Assessing the Impact of Cigarette Excise Taxes and Tobacco Control Expenditures on Cigarette Sales, Tax Revenue, and Smoking Prevalence in Vermont

Final Report

Prepared for

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1. INTRODUCTION

State cigarette excise taxes have increased significantly in the past decade (Exhibit 1-1). This has been especially true in New England states, where the average state tax in calendar year (CY) 2007 was $1.74 above the average in the rest of the United States of $0.95. The cigarette excise tax in Vermont has also followed the pattern in other New England states with a recent two-phase excise tax increase. The first increase of $0.60 (from $1.19 to $1.79 per pack) took effect on July 1, 2006, and the second increase of $0.20 (to $1.99 per pack) will take effect on July 1, 2008.

Exhibit 1-1. Real State Cigarette Excise Taxes, CY 1980–2007

Numerous studies have shown that increasing the cigarette excise tax decreases tobacco use (Chaloupka and Warner, 2000; Stehr, 2005; Farrelly et al., 2003, 2008). For every $1.00 increase in cigarette taxes, the average price of cigarettes increases by $1.25 (Keeler et al., 1996). This increase in price, in turn, encourages smokers to quit or reduce the number of cigarettes they smoke and for nonsmokers to remain nonsmokers. The consensus estimate is that a 10% increase in cigarette taxes can lead to a 3% to 5% decrease in overall cigarette consumption among adult smokers, with approximately half of this decline resulting from smokers quitting altogether (USDHHS, 1994; Chaloupka and Warner, 2000; Gallet and List, 2003).

The impact of tobacco control programs has been widely studied, and a significant body of literature has documented their effectiveness at reducing tobacco use within states with
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comprehensive programs (USDHHS, 2000). Several studies have also examined the impact of tobacco control program expenditures at the national level. Farrelly, Pechacek, and Chaloupka (2003) found that, after controlling for several confounding factors including changes in cigarette taxes and tax evasion, increases in per capita state tobacco control expenditures were independently associated with decreases in aggregate per capita cigarette sales. The authors found that if states began investing at Centers for Disease Control and Prevention (CDC) recommended minimum funding levels in 1994, aggregate cigarette sales would have dropped by an additional 9% by 2000, doubling the existing rate of decline in sales over the period. A more recent study also found that increases in state tobacco control program expenditures were associated with declines in adult smoking rates, above and beyond the influence of the price of cigarettes (Farrelly et al., 2008). The study estimated that if all states had funded their tobacco control programs at the CDC minimum recommended levels beginning in 1995, there would have been 2.2 million fewer smokers nationwide by 2003.

This report evaluates the influence of cigarette excise taxes and state tobacco control expenditures in Vermont on cigarette sales and adult smoking prevalence. We begin by analyzing tax-paid cigarette sales in Vermont by comparing actual cigarette sales with predicted values from a previous report. Because actual sales were higher than predicted, we explore possible explanations and alternative model specifications to increase the accuracy of our predictions. We then quantify the influence of state tobacco control expenditures on cigarette sales and adult smoking prevalence. For these latter models, we used data from all states to make inferences about the influence of Vermont’s state tobacco control expenditures on cigarette sales and adult smoking prevalence. Ideally, we would like to conduct these analyses with data from Vermont only. However, because annual tobacco control expenditures do not change very much from year to year, it is difficult to understand the influence of expenditures on cigarette sales and smoking prevalence. With the national data, there is considerable variation in tobacco control expenditures across states and from year to year to better understand how programs influence smoking. To illustrate the effect of tobacco control expenditures on cigarette sales in Vermont, we examined two hypothetical scenarios in which Vermont expenditures on tobacco control from 2000 through 2006 are (1) replaced with CDC minimum and maximum recommended funding levels and (2) eliminated to determine the full impact of Vermont’s tobacco control program.
2. DATA SOURCES

In this section, we discuss the primary data sources for the analysis and their strengths and limitations for assessing the impact of cigarette excise taxes and state tobacco control program expenditures on per capita cigarette sales and smoking prevalence in Vermont.

