



Robert Wood Johnson Foundation

RWJF Retrospective Series

The Impact of Tax and Smoke-Free Air Policy Changes

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A companion report to
*The Tobacco Campaigns of the
Robert Wood Johnson Foundation
and Collaborators, 1991–2010*

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Smoke-Free Air Policy Changes

Preface 1
Executive Summary 2
Introduction 5
Tobacco Taxation 8
Smoke-Free Air Policies 20
Modeling the Impact of Tobacco Taxes and Smoke-Free Policies 25
Conclusions 38
Sources 40

Figures:

Figure 1: State and Federal Cigarette Taxes, 1990–2009 11
Figure 2: State Cigarette Taxes and Prices, November 1, 2008 11
Figure 3: Cigarette Taxes and Prices, United States, 1954–2009 12
Figure 4: Cigarette Prices and Cigarette Sales, United States, 1970–2009 13
Figure 5: Cigarette Prices and Adult Smoking Prevalence, United States, 1970–2008 14
*Figure 6: Cigarette Prices and Former Smoking Rates,
50 States and District of Columbia, 2007* 15
Figure 7: Cigarette Prices and Youth Smoking Prevalence, United States, 1991–2008 17
*Figure 8: Cigarette Prices and 12 to 17-Year-Old Smoking
Prevalence Rates, 50 States and District of Columbia, 2005/2006* 17
Figure 9: Restrictiveness of State Laws Regulating Smoking in Public Places, 1960–2003 21
*Figure 10: Major Smoke-Free Air Legislation in the 50 States
and District of Columbia, 1991–2008* 22

Figure 11: Smoke-Free Air Policies and Adult Smoking Prevalence, 2003–2004 24

Figure 12: Smoke-Free Air Policies and Youth Smoking Prevalence, 2003–2004 24

Figure 13: Reduction in the Number of Smokers;
Tax and MSA Price Increase Impact, 1993–2010 29

Figure 14: Reduction in Deaths Caused by Smoking;
Tax and MSA Price Increase Impact, 1993–2010 30

Figure 15: Reduction in Number of Smokers;
Tax and MSA Price Increase Impact, 1993–2063 31

Figure 16: Reduction in Deaths Caused by Smoking;
Tax and MSA Price Increase Impact, 1993–2063 31

Figure 17: Reduction in Number of Smokers;
Smoke-Free Air Policy Impact, 1993–2010 32

Figure 18: Reduction in Deaths Caused by Smoking;
Smoke-Free Air Policy Impact, 1993–2010 32

Figure 19: Reduction in Number of Smokers;
Smoke-Free Air Policy Impact, 1993–2063 33

Figure 20: Reduction in Deaths Caused by Smoking;
Smoke-Free Air Policy Impact, 1993–2063 33

Figure 21: Reduction in Number of Smokers; Combined Tax and
Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2010 34

Figure 22: Reduction in Deaths Caused by Smoking; Combined Tax
and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2063 35

Figure 23: Reduction in Number of Smokers; Combined Tax and
Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2063 35

Figure 24: Reduction in Deaths Caused by Smoking; Combined Tax
and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2063 36

Tables:

Table 1: Summary of Impact of State Smoke-Free Air Policy Changes,
State and Federal Tax Increases, and MSA Price Increase, 1993–mid-2009 4

Table 2: Data Used in *SimSmoke* 26

Preface

Twenty years ago the Robert Wood Johnson Foundation decided to put our name and substantial financial and human resources behind a bold initiative to reduce tobacco use in this country. For two decades, RWJF has been working with partners in government, education, philanthropy and the private sector to make literally the air that we breathe safe to inhale and to free many Americans from a gripping, destructive addiction to which they were seduced in their youth. As this retrospective indicates, our tobacco-control campaigns often have seemed an uphill battle, but they have made significant inroads against the harmful effects of tobacco.

Because of that significant progress, we have scaled back our investments in tobacco control to allow us to focus on new public health challenges. Yet the moral injunction of medicine is “First, do no harm.” As we wound down these investments (though ongoing, we are still providing \$3,589,258 to reduce tobacco use), I was adamant that we needed to monitor the state of tobacco control going forward and to assess the legacy and impact of our body of tobacco-control work.

As we address other critical public health challenges, like the need to roll back the epidemic of childhood obesity, it is important to harvest lessons that can be learned from our tobacco-control work, which has been unique in terms of magnitude, duration, scope and methods. We therefore asked the Center for Public Program Evaluation to conduct an independent assessment to help us and the field understand the results of our efforts, what worked, what didn’t, and what could be adopted or adapted to fulfill our mission to improve and make a demonstrable difference in health and health care for all Americans.

I wish to emphasize our insistence that the center’s work be truly independent. The center’s president, George Grob, is a former Deputy Inspector General of the U.S. Department of Health and Human Services, who personally took charge of this assessment. Grob asked Henry Aaron, Bruce and Virginia MacLaury, senior fellow and former director of economic studies at the Brookings Institution, and Michael O’Grady, senior fellow at the National Opinion Research Center and principal, O’Grady Health Policy, to provide an additional layer of independent review. Aaron and O’Grady advised on study methods and findings, and reviewed draft reports. The resulting assessment report describes both the significance and limits of RWJF’s contributions and achievements.

I want to thank the many individuals and organizations—often working in collaboration—who conducted the tobacco-control campaigns, and I especially want to thank the many RWJF staff members (and former staff) who have worked with such competence and endurance on reducing Americans’ addiction to tobacco. Among them were: Diane Barker, Michael Beachler, Sallie Petrucci George, Karen Gerlach, Marjorie Gutman, Robert Hughes, Nancy Kaufman, Jim Knickman, Michelle Larkin, Joe Marx, Tracy Orleans, Marjorie Paloma and Steven Schroeder, and many others behind the scenes and too numerous to name.

Risa Lavizzo-Mourey, M.D., M.B.A.

*President and Chief Executive Officer
Robert Wood Johnson Foundation*

Executive Summary

The past two decades have seen unprecedented progress in tobacco control, with governments at all levels adopting and strengthening a range of tobacco-control policies and other interventions to promote cessation among current tobacco users and preventing youth from taking up tobacco use.

The past two decades have seen unprecedented progress in tobacco control, with governments at all levels adopting and strengthening a range of tobacco-control policies and other interventions to promote cessation among current tobacco users and preventing youth from taking up tobacco use.

A variety of factors have contributed to these changes, including greater recognition of the health consequences of tobacco use and exposure to tobacco smoke and related changes in social norms. These changes have been accelerated by the efforts of governmental and nongovernmental organizations that have invested considerable resources in building the evidence base for the effectiveness of tobacco-control interventions, implementing and evaluating a variety of innovative programs to reduce tobacco use, and supporting grassroots and national efforts to advocate for proven tobacco-control policies and programs.

Prominent among these are the substantial investments that the Robert Wood Johnson Foundation has made in all three areas—building the evidence base for tobacco-control policies and programs through diverse research; implementing a variety of innovative programs aimed at reducing tobacco use, particularly in high-risk populations; and supporting a range of national, state and local organizations to advocate for adopting and implementing effective tobacco-control strategies.

Progress has been particularly evident with respect to increases in tobacco product excise taxes and strengthened smoke-free air policies. Between 1990 and 2009, the federal excise tax rose from 16 cents per pack to just over \$1, average state cigarette excise taxes more than quadrupled, and a number of communities adopted significant additional excises. These tax increases, coupled with tobacco company pass-throughs of costs from legal settlements (most notably the 1998 Master Settlement Agreement [MSA]), led to an increase of more than 125 percent in the inflation-adjusted price of cigarettes during this period.

Similarly, as evidence about the harmful effects of nonsmokers' exposure to tobacco smoke accumulated, state and local governments adopted and strengthened policies limiting smoking in public places and private workplaces. Currently, every state and hundreds of localities have policies in place that limit smoking in at least some venues, with nearly three-quarters of the U.S. population residing in a jurisdiction that bans smoking in restaurants, bars and/or private worksites.

Over the past two decades, dozens of studies have clearly demonstrated that higher taxes and price increases on tobacco lead to significant reductions in tobacco use, particularly among youth and those with lower incomes.

These policy changes provided numerous natural experiments for tobacco-control policy researchers to evaluate. Over the past two decades, dozens of studies have clearly demonstrated that higher taxes and price increases on tobacco lead to significant reductions in tobacco use, particularly among youth and those with lower incomes. This is evident both in the number of current users who quit using tobacco and the number of young people who do not begin.

Likewise, comprehensive smoke-free air policies not only protect nonsmokers, but also increase cessation among existing smokers and prevent smoking initiation among youth. Several studies have paid particular attention to establishing the causal relationships between the policies and tobacco use. The accumulating evidence of the effectiveness of these policies has contributed to further policy changes.

This report summarizes the progress made over the past two decades in raising cigarette and other tobacco product excise taxes and in adopting and strengthening policies that limit smoking in public places and private worksites. The evolution of these policies is discussed and the evidence of their effectiveness in reducing tobacco use is reviewed.

Using this information, we use the *SimSmoke* tobacco-control policy simulation model to estimate the impact of changes in tobacco-control policy, especially taxation and smoke-free air policies, on the number of persons who smoke and on premature deaths caused by smoking. We use 1993 as our baseline, given the available data and timing of significant governmental and nongovernmental programs designed to reduce tobacco use through policy and media advocacy, building the evidence base for tobacco control, and other interventions (e.g., RWJF's efforts, the ASSIST program of the National Cancer Institute [NCI], the IMPACT program of the Center for Disease Control and Prevention [CDC]). We assess the impact of state and federal cigarette tax changes and state smoke-free air policies adopted through mid-2009. Finally, we also estimate the impact of the significant price increase that followed the Master Settlement Agreement in November 1998.

We estimate the impact of these policy changes on the number of individuals who smoke in 2010 and the cumulative number of premature deaths avoided by smoking policies put in place between 1993 and 2010. We find that the impact of these policy changes is substantial. According to our estimates:

- More than 2.4 million fewer individuals smoked in 2010 because of the state and federal tax increases that occurred from 1993 through mid-2009.
- Nearly 1.7 million fewer people smoked in 2010 as a result of the state smoke-free air policies adopted during this period.
- More than 5.3 million fewer people smoked in 2010 as a result of the combined effect of the tax increases, smoke-free air policies and MSA price increase.
- More than 60,000 premature deaths would have been caused by smoking between 1993 and 2010 had these policies changes not been made. (See Table 1 for a summary of these estimates.)

Given that these policies will deter many young people from taking up smoking in future years, and given the lags between smoking initiation and the onset of smoking-related diseases,

the longer-term impact of these policies changes will be enormous. We estimate, for example, that by 2063:

- More than 12 million fewer people will smoke as a result of the combined tax, price, and smoke-free air policy changes that occurred from 1993 through mid-2009—that includes almost 2.4 million fewer smokers because of the state smoke-free air policies and more than 6.3 million fewer because of the state and federal tax increases.
- Nearly 2.1 million premature deaths, which would have otherwise been caused by smoking between 1993 and 2063, will have been prevented.

Given the substantial reductions in the number of smokers by 2063, the public health impact of the policy changes will continue to grow, preventing millions of additional premature deaths in the later years of this century. (See Table 1 for a summary of these estimates.)

Moreover, these figures considerably underestimate the full impact of the changes that have occurred as a result of tobacco-control efforts over the past two decades, including the effects of local policy changes, exposure to effective mass-media countermarketing campaigns, greatly expanded support for cessation efforts, and the many other activities supported by various public and private organizations. Similarly, they do not capture the full extent of health benefits produced by the reductions in smoking, as they do not reflect the increases in quality-adjusted life years gained as a result of the premature deaths averted.

TABLE 1

Summary of Impact of State Smoke-Free Air Policy Changes, State and Federal Tax Increases, and MSA Price Increase, 1993–mid-2009

	Reduction in Number of Smokers	Cumulative Smoking-Attributable Deaths Averted
2010		
Impact of State Smoke-Free Air Policies	1,685,363	18,937
State and Federal Tax Increases	2,424,914	16,714
State and Federal Tax Increases and MSA Price Increase	3,717,956	37,982
State Smoke-Free Air Policies and State and Federal Tax Increases	3,969,225	39,183
State Smoke-Free Air Policies, State and Federal Tax Increases, and MSA Price Increase	5,332,504	60,451
2063		
Impact of State Smoke-Free Air Policies	2,376,731	673,854
State and Federal Tax Increases	6,320,595	893,824
State and Federal Tax Increases and MSA Price Increase	9,122,482	1,420,875
State Smoke-Free Air Policies and State and Federal Tax Increases	9,077,503	1,567,061
State Smoke-Free Air Policies, State and Federal Tax Increases, and MSA Price Increase	12,049,270	2,094,112

Introduction

Much of the progress in reducing tobacco use in the United States over the past few decades can be attributed to the adoption and strengthening of tobacco-control policies at the state and local levels (Giovino et al., 2009). Inflation-adjusted federal and state cigarette taxes have more than tripled since the early 1990s, and significant taxes have been adopted in several localities. On average, federal, state and local cigarette taxes currently add well over \$2 to the price of a pack of cigarettes, and much more in some localities.

