**Technical Appendix**

**and Additional Results:**

**Retrospective and Prospective**

**Benefit-Cost Analysis of US Anti-Smoking Policies**

February 12, 2015

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**1. Introduction**

This document describes the data sources and equations used in our smoking simulation model, which appears in our paper “Retrospective and Prospective Benefit-Cost Analysis of US Anti-Smoking Policies.” It also provides additional results.

Section 2 provides an overview of the model and defines key variables. Section 3 outlines the equations used to construct the model. Section 4 describes the simulations and data sources.

Table 1 provides a summary of the results of the retrospective simulations. Table 2 compares the model’s simulated smoking prevalence and cigarettes per day to estimates from the National Health Interview Survey. Table 3 provides a summary of the results of the prospective simulations.

Tables 4 – 7 contain additional BCA results. Table 4 presents the constructed demand curves used in the retrospective BCA. Table 5 presents the compensating variation calculations for the retrospective BCA. Table 6 presents the constructed demand curves used in the prospective BCA. Table 7 presents the compensating variation calculations for the prospective BCA.

**2. Model overview and definitions of variables**

The simulation model is an extension of a population dynamics model developed by Mendez, Warner and Courant (1998), which they use to predict US smoking prevalence through 2010 (Warner and Mendez, 2012). Our model uses estimates of birth rates, mortality rates, smoking initiation rates, and cessation rates to simulate the number of adults smoking in the US over time. We make assumptions about smoking initiation and cessation rates to simulate smoking prevalence and cigarette demand in a number of possible scenarios, both in the past and the future.

The baseline year is 1960 for the retrospective simulation model (1960-2010) and 2010 for the prospective simulation (2010-2040). We begin by estimating sex- and age-specific population of never-smokers, smokers, and former-smokers in the baseline year. For each subsequent year, the population evolves: we introduce a birth cohort, some never-smokers initiate smoking at age 18, some smokers quit and become former smokers, and everyone is subject to sex-, age-, and smoking status-specific mortality rates. Figure 1 provides an overview of the simulation model. The boxes correspond to the individuals in different groups, and arrows indicate the flows between groups.

Variables used in the model are defined as follows:

**3. Dynamic relationships**

The dynamic relationships in the simulation model are described by the following equations:

**4. Description of the simulation models**

**4.1. Retrospective: Observed (baseline)**

The retrospective simulation model sets 1960 as a baseline year. We estimate the initial 1960 population by age (0-90), sex, and smoking status (never-smoker; smoker; former-smoker), by combining the US population estimates with smoking prevalence. The US population in 1960 by sex and age are obtained from the US Census Bureau (1965). Population estimates are provided in age groups, so we use a simple average to estimate population for each year of age. Prevalence of smokers and former-smokers are obtained from the National Health Interview Survey (NHIS).

For each subsequent year, the model simulates smoking behavior of individuals, as shown in Figure 1. We introduce a birth cohort using the US Census Bureau’s (2012) estimates of live births in years 1960-2010. We follow Mendez et al. (1998) and assume that everyone aged 0-17 is a never-smoker, and some initiate smoking at age 18. Smoking initiation rates by sex and year are obtained from the Tobacco Use Supplement (TUS-CPS). More specifically, we estimate for each birth cohort the proportion of those who report having smoked 100 cigarettes in their lifetime, and assume that the initiation occurred at age 18.[[1]](#footnote-1) We also allow smokers to quit smoking, and the sex-, age-, and year-specific cessation rates are also obtained from the TUS-CPS. Those who quit become former smokers, and we assume re-initiation does not occur.

Finally, everyone is subject to sex-, age-, and category-specific mortality rates. Mortality rates for people aged 18 or above are obtained from Jha et al. (2013). They use NHIS data between 1997-2004 to estimate the death rates of never-smokers, smokers, and former-smokers by age and sex. For people aged 0-17, we use the general population death rates in 2000 from the US Census Bureau (2005). The year 2000 was chosen in order to make the data roughly comparable with Jha et al. (2013).

We measure observed consumption of cigarettes based on state tax-paid cigarette sales (Orzechowski and Walker 2013, p. 360).

The first set of rows of Table 1 summarize our estimates of the observed number of smokers, smoking prevalence, and cigarette consumption from 1960 - 2010.

Dividing the observed consumption of cigarettes in year t by the simulated number of smokers in year t yields an estimate of the annual number of packs of cigarettes per smoker, which can also be expressed as the number of cigarettes per smoker per day. We use this estimate in subsequent steps below.

Figures 2 and 3 and Table 2 compare the results of our simulation model to estimates from available data on smoking from the National Health Interview Survey (NHIS) for the years 1965, 1966, 1970, 1978-1980, 1987, 1988, 1992, 1997-2013. In those survey years the NHIS included questions about current smoking status and the average number of cigarettes smoked per day for all current smokers.[[2]](#footnote-2) We use the NHIS sample weights to make the make the analysis sample representative of the US adult population.

