PLAYING WITH FIRE: CIGARETTES, TAXES AND COMPETITION FROM THE INTERNET

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Abstract

This paper documents the rise of the Internet as a source of cigarette tax competition for states in the United States. Using data on the cigarette tax rates, taxable sales and individual smoking by state from 1980 to 2001 merged to data on the rise of Internet use, the paper documents that there has been a substantial increase in the sensitivity of the sales of cigarettes in a state to changes in the state's cigarette tax. It then shows that this increase in sensitivity is directly correlated with the rise of Internet usage across states and that the increase in the Internet may have almost doubled the tax sensitivity of within-state cigarette sales. Data on cigarette usage, however, documents that Internet growth has not made actual smoking any more sensitive to tax rates. If anything, rising Internet usage has made it *less* sensitive to tax rates as smokers now have another way to avoid high taxes. The impact of the Internet appears to be concentrated entirely in the amount of smuggled cigarettes. Overall, with the tax sensitivity of taxable cigarette sales having almost doubled, this has lessened the revenue generating potential of recent cigarette tax increases by 33 percent compared to the traditional, older demand estimates. Given the continuing growth of the Internet and of Internet cigarette merchants, the results imply serious problems for state revenue authorities.

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I. Introduction

Cigarette taxes have always given policymakers a benign tradeoff . On one hand, demand for cigarettes is thought to be inelastic so that raising taxes can generate a lot of revenue with a relatively low ratio of excess burden to revenue collected. On the other, since cigarettes are one of the leading causes of health problems in the country, to the extent that taxes fail to raise revenue (i.e., when they get people to consume fewer cigarettes), they save lives.

The rise of the Internet, however, has begun to seriously threaten that happy tradeoff because, by purchasing cigarettes online, consumers have been able to evade state cigarette taxes. The Internet has the potential to wreak havoc on both sides of the equation. When people can buy online, raising taxes may generate little revenue while at the same time doing nothing to improve health. Instead, people simply become more sensitive to where they choose to buy their cigarettes.

This has become an issue of first-order importance in the last several years as many states have significantly raised their cigarette taxes to help close their budget deficits. Since January, 2002, some 30 states and the District of Columbia have increased their cigarette tax rates, expecting to raise significant revenues based on the view that demand for cigarettes is relatively inelastic.[1] This paper will examine whether the rise of the Internet has made taxed cigarette purchases more responsive to tax rates.

Cigarettes are a natural place to look for the impact of tax evasion because state excise tax rates on cigarettes are particularly high relative to other consumption taxes and because

[1] There is an extensive literature on the demand for cigarettes, including recently Becker, Grossman, and Murphy (1994) and Gruber and Koszegi (2001), that is surveyed by Evans et al. (1999) and Chaloupka and Warner (2000). Evans et al. (1999), Hu et al. (1995), examine the impact of various non-tax public policies to reduce smoking.

avoidance and evasion, both informal and organized, is rampant.[2] For example, Internet cigarette merchants located on Native American reservations (where state excise taxes levied on wholesalers do not apply) and in states with very low cigarette taxes have dramatically increased. Little to no taxes are being paid on these sales although, in theory, the state tax rates still apply. Technically, consumers are required to pay the taxes individually and fill out a Cigarette Use Tax form for any cigarettes on which the wholesaler did not remit tax. Almost no one does. Indeed, the state of New York has recently attempted to ban Internet cigarette merchants completely, and has argued that it alone loses some $500 to $600 million per year of revenue from Internet, 800 number, and Indian reservation sales (REA, 2002).

In this paper we make use of survey data on Internet use by state and across time, state administrative data on taxed cigarette sales, and survey data on actual smoking to investigate how the growth of the Internet has affected the level and elasticity of taxed cigarette sales and of smoking. The results suggest that the rise of online shopping has dramatically increased the sensitivity of in-state purchases to state tax rates. The mean price elasticity of taxed cigarette sales has risen most in those places where the Internet has grown the fastest (holding other things equal) and, in magnitude, may have almost doubled in the last several years. The data on cigarette usage, however, reveal no indication that growth of the Internet has made *smoking* more sensitive to taxation than it was before people were able to evade local taxation. The overall impact of Internet growth on cigarette excise tax revenue thus far appears to be modest, but the impact on the ability of tax increases to generate additional revenue has been sizable. We predict that the tax increases of 2001-2003 would have

[2] Becker, Grossman, and Murphy (1994), Coats (1995), Thursby and Thursby (2000), Yurekli and Zhang (2000), Farrelly, et al. (2001), and Gruber et al. (2003) all document ways that smuggling and proximity to low-tax neighbors make cigarette sales more sensitive to tax rate changes. Slemrod (2003) shows how changing the enforcement regime affected the tax responsiveness of sales in Michigan.

generated about 25 percent more revenue had the Internet merchants not existed. In some states this is as high as 40 percent.