2.1 Tax-Paid Cigarette Sales and Excise Taxes

For our analysis of the impact of cigarette excise taxes on tax-paid cigarette sales in Vermont, we used monthly information on cigarette sales data from the Vermont Department of Finance and Management. For analyses that used data from all states, we obtained annual sales data and cigarette excise tax information from The Tax Burden on Tobacco (Orzechowski and Walker, 2005). The data for the Vermont-specific analysis cover the period from calendar year (CY) 1983 to 2007. For the national analysis, sales data were available for fiscal years (FY) 1985 to 2006. However, when constructing the national sales analysis, we were unable to obtain monthly sales data from all states as we have in the past. As a result, we had the option of conducting our analysis with annual data through FY 2006 or with monthly data through FY 2005. We performed both analyses and concluded that the monthly analysis was more informative than the analysis with annual data.

For all analyses, we calculated per capita cigarette sales (in packs) by dividing total sales by total state population estimates from the U.S. Census Bureau. Tax-paid sales data have a number of advantages. First, the data are available in a timely fashion and are a sensitive measure of total cigarette consumption. The monthly data are particularly useful for understanding smokers’ response to changes in cigarette taxes in the months before and after a significant tax change. Second, tax-paid sales are not subject to the self-reporting bias that can influence response to telephone surveys. However, tax-paid sales have their own limitations, which are addressed in Section 3, along with adjustments we made to address those limitations.

Unlike in previous analyses, we also treated Quebec, Canada, as a neighboring state. We include the population-/distance-weighted tax differential between it and Vermont in our summed measures of cross-border sales.

2.2 Cigarette Prices

In some of our models, we used data on cigarette prices rather than on cigarette excise taxes. The advantage of using cigarette excise taxes in analyses is that they represent the policy mechanism available to state policy makers. In contrast to cigarette prices that need

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1 In the past, we have been able to obtain monthly sales data from all states from the U.S. Department of Agriculture (USDA). Unfortunately, the key staff person at USDA in charge of tobacco-related data left his position and was not replaced. We attempted to obtain the data from the producers of The Tax Burden on Tobacco, but they were unwilling to share their data.
to be estimated, the value of cigarette excise taxes is known with certainty. Data on cigarette prices come from *The Tax Burden on Tobacco* and Nielsen scanner data. State-level data from *The Tax Burden on Tobacco* come from mail surveys of tobacco retailers. Details on the methodology and response rates are not available. The Nielsen scanner data are collected from grocery stores and are derived from actual cigarette purchases from 50 major markets covering approximately 77% of the total U.S. population. Using these two data sources, we created a hybrid price series that uses *Tax Burden on Tobacco* data from 1985 through 1993 and Nielsen scanner data from 1994 through 2006. The advantage of this approach is that the Nielsen data reflect all applicable discounts (e.g., cents off, buy-one-get-one-free offers), which are particularly relevant following the Master Settlement Agreement in November 1998.

However, there are also several drawbacks to using scanner data. First, the data represent markets that cross state boundaries. Because taxes differ across states, the market-level prices are a blend of prices across states. Therefore, we generated a state-specific price series based on the proportion of a state’s population that is contained by one or more Nielsen markets. If more than 80% of a state’s population is contained by one or more markets, the price is the population-weighted average of the market prices. If a state is below this threshold, we estimate and predict the average state price using applicable state excise tax rates, state fixed effects, and a series of state-specific linear time trends. Second, Nielsen scanner data come from sales at grocery stores where prices may differ from other common outlets for purchasing cigarettes such as convenience stores.

### 2.3 Tobacco Control Expenditures

Data on annual state expenditures for tobacco control programs come from the RTI Tobacco Control Funding Database and cover the period from 1985 through 2006 (Farrelly et al., 2003, 2008). Briefly, RTI gathered comprehensive data on financial resources available to state tobacco control programs from federal sources, the Robert Wood Johnson Foundation’s (RWJF’s) SmokeLess States program, and state sources. Data for the three national programs were provided to us by CDC, the National Cancer Institute (NCI), and RWJF. Although the budgeted amount of funding for these programs tended to change very little year by year, actual expenditures showed a wider range of variation, allowing us to determine more accurately the effects of funding on cigarette consumption. In our analyses, we used a cumulative measure of tobacco control program expenditures that was created by adding current annual expenditures and past expenditures discounted by 25% per year (Farrelly et al., 2008). For example, if current and past years’ expenditures were $100, then the cumulative expenditure for this year is $175 ([100*75%] + 100).