The model’s simulated smoking prevalence rates compare well to the prevalence rates estimated from the NHIS data, in both levels and trends. Our estimates of the number of cigarettes per smoker per day are usually almost double the corresponding NHIS estimates. This is consistent with other research that smokers under-report their consumption (Warner 1978). Our estimates and the NHIS estimates show the same general pattern: the number of cigarettes per day increases from 1964 through the 1970s and then steadily declines from1995 onwards.

We use the simulated smoking prevalence and cigarettes per day as dependent variables to estimate constant-elasticity demand functions:

Log (prevalence) = – 836.71 – 0.0009 log (Pricet) + 0.86 Year – 0.0002 Year2

(47.47) (0.011) (0.048) (0.00001)

Log (packs per dayt) = – 662.14 – 0.18 log (Pricet) + 0.67 Year – 0.00017 Year2

(155.94) (0.037) (0.158) (0.00004)

Log ( ) denotes the natural logarithm. The numbers in parenthesis are standard errors. The sample size is 47 years (1964 – 2010).

**4.2. Retrospective: “No policy” counterfactual**

In this model, we simulate what cigarette consumption would have been in the absence of the 1964 Surgeon General’s Report and subsequent anti-smoking policies. The smoking initiation and cessation rates remain constant at 1964 levels in years 1965-2010. We assume that the counterfactual number of cigarettes per smoker increases as in Table 2 through 1983, and then remains constant at the 1983 level through 2010.

To control for movements along the observed demand curve due to price changes, we use price-elasticity to adjust for the difference in consumption in year t due to the difference between the price in 1964 and the price in year t. Based on the constant-elasticity demand functions presented above, we use an estimate that the price-elasticity of cigarettes per day is – 0.18.

The second set of rows of Table 1 summarize our estimates of the counterfactual number of smokers, smoking prevalence, and cigarette consumption from 1960 - 2010.

**4.3. Retrospective: Rational consumption**

We use data from the 2010-2011 Tobacco Use Supplement (TUS-CPS) to estimate sex- and age-specific smoking cessation rates in year 2010 among smokers with a college degree or better, and we set this to be the “rational” smoking cessation rates for the years 1960-2010. Smoking initiation rate of a fully informed individual is assumed to be 5%. Let denote the number of rational smokers of sex *s*, age *a*, in year *t*, and let denote the smoking cessation rate of highly-educated smokers of sex *s*, age *a*, in year *t*. We have:

That is, the number of rational smokers in year *t* is based on the number of *observed* smokers in year *t*-1, rather than the number of *rational* smokers in *t*-1. Please refer to the paper for more discussion.

We assume that rational smokers smoke 16 cigarettes per day. This is based on the number of cigarettes smoked per day self-reported by highly educated smokers, after adjusting for underreporting.

The third set of rows of Table 1 summarize our estimates of the rational number of smokers, smoking prevalence, and cigarette consumption from 1960 - 2010.

**4.4. Prospective: Status quo (baseline)**

The prospective simulation model sets 2010 as a baseline year, and projects smoking prevalence and cigarette demand through year 2040. The US population in 2010 by age and sex are obtained from the US Census Bureau’s (2008) population projections. The population projections are chosen in favor of actual population estimates because the former is available by age years, while the latter is available by age groups. Both datasets yield almost identical results. Smoking initiation and cessation rates are assumed to remain constant at 2010 levels for the years 2010-2040.

**4.5. Prospective: Policy counter-factual**

In this model, we simulate an anti-smoking policy that: cuts the 2010 smoking initiation rate in half; increases the 2010 smoking cessation rates by a third; and decreases the 2010 number of cigarettes smoked per day by a third. These effects take place in 2011, and the initiation, cessation and daily smoking rates remain constant through 2040.

**4.6. Prospective: Rational consumption**

We use data from the 2010-2011 TUS-CPS to obtain age- and sex-specific smoking cessation rates in 2010 among smokers who have a college degree or better, and this is set as the “rational” cessation rates for the years 2010-2040. Smoking initiation rate of fully-informed individuals is again assumed to be 5%. Let denote the number of smokers under the policy counter-factual scenario. We have:

The number of rational smokers in year *t* is based on the number smokers in year *t*-1 under the *policy counterfactual scenario*, rather than the number of *rational* smokers in *t*-1. Please refer to the paper for more discussion.