The paper proceeds as follows. Section II discusses the cigarette retail industry and the role of the new Internet sites. Section III presents the methodology of our paper and describes the data we use. Section IV presents the basic results on taxed cigarette sales. Section V shows tests of robustness. Section VI documents the differential effect of Internet use on usage versus taxable sales, and clarifies the importance of smuggling. Section VII discusses the revenue implications of our findings, and Section VIII concludes.

II. The Cigarette Industry

With the growth of the Internet, websites offering cigarettes for sale online have spread enormously. A General Accounting Office (GAO) report specifically identified the some 147 such sites in 2002 and said that there might be 400 or more such sites in existence (GAO, 2002). With names like www.taxfreecigarettes.com, www.notaxsmokes.com and www.0taxcigs.com, it is clear that vendors are aware of the opportunities the Internet provides for tax evasion. Virtually all of the online merchants are physically located either on American Indian reservations (and thereby need not remit state excise taxes) or in states like North Carolina, Kentucky, or Virginia, where the state cigarette excise tax is very low.

While these sites make it easy for consumers to circumvent state excise taxes (which are usually remitted by the wholesaler and reflected in the retail price), they do not eliminate the legal obligation to do so. By state law, an individual is supposed to pay the excise tax on any cigarettes they consume in their state of residence, even if the cigarettes were purchased

elsewhere or received by mail. They are supposed to do this by filling out a Cigarette Use Tax form.[3] In reality, of course, almost no one does that.

Given the variation in tax rates on cigarettes around the country and the difficulties with enforcing use taxes, it isn't surprising that cross-border shipments would proliferate or that there would be laws designed to contain it. The Jenkins Act, a federal law, requires anyone that sells cigarettes for a profit to a customer across state lines (other than to a licensed distributor) to report the brand and quantity of the sale as well as the name and address of the customer to the buyer's state's tobacco tax authority. If online merchants did that, of course, it would be much easier for states to enforce taxes on Internet sales.

Violating the Jenkins Act, however, is only a misdemeanor and the penalty cannot exceed a $1000 fine (or 6 months in prison). Further, enforcement of the act is left to the Department of Justice and the FBI, who have not actively pursued such cases. The GAO reported that, of the websites they examined, almost 80 percent either claimed (falsely) that the Jenkins Act did not apply to them, or that they refused to comply and would keep all customer information secret (illegally). Another law, the Contraband Cigarette Trafficking Act of 1978, makes it a federal crime to transport more than 60,000 cigarettes (i.e., 300 cartons) across state lines without proof that state taxes have been paid but, apparently for this reason, most of the online sites specifically limit purchases to less than 300 cartons. Again, enforcement is difficult and the key matter for the online merchants.

Because the states do not have enforcement authority regarding the federal Jenkins Act, there is little they can do, as described in the existing GAO reports (GAO, 2002; 2003). New York has tried banning the delivery of cigarettes ordered online and began enforcing that

[3] An example of such a form is the New York State form CG-15, downloadable from the New York Department of Taxation and Finance web page at http://www.tax.state.ny.us/pdf/2004/altab/cg15_904.pdf.

ban in 2003 by threatening fines for delivery companies and by threatening to close down merchants within the state, many of which are operated on the Seneca Indian lands in upstate New York (*Business Review*, 2003). California has tried to notify Internet merchants and California residents directly. From May, 1999 to September, 2001 they notified 167 Internet vendors and 23,500 residents, but collected only $1.4 million in taxes, penalties, and interest (GAO, 2002). The federal government is also concerned about the issue. Recent legislation proposed in Congress would strengthen reporting requirements, raise violations of the Jenkins Act to a felony and reduce the number of cigarettes required to qualify as contraband to 10,000 (Glasner, 2003).

