Tax Revenue and Cigarette Consumption in Wyoming: May 1996–April 2014

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Tax Revenue and Cigarette Consumption in Wyoming: May 1996–April 2014

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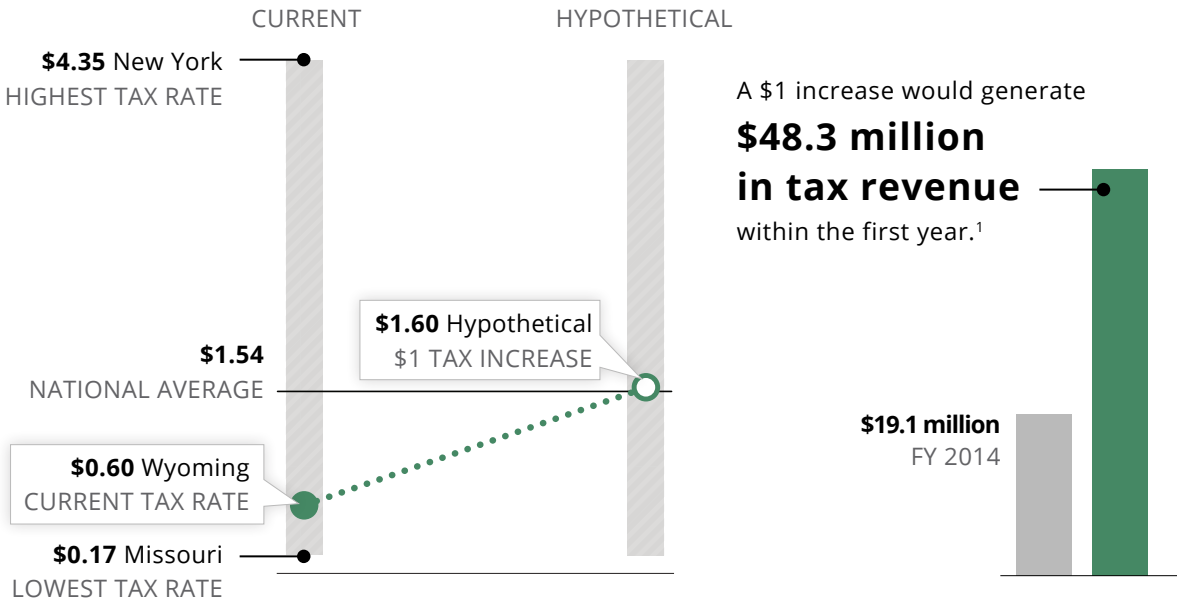
Wyoming Cigarette Tax Revenue & Consumption: May 1996-April 2014

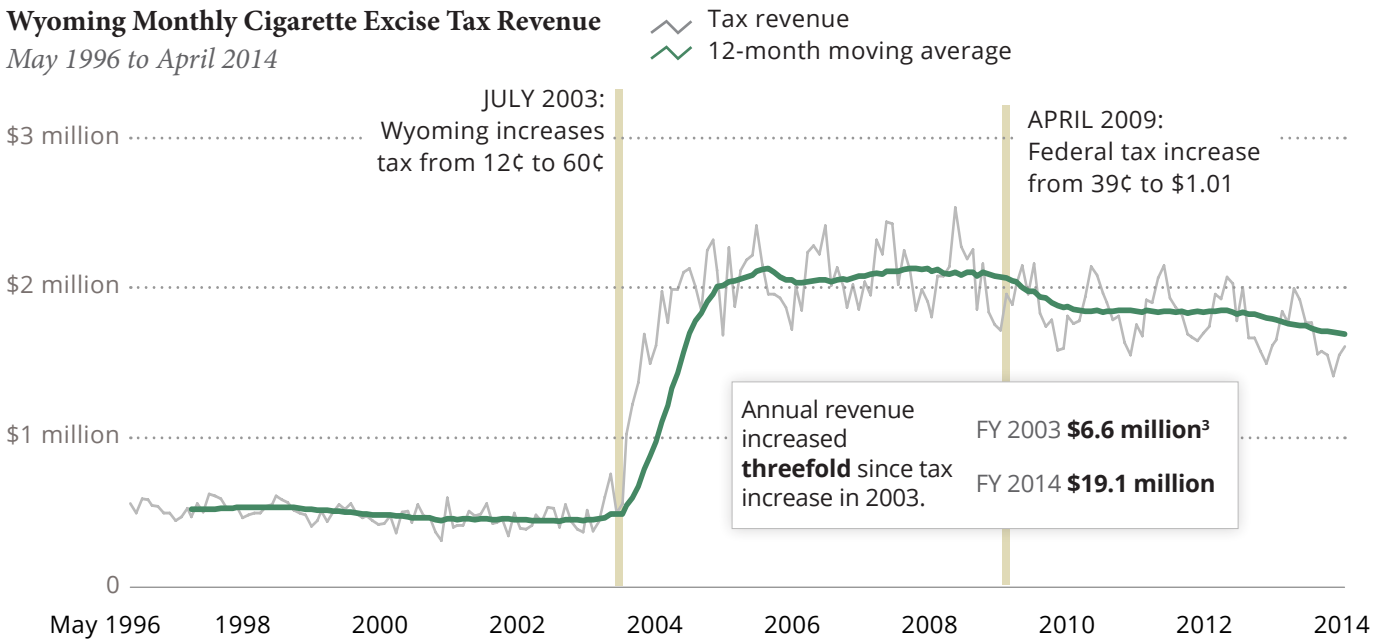
Tax Revenue

Wyoming's cigarette excise tax has always been below the average state excise tax. A $1.00 per pack increase would put the Wyoming rate slightly greater than the national average.



Every state that has implemented a significant tax increase has also realized a significant increase in cigarette tax revenue (Chaloupka, Straif & Leon, 2010; Farrelly, Nimsch & James, 2003).

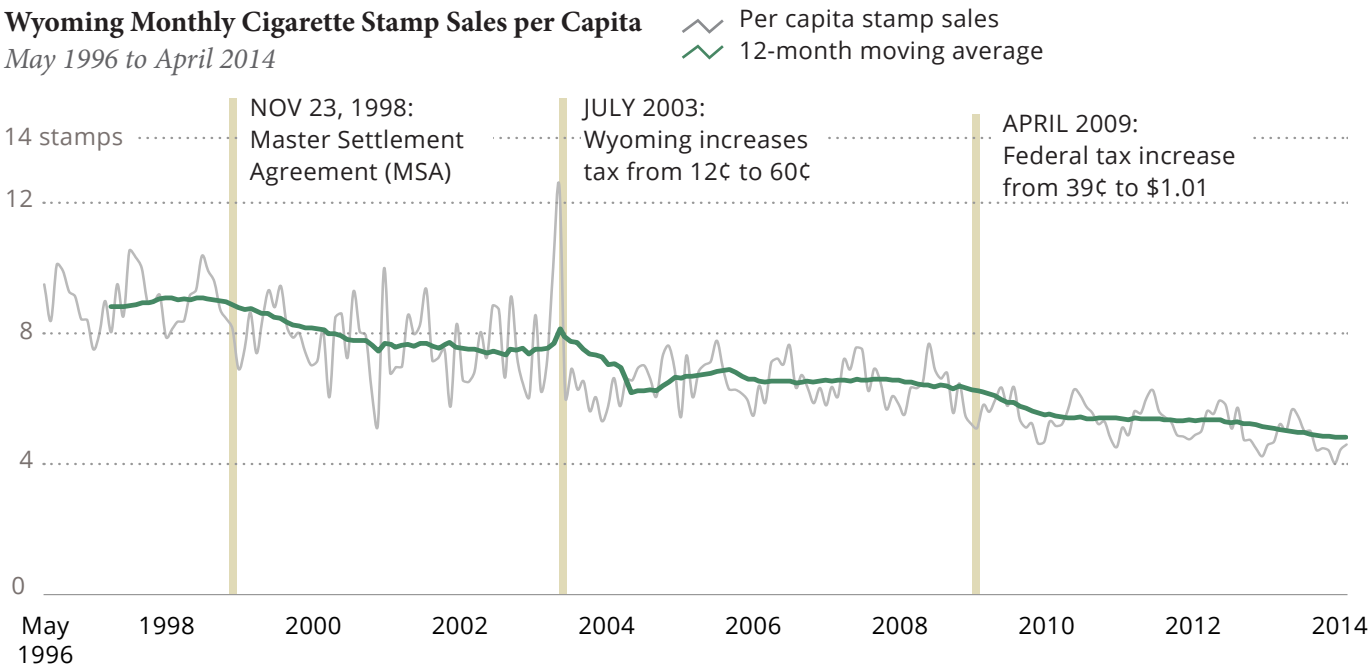
Wyoming Monthly Cigarette Excise Tax Revenue
May 1996 to April 2014



Cigarette Consumption

Many factors influence Wyoming's cigarette tax revenue and consumption. We use a modeling approach to understand the extent to which changes in cigarette prices influence consumption rates while controlling for other factors.

