Developing a *SimSmoke* Model
for Your State/Nation

User's Manual

MPOWER EU Models

Pacific Institute for Research and Evaluation

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Contents

Section One. Introducing the Model

Smoking is the single most preventable cause of premature mortality, increasing the risk of lung cancer, emphysema, heart disease, stroke and other diseases. Substantial evidence indicates that tobacco control policies can considerably reduce smoking rates through reduced initiation and increased cessation, but the magnitude and time pattern of effects on different smokers of the difference policies varies. In a population, the health benefits from tobacco control build over time, and tobacco control will reduce deaths caused by smoking. While some of the harms from smoking are relatively immediate (e.g., low birth weight babies), most measurable health effects are delayed until later years.

The *SimSmoke* tobacco control model, developed by researchers at the Pacific Institute for Research and Evaluation (PIRE), is a dynamic computer simulation model that projects smoking rates and total deaths attributable to smoking over time, and considers the effects of tobacco control policies (individually and in combination) on those outcomes. Specifically, the model is used to project trends in smoking prevalence by age and gender over time, and estimate the number of smoking attributable deaths (in total and by cause: lung cancer, heart disease, stroke and chronic obstructive pulmonary disease). The model then estimates how much smoking rates may be changed by the introduction of cigarette taxes, smoke-free air laws, media/education campaigns, advertising bans, health warnings, cessation treatment policies, and youth access enforcement. In combining data from different sources into a basic framework, the model also helps to identify gaps in our knowledge about the links between tobacco control policies, smoking rates and smoking-attributable deaths and the data needed to make better policy planning decisions.

Versions of *SimSmoke* have already been created for many states and countries, and a series of articles have been written about the model.[1-20] This manual discusses the data needed for nation level models, how to input that data, and how to use the model. Users of this model are expected to have different needs and interests in the levels of detail the model offers. The technical appendices to this manual provide greater detail regarding the software platform (technical details), available data sources for building state models, calculations of the model, and publications related to the model. The basic manual provides the guidance you need to collect and enter the basic data necessary to create your state/nation model and to use the output of your completed model for your policy and planning purposes. The manual may also help Users appreciate the potency and the different patterns of effects of the different tobacco control policies.

For those building a model, many decisions need to be made regarding the type and quality of data, parameters and adjustments to the model. Those who build the model from scratch should be willing to commit the necessary time. For that reason, the model is often developed by PIRE staff in cooperation with staff in the nation or state. In those cases, the user can go directly to section V on using the model after reading sections I and II introducing the model. However, sections II and III can be referenced to understand terms and concepts used in the model.

The descriptions of the model described in this manual apply to our basic model. That model can be modified to take into account specific characteristics of your state/nation, such as different policy parameters or specific needs. For example, the model may be tailored to consider health

outcomes besides deaths attributable to smoking, such as low birth weight babies. Users may also want to consider specific characteristics, such as distinctions by urban/rural or other geographic residence, income or racial/ethnic subgroups, etc. Advanced options for the development of your state/nation model will generally require guidance from PIRE researchers.

If Users are interested for the sake of comparison, models have been developed for the United States, for several states within the United States, and for over 30 nations. PIRE can present these models to Users for illustration.

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I. BACKGROUND CONCEPTS

SimSmoke has been designed to be used by novices of simulation modeling. Beginning with III. Getting Started: Creating a New Model, Users should be able to move through the steps of constructing a *SimSmoke* model with relative ease; the most difficult tasks will likely be collecting the necessary data. Despite the simplified design, however, the technical and conceptual functions of the model are likely new for some Users. The technical workings of *SimSmoke* are detailed in Appendix B. In this chapter, we present some background concepts that the User should review before initiating a model. Becoming familiar with the possible conceptual approaches to the *SimSmoke* model and with the definition of some terms will facilitate both using this Manual and getting started on a new model.

SimSmoke Structure

SimSmoke relies on three central components to create the expected projections. These components are the population module, the smoking module, and the policies modules (Figure 1).

The population module is the part of the *SimSmoke* model that allows population size to evolve over time. The population module starts in the base year with the population for each age group, distinguished by gender. Each year, births occur according to the selected fertility rates and a certain portion of each age group (by gender) dies according to mortality (or death) rates.

Figure 1. Structure of *SimSmoke* Model
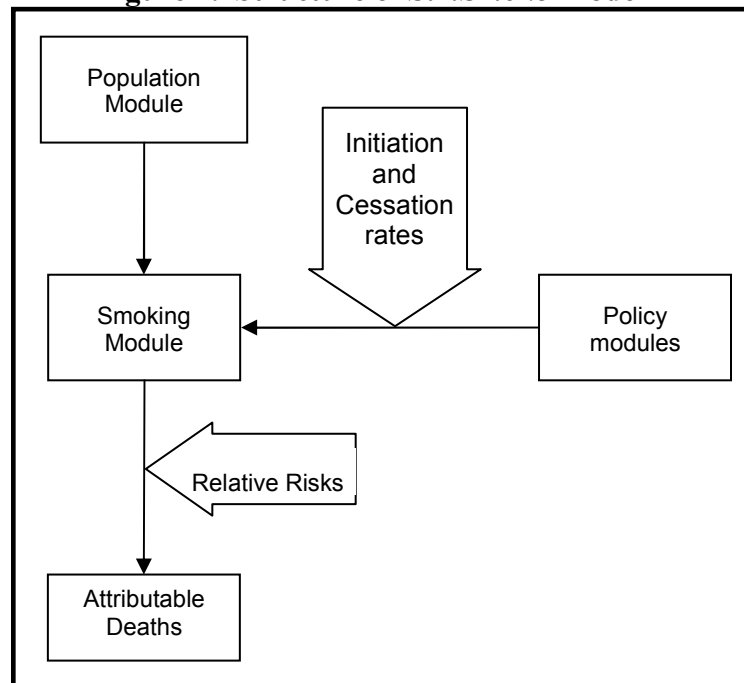
The smoking module divides the population in the base year into smokers, ex-smokers, and never smokers. Each year, individuals may evolve from never smokers to smokers through

smoking initiation. All individuals are classified as never smokers from birth until a certain portion initiates smoking or dies. Once a smoker, individuals may evolve to former smoker status through cessation and may return to smoking through relapse.

The policy modules affect initiation and cessation rates in the smoking module. Policies currently programmed in the *SimSmoke* model are excise taxes, smoke-free air laws, mass media campaigns, advertising bans, health warning requirements, youth access laws, and cessation treatment coverage. Different policies have different effect sizes (see Appendix C) which may more directly target initiation, cessation or both. The effects for some policies also vary by age and gender.

The number of deaths attributable to smoking are determined by smoking rates (from the smoking module), death rates (from the population module), and relative risks of deaths attributable to smoking. Smoking-attributable deaths in the *SimSmoke* model are predicted using standard attribution measures based on smoking prevalence rates and the total mortality risks of smokers and ex-smokers relative to non-smokers.

Choice of *SimSmoke* Model to Construct

As shown inFigure 2, *SimSmoke* can be constructed as a **Policy Tracking Model** or as a **Basic Model**. The choice is conceptual. There is no place in the *SimSmoke* model for the User to press a button to select the Policy Tracking Model or the Basic Model. Users will use the same *SimSmoke* software platform for either type of model, but making this choice at the outset will guide selection of options and data entry as the User develops the model. For each type of model, *SimSmoke* projects smoking rates and deaths attributable to smoking over a 30 to 40-year period (can be adapted to your model).

Figure 2. *SimSmoke* Modeling Options
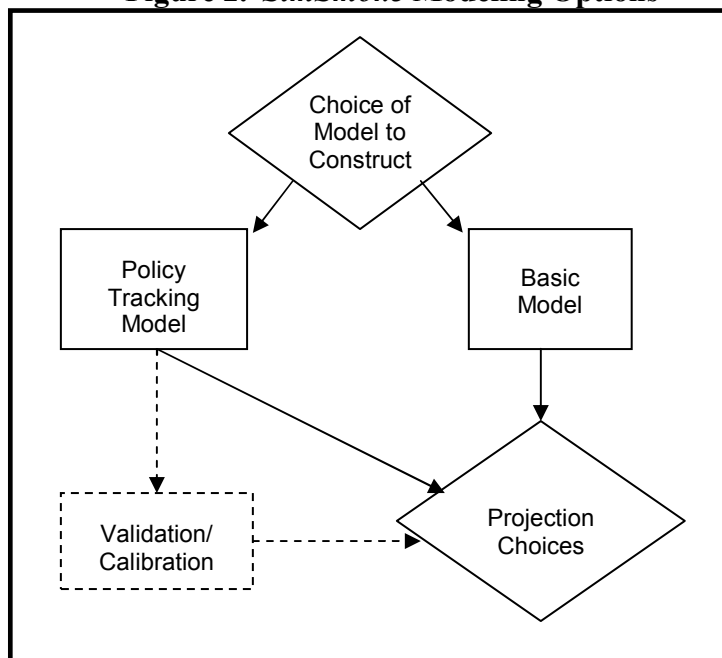
The **tracking period** refers to historical data (including population, smoking, and tobacco control policy data) and the **projection period** represents future years over which *SimSmoke* projects smoking and health outcome trends, taking tobacco control policies into account. The selection of a Basic Model or a Policy Tracking Model is implied by the length of the tracking period. Simply put, a tracking period of one year is a Basic (non-tracking) Model, while a tracking period of more than one year implies a Policy Tracking Model.

The User's choice between a Policy Tracking Model and a Basic Model is determined by data availability (e.g., lack of data from prior years may prevent the User from tracking over earlier years) and the User's needs and goals (e.g., the User may be limited by time or other resources). The Basic Model requires less data and is less complex, but the two models are closely related. A Policy Tracking Model includes a projection period, and a Basic Model updated over time can develop a policy tracking period. Particularly in the policy modeling sections of this Manual (Choice of SimSmoke Model to Construct, Policy Module), there are references to the two different types of models, and instructions may vary according to the User's choice of model.

Policy Tracking Model

The Policy Tracking Model requires more data but enables the User to show how smoking rates and death rates have changed as a result of changes in policies over the tracking period. The User begins the model at some past year, and then predicts forward from that year. The User is advised, if possible, to select a year before major policy changes were implemented, so that smoking and mortality changes resulting from new policies can be distinguished from long-term trends. That year becomes the **base year** for the model. The User enters the base year population data, smoking rates, and tobacco control policy data.

The Policy Tracking Model projects population, smoking prevalence, and smoking-attributable deaths for up to 50 years from the selected (historical) base year. Over the policy tracking period (from base year to current year), the role of different policies can be examined one at a time to measure individual impact. Looking forward into a projection period, the effects of selected tobacco control policies, implemented at different levels and different points in time, can also be examined.

This method also enables the User to use the tracking period to calibrate and validate the model. **Calibration** is a technique whereby values of key inputs (e.g., fertility rates, smoking initiation or cessation rates) or policy parameters are adjusted over a specified time period to more accurately fit trends in outcomes predicted from the model to those observed in from an outside source, e.g., reliable data sources or studies. **Validation** tests the *SimSmoke* model specification (i.e. the selected data and parameters) over a specific time period to determine how well outcomes of the chosen model specification fits trends observed in other data sources. Should the User decide to validate and calibrate a Policy Tracking Model, VIII. Calibration and Validation provides more detailed guidance.

The longer the policy tracking period (i.e., the longer the duration between the base year selected for the model and the current or recent year from which *SimSmoke* begins its projections), the greater the potential to validate and calibrate the model, creating a stronger foundation for the *SimSmoke* projections. Entering policy data that is as complete and accurate as possible during the tracking period strengthens subsequent *SimSmoke* projections. However, there are many

possible reasons why even strong policy data during the tracking period is not sufficient to accurately project actual smoking rates. For example, there may be problems with the smoking rate measures (especially the initiation and cessation measures); there may be policies not taken into account in the model; or the policy measures or effect sizes used in the model may not be appropriate, e.g., due to some special circumstances in the state/nation. Although empirical data may be missing, it is possible to adjust for gaps and inadequacies in a projection model, such as *SimSmoke,* through an iterative process of validation and calibration.[8]

Basic Model

This method *starts with data from the most recent year that data are available* for all the relevant measures and does not attempt to track policies that have been implemented since that year. The start year is the **base year** from which the User projects forward. The User enters the base year population data, smoking rates, and tobacco control policy data.

The Basic Model projects population, smoking prevalence, and smoking-attributable deaths for up to 50 years from a recent base year. The effects of selected tobacco control policies, implemented at different levels and different points in time, can be examined.

Projections will have a stronger foundation if the Basic Model is built on a Policy Tracking Model that has been validated (i.e., shown to predict well over the tracking period). In other words, while developing a Policy Tracking Model is not a necessary precursor to developing a Basic Model, it provides a stronger basis for model predictions. However, the User may begin with a Basic Model and, over time, substitute data on actual policy values as new policies are implemented. In this way, the User may develop and validate a Policy Tracking Model.

Projection Choices

Output from Policy Tracking or Basic Models can track trends in the absence of future policy changes. This output relies on the policy levels in the year prior to projection (the last year of the tracking period in the Tracking Model and the base year in the Basic Model) and assumes that these levels are constant over the projection period (i.e., that the User has not made changes to policy levels during the projection period). This set of projections is known as the **status quo policy scenario**.

The User may also develop a **modified policy scenario**, in which a policy or policies are changed from those in the first projection year. This is the second decision point — the modeling choices — illustrated in Figure 1. *SimSmoke* allows for different modeling approaches, including both simple and more advanced assumptions about future policies, and choices about the population characteristics selected for projection. These modeling approaches are described in more detail in "Section Three. Using the Model".

In either a Policy Tracking or a Basic Model, if the User chooses to develop a modified policy scenario, *SimSmoke* produces two sets of smoking and mortality projections. By comparing output under modified policy scenarios to the projections under the status quo scenario, the User can measure the degree of change in smoking and mortality projections resulting from the change in policies.

How *SimSmoke* Can Be Useful

Policy models such as *SimSmoke* may serve advocacy, strategic planning, or monitoring purposes as illustrated in Figure 3.[8,9] Because simulation models are simplistic versions of the real world, exact mimicry of real world trends cannot be expected. Unfortunately, ongoing surveys may not be available or may not collect all the data that would be desirable. *SimSmoke* projections — both smoking behavior and health outcomes — provide valuable information that can be used for planning public health interventions as well as public policy.