There is little information, however, on the most basic of issues such as the volume of online sales of cigarettes. Forrester Research (2001) has estimated that online sales of cigarettes will exceed $5 billion by 2005, equal to about 14 percent of total sales, causing $1.4 billion in lost state cigarette excise tax revenue. We have two other pieces of evidence on the question. The first comes from survey data on individuals. Surveys in 2002 found 2.2 percent of smokers had bought online in Oregon and 6.7 percent in New Jersey.[4] The second is indirect and comes from the frequency with which people use search engines to look for sites related to online cigarette sales. Search engines like Google and Yahoo sell advertisements whose prices depend on the number of consumers that search on a given term. Using Overture's *Keyword Selector Tool*, we computed the number of searches conducted in March, 2004 for terms associated with buying cigarettes online.[5] The results indicated that at

[4] See Hrywna, et al. (2004) and Oregon Center for Health Statistics and Vital Records (2002).

[5] The Keyword Selector Tool is available at http://inventory.overture.com/d/searchinventory/suggestion. The search terms we looked up were "cigs," "cheap cigarettes," "discount cigarettes," "cheap Marlboro," "discount Marlboro," "tax free cigarettes," "low price cigarettes," "cheapest cigarettes," "cigarettes online," "cigarettes price," "buy cigarettes," those same terms replacing the word "cigarettes" with "cigs" and also including the proposed variants suggested by the *Keyword Selector Tool* that referred to buying cigarettes online (the tool is designed to show other search terms that are similar to the one you enter that consumers also searched). We

Overture, there were about 350,000 searches for the month (4.2 million at an annual rate) using the basic search definitions and 734,000 searchers using a broader definition of the search terms (8.8 million annually). Scaling these numbers up by Overture's estimated market share implies that there are between 13 to 28 million searches per year for terms related to buying cigarettes online.[6] We do not know how many of these searches turned into purchases nor how many searches a typical customer might do in a year, but these numbers are large and might even understate the true magnitude if only because people that purchase online from a merchant may return directly to that merchant in the future rather than going back through the search engine. To be sure, such estimates are only suggestive. Virtually all expert observers agree, however, that online cigarette sales have been growing very rapidly in the last several years.

It is easy to understand why demand would be high for online cigarettes if most or all of the tax savings associated with online sales are passed on to consumers, rather than being captured by online merchants through higher pre-tax prices. To check this, in the fall of 2003 we gathered data on in-store retail prices from several merchants in Ann Arbor, Michigan and compared them to the prices available at the top five domestic cigarette sites listed at Google for the search phrase "tax free cigarettes."[7] We did this for the top ten cigarette brands, as

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excluded anything that referred specifically to other countries or had nothing to do with buying online such as "current cigarette tax rate". For a broader definition of online buying we also tried including "cigarettes" alone as well as the brand names alone (like "Marlboro"), though these are not associated only with online buying.

[6] The search engine market shares come from Web Side Story (http://www.websidestory.com/pressroom/pressreleases.html?id=219&ctl=x08x087h27h2) and assume that the Overture numbers represent all searches not included in the market shares of Google or Yahoo (the Yahoo market share statistics do not include Overture searches). This is obviously an upper bound for the size of Overture so the calculation puts a lower bound on the total number of searches.

[7] The retail merchants were Walgreen, Meijer, K-Mart, Campus Corner, and Kroger. The online sites were taxfreecigarettes.com, travelingsmoke.com, dutyfreetaxfree.com, tobaccobymail.com and 4cheapcigs.com. All of these sites are located on Indian reservation land in New York state. A similar analysis using merchants in Chicago showed a similar pattern as the one reported in the paper.

identified by Advertising Age (2002).[8] Weighting the ten brands by their national sales volume, we found that prices online were $27.33 a carton and pre-tax prices in the stores were $25.83. At that time Michigan taxes (including sales tax) amounted to $14.80 per carton, so the average online site was apparently passing about 90 percent of the tax savings through to the consumer. This is likely to be a lower bound on the cost savings, because with even a minor amount of search online one can find lower prices for any particular brand (using the minimum price among the online sites yielded prices actually lower than the pre-tax prices in the retail stores, i.e., prices were lower by more than 100% of the tax rate), and because a significant fraction of locally-purchased cigarettes are actually bought one pack at a time, at a higher per-pack price than would apply if buying by the carton. So it seems clear that online sites are, indeed, a way that non-taxpaying customers might save money when buying cigarettes and may very well increase the price sensitivity of taxed sales.