Several states earmark a portion of the revenues generated from these taxes to comprehensive state tobacco-control programs that aim to prevent smoking initiation and encourage smoking cessation; others use the payments they receive from tobacco companies as part of the MSA to fund these programs. Every state and hundreds of communities now restrict smoking in at least some public places, with a growing number banning smoking in virtually all indoor public places, including restaurants, bars and worksites. As of March 2010, nearly three-quarters of the U.S. population resides in a jurisdiction that bans smoking in private worksites, bars and/or restaurants. In response to federal legislation, all states have implemented policies prohibiting the sale of tobacco products to minors, with many states and communities adopting policies that go well beyond the mandated minimum.

These positive trends are likely to continue as governments at all levels continue to raise tobacco taxes, strengthen smoke-free air laws, and implement other policies and programs aimed at reducing tobacco use and its consequences. Moreover, new policies are likely to emerge as a result of the authority to regulate tobacco products given to the U.S. Food & Drug Administration under the Family Smoking Prevention and Tobacco Control Act of 2009 and the elimination of federal pre-emption of subnational restrictions on tobacco company marketing practices included in that act.

A variety of forces have contributed to these significant policy changes, including greater recognition of the health consequences of tobacco use and exposure to tobacco smoke and related changes in social norms. These changes have been accelerated by the efforts of governmental and nongovernmental organizations that have invested considerable resources in building the evidence base for the effectiveness of tobacco-control interventions, implementing and evaluating a variety of innovative programs to reduce tobacco use, and supporting grassroots and national efforts to

advocate for proven tobacco-control policies, programs and other interventions. These include programs such as:

- NCI's American Stop Smoking Intervention Study (ASSIST), which supported media and advocacy efforts aimed at strengthening state tobacco-control policy in the 1990s.
- CDC's Initiative to Mobilize for the Prevention and Control of Tobacco Use (IMPACT) program, which funded non-ASSIST states to support a variety of tobacco-control efforts.
- CDC's National Tobacco Control Program, which funded related efforts in all states following the end of the ASSIST program.
- The Robert Wood Johnson Foundation's *SmokeLess States®: National Tobacco Policy Initiative*, which funded nearly all states at some point in the 1990s and 2000s to support policy and media advocacy efforts to raise tobacco taxes, adopt and strengthen smoke-free air policies, and implement other policy initiatives.
- Comprehensive programs funded first by California in 1989 and later by many other states, using earmarked tobacco tax revenues, funds from legal settlements or general revenues.

These efforts often included support for three activities—building the evidence base for tobacco-control policies and programs through diverse research programs and projects; implementing a variety of innovative programs aimed at reducing tobacco use, particularly in high-risk populations; and supporting a range of national, state and local organizations to advocate for adopting and implementing effective tobacco-control strategies.

While existing research clearly demonstrates that funding for these efforts has significantly impacted tobacco-control policies and tobacco use, it is impossible to sort out the full effect of funding for a specific program. These programs worked together in complementary ways, with funding for one often spurring funding for others (as in the case of the *SmokeLess States* efforts to increase state taxes and the MSA funding for comprehensive state tobacco-control programs, which generated more funding for state tobacco-control efforts). Existing data and methods cannot disentangle the synergies among these programs or attribute to any one program some fraction of the changes that have occurred in tobacco-control policies and tobacco use.

This report summarizes the progress made over the past two decades in raising excise taxes on cigarettes and other tobacco products, and in adopting and strengthening policies limiting smoking in public places and private worksites. The evolution of these policies is discussed and the evidence of their effectiveness in reducing tobacco use is reviewed. Using this information, we apply the *SimSmoke* tobacco-control policy simulation model to estimate the impact of changes in state and federal cigarette taxes and state smoke-free air policies on the number of persons who smoke and on premature deaths caused by smoking. Given available data and the timing of significant governmental and nongovernmental programs, we use 1993 as our baseline and assess the impact of state and federal cigarette tax changes and state smoke-free air policies adopted through mid-2009, in line with the timing of our analyses. Finally, we estimate the impact of the significant price increase that followed the MSA in 1998.

We estimate the impact of these policy changes on the number of individuals who smoke (as of 2010) and the cumulative number of premature deaths that would have been caused by smoking had these policies not been put into place from 1993 through 2010. Since these policies will deter many young people from taking up smoking in future years, and since there are lags between smoking initiation and the onset of diseases caused by smoking, we also estimate the longer-term impact of these policies, specifically through 2063.

Given the substantial rise in cigarette prices and the diffusion of comprehensive smoke-free air policies during this period, we conclude that the number of smokers will be significantly reduced by 2010, with these reductions growing over time as these policy changes prevent youth from taking up smoking in future years. We project that these policy changes will prevent many premature deaths that otherwise would have been caused by smoking by 2010, with the number of deaths averted growing over time so that by 2063, millions of premature deaths will have been averted. The impact of these policy changes will continue to grow beyond that endpoint.

Tobacco Taxation

In the United States, cigarettes and other tobacco products are taxed in various ways by federal, state and local governments. Historically, the primary motivation for these taxes was to generate revenue. In recent years, however, growing evidence about the impact of higher tobacco taxes and prices on youth and adult tobacco use and the consequences has led to increased interest in tobacco taxation. This section reviews the recent history of these taxes, their relationship to price and evidence of the impact of price on tobacco use, both generally and in key populations.

FEDERAL TOBACCO TAXATION

The federal government has applied excise taxes to tobacco products in the United States since the late 18th century; these taxes rose and fell over time depending on the government's revenue needs, often rising during wartime and falling during times of peace and prosperity. The federal cigarette excise tax was set at 8 cents per pack in November 1951 and remained at that level until it was doubled in January 1983 as part of deficit reduction legislation. For two decades, the tax then rose modestly, increasing to 39 cents per pack in January 2003. Given the infrequent and typically small increases in the federal cigarette tax since 1951, the tax in 2003 amounted to about 70 percent of the inflation-adjusted value of the 1951 tax.

In April 2009, the federal cigarette excise tax was increased significantly to just over \$1 per pack (\$1.0067), with revenues from the tax used to fund an expansion of the State Children's Health Insurance Program. With this tax increase, the nominal federal cigarette tax more than quadrupled from January 1, 1993, while the real value of the tax nearly tripled.

In addition to cigarettes, federal excise taxes are applied to most other tobacco products, including cigars, pipe tobacco, chewing tobacco, snuff and roll-your-own tobacco (with a separate tax on rolling papers). Historically, these taxes have generally accounted for a lower percentage of the total retail price of the product, compared to the federal cigarette tax. As with cigarettes, federal excise taxes on other tobacco products had mostly been raised infrequently and modestly over time, but the April 2009 increases were much more significant. The new tax meant that the share of taxes in the total price of other tobacco products was comparable to the share represented by taxes in the total price of cigarettes.

While the public health benefits of higher federal tobacco taxes had been noted in debates over tax increases, the small, infrequent increases of the 1980s and early 1990s were generally adopted as part of budget deficit legislation (e.g., the Tax Equity and Fiscal Responsibility Act

of 1982, which doubled the tax, effective January 1983; and the Omnibus Budget Reconciliation Act of 1990, which included four-cent increases in 1991 and 1993). In contrast, the public health impact of higher tobacco taxes appears to be a key factor in the larger federal tax increases of the past decade, particularly the unprecedented increases in 2009.

STATE TOBACCO TAXATION

All states apply an excise tax on cigarettes. In 1921 Iowa became the first to adopt a state cigarette excise tax. Not surprisingly, North Carolina, one of the major tobacco growing and manufacturing states, was last, imposing a tax only in 1969. Similarly, most states impose excise taxes on other tobacco products. States also generally apply the sales tax to cigarettes and other tobacco products, usually adding it to the total price, including the excise taxes.

There is considerable variation across states in these taxes, as well as within most states over time. Currently, the simple average of cigarette excise taxes in the 50 states and the District of Columbia is \$1.34 per pack, with taxes as high as \$3.46 per pack in Rhode Island. As might be expected, given tobacco's historical and economic importance, cigarette taxes in the six major tobacco-growing or manufacturing states (Georgia, Kentucky, North Carolina, South Carolina, Tennessee and Virginia) are low, ranging from seven cents per pack in South Carolina to 62 cents per pack in Tennessee—with an average tax just over one-quarter of the average cigarette tax in other states.

The first evidence of states using higher taxes to improve public health comes from the numerous state cigarette tax increases following the dissemination about the early evidence on the health consequences of smoking in the mid-1950s and 1960s. From 1950 through 1954, there were a total of 14 state cigarette excise tax increases (and one reduction), and average taxes in tobacco-growing/manufacturing states were only slightly below those in other states (U.S. Department of Health and Human Services [U.S. DHHS], 2000). As information spread about the health consequences of smoking, many states continued to raise their cigarette taxes, some multiple times; from 1955 through 1971, an average of more than 10 states per year raised their tax. Not surprisingly, major tobacco growing and manufacturing states were least likely to do so; indeed, Virginia and Kentucky lowered their taxes. By the end of fiscal year 1971, the average tax in the six major tobacco growing and manufacturing states was less than 60 percent of that in other states.

Concerns about interstate cigarette smuggling, especially in states with higher taxes than their neighbors, deterred states from continuing to raise taxes over the next decade. Beginning in 1982, however, states again began raising taxes, partly because of the need for revenues caused by the significant economic slowdown of the early 1980s and partly in response to legislation that doubled the federal cigarette tax, which went into effect in 1983. At least some of these tax increases were most likely a response to the early economic research (described below) demonstrating that higher cigarette taxes reduced smoking, particularly among youth and young adults (Lewit and Coate, 1982; Lewit, Coate and Grossman, 1981). Further interest in raising state taxes to discourage tobacco use was almost certainly stimulated by subsequent studies concluding that the federal tax increase that went into effect in 1983 would prevent more than 100,000 deaths caused by smoking (e.g., Warner, 1986; Harris, 1987).

The emerging evidence on the effectiveness of state cigarette taxes in reducing smoking and improving public health inspired a renewed interest in using tax increases to discourage tobacco use. In 1988 California led this next wave with a voter initiative—Proposition 99, the Tobacco Tax and Health Protection Act—which increased the state’s cigarette excise tax by 25 cents per pack (then the largest single increase in a state cigarette tax) and raised other tobacco-product taxes. Voters went further and earmarked 25 percent of the revenues generated from these new state taxes to fund a comprehensive tobacco-control program. Massachusetts voters did the same in 1992, approving Question 1, which raised the state cigarette tax by 25 cents per pack, increased other tobacco product taxes, and recommended that part of the new revenues be used to fund a comprehensive tobacco-control program.

State tobacco taxes continued to increase over the next two decades, with the inflation-adjusted average state tax more than tripling since 1990. Nearly all states, even most major tobacco growing/manufacturing states, have increased their cigarette excise tax in recent years, and many have done so multiple times, often using the revenues generated from these taxes to fund tobacco-control programs. Politicians from both parties have supported increases in excise taxes on cigarettes, often pointing to the health benefits of reducing tobacco use. Similarly, public support for these taxes tends to be high, particularly when the new revenues are earmarked for comprehensive tobacco-control and other public health programs.

Over time, the number of states that also impose taxes on other tobacco products has increased—all states now do so except Pennsylvania—as have the rates applied to these products. These taxes have historically been *ad valorem* excises, levied as a percentage of distributor or manufacturer price, although some states have moved to specific excises (usually based on weight) in recent years to reduce the price gap between premium and discount brands. As with federal taxes on other tobacco products, these taxes have historically accounted for a smaller percentage of the total retail price, compared to the percentage of taxes in the total price of a cigarette pack. However, many states have narrowed or closed this differential in efforts to reduce incentives to substitute other tobacco products for cigarettes.

LOCAL TOBACCO TAXATION

Hundreds of communities also tax tobacco. While most apply relatively small taxes to cigarettes and, in some cases to other tobacco products, a few cities and counties have in recent years adopted significant local cigarette taxes. In 2002 New York City increased its cigarette tax from 8 cents per pack to \$1.50 per pack, with the public health impact of the higher tax the primary rationale for this unprecedented rise. Smokers buying cigarettes in New York City now pay more than \$5.25 per pack in local, state and federal excise taxes alone.

Over the past decade, Cook County, Illinois, raised its cigarette tax to \$1 per pack, followed a year later by an increase to \$2 per pack. Chicago’s cigarette tax has risen 68 cents per pack on top of that. A number of Alaska communities have adopted local taxes of \$1 per pack or more, and many Virginia communities have adopted or increased local taxes to 50 cents per pack or more. The public health impact of the taxes has often been a motivating factor for these and the many other local tax increases that have been imposed nationwide.

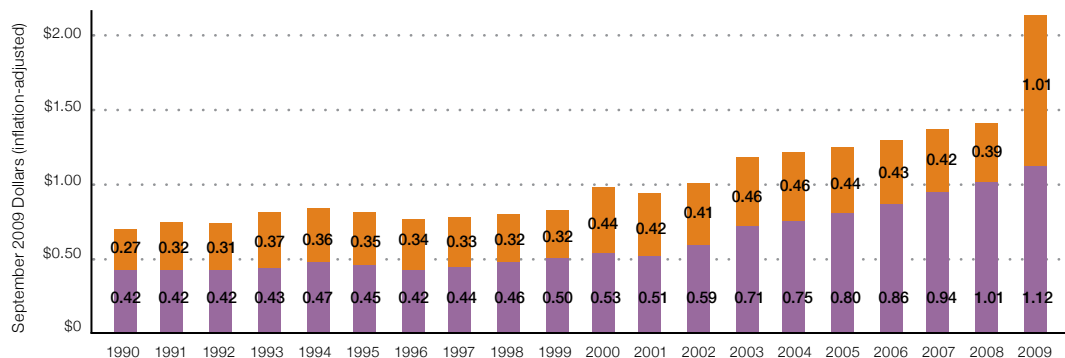
THE RELATIONSHIP BETWEEN TOBACCO TAXES AND TOBACCO PRICES

Sizable increases in state and local cigarette taxes have contributed to a significant increase in inflation-adjusted cigarette prices over the past decade. While many factors influence price, several studies demonstrate that the price of cigarettes rises to include the new taxes and sometimes goes even higher. Figure 1 shows the growth in inflation-adjusted state and federal cigarette excise taxes over the past two decades, while Figure 2 illustrates the clear relationship between state cigarette taxes and average state-level cigarette prices.