Figure 3. Possible Uses of the *SimSmoke* Model
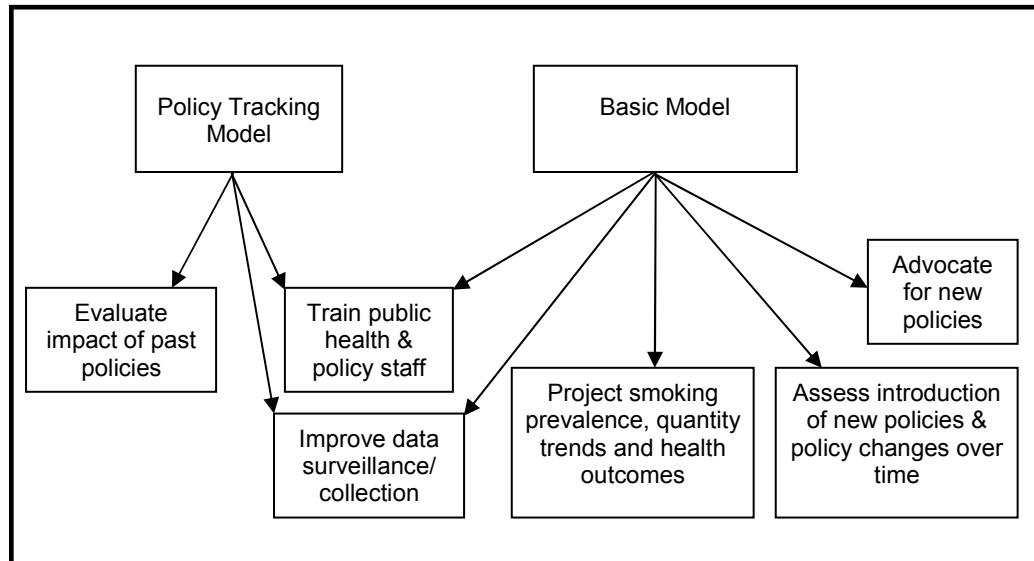
SimSmoke simulates the effects of tobacco-control policies on smoking rates, quantity consumed, and smoking-related mortality. Specifically, *SimSmoke* may be used to:

- Assess the magnitude of current and future smoking rates and tobacco-attributable deaths under present policies;

- Determine the effects of a new policy intervention on smoking rates and deaths;

- Compare the effect of different policy interventions;

- Distinguish the effects of policies by age, gender, and racial/ethnic group; and

- Evaluate and enhance the collection of smoking-related surveillance data.

SimSmoke can be used to show the likely trends in smoking rates in the absence of policies, and the deaths attributable to smoking in the absence of policy. The model also shows how specific policies or groups of policies may alter smoking rates, and also smoking attributable deaths. By comparing the predicted number of deaths in the absence of a policy (already implemented or proposed) to the predicted number of deaths with the policy in place, *SimSmoke* estimates the number of lives saved from implementing more stringent policies. Tobacco-control activities can thereby be better justified. Using the policy tracking model, the user can show the effect of past policies, or the lack thereof (e.g., due to implementing weak or no policies). Thus, policy

analyses can inform advocacy efforts to stimulate new tobacco control policy legislation that is projected to have the most impact in the selected population.

New tobacco control policy legislation requires strategic planning, and *SimSmoke* can play an important role in planning tobacco control policies. The model can be used to assess the effect of past policies (as described in Choice of *SimSmoke* Model to Construct regarding the Policy Tracking Model). Policy analyses can also enable the assessment of new tobacco control policies, prior to implementation and over time. *SimSmoke* predicts the effect of well-defined policies on prevalence rates and related problems before an actual expenditure of funds is required to implement policies. The model not only shows the effects of specific policies, but also how the effect of the different policies depends on how they are implemented, the synergistic effect of a combination of policies, and how policies affect some population more than others. The model also shows smoking rates and deaths for subpopulations (by age and gender), thereby identifying target groups that need special attention. Effective policies require effective implementation tailored for a specific environment, and *SimSmoke* estimates can advance strategic policy planning toward that goal.

SimSmoke has also been used to educate policymakers and prevention specialists because it translates empirical information into a user-friendly format that prevention specialists and policymakers can easily interpret. They, in turn, can incorporate the results into their decision-making. Developing a *SimSmoke* model in and of itself can be a learning experience in terms of understanding how different dynamic processes (population change, smoking rates, health risks) are part of an integrated system that results in the projected smoking and health outcomes.

SimSmoke not only provides a system-wide approach to understanding policy issues, but has also been used to encourage better surveillance and evaluation of policies.[8] Users of the model are challenged to seek the necessary data to develop the model. *SimSmoke* uses existing surveillance data from a nation, state or community to show progress towards health objectives and provides guidance in improving current surveillance and evaluation systems. In the process of identifying and evaluating appropriate data sources, Users may become aware of data limitations in their state/nation. (PIRE researchers can generally provide enough data to develop a *SimSmoke* model in a state/nation with weak smoking and policy surveillance data.) Where data on specific populations or particular smoking rates (e.g., youth rates) are not of sufficient quality, *SimSmoke* results may indicate how surveillance can be improved by collecting more detailed (and reliable) information on smoking rate measures (e.g., by socio-demographic group) and on the extent of policies implemented. The model results may indicate how evaluation can be improved through better choice of the outcomes to be considered (e.g., the specific populations likely to be affected and time pattern of effects) and whether the results of evaluations are plausible in light of past studies.

As new surveillance data and evaluation results are obtained, that information may be used to improve the predictability of the *SimSmoke* model. Users are urged to view the model building as an iterative process, whereby as new data are collected the model can be (re-)calibrated and validated and thereby improved as a policy planning tool.

II. OVERVIEW: NAVIGATING THE MODEL AND USING THIS MANUAL

The *SimSmoke* model has been developed in a manner that enables Users to input data for their particular nation, state or locality (referred to hereafter as the State) that result in a *SimSmoke* projection of smoking prevalence, measures of quantity smoked, and related mortality.

SimSmoke is programmed in Microsoft Excel software. Like other Excel workbooks, this model functions through a series of worksheets (over 75 different tabs). Because navigating through so many worksheets would be overwhelming, PIRE has hidden the usual tabs at the bottom of the Excel screen. When Users open *SimSmoke*, the first page that appears is the Welcome page, with introductory information and navigation buttons to get Users started and move them from sheet to sheet so that they may set up and use the model.

Copy Welcome/Title Page here in small box.

The Welcome page provides an introduction to the model and contact information for the model developers. Further, the Welcome page indicates separate starting points for New Users and Returning Users. New Users are encouraged to press the "Introduction to Model" button to read about the model. (This is less pertinent to Users who have read through this User's Manual to this point, but may be helpful for Users who do not have immediate access to the Manual.)

Introduction to Model

New Users who are ready to begin the development of a new *SimSmoke* model may select "Start New Model." Pressing this button will lead the User through a series of pages that require the User to identify the basic characteristics of the model (such as the geopolitical entity and the relevant time period) and to enter the background data which are necessary to project smoking and health outcomes over time. New Users will want to start here. Returning Users may also start here to initiate a new model.

Start New Model

This same Welcome page appears in the original *SimSmoke* template file (the blank program with data not yet entered) and in *SimSmoke* files that Users have saved under a new name with data already entered. Returning Users who want to jump directly into a model that has already been saved can select "Go to Index" to begin navigating the *SimSmoke* model they had already initiated. Direct links to most of the Excel worksheets in the model are available on the Index page. We do not recommend that new Users explore these links until they have initiated a model.

Go to Index

The Index Page in *SimSmoke* serves as the "homepage" for the model. From this page, the User can navigate to most of the worksheets in the *SimSmoke* model (worksheets that are not integral

to understanding the model calculations are hidden to minimize clutter). The accessible worksheets are organized into four different categories:

Model Options

- The first link in the Model Options section — *Starting a new model* — takes the User to the beginning of a data entry sequence to start a new model.
- The second link — *Demographics* — takes the User to a page on which demographic parameters of the model output are selected.
- The third link —*Policy Modeling Choices* — takes the User to pages that allow for the selection of a modified policy scenario to be created for comparison with the status quo policy scenario.
- The fourth link — *Policy Effect Size Options* — takes the User to a page on which policy effect sizes can be modified.

Graphs and Tables   In most models, Model output has been organized into two graphs and five tables that reflect the *SimSmoke* projections and outcomes of the model under modified policy assumptions. Some models contain more tables and graphs to accommodate additional characteristics pertaining to the particular State or nation (e.g. snus use). In addition, the output can be extended to include tables and graphs showing the number of disease specific deaths, per capita consumption (PCC) and the average quantity smoked per smoker (AQSS).

Data Entry pages   Nine data entry pages are organized as a sequence to guide the basic data needed to develop a *SimSmoke* model. The data entry pages are marked on the right hand side of the Index Page screen with two columns that mark whether the data have been fully entered (this is not an evaluation of the accuracy of entered data) and whether the source of data has been recorded.

Calculation pages   The remaining Excel worksheets (36 in total) contain the background calculations conducted by *SimSmoke* necessary to produce the model output. The formulas in these sheets have been locked in order to prevent changes being made by anyone other than the model developers at PIRE.

Individual pages are explained throughout this manual with reference to their purpose and use. Users can return to the Index Page at any point by clicking on the "Return to Index Page" button that appears at the top of most pages within *SimSmoke*.

Return to Index Page

The following Sections of this User's Manual provide details about all available pages and how to use them. Section Two of this Manual describes Model Development, or the necessary steps to create a new *SimSmoke* model. This includes selecting the relevant time period and identifying and entering the necessary data. Section Three of this Manual describes use of the *SimSmoke* model. This includes selecting model parameters including policy modeling choices;

reviewing the *SimSmoke* output provided in default table and graph format; and interpreting and presenting results. Section Four of this Manual discusses adjustments that the User may need or choose to make to the model once it is complete and initial output has been reviewed.

A copy of the Index Page, which lists all the worksheets included in *SimSmoke*, is included as Appendix A. A technical description of the model calculations appears as Appendix B and the basis for policy parameters are described in Appendix C.

Like any computer file, the information that has been entered into the program must be saved for later use. Saving different aspects of a *SimSmoke* model is described where relevant throughout the Manual. See Saving the Population, Smoking, and Status Quo Policy Modules for guidance on saving the basic data entry; Saving Modified Policy Scenarios for saving modified policy scenarios; and Saving Projections for Different Age Groups for saving projections for different age groups.

Section Two. Model Development

III. GETTING STARTED: CREATING A NEW MODEL

From the title page, to initiate a new *SimSmoke* model, the User should select the "Start New Model" button to begin the process of data entry. *SimSmoke* is set up to carry you through a series of data entry pages. The User need only follow the instructions on each page, clicking on the red arrow to move to the next step when a page is completed.

In addition to the arrows used to move to the next step, there is a button marked "Return to Index Page" on every data entry page. To return to a previous data entry page — perhaps the data entry was not completed or the User wants to review the data source that was entered — click on the "Return to Index Page" button to access the *SimSmoke*'s index page. From this page, the User can navigate to any of the available worksheets in the *SimSmoke* file. Data entry pages are grouped together under the Data Entry heading; clicking on the specific Data Entry page being sought will take the User directly to that page. From there, the User can continue to navigate through Data Entry pages using the red arrows, or return to the Index at any time.

Setting the Basic Characteristics of the Model

Location
Users must type in the name of the geopolitical area for which they are creating a *SimSmoke* model. This is the text that will appear in the titles of the output graphs and tables, so Users should be sure to type it in as they want it to appear. (For example, type "Maryland" not "MD".)

Base Line Year
The User must identify the starting (or "baseline") year of the model and the number of tracking years to initiate a new model. Even if the User is developing a Basic Model without a prolonged tracking period, *SimSmoke* requires baseline data from which to project forward.

The base year requires acceptable data on population data, smoking rates, and policies in that year. If the User wants to create a Policy Tracking Model (in essence, a strong foundation for *SimSmoke* projections with as long a tracking period as data allow), the User will select a base year before major policy changes. If the User does not have the historical data or is not interested in focusing on a tracking period, the User will select a recent year for a Basic Model. The choice is often determined by the availability of a large scale survey of smoking in a given year.

Example: Base Year = 2000

First Projection Year
Just as there is a first year of the tracking period (the base year), there is a final year to the tracking period, followed immediately by the first year of the projection period. The interval including the base year and the final year of the tracking period is called the "tracking period." . The first year of the projection is the first year after the tracking period ends. In most cases, the first year of projection will be the current year or the coming year.
Example. First Projection Year = 2006

Tracking Period Length

The tracking period is the difference between the first projection year and the baseline year. This data is inserted to make sure that the user understands the concept of the tracking period. In the Basic Model (with no tracking period), the first projection year is simply the first year following the baseline year and the tracking period is one. Enter the duration of the tracking period in years.

Example: Tracking Period Length = 5

SimSmoke will check the entries for baseline year, first projection year, and tracking period length to confirm that these entries are consistent with each other. If there is a conflict, when the "Change Tracking Period" button is pressed *SimSmoke* will give the following error, prompting the User to resolve the inconsistency in dates.

Error. Tracking Period must equal
First Projection Year – Baseline Year

Should the User return to this page at a later point, e.g., to change the duration of the tracking period once new data is available, entry of new values must be finalized by pressing the button "Change Tracking Period."

> Change Tracking Period

Preparing for Data Entry

Population and smoking rate data that the User enters should correspond as closely as possible to the selected base year. Data are tabulated by age and/or gender. Fertility data is for females, but the information in all other worksheets is ordered in columns by gender: male, followed by female, and then the total of both genders. Each row corresponds to an age 0 through 85, where age 85 includes ages 85 and older. "Age 0" represents individuals who have not yet reached their first birthday, defined as 12 months since birth. Typically, the population mortality, fertility and smoking rate data available to use in the *SimSmoke* model will be available (with reasonable reliability) in aggregated age groups rather than for a single age. Suggested adjustments are described below as necessary.

There are 9 data entry pages (numbered for identification and easy reference in the Index) essential to the development of a *SimSmoke* model. These are listed and described in Chapter IV.

> *Reminder*
> Remember to use the scroll bars on the bottom and the right side of each Excel worksheet to scroll down or to the right. Not all data entry cells fit on a single computer screen and the User will often need to scroll down or to the right to complete the data entry for a single worksheet.

