$	510	***	$	(571)	***
Other Services	$	456	***	$	(480)	***
Annual Tax Liability 1 to 1,000	$	194		$	184	
Annual Tax Liability 1,000 to 10,000	$	686	***	$	670	***
Annual Tax Liability 10,001 to 30,000	$	955	***	$	954	***
Annual Tax Liability 30,001 to 75,000	$	1,311	***	$	1,336	***
Annual Tax Liability 75,001 to 200,000	$	1,555	***	$	1,623	***
Annual Tax Liability 200,000 to 500,000	$	1,841	***	$	2,001	***
Annual Tax Liability > 500,001	$	151	**	$	302	**
Lambda	$	(15,988)	***	$	(25,102)	***
Number of Observations		*29,527*			*20,672*	
Log-likelihood		*(184,884.16)*			*(179,662)*	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

TABLE 4b				
TOBIT ESTIMATES: PROBABILITY OF NONCOMPLIANCE CONTROLLING FOR AUDIT SELECTION USING PROPENSITY SCORE WEIGHTING				
Independent Variable	**Use Tax Coefficients**		**Sales Tax Coefficients**	
Intercept	$ 45		$ (55)	
Mining & Utilities	$ 407	***	$ 172	***
Construction	$ (3)		$ (20)	
Manufacturing	$ 416	***	$ (4)	
Wholesale Trade	$ (359)	***	$ (136)	***
Retail Trade	$ (380)	***	$ 1	
Transp. & Warehousing	$ (135)		$ (55)	
Information	$ (183)	***	$ 657	***
Finance & Insurance	$ 912	***	$ (75)	
Real Estate & Leasing	$ (240)	***	$ 106	***
Prof. & Technical Services	$ (86)	***	$ 71	***
Adm. & Waste Management	$ (156)	***	$ 70	***
Arts, Entertainment & Recreation	$ (387)	***	$ (152)	**
Accomodations & Food Services	$ (463)	***	$ 38	***
Other Services	$ (241)	***	$ 44	
Annual Tax Liability 1 to 1,000	$ 18	**	$ 21	
Annual Tax Liability 1,000 to 10,000	$ 100	***	$ 54	***
Annual Tax Liability 10,001 to 30,000	$ 253	***	$ 154	***
Annual Tax Liability 30,001 to 75,000	$ 332	***	$ 323	***
Annual Tax Liability 75,001 to 200,000	$ 526	***	$ 392	***
Annual Tax Liability 200,000 to 500,000	$ 835	***	$ 668	***
Annual Tax Liability > 500,001	$ 2,646	***	$ 2,044	***
Number of Observations	*29,672*		*20,673*	
Log-likelihood	*(2,051,917)*		*(2,164,648)*	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

TABLE 4c				
OLS AUDIT ASSESSMENT REGRESSION				
Independent Variable	**Dependent Variable**			
	OLS Sales Assessment		**OLS Use Assessment**	
Intercept	-53.18	***	73.84	***
Mining & Utilities	-18.35	***	3437.35	***
Construction	-11.45	**	1012.39	
Manufacturing	8.74	***	922.97	***
Wholesale Trade	-104.79	***	706.17	***
Retail Trade	7.93	***	478.88	***
Transp. & Warehousing	20.96	***	371.69	***
Information	651.42	***	314.97	***
Finance & Insurance	-49.38		271.35	
Real Estate & Leasing	88.46	**	94.31	***
Prof. & Technical Services	55.53	***	8.73	***
Adm. & Waste Management	93.91	***	-0.73	***
Arts, Entertainment & Recreation	-45.20	***	-70.52	***
Accomodations & Food Services	-28.62	***	-73.90	***
Other Services	34.02		-103.73	***
Annual Tax Liability 1 to 1,000	16.44	***	122.76	***
Annual Tax Liability 1,000 to 10,000	88.97	***	129.61	***
Annual Tax	283.29		206.58	***

Liability 10,001 to 30,000				
Annual Tax Liability 30,001 to 75,000	515.28	***	268.52	**
Annual Tax Liability 75,001 to 200,000	732.26	***	277.61	
Annual Tax Liability 200,000 to 500,000	972.81	***	325.15	***
Annual Tax Liability > 500,001	3524.58	***	433.99	***
Number of Observations	39,878		39,878	
R-squared	0.0377		0.069	

Note: *** denotes statistical significance at the 99% confidence level for a two-tailed test; ** and * denote significance at the 95% and 90% levels. The coefficients shown in the table are percentage point differences in predicted audit rates.