Wyoming Monthly Cigarette Stamp Sales per Capita
May 1996 to April 2014



Impact of Price Increase

Among adults, roughly half of the impact of price on cigarette consumption results from reductions in the number of people smoking and roughly half results from remaining smokers smoking fewer cigarettes (Chaloupa, Straif & Leon, 2010). Compared to the general population, youth are two to three times more sensitive to an increase in cigarette price (Bader, Boisclair & Ferrence, 2011) and are less likely to initiate smoking as prices increase (Cawley, Markowitz & Tauras, 2004; Tauras, O'Malley & Johnston, 2011).

We estimate for a per-pack price increase of ▲ **10%** cigarette stamp sales would fall by ▼ **3.1%**

If the Wyoming excise tax rate per pack of cigarettes increased by ▲ **$1** we estimate consumption would decrease by ▼ **6.3%**

— that's **178,000 packs** per month.

NOTES
1. As with any statistical model, actual results may differ from predictions.
2. Adjusted for inflation.

2. Introduction

To reduce smoking rates, as well as tobacco-related diseases and deaths, the Centers for Disease Control and Prevention (CDC) recommends that states adopt a comprehensive approach to tobacco control (CDC, 2014a). A comprehensive tobacco control program includes coordinating efforts on multiple fronts including implementation of smokefree policies, modification of social norms, promotion of and assistance with tobacco cessation, and prevention of initiation of tobacco use. Thus a comprehensive tobacco control program relies on a combination of educational, medical, regulatory, social, and economic strategies. In this report, we focus on the effect of increasing the unit price of a pack of cigarettes on consumption and the attendant generation of tax revenue. **Notably, the empirical evidence shows that *every* state that has implemented a significant tax increase has subsequently realized a significant increase in cigarette tax revenue** (Chaloupka, Straif, & Leon, 2010; Farrelly, Nimsch, & James, 2003; Campaign for Tobacco-Free Kids, 2014a).

Governments tax tobacco products using both excise and general sales taxes. Excise taxes are levied on each unit of a specific good (e.g., $0.60 on each pack of cigarettes in Wyoming), whereas sales taxes are levied on the price of a good (e.g., 4% of the price, including excise taxes). Federal, state, and local governments levy cigarette excise taxes, but only state and local governments levy cigarette sales taxes. Because states set the amount of excise taxes levied on a pack of cigarettes, states can use taxation as an economic policy tool to achieve smoking deterrence.

The analyses that we present in this report focus exclusively on cigarette excise taxes with an emphasis on state taxes, particularly Wyoming's. This report does not address tax impacts for other tobacco products (e.g., smokeless tobacco, cigars, and cigarillos).

The remainder of this report is organized as follows: Section 3 presents a review of the research on the effects of price on cigarette consumption. We present our measures of cigarette consumption and price in Section 4. Our estimate of the change in demand for cigarettes as price increases is presented in Section 5. Section 6 presents other factors that affect price and thus cigarette demand. Section 7 compares taxation of cigarettes in Wyoming, surrounding states and the nation. We present our conclusions in Section 8.

3. The Economics of Tobacco Taxation

The three common objectives for tobacco taxation are *revenue generation, deterrence,* and *efficiency* (Zimring and Nelson, 1995; World Health Organization, 2010). We discuss the relationship between these objectives and taxation in this section.

3.1. Revenue Generation

The two components of revenue—tax and consumption—move revenue in opposite directions: If taxes go up, so would revenue. However, increasing prices by increasing taxes will cause consumption to go down, along with revenue. For tax revenue to rise, *the effects of the tax increase must be larger than the effects of the consumption decrease*. Tax revenue will rise if demand (i.e., consumption) is relatively unresponsive to price changes, in which case demand is said to be *inelastic*. Numerous studies have demonstrated that the demand for cigarettes is relatively inelastic. Thus, an increase in the cigarette excise tax will result in an increase in tax revenue even while consumption decreases. This outcome is supported by data showing that *every* state that has implemented a significant tax increase has also realized a significant increase in cigarette tax revenue (Chaloupka, Straif, & Leon, 2010; Farrelly, Nimsch, & James, 2003; Campaign for Tobacco-Free Kids, 2014a).

However, in addition to reducing consumption, smokers may also respond to an increase in cigarette taxes by avoiding or evading taxes.[1] One study found that heavier smokers (11 or more cigarettes per day) were more likely to purchase low-tax or untaxed cigarettes compared to light smokers (1 to 10 cigarettes per day; Guindon, Driezen, Chaloupka, & Fong, 2014). The same study also found that smokers with quit intention were less likely to engage in cigarette tax avoidance or evasion than smokers who had no intention of quitting. Stehr (2005) found that the percentage of cigarettes purchased in the United States for which the consumer did not pay state excise taxes increased from 7.2% in 1985 to 12.7% in 2001. In the United States, Indian reservations were found to be the primary source of smokers' most recent purchases of low-tax or untaxed cigarettes between 2002 and 2010/2011 while out-of-state and direct purchases through the mail, telephone or Internet were the second most popular sources in recent years (Guindon et al., 2014). The tax avoidance loophole of direct purchasing cigarettes over the Internet, by telephone, fax or through the mail was tightened when President Obama signed the Prevent All Cigarette Trafficking (PACT) Act. The PACT Act, which took effect on June 29, 2010, requires those selling cigarettes on the Internet and other remote sellers to pay all federal, state, local, or tribal tobacco taxes as if the sellers were located in the same tax jurisdiction as the delivery address.

Smokers may also travel to and buy cigarettes from neighboring states with lower excise taxes. A recent study found that smokers are more likely to purchase cigarettes from a neighboring low-tax state when faced with a combination of shorter driving distances to the border and greater differences in excise taxes (DeCicca, Kenkel, & Liu, 2013). However, Chiou and Muehlegger (2008) report that 98 percent of smokers drive *40 miles or* less to make cigarette purchases. Furthermore, the effect of a given state's tax increase on sales in neighboring states was found to be dependent on the demographics of a state's population and how the people are dispersed across the landscape (Chiou & Muehlegger, 2008). For instance, in a small geographic area like the District of Columbia, incentives to buy cigarettes from a different jurisdiction are significant and barriers to doing so are low, leading to a much lower estimate of increased revenue generation after a tax increase. In comparison, an excise tax increase in the larger geographic area of Maryland would lead to a modest decline in expected revenue generation after accounting for cross-border purchases. More importantly, even when there is increased tax avoidance and tax evasion, studies have shown that these activities reduce, but do not eliminate, the revenue impact of tobacco tax increases (Chaloupka, Straif, & Leon, 2010).

Based on this literature review, we would expect Wyoming to have relatively low cross-border sales from residents traveling to neighboring states because those states generally have higher tax rates. Similarly, travel into Wyoming from large population centers in neighboring states often exceeds the 40-mile threshold described by Chiou and Muehlegger (2008), suggesting a low rate of cross-border sales from people traveling from other states. Additionally, most cities and towns in Wyoming are more than 40 miles from a reservation (including the Wind River Indian Reservation), making it impractical for most Wyoming residents to routinely avoid taxes by purchasing cigarettes on a reservation.