Saving the Population, Smoking, and Status Quo Policy Modules

There are separate components of a *SimSmoke* model that can be saved for later retrieval. Each has a separate means of saving. What follows is guidance for saving the basic data entry that comprises the population, smoking and status quo policy modules. Later in this User's Manual, there is guidance for saving modified policy scenarios and model output for different age groups.

Users enter population, smoking, and current policy data through the Data Entry pages described in detail below. This information is the basis for a new (and complete) *SimSmoke* model and Users will likely access this model again and again. To save a completed model (whether the User plans to do more policy analysis in the future or not), the User should use the *Save* option in the *File* menu from the Excel drop down menu or toolbar.

Usually, Users will not want to make changes to a *SimSmoke* model that has been saved. Users may open the *SimSmoke* model on multiple occasions to conduct policy analyses, sometimes saving output from these particular analyses (see below for method). However, after conducting policy analyses in a given session, Users should close the *SimSmoke* model without saving the model again. Once the data entry is complete and the model has been saved once, re-saving the model after a session of use will over-write the original model and may result in unplanned (and perhaps unnoticed) changes to data entry becoming permanent.

> ### *Reminder*
> In most cases, once data entry is complete, the *SimSmoke* model should only be saved *if you want to add the new data or change the data entered*, using the Save option in the drop-down File menu of Excel.

An exception would be if the User began a process of calibrating the model. In this case, the User would not want to permanently lose the basic data entry that has already been completed but might want to save the calibration work that has been done, e.g., because the specification of data has been changed to improve the model. See VIII. Calibration and Validation for a discussion of Calibration and saving a calibrated model.

IV. ENTERING BASELINE DATA

Source Information and Notes

At the top of each Data Entry worksheet, there are three reference boxes that the User should fill in before continuing to the next data entry page. These reference boxes are described and examples given below. The importance of entering source information as the User proceeds with each Data Entry page cannot be overemphasized. Once the model is completed, the User will need to have these sources documented, and entering the information during the data entry process will make this task both easier and more reliable.

This step of referencing the data used should be repeated for each data entry page. The references to the source year, data, and additional notes are automatically compiled by *SimSmoke* in a separate worksheet accessible through the index (Table 5: Compilation of Sources of Data used in the Model).

Source.   Note the source or reference for the data to be entered on that page, including the publication title, the publication source, and internet links if available. In the example below is a screenshot with reference to the data from the U.S. Census:

Source:	U.S. Census Bureau, Current Population Survey. http://www.bls.census.gov/cps/cpsmain.htm. Accessed March 23, 2006. K
Source year:	2000
Notes:	Age classifications of source, problems with survey, etc.

Source Year.   Note the year that corresponds with the data being entered on that worksheet. In the example above, the User is entering the population size by age and gender of the User's state/nation for the year 2000, enter "2000" in the "Source Year" box.

Notes. Record any specifications that will be important for Users of the tailored *SimSmoke* model to know about the data. For example, if the data originally come in age categories that do not match the categories being used in *SimSmoke* model, and the User needs to adjust values, make a note on the appropriate Data Entry page. If the data you are using come from a survey with known problems, like a difference in the measurement question for smoking behavior from the measure commonly used in the model, record that limitation.

Reminder Checklists

As noted in the Overview, the Index Page includes, to the right side of the screen, two checklists. The first — "Completed Data Entry" — marks a check for Data Entry pages that are completely filled in. A check mark next to a Data Entry page on the Index Page **does not** evaluate the quality or the accuracy of the data entered into that page. It only indicates whether data are missing or not. The User is responsible for the quality of data entered into *SimSmoke*. However,

this checklist is an important tool for the User to review before using model output in the form of graphs and tables. Because it is possible for *SimSmoke* to produce graphs and tables even if some data (e.g. initiation or cessation rates for youth) have not been entered into the model, the User should scan the checklist to ensure complete data entry before using *SimSmoke* model output.

The second checklist marks whether source information for each data entry page (or each policy in the case of Data Entry 9) has been entered on each page. While the model will function with or without the User entering the source information, a *SimSmoke* model is not complete without a complete list of sources documented. As described below, the source information entered on each page is compiled by *SimSmoke* and reproduced as Table 5. The checklist is a reminder to the User to fill in any missing source information for a given Data Entry page.

Population Module

The first three entries are for the Population module, which tracks population through births and deaths. Table 1 below sets out the kinds of information required. Recall from above, that the population data depends on the baseline year of the model, the choice of which is discussed above.

Table 1. *Population Module Data Requirements*

Variable	Minimal needs	More sophisticated models
A. Current population	Recent year population of country with breakdowns by age* and gender	Finer breakdowns by age (especially under the age of 25). Breakdowns by SES, racial/ethnic, or regional differences (urban/rural) if relevant.**
B. Fertility rates	By age* groups	Breakdowns by other socio-demographic variables if relevant, projected changes in fertility rates over time. May want to incorporate immigrations rates if immigration is an important part of population growth.
C. Mortality rates	Overall death rates by age and gender groups used above or reasonable approximation (can apply averages over broader age groups to younger age groups)	Any additional socio-demographic breakdowns as suggested above. In addition to all deaths, by lung cancer, COPD, heart and stroke
D. Economic data	Country's income status, percent of the labor force employed in agriculture and the adjusted labor participation rate (relative to USA)	

* The age groups need to be less broad at the earlier levels to account for initiation and fertility. A reasonable breakdown would be (0-9, 10-14, 15-19, 20-24, 25-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80+).
** Other socio-demographic distinctions beyond age and gender may be considered because those groups are of political interest or they have different and identifiable smoking or other health (as suggested in different mortality patterns) habits. Data must be available to distinguish different smoking patterns if that is the important consideration.

Data Entry 1. Baseline population by age and gender

Record the data source, the year, and pertinent notes.

Input population data in the Population Data sheet. This data should represent the number of people in the population of the geographic area by age and gender. If the data are aggregated into age groups, then that number must be apportioned to each of the ages in that group. The User may designate the same number for each age in the category by taking the total count for the age group, dividing by the number of age years in the group, and then designating that same number to each of the different ages in the group. For example, for a 5-year age group total, each cell contains the total number of people in the age group divided by five. Note that should be exercised in apportioning people to the age zero (first year after birth), where there are often higher death rates.

If the data is not divided up by gender, the User may estimate the population of each gender by multiplying the total population by the male-to-female ratio of the particular area.

> **Example**. If the population contains an equal male-to-female ratio (50% male and 50% female), a population of 10,000 people would contain 5,000 males and 5,000 females.

Notes: As necessary, describe in the "Notes" box at the top of the page the initial level of aggregation of population data (e.g., over 5 age years) and any limitations of the data (e.g. survey problems).

Data Entry 2. Fertility rates per 1000 women by age

Record the data source, the year, and pertinent notes.

Add fertility (birth) rates to the Fertility Data sheet. The fertility rates are set at per 1000 women. Make sure that the birth rate and death rate data correspond in the first year after birth. In other words, if birth rates refer to live births then death rates in year zero should refer to deaths following a live birth up to age 1. If the data is aggregated over age groups, generally use the same number for each applicable age. For example, if the fertility rate information is for 25-29 year olds, then insert that same mortality rate in each of the cells for ages 25, 26, 27, 28 and 29.

If the fertility data is aggregated over age groups, you can use the same number for each applicable age. For example, if fertility rate information is for 20-24 year olds, then insert that same fertility rate in each of the cells for ages 20, 21, 22, 23 and 24. Be sure to calculate the correct rate by dividing with the specific population in which the data was collected (e.g., births per 1,000 persons).

Notes: An alternative method to using the same fertility rate for each age within an age group is to assign the group value to the midpoint age or ages, and then interpolate between the midpoint values. This method may be preferred if the data is highly aggregated and there are large differences between contiguous age groups.

Describe in the "Notes" box at the top of the page the initial level of aggregation of the data (e.g., over 5 age years), the base (e.g., births per 1,000 women) and any limitations of the data (e.g. survey problems).

The default fertility setting in *SimSmoke* uses a single set of fertility rates that is applied to all future years. If the tracking period is more than several years, we usually use data for a recent year, so that it adequately reflects future trends. We recommend that the user examine trends in fertility rates to determine if this is an important concern. The model can be modified to allow separate fertility rates for each year, or projected changes in the fertility rate in the near future with an assumed constant fertility rate for the remainder of the projection period, so that the model takes into account changes in fertility rates over time, but this modification should be done in consultation with PIRE staff.

Data Entry 3. Mortality rates by age

Record the data source, the year, and pertinent notes.

Add data on mortality rates by age for *all causes* to Data Entry 3, the Mortality Rate worksheet. Make sure that the data are from the same year as the population data (or the closest year for which good data are available).

Make sure that the birth rate and death rate data correspond in the first year after birth. In other words, if birth rates (entered on the worksheet Data Entry 2) refer to live births then death rates in year zero should refer to deaths following a live birth up to age 1.

It is preferable to use single age data, if such data are available and sufficiently reliable. If the sample of deaths is small, the User may want to average the mortality rate over several years or use broad age categories. Use the smallest age interval for which acceptable data is available.

If the mortality data is aggregated over age groups (for purposes of stability as described above or because that is the only data available), generally use the same number for each applicable age. For example, if the mortality rate information is for 45-49 year olds, then insert that same mortality rate in each of the cells for ages 45, 46, 47, 48 and 49. An exception may be when an age in the group may be different (e.g., the first year of birth may include more people due to death at or near birth). Be sure to calculate the correct rate by dividing with the specific population in which the data was collected (e.g., deaths per 1,000 persons).

Notes: An alternative method to using the same mortality rate for each age within an age group is to assign the group value to the midpoint age or ages, and then interpolate between the midpoint values. This method may be preferred if the data is highly aggregated and there are large differences between contiguous age groups.

Describe in the "Notes" box at the top of the page the initial level of aggregation of the data (e.g., over 5 age years), the base (e.g., deaths per 1,000 persons) and any limitations in the data (e.g. survey problems).

SimSmoke uses a single set of mortality rates that is applied to all future years. If the tracking period is more than several years, we usually use data for a recent year, so that it adequately reflects future trends. We recommend that the user examine trends in mortality rates to determine if this is an important concern due to major changes over time. The model can be modified to

allow separate rates for each year, or projected changes in the mortality rate in the near future with an assumed constant mortality rate for the remainder of the projection period, so that the model takes into account changes in mortality rates over time. However, this modification should be done in consultation with PIRE staff.

Reminder: **Migration/Immigration**

The model does not adjust for net migration. That adjustment may be accomplished by adding a separate sheet and adding net migration to the equations for calculating the projected population. Migration is important in a state with significant immigration or emigration, especially where there are widely differing smoking rates for immigrants or emigrants compared to the rest of the population. For states with very large and changing levels of migration, adjustments in fertility and mortality rates might also be considered, but it is recommended that the User consult with PIRE researchers before undertaking any adjustments on the Data Entry 2 or Data Entry 3 worksheets.

Describe in the "Notes" box at the top of Data Entry 1 (population data) any available information about the importance of net migration in your state, and the source of that data. If there are data on net migration by age group and gender, please contact PIRE researchers to designate a separate page in the Excel file where the data may be included.

Data Entry 4. Economic data

Enter the country's income status. Enter a "1" if the country is a low income country (LIC), a "2" if the country is a medium income country (MIC) or a "3' if the country is a high income country (HIC). This figure is used to calculate a "Knowledge" factor which is used to adjust the parameters associated with Advertising Bans, Cessation Policies, Clean Air Laws, Health Warnings and Media Campaigns. For LICs and MICs, this factor takes on values of 1.5 (Cessation policies, Clean Air Laws and Media Campaigns) and 2 (Advertising Bans and Health Warnings). For HICs, the value is 1.

Enter the percent of the labor force employed in agriculture. This figure is used to calculate an "Urban" factor which adjusts the parameters associated with Cessation, Clean Air and Tobacco Control. The Urban factor is equal to 100% minus the percent of the labor force employed in agriculture. This information as well as information on labor participation rates can be obtained online from the World Factbook (www.theodora.com).

Enter the labor participation rate, which is the total labor force divided by the population aged 15 or older. This is automatically divided by the US labor participation rate to calculate the adjusted labor participation rate. The adjusted labor participation rate is then used to calculate the "urban-rural and labor participation adjuster", which adjusts parameters associated with Clean Air. If the adjusted labor participation rate is less than 1, then the value of the adjuster is 1. However, if the adjusted labor participation rate is less than 1, or equal to 1, then the adjuster takes on the value of the adjusted labor participation rate.

Smoking Module

Smoking prevalence data by age and gender is necessary for the model, preferably including former smokers. Data on cessation can often be constructed from the prevalence data. Other data, .e.g., relapse and initiation data, are less essential, and quantity and per capita consumption are only necessary if these are outcomes of the model.

Table 2. *Smoking Module Data Requirements*

Variable	Minimal needs	More sophisticated models
A. Baseline smoking rates for current smokers and ex-smokers	Number of current smokers (at least 100+ cigarettes lifetime is the preferred measure) in the nation by the age* and gender groups**.	Some indication of the number of ex-smokers, preferably breakdowns of ex-smokers by age and gender, and number of years since quitting (<1, 1-2, 3-5, 6-10, 11-14, 15+ years), or any additional socio-demographic breakdowns as suggested above.
B. Initiation rates	Not needed. Inferred from current smoking rates of those ages 10 to an upper age limit, depending on the nation's smoking patterns.	Specific information on initiation by socio-demographic groups. May account for trends as income of the nation increases
C. First year cessation	Population indicator of annual cessation rates in the previous year desired, but not needed.	Specific information on cessation by socio-demographic groups. See also cessation module below.
D. Relapse rates	None	Measures of rates corresponding to ex-smoker groups above.
E. Per Capita Consumption (PCC)	None, unless PCC is an outcome to be considered. This measure is only available for the entire population	Data for the all years since the tracking period, since it is important to calibrate and validate this measure.
F. Quantity smoked	None, unless quantity is an outcome to be considered	Measures of average quantity smoked by age and gender specific, may distinguish every and some day smokers.

* The age groups need to be narrower at the younger levels to account for smoking initiation. A reasonable breakdown would be (0-9, 10-14, 15-19, 20-24, 25-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80+).
** Other socio-demographic distinctions beyond age and gender may be considered because those groups are of political interest or they have different and identifiable smoking or other health (as suggested in different mortality patterns) habits. Data must be available to distinguish different smoking patterns if that is the important consideration.