FIGURE 1

State and Federal Cigarette Taxes, 1990–2009

■ State Tax
■ Federal Tax



Source: *Tax Burden on Tobacco*, 2009, and authors' calculations

FIGURE 2

State Cigarette Taxes and Prices, November 1, 2008

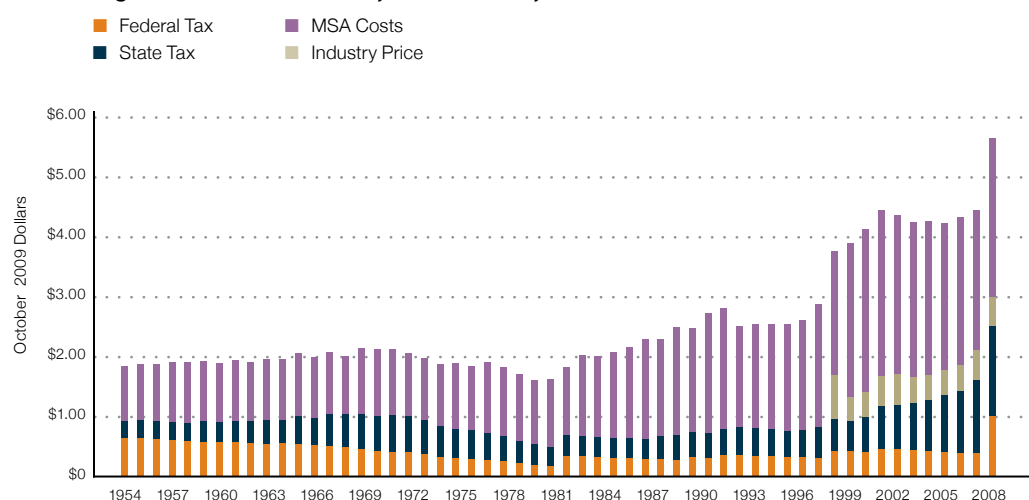


Source: *Tax Burden on Tobacco*, 2009, and authors' calculations. Note that state taxes do not include the significant local taxes imposed in some jurisdictions in some states (notably: New York City; Chicago, Cook County, and others in Illinois; and multiple communities in Alaska and Virginia, among other states); this accounts for some of the apparent outliers.

Likewise, the settlements of state and local lawsuits against tobacco companies have resulted in cigarette price increases. The pass-through of costs resulting from settlements of lawsuits with Mississippi, Florida, Texas and Minnesota in 1997 and 1998 accounted for most, if not all, of the more than 25 cents per pack increase in wholesale prices during this period. The November 1998 Master Settlement Agreement, which settled remaining lawsuits, resulted in an immediate wholesale price increase of 45 cents per pack.

Figure 3 illustrates the significant increase in cigarette prices over the past decade, largely resulting from increased state and federal taxes and the pass-through of settlement costs. Between 1990 and 2009, inflation-adjusted cigarette prices increased by more than 125 percent.

FIGURE 3

Cigarette Taxes and Prices, United States, 1954–2009

Source: *Tax Burden on Tobacco*, 2009, and authors' calculations

TOBACCO TAXES, PRICES AND OVERALL TOBACCO USE

A fundamental principle of economics is the “downward sloping demand curve,” which dictates that as the price of a product rises, the consumption of that product falls. For many years, the conventional wisdom was that addictive products like cigarettes and other tobacco products might be an exception to this basic principle. However, over the past few decades, well over 100 studies looking at the United States and other high-income countries, as well as various U.S. states, have clearly and consistently demonstrated that higher prices reduce tobacco use.

These studies have used a variety of designs and have applied diverse econometric and statistical methods to a wide range of aggregate and individual-level data, while controlling for the array of other factors likely to affect tobacco use. These reductions in use result from increased cessation among current tobacco users, reduced initiation among youth, less relapse among former users and reductions in the amount consumed by those who continue to use tobacco.

The inverse relationship between cigarette prices and cigarette consumption in the United States is illustrated in Figure 4. Stable federal and state cigarette taxes in the 1970s and early 1980s, coupled with high inflation, resulted in a drop in inflation-adjusted cigarette prices and

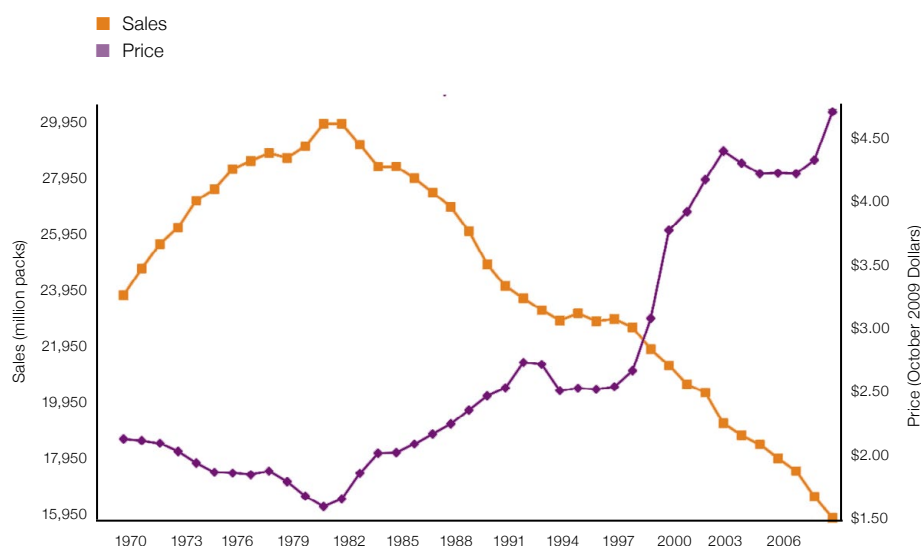
a rise in cigarette consumption. Beginning with the doubling of the federal cigarette excise tax in 1983, and followed by increases in the industry price and in state cigarette taxes, inflation-adjusted cigarette prices began to rise and cigarette consumption declined.

These trends continued until 1993 and what has come to be known as “Marlboro Friday.” In April 1993, Philip Morris implemented a variety of promotions for Marlboro cigarettes that lowered price by about 25 percent. These price reductions were quickly matched by other companies and spread to other brands, halting the downward trend in cigarette consumption. Consumption remained flat for the next few years as inflation-adjusted prices remained steady. More recently, as prices rose rapidly in the late 1990s and early 2000s, reflecting two federal tax increases, numerous state tax increases, and the pass-through of settlement costs, U.S. cigarette consumption has declined sharply.

Economists use the “price elasticity of demand” to quantify the impact of a change in price on a change in consumption. The price elasticity of demand is formally defined as the percent change in consumption that results from a one percent increase in price. While the many studies of cigarette demand produce a wide range of estimates, most fall in the narrow range from -0.25 to -0.5 , implying that a 10 percent increase in cigarette prices reduces overall cigarette consumption by between 2.5 percent and 5 percent (U.S. DHHS, 2000; Chaloupka et al., 2000; Gallet and List, 2003).

Studies for other tobacco products are consistent in showing that higher taxes and prices reduce their use, although fewer such studies have been conducted (U.S. DHHS, 2000; Chaloupka et al., 2000). These studies also indicate that tobacco products can substitute for one another, implying, for example, that if the price of cigarettes increases relative to the price of smokeless tobacco products, reduced cigarette consumption would be partially offset by increases in the use of smokeless tobacco (e.g., Ohsfeldt, Boyle and Capilouto, 1999). Similarly, a few recent studies show that increases in cigarette prices lead smokers to change brands, including switching

FIGURE 4
Cigarette Prices and Cigarette Sales, United States, 1970–2009



Source: *Tax Burden on Tobacco*, 2009, and authors' calculations

from premium to discount brands (e.g., Tauras, Peck and Chaloupka, 2006) and switching to longer cigarettes, or cigarettes higher in tar and nicotine (e.g., Evans and Farrelly, 1998).

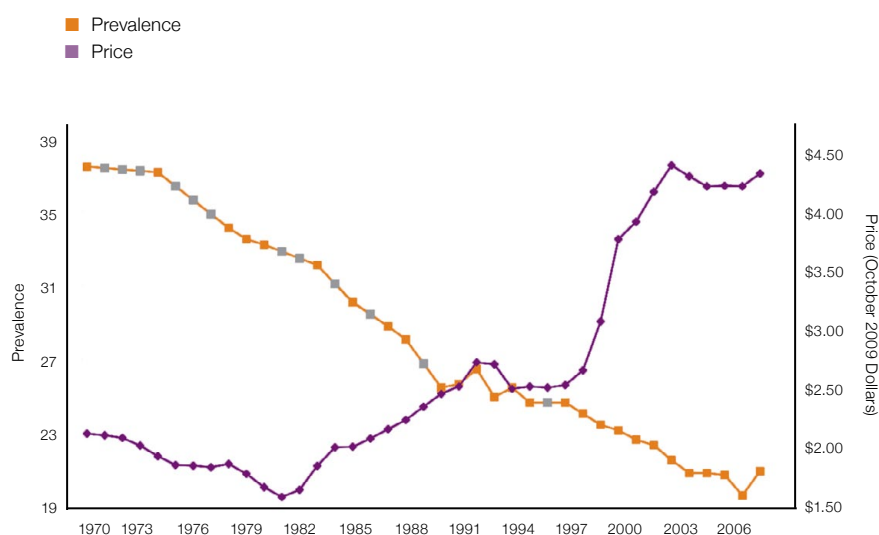
Experiences from U.S. states that have significantly increased cigarette taxes, as well as from a variety of high-income countries where taxes account for a much higher share of cigarette prices, and where the per-pack price is well above that in the United States as a whole, suggest that these estimates apply over a wide range of prices. These experiences also suggest that additional increases in taxes and total prices would continue to reduce cigarette smoking by a comparable magnitude. Recent studies that account for the addictive nature of cigarette smoking find that smokers respond gradually to price increases so that the effect grows over time—the long-run impact of price is about twice as large as the immediate impact (Chaloupka, 1991; Becker, Grossman and Murphy, 1994; Chaloupka, Tauras and Grossman, 2000).

TAXES, PRICES, AND ADULT PREVALENCE AND CESSATION

A growing number of studies based on individual-level survey data attempt to disentangle the effects of taxes and higher prices on prevalence and consumption. These studies generally find that about half of the drop in overall cigarette consumption that results from a price increase reflects a decline in smoking prevalence, with the remainder accounted for by reductions in the number of cigarettes consumed by continuing smokers (e.g., Hu et al., 1995; Farrelly et al., 2001). Estimates from most of these studies indicate that a 10 percent increase in price reduces adult smoking prevalence by between 1 percent and 2.5 percent. The relationship between cigarette prices and adult smoking prevalence is illustrated in Figure 5. As with cigarette consumption, the downward trend in adult prevalence was halted in the mid-1990s following the Marlboro Friday price cuts and resumed later in the decade as taxes and prices rose. During much of the first decade of the 21st century, prior to the 2009 federal tax increase, cigarette prices held steady and the downward trend in prevalence flattened out.

FIGURE 5

Cigarette Prices and Adult Smoking Prevalence, United States, 1970–2008



Note: Grey data points for prevalence are interpolated assuming linear trend.

Sources: National Health Interview Surveys, various years; *Tax Burden on Tobacco*, 2009; and authors' calculations

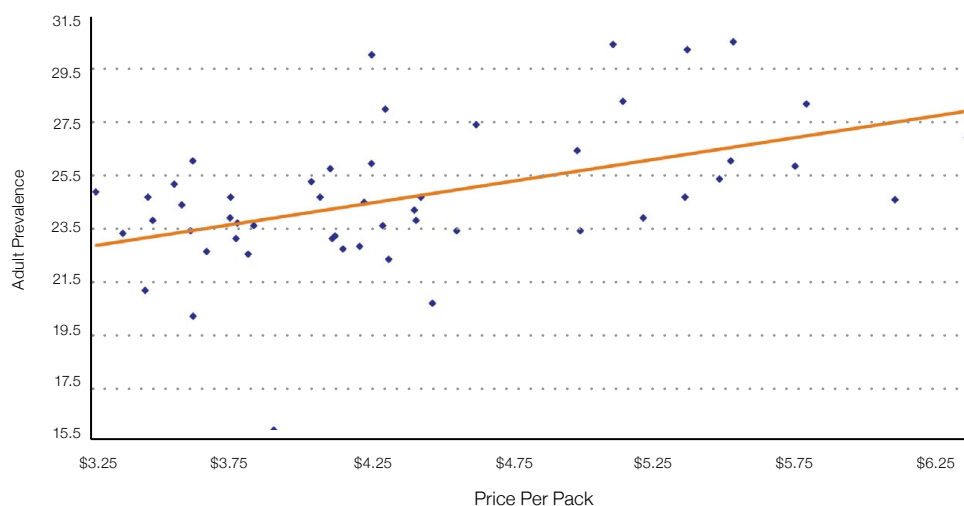
Changes in adult prevalence result from increased cessation among adult smokers, rather than smoking initiation, most of which occurs during adolescence (U.S. DHHS, 1994). Early studies of the relationship between cigarette prices and smoking cessation based on retrospective, cross-sectional data found that higher prices reduced the duration of smoking and increased the likelihood of quitting (Douglas and Hariharan, 1994; Douglas, 1998).