[1] Tax *avoidance* includes legal activities and purchases, most of which are done by individual tobacco users including cross-border shopping, tourist shopping, and duty-free shopping. Tax *evasion* includes illegal activities such as purchasing smuggled or illicit manufactured tobacco products. Most of these type of activities are done by large scale operations (Chaloupka, Straif, & Leon, 2010).

3.2. Deterrence

Research on the extent to which the use of a product falls or rises after an increase or decrease in its price, *price elasticity of demand*, has consistently shown that an increase in the price of tobacco products is followed by a decrease in the number of people smoking and the number of cigarettes consumed by those who continue to smoke. A tax increase discourages people from taking up smoking, encourages current smokers to quit, and discourages former smokers from beginning again (Chaloupka, Straif, & Leon, 2010). A group of experts from 12 countries convened by the International Agency for Research on Cancer found sufficient evidence that increasing tobacco excise taxes is effective in reducing overall tobacco consumption (Chaloupka, Straif, & Leon, 2010).[2] A recent paper that systematically reviewed the impact of tobacco control polices also found sufficient evidence to support the independent impact on smoking behavior from increasing taxes on tobacco products (Wilson et al., 2012).

Researchers using data from surveys of individuals have examined the effect price increases have on smoking participation and smoking intensity. The more recent of these studies have shown that overall, *among adults*, roughly half of the impact of price on cigarette consumption results from reductions in the number of people smoking and roughly half results from remaining smokers smoking fewer cigarettes (Chaloupka, Straif, & Leon, 2010).

A synthesis of studies focused on youth (18 and younger) generally found that adolescents are two to three times more sensitive to price than the general population (Bader, Boisclair, & Ferrence, 2011). In addition, researchers using longitudinal data have found that youth smoking initiation is negatively correlated with price (Cawley, Markowitz & Tauras, 2004; Tauras, O'Malley & Johnston, 2001). However, studies using cross-sectional data have found mixed results on the effect of price in preventing youth smoking initiation (DeCicca, Kenkel, & Mathios, 2002; Carpenter & Cook, 2008; Bader, Boisclair, & Ferrence, 2011; Farrelly et al, 2013).

Based on this literature review, we would expect Wyoming to see reductions in cigarette consumption after raising taxes on cigarettes. To reiterate, no state has found these reductions in cigarette consumption sufficient to reduce revenue. Instead, every state that has implemented a significant tax increase has subsequently realized a significant *increase* in cigarette tax revenue (Chaloupka et al., 2010; Farrelly et al., 2003; Campaign for Tobacco-Free Kids, 2014a). Our previous reports (e.g., WYSAC, 2012a) have found this to be the case for Wyoming.

3.3. Efficiency

Economic efficiency is achieved in a market when the price of the good being exchanged equals all social costs generated by the consumption of that good (Varian, 1992). Taxes on products with high social costs, such as cigarettes, can offset the inefficiency, at least as it relates to government costs. WYSAC estimated the total economic costs of tobacco as a result of health care costs and productivity losses to be $689.4 million in 2010 (WYSAC, 2012b). The U. S. average social costs arising from the health impacts and lost productivity associated with cigarette consumption are estimated to be $18.20 per pack (Campaign for Tobacco-Free Kids, 2014b. Total social costs are likely even higher than the Campaign's estimate because of other social impacts, such as reduced air quality. Because the social costs of smoking exceed current taxes (the highest total excise tax is $7.17 per pack in Chicago;

[2] Chalpouka, Straif, and Leon (2010, p. 236) define sufficient evidence as "an association…between the intervention under consideration and a given effect in studies in which chance, bias and confounding can be ruled out with reasonable confidence. The association is highly likely to be causal."

Campaign for Tobacco-Free Kids, 2014b), further increases in excise taxes will increase economic efficiency.

4. Wyoming Tax Revenue and Consumption

Direct measures of cigarette consumption in Wyoming do not exist. However, we can infer consumption from an indirect measure using tax revenue data from the Wyoming Department of Revenue (WYDOR). Cigarette tax revenue is generated when wholesalers buy cigarette stamps. The wholesalers affix one of these stamps to each cigarette pack before distributing them to retailers. The WYDOR [ca. 2014a] tracks and precisely measures tax revenue through the sale of cigarette stamps.

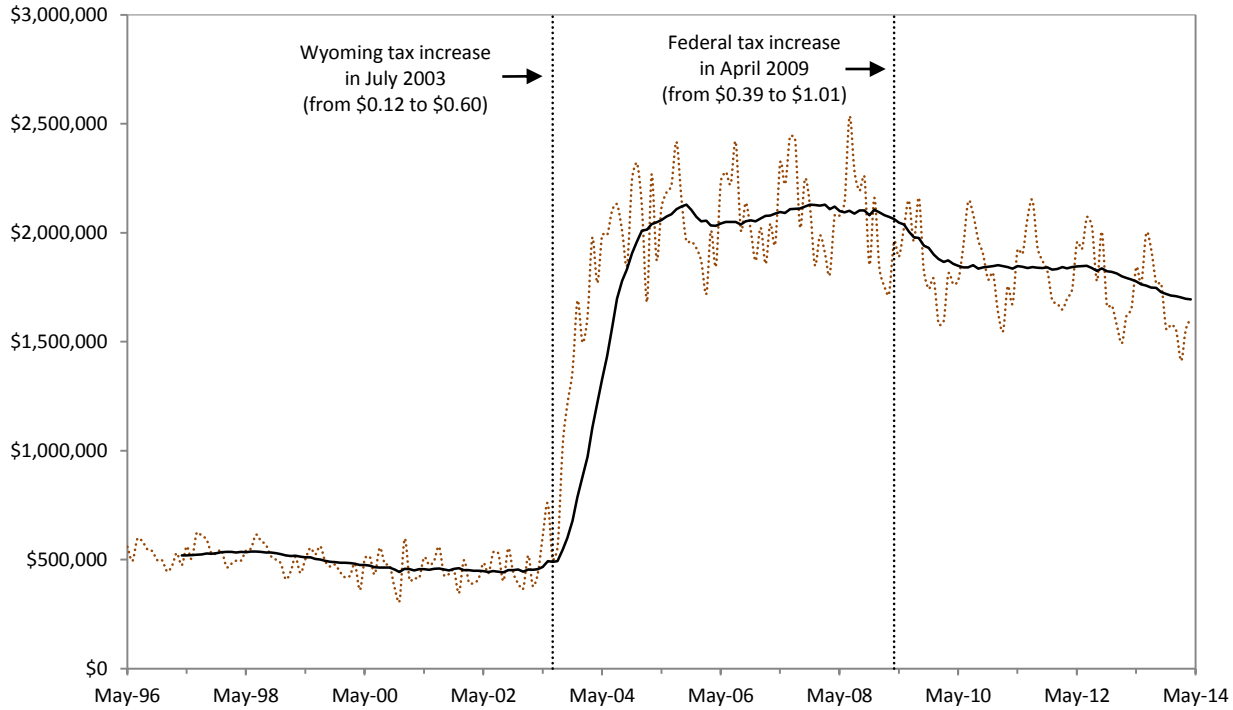
Because cigarette stamp sales are an indirect measure of consumption, the number of cigarette stamps sold in a given month does not exactly equal the number of cigarette packs consumed that month. It takes time for a pack of cigarettes to move through the marketing chain, and wholesalers, retailers, and consumers all hold inventories. However, these timing and inventory effects become negligible when averaging the data over numerous periods, as most statistical analyses do (including the analyses we have conducted).

We use tax revenue data and a revenue distribution formula specified in Wyoming Statute to compute stamp sales (Wyo. Stat § 39.18-111). See Appendix A for details on our calculation of cigarette stamp sales.