Data Entry 5. Smoking prevalence by age and smoking status

> *Record the data source, the year, and pertinent notes.*

The smoking data should be entered as prevalence rates in this Smoking Prevalence worksheet. If the original data are in the format of population counts of never smokers, current smokers and ex-smokers by age and gender, simply divide the age and gender-specific numbers by the age and gender-specific population counts. If the data are aggregated over ages, apply the same number to each age group, unless there is reason to suspect important differences among the different ages.

The definition of smoking status may vary according to the data source. Below, we have provided standard definitions used in *SimSmoke* models for the U.S. and various states. If these definitions fit with the data source, the User may proceed with data entry. If the data source informs different definitions of never smokers, current smokers, and ex-smokers, record those definitions in the Notes box at the top of the page.

Never-smokers: Individuals who have not smoked 100 cigarettes during their lifetime.

Current smokers: Defined as established smokers. The current smoking rates (of established

smokers) are defined as the number of people who currently smoke and have smoked at least 100+ cigarettes during their lifetime. It is important that this or another measure of established smokers is consistently applied for all age groups. For example, many studies measure youth smoking rates by whether the individual has smoked in the last 30 days, but some of these individuals do not continue to smoke and have no health effects. Adjustments will need to be made if separate measures are used for youth, so that they correspond to the measure of smokers for adults. In U.S. based models of *SimSmoke*, PIRE researchers have included both "some days" and "every day" smokers as established smokers, but the User may want to omit or treat differently those who only smoke on some days.

Using the chosen measure of an established smoker, input the prevalence rates (by gender and total) in the Data Entry 5 <u>Smoking Prevalence</u> worksheet. The age groups should be large enough to insure relatively accurate measures and to smooth irregularities. Narrower age groups are particularly desirable for individuals between ages 10 to 24, when smoking initiation takes place. Smoking rates should increase or stay constant between the ages 10 and 24, although, in some countries, smoking rates may be increasing through age 30 or even beyond.

Ex-smokers: (*or* former smokers.) These are individuals who have smoked at least 100 cigarettes in their lifetime and are not currently smoking. If local data are entered to override the default values, the data entry will depend on the chosen measure of an ex-smoker.

Because rates of ex-smokers by the selected categorical duration of cessation are not usually readily available, the default *SimSmoke* already includes the U.S. values for ex-smokers by duration of cessation.

The current breakdowns for ex-smokers are by the number of years since quitting (<1, 1-2, 3-5, 6-10, 11-14, 15+ years). Depending on the data available, the User may use different categories for the number of years since quitting, but the relative risks and relapse rates (see below) must be changed to correspond to the new categories and adjustments must be made in the smoking rate equations. (If the categories are broader, the User could use the relative percentages in the U.S. ex-smoking rates to retain the same level of detail, but the PIRE researchers should be consulted if this method is used).

If the smoking rate data are aggregated over age groups (for purposes of stability as described above or because those are the only data available), generally use the same number for each applicable age. For example, if the smoking rate information is for 45-49 year olds, then insert that same mortality rate in each of the cells for ages 45, 46, 47, 48 and 49. An alternative method to using the same smoking rate for each age within an age group is to assign the group value to the midpoint age or ages, and then interpolate between the midpoint values. This method may be preferred if the data are highly aggregated and there are large differences between contiguous age groups. Note that this second method should generally be used during the early ages of

smoking when initiation takes place (and large changes in the smoking rate occur), in order to avoid discrete jumps in smoking rates over time in future trends.

Note: The current model has no ex-smokers before age 24. The reason for not tracking ex-smokers before age 24 is that those who quit before age 30 have negligible health effects. Since the reason for tracking ex-smokers is to compute health effects of their previous smoking, the User may ignore ex-smokers through age 24 or even later if data are unavailable or unreliable for earlier ages. Note that this number also corresponds to the age at which initiation stops in the US model. In some cases, the last relevant age of initiation may be different. In that case, please consult the developers of the model.

Make sure that the percent smokers + percent ex-smokers + percent never smokers = 1 for each age group (and by gender). The percentages should add up to one hundred. An error message will appear ("Error: sum>1") if the sum of the percentages is greater than 100%.

Notes: Describe in the "Notes" box at the top of the page the definition of established smoker, never smoker and ex-smoker used in the *SimSmoke* model. If it is possible to distinguish ex-smokers by the number of years since quitting (i.e., if the U.S. default values are not being used), what categories are used? If the initial level of aggregation of the data (e.g., over 5 age years) differs from the age categories, note the difference and any limitations of the data (e.g. survey problems, lack of data on ex-smokers, etc.).

Data Entry 6. First year cessation rate by age

Record the data source, the year, and pertinent notes.

The User will need to calculate the percent quit by age groups for the <u>Cessation Rate</u> worksheet. Cessation rates in *SimSmoke* are defined as:

$$\frac{\underline{\text{Individuals who quit within the last year and are currently not smoking}}}{\text{All smokers one year ago}}$$

The denominator (all smokers one year ago) is the sum of current smokers and individuals who quit in the last year and are currently not smoking. If there are data on how long ago individuals quit in the last year or the rate of unsuccessful quits in the last year, then the cessation rates may be improved. However, consult with PIRE researchers about the procedures for doing this. Data on cessation rates are less common than data on smoking rates, and there may be too few observations to create cessation rates by age and gender (i.e., the sample of cessation relies on the sample of smokers, which is a subset of the population). Please consult PIRE researchers or the survey managers who collected the smoking rate data if adequate cessation data are not available.

The age categories may be broader than the age groups in the population model. For example, the User may calculate the cessation rate for ages 25-39, 40-59, and for ages 60 and older (or other breakdowns that yield reliable estimates).

Begin by calculating the total percent quit (males + females), and then calculate percent quit

separately by gender if sufficiently reliable data are available to distinguish males and females by age. Otherwise, calculate the gender-specific cessation rates by age groups as in the following example:

$$\text{Percent Quit Males }_{25\text{-}39} = (\text{total \% Quit }_{25\text{-}39})* (\% \text{ Quit Male/ total \% quit})$$

If only the average cessation rate for the total population is available, rather than by any age breakdown, then contact PIRE researchers to obtain U.S. data on the percent difference from the average rate by age and gender to adjust the total population data (similar to that suggested above for gender differences).

Notes: Describe in the "Notes" box at the top of the page the definition of cessation being used. Further, if different age groups are being used, describe the initial age group aggregation of the data source and how new age-specific cessation rates are calculated. Describe any limitations of the data (e.g. survey problems).

Data Entry 7. Relapse rates by age and year(s) since quitting

Record the data source, the year, and pertinent notes.

Relapse rates measure the percent of ex-smokers in each quitting category (by duration in years since quitting) who relapse. These data are generally not available for states/nations other than the U.S. If that is the case, use the default U.S. relapse rates PIRE has provided with the *SimSmoke* software. If there are data available specific to the selected state/nation, enter these in the data cells in Data Entry 6, overwriting the default values. If the categories (years since quitting) differ from the ex-smoker categories currently in the model (this will only be the case if the User has changed the categories from the original *SimSmoke* model), make adjustments on the Data Entry 6 sheet in consultation with PIRE researchers.

Notes: Describe in the "Notes" box at the top of the page the definition of relapse that is used. Note whether it is possible to distinguish relapse by the number of years since quitting and if so, what categories are used. Describe the initial level of aggregation of the data (e.g., over 5 age years, note that there may be different levels of aggregation for different ages) and any limitations of the data.

Relative Risks
Relative risks are used to calculate smoking attributable deaths (SADs). SADs are based on the excess risks of smokers and ex-smokers relative to never smokers. Death rates are first calculated by age, gender, and smoking categories (never, current, and the 6 ex-smoker groups) using the data on death rates, smoking rates, and relative risks (see Appendix B). These deaths can be calculated in terms of all SADs or for particular types of deaths attributable to smoking, which may include lung cancer, heart disease, stroke, and chronic obstructive pulmonary disease (COPD).

Data Entry 8. The relative total mortality and disease-specific mortality risks attributable to smoking

Record the data source, the year, and pertinent notes.

The current configuration of the model is set to calculate total smoking-attributable deaths, but *SimSmoke* can also calculate smoking-attributable lung cancer deaths, which are not necessary to the model but is a type of death particularly sensitive to smoking rates. In consultation with PIRE researchers, the User may extend the model to include relative risks of heart disease, stroke, and COPD. Death rates will be required in addition to relative risks in order for disease specific smoking-attributable mortalities to be calculated

Data may be available specific to the selected geographic area for total mortality and lung cancer mortality attributable to smoking. If you have access to these data, enter them on this page, Data Entry 8, the <u>Relative Risk</u> worksheet. If relative risks are not available for the selected state/nation, the User may want to use those of a state/nation with similar health and smoking risks.

Where available, estimates of the relative risk of smoking were based on studies for the nation. When unavailable, we generally use rates for a similarly situated nation in terms of its stage of economic development and smoking patterns. Studies of relative risks for China[21-23] have obtained relative risks of around 1.35, all in the range of 1.2-1.4. These act as a relative risk measure for a low income nation with a recent smoking history relative to most HICs. Studies for Taiwan and Korea[24-26] with a less recent smoking history typify a middle income nation, and generally show relative risks of about 1.55. HICs with a long smoking history were assigned risks similar to the U.S. For the U.S. and countries in the later stages of the smoking epidemic, we use relative risk estimates from the Cancer Prevention Study II,[27-29] which are about 2.4 for men and 2.1 for women. Studies for some nations provided comparable risks, such as recent studies for India [30] and Russia.[31]. For ex-smokers, few studies have been conducted for countries other than the US and the UK. We generally assume that relative risks decline with years quit at the rate observed in U.S. studies.[32,33] Relative risks from the U.S. were used to distinguish differential effects by age.

Alternatively, the User can use the default values that are included in the model when PIRE provides it. These are the current U.S. total and lung cancer relative risk rates. In consultation with PIRE researchers, adjustments may be made to these default U.S. values based on the relative risk of smokers who smoke similar amounts and of similar duration to smokers and nonsmokers with similar background risks in the selected state/nation.

Separate rates are used to adjust relative risks downward for ex-smokers based on years since quitting. Default values are already entered and may be found below the rates for Smokers on Data Entry 8. Data are unlikely to be available for most categories (defined by duration of years since quitting) to adjust ex-smoker categories. If the ex-smoker categories (in duration since quitting) have changed from the original categories provided with the *SimSmoke* model, the User will need to make adjustments in the model to correct for these changes.

Notes: Describe in the "Notes" box at the top of the page the data used if they are not the default

U.S. values. Sate if separate data for smokers and ex-smokers are used. Describe here any limitations of the study or studies. Describe any other outcomes that would be of particular interest to policy makers in the selected nation or state.

Policy Modules

The data for all policies are inputted on one page. For each policy, information is needed about the policies in effect from the baseline year of the model to the current year.

As noted above, it is important at the outset for the User to understand the three conceptual choices differentiating the type of *SimSmoke* model desired. Please review the Section entitled "Choice of SimSmoke Model to Construct" to clarify these choices. For the Policy Tracking Model, at least two years of past policy data are used for projections, while the basic model uses only one year of data. The tracking period was identified when this new model was initiated and when a *base year* and a *last tracking year* were specified. Data Entry 8 is the Tracking Period Policies worksheet on which past policy values need to be entered.

Most recent models use data patterned after the information collected in the MPOWER reports.[34] At this point, you might want to turn to Appendix C to review the types of policy data you will need for your model.

Data Entry 9. Policy values for tracking period

Tax/Price Policy

   Record the data source and pertinent notes.

Cigarette excise taxes are considered one of the most important tobacco control policy tools. Many studies, using a variety of statistical techniques and for a wide spectrum of countries, have been conducted, and they almost uniformly find that prices or taxes affect smoking rates.

From economic theory and empirical studies, the impact of a tax change will depend on the initial price of cigarettes, the size of the tax, and the average income of the smoking population. Over time, the effect will depend on the price of cigarettes relative to the price of other goods (generally measured by a consumer price index).

If the User is developing a Basic Model, there will be fewer past years for which to enter price and tax rates than if the User is developing a Policy Tracking Model. A price measure for cigarettes and the consumer price index is needed for all years. In a Policy Tracking Model, specifically, while we recommend inputting tax rates over all the policy tracking years, the tax rate is essential only for the last policy-tracking year.

Starting with the base year, enter the past average retail prices, including taxes, along with the tax per pack of cigarettes, and the consumer price index (for all goods) to adjust for inflation over time. While values for each row may repeat themselves, they must be entered individually in each cell. Variations in prices or taxes may appropriately be entered, as well. Definitions of the required data are as follows:

Past average cigarette retail price (including taxes):

Actual prices over policy tracking period, (usually unadjusted for inflation).

Ideally, the price measure should be a composite representative average price (weighted by the amount smoked) of all brands of cigarettes in market. When not available, the price per pack of the most widely smoked cigarettes may be used, subject to cautions (smokers may be expected to switch to different brands as the relative price of different cigarette brands changes).

Past cigarette tax: Actual cigarette tax burden over the policy tracking period, corresponding to price measure. Although this data is only needed for the most recent year, we generally recommend including it for all years.

The tax burden refers to the overall amount of the average tax as a component in the price of cigarettes. The tax structure may be complex. There may be more than one type of tax (excise tax, import tax, VAT) and different types of cigarettes (domestic vs. import) may be taxed differently. We generally do not include a sales tax or import tax. However, value added tax, which applies to all or most consumer goods, is included separately. When different taxes apply to different types of cigarettes, it is best to construct a weighted index for the different types of cigarettes, where the weights correspond to the respective market shares. Similar weights should be applied to prices. Note that the model is set up to track tax data assuming that taxes are imposed as taxes are determined as a percent of prices (usually called *ad valorem* taxes). Modifications will have to be made in the model if the unit entered is excise taxes, i.e., a constant amount per unit, including the MPOWER models, in consultation with PIRE researchers.

Past VAT: Actual VAT over the policy tracking period, expressed as a percent of price. This option is not available on all models, since it is only a recent addition to the model. In the models in which it is not included here (in the Past Policies sheet) it is included in the "Taxes" calculation sheet and may only be changed by PIRE staff.