**Figure 1: Simulation diagram**

Deaths

*Data source: Jha et al. (2013)*

Deaths

*Data source: US Census Bureau*

**Births**

*Data source: US Census Bureau*

**Never smokers**

*Age: 0, …, 17*

**Never smokers**

*Age: 18, …, 90*

Initiation at 18

*Data source: TUS-CPS*

**Smokers**

*Age: 18, …, 90*

**Former smokers**

*Age: 19, …, 90*

Quit smoking

*Data source: TUS-CPS*

**Deaths**

*Age: 0, …, 90*

**Figure 2: Comparison of simulation results and NHIS estimates of smoking prevalence, 1964-2010**



**Figure 3: Comparison of simulation results and NHIS estimates of cigarettes per day, 1964-2010**



**Table 1: Retrospective Simulations: Summary Results**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1960** | **1970** | **1980** | **1990** | **2000** | **2010** |
| **Observed** |  |  |  |  |  |  |
| # Smokers | 45,587,812 | 49,487,727 | 52,616,281 | 48,526,168 | 42,478,777 | 35,007,432 |
| Prevalence | 39.43% | 36.24% | 32.47% | 27.03% | 22.22% | 17.04% |
| Cigarette consumption  (packs per year, millions) | 20,457 | 23,894 | 29,184 | 24,994 | 21,405 | 14,697 |
| **“No policy”**  **counter-factual** |  |  |  |  |  |  |
| # Smokers | 45,587,812 | 51,490,614 | 61,586,461 | 67,802,003 | 70,883,400 | 75,473,529 |
| Prevalence | 39.43% | 37.72% | 38.13% | 38.09% | 37.54% | 37.29% |
| Cigarette consumption  (packs per year, millions) | 20,533 | 24,598 | 35,611 | 36,672 | 36,293 | 37,424 |
| **Rational** |  |  |  |  |  |  |
| # Smokers | 45,587,812 | 45,666,091 | 48,712,747 | 45,707,522 | 40,188,493 | 33,512,767 |
| Prevalence | 39.43% | 34.41% | 30.80% | 25.86% | 21.28% | 16.43% |
| Cigarette consumption  (packs per year, millions) | 18,912 | 18,388 | 21,819 | 17,528 | 13,644 | 10,552 |

**Table 2. Simulation results versus NHIS estimated smoking prevalence and cigarettes per day**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Simulated smoking prevalence (%) | NHIS estimated smoking prevalence (%) | Simulated cigarettes per cay | NHIS estimated cigarettes per day |
| 1964 | 38 |  | 27 |  |
| 1965 | 38 | 40 | 27 | 14 |
| 1966 | 38 | 40 | 27 | 14 |
| 1967 | 37 |  | 27 |  |
| 1968 | 37 |  | 27 |  |
| 1969 | 36 |  | 26 |  |
| 1970 | 36 | 37 | 26 | 19 |
| 1971 | 36 |  | 27 |  |
| 1972 | 35 |  | 28 |  |
| 1973 | 35 |  | 29 |  |
| 1974 | 34 | 37 | 30 | 20 |
| 1975 | 34 |  | 30 |  |
| 1976 | 34 | 37 | 30 | 20 |
| 1977 | 33 | 36 | 30 | 20 |
| 1978 | 33 | 35 | 30 |  |
| 1979 | 33 | 35 | 30 |  |
| 1980 | 32 | 34 | 30 |  |
| 1981 | 32 |  | 31 |  |
| 1982 | 31 |  | 31 |  |
| 1983 | 31 | 32 | 31 |  |
| 1984 | 30 |  | 30 |  |
| 1985 | 30 | 30 | 30 | 20 |
| 1986 | 29 |  | 30 |  |
| 1987 | 29 | 29 | 30 |  |
| 1988 | 28 | 28 | 30 |  |
| 1989 | 28 |  | 29 |  |
| 1990 | 27 | 26 | 28 |  |
| 1991 | 26 | 26 | 28 |  |
| 1992 | 26 | 27 | 28 |  |
| 1993 | 25 | 25 | 28 |  |
| 1994 | 25 | 26 | 27 |  |
| 1995 | 24 | 25 | 28 |  |
| 1996 | 24 |  | 28 |  |
| 1997 | 23 | 25 | 29 | 17 |
| 1998 | 23 | 25 | 29 | 17 |
| 1999 | 23 | 24 | 28 | 16 |
| 2000 | 22 | 24 | 28 | 16 |
| 2001 | 22 | 24 | 27 | 16 |
| 2002 | 21 | 23 | 27 | 15 |
| 2003 | 21 | 22 | 26 | 15 |
| 2004 | 20 | 21 | 26 | 15 |
| 2005 | 20 | 21 | 26 | 14 |
| 2006 | 19 | 21 | 26 | 14 |
| 2007 | 19 | 20 | 26 | 14 |
| 2008 | 18 | 21 | 25 | 14 |
| 2009 | 18 | 21 | 25 | 13 |
| 2010 | 17 | 20 | 23 | 13 |

**Table 3: Prospective Simulations: Summary Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2010** | **2020** | **2030** | **2040** |
| **Status quo** |  |  |  |  |
| # Smokers | 46,027,669 | 35,207,258 | 27,814,499 | 23,902,762 |
| Prevalence | 19.72% | 14.05% | 10.60% | 8.84% |
| Cigarette consumption  (packs per year, millions) | 19,323 | 14,781 | 11,677 | 10,035 |
| **Policy counter-factual** |  |  |  |  |
| # Smokers | 46,027,669 | 29,432,118 | 18,793,285 | 13,203,611 |
| Prevalence | 19.72% | 11.74% | 7.15% | 4.87% |
| Cigarette consumption  (packs per year, millions) | 12,882 | 8,237 | 5,260 | 3,695 |
| **Rational consumption** |  |  |  |  |
| # Smokers | 46,027,669 | 28,908,744 | 18,488,080 | 12,887,386 |
| Prevalence | 19.72% | 11.55% | 7.04% | 4.76% |
| Cigarette consumption  (packs per year, millions) | 12,882 | 8,091 | 5,174 | 3,607 |