III. Methodology and Data

1. Methodology

We first seek to investigate whether the level and tax responsiveness of a state's taxed cigarette sales are related to the extent of Internet use in that state (denoted with a subscript s below) in a given year (denoted with a subscript t). We regress the logarithm of per-capita taxed cigarette packs against the log of the real tax-inclusive price of cigarettes in the state and a measure of neighboring states' tax-inclusive prices. Then, we add the state's log tax-inclusive price interacted with a measure of Internet usage, and the level of Internet usage by itself. The basic specification is

[8] These were Marlboro, Newport, Doral, Camel, Basic, Winston, GPC, Kool, Salem, and Virginia Slims.

$$\ln(q_{st}) = a_s + a_t + a_2 \ln(P_{st} + tax_{st}) + a_3(I_{st}) \ln(P_{st} + tax_{st}) + a_4(I_{st}) + a_5 \ln(Neighbors'(P_{st} + tax_{st})) + a_6 \ln(Y_{st}) + \varepsilon_{st} \quad (1)$$

where q is the quantity of taxed cigarette packs sold per capita in a given state and year, P is the pre-tax price, tax is the state tax rate (excise plus sales), I is a measure of Internet usage in the state (discussed below), and Y is real personal income per capita in the state. The neighboring states' are simple averages of all contiguous states' values. Because we do not expect to be able to explain all of the cross-state and cross-time variation in taxed sales due to non-tax factors, we also include dummy variables for each state and each year. With both state and year dummy variables included, we are seeking to explain the year-to-year changes in a state's per capita taxed sales relative to the average year-to-year changes, as a function of the state's year-to-year changes in the real retail price including the state excise tax. In particular we seek evidence as to whether the tax sensitivity has increased most in states where Internet usage has grown the fastest.[9] We will also present results where we allow the baseline price elasticity to vary across states or across time.

2. Data

Although we do not have any direct measures of how much people use the Internet to make or research online cigarette purchases, we will use information about the share of people in a state that use the Internet as a proxy, implicitly assuming that use of Internet cigarette sites is proportional to other measures of Internet use. Our primary data source will be the computer supplements to the Current Population Survey that ask about computer usage in

[9] We ignore the possibility that the extent of Internet use is itself affected by the level of cigarette taxes in a state, and therefore the potential tax savings from using the Internet to avoid or evade taxes. Goolsbee (2000) showed our assumption to be true for the case of retail sales taxes, and cigarette taxes are even less likely to motivate people to go online (since the amount of money at stake is typically smaller).

1994, 1997, 1998, 2000, and 2001.[10] The survey question we use is whether the respondent uses the Internet. Unfortunately, the CPS wording changes from year to year. The 2001 estimates, for example, report Internet use from any location, whereas in the 2000 and 1998, they report Internet use at home and outside the home separately and in 1997 home, work, and school separately. For 1997, 1998, and 2000 we define an individual as an Internet user if they respond yes to any of these questions. The 1994 version of the survey does not contain any questions related to the Internet, but did ask whether they had a computer with a modem. This was repeated in 1997 so we multiply the share of modem users in 1994 by the share of modem users in 1997 that had Internet access (58 percent).[11]

We will also use data from a large consumer survey conducted by Forrester Research, Inc. as part of the Technographics 2002 program. The survey asked some 80,000 people about their demographics (including whether they smoke) along with questions about whether they use the Internet at all, whether they have ever bought something online, and their past history of Internet usage. The data is meant to be nationally representative; more details can be found in Yonish et al. (2001) or Goolsbee (2000). Using the data on how long each person has been online, we are able to create a measure of the share of each state's population that was online in a given year from 1995 to the present following the method of Goolsbee and Brown (2002). For years before 1995, we set all the Internet use measures to zero. We will use the share of the state population that had online access in the year as our measure. The survey data would also allow us to compute alternative measures such as share of people in the state that have bought something online, the share that smoke and have Internet access, the

[10] The surveys take place late in the year, so we associate a given year of Internet usage data with the following fiscal year.

[11] We tried more sophisticated approaches to predicting Internet usage from the modem usage data such as various county-level regression and individual level probit specifications, but because they did not lead to any significant change in the results we report only the results based on the simpler approach.

share that smoke and have bought online, and the share of smokers in the state that are online. Varying the measure of Internet access, though, made little difference to the results so we have left these alternative measures out to save space.