Figure 1 plots the revenue generated from cigarette excise taxes. The light-colored, dotted line depicts the actual monthly revenue and the black, solid line depicts the 12-month moving average. Because the data fluctuate from month to month, we added a 12-month moving average[3] to smooth out the peaks and valleys allowing for a clearer picture of the overall trend in the data. The use of smoothing filters like a 12-month moving average is common in time series data especially when the data fluctuate seasonally or show month-to-month volatility, as with our cigarette data. The last increase in Wyoming's cigarette excise tax was in July 2003 and represented a $0.48 per pack increase in price. After the July 2003 Wyoming tax increase, revenue rose steadily for about a year, and then stabilized until the April 2009 federal tax increase. After the federal tax increase, Wyoming cigarette tax revenue decreased to a lower constant level from approximately May 2009 until November 2012 when it began to decline again. This last downturn in cigarette tax revenue appears to be a national phenomenon appearing in a figure depicting the amount of federal and state cigarette taxes generated per year in Orzechowski and Walker's Tax Burden report (2014).

[3] A 12-month moving average is the average of the previous 11 monthly data points and the current monthly data point. The calculation is repeated for each successive data point in the series, moving forward in time over the entire range of data.

Figure 1. Monthly Wyoming Cigarette Excise Tax Revenue, May 1996–April 2014



Source: WYDOR [ca. 2014].

Excise tax revenue from cigarette sales equaled $5.140 million for fiscal year 2003, before the tax increase took effect. The Wyoming general fund received $1.310 million of the total and the remaining $3.830 million was distributed to local governments. After adjusting for inflation, FY2003 total excise tax revenue equals $6,631,939 and the dollar value distributed to the general fund equals $1,690,729 in 2014 dollars (WYDOR, [ca. 2014b]).

WYDOR [ca. 2014b] reported the fiscal year 2014 excise tax revenue from cigarette sales as $19.135 million.[4] The Wyoming general fund received $16.287 million (85.1%) of the total and the remaining $2.848 million (14.9%) was distributed to the towns, cities, and counties where the cigarettes were sold. After adjusting for inflation that occurred between fiscal years 2003 and 2014, the increase in excise tax revenue from cigarette sales has nearly **tripled,** and the amount of monies distributed to the general fund has increased by a factor of **9.6**.[5] The additional revenue generated from the 2003 tax increase, $0.48, was allocated to the general fund. This explains the considerable increase in excise tax revenue distributed to the general fund in fiscal year 2014.

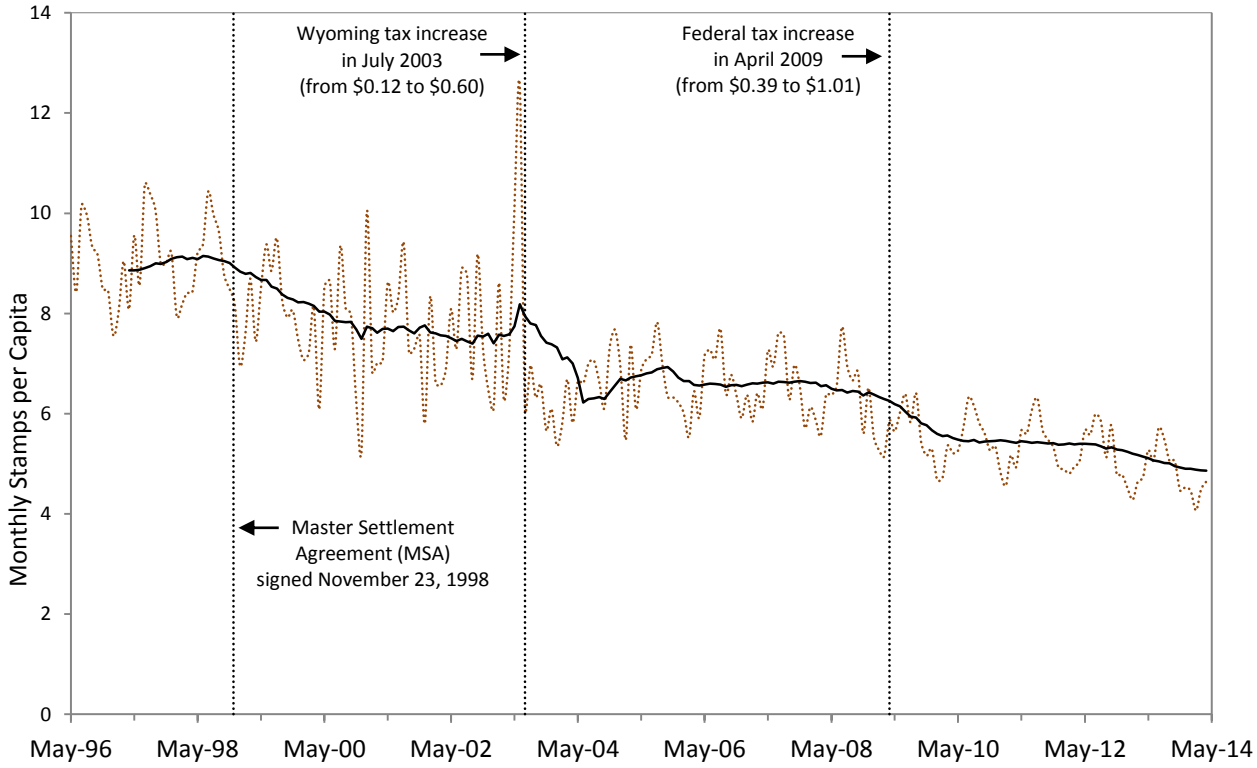
Figure 2 plots monthly Wyoming per capita cigarette stamps sold, with the light-colored, dotted line showing the actual monthly stamps sold and the black, solid line showing the 12-month moving average. Figure 2 shows a nearly continuous decline in cigarette consumption, as depicted by the 12-month moving average, since the signing of the landmark Master Settlement Agreement (MSA) on November 23, 1998. The signing of the MSA marks the beginning of payments, to be made in

[4] The WYDOR reports on revenue from cigarette stamps that were sold two-months prior. Thus, the reported revenue generated from cigarette sales in fiscal year 2014 represents stamps sales from April 2013 to May 2014.
[5] After adjusting for inflation, FY2003 total excise tax revenue equals $6,631,939 (=$5,140,028 *(234.97/182.1)) and the dollar value distributed to the general fund equals $1,690,729 ($1,310,385*(234.97/182.1)). These tax revenue totals for FY2003 and FY2014 do not include the 6% returned to wholesalers.

perpetuity, by five United States tobacco companies to 46 states, five United States territories, and the District of Columbia to compensate them for some of the medical costs of caring for persons with smoking-related illnesses (William Mitchell College of Law, 2010). The tobacco companies essentially passed on these costs to consumers in the form of higher cigarette prices (see Figure 3).

The steady decline in cigarette demand is interrupted once before the July 2003 Wyoming tax increase. This increase occurs because of inventory accumulations immediately preceding the tax increase. Sales fall for several months immediately following the tax increase as the accumulated inventory was consumed and/or smokers engaged in other tax-avoidance behavior such as quitting, cutting back on smoking, and purchasing from alternative low-price sources. This pattern resembles the trend observed in other states that have enacted large tax increases: increased sales prior to the tax increase, a sharp decline in sales immediately after the tax increase, and a slow rise to a sales level lower than before the tax increased (Farrelly, Nimsch, & James, 2003). A spike in cigarette sales did not accompany the April 1, 2009 federal excise tax increase because the U.S. government also imposed a one-time tax on untaxed or under-taxed cigarettes and other tobacco products, also known as a floor tax, in retailers' and wholesalers' inventories.

Figure 2. Monthly Wyoming per Capita Cigarette Stamp Sales, May 1996–April 2014



Sources: U.S. Census Bureau, 2002, 2011, 2013; WYDOR, [ca.2014].

5. Estimation of the Cigarette Price Elasticity of Demand

Many factors contribute to the trends shown in Figures 1 and 2. To understand the extent to which demand for cigarettes responds to changes in price, we use an empirical approach. *Price elasticity of demand* measures the amount by which cigarette use falls after an increase in price. For instance, if the price elasticity for cigarettes were -0.3 this means that a 10% increase in price would reduce cigarette consumption by 3%. We then use our estimate of price elasticity to estimate the tax-related reduction in consumption and to predict the impact of future tax increases on consumption and revenue generation.