**Table 4A. Rational demand curves in retrospective BCA**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Rational consumption | Intercept | Slope | Price | Height at counterfactual consumption | Height at observed  consumption |
|  | A\_Rt | A\_t-1 | = Intercept | + Slope | x Pt |  |  |
| 1964 | 17777 | 26208 | -4296 | 1.96 | 0.89 | 0.89 |
| 1965 | 17909 | 26295 | -4296 | 1.95 | 0.67 | 0.67 |
| 1966 | 17956 | 26630 | -4296 | 2.02 | 0.79 | 0.78 |
| 1967 | 18277 | 26832 | -4296 | 1.99 | 0.62 | 0.68 |
| 1968 | 18290 | 26985 | -4296 | 2.02 | 0.72 | 0.79 |
| 1969 | 18746 | 27119 | -4296 | 1.95 | 0.63 | 0.82 |
| 1970 | 18388 | 27346 | -4296 | 2.09 | 0.64 | 0.80 |
| 1971 | 18604 | 27602 | -4296 | 2.09 | 0.41 | 0.64 |
| 1972 | 18775 | 27739 | -4296 | 2.09 | 0.14 | 0.47 |
| 1973 | 19215 | 27718 | -4296 | 1.98 | -0.13 | 0.33 |
| 1974 | 19857 | 27800 | -4296 | 1.85 | -0.59 | 0.13 |
| 1975 | 20002 | 27751 | -4296 | 1.80 | -0.77 | 0.02 |
| 1976 | 20156 | 28042 | -4296 | 1.84 | -0.93 | -0.08 |
| 1977 | 20597 | 28203 | -4296 | 1.77 | -1.16 | -0.11 |
| 1978 | 20400 | 28202 | -4296 | 1.82 | -1.25 | -0.17 |
| 1979 | 21124 | 28453 | -4296 | 1.71 | -1.37 | -0.07 |
| 1980 | 21819 | 28640 | -4296 | 1.59 | -1.62 | -0.13 |
| 1981 | 22470 | 28962 | -4296 | 1.51 | -1.98 | -0.24 |
| 1982 | 22103 | 28869 | -4296 | 1.57 | -2.12 | -0.26 |
| 1983 | 20766 | 28470 | -4296 | 1.79 | -1.86 | -0.18 |
| 1984 | 19947 | 28485 | -4296 | 1.99 | -1.78 | 0.01 |
| 1985 | 19653 | 28168 | -4296 | 1.98 | -1.93 | -0.07 |
| 1986 | 19253 | 28186 | -4296 | 2.08 | -1.92 | 0.03 |
| 1987 | 18971 | 28042 | -4296 | 2.11 | -2.00 | 0.12 |
| 1988 | 18252 | 27929 | -4296 | 2.25 | -2.02 | 0.21 |
| 1989 | 18155 | 27788 | -4296 | 2.24 | -2.12 | 0.38 |
| 1990 | 17528 | 27857 | -4296 | 2.40 | -2.05 | 0.67 |
| 1991 | 17220 | 27764 | -4296 | 2.45 | -2.08 | 0.83 |
| 1992 | 16471 | 28056 | -4296 | 2.70 | -1.93 | 0.99 |
| 1993 | 16110 | 28020 | -4296 | 2.77 | -1.93 | 1.09 |
| 1994 | 16419 | 27121 | -4296 | 2.49 | -2.30 | 0.97 |
| 1995 | 16130 | 26936 | -4296 | 2.52 | -2.37 | 0.86 |
| 1996 | 15958 | 26682 | -4296 | 2.50 | -2.47 | 0.86 |
| 1997 | 15700 | 26521 | -4296 | 2.52 | -2.54 | 0.81 |
| 1998 | 15339 | 26546 | -4296 | 2.61 | -2.54 | 0.88 |
| 1999 | 14797 | 27027 | -4296 | 2.85 | -2.37 | 1.18 |
| 2000 | 13644 | 29562 | -4296 | 3.71 | -1.57 | 1.90 |
| 2001 | 13384 | 29909 | -4296 | 3.85 | -1.50 | 2.14 |
| 2002 | 13040 | 30599 | -4296 | 4.09 | -1.33 | 2.37 |
| 2003 | 12630 | 31579 | -4296 | 4.41 | -1.09 | 2.85 |
| 2004 | 12496 | 30920 | -4296 | 4.29 | -1.31 | 2.79 |
| 2005 | 12333 | 30272 | -4296 | 4.18 | -1.53 | 2.72 |
| 2006 | 12031 | 30098 | -4296 | 4.21 | -1.62 | 2.79 |
| 2007 | 11825 | 29563 | -4296 | 4.13 | -1.82 | 2.77 |
| 2008 | 11477 | 29752 | -4296 | 4.25 | -1.82 | 3.03 |
| 2009 | 11161 | 30164 | -4296 | 4.42 | -1.76 | 3.29 |
| 2010 | 10552 | 33386 | -4296 | 5.32 | -0.94 | 4.35 |