The data on taxed cigarette sales, excise taxes, and the retail prices of cigarettes span 1980 to 2001, and are taken from *The Tax Burden on Tobacco*, published by The Tobacco Institute until 1998 and updated by Orzechowski and Walker (2001). The tax rate is the weighted average over the fiscal year. Since the price is only reported at a point in time (November 1 of the year) we impute an estimate for the weighted average price over the fiscal year, although our results were very similar just using the point-in-time measure instead.[12] Because of our concern that the pre-tax price might be endogenous to the state excise tax rate, we use the tax rate alone as an instrument for the tax-inclusive price, p+t.

When we examine the actual consumption of cigarettes in the states in response to tax changes, we analyze data for 1990 to 2000 from the Center for Disease Control's Behavioral Risk Factor Surveillance System (BRFSS). These data provide information on the number of cigarettes smoked per day for people that report being smokers. The BRFSS is a very large dataset and is meant to provide a comprehensive look at the risky behaviors of individuals in the United States. The data are collected from a random sample of adults (age 18 and over) annually. More details on the BRFSS can be found in CDC (2003).

Summary statistics for the variables used in our analysis from all the sources are presented in Table 1. There is an increase between 1990 and 2000 in the tax rate and real price of cigarettes, as well as a huge increase in the share of people using the Internet. A

[12] To do this imputation, we assume constant linear growth from November to November of each year. Given this assumption and prices from the previous and following years, the formula for the weighted average price in the year is $P=1/18\ (P_{Nov,t-1}) + 13/18\ (P_{Nov,t}) + 4/18\ (P_{Nov,t+1})$. In the final year of our sample we have no data on $P_{Nov,t+1}$ so we set it equal to $(P_{Nov,t})$. Given the low weighting on this value, this is not crucial to the results.

major cause of the increase in prices came about from the tobacco settlement which put in place regulatory charges that are essentially like per pack taxes but are counted in the pre-tax price of the cigarettes. It is also worth noting that there is cross-sectional variation in the tax rate as well as across time variation. Across time, the standard deviation in the real tax rate for the mean state is 4.7 cents. Across states, the standard deviation for the mean year is 8.5 cents. For the Internet, however, most of the variation comes across time. Across states within a year, as seen in the table, the variation in Internet usage is much tighter.

IV. Basic Results

We begin with the baseline specification of log taxed sales per capita regressed on the log real price (including taxes) as well as the real price interacted with the share of people in the state-year with Internet access as measured in the Forrester data, instrumenting for the price terms using the log of the real tax term and the level of the real tax term.[13] We present the results from this regression in column (1) of Table 2. The estimated elasticity of taxable sales even before the rise of the Internet is, at -1.28, already at the high end of elasticities found in the previous literature. The elasticity of taxable sales with respect to the mean tax-inclusive price of neighboring states is positive, as expected, although it is not significantly different from zero.

The interaction of the state tax rate with the share of the state that uses the Internet is negative and very significant. Clearly the data indicate that the sensitivity of purchases to prices has increased substantially. The point estimates suggest that growth of the Internet in

[13] We instrument the interaction of the share online with the log (tax inclusive) price using the log of taxes interacted with the share online and the level of real taxes interacted with the share online. We tried using just the log of taxes, just the level of taxes, as well as combinations of higher-order terms and interactions, and found similar results to those reported here.

the sample from zero to its average value in 2000 corresponds with a near-doubling of the elasticity, from -1.28 to -2.09.[14]

As a check on the robustness of the result using the CPS measure of Internet usage, the next several columns try alternatives. Column (2) uses the alternative Forrester measure of Internet usage in the state. Again the results show a large and significant increase in the elasticity of taxable sales in states as the usage of the Internet rises. The magnitudes are close. Here the elasticity rises from -1.35 to -1.97 with the growth of the Internet in the sample. Column (3) first differences the data, using the CPS measure of Internet use. The results again show the rising price sensitivity of cigarette purchases in places where the Internet is growing fastest (controlling for state and year dummies), though the overall magnitude is smaller. Here the growth of the internet corresponds with a change in the elasticity from -1.08 to -1.58. Columns (4) and (5) deal with the issue of imputed values. Column (4) restricts the sample to only those years where Internet usage is positive (i.e., no imputed zeros) by looking only at the years after 1995. Column (5) uses only years in which the CPS actually has observations (i.e., no imputed Internet usage between survey years). Both procedures yield very similar results.