Using multivariate regression, we estimated the price elasticity of demand for cigarettes as part of a model with cigarette consumption as the response variable. Regression analysis quantifies the relationship between a response variable (e.g., cigarette consumption) and multiple explanatory variables (e.g., price, seasonality, time), each of which may have a causal relationship with the response variable. See Appendix A for technical details on our model.

The response variable in the analysis is monthly Wyoming cigarette stamp sales per capita (based on the total state population), a proxy for per-capita cigarette consumption. In addition to cigarette price, the regression model accounts for the effects of inventories, inflation, seasonality, and the Wyoming and federal excise tax increases. The analysis used monthly data from May 1996 to April 2014 (216 observations; see Appendix A for details of the regression analysis). We cannot tell why consumption decreases—a reduction in smokers, a reduction in the quantity smoked, or other behavioral changes by smokers.

From our model, we estimate Wyoming's cigarette price elasticity to be -0.31. This estimate means that for a 10% increase in cigarette price, tax stamp sales will fall by 3.1%. This estimate of responsiveness is consistent with the review conducted by the International Agency on Cancer which concluded that studies on the impact of price increases on aggregate demand had estimates of the price elasticity falling between -0.2 and -0.6. These estimates of price elasticity indicate that tobacco demand, in Wyoming and more generally, is not very sensitive to price changes. This relationship explains why every state, including Wyoming, that has instituted a large tax increase has seen reductions in consumption and increases in revenue (Chaloupka, Straif, & Leon, 2010; Farrelly, Nimsch, & James, 2003; Campaign for Tobacco-Free Kids, 2014a).

In addition, we can use the model results to predict the consequences of further tax increases. We considered a tax increase of $1.00, which would bring the Wyoming excise tax close to the national average of $1.54 (CDC, 2014b). The average price of a pack of cigarettes in Wyoming (including the Wyoming and federal excise taxes, but not sales tax) as of November 2013 was $5.02 (Orzechowski & Walker, 2014). An additional $1.00 tax (for a total Wyoming excise tax of $1.60) would increase the price of a pack of cigarettes to $6.02, representing a price increase of 20%. The predicted decrease in consumption is 6.2%, or about 0.31 packs per capita per month, which equals a statewide decrease of approximately 178,000 packs per month. This decrease in consumption would leave Wyoming with about 4.59 packs sold per capita per month, or about 2.67 million packs per month. The total revenue

generated by 2.67 million packs per month at a tax rate of $1.60 would be nearly $4.283 million per month as compared to the average monthly revenue compared to fiscal year 2014 of $1.694 million.[6]

After accounting for the 6% discount rate that is returned to wholesalers, we estimate that a Wyoming excise tax of $1.60 per pack would generate approximately $48.315 million in total tax revenue.

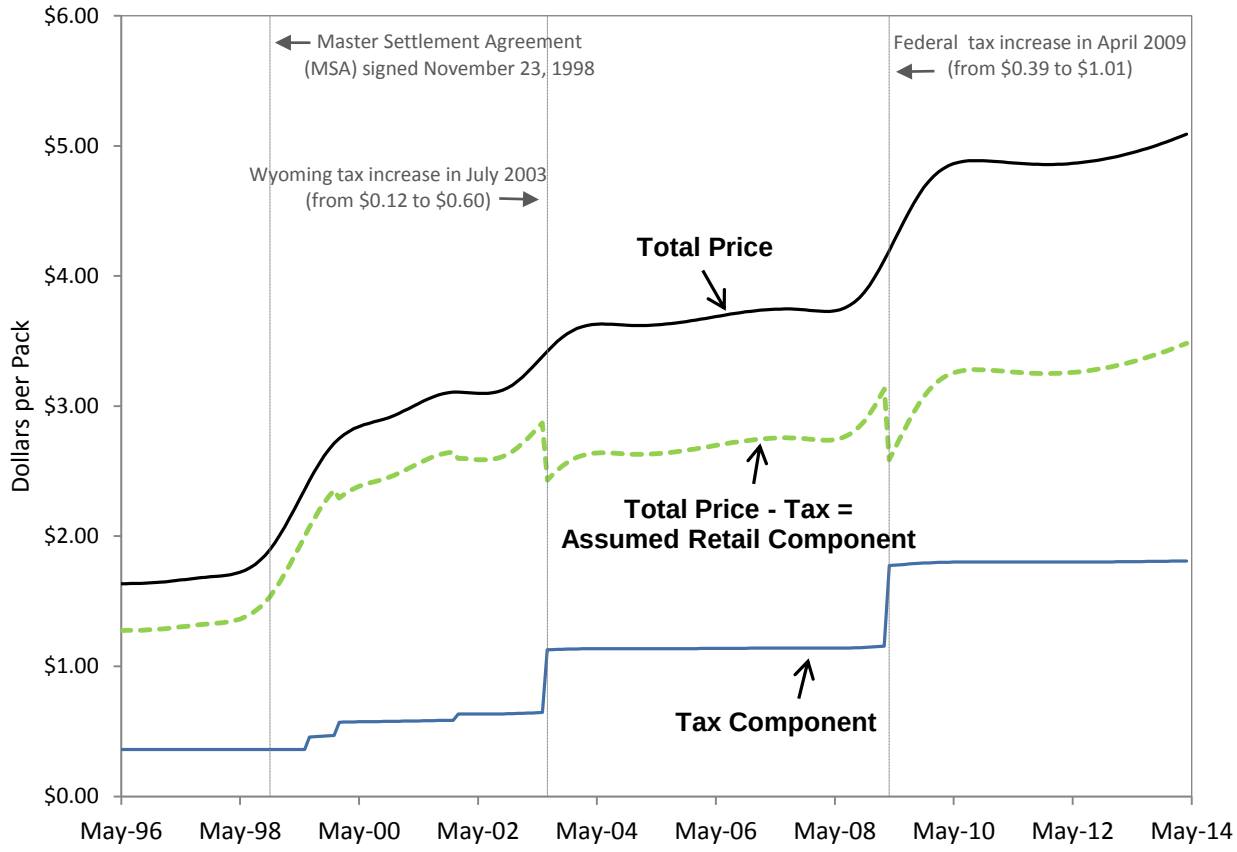
6. Other Factors Influencing Wyoming Cigarette Consumption and Tax Revenue

Non-tax determinants of price include promotional and other pricing strategies used by manufacturers, wholesalers and retailers, in order to dampen the sudden increase in price that results from an increase in excise tax. Fitch (an international market ratings agency) reported that cigarette manufacturers increased their wholesale cigarette prices during the first quarter of 2009 in anticipation of the April 1, 2009 federal excise tax increase of $0.62 per pack of cigarettes (Managed Care Weekly Digest, 2009). Concurrently, a floor tax (a one-time tax on untaxed or under-taxed products) was assessed by the U.S. government for cigarettes and other tobacco products in retailers' and wholesalers' inventories. Fitch speculated this floor tax may have also influenced retailers to raise their cigarette prices. Studies also found that, after the tax went into effect, cigarette manufacturers' price-reducing promotions or increased advertising expenditures succeeded in reducing the effects of tax increases (Keeler et al., 2004; Chaloupka, Cummings, Morley, & Horan, 2002).

To examine the non-tax determinants of price, we disaggregated our measure of cigarette price into its retail and tax components. The tax component includes federal and state excise taxes and Wyoming state sales tax. The retail component is constructed from the difference between the known total price and the known tax component. Figure 3 illustrates the total price and tax component of Wyoming cigarette prices as well as our constructed retail price. The tobacco companies' response to the MSA is evident in the steadily increasing price of a pack of cigarettes immediately after the agreement was signed. Increases in the retail component of cigarette prices in Wyoming prior to July 2003, and prior to April 1, 2009, are evident in Figure 3. Although we do not know with certainty that our constructed retail price is true, we believe that our constructed retail price in Figure 3 reflects what others have reported, namely that manufacturers, wholesalers, and/or retailers manipulated the price of cigarettes in Wyoming, in part, to offset both the state and federal increases in cigarette excise tax.