3.6 Sales and Use Tax Gap Estimation

We have examined four possible means of estimating the size of the sales and use tax gap. In the first approach, we stratify the data by industry and/or firm size and multiply the average assessment by the number of firms in the industry or the number of firms in each income category to yield a gap estimate. Second, we use a basic OLS regression to yield a gap estimate. Finally, we use results from the Heckman second-stage regression and the IPTW regression to estimate the size of the sales and use tax gap.

The gap estimates for each of the estimation attempts can be found in Figure 3.3. It may be useful to compare these gap estimates with the actual compliance rate by industry for sales and use tax, the revenue collected by industry for 2011 can be found in Table 5 of the appendix. We estimate the gap first using the average assessment by industry; this methodology yields a sales tax gap of $49 million and a use tax gap of $31 million. Similarly, we estimate the gap by multiplying the average assessment by firm size by the number of firms in each category. This approach yields a sales tax gap of $117 million and a use tax gap of $87 million.

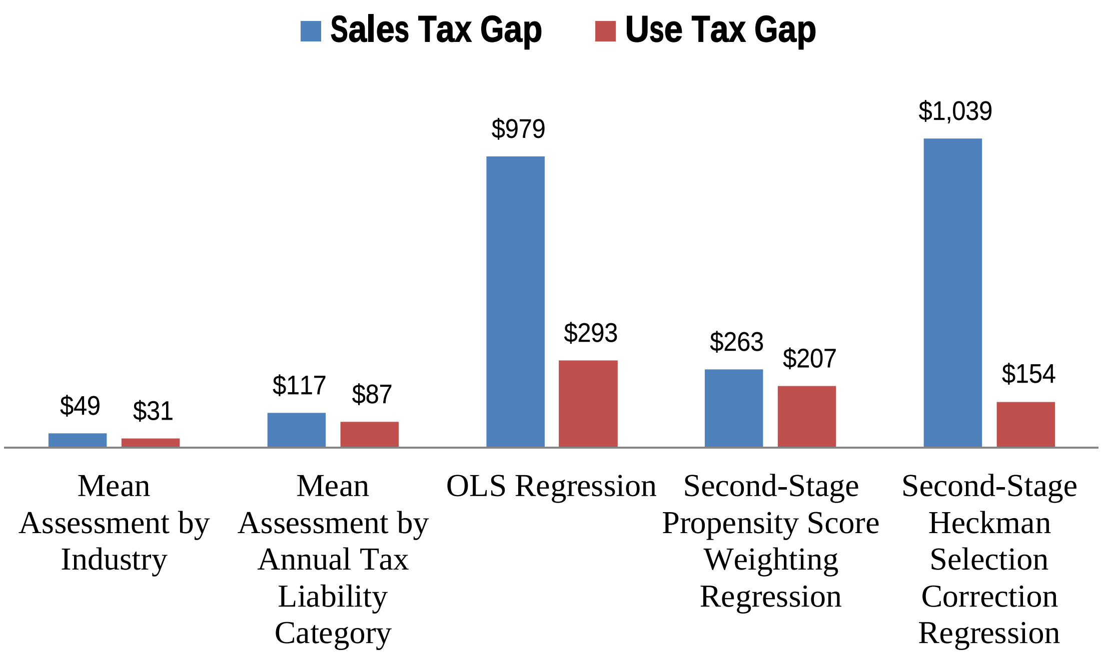
The estimates from the regression results listed in Tables 4a, 4b and 4c allow us to estimate the sales and use tax gap using a different methodology. We do this by first multiplying the coefficients by 12, to convert the monthly estimate to an annual estimate. Next, we multiply the coefficient by the number of firms in each industry or income category that were actively filing with the Department of Revenue in 2010. As such, all estimates reflect a gap estimate for 2010. Using the OLS regression results found in Table 4c, this approach yields a sales tax gap of $979 million and a use tax gap of $293 million. We then use the results from the two-stage regression estimation using the IPTW approach to control for audit selection (Table 4b), which yields a sales tax gap of $263 million and a use tax gap of $207 million. Finally, we use the results form the two-stage regression estimation using the inverse Mills ratio to control for audit selection (Table 4a), which yields a sales tax gap of $1,039 million and a use tax gap of 154 million.