**Table 4B. Counterfactual demand curves in retrospective BCA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Counterfactual consumption | Intercept | Slope | Price |
|  | A\_CFt | = Intercept | + Slope | x Pt |
| 1964 | 22378 | 30809 | -4296 | 1.96 |
| 1965 | 23422 | 31809 | -4296 | 1.95 |
| 1966 | 23222 | 31896 | -4296 | 2.02 |
| 1967 | 24171 | 32725 | -4296 | 1.99 |
| 1968 | 23903 | 32598 | -4296 | 2.02 |
| 1969 | 24427 | 32800 | -4296 | 1.95 |
| 1970 | 24598 | 33556 | -4296 | 2.09 |
| 1971 | 25829 | 34827 | -4296 | 2.09 |
| 1972 | 27136 | 36101 | -4296 | 2.09 |
| 1973 | 28289 | 36792 | -4296 | 1.98 |
| 1974 | 30323 | 38265 | -4296 | 1.85 |
| 1975 | 31040 | 38789 | -4296 | 1.80 |
| 1976 | 32051 | 39938 | -4296 | 1.84 |
| 1977 | 33169 | 40774 | -4296 | 1.77 |
| 1978 | 33585 | 41387 | -4296 | 1.82 |
| 1979 | 34335 | 41664 | -4296 | 1.71 |
| 1980 | 35611 | 42432 | -4296 | 1.59 |
| 1981 | 37461 | 43954 | -4296 | 1.51 |
| 1982 | 37961 | 44727 | -4296 | 1.57 |
| 1983 | 36469 | 44172 | -4296 | 1.79 |
| 1984 | 36124 | 44662 | -4296 | 1.99 |
| 1985 | 36454 | 44969 | -4296 | 1.98 |
| 1986 | 36444 | 45376 | -4296 | 2.08 |
| 1987 | 36648 | 45719 | -4296 | 2.11 |
| 1988 | 36593 | 46270 | -4296 | 2.25 |
| 1989 | 36894 | 46527 | -4296 | 2.24 |
| 1990 | 36672 | 47001 | -4296 | 2.40 |
| 1991 | 36697 | 47242 | -4296 | 2.45 |
| 1992 | 36338 | 47923 | -4296 | 2.70 |
| 1993 | 36327 | 48236 | -4296 | 2.77 |
| 1994 | 37004 | 47706 | -4296 | 2.49 |
| 1995 | 37106 | 47912 | -4296 | 2.52 |
| 1996 | 37300 | 48024 | -4296 | 2.50 |
| 1997 | 37432 | 48254 | -4296 | 2.52 |
| 1998 | 37456 | 48663 | -4296 | 2.61 |
| 1999 | 37218 | 49448 | -4296 | 2.85 |
| 2000 | 36293 | 52211 | -4296 | 3.71 |
| 2001 | 36344 | 52869 | -4296 | 3.85 |
| 2002 | 36313 | 53872 | -4296 | 4.09 |
| 2003 | 36262 | 55212 | -4296 | 4.41 |
| 2004 | 36557 | 54981 | -4296 | 4.29 |
| 2005 | 36863 | 54803 | -4296 | 4.18 |
| 2006 | 37074 | 55140 | -4296 | 4.21 |
| 2007 | 37403 | 55141 | -4296 | 4.13 |
| 2008 | 37592 | 55866 | -4296 | 4.25 |
| 2009 | 37733 | 56736 | -4296 | 4.42 |
| 2010 | 37424 | 60258 | -4296 | 5.32 |