Finally, in column (6), we include lags and leads of the tax rates to determine if the results are simply the result of short-run shifting of purchases. We find that the lagged and leading tax variables have a very small impact. All that matters are the contemporaneous values. Short-run timing shifts are, on average, relatively small (perhaps because the tax changes are not anticipated well) and the baseline effects are almost the same as before.

These baseline specifications, then, suggest that as Internet use grew in states, the sensitivity of taxable Internet sales in those states grew as well and that the elasticity has risen

[14] The -2.09 is equal to -1.28 + (-1.85*.44), where .44 is the 2000 state average of Internet usage in the CPS.

greatly. We next consider whether this evidence is consistent with alternative explanations or is likely to be tied to a rise in cigarette smuggling due to the Internet. Although it did not estimate a price elasticity, a recent medical study of 3500 smokers in New Jersey in the period surrounding a large increase in cigarette taxes points in the same direction as our findings in that it documented that the share of people reporting they had bought cigarettes online jumped by a factor of six following the tax increase (Hrywna, Delnevo, and Staniewska 2004).

V. Tests of Robustness

The first thing we show, in column (1) of Table 3, is that the results are not simply the spurious correlation of high Internet usage late in the sample with the large rise in prices due to the tobacco settlement. We do this by restricting the sample to only the years before fiscal year 1999 (when the settlement raised pre-tax prices substantially in our data).[15] The results are almost exactly the same.

Second, in column (2), we exclude the four states with the lowest cigarette taxes (VA, KY, NC, SC); because they are frequently the source of the Internet cigarettes, taxable sales in these states might conceivably respond quite differently to changes in Internet usage. They are only a small segment of the sample but, as would be expected, the point estimates do show slightly more sensitivity when they are excluded. Column (3) weights each observation by population, in case the results are being driven by a few outlying observations in small states. If anything, the estimated influence of Internet usage on the price elasticity of taxed sales is higher.

[15] We observe that, in regressions using data for all the years, the estimated coefficients on the year dummy variables often have a sharp upward spike in 2000 and 2001, though it does not matter for the coefficients on the covariates.

In columns (4) and (5) we consider the role of Native American reservations as an alternative source of smuggling. As detailed in Evans, et al. (2002), a loosening of the rules regarding gambling on reservation land in 1989 caused a dramatic increase in the number of Indian casinos in the United States in the last 15 years. To the extent that more people are going to such casinos and are, then, able to pick up cigarettes tax free when they are there, this will make the price sensitivity of sales in a state more sensitive to tax rates due to tax avoidance, but will be only spuriously correlated with the growth of Internet-related tax avoidance over the same time period.

We have no direct measures of the number of Indian gaming visits by state across time. However, using the data from the National Indian Gaming Association, we have been able to count the number of Indian casinos by state in 2004, and in these two columns we split the sample into states where there were no casinos in 2004 (column 4) and states in the highest quartile that had more than five casinos by 2004 (column 5). The results show that while the baseline price elasticity is greater in the no-casino states, there is no difference in the impact of the Internet on the increase in that elasticity. It is the identical magnitude in both cases. We found the same thing interacting with the number of casinos in the state rather than splitting the sample.

In column (6) we deal with the issues of changing demographics. For example, if there has been a rise in teen smoking, and teens are both relatively price-sensitive (as documented in Gruber, 2000) and tend to live in states where the Internet grew fastest, this could cause us to spuriously conclude that rising Internet use makes taxed cigarette sales more tax-sensitive. We suspect, though, that any measure of the actual change of demographic characteristics in a state will almost certainly not give an explanation as to why the tax

sensitivity of cigarette sales has nearly doubled in such a short time frame. The changes and the differences in elasticities across groups are simply too small. To further investigate this possibility, or any other state-specific factor, we allow the baseline elasticity to differ in every state (in addition to the existing state and year dummies accounting for differing levels of consumption).[16] The specification also includes the Internet interaction term, so it examines whether higher Internet use makes states more price-sensitive than they would otherwise have been and accounts for any state-level differences in price sensitivity. In this specification the estimated impact of the Internet on tax sensitivity is statistically significant and still large, though smaller than in the baseline specification. The average t-statistic on the state level price elasticities is almost seven, so there is still enough variation to estimate these separately.