As Figure 3.3 illustrates, the OLS regression yields very different results than the IPTW approach. This suggests that controlling for factors related to audit selection helps us estimate a more accurate tax gap. Ideally, our results from the IPTW approach and the Heckman selection correction approach would yield similar results. It is likely that the

Heckman selection correction approach is not the appropriate fit for this model. There are two well-documented limitations to the Heckman approach. First, as with any estimated regressor, the estimated variance-covariance matrix needs to be adjusted, which is beyond the scope of this project. Second, the Heckman selection method is highly sensitive to specification. The IPTW approach does not suffer these limitations, making it the best model to estimate the sales and use tax gap in the future. While it is helpful in providing an upper-bound to our gap estimation, the Heckman selection correction results are likely an overestimate and should not be relied upon. Future research could explore the sensitivity of the predicted tax revenue gaps to different specifications.

Our results suggest that the sales tax gap is somewhere between \$263-\$1,039 million each year and that use tax gap is somewhere between \$154-293 million. We then add these results to our findings from the remote sales tax gap due to e-commerce. The projected e-commerce gap in 2010 was approximately 107.3. This increases the size of the projected annual use tax gap to \$261.3-\$400.3 million. This puts the annual combined sales and use tax gap for filers somewhere between \$524.3 million and \$1,439.3 million. Ideally, the tax gap estimation process would also include the size of the total sales and use tax gap for non-filers. The Department of Revenue collected \$4.3 billion in sales tax revenue and \$338 million in use tax revenue in 2010; the projected gap estimates illustrate that the sales tax gap represents a very minimal proportion of total sales tax liability, whereas the use tax gap represents a very large share of total use tax liability.

Figure 3.3: Sales and Use Tax Gap Estimation



Chapter 4

Conclusions

We observed the rapidly growing e-commerce sector and the role online shopping is playing in Minnesota. In 1999, e-commerce represented approximately $8.7 million dollars in lost revenue. As consumers shift from traditional retailers to online alternatives, this number has rapidly increased in recent years and continues to climb each year. Using the aggregate data from the U.S. Census Bureau, we estimate the Minnesota e-commerce gap to represent an estimated $96.5 million dollars in lost revenue for 2013. We estimate this figure will grow to $190.9 million by 2017. Similarly, we estimate the lost sales and use tax revenue due to the mail order gap. While the mail order gap is not growing as rapidly as e-commerce, these sales represent an estimated $72.4 million dollars in lost revenue in 2013, with that figure growing to $81.5 by 2017.

It is likely that a combination of federal and state legislation will aim to recover the use revenue lost to e-commerce in coming years. While this will significantly decrease the size of the business-to-consumer gap, as well as the use tax gap for both firms and individuals, a sales tax gap will persist. We estimate the business-to-business sales and use tax gap using MN audit experience. After controlling for audit selection, we estimate the sales tax gap to be between $263 million to $1,039 million dollars each year. The use tax gap is somewhere between $261.3 million dollars and $400.3 million dollars.

We find larger firms are more likely to be audited, but that they are more likely to yield a no-change assessment, indicating that compliance increases as firm size increases. However, the size of audit assessments increase as tax liability increases, which likely explains why audit rates increase as firm size increases. We also find that firms with out of state addresses are less likely to be audited but are more likely to be noncompliant. It is possible that firms with non-state ownership may not have a thorough knowledge of sales tax laws in Minnesota. It is also possible that Minnesota tax law complexity provides out of state taxpayers with an increased opportunity to underreport. These findings are in line with those of Murray (1995), and support the theory that the likelihood of auditing out of state is correlated with auditing resources.