Our models focus on cumulative tobacco control program expenditures for two reasons. First, because the total expenditures represent a variety of interventions and activities in any given year, there can be both an immediate- and a longer-term effect on tobacco use.
For example, a media campaign might encourage some smokers to quit immediately, whereas, for others not ready to quit, it might change their attitudes and beliefs, which leads to quitting in the future. Second, some of the expenditures represent planning and capacity building that may not yield immediate benefits. Both of these concepts imply that investments in any one year may have lasting effects on smoking behavior in future years.

### 2.4 Smoking Prevalence

Information on smoking prevalence was obtained from the Behavioral Risk Factor Surveillance System (BRFSS) from 1985 to 2005 and the Tobacco Use Supplements to the Current Population Survey (TUS–CPS) from 1985 to 2003. BRFSS is an annual, repeated cross-sectional, nationally representative survey of U.S. residents aged 18 and older. The survey measures the prevalence of smoking and provides information on a number of other smoking behaviors. It also provides detailed demographic, and in some years geographic, information for each respondent. Overall, 23 states were included in the 1985 BRFSS, with the number of states increasing to 36 in 1988. The first year to include all 50 states and the District of Columbia was 1996. Survey sample sizes ranged from 25,214 in 1985 to 345,395 in 2006.

In contrast to BRFSS, CPS is a monthly survey of approximately 50,000 households, in which individuals aged 15 or older are interviewed about various labor characteristics and other measures. The monthly CPS includes several supplements that measure the prevalence of tobacco use, as well as other tobacco use behaviors. The monthly CPS uses a mixture of data collection procedures, with approximately 34% of data collected through in-person interviews and 66% through telephone interviews. The survey also allows for responses by proxy. The response rates for the TUS–CPS ranged from 72% in 1995 to 88% in 2003. Analyses were limited to adults aged 18 or older who responded themselves. In addition to smoking status, CPS also provides information on a wide range of demographic characteristics, including age, gender, race/ethnicity, marital status, education level, income level, and employment status.

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3. METHODS

In this section, we discuss the analytical methods used to assess the impact of Vermont’s cigarette excise tax and tobacco control expenditures.

3.1 The Impact of Cigarette Excise Taxes on Cigarette Sales—Vermont-Specific Model

The outcome for this model is monthly per capita cigarette sales. The covariates include inflation-adjusted total cigarette excise taxes (state + federal taxes), a measure of the potential for cigarettes to be purchased by neighboring states, time (to control for a secular trend in sales), and monthly time indicators to control for seasonality.

Tax-paid sales have some limitations. One limitation of tax-paid sales is that they do not necessarily reflect actual consumption because of tax evasion and tax avoidance. For example, smokers can avoid their own state’s tax by crossing state lines and purchasing cigarettes from a bordering state with a lower cigarette tax. They may also purchase less expensive cigarettes from Native American reservations. In both cases, tax-paid sales will underestimate actual consumption. Alternatively, when a state has a relatively low cigarette excise tax, tax-paid sales may overestimate actual consumption because the sales data will reflect purchases made by smokers from out of state. Finally, tax-paid sales can misrepresent actual consumption if there is organized smuggling of large quantities of cigarettes to and from a state. For example, there have been cases of large quantities of cigarettes being transported from low-tax tobacco-producing states to high-tax states. In this case, the cigarettes may be sold informally (e.g., out of the back of trucks) or through traditional outlets at regular or discounted prices. To account for these phenomena, we created measures of the potential for short-distance cross-border cigarette sales based on population- and distance-weighted cigarette tax differentials between neighboring states. Tax differentials were calculated between a given state and each of its neighbors during each time period of data. For example, if state A has a lower excise tax rate than state B, then the propensity to export cigarettes from state A to state B is positive and is equal to the weighted tax differential between the two. States in contrast, we assigned the propensity to import from state A to B as zero, given that there is no financial incentive for citizens to purchase cigarettes across that state border. These differentials were then weighted by both the distance between the two state population centers and the relative difference in state populations. We then summed the weighted differentials across all neighboring states to provide two measures (import and export) that capture the cumulative propensity to purchase cigarettes across state lines during a given time period.