[6] An additional $1.00 tax would increase the average price of a pack of cigarettes to $6.02, representing a price increase of 20% (($6.02/$5.02)*100). The predicted decrease in consumption is 6.2% (0.31 * 20%), or about 0.31 packs per capita per month (6.2% of the average 4.9 packs per capita per month currently sold). This decrease in consumption would leave Wyoming with about 4.59 packs sold per capita per month (4.9 – 0.31), or about 2.67 million packs per month (4.59 * 582,658). Our estimate of tax revenue after a $1.00 tax increase is approximately $48.315 million (($4.283 million*12)*0.84).

Figure 3. Decomposition of Mean Wyoming Cigarette Price into Retail and Tax Components, May 1996–April 2014



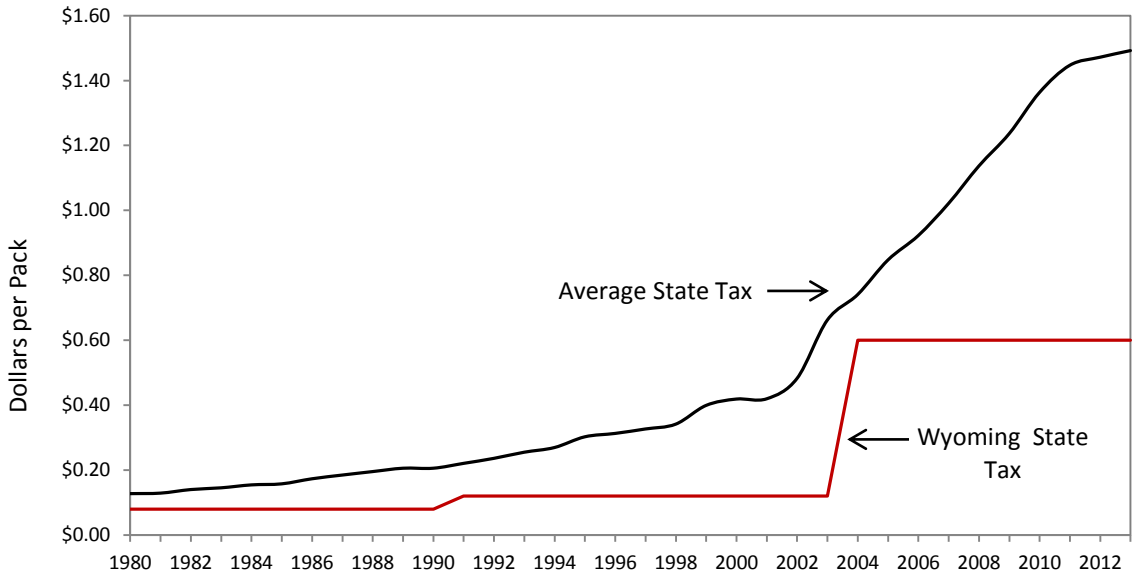
7. Tobacco Taxation in Wyoming and the Country

It has been over 11 years since Wyoming has increased its cigarette excise tax from $0.12 to $0.60 in July 2003. The World Health Organization (2010) recommends that excise taxes be adjusted with the Consumer Price Index (CPI) to keep pace with inflation. Otherwise the real value of the excise tax and associated revenue falls over time. Had this been the case, the current Wyoming excise tax would be $0.78. Thus the real value of Wyoming's $0.60 excise tax has dropped nearly 30% since July 2003.[7]

Wyoming's cigarette excise tax has always been below the average state excise tax (Figure 4). Among its bordering states, Wyoming had the lowest excise tax rate until the July 2003 increase to $0.60 (see Table 1). Currently, the only bordering state with a lower rate than Wyoming is Idaho at $0.57 per pack (set in June 2003). Three bordering states, Montana, South Dakota and Utah have excise tax rates over $1.50 per pack.

[7] Rate of inflation = ((FY2014 CPI - FY2003 CPI)/ FY2003CPI)*100 = ((234.97-182.1)/182.1)*100 = 28.9%.

Figure 4. National Average and Wyoming State Cigarette Taxes, Fiscal Years 1980–2013[1]



[1]Fiscal years ending in June 30.
Source: Table 7, Orzechowski and Walker, 2014.

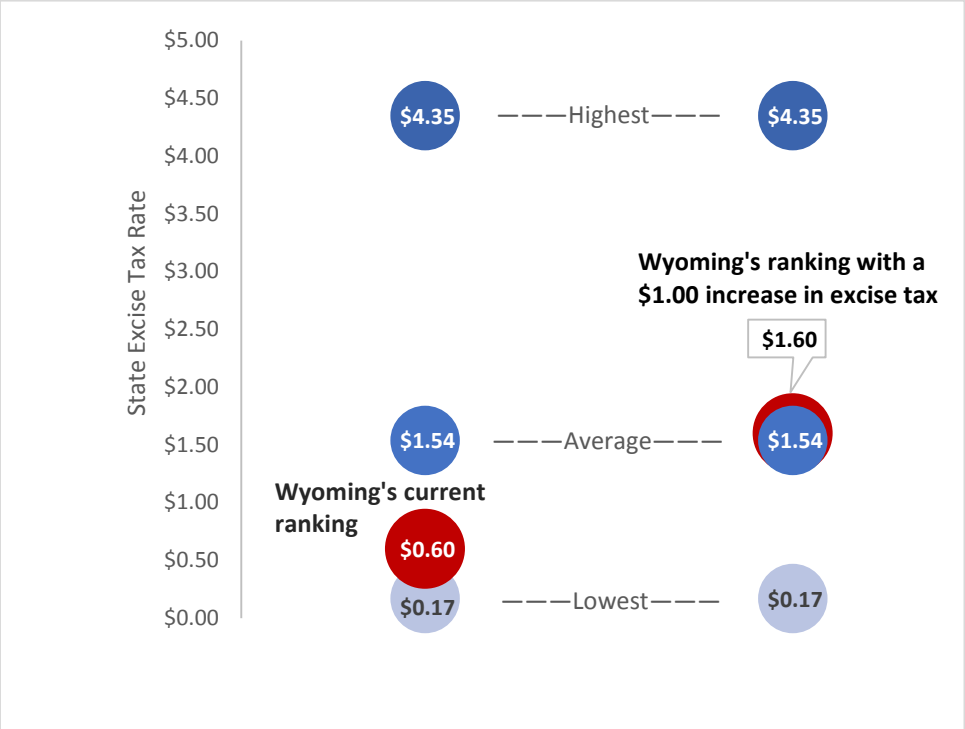
Table 1. State Cigarette Taxes, per Pack, in Wyoming and Bordering States, May 1996–April 2014

Date	Colorado	Idaho	Montana	Nebraska	South Dakota	Utah	Wyoming
May-96	$0.20	$0.28	$0.18	$0.34	$0.33	$0.265	**$0.12**
Jul-97						$0.515	
May-02						$0.695	
Oct-02							
Mar-03							
May-03			$0.70	$0.64	$0.530		
Jun-03		$0.57					
Jul-03							**$0.60**
Jan-05	$0.84		$1.70		$1.53	$1.70	
Jan-07							
Jul-10							
Apr-14							

Figure 5 shows the considerable range of state cigarette excise tax rates in 2014, from a low of $0.17 per pack in Missouri to a high of $4.35 per pack in New York (Campaign for Tobacco-Free Kids, 2014c). Currently Wyoming's excise tax rate of $0.60 places it 40th among state excise tax rates. Also shown in Figure 5 is Wyoming's ranking if the Wyoming legislature should increase the cigarette excise tax by $1.00 to a rate of $1.60 per pack. This new hypothetical rate would place Wyoming 22nd among state excise tax rates, tying it with Pennsylvania and placing Wyoming just slightly higher than the

current overall states' average of $1.54 per pack. A hypothetical rate of $1.60 would also make Wyoming's tax similar to its neighboring states Montana, South Dakota, and Utah.