The industries with the lowest probability of audit are firms in the following industries: *Accommodations & Food Services, Other Services* and *Retail Trade*. The firms most likely to be selected for audit are firms in the *Finance & Insurance* industries and firms in the *Construction* and *Information* industries.

From our secondary regression analyzing noncompliance of audited firms, we can conclude that the industries most likely to be fully compliant with sales tax, or to yield a no-change audit, are firms in the *Accommodations and Food Services, Retail Trade* and *Wholesale Trade Sectors,* while the least compliant industries are firms in the *Finance & Insurance* industry. With regard to use tax, we find that the firms least likely to yield an assessment were firms in the *Construction, Finance & Insurance* and *Professional & Technical Services* sectors. The firms most likely to yield an audit assessment for use tax are industries in the *Retail Trade, Administration & Waste* and *Accommodations & Food Services* sectors.

Finally, from our analysis of the predicted magnitude of noncompliance, we can conclude that, after controlling for firm size and audit selection, the industries most likely to yield high use tax audit assessments are firms in the *Mining and Utilities* and *Finance & Insurance* industries. Firms most likely to yield high sales tax audit assessments are firms in the *Information* industry.

4.1 Limitations and Updating the Model

The greatest limitation we face in this study is in addressing the endogenous nature of the relationship between auditors and audited firms. The auditors have information about the likelihood a firm is noncompliant that we are unable to control for in the model. While we attempted to mitigate the endogoneity through a two-stage regression equation, our parameter estimates iusing the Heckman sample selection correction (1979) may represent an overestimate of the sales and use tax gap. When employing the Heckman correction, the estimated variance covariance matrix needs to be adjusted to control for the inclusion of the estimated regressor. Future research could explore the sensitivity of the predicted tax revenue gaps to different specifications.

Several variables could provide further insight in future research. If the data were available, it would be interesting to analyze how firms with affiliates play the sales tax compliance game. Things such as the age of the firm or variations in reporting might also be helpful in discovering patterns in compliance behavior. It is important to note that these results are specific to firms filing in the state of Minnesota and as such, it is possible that other states may have contrary results. We should also note that auditors may not fully uncover unreported tax liability. Additionally, because we had to convert much of the data to monthly data, we are unable to observe when firms are more likely to be non-compliant.

There are many ways in which the model could be improved. We were unable to observe and compare the compliance behavior of non-filing firms. Unfortunately, we were unable to conduct this type of analysis because we did not have enough information from the audited sample to reliably compare non-filers with filers at this time.

4.2 Potential Practical Applications

The erosion of the traditional sales tax base attributed to online sales is an issue that has come to the forefront of tax policy decision making in recent years. Internet retailing is growing at the expense of traditional retailing, diminishing revenue states have historically relied upon. Because sales tax is enforced at the state and local level, it is difficult to enforce collection of sales tax on purchases made out-of-state. The increasing popularity of online sales has influenced consumer behavior, as it encourages consumers to make purchases online rather than brick-and-mortar stores. Firm behavior is also distorted, as failure to collect sales tax on online sales favors relocation of physical operations to avoid nexus in sales tax states.

In addition to mitigating lost revenue due to e-commerce and mail-order sales, it is in the best interest of Revenue authorities to best utilize the resources available to increase compliance behavior within the state. Examining the types of firms most likely to be noncompliant can improve the efficiency of allocation of auditing resources, both to increase sales and use tax revenue, but also to improve taxpayer compliance and education of their responsibility to collect and remit tax.

CHAPTER 4. CONCLUSIONS

In this paper we have illustrated the extremely low use tax compliance rates present across firms and industries. While audit frequency may improve use tax compliance, the use tax gap remains significant. Minnesota has a number of options to increase use tax compliance. First, Minnesota could repeal the de minimis exemption and place a use tax reporting line on the individual income tax return. This may increase individual use tax compliance, but would not address firm noncompliance.