VAT included in total taxes: This is an indicator value (which is included only when there is a row for VAT) and its value depends on whether VAT is included in the past cigarette tax. No is denoted as "0" and Yes is denoted as "1".

Consumer Price Index: Consumer (all goods or closest equivalent) price index over policy tracking period if cigarette prices have not already been adjusted for inflation.

Note that the consumer price index (CPI) is a market basket representing all goods and services consumed by the typical individual. The annual percentage change over time in the CPI (or a closely related measure) is generally used to calculate the inflation rate for the economy.

Note: If your cigarette price data are already corrected for changes in the CPI (also

known as "real prices" by economists), then set the CPI values to 100 for all years (i.e., not change over time).

In *SimSmoke*, while an *expected future* inflation rate is used in the tax module, as a factor which affects the impact of tax policies, that value is not recorded in the Policy Values page, because it is intended to reflect future policies and not past policies. The value of the expected inflation rate is recorded in the Future Policy Options pages (Simple or Advanced).

Notes: Describe in the "Notes" box which tobacco products and brands are included in the cigarette price index, the different types of taxes on cigarettes, whether different taxes apply to different types of cigarettes in your nation/state, and any other measurement issues. Describe here any studies that apply to your country or state (the elasticity), and whether the elasticity applies to overall tobacco consumption (per capita) or to smoking prevalence. Describe any sources of leakages and any studies or data that you have on the magnitude of the problem.

General Comment Applying to Following Policy Sections

Whereas the previous Data Entry pages required the User to enter discrete pieces of information that have already been gathered and are likely well documented, the following policy sections may require a great deal of thoughtful judgment on the part of the User. These policy sections are introduced in the SimSmoke model with the following text box:

> *Section 2:*
> In this section you will enter the values for smoke-free air laws, mass media campaigns, advertising bans, health warning requirements, youth access laws, cessation treatment coverage, and school-based educational programs. The range of possible values for all of the following policies is from 0 to 1. This range may apply to geographic coverage or intensity of enforcement within the state/nation. Consult the User's Manual for specific guidance for each policy.

The challenge is that each cell requires a value that may represent *either* geographic coverage *or* intensity of enforcement or coverage over some dimension *or* some combination of the two. An example of the measure of **geographic coverage** might be that 70 out of 100 counties in your state have implemented the policy. This data would be entered as 0.70, reflecting 70% geographic coverage. Alternatively, a policy may have been instituted across 100% of the state jurisdictions, but may not be consistently enforced in all areas. The User may decide to enter a value that reflects the **intensity of enforcement** of the policy, e.g., an estimate of 0.70, reflecting 70% of total possible enforcement effort.

Some policies include characteristics that specify the level of coverage/enforcement directly (e.g. smoke-free air laws). In such cases, it is simpler for the User to think of the range of possible values for each cell as primarily reflecting geographic coverage.

Determining the appropriate value to enter into each cell requires the User may require multiple judgment calls. Because data sources sometimes vary widely and are incomplete, for the time being PIRE researchers have chosen to maintain the flexibility of data entry in the policy cells.

Smoke-Free Air Laws

Record your data source and pertinent notes.

Smoke-free air laws may prohibit smoking in elevators, health care facilities, public transportation, indoor recreational facilities, government buildings, schools, shopping malls, and retail stores. The most extensive laws also include restaurants and private workplaces. Smoke-free air laws may make smoking less attractive by reducing opportunities to smoke and by supporting social norms against smoking.

Many studies, using a variety of different methodologies, have found that smoking restrictions have reduced smoking behaviors. However, these studies have all been conducted for higher income countries. While compliance in the U.S. is relatively high, compliance problems may arise in countries without a firm base of public support for the law. In particular, states or nations with high smoking rates and a lack of mobilized non-smokers may find that compliance with strict bans is low.

The smoke-free air policy module examines the effect of four types of laws: work site, restaurant, schools, and other public places. The effectiveness of smoke-free air restrictions will depend on enforcement and on how easily they may be circumvented by the smoker. Laws are assumed to be constant in a given year; in other words, the user can only select one each of the worksite and restaurant law categories for any particular year. Details about what value to enter for each category follow the definitions below.

<u>Worksite smoking bans</u> are assumed to fall into one of three categories. Specific details for each category are as follows:

Smokefree Worksites: Smoke free worksites operate with a total smoking ban in all indoor spaces.

Restricted Smoking Worksites: Worksites that restrict smoking to separate indoor areas that are specially ventilated are designated as restricted smoking sites. Sometimes, this category is considered a partial smoking ban.

Limited Smoking Worksites: Some worksites with a "partial" smoking ban have less restrictive regulations than a restricted smoking worksite. Worksites that limit smoking to separate common areas (without ventilation requirements) such as a communal break rooms or lunch rooms, fall into this category.

For the MPOWER models, worksite bans are distinguished corresponding to data provided in the MPOWER Report as: 1) partial as designated by a ban in 2 of the 3 types of facilities: health, university, and government facilities, 2) ban in indoor offices only, and 3) ban in all indoor workplaces (including offices and other indoor workplaces, universities, and government).

Geographic Coverage

Because smoke-free air laws are a collection of local laws and regulations, the degree of smoking restrictions may vary across a state, for example, by county. *SimSmoke* allows the User to specify the relative geographic coverage of smoke-free air laws in terms of the proportionate coverage of the population. Thus, if all counties (or other geographic subdivisions) have implemented strict smoking bans at worksites, for example, you would enter a "1" (for 100%) representing this coverage.

> **Example**: If three-quarters of the population in the different counties in the state have smoke-free workplaces, you would enter "0.75" in the base year for Smokefree Worksites. Do the remaining 25% of counties have any worksite smoking policies? If these limit smoking to separate indoor ventilated areas, enter "0.25" in Restricted Smoking Worksites. If they only limit smoking to a specified common area, enter "0.25" in Limited Smoking Worksites

The sum of values entered for the three levels of smoking restrictions is equal to the total rate of worksites with any degree of smoking restrictions. The sum may not exceed one (or 100%), but do not need to sum to one. In other words, it is possible that there are no Smokefree Worksites ("0"), and that only half of the state/nation has worksites with Limited Smoking ("0.5"). Rates may vary over the years of the tracking period.

Smokefree Restaurant: Ban on smoking in all indoor spaces of restaurant.

Restricted Smoking Restaurant: Indoor smoking is restricted to separate areas.

The rate of restaurants with total smoking bans and the rate of restaurants with partial smoking bans should sum to equal the total rate of restaurants with any degree of smoking restrictions. The sum may not exceed one (or 100%), but do not need to sum to one. Rates may vary over the years of the tracking period. In the MPOWER models, restricted smoking restaurants are not distinguished. However, the user can distinguish them by weighting the smoke-free measure by 50%.

Smoking Bans in Other Places: State/nations with smoking bans in at least three of the following four categories of public spaces qualify as having Smoking Bans in Other Places. The four options are transit, shopping malls, retail establishments, and public arenas.

Some earlier models include smoking bans in schools as a separate category.

Smoking Bans in Schools: Represents a complete ban on smoking at all K-12 school indoor and outdoor facilities, applied to students, faculty, and staff.

Smoking Bans in *Other Places* and in *Schools* are unrelated, but may each vary from zero to one depending on the geographic coverage of the bans within the state/nation. Single rates may vary over the years of the tracking period.

Greater government enforcement through fines and compliance checks and media publicity

about the laws and the dangers of secondhand smoke may also increase compliance. The characteristics of *Enforcement* and *Publicity* are applied to all of the smoking ban categories above (worksite, restaurant, other places, schools). These characteristics will often involve subjective judgment by the User. Past versions included an explicit value for publicity, but the MPOWER version has a direct link to the mass media campaign policy as described in Appendix B. More recent models use the enforcement index based on the MPOWER Report, whereby enforcement is scored between 1 and 10, with10 being the highest level. When information is not provided by MPOWER for the relevant years, compliance data can be used as a proxy, e.g., the percent of workers that are exposed to second hand smoke at work.

Values ranging from zero to one are possible in a given year for the level of the Enforcement characteristic. Proportionate values within this range may represent the degree of geographic coverage of the selected Enforcement level within the state/nation.

Enforcement may center on a particular category of public spaces, such as restaurants or worksites. The User may implicitly weight the characteristic (e.g., two-thirds of publicity content or enforcement efforts focused on worksites, one-third focused on restaurants) or, if you feel that this is a complex topic in a given state/nation, contact PIRE researchers to adapt *SimSmoke* to distinguish Enforcement or Publicity in different categories of public spaces.

Notes: Describe in the "Notes" box the extent of compliance with the laws, and the extent of enforcement and the extent of publicity. Describe any peculiarities of the law. Describe here any studies that you have on smoke-free air laws for your state/nation. Describe here special issues that may apply to the application of laws in your state/nation (e.g. percent of the population that is rural and if smoking rates in that population differ from the urban population)

Tobacco Control Mass Media Campaigns

Record your data source and pertinent notes.

Anti-tobacco media campaigns, often called counter-advertising campaigns, were originally aimed at countering the effects of tobacco advertising by cigarette manufacturers. Their focus was generally to change individual behavior by educating consumers on the health risks of smoking. More recent campaigns have attempted to decrease smoking rates by changing social norms through generating public support for various tobacco control policies or by targeting specific actions such as cessation.

Many studies have been conducted on media campaigns, but the estimated effects vary. Studies of anti-tobacco media campaigns at the national and state-level campaigns have generally found that smoking rates declined, but studies at the community level have shown a more mixed picture. In addition, media campaigns are often implemented with a host of other tobacco control policies, and the ability to distinguish their effects from other policies is limited.

The effectiveness of a mass media campaign depends on its scale and duration. Expenditures must be at a high enough level to reach smokers a sufficient number of times and over a time period of sufficient duration. While campaign effectiveness may diminish over time (corresponding to some level of expenditures) renewed effectiveness may be achieved by

diversifying ads to target different audiences (e.g., tailored to specific socio-demographic groups) and changing ad content. We distinguish three possible levels of a mass media campaign, of which the User may pick one.

Highly Publicized Media Campaign: The campaign is publicized heavily on TV (at least two months of the year) and through at least some other media (radio, print, billboards). The campaign is well targeted with a social marketing approach that includes measuring the campaign impact.

Moderately Publicized Media Campaign: The campaign is publicized sporadically on TV and through at least some other media (radio, print, billboards).

Low Publicity Media Campaign: The campaign is lightly publicized through billboards or print media.

If a mass media campaign was initiated during the tracking period, the User must select the level of intensity (highly publicized, moderately publicized, low publicity). Values ranging from zero to one are possible for each of the three intensity levels of a mass media campaign.

For recent nation models, we use information from the MPOWER Reports, which focuses more broadly on tobacco control campaigns. The MPOWER report provides information on whether there is a national tobacco control strategy and goals, as well as the number of employees and overall budget for tobacco control. We use the budget information to compute the per capita expenditures in U.S. dollars. Three levels are specified for tobacco control campaigns. To qualify for a low level campaign, there must be a national agency and a positive level of funding and/or employees. To qualify for a medium level campaign, the nation must meet the requirements for a low level campaign, plus have either more than 10 employees devoted to tobacco control or per capita expenditures over $0.10 USD per capita. To qualify for a high level campaign, the nation must meet the requirements for a low level campaign, plus have per capita expenditures over $0.50 USD per capita. In developing the measures, we considered supplementary information on the extent of campaigns and national and local organization.

SimSmoke uses a reconfigured version of media campaign, the levels of which are outlined below.

Low funded media/tobacco control campaign: A national agency and at least some level of funding and/ or employees greater than zero from MPOWER, or evidence from other sources of an intermittent media campaign.

Moderately funded media/tobacco control campaign: Meets the requirements for a low level campaign, plus have either more than 10 employees devoted to tobacco control or per capita expenditures over $0.10 USD per capita from MPOWER, or evidence from other sources of a

regular media campaign.

Well funded media/tobacco control campaign: Meets the requirements for a medium level campaign, plus have per capita expenditures over $1.00 USD per capita from MPOWER, or evidence from other sources of an strong, well-focused media campaign and strong local campaigns.

Proportionate values within this range represent the degree of geographic coverage of the selected Enforcement level within the State. If the intensity of implementation is uneven in the State, the User can estimate an appropriate percentage and enter that value. For example, if a high publicity campaign is initiated in 75% of the counties in a state, then "0.75" could be entered under highly publicized campaign and a value ranging between "0" and "0.25" (in sum) for the other levels. If the intensity of the media campaign is maintained at the selected level, then the User should continue to enter "1" (or whatever proportion was entered in the initial year) for remaining years of that tracking period at that level. Changes in intensity or the cessation of a media campaign would result in greater or lesser values, or "0" as appropriate.

If no tobacco control/mass media campaign, of any level of intensity, was implemented in your state/nation during the tracking period, all values in the first cluster (of three rows) in this section will be entered as "0".

For each of the levels of mass media campaign, the effect depends on whether other policies are in place. The more effective campaigns appear to be those that are conducted in conjunction with other tobacco control policies. The likely synergy between mass media communications and other tobacco control policies in place at the same time may either be in terms of advertising the other policies directly or tailoring media content to complement other policies.

Notes: Describe in the "Notes" box any data or studies that you have on the extent of media campaigns and years for your state/nation, and any notable relationship between the media campaign and other tobacco control policies in place at the same time. Describe here any factors that may be relevant to the effectiveness of a campaign (e.g., knowledge about the dangers of smoking, ability to reach populations through the media, whether there are other policies tied in with the campaign such as local/community programs).

Marketing Ban

Record your data source and pertinent notes.

Advertising and promotions can increase the attractiveness of smoking by creating an image favorable to those considering or already engaged in smoking. Advertising restrictions may take various forms. For example, in the U.S., policies to control the advertising and promotion of tobacco products are mostly at the national level, including a ban on radio and television advertising, and attempts to limit advertising and promotions aimed at youth. At the state and local levels in the U.S., restrictions have been limited primarily to bans on advertising in particular locations (e.g., billboards) and on particular promotion practices (e.g., distribution of free samples), which are generally considered to be low levels in the model.

Studies of advertising bans have obtained mixed results, but some studies indicate a potent effect of bans when they are comprehensive. Advertising bans have been important in some of the countries successful in their tobacco control efforts, such as Canada, Poland, and New Zealand.