More recent studies based on longitudinal data that directly assesses cessation behavior conclude that higher cigarette prices increase the likelihood that a smoker will try to quit smoking. Tauras and Chaloupka (2001), for example, estimate that a 10 percent increase in cigarette prices increases the probability of a quit attempt among young adult smokers by between 6 percent and 9 percent. In a subsequent study that accounted for unsuccessful quit attempts, Tauras (2004) estimates that a 10 percent price increase increases the likelihood of a successful quit attempt by about 3.5 percent.

Figure 6 illustrates the association between cigarette prices and cessation; consistent with the findings from more rigorous empirical studies, there is a higher percentage of former smokers in states with higher cigarette prices.

Recent research on the demand for cessation pharmacotherapies produces consistent findings. Tauras and his colleagues (2003, 2005), for example, find that higher cigarette prices increase the sales of nicotine replacement products.

FIGURE 6
Cigarette Prices and Former Smoking Rates, 50 States and District of Columbia, 2007



Source: Behavioral Risk Factor Surveillance System, 2009; *Tax Burden on Tobacco*, 2009; and author's calculations

TAXES, PRICES, AND YOUTH AND YOUNG ADULT TOBACCO USE

Economic theory suggests several reasons that prices have more impact on youth smoking, compared to adult smoking (Chaloupka, 2003; Chaloupka et al., 2000). These include:

- Lower disposable income of the typical youth, such that changes in the prices of any of the products they consume will have a greater impact on their consumption.
- Greater importance of peer behavior among youth, with price-induced changes in the smoking behavior of some youth leading to changes in the smoking behavior of others.
- Shorter smoking histories of younger smokers, suggesting that they may be less addicted and able to respond more quickly to price changes.
- Greater relative importance of short-term costs (e.g., price) compared to long-term costs (e.g., health consequences), given the greater propensity of youth to discount the future.
- Other channels through which price indirectly influences youth smoking (e.g., reducing parental smoking).

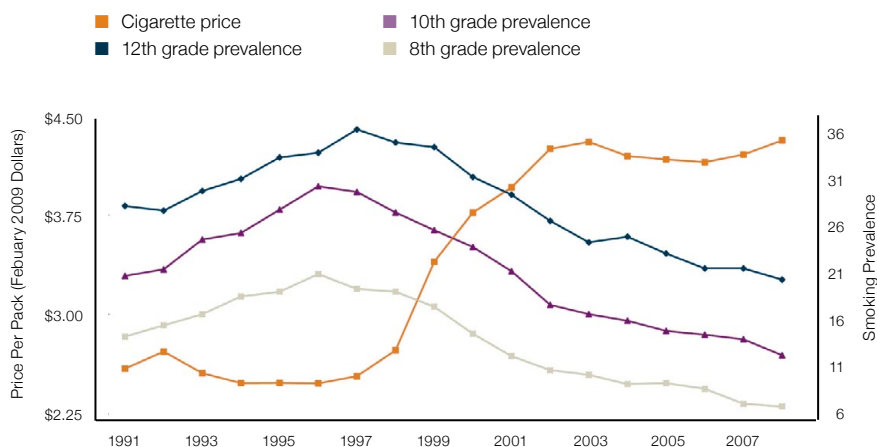
Early research on youth smoking based on cross-sectional survey data confirmed these predictions. In the first studies of the impact of price on youth, young adult and adult smoking, Lewit and his colleagues (1981, 1982), found that smoking among teens was about three times more responsive to price than among adults, with young adults about twice as responsive as older adults. While some studies do not find differences in the effects of price on smoking among different age groups (e.g., Wasserman et al., 1991), most studies have confirmed the greater impact among younger persons. For example, Harris and Chan (1999) estimated that a 10 percent price increase would reduce smoking by about 10 percent among 15- through 17-year-olds; almost 8 percent among 18- through 20-year-olds; between 6 percent and 7 percent among 21- through 26-year-olds; and just over 3 percent among 27- through 29-year-olds. Similarly, a small number of studies have examined the impact of smokeless tobacco taxes and concluded that higher taxes are effective in reducing the prevalence and frequency of youth use of these products (e.g., Chaloupka, Tauras and Grossman, 1997; Tauras et al., 2007).

The relationships between cigarette prices and youth smoking are illustrated in Figures 7 and 8, which show cigarette prices and youth smoking rates over time and across states, respectively. As with cigarette sales and adult prevalence, youth smoking responds inversely to price. The rise in youth smoking in the mid-1990s, is in part explained by the Marlboro Friday price cuts of 1993; Gruber and Zinman (2001), for example, estimate that more than one-quarter of the increase was caused by price reductions for Marlboro and other leading brands. The declines beginning in the late 1990s and continuing for much of the first decade of the 21st century are partly explained by the increased prices that followed state and federal tax increases and the pass-through of litigation settlement costs.

A few recent studies have explored the direct and indirect influences of price on youth smoking that are suggested by economic theory (Chaloupka, 2003). For example, Powell and colleagues (2005) found that more than one-third of the overall impact of price on youth smoking is linked to peer behavior—that is, as some youth are deterred from smoking by higher prices, other youth are less likely to smoke because fewer of their peers smoke. Similarly, Powell and Chaloupka (2005) found that about one-fifth of the overall impact of price on youth smoking is explained by the effects of price on parental smoking.

FIGURE 7

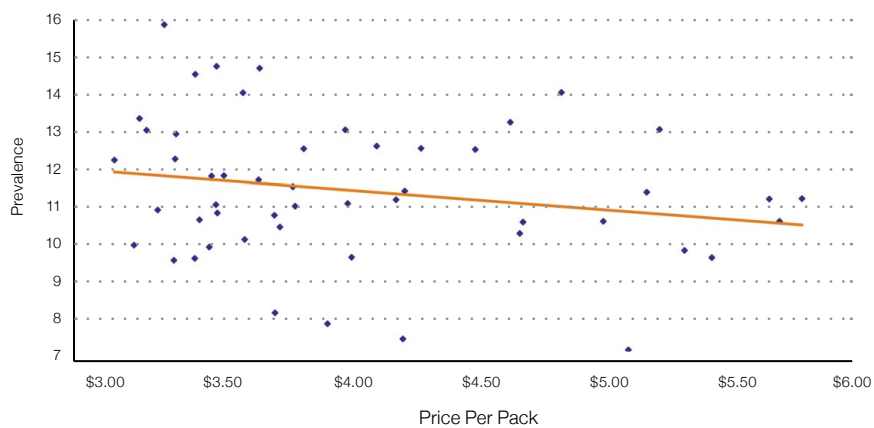
Cigarette Prices and Youth Smoking Prevalence, United States, 1991-2008



Source: Monitoring the Future, 2008; *Tax Burden on Tobacco*, 2009; and author's calculations

FIGURE 8

Cigarette Prices and 12 to 17-Year-Old Smoking Prevalence Rates, 50 States and District of Columbia, 2005/2006



More recent research has focused on the role of cigarette prices in the youth smoking uptake process. The Surgeon General (U.S. DHHS, 1994) describes uptake as moving through several stages, including experimentation, regular smoking and addiction. A few recent studies using cross-sectional data find that prices have relatively little impact on the early stages of smoking uptake, but have a much greater impact on moving from experimentation into regular smoking and, eventually, addiction (e.g., Gruber and Zinman, 2001; Liang and Chaloupka, 2002; Emery et al., 2001; Ross et al., 2006). This is consistent with the observation that most youth at early stages of uptake smoke few cigarettes and typically get their cigarettes from social sources, while those smoking more regularly are more likely to buy their own cigarettes and thus be more directly influenced by price.

This finding is generally confirmed by studies using longitudinal data on youth (for an exception, see DeCicca et al., 2002). For example, Tauras and colleagues (2001) use the Monitoring the Future longitudinal data on youth smoking, with baseline data collected from eighth and tenth graders in the early 1990s, to examine the impact of cigarette price on smoking initiation. These data are ideal given the multiple cohorts (six) they include and the fluctuation of cigarette prices in the 1990s. Tauras and colleagues estimate that a 10 percent price increase reduces the probability of any smoking initiation (including experimentation) by 1 percent to 3 percent; reduces the probabilities of initiating daily smoking by 8 percent to 12 percent; and reduces the probability of heavy daily smoking (half pack or more per day) by 10 percent to 14 percent. Tauras (2005) finds similar effects in his more recent research on the effects of price on smoking escalation among young adults, concluding that higher cigarette taxes and prices are most effective in keeping young adults from moving from less than daily smoking into daily and heavy daily smoking.

DIFFERENCES IN THE EFFECTS OF TAXES AND PRICES BY SOCIOECONOMIC STATUS

Economic theory predicts that the effects of price on consumption will be larger among lower-income consumers than among higher-income consumers, if all else remains the same. Several studies have examined differences in price responsiveness by income and related characteristics (e.g., education and socioeconomic class), and generally conclude that persons in lower socioeconomic groups are more responsive to changes in cigarette prices than those in higher socioeconomic groups.

Farrelly and colleagues (2001), for example, estimate that smoking among persons in U.S. households below the median income level was about four times more responsive to changes in cigarette prices than smoking among those in higher-income households. Similarly, Chaloupka (1991) found that smoking among less-educated people was more sensitive to price than among more educated persons, while Townsend and colleagues (1994) found that smoking among people in the lowest socioeconomic classes in the United Kingdom was much more responsive to price than among those in the highest socioeconomic classes.

Emerging evidence from low and middle-income countries produces similar findings, with smoking in the lowest-income countries more influenced by price than smoking in higher-income countries (Ross and Chaloupka, 2006).

SUMMARY

Research evidence clearly demonstrates that increases in cigarette taxes result in at least comparable increases in cigarette prices. Well over 100 studies from the past three decades have consistently found that these higher prices significantly reduce cigarette smoking by motivating current smokers to quit, preventing youth from becoming regular smokers and reducing consumption among those who continue to smoke. Price elasticity estimates from studies are generally consistent, with most indicating that a 10 percent increase in cigarette prices reduces overall consumption by between 2.5 percent and 5 percent; about half the overall impact is on prevalence and the remainder on consumption among continuing smokers, with even greater effects among young people and those in lower socioeconomic groups. This evidence has played a critical role in motivating governments at all levels to adopt and increase taxes as a way of promoting public health by reducing tobacco use and the death and disease it causes.

Smoke-Free Air Policies

DIFFUSION OF SMOKE-FREE AIR POLICIES

State and local governments have restricted smoking in a variety of places for many years. The earliest of these policies typically limited smoking in venues such as theaters and food preparation areas, and were intended to prevent fires or food contamination. Further policies were adopted as more evidence emerged about the health consequences of smoking (including limited evidence about the consequences of exposing nonsmokers to tobacco smoke, which was first reported by the Surgeon General in a 1972 report (U.S. Department of Health, Education and Welfare [U.S. DHEW], 1972).

The earliest of these state policies was a 1973 Arizona law which limited smoking in a number of places. In 1974 Connecticut became the first state to restrict smoking in restaurants and in 1975 Minnesota became the first to do so in private worksites. In 1977 Berkeley, California, adopted the first local restrictions on smoking in restaurants and other public places. Over the next few years, a growing number of state and local governments adopted increasingly strong restrictions.

Given the success of Berkeley's local ordinance and the adoption of comparable ordinances in other California communities, legislative efforts were undertaken and ballot initiatives proposed to enact statewide restrictions on smoking. Somewhat surprisingly, given that California has been at the forefront of other tobacco-control efforts (e.g., higher taxes and funding for comprehensive tobacco-control programs), voters twice rejected ballot initiatives (Proposition 5 in 1978 and Proposition 10 in 1980) and the legislature rejected similar measures. The failure at the state level led to increased momentum for strong local policies, resulting additional ordinances restricting smoking in San Francisco, Los Angeles, Sacramento, San Diego and many other California communities in the early 1980s.