Minnesota could also provide a lookup table for taxpayers to use in estimating liability. States with lookup tables tend to experience greater participation and overall collections; Manzi (2012) speculates that Minnesota collections could reach $4.4. million if a lookup table for use tax liability were included in income tax instructions.[15]

Another approach to capture use tax is taxing some services, including business-to-business services. This approach is controversial, as it may introduce distortions favoring firms that are vertically integrated over smaller firms with limited resources. There has also been consideration of a national sales tax, that would replace existing state and local sales taxes. However, this approach is highly controversial, and remains unlikely. While it is unclear exactly how state and federal lawmakers will enforce the taxation of online sales, it is highly likely a resolution will be reached in the near future.

Under the current sales and use tax system in Minnesota, audits may be most effective if they are concentrated in service industries, as well as industries most likely to participate in online sales such as retail trade. We can also conclude that firms with greater tax liability are highly compliant; however, the small proportions of large firms that are non-compliant represent substantial amounts of unreported revenue.

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[15] This estimate is based on experiences in states with lookup tables.

APPENDIX

APPENDIX TABLE 1					
MINNESOTA APPORTIONMENT RATIOS					
(USED TO CALCULATE REMOTE SALES TAX GAP)					
NAICS Code	**Selected Industry**	**Description**	**US Value of sales, shipments, receipts, revenue or business done**	**MN Value of sales, shipments, receipts, revenue or business done**	**MN apportionment ratio**
441	***Retail Trade Sales***	Motor vehicle and parts dealers	891,036,746	13,764,244	1.54%
442		Furniture and home furnishings stores	108,220,081	1,933,796	1.79%
443		Electronics and appliance stores	109,014,992	2,053,591	1.88%
444		Building material and garden equipment and supplies dealers	318,320,271	6,658,264	2.09%
445		Food and beverage stores	539,207,574	8,418,647	1.56%
446		Health and personal care stores	234,026,783	3,444,707	1.47%
447		Gasoline stations	450,413,061	9,848,967	2.19%
448		Clothing and clothing accessories stores	215,647,177	2,970,993	1.38%
451		Sporting goods, hobby, book, and music stores	81,084,315	1,736,039	2.14%
452		General merchandise stores	577,098,195	10,564,370	1.83%
453		Miscellaneous store retailers	104,068,221	1,474,363	1.42%
454		Nonstore retailers	289,526,040	8,516,122	2.94%

45411		Electronic shopping and mail-order houses	220,656,247	6,907,101	3.13%
48-49(102)	***Selected Service Industries***	Transportation and warehousing(102)	639,916,407	15,056,099	2.35%
481(101)		Air transportation(101)	146,612,459	5,978,532	1.25%
483		Water transportation	36,056,934	91,675	0.25%
484		Truck transportation	221,737,480	5,367,790	2.42%
485		Transit and ground passenger transportation	26,464,611	379,121	1.26%
486		Pipeline transportation	25,717,767	440,165	1.71%
487		Scenic and sightseeing transportation	2,447,598	17,913	0.73%
488		Support activities for transportation	86,596,320	1,040,179	1.20%
492		Couriers and messengers	77,876,714	1,234,285	1.58%
493		Warehousing and storage	21,920,686	243,732	1.11%
51		Information	1,072,342,856	N	
511		Publishing industries (except Internet)	282,223,524	6,394,899	2.27%
517		Telecommunications	480,031,235	N	1.71%
51811		Internet service providers	21,418,640	94,832	0.44%
52		Finance and insurance	3,711,218,495	3,069,624	2.00%
5223		Activities related to credit intermediation	70,286,514	1,577,611	2.24%
523x		Selected finance7			
5231		Securities and commodity contracts	611,507,962	10,007,895	1.64%

		intermediation and brokerage			
53		Real estate and rental and leasing	443,142,793	8,944,405	2.02%
54		Professional, scientific, and technical services	1,258,012,450	20,675,362	1.64%
5415		Computer systems design and related services	244,389,132	3,892,378	1.59%
56		Administrative and support and waste management and remediation services	623,762,145	9,979,512	1.60%
62		Health care and social assistance	1,668,276,808	33,997,419	2.04%
61		Educational Services	44,980,656	653,127	1.45%
71		Arts, entertainment, and recreation	189,416,942	2,923,638	1.54%
72		Accommodation and food services	613,795,732	10,423,660	1.70%
81		Other services (except public administration)	405,283,270	2,538,024	0.63%
811		Repair and maintenance	137,732,616	2,538,024	1.84%