T**able 4C. Observed demand curves in retrospective BCA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Observed consumption (A\_Ot) | Intercept | Slope | Price |
|  | A\_Ot | = Intercept | + Slope | x Pt |
| 1964 | 22378 | 30809 | -4296 | 1.96 |
| 1965 | 23400 | 31787 | -4296 | 1.95 |
| 1966 | 23268 | 31942 | -4296 | 2.02 |
| 1967 | 23910 | 32464 | -4296 | 1.99 |
| 1968 | 23588 | 32283 | -4296 | 2.02 |
| 1969 | 23592 | 31964 | -4296 | 1.95 |
| 1970 | 23894 | 32852 | -4296 | 2.09 |
| 1971 | 24842 | 33840 | -4296 | 2.09 |
| 1972 | 25716 | 34681 | -4296 | 2.09 |
| 1973 | 26303 | 34806 | -4296 | 1.98 |
| 1974 | 27260 | 35203 | -4296 | 1.85 |
| 1975 | 27665 | 35414 | -4296 | 1.80 |
| 1976 | 28378 | 36264 | -4296 | 1.84 |
| 1977 | 28669 | 36275 | -4296 | 1.77 |
| 1978 | 28943 | 36745 | -4296 | 1.82 |
| 1979 | 28775 | 36104 | -4296 | 1.71 |
| 1980 | 29184 | 36006 | -4296 | 1.59 |
| 1981 | 29980 | 36473 | -4296 | 1.51 |
| 1982 | 29978 | 36744 | -4296 | 1.57 |
| 1983 | 29243 | 36947 | -4296 | 1.79 |
| 1984 | 28462 | 37000 | -4296 | 1.99 |
| 1985 | 28464 | 36979 | -4296 | 1.98 |
| 1986 | 28044 | 36976 | -4296 | 2.08 |
| 1987 | 27547 | 36618 | -4296 | 2.11 |
| 1988 | 27027 | 36704 | -4296 | 2.25 |
| 1989 | 26166 | 35798 | -4296 | 2.24 |
| 1990 | 24994 | 35323 | -4296 | 2.40 |
| 1991 | 24201 | 34745 | -4296 | 2.45 |
| 1992 | 23783 | 35368 | -4296 | 2.70 |
| 1993 | 23345 | 35255 | -4296 | 2.77 |
| 1994 | 22954 | 33655 | -4296 | 2.49 |
| 1995 | 23245 | 34052 | -4296 | 2.52 |
| 1996 | 22973 | 33696 | -4296 | 2.50 |
| 1997 | 23046 | 33867 | -4296 | 2.52 |
| 1998 | 22756 | 33963 | -4296 | 2.61 |
| 1999 | 21973 | 34203 | -4296 | 2.85 |
| 2000 | 21405 | 37323 | -4296 | 3.71 |
| 2001 | 20727 | 37252 | -4296 | 3.85 |
| 2002 | 20435 | 37994 | -4296 | 4.09 |
| 2003 | 19336 | 38286 | -4296 | 4.41 |
| 2004 | 18922 | 37346 | -4296 | 4.29 |
| 2005 | 18590 | 36530 | -4296 | 4.18 |
| 2006 | 18101 | 36168 | -4296 | 4.21 |
| 2007 | 17647 | 35385 | -4296 | 4.13 |
| 2008 | 16737 | 35011 | -4296 | 4.25 |
| 2009 | 16020 | 35024 | -4296 | 4.42 |
| 2010 | 14697 | 37531 | -4296 | 5.32 |

**Table 5. Retrospective BCA: Compensating Variation Calculations**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | Marginal Internality at counter-factual consumption (ACFt) | Marginal Internality at observed consumption (AOt) | Consumption difference  (counter-factual -observed)  ACFt - AOt | Compensating Variation  (1964-present value  at a 3% discount rate) | Compensating Variation  (1964-present value  at a 7% discount rate) |
| 1964 | 1.07 | 1.07 | 0 | 0 | 0 |
| 1965 | 1.28 | 1.28 | 22 | 28 | 27 |
| 1966 | 1.23 | 1.24 | -46 | -53 | -49 |
| 1967 | 1.37 | 1.31 | 261 | 320 | 286 |
| 1968 | 1.31 | 1.23 | 315 | 355 | 305 |
| 1969 | 1.32 | 1.13 | 836 | 883 | 730 |
| 1970 | 1.45 | 1.28 | 704 | 804 | 640 |
| 1971 | 1.68 | 1.45 | 987 | 1257 | 963 |
| 1972 | 1.95 | 1.62 | 1420 | 1996 | 1471 |
| 1973 | 2.11 | 1.65 | 1986 | 2863 | 2032 |
| 1974 | 2.44 | 1.72 | 3063 | 4739 | 3238 |
| 1975 | 2.57 | 1.78 | 3375 | 5307 | 3490 |
| 1976 | 2.77 | 1.91 | 3673 | 6032 | 3819 |
| 1977 | 2.93 | 1.88 | 4499 | 7361 | 4486 |
| 1978 | 3.07 | 1.99 | 4642 | 7760 | 4552 |
| 1979 | 3.07 | 1.78 | 5559 | 8664 | 4892 |
| 1980 | 3.21 | 1.71 | 6427 | 9861 | 5360 |
| 1981 | 3.49 | 1.75 | 7481 | 11853 | 6202 |
| 1982 | 3.69 | 1.83 | 7983 | 12951 | 6523 |
| 1983 | 3.65 | 1.97 | 7225 | 11595 | 5622 |
| 1984 | 3.77 | 1.98 | 7662 | 12191 | 5690 |
| 1985 | 3.91 | 2.05 | 7990 | 12802 | 5752 |
| 1986 | 4.00 | 2.05 | 8400 | 13256 | 5733 |
| 1987 | 4.11 | 2.00 | 9100 | 14088 | 5865 |
| 1988 | 4.27 | 2.04 | 9566 | 14852 | 5952 |
| 1989 | 4.36 | 1.86 | 10728 | 15952 | 6154 |
| 1990 | 4.46 | 1.74 | 11678 | 16770 | 6228 |
| 1991 | 4.53 | 1.62 | 12496 | 17323 | 6193 |
| 1992 | 4.62 | 1.70 | 12555 | 17358 | 5973 |
| 1993 | 4.71 | 1.68 | 12981 | 17599 | 5830 |
| 1994 | 4.79 | 1.52 | 14051 | 18271 | 5826 |
| 1995 | 4.88 | 1.66 | 13861 | 18126 | 5564 |
| 1996 | 4.97 | 1.63 | 14327 | 18362 | 5425 |
| 1997 | 5.06 | 1.71 | 14387 | 18357 | 5221 |
| 1998 | 5.15 | 1.73 | 14700 | 18495 | 5064 |
| 1999 | 5.22 | 1.67 | 15245 | 18662 | 4919 |
| 2000 | 5.27 | 1.81 | 14888 | 18181 | 4613 |
| 2001 | 5.34 | 1.71 | 15617 | 18450 | 4506 |
| 2002 | 5.42 | 1.72 | 15878 | 18432 | 4333 |
| 2003 | 5.50 | 1.56 | 16926 | 18871 | 4271 |
| 2004 | 5.60 | 1.50 | 17635 | 19182 | 4179 |
| 2005 | 5.71 | 1.46 | 18273 | 19487 | 4086 |
| 2006 | 5.83 | 1.41 | 18973 | 19851 | 4007 |
| 2007 | 5.95 | 1.36 | 19756 | 20253 | 3935 |
| 2008 | 6.08 | 1.22 | 20855 | 20741 | 3880 |
| 2009 | 6.19 | 1.13 | 21712 | 21004 | 3782 |
| 2010 | 6.25 | 0.96 | 22727 | 21063 | 3651 |
|  |  |  |  | Total: 572,558 | Total: 191,218 |