We begin our analysis of tax-paid cigarette sales by comparing the actual cigarette sales in Vermont with values predicted in our previous reports (Nimsch, Nonnemaker, and Farrelly, 2002; Nonnemaker et al., 2006) to assess the validity of our analytical approach. In 2002,
we predicted cigarette sales for fiscal years (FY) 2003 and 2004. We predicted that a cigarette excise tax increase in 2003 from $0.93 to $1.19 would reduce per capita sales to 77.3 packs, whereas actual per capita sales were 77.4 packs (total sales of 47.7 million packs versus 47.8 million packs). Also, the predicted FY 2004 per capita sales of 71.3 packs was very close to the actual per capita sales of 69.2 packs (total sales of 44.2 million packs versus 42.8 million packs), an overestimate of only 3%. We predicted that a cigarette excise tax increase in 2006 from $1.19 to the current level of $1.79 would reduce per capita sales to 46.8 packs. Exhibit 3-1 shows the actual and predicted per capita cigarette sales for FY 2007. Because actual per capita sales were higher than predicted sales for FY 2007 (54.5 versus 46.8 packs), we explored possible explanations of the variation between actual cigarette sales and our predictions.

Exhibit 3-1. Actual and Predicted Per Capita Cigarette Sales for Vermont Using Actual Sales and RTI 2006 Report, FY 1999–2007

Note: Prediction with the projected changes are based on the model reported in Nonnemaker et al. (2006) but using updated sales and population data for FY 2007.

We explored tax evasion and cross-border sales between Vermont and Quebec as a plausible explanation for the difference between actual and predicted sales. Quebec smokers experienced steady increases in the provincial and federal excise cigarette taxes for FY 2002 through 2007. In addition, the average total (provincial + federal) excise tax in Quebec reached almost twice the total (state + federal) excise tax in Vermont by FY 2006 (US
The difference in the excise taxes is mainly caused by the continuous decline in the value of the U.S. dollar compared with the Canadian dollar.

We used the results of our regression model to predict consumption under two tax scenarios. The first scenario predicted cigarette sales and tax revenue with the announced tax increases in cigarette excise taxes—from $1.19 to $1.79 per pack that took effect on July 1, 2006, and from $1.79 to $1.99 per pack that will take effect on July 1, 2008. The second scenario predicted cigarette sales and revenue assuming no tax increase. This comparison demonstrates the net impact of the increase in cigarette excise taxes. By net impact, we mean an impact of taxes on cigarette sales and tax revenue above and beyond the impact of cross-border sales and secular trends.

### 3.2 The Impact of Cigarette Excise Taxes and State Tobacco Control Expenditures on Per Capita Cigarette Sales—National Model

Funding for the Vermont Tobacco Control Program (VTCP) has been fairly stable across years, making it difficult to relate changes in tobacco control expenditures to changes in cigarette sales (and smoking prevalence). As a result, we analyzed data from all states to understand the relationship between changes in state-level tobacco control program expenditures and tax-paid sales. The advantage of this approach is that it provides sufficient variability in cigarette excise taxes and tobacco control program expenditures to more precisely estimate the respective independent influences on tax-paid sales. The disadvantage of this approach is that it assumes that the influence of VTCP expenditures is the same as the average state expenditures. We tested this assumption in our models by including an interaction term of the expenditures and Vermont-specific indicator. Because the interaction term is statistically significant, we retained it in our national models to control for the program effects that are specific to Vermont.

Similar to our Vermont-only analysis, our national model includes controls for cigarette excise taxes, tax evasion, and a secular trend. In addition, our national model includes controls for state-specific differences by including separate indicator variables for each state (with one state omitted as the reference state). Our model accounts for the two primary sources of tax evasion: sales from Native American reservations and sales from other states. Although the former is not relevant for Vermont, we included it to increase the accuracy of the overall model. We measured the extent of tax evasion from Native American reservations by including a measure of the proportion of a state’s population who live in a county containing, bordering, or within 50 miles of Native American tribal lands. Like our Vermont-only model, we accounted for cross-border sales through two indicators that

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3 Economic theory suggests that Quebec smokers have a growing incentive to cross the border to purchase lower-tax cigarettes from Vermont. Accounting for the Quebecois cross-border tax evasion in our analytical model improves our prediction significantly. Hence, we retain it in our current prediction to evaluate the second phase of the announced excise tax increase in July 2008.
measure the propensity to import cigarettes and export cigarettes, respectively. These indicators, which are calculated by summing weighted tax differentials across all neighboring states, are discussed in more detail in Section 4.