APPENDIX

APPENDIX TABLE 2						
REMOTE SALES TAX GAP (Retail Only)						
	Total Tax Liability Calculated using E-Stats	Less de minimis	Tax liability	Sales tax remitted by remote sellers	Use tax paid by individuals	Tax Gap
1999	78.09	4.20	73.89	16.20	0.12	57.57
2000	92.58	4.80	87.78	20.10	0.16	67.52
2001	89.67	5.40	84.27	21.70	0.16	62.41
2002	98.88	6.00	92.88	23.40	0.17	69.31
2003	100.79	6.40	94.39	23.50	0.18	94.21
2004	105.27	6.80	98.47	23.47	0.22	74.78
2005	123.60	7.25	116.35	29.76	0.24	86.35
2006	135.71	7.75	127.96	36.40	0.27	91.30
2007	156.62	8.35	148.27	35.80	0.34	112.13
2008	157.93	9.00	148.93	41.03	0.34	107.56
2009	158.17	9.70	148.47	57.95	0.38	90.14
2010	177.81	10.55	167.26	56.99	0.37	109.90

APPENDIX TABLE 3		
DESCRIPTION OF VARIABLES		
Variable Name	**Description**	**Source of Variable**
Compliance Rate	The compliance rate of audited firms is calculated by dividing the voluntary compliance of the taxpayer by the "true" tax liability, or post-audit findings.	Original Return
Average Voluntary Compliance	Average monthly voluntary payment remitted to the Minnesota Department of Revenue.	Original Return
Normalized Voluntary Compliance	The log of the monthly sales and use tax voluntarily remitted to the Minnesota Deparment of Revenue.	Original Return
Month total	Total number of months reported on one return by the taxpayer; the number of months reported on a return varies depending on whether or not the taxpayer files monthly, quarterly, semi-annually or annually.	Original Return
Audit Selection	Dummy variable equal to 1 if the firm was selected for audit between Jan 1, 2008 and August 15, 2012.	Audited Files
Audit Outcome	Dummy variable equal to 1 if the audit resulted in an assessment and 0 if the audit resulted in no change.	Audited Files
Average Monthly	Average monthly assessment, as determined by Department of Revenue Auditors.	Audited Files

APPENDIX

Assessment		
Normalized Assessment	The log of the monthly assessment, as determined by Department of Revenue auditors.	Audited Files
Accomodations & Food Services	Dummy variable equal to 1 if NAICS code falls within the range: 720000 – 722410	Found on both Original Return and Audit Files
Adm. & Waste Management	Dummy variable equal to 1 if NAICS code falls within the range: 560000-562998	Found on both Original Return and Audit Files
Arts, Entertainment & Recreation	Dummy variable equal to 1 if NAICS code falls within the range: 710000 – 713990	Found on both Original Return and Audit Files
Construction	Dummy variable equal to 1 if NAICS code falls within the range: 236000 – 238990	Found on both Original Return and Audit Files
Finance & Insurance	Dummy variable equal to 1 if NAICS code falls within the range: 520000 – 525990	Found on both Original Return and Audit Files
Information	Dummy variable equal to 1 if NAICS code falls within the range: 510000 – 519190	Found on both Original Return and Audit Files
Manufacturing	Dummy variable equal to 1 if NAICS code falls within the range: 311000 – 339999	Found on both Original Return and Audit Files
Mining & Utilities	Dummy variable equal to 1 if NAICS code falls within the range: 210000 – 213115	Found on both Original Return and Audit Files
Miscellaneous	Dummy variable equal to 1 if NAICS code falls within the range: 810000 – 928120	Found on both Original