Figure 5. Wyoming's Excise Tax Rate Ranking for 2014 and with a Hypothetical Excise Tax Increase



8. Conclusions

In fiscal year 2014, the excise tax revenue generated from cigarette sales equaled $19.135 million with $16.287 million (85.1%) being distributed to Wyoming's general fund (WYDOR, [ca. 2014b]). These funds are the result of an excise tax rate of $0.60 per pack of cigarettes sold. The current excise tax rate was enacted over 11 years ago in July 2003 when the Wyoming legislature increased the rate by $0.48 per pack, all of which went to the general fund. That legislative action has nearly **tripled** the total amount of revenue generated from the sale of cigarettes and increased the amount of monies distributed to the general fund by a factor of **9.6**, after adjusting for inflation.

In addition, the increased tax also produced a decrease in consumption. Using Wyoming data on the number of cigarette packs sold and the average price per pack, we estimate that the demand for cigarettes would drop by 3.1% for every 10% increase in price. The decline in the number of cigarette packs sold is a combination of a decrease in the number of people smoking and the number of cigarettes consumed by those who continue to smoke (Chaloupka, Straif, & Leon, 2010).

Currently, Wyoming's excise tax rate of $0.60 per pack of cigarettes places it 40th among all state excise tax rates and second lowest in the region comprised of Wyoming and the six bordering states. The real value of Wyoming's $0.60 excise tax and the attendant tax revenue has dropped nearly 30% since July 2003. Furthermore, three of Wyoming's six neighboring states—Montana, South Dakota, and Utah—

all have excise tax rates in excess of $1.50 per pack. If the Wyoming legislature should decide to increase the excise tax rate by $1.00, the new hypothetical rate of $1.60 would place Wyoming 22nd among excise tax rates and just slightly higher than the current overall states' average of $1.54 per pack (CDC, 2014b).

The increase in price would likely result in a decrease in consumption. As with any statistical model, actual results may differ from predictions. Nonetheless, our model estimates that a $1.00 increase in Wyoming excise tax rate would decrease consumption by 6.2%, or about 0.31 packs per capita per month, which equals a decrease of approximately 178,000 packs per month. At the same time, because cigarette demand is relatively inelastic, we expect revenue to increase. After accounting for the decrease in consumption, we estimate that a Wyoming excise tax of $1.60 per pack would generate approximately $48.315 million in tax revenue.

9. References

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10. Appendix: Regression Analysis of Cigarette Price and Consumption in Wyoming

Since April 2006, we had been using the same model to estimate the effect of changes in price on the consumption of cigarettes and the attendant generation of tax revenue in Wyoming. Up through our last report in July 2012, we believe that our model performed well, explaining over 80% of the variability in the number of stamps sold per capita (the response variable), displaying a good correspondence between actual and predicted stamp sales, and passing the Durbin-Watson test statistic for no autocorrelation in the error terms. Autocorrelation is when the value of a residual (or a variable) observed in the current time period is influenced by its value in a preceding time period. When testing the model using our current data set (May 1996-April 2014) the Durbin-Watson test failed to reject the presence of autocorrelation in the residuals. Additional tests for the presence of autocorrelation (i.e., Durbin's alternative test and Breusch-Godfrey test) also provided similar evidence. Because we are using time series data, it is not unusual that autocorrelation is present. Thus our initial 2014 model violated the assumption of the errors being independent. The estimated coefficients from this model are not "wrong", they remain unbiased, but they will have biased standard error estimates.

To address the problem of autocorrelated error terms we looked to the time series analysis literature. Because our interest is primarily in understanding the effect of price on consumption—the price elasticity of demand (i.e., the coefficient on our log price variable), we chose to address the autocorrelation in our error terms using a heteroskedasticity and autocorrelation consistent covariance estimation method. We used the Newey-West variance estimator which produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity (Zeileis, 2004). If, on the other hand, we were interested in using our model to make long-range forecasts, then our approach would have been to use a time series approach that modifies the forecasts based on the autocorrelation observed.

The 2014 demand model for cigarettes is

$$\log(PCCigSales_t) = \alpha_0 + \alpha_1 \log(Price_t) + \sum_{k=1}^{11} \alpha_{k+4} M_{kt} + \alpha_{13} InvAccumulate_t +$$

$$\alpha_{14} InvDeplete_t + \alpha_{15} WyTaxIncrease_t + \alpha_{16} FedTaxIncrease_t + \varepsilon_t,$$

where t is a time index tracking the number of months of data; PCCigSales is per capita cigarette stamp sales; Price is real (i.e., inflation-adjusted) retail cigarette price per pack of cigarettes; M are monthly dummy variables accounting for seasonality; InvAccumulate and InvDeplete account for the inventory effects resulting from the July 2003 excise tax increase; WyTaxIncrease and FedTaxIncrease account for the increases in the state and federal excise tax; and ε is a random error. We fit the model using data from May 1996 to April 2014 (n = 216 months). We fit the model in logarithmic form so that the estimated coefficient of price, α_1, is a direct estimate of consumer responsiveness (i.e., price elasticity). The logarithmic form also gives a slightly better fit than the linear (i.e., without a logarithmic transformation applied to the variables) form.

We address the construction of the response variable and each explanatory variable used in the demand equation below.

The optimal response variable would be Wyoming cigarette consumption per capita. But, as discussed in Section 5, cigarette consumption is not measured directly, and the best available proxy measure is the number of cigarette stamps purchased by cigarette wholesalers. The number of stamps sold is calculated as follows:

Stamps = (tax revenue distributed to towns, cities, and counties) / $0.084036.

Where $0.084036 is the amount of money distributed to town, cities, and counties per stamp sold and was calculated as follows:

[($0.006 * 33 1/3%) + (($0.006 * 66 2/3%) * 61 3/4%)] * 20 * 0.94

Where $0.006 is the tax rate per cigarette as it applies to local distribution; 20 is the number of cigarettes per pack; and 0.94 accounts for the wholesaler discount. See the Wyoming Statute Title 39 Chapter 18 for details on the distribution of the excise tax.

When we measure cigarette stamps purchased on a per capita basis, we eliminate variations in stamp sales that occur because of changes in population and more accurately estimate a typical smoker's response to cigarette price changes. The response variable, PCCigSales, is determined as follows:

PCCigSales = Stamps/Wyoming Population

Annually, the economic consulting firm Orzechowski and Walker surveys cigarette retailers across the nation requesting data on their retail prices (excluding sales tax) for premium, generic, and deep discount cigarettes by pack and by carton (Orzechowski and Walker, 2014). Orzechowski and Walker weight the data by the share of each type (premium, generic, or deep discount) and form (pack or carton) of cigarettes sold generating an average retail cigarette price for each state (R. Walker, personal email communication, January 13, 2009). The reported average retail cigarette price represents the average price as of November 1st of that year. To obtain monthly price data we interpolate the annual (November) data for all other months.

We use real (inflation adjusted to current dollars) Wyoming retail cigarette price as an explanatory variable in our model using Orzechowski and Walker's (2014) retail cigarette price (with generic, but not deep discount, brands included) data for Wyoming, the state's sales tax, and the consumer price index (CPI). This price is calculated using the following formula:

Price = (Weighted Average Price per Pack * State Sales Tax Factor)/Consumer Price Index

The Wyoming state sales tax is 4%, charged on tobacco products since July 1999 (J. Dryden, WYDOR Excise Tax Division, Region 2 Supervisor, personal communication, May 15, 2009). Therefore, the state sales tax factor is 1.04. The U.S. Department of Labor (n.d.) provides the CPI.

We include the following additional explanatory variables in the model to account for seasonal, inventory effects, and changes in excise taxes in the response variable (i.e., stamps per capita).