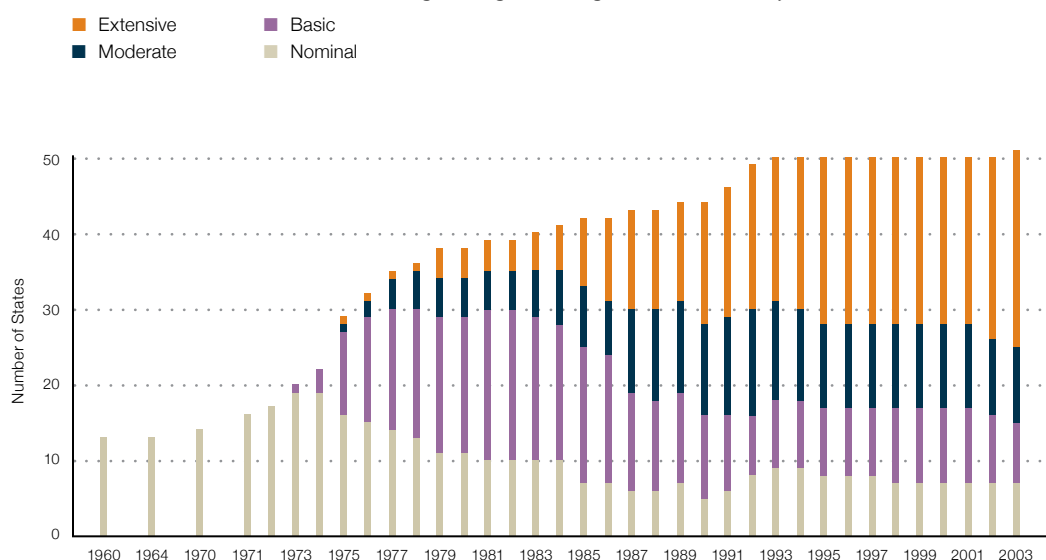
The local successes in California and the lack of action (or adoption of relatively weak policies) at the state level led to similar local efforts across the United States. These grassroots efforts were supported by a variety of organizations, including Americans for Nonsmokers' Rights (ANR), the Group Against Smoking Pollution, the American Lung Association, the American Heart Association and the American Cancer Society. Efforts to mobilize support for local ordinances included intensive public education efforts and the resulting ordinances typically went as far in restricting smoking as public sentiment allowed (U.S. DHHS, 2006). In some states, the

spread of local ordinances eventually led to state policies limiting smoking, but in some instances those policies pre-empted communities from adopting more restrictive ordinances.

Momentum for smoke-free policies increased significantly with the release of the 1986 Surgeon General’s report, *The Health Consequences of Involuntary Smoking*, which concluded that exposure to tobacco smoke caused diseases, including lung cancer, and that children of smoking parents were at increased risk of respiratory diseases (U.S. DHHS, 1986). In addition, the report found that simply separating smokers and nonsmokers might reduce, but did not eliminate, the exposure risks. This report prompted new federal regulations banning smoking on domestic flights of two hours or less and, eventually, on virtually all domestic flights (in 1990) and all international flights departing from or arriving in the United States (in 2000). Similarly, it spurred state and local government to strengthen existing policies and to adopt new policies, including complete bans on smoking in some venues (e.g., health care facilities). In addition, it led numerous private companies to adopt policies governing smoking in their workplaces.

As evidence mounted about the risks of tobacco smoke to nonsmokers, state and local policies grew increasingly strong. The 1997 release of the California Environmental Protection Agency’s (EPA) report on the health consequences of exposure (California EPA, 1997) was followed in 1998 by California’s law banning smoking in bars without separately ventilated smoking areas. In 2002 New York City made history by banning smoking in bars, restaurants and virtually all other workplaces beginning the following year, while Florida voters overwhelmingly supported a ballot initiative that, with some exceptions (notably in bars), did the same. By 2003 every state and thousands of localities had adopted policies limiting or banning smoking in a variety of locales. The growth and strengthening of these state policies is illustrated in Figure 9.

FIGURE 9
Restrictiveness of State Laws Regulating Smoking in Public Places, 1960–2003



Note: Classification scheme from 1989 Surgeon General’s Report (U.S. DHHS, 1989) used to define restrictiveness as follows: **Nominal**—one to three public places, not including restaurants or worksites; **Basic**—four or more public places, not including restaurants or worksites; **Moderate**—regulates smoking in restaurants but not worksites; **Extensive**—regulates smoking in private worksites.

Source: Roswell Park Cancer Institute and the ImpacTeen Project, unpublished data

Most recently, the 2006 Surgeon General’s report *The Health Consequences of Involuntary Exposure to Tobacco Smoke* (U.S. DHHS, 2006) stimulated further action, leading a growing number of states and communities to adopt comprehensive bans on cigarette smoking in virtually all public places and private worksites, as well as some outdoor spaces (e.g., sports stadiums and public parks). As of early 2010, 34 states, Washington, D.C., and hundreds of communities had adopted comprehensive smoke-free air policies banning smoking in some combination of restaurants, bars and/or private worksites, while similar measures are pending in a number of other jurisdictions (American Nonsmokers’ Rights Foundation [ANRF], 2010). The growth in these comprehensive policies from 1991 through 2008 is illustrated in Figure 10.

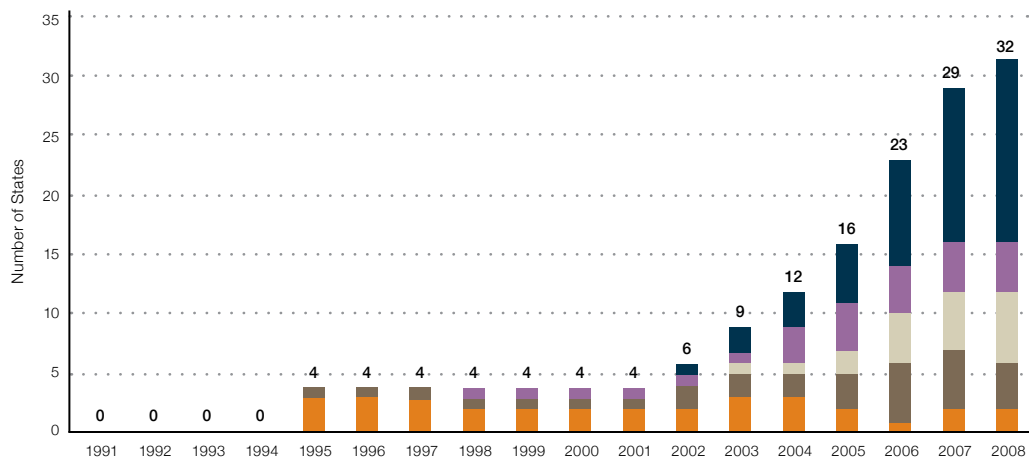
Comprehensive state policies (including those scheduled to take effect in the future), coupled with comparable local policies, currently apply to nearly three-quarters of the U.S. population. Further limits on smoking are beginning to appear in some jurisdictions, with new policies banning smoking in casinos and a wide variety of outdoor spaces, prohibiting smoking in private cars when children are present, and limiting smoking in multi-unit housing complexes.

In addition, as awareness of the health consequences of exposure to tobacco smoke grew and public and private policies were implemented and strengthened, a growing number of households, including those of smokers, adopted personal rules governing smoking in the home. By 2002 about two-thirds of U.S. households had smoke-free rules in place at home (U.S. DHHS, 2006; International Agency for Research on Cancer [IARC], 2009).

FIGURE 10

Major Smoke-Free Air Legislation in the 50 States and District of Columbia, 1991–2008

- Smoke-free worksites, restaurants and bars
- Smoke-free worksites
- Smoke-free restaurants and bars
- Smoke-free restaurants
- Smoke-free worksites and restaurants



Source: Giovino GA, Chaloupka FJ, Hartman AM, et al. *Cigarette Smoking Prevalence and Policies in the 50 States: An Era of Change—The Robert Wood Johnson Foundation ImpactTeen Tobacco Chart Book*. Buffalo, NY: University at Buffalo, State University of New York, 2009.

IMPACT OF SMOKE-FREE AIR POLICIES

In general, research suggests that smoke-free policies are self-enforcing and that compliance is high within a short time after their implementation (e.g., Jacobson and Wasserman, 1997, 1999; Borland et al., 2006; IARC, 2009). As a result, these policies are highly effective in reducing nonsmokers' exposure to tobacco smoke (Task Force on Community Preventive Services, 2001, 2005; U.S. DHHS, 2006; IARC, 2009). Somewhat surprisingly perhaps, most smokers residing in communities where smoking is banned in restaurants indicate that they support such bans (Borland et al., 2006). For example, in one recent survey, 83 percent of Irish smokers said that the comprehensive smoking ban implemented in Ireland in March 2004 was a "good" or "very good" policy (Fong et al., 2006).

In addition to protecting nonsmokers from exposure to tobacco smoke, these policies are effective in reducing cigarette smoking, both by encouraging adult smokers to quit and preventing youth from starting. These reductions result, in part, from the strengthening of social norms against smoking that follows the adoption of new policies, as well as from limiting opportunities to smoke and raising the "costs" (e.g., the inconvenience of or discomfort associated with smoking outdoors).

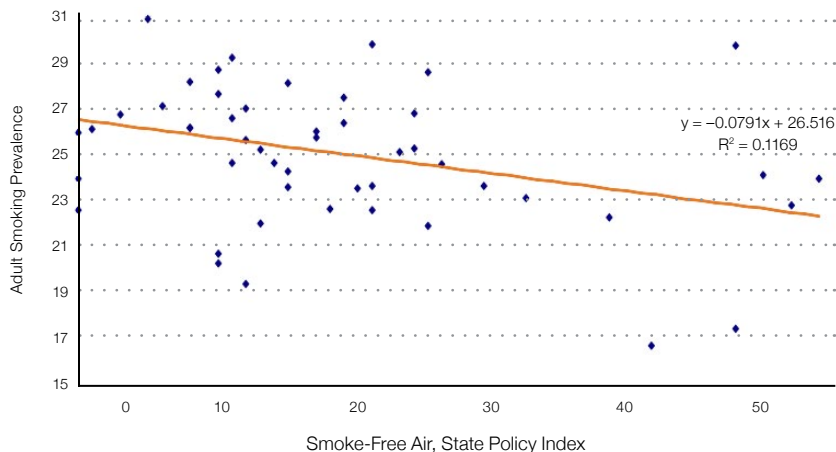
Dozens of studies have assessed the relationship between smoke-free policies and smoking behavior, using alternative designs and both aggregated and individual-level data, with many focused on assessing the causal nature of these relationships. Comprehensive reviews of the research evidence on the impact of smoke-free workplace policies by the NCI (2000), the Task Force on Community Preventive Services (2001, 2005), the Surgeon General (U.S. DHHS, 2006), and the International Agency for Research on Cancer (2009) find that these policies cause some smokers to quit and reduce the number of cigarettes consumed by those who continue to smoke.

Likewise, among youth and young adults, these policies are associated with stronger perceptions of the risks from smoking and the perception that fewer adults smoke. These factors and the increased "costs" of smoking associated with the policies help explain the consistent findings from a growing number of studies that comprehensive smoke-free air policies reduce youth smoking prevalence, initiation and uptake (Task Force on Community Preventive Services, 2005; U.S. DHHS, 2006; IARC, 2009).

The associations between state smoke-free air policies and adult and youth smoking prevalence are illustrated in Figures 11 and 12, respectively. While these simple graphs do not control for the other factors that affect smoking prevalence, or for the potential reverse causality between prevalence and state policies, they are consistent with the extensive and growing body of research that does incorporate these factors. Both figures use an index developed by the ImpacTeen Project to reflect the number of places covered by state smoke-free air policies and the extent of their restrictions (which range from no restrictions to a complete ban).

FIGURE 11

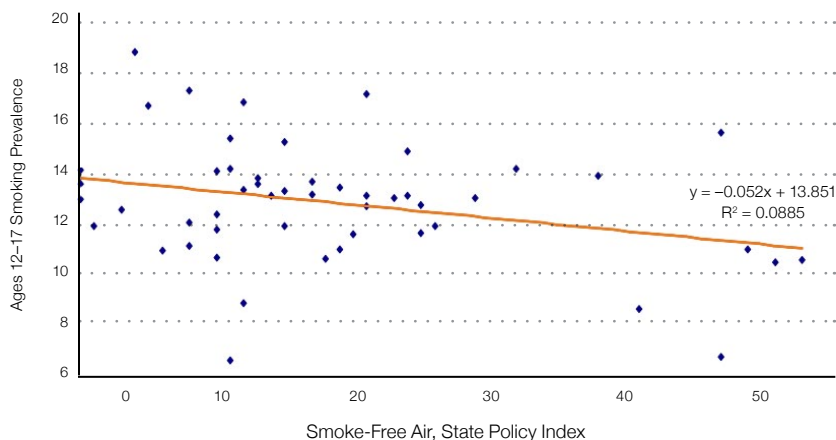
Smoke-Free Air Policies and Adult Smoking Prevalence, 2003–2004



Source: Substance Abuse and Mental Health Services Administration (2006a) and Roswell Park Cancer Institute and the ImpacTeen Project, unpublished data

FIGURE 12

Smoke-Free Air Policies and Youth Smoking Prevalence, 2003–2004



Source: Substance Abuse and Mental Health Services Administration (2006a) and Roswell Park Cancer Institute and the ImpacTeen Project, unpublished data

SUMMARY

Growing evidence of the health consequences of exposure to tobacco smoke led many governments to adopt policies that first restricted and eventually banned smoking in a variety of public places, including bars and restaurants, as well as in private worksites. These policies are generally self-enforcing with high compliance, and substantially reduce nonsmokers' exposure to tobacco smoke and the associated health consequences. These policies also have proven effective in reducing smoking by inducing adult smokers to quit and preventing young people from ever starting.

Modeling the Impact of Tobacco Taxes and Smoke-Free Policies

Increases in cigarette taxes and prices and the adoption and strengthening of smoke-free air policies will substantially reduce the death and disease caused by cigarette smoke. A few early studies used estimates of the impact of price on smoking prevalence to predict that significant federal cigarette excise tax increases would prevent hundreds of thousands of premature deaths (e.g., Warner, 1986; Harris, 1987). More recent studies have directly demonstrated the link between higher cigarette taxes and improved health outcomes. For example, Moore (1996) used state-level data on death rates from smoking-related diseases to estimate that a 10 percent increase in cigarette taxes would prevent more than 5,000 smoking-attributable premature deaths each year in the United States. Likewise, Ringel and Evans showed that higher cigarette excise taxes reduce smoking prevalence among pregnant women and that birth outcomes improve as a result (Ringel and Evans, 2001; Evans and Ringel, 1999). Similarly, a growing number of studies from various jurisdictions in the United States, Canada, Scotland, Italy and elsewhere have found that cardiovascular health improves significantly following the adoption and implementation of a comprehensive smoke-free policy (IARC, 2009).