		Return and Audit Files
Other Services	Dummy variable equal to 1 if NAICS code falls within the range: 540000-541990	Found on both Original Return and Audit Files
Prof. & Technical Services	Dummy variable equal to 1 if NAICS code falls within the range: 530000 – 533110	Found on both Original Return and Audit Files
Real Estate & Leasing	Dummy variable equal to 1 if NAICS code falls within the range: 441000 – 454390	Found on both Original Return and Audit Files
Retail Trade	Dummy variable equal to 1 if NAICS code falls within the range: 481000 – 493190	Found on both Original Return and Audit Files
Transp. & Warehousing	Dummy variable equal to 1 if NAICS code falls within the range: 220000 – 221330	Found on both Original Return and Audit Files
Wholesale Trade	Dummy variable equal to 1 if NAICS code falls within the range: 420000 – 425120	Found on both Original Return and Audit Files
De Minimus & Unclassified	Dummy variable equal to 1 if NAICScode falls within the following ranges: 110000 – 115310; 550000 – 551114; 610000 – 611710 and 990000-999999 (This includes the following industries: Forestry, Fishing, Hunting and Agriculture Support; Management of Companies and Enterprises; Education; Health Care and Social Assistance and Unclassified)	Found on both Original Return and Audit Files
Annual Tax Liability Less than or equal to zero	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Annual Tax Liability 1 to	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return	Found on both

1,000	plus any additional audit assessments.	Original Return and Audit Files
Annual Tax Liability 1,000 to 10,000	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Annual Tax Liability 10,001 to 75,000	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Annual Tax Liability 75,000 to 200,000	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Annual Tax Liability Greater than 200,001 to 500,000	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Annual Tax Liability Greater than 500,000	Dummy variable indicating firm size. The annual tax liability is the amount voluntary reported on the return plus any additional audit assessments.	Found on both Original Return and Audit Files
Out of State	Indicates firms with out-of-state addresses.	Original Return
Non-filer	Indicates audited firms that were not filing with the Department of Minnesota for at least one month during the audited period.	Audited Files
Inverse Mills Ratio	Inverse Mills Ratio from the audit selection equation	Stage One Audit Selection Estimation
Predicted Audit Rate	Fitted values from the audit compliance equation	Stage Two Audit Complianc e Estimation

APPENDIX 4 DESCRIPTIVE STATISTICS FOR AUDITED AND NON-AUDITED FIRMS				
Variable	**Overall**		**Audited Firms**	
	Mean	Standard Deviation	Mean	Standard Deviation
Monthly Assessment			$ 403	$ 2,329
Monthly Sales Noncompliance			$ 193	$ 1,459
Monthly Use Noncompliance			$ 185	$ 1,627
Assessment Total			$ 16,900	$ 115,150
Monthly Voluntary Compliance	$ 2,986	$ 69,209	$ 13,426	$ 146,673
Out of State address	15%		9%	

APPENDIX TABLE 5 COMPLIANCE RATE BY INDUSTRY 2011		
	Sales Tax Compliance 2011	Use Tax Compliance 2011
De Minimus	$38,242,757	$12,317,431
Mining & Utilities	$325,751,861	$46,966,712
Construction	$39,134,384	$31,534,311
Manufacturing	$276,919,375	$96,537,516
Wholesale Trade	$376,416,968	$30,157,664
Retail Trade	$1,774,697,756	$46,484,084
Transp. & Warehousing	$25,299,315	$14,361,665
Information	$419,116,784	$13,247,484
Finance & Insurance	$11,185,023	$7,982,957
Real Estate & Leasing	$120,706,287	$4,034,531
Prof. & Technical Services	$88,642,052	$14,184,745
Adm. & Waste Management	$110,532,082	$6,870,825
Arts, Entertainment & Recreation	$127,886,531	$1,912,796
Accomodations & Food Services	$640,928,662	$7,934,098
Other Services	$151,265,314	$5,806,123

Total	$4,526,725,151	$340,332,942

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