In column (7) we examine whether the Internet effect on the price elasticity can be differentiated from a linear trend in the elasticity that applies to all states. We do this by adding an explanatory variable that interacts the log of price with the year. This exercise suggest that, indeed, there is an upward drift in the (absolute value of) the price elasticity, but that this trend can be statistically differentiated from the impact of Internet use on the price elasticity. In column (7) the Internet effect is large, although not as large as in the baseline specifications.

Finally, in columns (8) and (9), we take the robustness check to the full extreme—in (8) allowing a linear time trend and state-specific elasticities, and in (9) allowing every state and every year to have a separate baseline elasticity—and identify the impact of the Internet on price sensitivity relative to these. Here the results break down. The point estimate of the interaction term is not significant and, in column (9), the point estimate has the wrong sign. Further, none of the state or year price elasticities are individually significant, either (average

[16] These coefficients are not reported individually in order to save space.

t-statistics of only around 0.2). The data are simply unable to estimate all of these effects separately.

VI. Taxes, Smoking and Smuggling

The results discussed to this point show rather clearly that the elasticity of taxed cigarette sales have grown and that the growth in the elasticity appears to be correlated with the rise of the Internet in different states. The implications of something that facilitates the purchase of tax-free cigarettes are, however, quite different for smoking than they are for cigarette purchases. Consumption should be *less* sensitive than taxed purchases to the home state tax rate because people can avoid it by buying cigarettes in neighboring states or on the Internet. In addition, greater Internet access probably does not make consumption more sensitive to changes in tax rates. Indeed, it is likely that rising Internet usage makes smoking *less* sensitive to changes in the tax rate because it provides a new way to get around state taxes and because those smokers that already buy over the Internet would not be affected at all.[17]

To investigate this issue, we turn to the BRFSS for data on cigarette consumption per day and convert it into a state level measure of annual packs-per-person so that it is comparable to our taxable sales data. We show in columns (1)-(3) of Table 4 the results of

[17] Gruber, Sen, and Stabile (2003) makes a similar argument regarding cigarette sales versus consumption among Canadians along the U.S. border. Assuming that smokers either buy taxed cigarettes or over the Internet, the relationship between the price elasticity of taxed sales and usage is as follows: $e_U = (1-i)e_T + ise_I$, where e_U is the price elasticity of usage, i is the fraction of total usage that is purchased on the Internet, e_T is the price elasticity of taxed sales among those who buy taxed cigarettes, s is the difference in per capita usage between Internet purchasers and taxed cigarette purchasers (expressed as a fraction of Internet purchases), and e_I is the price elasticity of the fraction of the population that buy cigarettes over the Internet. The difference between the price elasticity of usage and the price elasticity of taxed sales, $e_U - e_T$, is equal to $i(-e_T + se_I)$. Because $e_T<0$, sufficient conditions for this to be positive (i.e., for usage to be less price-elastic than taxed sales) are that higher cigarette taxes induce some people to buy cigarettes over the Internet ($e_I>0$), and Internet users purchase more cigarettes than taxed cigarette upurcahsers ($s>0$)..

estimating many of the same regression specifications as we did previously, but with smoking rather than taxed purchases as the dependent variable. The baseline price sensitivity of smoking is clearly much smaller than the elasticity of taxable purchases. Further, the Internet shows no significant influence on that elasticity. In column (1) the point estimate of the interaction term is negative, but small in absolute value and insignificant. In columns (2) and (3), where we allow state-specific elasticities, it is positive (implying that rising Internet usage has made consumption less sensitive to tax changes), although again it is not significantly different from zero.

These results are consistent with a change in the technology of smuggling. Taxed purchases have become dramatically more elastic with respect to state tax rate changes, while the price elasticity of smoking has remained the same or perhaps gotten smaller in absolute value. In columns (4)-(6) we create an indicator of the amount of smuggled cigarettes by taking the log difference of the amount of cigarettes people say they smoked in the year and the amount they purchased in-state. This should respond positively to changes in the price caused by tax changes and in all three cases it does, although as we add more and more flexible controls, the standard error gets large. In the baseline, column (4), higher taxes lead to more smuggling and the amount of additional smuggling has grown significantly with the rise of the Internet. The magnitude in the baseline specification says that the amount of smuggling arising from a change in a state's tax rate has almost doubled due to the rise of the Internet in this sample. Allowing each state to have a separate baseline elasticity, in column (5), still shows a significant impact of Internet growth on tax induced smuggling, here more than twice as big as the baseline. Introducing a linear time trend with the state-specific

elasticities, as in (6) yields positive point estimates of the Internet interaction term, but with a large standard error.