Unlike the Vermont-only model, the national model also controls for the possibility of long-distance cigarette smuggling (i.e., from non-neighboring states) from low-tax states. Similar to the methods used to calculate the propensity to import or export across state borders, we calculated the distance-weighted tax differential between a state and each other state in the United States. This value was then multiplied by the difference between tax-paid sales of cigarettes and estimated cigarette consumption (using the Behavioral Risk Factor Surveillance Survey [BRFSS]). Next, rather than summing these values over all non-neighboring states, as in our short-distance propensity measures, we used the weighted tax differential\(^4\) (sales–consumption) score to identify the states for which the incentive to transport cigarettes from or to is highest in each time period. The scores from these states were then included in the national model as the propensity to import or export cigarettes long distances, respectively.

### 3.3 The Impact of Cigarette Prices and State Tobacco Control Expenditures on Smoking Prevalence—National Model

To assess the impact of cigarette prices and cumulative tobacco control expenditures on adult smoking prevalence, we used the approach recently published in the *American Journal of Public Health* (Farrelly et al., 2008), adapted to the BRFSS to make use of more recent data. This model accounts for other influences on smoking, such as age, race/ethnicity, gender, and income. Finally, we included indicator variables for year, month, and state to account for secular trends, seasonality, and differences between states, respectively. Similar to the national cigarette sales model above, we tested whether VTCP expenditures have specific effects on smoking prevalence. Unlike the national cigarette sales model, the interaction term of the expenditures and Vermont-specific indicator is statistically insignificant; thus, we dropped it from our national smoking prevalence model.

### 3.4 What-if Scenarios

To help illustrate and quantify the impact of tobacco control program expenditures on cigarette sales and smoking prevalence, we conducted two what-if scenarios based on the results of each of these analyses. The models generate estimates of the relationship between cumulative tobacco control program expenditures, cigarette excise taxes, and cigarette sales and smoking prevalence. To understand the implications of these national

\(^4\) Computationally, this propensity was calculated by determining the tax differential between a state and its neighbor and then weighting this result by the distance between the states’ population centers (census block group centroids derived from the U.S. Census TIGER/Line files and calculated using geographic information system [GIS] software). These values were then summed for all neighboring states.
models for Vermont, we made predictions that are specific to Vermont. We first compared how these predictions matched the actual level of sales and prevalence in Vermont. We then made predictions from both of these models under two hypothetical TCP funding scenarios:

1. eliminating Vermont’s actual expenditures, and

2. replacing Vermont’s actual expenditures with the CDC minimum and maximum recommended funding levels for Vermont.

For the last year of our model, FY 2005 and adjusted for inflation, the actual CDC minimum and maximum recommended per capita expenditures for Vermont were $15.8 and $31.8, respectively. The actual per capita expenditures in FY 2005, however, were $9.2.

The what-if analyses were accomplished by using the estimated models to predict sales or prevalence under these alternative scenarios (i.e., plug in 0 funding or CDC minimum or maximum funding in the place of actual funding and predict the new level of sales or prevalence). By comparing these results to actual sales or smoking prevalence, we can better quantify the impact of tobacco control program expenditures.
4. **FINDINGS**

In this section, we present the results of the four models described above.

**4.1 The Impact of Cigarette Excise Taxes on Cigarette Sales**

Consistent with the previous literature (Farrelly et al., 2003) and previous reports (Nonnemaker et al., 2006), we find a significant and negative relationship between cigarette excise taxes and per capita cigarette sales (Exhibit 4-1). Our model predicts that a 10% increase in the cigarette excise tax is associated with a 1.5% drop in per capita cigarette sales.

The propensity to export to neighboring states and Quebec is positive, as expected, but not statistically significant. The measure for time is negative and significant, which indicates a consistently declining trend in per capita cigarette sales.