METHODOLOGY

Over the past decade, multiple simulation models have been developed that assess and predict the impact of tobacco-control interventions on smoking prevalence, premature deaths caused by smoking, tax revenues, health care costs and related outcomes (Levy and Zaloshjina, in progress; Chaloupka and Tauras, 2009). Of these, the *SimSmoke* tobacco-control policy simulation model is the most well-developed for projecting the impact of changes in tobacco taxes, smoke-free air policies, mass-media campaigns, limits on youth access to tobacco and cessation interventions. For this analysis, we use *SimSmoke* to assess the impact on cigarette smoking and smoking-attributable deaths from 1993 through 2063 of: 1) increases in state and federal cigarette excise taxes, and 2) adoption and strengthening of state smoke-free air policies.

Discussed in detail elsewhere (Levy et al., 2010; Levy et al., 2006; Levy et al., 2002; Levy et al., 2000; Levy et al., 2005a; Levy et al., 2005b), *SimSmoke* begins in 1993, a year chosen for the availability of key smoking-prevalence data. In this model, the population, distinguished by age, evolves over time through birth and death rates following a discrete first-order Markov process.

The 1993 population is further divided into never, current and former smokers (by year, corresponding to years quit). Smokers are defined as individuals who have smoked more than 100 cigarettes in their lifetime and are currently smoking some or all days. Former smokers are defined as those who have smoked more than 100 cigarettes, but are not currently smoking and are distinguished by years quit. Those who have not smoked 10 cigarettes are never smokers. Individuals are classified as never smokers from birth until the age when they initiate smoking. In the absence of policy changes, individuals evolve into and out of smoking through initiation, cessation and relapse following a discrete first-order Markov process. To insure stability of the model, initiation rates at a particular age are measured as the difference between the prevalence of smoking at that age and the prevalence of smoking among individuals one year younger. Since almost all initiation occurs before age 25 (U.S. DHHS, 1992), initiation is tracked only until that age. Cessation and relapse are tracked after age 24, when those who quit may still have elevated mortality risks (U.S. DHHS, 1990). One-year cessation rates are defined as the number of people who were smokers one year ago and had quit at the time of the survey.

Smoking-attributable deaths in the *SimSmoke* model are estimated using standard attribution methods (Shultz et al., 1991). The relative risks, prevalence rate of smokers and ex-smokers, and death rates are used to estimate separate death rates for never smokers, smokers, and ex-smokers. The number of smokers and ex-smokers at each age is then multiplied by their respective death rate minus the death rate of never smokers to obtain the excess deaths due to smoking. Data sources for the full *SimSmoke* model, including modules not employed in this analysis, are presented in Table 2.

TABLE 2

Data Used in *SimSmoke*

Variable	Current Source	Current Specifications
I. Population Model		
A. Population	1993 Current Population Survey (CPS)	Breakdowns by age
B. Fertility rates	U.S. Census Vital Rate Inputs Tables	Breakdowns by age
C. Mortality rates	2000 Multiple Cause-of-Death File	Breakdowns by age
II. Smoking Model		
A. Baseline smoking rates for current and ex-smokers	Tobacco Use Supplement of the CPS (1992–1993) for age 15+, and 1993 Teenage Attitudes and Practices Survey for < age 15.	Based on 100+ cigarettes lifetime and distinction between current and former smokers. Breakdowns by age and for former smokers by years quit (<1, 1–2, 3–5, 6–10, 11–14, 15+ years)
B. Initiation rates	Change in smoking rates between contiguous age groups	Breakdowns by age
C. First-year cessation rates	Calculated from cessation module with adjusters for demographic group based on the CPS	Breakdowns by age

continued on next page

Data Used in *SimSmoke* (continued)

Variable	Current Source	Current Specifications
II. Smoking Model (continued)		
D. Relapse rates	U.S. DHHS, 1990, and various studies (Gilpin et al., 1997; Hughes et al., 2004; McWhorter et al., 1990)	Breakdowns by age
E. Relative death risks of smokers and ex-smokers	Cancer Prevention Study II—see National Cancer Institute 1997; U.S. DHHS, 2004	Breakdowns by age
III. Policy Modules		
A. Price and Taxes	Tobacco Institute, www.bls.gov/cpi/home.htm As available at the ImpacTeen website	Prices and CPI for 1993–2002
B. Clean-air laws	As available at the ImpacTeen website	Different types of laws and their stringency
C. Tobacco-control spending	ImpacTeen	Expenditures per capita
D. Youth access	CDC, SAMHSA (Levy et al., 2001)	Enforcement checks, penalties, community campaigns, self-service and vending machine bans
E. Cessation-treatment policies	Various sources (Levy et al., 2010)	Quitlines, financial coverage and health care provider interventions

Over time, smoking rates are affected by changes in policy. Each policy is expressed in terms of a percentage reduction: $PR = (\text{post-policy rate} - \text{initial rate}) / \text{initial rate}$. Policies have their greatest effect on cessation directly through an additive effect on prevalence [i.e., prevalence* (1+PR)] spread equally over the first three years that the policy is in effect. The percentage reduction is also applied to the initiation rate as (1+PR) and to the first-year cessation rate as (1-PR) while the policy is in effect. When more than one policy is being modeled, the percentage reductions are multiplied, implying that the effect of an additional policy is reduced proportionally to the effect of any other policy.

SimSmoke models the effects of price interventions (taxes), smoke-free air policies, tobacco-control mass-media campaigns and other interventions. Estimates for the impact of these policies and interventions on smoking rates are based on the evidence from current research, as well as the advice of an expert panel. This includes evidence on the effects of taxes/prices and smoke-free air policies on youth and adult smoking described earlier in this paper. The *SimSmoke* model has been validated for the United States (Levy et al., 2005), various states (Levy et al., 2007; Levy et al., 2007; Levy et al., 2008) and several nations (Levy et al., 2008; Levy et al., in press). For the U.S. model used here, validation has been conducted by examining how well the model predicts actual smoking rates for the period 1993–2008.

When estimating the impact of tax increases (Levy et al., 2000), the effects are modeled as age-specific constant proportional effects on prevalence, initiation and cessation rates resulting from the higher prices associated with a tax increase. Changes in price are then translated into changes in smoking prevalence through an equation dependent on price elasticities. Based on the extensive evidence described above of differences in price elasticity by age, the model shows that a 10 percent increase in price reduces prevalence by 6 percent for individuals below age 18; by

3 percent for those ages 18 to 24; by 2 percent for those ages 25 to 34; and by 1 percent for those ages 35 and above. When the tax rate changes, an equation translates that change directly into a price change of the same magnitude. Prices are measured in real (i.e., inflation-adjusted) terms; for future taxes, we assume that the real values of average state taxes and the federal tax in 2009 are maintained over time.

The *SimSmoke* smoke-free air policy module focuses on smoke-free policies in three venues: private worksites, restaurants and bars (Levy et al., 2001). Based on empirical evidence, a comprehensive smoke-free policy is modeled as reducing smoking prevalence by 10 percent, compared to the prevalence when no smoke-free policy is in place. Given the research evidence, policies covering private worksites are assumed to have the largest effect (an estimated seven of the 10 percent reduction in prevalence), with smaller impacts from smoke-free restaurant laws (2% reduction) and laws covering bars (1% reduction). Given the evidence that less comprehensive policies have weaker effects, the smoke-free policy component of the model is modified to account for less than complete restrictions, with smoking restricted to a common area having 25 percent of the effect of a comprehensive policy and smoking restricted to ventilated areas as having 50 percent of the comprehensive policy effect.

Because this approach involves non-linearities in the policies (where marginal changes at the top—e.g., moving to a complete ban—have a larger impact than those at the bottom—e.g., moving from no policy to limited restrictions) and because the values of aggregated measures based on state policies will fall between the four levels that are modeled, we assumed a linear interpolation of the effects. More details on these underlying assumptions are contained in Levy et al. (2001, 2003, 2004), with estimated effect sizes based on the research evidence described above.

Actual policies for the United States are programmed into the model for the period from 1993 through mid-2009. Because most policies are at the state level, policies are entered into the national model as a population-weighted average of the policies in states. We tested alternative measures weighted based on adult population, cigarette sales and number of adult smokers; results from these alternative measures are consistent with those presented below. The policy measures were obtained from the ImpacTeen state tobacco-control policy database (www.impactteen.org).

To assess and project the impact of state and federal taxation and of state smoke-free air policies implemented since 1993, we compared two scenarios: 1) what would have happened had there been no tax or policy changes since January 1993, and 2) what actually happened as a result of policies adopted from January 1, 1993, through June 30, 2009. The difference between the estimated prevalence under each scenario represents the effects of policies implemented from 1993 to 2009. Similarly, we compute the effect of policies on deaths attributable to smoking.

We conduct two sets of analyses on the effect of policy-induced price effects. When modeling the effects of taxes in the first set, we use a measure of price that subtracts state and federal tax changes during these years, but incorporates price changes due to industry actions and other factors. This gives a conservative estimate of the impact of the cigarette tax changes, since local tax increases are not included, due to lack of data, nor are the effects of the price increase following the MSA. It may also underestimate the effects of the tax since it assumes that taxes increase price only by the amount of the tax, even though some recent studies conclude that the industry actually raises prices beyond that. (Sullivan, 2010). In a second set of analyses, we incorporate the effects of the significant November 1998 price increase that followed the MSA (in addition to the tax increases). Although the MSA price increase is not directly related to a

specific policy, it can be viewed as the cumulative effect of changing attitudes toward smoking and has the same effect as an additional tax on cigarettes.

We model the tax/price-tax (in both forms) and smoke-free policy changes separately to show their individual effects. We also model the effects of the two types of policies together to show their combined effects.

We estimate and project the impact of changes in policies on the number of smokers and on the number of deaths caused by smoking in each year from 1993 through 2063. The net reduction in smokers each year reflects the combination of increased cessation and reduced initiation in response to the policy changes, underlying levels of smoking initiation and cessation, and deaths of smokers in that year. The estimated reductions in premature deaths caused by smoking in each year reflect the cumulative effects of the policies over time. Estimates are presented through 2010 and through 2063.

ESTIMATED/PROJECTED IMPACT OF TAX AND PRICE INCREASES

Figure 13 estimates the impact of increases in state and federal cigarette taxes and the MSA-induced price increase on the number of smokers from 1993 through 2010. Figure 14 estimates their impact on cumulative premature deaths. We estimate that the price increases that resulted from these tax increases reduced the number of smokers in 2010 by more than 2.4 million, with the 1998 MSA-induced price increase reducing the number of smokers by an additional almost 1.3 million. In the absence of both the federal and state tax increases and the additional state smoke-free policies implemented between 1993 and 1999, we estimate that almost 41.2 million persons would have been smokers in 2010.

Based on these findings, the tax and price increases from 1993 through mid-2009 are estimated to have reduced the number of smokers in 2010 by about 9 percent. Because the relatively larger impact of these tax and price increases is on youth smoking and because the effects of reduced smoking rates on smoking-attributable deaths are delayed, especially for youth, the cumulative number of smoking-attributable premature deaths averted from 1993 through 2010 is modest—almost 17,000 from the tax increases alone and over 21,200 more from the MSA price increase.