SimSmoke distinguishes three levels of advertising, with lower levels nested in the more comprehensive levels. These are described below.

Total Marketing Ban: Tobacco control policy attempts to restrict all three of the following marketing strategies: (1) brand stretching, in which products other than cigarettes are marked with cigarette brand name (e.g. sportswear marked with Marlboro brand name); (2) sponsorships of events; (3) free samples. In addition, the *Total Marketing Ban* includes the *Total Advertising Ban* described next.

Total Ad Ban: Ban on all forms of media (radio, print, television) advertising of tobacco products.

Partial Ad Ban: Ban on some forms of media (radio, print, television) advertising of tobacco products.

Corresponding to our three cases in reverse order, the MPOWER report provides 4 levels of data for direct marketing (advertising and point of sale) and indirect marketing (such as sponsorships, branding, or promotional discounts): 1) no policy (no restrictions on advertising), 2) minimal policy (up to 3 direct or 1 indirect ban), 3) moderate policy (4-6 direct or 1 indirect), and 4) complete policy (complete direct and indirect). The 4 levels used in the marketing ban model are cumulative of the preceding policy and correspond to the MPOWER policies. Using data in the MPOWER report, marketing bans are also affected by enforcement.

Values ranging from zero to one are possible for each of the three intensity levels of advertising bans. Proportionate values within this range represent the degree of geographic coverage of the selected advertising level within the state/nation.

> **Example:** If most of the counties have a ban on all marketing of tobacco products, you might enter "0.90" in the base year for All Marketing. Do the remaining 10% of counties have any advertising bans? If these are a total ban on print, radio and television advertising, enter "0.10" in Total Advertising Ban. If they only limit advertising on television, e.g., enter "0.10" in Partial Advertising Ban.

The characteristic of *Enforcement* requires the User to develop estimated values, either from the literature, in consultation with local experts, or independently. Values ranging from zero to one hundred percent are possible for the Enforcement characteristic associated with advertising bans. More recent models use the enforcement index based on the MPOWER Report, whereby enforcement is scored between 1 and 10, with10 the highest level. When information is not provided by MPOWER for the relevant years, compliance data can be used as a proxy, e.g., the percent of the population that recall having seen advertisements in the last year.

Proportionate values within this range represent the degree of geographic coverage of

enforcement of advertising restrictions within the state/nation.

> Notes: Describe in the "Notes" box any data or studies that you have on the extent of advertising bans and years for your state/nation. Describe how the law is applied (which media) and the extent of enforcement). Describe any notable relationship between advertising bans and other tobacco control policies in place at the same time.

Health Warnings

> *Record your data source and pertinent notes.*

One form of advertising is the logo and other material contained on the cigarette package. Instead of advertising, government may require that the manufacturers supply information about their product by requiring health warnings labels on the package of cigarettes. For package warnings to be effective, evidence indicates that they must be bold and graphic.

Strong Health Warnings: Warning regarding health risks associated with smoking that generally cover at least one-third of the package. Strong warnings are bold, graphic, and hard to ignore. They usually include pictorial content.

Moderate Health Warnings: Warnings that do not qualify as strong warnings but do communicate health risks usually using rotating messages and cover a large part of the package may be assessed as moderate health warnings. Usually, these cover at least one-third of the package.

Mild Health Warnings: Warnings that do not qualify as moderate warnings but do communicate health risks and cover a large part of the package may be assessed as mild health warnings. Usually, these cover less than one-third of the package.

The MPOWER[34] report provides 4 levels for health warnings corresponding to our measures but in reverse order: no policy, minimal policy (< 30% of the principal display area of the pack), moderate policy (a warning that covers at least 30% of the principal display area of the pack, and includes 1 to 7 of the seven pack warning criteria outlined in the Technical Note of Appendix II), and complete policy (a warning that covers at least 50% of the principal display area of the pack and includes all seven pack warning criteria (including graphic warnings) outlined in the Technical Note I as well as a ban on deceitful terms).

Currently, all states in the US adopt federal policy, which we consider a mild health warning. Warning labels have been an important part of tobacco control in some of the countries more successful in their tobacco control efforts, notably Canada, Poland, Thailand, and New Zealand. If the nation requires health warnings on tobacco products, then the User must evaluate the strength of the health warnings required: Strong or Mild. Values ranging from zero to one are possible for either level of Health Warnings, but in practice these two categories will be mutually exclusive. While *SimSmoke* allows for proportionate values within this range, representing the degree of geographic coverage of Health Warnings within the State, in practice because the requirements are usually at the nation level, the User will enter "zero" or "one" for either Strong

or Mild Health Warnings. Previous versions of SimSmoke had an explicit variable for publicity denoted *Publicity*: Moderate or strong media publicity focused on the risks of smoking. Current versions have an automatic link as described in Appendix C.

Notes: Describe in the "Notes" box any data or studies that you have on the extent of health warnings over time for your state/nation. Describe how the law is applied (size, language, and the extent of enforcement of warning requirements, etc.). Describe any notable relationship between health warnings and other tobacco control policies in place at the same time. Describe any problems that you foresee in the enforcement of health warning requirements (e.g., smuggled goods without labels).

Cessation Treatment Policies

Record your data source and pertinent notes.

In a previously published version of the cessation treatment policy module, *SimSmoke* considers the effects of mandated brief interventions delivered by health care providers to encourage patients to quit smoking, and complete financial coverage of cessation treatments with the smoker having the flexibility to choose from the array of treatment options [13,35]. Physicians receive training and their practices are monitored and the financial coverage is well publicized. In that version, cessation policies only affect first year quit rates. In current versions, the policies affect prevalence and quit rates. Cessation treatment is the most complex policy module, because there are many potential variations of cessation treatment provision.

The cessation treatment module has been revised based on recommendations from the Institute of Medicine (IOM) report to consider a more all inclusive policy. In particular, the module considers the effect of quitlines that are well publicized (e.g., through a media campaign) and encourage follow-up with multiple sessions. In addition, the quitline is accompanied by a "free nicotine replacement therapy (NRT)" program that enables quitline callers to obtain NRT for a specified period of time. The module has also been modified to allow for a direct prevalence effect as well a continuous effect on the future one-year quit rates. The effect on future one-year quit rates is halved to reflect the greater use of treatments and effectiveness of interventions in the first year of the program. In addition, accordance with the MPOWER Reports,[34] we have added a new sub-policy related to the availability of pharmacotherapies. The MPOWER cessation treatment policy model now has four sub-measures: pharmacotherapy (PT) availability, financial coverage of treatments, quitlines, and brief interventions.

The new PT availability sub-policy corresponds to the information in the Report regarding whether nicotine replacement treatment (NRT) and/or buproprion are available and where they may be obtained. The availability index was given full weight if: 1) both forms of pharmacotherapy are available, and 2) if available in a pharmacy without prescription or general store. Access policies refer to the availability of cessation treatment services, whether these services are publicized, and to what extent financial coverage (insurance) is provided for the services.

Availability of Pharmacotherapy	
NRT	**1 if NRT is provided by either general store or pharmacy w/ Rx, 2 if NRT is provided by general store or pharmacy (no Rx required). Otherwise 0.**
Buproprion	**1 if Buproprion is provided by either general store or pharmacy with or without Rx, otherwise 0.**

For treatment coverage measures, we followed the MPOWER Report, which distinguishes the following places providing cessation treatments: primary care facilities, hospitals, offices of health professionals, community, and other. The Report designates if treatments are available in most (accorded the full effect), in some (half the effect) or none (zero effect) of each location. The synergistic effect of publicity on financial coverage is captured by whether there is a high or mid-level tobacco control campaign.

Provision of treatments (including pharmacotherapy and behavioral therapy)	
Primary care facilities	0 = None, 1 = Yes in some, 2 = Yes in most
Hospitals	0 = None, 1 = Yes in some, 2 = Yes in most
Offices of health professionals	0 = None, 1 = Yes in some, 2 = Yes in most
Community	0 = None, 1 = Yes in some, 2 = Yes in most
Other	0 = None, 1 = Yes in some, 2 = Yes in most

The MPOWER Reports focus on the provision of coverage. Previous SimSmoke models focused on financial coverage of treatments. While we currently use the MPOWER classifications, we examine access to treatment through the availability of cessation treatment services (both pharmacotherapy (PT) and behavioral therapy (BT)), whether these services are publicized, and to what extent financial coverage (insurance, private and public) is provided for the services. Complete coverage of PT and BT with publicity about its availability would correspond to yes in most for the places of treatment in MPOWER.

The third category of cessation services refer to the availability and design of telephone helplines to support individuals interested in smoking cessation. The MPOWER Report distinguishes whether the nation has access to a toll-free quitline. We extend that to consider supporting characteristics of quitlines, such as type and free pharmacotherapy products.

Reactive: Refers to a quitline service that provides telephone counseling only upon receiving a call from an individual.

Proactive single session: Refers to a quitline service that, once an individual makes an initial contact with the quitline, provides a single session of counseling via telephone.

Proactive multiple sessions: Refers to a quitline service that, once an individual makes an initial contact with the quitline, provides multiple sessions of counseling via telephone.

Free NRT: Quitline service includes the offer and provision of free nicotine replacement therapy (NRT) in addition to telephone counseling session(s).

In the model, the user fills in the following:

Quitline	0 = None, 1 = Yes
Quitline type	Passive = 1, Active = 2, Active w/ follow up = 3, Default = 2.
Free NRT	1 = fully available and publicized. Can vary between 0 and 1. Default = 0

Proportionate values within the 0-1 range can also represent the degree of geographic coverage of the selected level within the state/nation.

Example: If most of the geographic areas with the state/nation have a quitline but 10% of areas do not have effective access, you might enter "0.90" in the base year for self-service bans.

The final category of cessation services is Brief Interventions. MPOWER does not explicitly consider brief interventions, but mentions their importance. We consider the following characteristics.

Required Physician Intervention: Health service providers assess patients' smoking status and provide advice consistent with smoking cessation.

Well publicized and monitored: Assumes monitoring of physician services on a regular basis and the provision of educational programs to physicians to encourage and facilitate provision of cessation treatment interventions. May involve penalties or some kind of financial incentives.

In the model, the user fills in the following:

Health care provider involvement	1 = required or adequately subsidized intervention with follow up by health care providers and with training and reminder systems. Can vary between 0 and 1. Default = 0

Values ranging from zero to one are possible for each brief intervention. These variations correspond to the percent of doctors or other health care providers that provide complete brief interventions, with a discounted effect for those health care providers that do not fully implement the policy. In other work by the developers of SimSmoke, more extensive models have been developed that consider follow-up and interactions with the financial coverage of treatments.[3,4]

Notes: Describe in the "Notes" box any data and years of the data and any pertinent information. Describe any studies on cessation treatment or cessation treatment policies for your state/nation or any information that you have on the current effectiveness. Describe any problems that you foresee in the enforcement of these programs.

Youth Access Enforcement

     Record your data source and pertinent notes.

Youth access policies aim to reduce the sales of cigarettes to minors. These policies establish or enforce laws that prohibit the sale of cigarettes by retailers to minors (usually defined as individuals under age 18). Many studies of youth access policies find that well enforced policies reduced the percentage of stores selling to youth, but a smaller number of studies indicate that the effect of youth access policies on prevalence rates has been mixed. Retail compliance rates increase when there are bans on self-service and vending machines, sufficient enforcement through compliance checks, strict penalties, merchant awareness programs, and higher community involvement.

First, the user must distinguish whether the state/nation has a ban on vending machines. We only distinguish whether there is a strict ban, but the user can scale the effect as described below.

Vending machine Ban: Vending machines are prohibited in all establishments throughout geographic area.

Self-service Ban: Consumers are not permitted to access tobacco products personally to make the purchase but must instead request specified products from the salesperson to make the purchase.

The second component of youth access policy is retail compliance policies, which involves compliance checks and penalties to violators. We distinguish three levels for states/nations that have a youth access policy.

Strongly enforced: Enforcement agency conducts repeated compliance checks at *all* retail outlets, with escalating penalties for repeat offenses.

Well enforced: Enforcement agency conducts repeated compliance checks at *most* retail outlets, with escalating penalties for repeat offenses.

Low enforcement: Compliance checks are conducted sporadically, with weak penalties or with penalties that are not generally enforced.

The final component is merchant awareness/community involvement.

Community publicity campaign: Publicity campaign focusing on entire community, including merchants, regarding youth access restrictions. Potential negative publicity for merchant violators. Potential link to community program accompanying school-based education programs.

Merchant awareness campaign: Campaign targeting merchants to ensure awareness of restrictions.

The User should refer to values entered in the *SimSmoke* mass media policy section when estimating a value for Publicity associated with youth access. If the intensity of the State's mass media campaign falls generally in the "low publicity" category, the User will probably not enter a value here for Youth Access publicity. An exception would be if the low mass media effort was entirely focused on youth access. If the intensity of the State's mass media campaign falls generally in the "moderate" or "high publicity" categories, the User may choose to enter a value here for publicity.

Values ranging from zero to one are possible for each of the three intensity levels of compliance, vending machine and self-service bans and publicity. Proportionate values within the 0-1 range can also represent the degree of geographic coverage of the selected level within the state/nation.

> **Example:** If most of the geographic areas with the state/nation have a ban on all self-service, you might enter "0.90" in the base year for self-service bans.

Notes: Describe in the "Notes" box any data and years of the data and any pertinent information on the legal purchase age, the penalties, the extent of enforcement of the laws, the other programs related to enforcement (e.g., merchant awareness programs). Describe any studies on youth access for your nation/state or any information that you have on the current effectiveness or percent of cigarettes bought from stores. Describe any problems that you foresee in the enforcement of these programs.

Potential modifications to SimSmoke

Previous versions of SimSmoke had slightly different specifications of the policies, and other policies. For example, smoke-free air laws included school based laws. Another difference is that the model developed in conjunction with the Institute of Medicine included a policy group for school-based education programs.

School-Based Educational Programs

SimSmoke Current educational programs are often not implemented in a consistent manner, do not use well tested formats and are not continuously implemented throughout middle and high school. Under these conditions, the effects of a school-based program have not been shown to be effective. However, strong, well-tested programs, implemented under public or private auspices, have been shown to reduce smoking among youth. If school-based educational programs are enhanced by community-based campaigns or a focus on youth anti-smoking messages in a mass media campaign, the synergistic effect is greater.