**Exhibit 4-1. Association between Per Capita Cigarette Sales and Cigarette Excise Taxes and Tax Evasion (Vermont-Specific Model, CY 1985–2007)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient [95% CI]</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real cigarette excise taxes (federal + state)</td>
<td>−1.43 [−1.92, −0.94]</td>
<td>−0.15</td>
</tr>
<tr>
<td>Propensity to export to neighboring states and Quebec</td>
<td>0.17 [−0.41, 0.75]</td>
<td>0.008</td>
</tr>
<tr>
<td>Time</td>
<td>−0.02 [−0.022, −0.015]</td>
<td>−0.32</td>
</tr>
</tbody>
</table>

N 300

R² 0.79

Note: Model also includes monthly indicators.

Based on the results of our analysis, we predicted per capita cigarette sales in Vermont and then compared them to actual sales (Exhibit 4-2). The first phase of the tax increase—from $1.19 to $1.79 per pack (in July 2006)—led to a predicted drop of 9.1 packs in annual per capita sales (63.7, predicted at FY 2006 excise tax level, versus 54.5, actual sales at current excise tax level, annual per capita sales). The second phase of the tax increase (from $1.79 to $1.99 per pack in July 2008) is expected to lower the per capita cigarette sales by an additional 3.6 packs (47.1 versus 43.5 annual per capita sales).
Exhibit 4-2. **Actual and Predicted Per Capita Cigarette Sales for Vermont Using Vermont-Specific Model, FY 1995–2009**

To measure the monetary impact of the excise tax increases, we calculated the predicted cigarette tax revenue in Vermont resulting from the tax increases in FY 2007 and FY 2009 (Exhibit 4-3). The first phase of the tax increase is associated with an increase in cigarette tax revenue of $11.1 million (a 24% increase) (from $47.3 million to $58.4 million). The second phase of the tax increase is predicted to increase the cigarette tax revenue by $1.44 million, or 2.7% (from $53.03 million to $54.47 million).
Section 4 — Findings


4.2 Per Capita Cigarette Sales Using a National Model

In our national model, we find that both higher excise taxes and increases in tobacco control expenditures are associated with lower per capita cigarette sales (Exhibit 4-4). We estimate that a 10% increase in cigarette excise taxes leads to a 1.1% decrease in per capita cigarette sales. We also find a significant and positive relationship between per capita cumulative expenditures and per capita cigarette sales at the national level. Overall, we find that doubling per capita cumulative funding leads to a 0.4% decrease in cigarette consumption or 0.13 packs per person each year. However, the statistically significant and negative interaction between tobacco control expenditures and an indicator for Vermont suggests that increases in expenditures have a larger effect in Vermont than in the average state. As a result, the combined effect is $-0.0039$, doubling per capita cumulative funding in Vermont leads to a 0.39% drop in cigarette sales or 0.41 packs per person per year.

In addition, per capita cigarette sales are higher in states with relatively lower cigarette excise taxes as a result of sales to smokers in neighboring states (i.e., the “propensity to export to neighboring states” term) and more distant states (i.e., the “propensity to export to non-neighboring states” term). Tax avoidance and smuggling are also associated with lower sales in states with relatively high taxes.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient [95% CI]</th>
<th>Elasticity&lt;sup&gt;a&lt;/sup&gt;</th>
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<tr>
<td>Real cigarette excise taxes (federal + state)</td>
<td>−1.14 [−1.32, −0.95]</td>
<td>−0.113</td>
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<td>Per capita cumulative tobacco control expenditures&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.09 [−0.15, −0.03]</td>
<td>−0.0035</td>
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<td>Interaction of tobacco control expenditure and Vermont specific indicator</td>
<td>−0.24 [−0.39, −0.09]</td>
<td>−0.00035&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Propensity to export to neighboring states</td>
<td>2.50 [2.00, 3.00]</td>
<td>0.011</td>
</tr>
<tr>
<td>Propensity to import from neighboring states</td>
<td>−0.60 [−1.06, −0.14]</td>
<td>−0.002</td>
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<tr>
<td>Propensity to export to non-neighboring states</td>
<td>5.22 [4.59, 5.85]</td>
<td>0.023</td>
</tr>
<tr>
<td>Propensity to import from non-neighboring states</td>
<td>−1.16 [−1.76, −0.56]</td>
<td>−0.010</td>
</tr>
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<td>N</td>
<td>12,852</td>
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</tr>
<tr>
<td>Adj. R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.80</td>
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<sup>a</sup>Cumulative per capita funding scaled by a factor of 10.