**Table 6A. Policy scenario demand curves in prospective BCA**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | Policy consumption | Intercept | Slope | Price | Height at status quo consumption |
| 2010 | 12882 | 35716 | -4296 | 5.32 | 3.82 |
| 2011 | 12548 | 35382 | -4296 | 5.32 | 3.85 |
| 2012 | 11986 | 34820 | -4296 | 5.32 | 3.84 |
| 2013 | 11444 | 34278 | -4296 | 5.32 | 3.83 |
| 2014 | 10922 | 33756 | -4296 | 5.32 | 3.81 |
| 2015 | 10421 | 33255 | -4296 | 5.32 | 3.81 |
| 2016 | 9943 | 32777 | -4296 | 5.32 | 3.80 |
| 2017 | 9483 | 32317 | -4296 | 5.32 | 3.80 |
| 2018 | 9045 | 31879 | -4296 | 5.32 | 3.80 |
| 2019 | 8632 | 31466 | -4296 | 5.32 | 3.79 |
| 2020 | 8237 | 31071 | -4296 | 5.32 | 3.79 |
| 2021 | 7859 | 30693 | -4296 | 5.32 | 3.79 |
| 2022 | 7504 | 30338 | -4296 | 5.32 | 3.79 |
| 2023 | 7165 | 29999 | -4296 | 5.32 | 3.80 |
| 2024 | 6846 | 29680 | -4296 | 5.32 | 3.80 |
| 2025 | 6542 | 29376 | -4296 | 5.32 | 3.80 |
| 2026 | 6254 | 29088 | -4296 | 5.32 | 3.81 |
| 2027 | 5982 | 28817 | -4296 | 5.32 | 3.81 |
| 2028 | 5727 | 28561 | -4296 | 5.32 | 3.81 |
| 2029 | 5485 | 28319 | -4296 | 5.32 | 3.82 |
| 2030 | 5260 | 28094 | -4296 | 5.32 | 3.82 |
| 2031 | 5049 | 27883 | -4296 | 5.32 | 3.82 |
| 2032 | 4852 | 27686 | -4296 | 5.32 | 3.83 |
| 2033 | 4669 | 27503 | -4296 | 5.32 | 3.83 |
| 2034 | 4497 | 27331 | -4296 | 5.32 | 3.83 |
| 2035 | 4338 | 27172 | -4296 | 5.32 | 3.83 |
| 2036 | 4191 | 27025 | -4296 | 5.32 | 3.84 |
| 2037 | 4052 | 26886 | -4296 | 5.32 | 3.84 |
| 2038 | 3925 | 26759 | -4296 | 5.32 | 3.84 |
| 2039 | 3806 | 26640 | -4296 | 5.32 | 3.84 |
| 2040 | 3695 | 26529 | -4296 | 5.32 | 3.84 |