FIGURE 13

Reduction in Number of Smokers; Tax and MSA Price Increase Impact, 1993–2010

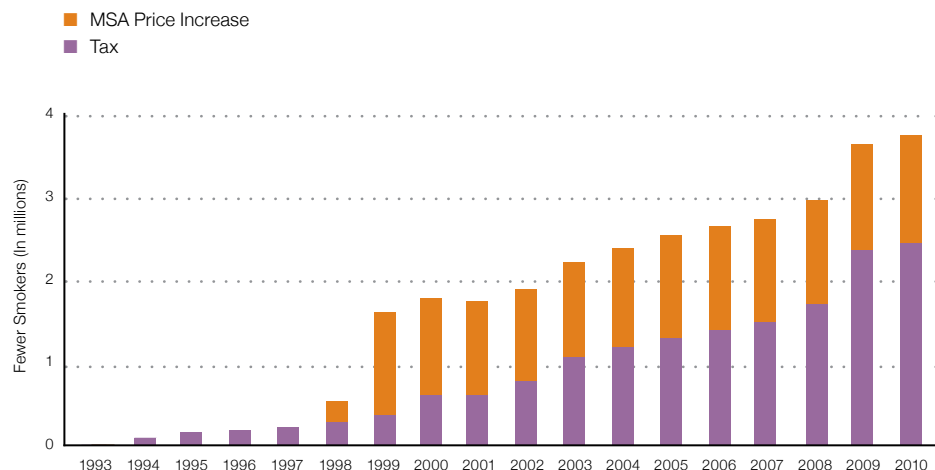
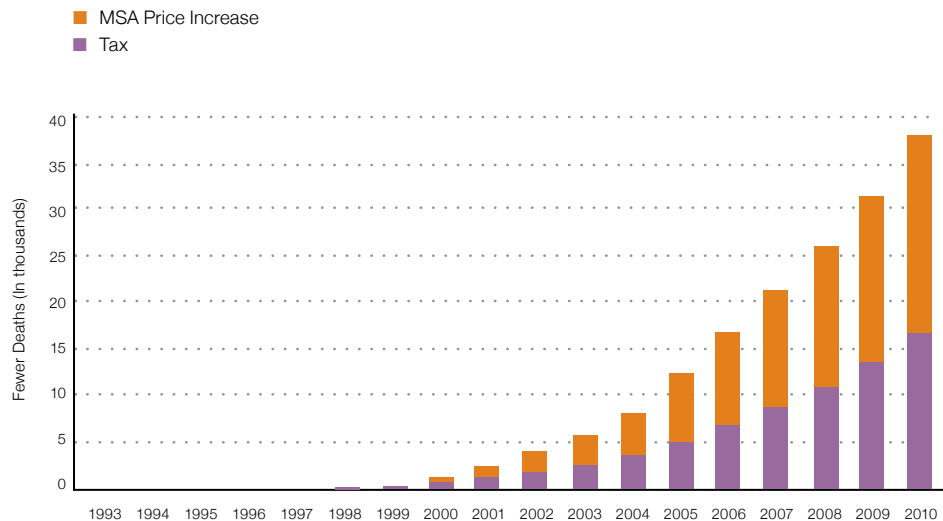


FIGURE 14

**Reduction in Deaths Caused by Smoking;
Tax and MSA Price Increase Impact, 1993–2010**



Figures 15 and 16 illustrate the future impact of these tax and price increases, clearly demonstrating how the health benefits grow over time as the impact of increased cessation and prevented initiation accumulate. We estimate that by 2063, there will be more than 6.3 million fewer smokers as a result of the state and federal tax increases that occurred from 1993 through mid-2009, plus more than 2.8 million fewer smokers as a result of the MSA price increase. The continued reduction over time in the number of smokers reflects the larger impact of price increases on youth initiation. Compared to *SimSmoke*'s prediction that more than 48.2 million persons would have been smoking in 2063 without the tax and price increases and smoke-free policies implemented from 1993 through mid-2009, our model shows that about 19 percent fewer people will be smoking in 2063.

This will substantially improve public health. Between 1993 and 2063, we estimate these tax increases will have cumulatively prevented almost 900,000 fewer premature deaths associated with smoking, with more than 525,000 more averted as a result of the MSA price increase. With substantially fewer smokers in 2063, these reductions in smoking and its consequences will continue to grow over time, with millions of additional smoking-attributable premature deaths avoided in subsequent decades.

FIGURE 15

**Reduction in Number of Smokers;
Tax and MSA Price Increase Impact, 1993-2063**

■ MSA Price Increase
■ Tax

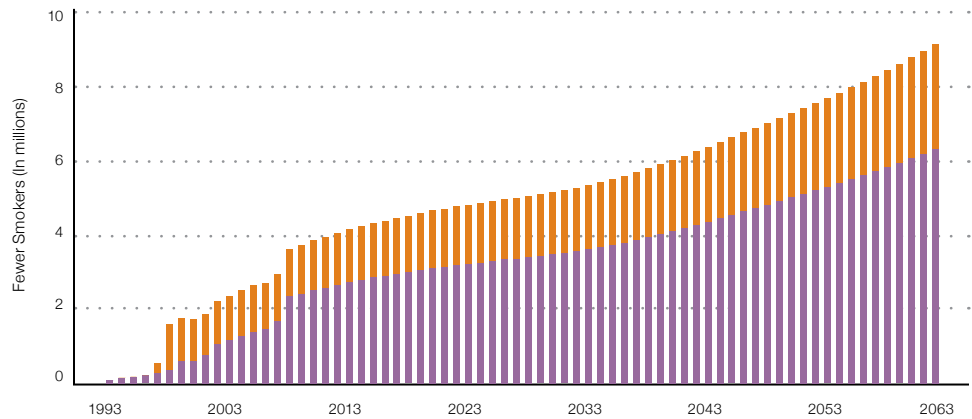
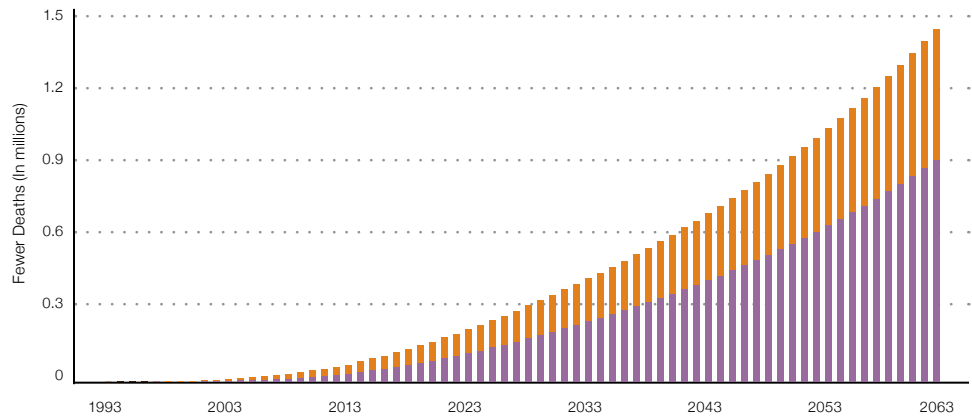


FIGURE 16

**Reduction in Deaths Caused by Smoking;
Tax and MSA Price Increase Impact, 1993-2063**

■ MSA Price Increase
■ Tax



ESTIMATED/PROJECTED IMPACT OF SMOKE-FREE AIR POLICIES

Figures 17 and 18 present the estimated impact of the adoption and strengthening of state smoke-free air policies on the number of smokers and premature deaths caused by smoking, respectively, from 1993 through 2010. We estimate that these smoke-free air policy changes reduced the number of smokers in 2010 by nearly 1.7 million (a more than 4% reduction compared to the number of smokers predicted in the absence of the policies), and that these policies prevented nearly 19,000 premature deaths that would have resulted from cigarette smoking during this period.

FIGURE 17

**Reduction in Number of Smokers;
Smoke-Free Air Policy Impact, 1993–2010**

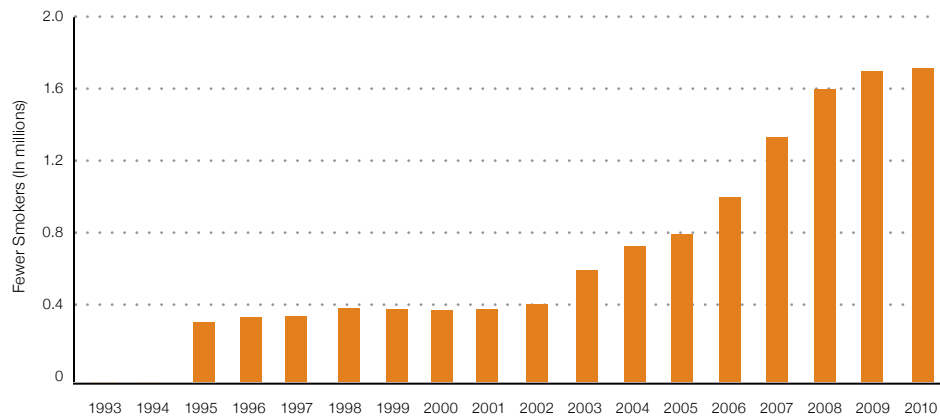
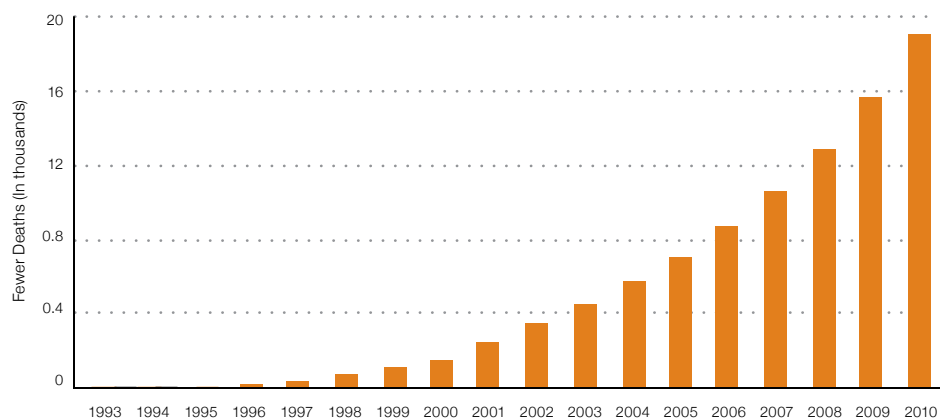


FIGURE 18

**Reduction in Deaths Caused by Smoking;
Smoke-Free Air Policy Impact, 1993–2010**



Figures 19 and 20 illustrate the future impact of these smoke-free air policy changes, again demonstrating how the health benefits grow over time as the longer run impact of increased cessation and prevented initiation accumulate. We estimate that by 2063, there will be nearly 2.4 million fewer smokers as a result of the state smoke-free air policy changes that occurred from 1993 through mid-2009, a reduction of about 5 percent in the estimated number of smokers in the absence of the policies we model. In contrast to the more rapid rise over time seen for the tax and price increases, the relatively stable estimated impact over the next few decades reflects the comparable impact of smoke-free policies on adult cessation and on youth initiation; the rise in later years reflects underlying increases in population. Between 1993 and 2063, we estimate that the smoke-free air policy changes will have prevented a cumulative total of almost 700,000 fewer premature deaths from smoking.

FIGURE 19

**Reduction in Number of Smokers;
Smoke-Free Air Policy Impact, 1993–2063**

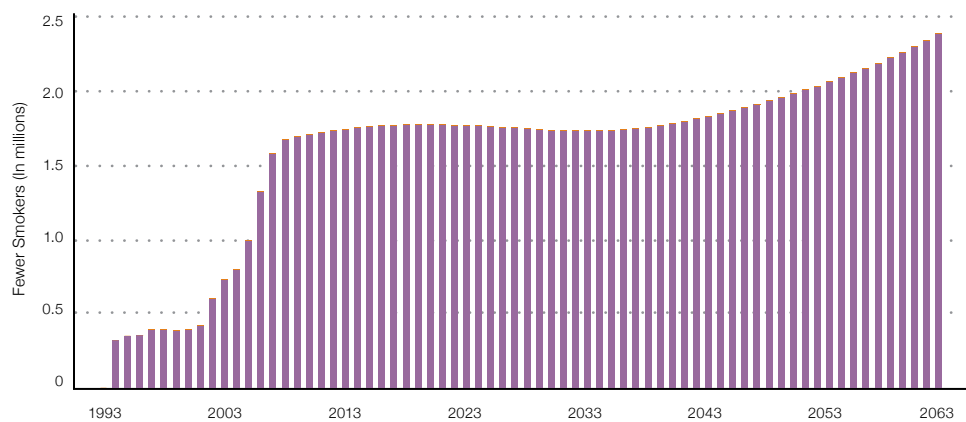
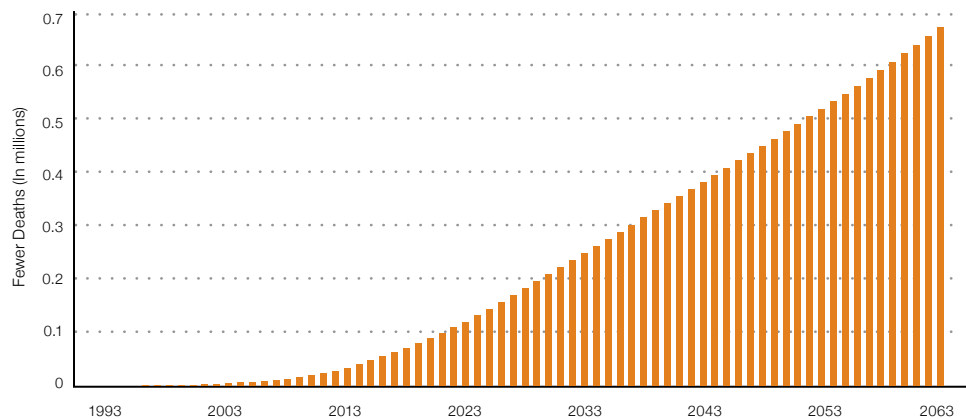


FIGURE 20

**Reduction in Deaths Caused by Smoking;
Smoke-Free Air Policy Impact, 1993–2063**



As with the tax/price-induced reductions in smoking and its consequences, the reductions resulting from the adoption and strengthening of state smoke-free air policies will continue to grow over time.

COMBINED TAX/PRICE AND SMOKE-FREE AIR POLICY IMPACT

Figures 21 through 24 illustrate the combined effects of the tax/price increases and smoke-free policy changes occurring from 1993 through mid-2009. By 2010, the tax and smoke-free policies are estimated to have reduced the number of smokers by nearly 4 million, with an additional 1.3 million fewer smokers as a result of the MSA price increase. This is a reduction of about 13 percent in the number of persons we estimate would have been smoking in 2010 in the absence of these policies. We estimate that these policies will reduce the number of smokers in 2063 by more than 9 million, with an additional almost 3 million fewer smokers as a result of the MSA price increase. Together, these two modeled policies will result in 25 percent fewer smokers in 2063.