<sup>b</sup>Elasticity is based on expenditures and the interaction term with the Vermont-specific indicator.

Note: Model includes state, year, month, sales from Native American reservations, and state-level monthly unemployment rate.

What-if Scenarios

To put the findings from the national model into Vermont’s perspective, we predicted per capita cigarette sales in Vermont using Vermont’s actual tobacco control expenditures in the national model under two tobacco control funding scenarios:

- eliminating Vermont’s actual expenditures, and
- replacing Vermont’s actual expenditures with the CDC minimum and maximum recommended level for Vermont.

Per capita cigarette sales from FY 2000–2005 would have been consistently higher than the actual levels (Exhibit 4-5) in the absence of program funding. These results suggest that the tobacco control program expenditures were responsible for decreasing cigarette consumption in VT by 28.8 million packs over the 6-year period. In 2005, the program’s efforts led to 7.5 million fewer packs being sold in Vermont.
Section 4 — Findings

Exhibit 4-5. Per Capita Cigarette Sales for Hypothetical Tobacco Control Program Expenditure Scenarios (FY 1995–2005)

As noted in Section 3.4, for FY 2005 and adjusted for inflation, the CDC minimum and maximum recommended per capita expenditures for Vermont were $15.8 and $31.8, respectively. Actual expenditures, however, were $9.2. Had Vermont’s tobacco control program been funded at the CDC minimum or maximum level from FY 2000 through 2005, Vermont smokers would have purchased 21.1 and 69.8 million fewer packs than the actual number of packs observed in FY 2000 through FY 2005, respectively.

4.3 Smoking Prevalence

The results of our national model of smoking prevalence confirm previous findings showing that increases in per capita cumulative expenditures are associated with a lower prevalence of adult smoking (Exhibit 4-6). We illustrate the magnitude of the effect of expenditures in the following section. We also find that higher cigarette prices are associated with decreased adult smoking prevalence. We estimate that a 10% increase in cigarette prices will decrease adult smoking prevalence by 1.7%.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio [95% CI]</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita cumulative tobacco control</td>
<td>0.98</td>
<td>−0.009</td>
</tr>
<tr>
<td>expenditures a</td>
<td>[0.96–0.99]</td>
<td></td>
</tr>
<tr>
<td>Real cigarette price</td>
<td>0.93</td>
<td>−0.172</td>
</tr>
<tr>
<td></td>
<td>[0.89, 0.97]</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3,229,493</td>
<td></td>
</tr>
</tbody>
</table>

aCumulative per capita funding scaled by a factor of 10.

Note: Model includes state, year, month, and income fixed effects in addition to an indicator of living in county containing, bordering, or within 25 miles of Native American tribal lands, price X tribal land interaction, and other sociodemographic covariates.

What-if Scenarios

To put the findings from the national model into Vermont’s perspective, we predicted adult smoking prevalence under the same what-if scenarios used in the sales model. We find that had there been no tobacco control program in Vermont, adult smoking prevalence from FY 2000–2006 would have been consistently higher than the current levels (Exhibit 4-7). In FY 2006, for example, the actual smoking prevalence in Vermont was 18.3%. However, with the three what-if scenarios (no tobacco program, CDC minimum recommended funding level, CDC maximum recommended funding level), the smoking prevalence in FY 2006 in Vermont would have been 19.4%, 17.2%, and 15.1%, respectively. These results suggest that the tobacco program expenditures were responsible for decreasing the number of adult smokers over the 7-year period by 34,800 individuals in Vermont. However, had Vermont’s tobacco control program been funded at the CDC minimum or maximum level from FY 2000 through 2006, Vermont would have had 69,000 or 160,200 fewer smokers, respectively.

![Graph showing smoking prevalence over fiscal years 1995 to 2006 for different funding levels.]