**Table 6B. Status quo scenario demand curves in prospective BCA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Status quo consumption | Intercept | Slope | Price |
| 2010 | 19323 | 42157 | -4296 | 5.32 |
| 2011 | 18822 | 41656 | -4296 | 5.32 |
| 2012 | 18328 | 41162 | -4296 | 5.32 |
| 2013 | 17843 | 40677 | -4296 | 5.32 |
| 2014 | 17367 | 40201 | -4296 | 5.32 |
| 2015 | 16898 | 39732 | -4296 | 5.32 |
| 2016 | 16444 | 39278 | -4296 | 5.32 |
| 2017 | 16001 | 38835 | -4296 | 5.32 |
| 2018 | 15572 | 38406 | -4296 | 5.32 |
| 2019 | 15172 | 38006 | -4296 | 5.32 |
| 2020 | 14781 | 37615 | -4296 | 5.32 |
| 2021 | 14398 | 37232 | -4296 | 5.32 |
| 2022 | 14038 | 36873 | -4296 | 5.32 |
| 2023 | 13692 | 36526 | -4296 | 5.32 |
| 2024 | 13362 | 36196 | -4296 | 5.32 |
| 2025 | 13044 | 35878 | -4296 | 5.32 |
| 2026 | 12740 | 35574 | -4296 | 5.32 |
| 2027 | 12452 | 35286 | -4296 | 5.32 |
| 2028 | 12180 | 35014 | -4296 | 5.32 |
| 2029 | 11919 | 34753 | -4296 | 5.32 |
| 2030 | 11677 | 34511 | -4296 | 5.32 |
| 2031 | 11452 | 34286 | -4296 | 5.32 |
| 2032 | 11242 | 34076 | -4296 | 5.32 |
| 2033 | 11047 | 33881 | -4296 | 5.32 |
| 2034 | 10865 | 33699 | -4296 | 5.32 |
| 2035 | 10698 | 33532 | -4296 | 5.32 |
| 2036 | 10545 | 33379 | -4296 | 5.32 |
| 2037 | 10401 | 33235 | -4296 | 5.32 |
| 2038 | 10270 | 33104 | -4296 | 5.32 |
| 2039 | 10147 | 32981 | -4296 | 5.32 |
| 2040 | 10035 | 32869 | -4296 | 5.32 |

**Table 7. Prospective BCA: Compensating Variation Calculations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Marginal internality  At status quo consumption | Consumption difference  (status quo - policy) | Compensating variation  (2010 value at a 3% discount rate) | Compensating variation  (2010 value at a 7% discount rate) |
| 2010 | 1.50 | 6441 | 4828 | 4828 |
| 2011 | 1.46 | 6274 | 4448 | 4282 |
| 2012 | 1.48 | 6342 | 4413 | 4089 |
| 2013 | 1.49 | 6399 | 4361 | 3890 |
| 2014 | 1.50 | 6444 | 4295 | 3687 |
| 2015 | 1.51 | 6477 | 4212 | 3482 |
| 2016 | 1.51 | 6502 | 4120 | 3278 |
| 2017 | 1.52 | 6518 | 4020 | 3079 |
| 2018 | 1.52 | 6528 | 3915 | 2886 |
| 2019 | 1.52 | 6539 | 3814 | 2707 |
| 2020 | 1.52 | 6543 | 3708 | 2533 |
| 2021 | 1.52 | 6539 | 3595 | 2364 |
| 2022 | 1.52 | 6535 | 3486 | 2207 |
| 2023 | 1.52 | 6526 | 3376 | 2057 |
| 2024 | 1.52 | 6517 | 3267 | 1917 |
| 2025 | 1.51 | 6503 | 3159 | 1784 |
| 2026 | 1.51 | 6486 | 3051 | 1659 |
| 2027 | 1.51 | 6470 | 2947 | 1542 |
| 2028 | 1.50 | 6452 | 2846 | 1434 |
| 2029 | 1.50 | 6434 | 2747 | 1332 |
| 2030 | 1.49 | 6417 | 2654 | 1239 |
| 2031 | 1.49 | 6402 | 2565 | 1152 |
| 2032 | 1.49 | 6390 | 2480 | 1073 |
| 2033 | 1.48 | 6378 | 2399 | 999 |
| 2034 | 1.48 | 6368 | 2322 | 931 |
| 2035 | 1.48 | 6360 | 2248 | 867 |
| 2036 | 1.48 | 6354 | 2179 | 809 |
| 2037 | 1.48 | 6348 | 2112 | 755 |
| 2038 | 1.48 | 6345 | 2048 | 705 |
| 2039 | 1.48 | 6341 | 1986 | 658 |
| 2040 | 1.48 | 6339 | 1927 | 614 |
|  |  |  | Total: 99527 | Total: 64837 |

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1. For example, 46.5% of females born in 1960 report having smoked at least 100 cigarettes in their lifetime, so the female smoking initiation rate is 46.5% in 1978. [↑](#footnote-ref-1)
2. The data for 1965, 1966, 1987, 1988, and 1991 are from the National Center for Health Statistics (NCHS) website at <http://www.cdc.gov/nchs/nhis/nhis_questionnaires.htm>. The data for the rest of the years are from the Integrated Health Interview Series (IHIS) (Minnesota Population Center and State Health Access Data Assistance Center 2012). The IHIS variables are consistently coded to facilitate comparisons over time. We use the IHIS definition to code smoking status from the NHIS waves we use from the NCHS. The IHIS documentation notes that “apart from changes in the universe, changes in the classification of smoking status reduce comparability between 1991 and 1992 forward. In addition, proxy reporting in 1970 reduces comparability with all later years.” [↑](#footnote-ref-2)