The health impact of these reductions is enormous. By 2063 we estimate that these tax and smoke-free air policy changes will have cumulatively prevented more than 1.5 million deaths, with an additional half-million premature deaths prevented by the MSA price increase. The longer term health impact will be even larger—as many as 4.5 million more premature deaths prevented in the cohort of youth, young adults and adults alive in 2063. For deaths in 2063 alone (not cumulatively), we estimate that the modeled policies will have reduced premature deaths caused by smoking by more than 21 percent.

FIGURE 21

Reduction in Number of Smokers; Combined Tax and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2010

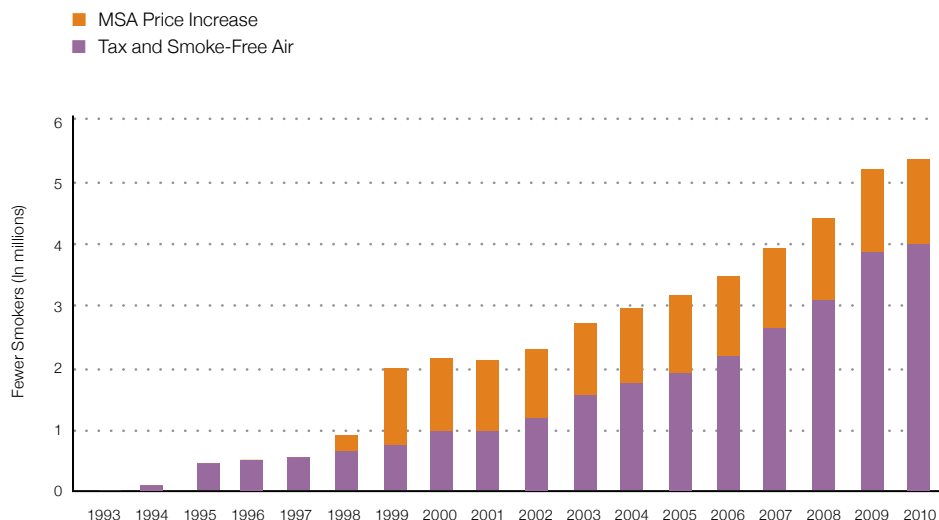


FIGURE 22

Reduction in Deaths Caused by Smoking; Combined Tax and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2010

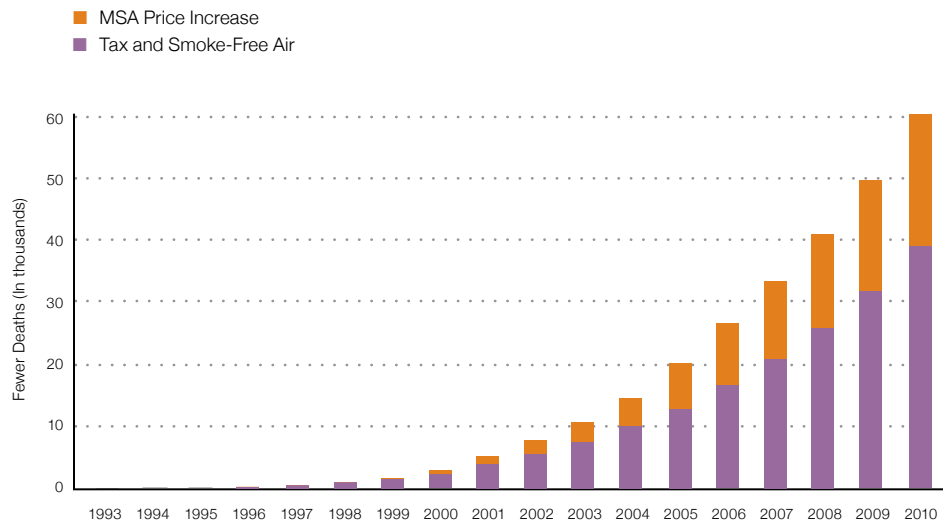


FIGURE 23

Reduction in Number of Smokers; Combined Tax and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2063

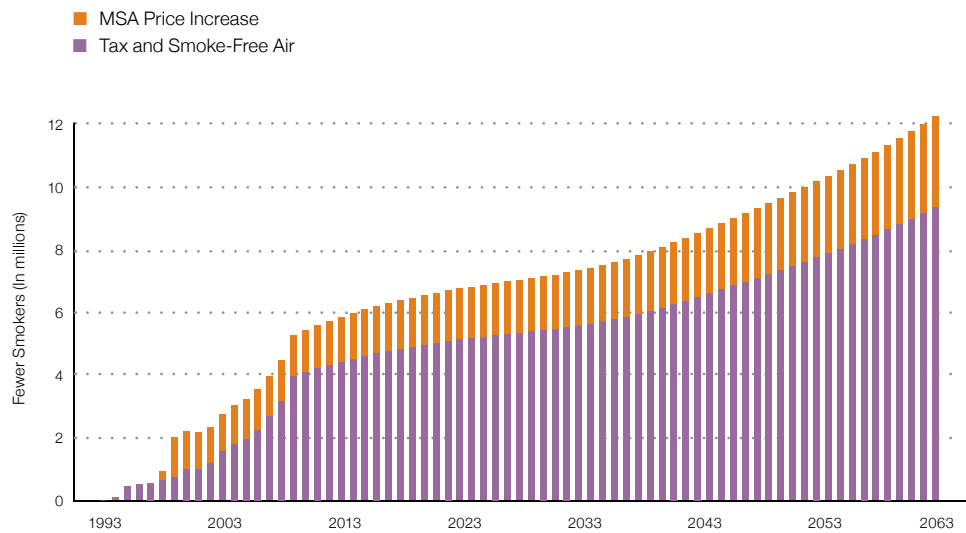
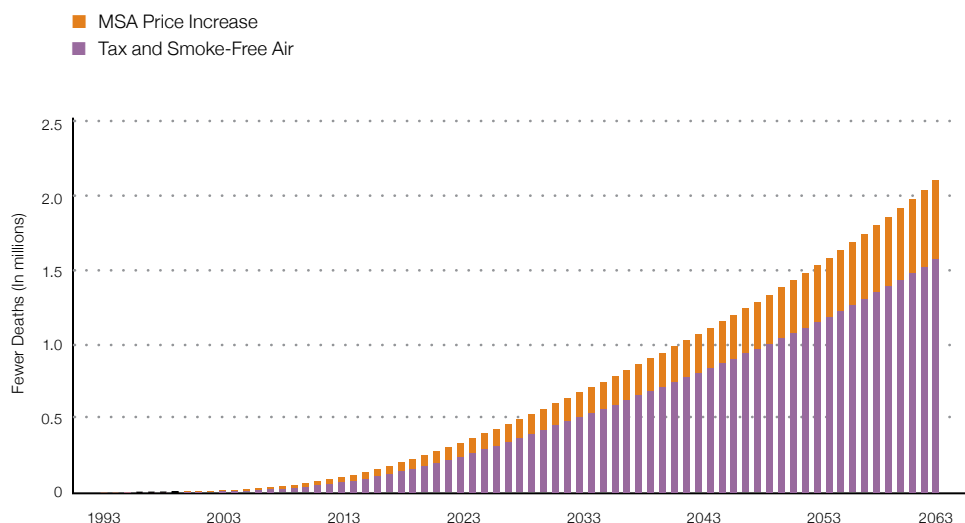


FIGURE 24

Reduction in Deaths Caused by Smoking; Combined Tax and Smoke-Free Air Policy and MSA Price Increase Impact, 1993–2063



LIMITATIONS

The estimates described above are subject to several limitations that may result in underestimates of the effects of the changes in tax and smoke-free policies that occurred since 1993. As noted previously, these estimates exclude the impact of local policies, given the lack of complete data on local cigarette excise taxes and smoke-free air policies. Nonetheless, the sizable local taxes and strengthened smoke-free air policies adopted in recent years in many locations will add to the estimated and projected reductions in the numbers of smokers and premature deaths caused by smoking. In addition, we only considered price changes through 2009. Additional tax changes and smoke-free air policies have already been implemented since June 1, 2009 and other policies are likely to be implemented in the future.

A second limitation that will also lead to underestimates of the impact of tax and smoke-free air policy changes during this period is the omission of other tobacco-control interventions from the modeling. Many states earmarked a portion of the new revenues generated from tax increases for comprehensive state tobacco-control programs. These programs often included funds for efforts to support cessation (e.g., state quitlines and subsidized pharmacotherapies) and to prevent initiation. Similarly, many states dedicated a portion of the payments they received from tobacco companies under the MSA and other settlements for comprehensive tobacco-control programs. Various other strategies implemented during this period to stimulate cessation and prevention initiation are not captured in these simulations.

A third limitation of this analysis is the inability to attribute policy changes to specific funders. As noted above, existing research shows that funding for coalition-based efforts to change tobacco-control policies at the state level (e.g., RWJF’s *SmokeLess States: National Tobacco Policy Initiative* and the NCI’s ASSIST) significantly contributed to higher state cigarette taxes

and more comprehensive smoke-free air policies (NCI, 2006; Chaloupka, 2008). However, efforts to fully disentangle the related and complementary funding streams in order to attribute some fraction of the changes in policies and smoking rates to any single funder are hampered by the lack of necessary data and appropriate methods. Efforts to attribute changes in the estimates contained in this report specifically to RWJF funding were limited by challenges in modeling the impact of funding for national level programs, an inability to model the synergies among RWJF, NCI, CDC and other funding, and an inability to model the stimulating effect that funding from one source had on funding from other organizations working on tobacco control.

A fourth limitation of this analysis is the underestimation of the full health impact of the changes in smoking that result from the policy changes. *SimSmoke* estimates of premature deaths caused by smoking reflect the direct impact of smoking and do not include the reductions in deaths that result from cancer, cardiovascular disease, respiratory disease and other causes as a result of nonsmokers' exposure to tobacco smoke (U.S. DHHS, 2006). In addition, *SimSmoke* uses the relatively conservative estimates of the increased risk of premature death resulting from smoking available when the model was developed. More recent evidence suggests that this risk may be considerably higher, with as many as half of regular adult smokers dying prematurely from a disease caused by smoking (e.g., Jha et al., 2008). Further, the savings in medical costs and lost productivity resulting from less smoking are not considered in this analysis, including the high costs associated with maternal and child health (e.g., SIDS, the high and continuing costs associated with low-birthweight babies, and pregnancy-related complications [U.S. DHHS, 2004]). Finally, the *SimSmoke* model does not capture the health gains that result from reduced morbidity and related increases in disability-adjusted life years.

An additional limitation concerns the inputs into the *SimSmoke* simulation model. There are inherent limitations in the data used to estimate smoking prevalence, smoking initiation and smoking cessation that can affect the estimated impact and projections. Similarly, while the assumed effect sizes for the tax and smoke-free air policies reflect the best evidence currently available, these effects may change over time as the composition of tobacco users (including smokeless tobacco) and the mix of tobacco-control policies change.

A final limitation of this analysis is an inability to fully estimate the long-term impact of these policy changes. As demonstrated by the projections presented here, there will be very large and growing reductions in the number of smokers over time as a result of the policies adopted from 1993 through mid-2009, with as many as 12 million fewer smokers—a 25 percent reduction—in 2063. The premature deaths avoided among this population will continue to grow for many years after 2063 so the full, long-term impact of these policy changes is considerably understated.

Conclusions

The past two decades have seen considerable progress in tobacco control. The inflation-adjusted value of state and federal cigarette taxes has more than tripled since 1990. These tax increases, combined with the pass-through of costs from tobacco company litigation settlements, have more than doubled inflation-adjusted cigarette prices. All states have enacted legislation limiting smoking in a variety of public places, with many states and numerous localities banning smoking in some combination of restaurants, bars and private worksites. These changes were fueled by growing evidence on the health consequences of tobacco use and exposure to tobacco smoke and on the effectiveness of tax and smoke-free policies in reducing tobacco use.

Funding to build the evidence base for these and other tobacco-control interventions was provided by a variety of public and private organizations, most notably the Robert Wood Johnson Foundation, National Cancer Institute, the Centers for Disease Control and Prevention, and many state governments. Additional funding from these and other organizations supported the policy and media advocacy efforts (e.g., *SmokeLess States* and ASSIST) that further drove tobacco-control policy change at the national, state and local levels.

Research evidence clearly shows that higher cigarette and other tobacco product taxes and prices and strong smoke-free air policies induce adult users to quit, prevent young people from starting and reduce consumption among continuing users. Given the extensive evidence on its health consequences, these policy-induced declines in tobacco use have significantly reduced the death, disease and economic costs caused by tobacco.

By 2010, we estimate that the price increases resulting from the federal and state tax increases from 1993 through mid-2009, coupled with the MSA price increase of 1998, reduced the number of smokers in the United States by more than 3.7 million, while preventing almost 38,000 premature deaths from smoking. Additionally, we estimate that nearly 1.7 million fewer people smoke in 2010 as a result of the state smoke-free air policies adopted during these years, preventing almost 19,000 more premature deaths caused by smoking by 2010. The impact of these price and policy changes will grow considerably over time. In 2063, we estimate that there will be over 12 million fewer smokers as a result and that more than two million premature deaths that would have been caused by smoking will have been averted, with millions more prevented in subsequent decades.

CONCLUSIONS

These are but a fraction of the public health gains resulting from the tobacco-control efforts of the past two decades. Local tax and smoke-free air policies, other tobacco-control policy changes at all levels of government, greatly expanded access to cessation products and support, extensive mass-media public education campaigns, and more have further strengthened anti-tobacco norms and reduced tobacco use, further improving public health.

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