- Actual Prevalence
- Zero Funding Levels
- CDC Maximum Funding 2000-2005
- CDC Minimum Funding
5. DISCUSSION

Consistent with previous literature and our previous reports, we find that increases in cigarette excise taxes decrease cigarette sales, above and beyond the influence of tax avoidance. We found, however, that our previous models overestimated the impact of the cigarette excise taxes. In other words, actual sales were higher than our predicted sales (actual per capita sales of 54.5 versus predicted per capita sales of 46.8 packs, or a gap of 7.7 packs). Our analyses for this report identified cross-border sales with Canada as a missing factor that may have contributed to the gap between actual and predicted sales. Accounting for cross-border sales with Canada would have led to a more accurate prediction, narrowing the gap between our prediction and actual per capita sales to 2.2 packs (54.5 versus 52.3 packs). We are hopeful that this adjustment will lead to more accurate predictions of the planned excise tax increase in July 2008. We estimate that the $0.20 increase in the tax from $1.79 to $1.99 will lead to a decline in per capita sales by 3.6 packs. The corresponding increase in revenue is predicted to be $1.44 million (2.7%) (from $53.03 million to $54.47 million).

One caveat concerning our predictions for FY 2009 for actual cigarette sales and cigarette tax revenue is that we are unsure how changes in immigration laws will affect the predictions. As of January 31, 2008, Canadian citizens had to show a proof of citizenship when crossing the border; beginning in summer 2008, Canadian travelers will be required to show a valid passport before entering the United States (U.S. Department of Homeland Security, 2007). These regulations may influence Canadian smokers’ propensity to cross the border to purchase cigarettes and other U.S. goods.

With respect to programmatic efforts to reduce smoking, we find that tobacco control program expenditures are associated with decreases in cigarette sales and smoking prevalence, above and beyond the influence of cigarette taxes/prices. In addition, we find evidence that an increase in tobacco control expenditures in Vermont leads to a slightly larger decline in cigarette sales than a comparable increase in expenditures for an average state tobacco control program. These results indicate that had there not been a tobacco control program in Vermont from FY 2000–2005, cigarette sales would have been 29 million packs higher over this period. In other words, the decline in cigarette sales that is attributable to VTCP over this period is 29 million packs. In addition, had VTCP been funded at CDC recommended funding levels over this period (minimum and maximum recommended funding levels of $15.8 and $31.8, respectively, for FY 2005), cigarette sales would have been lower than the actual number of packs observed by 21 to 70 million packs.

We also find that increases in tobacco control expenditures are associated with declines in smoking prevalence in Vermont. Consistent with this finding, the prevalence of smoking declined in FY 2006, after several years of remaining fairly stable. This pattern may reflect
what is reflected in our analysis above—that it takes time for tobacco control program funding to translate into changes in behavior as it takes time to build program capacity. We find that had there been no tobacco control program in Vermont from FY 2000–2006, the prevalence of smoking in FY 2006 would have been 19.4%—1 percentage point higher than the actual smoking prevalence, representing 34,800 fewer smokers. Had the program been funded at the CDC minimum or maximum funding levels over this period, smoking prevalence in FY 2006 would have been even lower at 17.2% and 15.1%, respectively. As a result, the recommended CDC minimum and maximum tobacco control expenditures for FY 2000 to 2006 would have led to 69,000 and 160,200 fewer smokers in Vermont, respectively.

All of these results confirm that Vermont’s tobacco control program has had an influence on smoking above and beyond the influence of increases in the cigarette excise tax. In addition, these increases have led to decreased smoking by continuing smokers and fewer smokers in Vermont. The findings suggest that support for VTCP has been a wise investment and is likely leading to reductions in smoking-related mortality, morbidity, and economic costs. Despite the success of VTCP represented in these results, our previous evaluations have noted that progress in some of the program’s key metrics have stalled in recent years. For example, despite considerable efforts by VTCP to promote cessation, both intermediate- and longer-term cessation outcomes have not changed. However, with the recent decline in prevalence, the most recent Adult Tobacco Survey may suggest otherwise. If these indicators remain unchanged, our previous recommendations to re-examine the current mix and allocation of funds across strategies may require further attention.
REFERENCES