Seasonal effects are accounted for by the explanatory monthly dummy variables:

- Jan = 1 in January, 0 otherwise
- Feb = 1 in February, 0 otherwise
- Mar = 1 in March, 0 otherwise
- Apr = 1 in April, 0 otherwise
- May = 1 in May, 0 otherwise
- Jun = 1 in June, 0 otherwise
- Jul = 1 in July, 0 otherwise
- Aug = 1 in August, 0 otherwise
- Sep = 1 in September, 0 otherwise
- Oct = 1 in October, 0 otherwise
- Nov = 1 in November, 0 otherwise

We do not include a December variable for a technical reason that arises in all regression models with dummy variables: the twelfth monthly variable and the model intercept would be mathematically redundant and give a regression model that does not have a unique solution.

The explanatory variables InvAccumulate and InvDeplete account for the inventory effects related to Wyoming's excise tax increase as defined below: The first variable accounts for the buildup of inventories just before the July 2003 tax increase. We expect this variable to have a positive coefficient.

InvAccumulate = 1 in May and June of 2003, 0 otherwise

The second variable accounts for the depletion of the accumulated inventories just before the July 2003 tax increase. We expect this variable to have a negative coefficient.

InvDeplete = 1 in July and August of 2003, 0 otherwise

The explanatory variables WyTaxIncrease and FedTaxIncrease account for the increase in excise tax at the state and federal level.

WyTaxIncrease=1 from July 2003 forward, 0 otherwise

FedTaxIncrease=1 from April 2009 forward, 0 otherwise

We expect both of these variables to have a negative sign associated with their coefficient, meaning that each tax increase was associated with a reduction in cigarette consumption.Table 2 reports the results of the regression analysis. We report the Newey-West standard errors which are consistent in the presence of autocorrelation. However, we report the R^2 from the ordinary least squares regression because the Newey-West command in Stata does not provide this statistic. The variables Price, InvAccumulate, InvDeplete, WyTaxIncrease, and FedTaxIncrease, all had the expected signs and are significant at the .01 level. Most of the seasonal dummy variables (i.e., May through October) are significant at the .01 level, and the coefficients show heightened stamp sales during the

late spring, summer and early fall months as compared to the winter months (i.e., November through April).

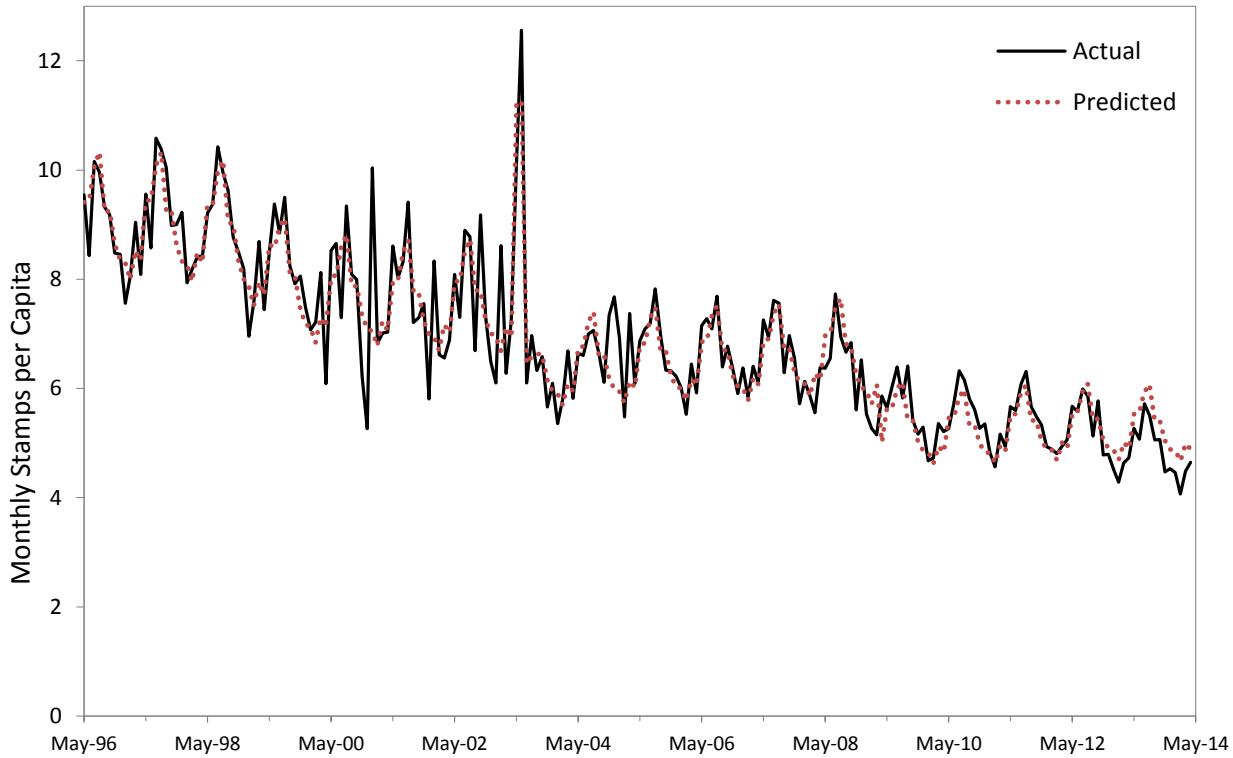
Table 2. Regression Analysis of Wyoming Cigarette Excise Tax Stamp Sales

The dependent variable is log(Stamps Per Capita),
May 1996–April 2014 (n = 216).

Variable	Coefficient	Newey-West Std. Error	t value	P value
log(Price)	-0.31	0.02	-14.02	<0.01
January	-0.01	0.05	-0.14	0.89
February	-0.05	0.04	-1.23	0.22
March	0.02	0.03	0.64	0.52
April	0.00	0.03	-0.06	0.95
May	0.12	0.03	3.50	<0.01
June	0.12	0.03	3.85	<0.01
July	0.19	0.03	6.92	<0.01
August	0.21	0.03	6.10	<0.01
September	0.10	0.03	3.88	<0.01
October	0.10	0.03	2.91	<0.01
November	0.03	0.02	1.31	0.19
InvAccumulate	0.36	0.03	14.22	<0.01
InvDeplete	-0.12	0.02	-6.86	<0.01
WyTaxIncrease	-0.13	0.02	-8.47	<0.01
FedTtaxIncrease	-0.16	0.03	-6.05	<0.01
Intercept	2.13	0.03	75.23	<0.01

Figure 6 shows a plot of actual and predicted stamps per capita sold over time. The plot shows a strong correspondence (better than the model used in the 2012 report) between predicted and actual values, especially around the time of the July 2003 tax increase. Thus, the variables InvAccumulate and InvDeplete appear to help account for tax-induced inventory adjustments. However, towards the end of the data series, around January 2013, the model predicts a greater amount of monthly stamps per capita being sold than is actually recorded by the WYDOR. This divergence indicates lower demand than what is predicted by our model over that time period. We are uncertain as to the reason for this shift.

Figure 6. Actual and Predicted Monthly Wyoming per Capita Cigarette Stamp Sales, May 1996–April 2014



In addition, we can use the model results to predict the consequences of further tax increases. We considered a tax increase of $1.00. The price of a pack of cigarettes (including the Wyoming and federal excise taxes, but not sales tax) as of November 2013 was $5.02 (Orzechowski & Walker, 2014). An additional $1.00 tax (for a total Wyoming excise tax of $1.60) would increase the price of a pack of cigarettes to $6.02, representing a price increase of 20%. The predicted decrease in consumption is 6.2% (0.31 * 20%), or about 0.31 packs per capita per month (6.2% of the average 4.9 packs per capita per month currently sold), which equals a statewide decrease of approximately 178,000 packs per month. This decrease in consumption would leave Wyoming with about 4.59 packs sold per capita per month (4.9 – 0.31), or about 2.67 million packs per month (4.59 * 582,658). The total revenue generated by 2.67 million packs per month at a tax rate of $1.60 would be nearly $4.283 million per month as compared to the average monthly revenue compared to fiscal year 2014 ($1.694 million).

After accounting for the 6% discount rate that is returned to wholesalers, we estimate that a Wyoming excise tax of $1.60 per pack would generate approximately $48.315 million in tax revenue (($4.283 million*12)*0.84).