In *SimSmoke*, educational programs have been defined in two levels:

Strong, Proven Program with Community Component:
> Strong, proven school-based educational programs enhanced by a coordinated and supportive community component focused on youth anti-smoking.

Strong, Proven Program: Strong school-based educational programs documented to be effecting in curtailing youth smoking, implemented under public or private auspices or a combination of the above.

Values may be entered in the range of zero to one for these two descriptive characteristics of a school-based educational program. Proportionate values within this range represent the degree of geographic coverage of the program within the state/nation. The value entered for the more comprehensive Community Based Component (which includes a strong, proven school-based educational program) determines the value to be entered for the school program alone.

> **Example**. Value of "0.2" is entered for Community Based Component, meaning that 20% of state/nation implements this level of programming.
> Value of "0.8" is entered in Strong, Proven Program, meaning that the remaining 80% of state/nation implements the well tested school program in the absence of a coordinated community component.

The values entered here may not exceed one (or 100%), but do not need to sum to one. In other words, it is possible that there is no community based component to school education programs in the state/nation ("0"), and that only half of the state/nation implements the well tested school program ("0.5"). There is a potential synergy of the school based programs, particularly when coordinated with a community based component, with a mass media campaign.

Heavily Publicized Youth Anti-Smoking Message: Entering a value greater than zero here indicates that a youth anti-smoking component of medium or high intensity is part of the state/nation's mass media campaign. Values between zero and one represent the degree of geographic coverage of the program within the state/nation.

Notes: Describe in the "Notes" box any data or studies that you have on the extent of school-based educational programs and years for your state/nation, and any notable relationship between educational programs and other tobacco control policies in place at the same time.

Other Potential Extensions

The model can be used to track two other outcomes of interest: quantity and per capita consumption. Quantity is useful as a measure of the intensity of smoking, that may affect health risk and the ability to quit smoking i.e., the probability of cessation, although we note that changes in quantity may lead to compensating behavior (e.g., inhaling deeper) that may offset some of these effects. Per capita consumption may be of interest, since it is related to tax revenues and may be of interest in examining economic impacts of reductions in smoking. Per capita consumption takes into account quantity reductions and prevalence reductions (see Appendix B. We note that knowledge about the effects of policies on quantity smoked is generally less certain than knowledge about the effects on prevalence, and thus predictions of future trends is less certain.

Data Entry Quantity

SimSmoke allows Users to examine the trends in quantity smoked by age and gender. Data Entry 8 is the Quantity worksheet which requires data about the quantity and frequency different groups (by age and gender) smoke. If Quantity information is not available or if tracking or projecting quantity smoked is not the User's goal, it is not necessary to enter data on this worksheet. *SimSmoke* will be able to carry out the standard projections without this data. However, *SimSmoke* will not produce a table for Average Quantity Smoked per Smoker" without data entered on the Quantity worksheet. There are three columns for data entry for males, females, and total. These columns are defined in the table below. *SimSmoke* calculates the average number of cigarettes an individual would smoke per day if she/he smoked everyday and the average number of cigarettes smoked per day by both everyday and someday smokers in that age group.

Columns for User to Enter Data

Column heading:	%	# cigs	Days/month
What it means:	Proportion of individuals who are someday or everyday smokers. Sum of two values should add to 1.	Average number of cigarettes a smoker reports smoking on the days she or he smokes.	Average number of days in the past month a smoker reports having smoked.

If the smoking prevalence data source distinguishes whether smokers smoke every day or only on some days, then the User will enter the appropriate proportions into the % column of each age and gender group. Likewise, ideally, the number of days in the past month and the number of cigarettes per day that a smoker reports smoking is available from a data source.

The local data source may not distinguish everyday from someday smokers. If the data source provides the number of days smoked in the past month, then the User can use this information to calculate a weighted average of someday versus everyday smokers.

Technically, the User could enter "1" in the everyday smokers box (for a specific or all age/gender groups) and a "0" in the someday smokers box, or vice versa. If the data source does not provide quantity breakdowns for every day and someday, the User should consult with PIRE researchers for a revised Data Entry 8 worksheet that best meets the User's needs.

Data Entry Per Capita Consumption

PCC data is readily available for most countries by year, and serves as a measure of overall consumption that can be tracked over time and used to validate the model. PCC is sometimes referred to as tax-paid sales, and is usually measured as per capita (adult ages 18+) sales (in packs of cigarettes), and is adjusted to include inventory change, taxable removals, miscellaneous shipments, and imports.

Per capita consumption data is generally only available for the entire population, and is not broken down by age and gender. Consequently, *SimSmoke* uses only this aggregated measure as a single variable. The convention of using consumption as a percent of those ages 18 and above

is used because of the low level or absence of consumption for those below age 18.

PCC: Per capita consumption based on sales data within the geographic area of interest.

Notes: Describe in the "Notes" box at the top of the page the definition of PCC that is used. Note whether it is possible to distinguish consumption by age or other demographic characteristics (this is unlikely unless the sales data are based on a retail survey). Note if PCC is for an age group other than ages 18 and above.

Section Three. Using the Model

V. SELECTING MODEL PARAMETERS

The User's selection of varying policy options, described below, is central to the output and
purpose of the *SimSmoke* model. Also important is the impact of the choice of demographic
parameters. Graphs and tables are designed to specify whether output reflects projections for the
total population or for a single gender, and for what age group. The User makes these selections
before viewing output. Further, selecting the set of fertility rates has an impact on population
size and thus the number of smokers and the number of deaths. Different age groups may
respond differently to various policy scenarios, and so output would depend on the age
selections. The User should make these selections based on the policy, planning, or advocacy
needs that underpin use of *SimSmoke*.

Specifying Demographic Parameters

SimSmoke's dynamic population projection module requires basic demographic parameters to
produce the desired output. (See Appendix B for more technical detail).

Gender
While *SimSmoke* requires demographic data for the full population age range and both males and
females, for projection purposes the User may wish to focus on a selected age range and/or
gender.

Age
The default age group for the *SimSmoke* model is 18 to 85, where "85" represents individuals
ages 85 and older. The User may enter any age group between 0 and 85 to examine age-specific
smoking prevalence, related mortality, or (if you are developing a Policy Tracking Model) the
impact of selected tobacco control policies.

The User may wish to focus on a population of established smokers — for example, the
population of smokers ages 35 and older. Specify the selected age range on this page.

> **Reminder**
> While the User may examine *SimSmoke* output for selected
> age groups, population and smoking data for the full
> population must be entered into the Data Entry pages.

Fertility
SimSmoke is programmed to accept one of three fertility rates — low, medium, or high — one of
which the User must select. The population size over time will rely on the selected rate. In the
US model, these rates reflect the CDC (NCHS) 2003 fertility rates for the United States as a
whole. These rates are relatively stable over time, and consequently are assigned as "medium".

The default value is "medium fertility." The low fertility rate = 0.98*medium fertility rate, and
high fertility rate = 1.04*medium fertility rate. When the User chooses high or low fertility, the

model multiplies the values in the fertility data entry page by the corresponding multiplier.

Next Steps

Having selected the demographic parameters of the *SimSmoke* model, the User has completed the minimum data entry and modeling choice requirements to produce model output in the form of tables and graphs. Clicking on the "Tables and Graphs" button will take the User to the Index Page and the list of available tables and graphs. Alternatively, as from any page in the model, the User may click on the "Return to Index" button.

> Tables & Graphs

The User is advised to take this opportunity to examine *SimSmoke* predictions (smoking prevalence, attributable deaths, etc.) in the absence of further policy analysis. (The default tables and graphs created by *SimSmoke* are described in Chapter VI. Basic Output: Graphs and Tables below for guidance.)

Alternatively, the User can proceed directly to policy analysis by clicking on the button marked "policy modeling choices" on the Demographics page. (The "Policy Modeling Choices" page is also accessible through a link of that name on the Index Page.) The next section in the Manual describes these choices.

> Policy Modeling Choices

Policy Modeling Choices
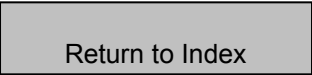
From this page, the User has a choice regarding next steps. The User may wish to refer to Choice of SimSmoke Model to Construct of this manual to review the policy modeling options in developing a *SimSmoke* model.

> **Reminder**
> If the User has not yet examined the basic model output, it is advisable to take a moment to look at the available Tables and Graphs. Model output may be accessed directly from this page through the "Tables and Graphs" button or through the ubiquitous "Return to Index" button.
>
> | Tables & Graphs | Return to Index |

As illustrated in Figure **2**, Users may be planning to assess the impact of past tobacco control policies in addition to creating projections (a Policy Tracking Model), or Users may begin in a recent base year and move directly to evaluating future policy scenarios (a Basic Model). This is

the first choice in model development. The User may have already made this choice by entering only a single year of policy data in Data Entry 9, i.e., there is insufficient data for a Policy Tracking Model. If only a single year of policy data was entered, the User is automatically developing a Basic Model.

However, if more than a single year of policy data was entered (i.e., if there is a tracking period), the User can still make a choice whether to conduct policy analyses in a Policy Tracking Model or in a Basic Model. This choice is not irrevocable, as the User may conduct policy analyses for the tracking period in some sessions, and policy analyses for the projection period in other sessions.

Past Policy Options
Using a Policy Tracking Model, the User may examine the role of different policies implemented during the tracking period. This policy analysis process is initiated through a page entitled Past Policy Options.

The Policy Tracking Model focuses on the effect of policies that have been implemented prior to the most recent year from which projections are made. Their effects can be shown on population, smoking prevalence, and smoking-attributable deaths for up to 50 years from the selected (historical) base year. Over the policy tracking period (from base year to current year), the role of different policies can be examined one at a time to measure individual impact. Looking forward into a projection period, the effects of selected tobacco control policies, implemented at different levels and different points in time, can also be examined. As described in Chapter VIII Calibration and Validation, this analysis can be used to calibrate the *SimSmoke* model.

<div align="center">

Past Policy Options

</div>

The Past Policy Options page is set up exactly like Data Entry 9. *SimSmoke* has copied the policy values that the User entered on Data Entry 9 for each policy characteristic for each year of the tracking period. Making changes to the Past Policy Options page does not change the values on the Data Entry 9 page. Unless the User saves a modified policy scenario (see Saving Modified Policy Scenarios below), every time the User opens *SimSmoke* for a new session, the values entered into Data Entry 9 will appear on the Past Policy Options page.

To examine the role of one specific policy over the tracking period, the User selects one policy at a time for analysis. Then, the User should reset the values for each of the remaining policies to their base year values (see inset box).

With all other policies reset to their base year values, the User should leave the actual values of the selected policy just as they appear. That is, the tracking period policy data entered

---

Resetting tracking period policy values to base year values

Because *SimSmoke* is programmed in Excel, this can easily be done by left-clicking once on a base year data entry cell for a given policy characteristic, positioning the cursor on the bottom right corner until a black cross appears, left-clicking again while dragging the cross across the tracking period in that row, then releasing the left-click. The value is copied to all the cells. If the User makes an error and wants to retrieve a single base year value, click the Undo arrow to restore. For larger errors, the User may choose to reset the policy values to those entered on Data Entry 10. This can be done for all policies at one time using the following button:

<div align="center">

Reset to Status Quo Policies

</div>

during Data Entry 9.   At this point, the User may access *SimSmoke* output through the selection of Graphs and Tables on the Index Page.

Examining the impact of changes to single policies is an iterative process. *SimSmoke* output will illustrate trends in smoking and health outcomes under the status quo policy scenario (using the unmodified policy values entered on Data Entry 9) in comparison to the modified policy scenario.

> **Example:** If all policies are held to base year levels except for youth access laws, the comparison presented on Graph 1 would show the impact of youth access laws on smoking prevalence in the absence of changes to other tobacco control policies over the tracking period. To record the projected impact of a single policy in the tracking period, see Saving Modified Policy Scenarios.

There is a second possible method for examining the effects of individual policies over the tracking period. Essentially, this method is the reverse of the method described above. Having selected a focal policy for analysis, all other policy levels should be left just as they appear. Then, the levels for each characteristic of the focal policy can be set to their lowest possible levels. If this policy exhibited no change over the tracking period, the lowest possible level may be represented by removal of the policy altogether, i.e., setting the policy level to zero. Alternatively, if there has been a policy change during the tracking period, the lowest possible levels could be reflected by the base year levels. These choices are up to the User but should be reflected in the interpretation of *SimSmoke* output. In *SimSmoke* graphs and tables, status quo predictions can be compared to the modified policy scenario when a single policy is set to its lowest possible level.

A Policy Tracking Model also enables the User to validate and calibrate the model in comparison to an independent smoking or health outcomes data source. Validation and calibration are described in further detail in Chapter VIII. Calibration and Validation.

Future Policy Options
The second choice illustrated in Figure **2** applies both to Basic and to Policy Tracking Models, in that both of these models create a 40-year projection period. Over the projection period, *SimSmoke* allows adjustment of future policy levels in two ways. Policy levels may be adjusted a single time as of the beginning of the projection period and retain their adjusted levels through the remainder of the projection period. If this is the User's intended approach, select the "future policy options (simple)" button.

> Future Policy Options (Simple)

Alternatively, policy levels may be adjusted in any given year of the projection period, or in multiple years of the projection period. If the User is seeking this flexibility over the projection period, select the "future policy options (advanced)" button.

> Future Policy Options (Advanced)

The level of policies in the last year for which data are available is designated as the *status quo*

level. *SimSmoke* has automatically copied the status quo policy values from Data Entry 9 into both the simple and the advanced Future Policy Options pages. On the Simple Policy Options page, the status quo policy values are background information that is translated into checklists for each policy. See Data Entry 9. Policy Values for Tracking Period for details about the numerical values that underlie each checklist option on this page. Reviewing the definition of policy characteristics in that section may also be helpful.

> ### *Resetting projection period policy levels*
> At any point in the policy analysis process, the User may click on the following button to return to the initial policy levels entered on Data Entry 9. Closing and restarting the *SimSmoke* program has the same effect.
>
> [Reset to Status Quo Policies]
>
> Clicking on this button retrieves the original policy information entered by the User, erasing any policy changes made to the tracking period, the first year of the projection period, or subsequent years of the projection period.

On the Advanced Policy Options page, the status quo policy values are presented numerically in the first projection year in data entry cells, beginning with the first projection year. *SimSmoke* initially copies the status quo policy values across the entire projection period, awaiting modification by the User.