These last three columns provide the clearest evidence that as access to tax-free Internet sales rises, smokers are not smoking less, they are merely paying less and buying their cigarettes from other sources. Such tax avoidance behavior is highly relevant for forecasting tax revenue, of course.

VII. Revenue

Given the apparent significance of Internet use on tax sensitivity, it is clear that there will be major revenue implications for the states. We present two types of calculations. The first is to estimate the overall impact of Internet growth on the volume of taxable cigarette purchases in the state. This combines the coefficients on the Internet alone with the coefficient on the interaction term of prices with the Internet. Using the average log of the real price in 2001, reducing Internet usage from its average in that year (about .5) to zero indicates that the growth of the Internet has reduced overall sales by a little less than 4 percent, although the standard errors associated with the point estimates do not allow us to say with high confidence that the true effect is not zero.[18]

While the overall impact of the Internet has probably been modest thus far, the impact on revenue coming from recent tax increases has almost certainly not been. Here, we need to look at the impact of changing the tax rate for a given level of Internet use, which is a large number. To get a feel for the magnitude of this effect, we gathered data on the cigarette tax increases that occurred between the end of our sample and September 2003. This included 30

[18] We also tried doing this computation for specifications using the various measures in the Forrester data, but this produced noisy estimates so that none of the estimates was significantly different from zero.

states plus the District of Columbia. Among that group, average real taxes *doubled* in the intervening two years. For each state, we compute the change in log revenue that would occur under different assumptions of the elasticity according to the formula

$$\ln(\text{Re}\,v_1) - \ln(\text{Re}\,v_0) = \ln(t_1) - \ln(t_0) + \ln(q_1) - \ln(q_0)$$

$$= \ln(t_1) - \ln(t_0) + \eta[\ln(p + t_1) - \ln(p + t_0)]$$

where η is the price elasticity. We hold all the other covariates constant from our empirical model and keep the real price fixed at its 2001 level and then examine the change in the real tax rate assuming three levels of elasticity. The first is the baseline elasticity in our paper of -1.28. The second is the consensus elasticity in the previous literature or around -.45 as described in Evans et al. (1999) or Gruber and Koszegi (2001). The third is, for each state, the estimated elasticity in our model given the state's internet usage in 2001. We saw above that, on average, this had increased the elasticity to around -2.

The average change in log tax rates among the states with a tax increase was .740. The average change in log p+t was .126. The predicted log revenue gain should have averaged something like .68 using the consensus elasticity or .58 using the no-internet baseline from our model. Using the full elasticity for taxable purchases including the effect of Internet smuggling, however, yields an average revenue gain 21 percent lower than our baseline and 33 percent lower than conventional revenue estimates. In the extreme cases where Internet usage was high and where taxes rose a great deal like New Jersey (where taxes rose from 80 cents per pack to 205 cents per pack) or Connecticut (45 cents to 151 cents), the revenue gains from the tax increases will be 60 and 45 percent lower than using standard elasticities, respectively (or 44 and 30 percent lower using our -1.28, no-internet baseline). Interestingly, in New York, where the tax went from 56 cents to 150 cents, one industry group

has claimed that the revenues from this tax increase were some 50 percent smaller than originally forecast (SBSC, 2003). This general effect has been clearly noted among anti-tax advocates looking at the cigarette tax increases (Bartlett, 2003).

While it is true that the cigarette tax increases of the last two years have been especially large and that may have contributed to the revenue discrepancies being so large, our findings suggest that there is a significant shift underway in the ability of states to raise money through tobacco taxes.

VIII. Conclusions

Using information on the purchases of cigarettes and the use of the Internet across states and time since 1990, this paper has presented evidence suggesting that the rise of the Internet and the associated increase in the ability of individuals to purchase tax-free cigarettes has significantly increased the tax sensitivity of consumers. The elasticity of sales may have doubled due to the growth of cigarette sellers online. The evidence also suggests that this is due to smuggling and not due to any greater sensitivity of cigarette consumption. We find no evidence that the increasing sensitivity is due to spuriously correlated factors that differ across states, although our data do not allow us to distinguish the Internet hypothesis from a model with both state-specific elasticities and either year-specific or linearly increasing elasticities. The large estimates imply major reductions in the ability of states to raise revenue by increasing the cigarette tax.

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