Future Policy Options (Simple)
As noted, the status quo policies of the tracking period have already been entered into the model (see Data Entry 9) and copied onto the Policy Options pages for the projection period. Definitions of each policy and its characteristics are provided in the directions for Data Entry 9 in this manual.

The User can modify Simple Policy Options by changing the characteristics of each policy. *SimSmoke* applies adjustments to policy levels a single time — in the first projection year — and retains the modified policy levels through the remainder of the projection period.

> ### *Reminder*
> Characteristics of some policies are mutually exclusive, such as a "ban in all indoor restaurants" and "smoking restricted to separate areas," and the user should specify concurrent selection of both options at levels that exceed 100%. However, if the user determines that the policy is such that there is a ban is some restaurants (e.g., above a certain size) and restricted to ventilated areas in other restaurants, then a weight can be applied, such as 50% to ventilated restaurants and 50% to a ban.

Making selections on the Simple Policy Options page for each policy prompts *SimSmoke* to write new values into the cells on the Advanced Policy Options page. These changed levels on the Advanced Policy Options page will appear as constants over the projection period. If variable levels of future policies are the goal, then the User should go directly to the Advanced Policy Options page.

Users may want to modify the selected policies to examine the estimated impact of a policy for

planning purposes, e.g. toward attaining goals in reaching a certain level of the adult smoking prevalence. Modifying policies may also be used to produce estimates that can be used for advocacy purposes (see How SimSmoke Can Be Useful for discussion of using model output), e.g., in showing the number of lives saved by comparing the number of lives lost to smoking in the absence of the policy to the number of lives lost with the new policy in place.

Future Policy Options (Advanced)
Using the Advanced Policy Options page, the User takes the further step of *examining and adjusting future policy levels in specific years*. If the User is seeking flexibility over the projection period, the Advanced Policy Options page allows policy values to be adjusted in any given year of the projection period, or in multiple years of the projection period.

The User may be aware of specific tobacco control policies already legislated and scheduled for implementation at a set time point in the projection period, or the User may want to simulate the implementation of specific policies at specific points in time. The advanced policy options might be useful in considering the effect on smoking rates or smoking-attributable deaths if a new policy is abandoned after a specified number of years. It can also be used for planning purposes in showing the effects of policies adopted sequentially over time of showing the effects of delaying implementation of a policy.

As with any model, *SimSmoke* projects two sets of output in terms of population, smoking rates, and smoking-attributable deaths: the projections under the modified policy scenario and the comparison projection of outputs given the status quo policy scenario.

Again, selecting values for each policy on the Advanced Policy Options page follows the same instructions provided for Data Entry 9. These details will not be repeated here. Instead, we provide an example of a User's choices on this page:

> **Example**: Initially, to define the *status quo* scenario, set the tax rate for all future years equal to the current level and do not adjust prices for inflation. Then, examine the effect of changes in the tax rate and/or adjustments for inflation compared to the *status quo* scenario. You may designate different taxes for each year or you may designate a single one-time change. You may also allow cigarette taxes to adjust upward with inflation or to stay at the levels that you choose.

> *Reminder*
> *SimSmoke* automatically reverts to the status quo policy scenario (the initial policy values) each time the User opens the program. Up to two modified policy scenarios can be saved as described.

Projections for Different Age Groups

The User may be interested in projections for different age groups, either under the status quo policy scenario or in terms of the impact of selected policy scenarios on different age groups. Thus, the User may wish to save the historical policy effects (in a Policy Tracking Model) or predictions (from any projection) for different age groups. This section describes the two

methods for saving *SimSmoke* output that applies to different age groups.

One way to compare projections for different age groups is to copy and save table or graph output in another Excel file or software program. If multiple Tables reporting the same output, (e.g. smoking prevalence under a single selected policy scenario) are copied to a new Excel worksheet/workbook, the User can create a new graph that includes both projections in the same graph, i.e., copying the *SimSmoke* output to a new file, the User can compare the impact of a single policy scenario on two or more age groups in a single format. With the model output thus saved, visual comparison and analysis can proceed.

<div style="border:1px solid black; padding:10px;">

Reminder
The age group can be re-selected at any time within a single *SimSmoke* model by returning (via the Index Page) to the Demographics page. (There will be a slight pause and perhaps a flicker of the screen while *SimSmoke* recalculates projections for the new age group.)

</div>

See Using the Model for more guidance.

VI. BASIC OUTPUT: GRAPHS AND TABLES

There are two graphs and five tables included in *SimSmoke* as standard output of the model. Use of these graphs and tables assumes that you have completed the full data entry procedure *and* fully documented your data sources. Each of the tables and graphs are described below, in terms of what data they present.

Graphs or tables may be effectively included in written reports of *SimSmoke* model development and output to illustrate projected smoking outcomes and the potential effect of modified tobacco control policies. The graphs lend themselves to inclusion in visual presentations better than the tables do. In any presentation of data (written or visual), Table 5 should be included as a reference.

Graphs

Graph 1. Smoking Prevalence
Graph 1 presents the percentage (or rate) of current smokers beginning in the base year of the model and continuing though all the years of the projection.

These rates are based on the population data entered into *SimSmoke* by the User, and apply only to the current population under study. The title of the table indicates the age range for which the User has selected to project smoking rates. The User should confirm the age range of data presented in Table 1 matches the intended age range of the projection.

Two possible values of current smoking prevalence may be presented in Graph 1. These are "Status quo" and "Intervention (if applied)" which refers to the Smoking Prevalence under modified policy scenario as presented in Table 1. The former represents projected smoking rates given no change in tobacco control policies over time, i.e., the *status quo*. This line is usually

used to illustrate the effect of no new policy. The latter represents projected smoking rates given adjustments and modifications to tobacco control policies as entered by the User, or the modified policy scenario.

If no modifications have been made to the baseline tobacco control policies, only one line (in blue) will appear on the graph. A second line (in pink) will appear if the User has made modifications to current or future tobacco control policies.

Graph 2. Smoking-Attributable Deaths

Two possible values of smoking attributable deaths may be presented in Graph 2. These are "Status quo" and "Intervention" which refers to the number of Attributable Deaths under a modified policy scenario as presented in Table 2. The former represents projected attributable deaths given no change in tobacco control policies over time, i.e., the *status quo*. The latter represents projected attributable deaths given adjustments and modifications to tobacco control policies as entered by the User.

If no modifications have been made to the baseline tobacco control policies, only one line (in blue) will appear on the graph. A second line (in pink) will appear if the User has made modifications to current or future tobacco control policies.

Other potential graphs

Graph …. Number of Disease-Specific Deaths

If included, this graph would present attributable deaths in the same manner as Graph 2. However, it draws on death rates for a particular disease, such as lung cancer and relative risks attributable to a particular disease in addition to population data and smoking prevalence. The interpretation of this graph would match that of Graph 2 with the caveat of disease specificity.

Graph …. PCC, Per Capita Consumption

This graph would present the estimated per capita consumption, or the projected packs of cigarettes consumed per adult within the study population, over the modeling period. The line graph would reflects the values presented in the associated table.

Projected values of per capita consumption would limited to the total adult population. Thus, if the User has selected a specific age range that limits the *SimSmoke* projection (e.g., smoking prevalence of 35 to 54-year-olds), this age limitation would not be reflected in the PCC projections.

Graph …. AQSS, Average Quantity Smoked per Smoker

The AQSS graph would present the average quantity smoked per smoker, or the projected number of cigarettes smoked daily per individual within the study population, over the modeling period. The line graph would reflect the values presented in table by the same name.

Unlike the PCC measure, the AQSS applies to all individuals in the specified age range of the *SimSmoke* projection.

<u>Tables</u>

Table 1. Smoking prevalence under status quo and specified policy scenarios

Table 1 presents the number of never smokers, current smokers, and ex-smokers (by years since quitting) beginning in the base year of the model and continuing though all the years of the projection. These counts are based on the population data entered into *SimSmoke* by the User, and apply only to the current population under study. The title of the table indicates the age range for which the User has selected to project smoking rates. The User should confirm the age range of data presented in Table 1 matches the intended age range of the projection.

The total smoking prevalence is also presented in percentage terms, also known as the smoking rate for the total population. Two possible values of current smoking prevalence are provided in Table 1. These are "Status quo Smoking Prevalence" and "Smoking Prevalence under modified policy scenario." The former represents projected smoking rates given no change in tobacco control policies over time, i.e., the *status quo*. It is usually used to gauge the effect of no new policy. The latter represents projected smoking rates given adjustments and modifications to tobacco control policies as entered by the User.

If the User has made no changes to the tracking period (or baseline) or future policy values, then rates presented from each year under the two possible policy scenarios will be equal, and the final row in the table "Relative difference from implementing chosen policies" will show zero differences. Values less than zero indicate the projected decrease in smoking prevalence as a result of the policy modifications entered into *SimSmoke,* assuming the tobacco control policies were made stronger.

It is also possible to look at absolute differences in the comparison of the status quo and a modified policy scenario projections. *SimSmoke* is programmed to present percentage differences because it is the relative effect of a new or modified policy intervention that will most often serve the User's strategic planning or advocacy goals. Users who wish to report absolute differences are advised to cut and paste the default Table 1 output into a new Excel worksheet and calculate the differences there.

Table 2. Number of smoking attributable deaths under status quo and specified policy scenarios

Table 2 presents the number of deaths that are attributable to smoking. Two possible values of smoking attributable deaths are provided in Table 2. These are "Status quo Attributable Deaths" and "Attributable Deaths under modified policy scenario." The former represents projected attributable deaths given no change in tobacco control policies over time, i.e., the *status quo*. The latter represents projected attributable deaths given adjustments and modifications to tobacco control policies as entered by the User.

The third row of the table presents the "Per capita Attributable Deaths under modified policy scenario." For each year, this number is the "Attributable Deaths under modified policy scenario" divided by the total population, to obtain the number of attributable deaths per capita given adjustments to tobacco control policies.

If the User has made no changes to the tracking period (or baseline) or future policy values, then rates presented from each year under the two possible policy scenarios will be equal, and the final row in the table "Lives Saved under modified policy scenario" will show zero. Values

greater than zero indicate the projected number of lives saved should the policy modifications entered into *SimSmoke* be implemented in the state/nation. The projections are subject to the assumptions about the policy parameters, or the assumed effect size of each policy.

Table 3. Smoking prevalence under best case policies individually and combined

The Institute of Medicine (IOM) advisory board on smoking has identified a package of tobacco control policies believed to be effective in reducing smoking prevalence. Table 3 has been included as a default table so that the User may easily assess the impact of implementing these IOM-recommended tobacco control policies in the geographic area of interest (i.e. the *SimSmoke* study population).

Table 3 pertains to Smoking Prevalence. It details: (1) the status quo policy scenario; (2) the implementation of single policies, i.e., in the absence of changes to other policies; and (3) the combined implementation of the full package of IOM recommendations, distinguished by the level of excise tax implemented.

These tables can be used to develop graphs depicting the effect of different combinations of policies on smoking prevalence on a single graph.

The estimated smoking prevalence under each policy, i.e., in a given row of the table, is then compared to the smoking prevalence under the status quo policy scenario in terms of percent difference. The percent difference between selected policy changes and the status quo policy scenario appears in the rows underneath the estimated smoking prevalence for each policy scenario. The results presented in Table 3 (and Table 4) are generated by clicking on the "Get Best Case" button located above the table. A new Table 3 (and Table 4) should be generated when gender is changed or any policy change is made.

Table 4. Smoking-attributable deaths under best case policies individually and combined

Table 4 has also been included as a default table to enable the User to assess the impact of implementing these IOM-recommended tobacco control policies in the geographic area of interest.

Table 4 pertains to smoking-attributable deaths and, as with Table 3, it details: (1) the status quo policy scenario; (2) the implementation of single policies, i.e., in the absence of changes to other policies; and (3) the combined implementation of the full package of IOM recommendations, distinguished by the level of excise tax implemented.

These tables can be used to develop graphs depicting the effect of combinations of policies on a single graph.

The estimated smoking-attributable deaths under each policy, i.e., in a given row of the table, is then compared to the attributable deaths under the status quo policy scenario in terms of absolute difference. The absolute difference between selected policy changes and the status quo policy

scenario appears in the rows underneath the estimated attributable deaths for each policy scenario. This absolute change in deaths is equivalent to the lives saved as a result of policies.

The results presented in Table 4 are generated by clicking on the "Get Best Case" button located above Table 3. As noted previously, a new table should be generated when gender is changed or any policy change is made.

Table 5. Compilation of sources of data used in model
At the top of each of the Data Entry pages in *SimSmoke*, Users should have entered the source of the data they were entering and additional information about that data (e.g., how it was collected, how age groups needed to be modified, etc.) that may be pertinent to interpretation of model projections. Having diligently entered this source information during the data entry process, Users are rewarded in Table 7 with a compiled list of references and comments that document the development of this particular *SimSmoke* model.

Other potential tables

Table …. Number of disease specific deaths under status quo and specified policy scenarios
This table presents attributable deaths in the same manner as Table 2. However, it draws on the data pertaining to specified deaths attributable to a particular disease, such as lung cancer. The interpretation of this table matches that of Table 2 with the caveat of disease specificity.

Table ….   PCC, Per Capita Consumption
The PCC table presents per capita consumption, or the projected packs of cigarettes consumed per adult within the study population over time.

Projected values of per capita consumption are limited to the total adult population. Thus, if the User has selected a specific age range that limits the *SimSmoke* projection (e.g., smoking prevalence of 35 to 54-year-olds), this age limitation will not be reflected in the PCC projections.

Table ….   AQSS, Average Quantity Smoked per Smoker
The AQSS table presents the average quantity smoked per smoker, or the projected number of cigarettes smoked daily per individual within the study population, over the modeling period.

VII.   INTERPRETING AND PRESENTING *SIMSMOKE* OUTPUT

The process of entering basic population, smoking, and population data; making demographic selections; and investigating modified policy scenarios already integrate the interpretation and presentation of *SimSmoke* output. Having made it this far, the User has considerable expertise with the model. In this section, we present some summary comments and cautions in interpreting and presenting results, and the concept of sensitivity analysis.

Interpreting Results

Interpreting *SimSmoke* results is an art that requires careful judgment and, likely, iterative adjustments to the model. First and foremost, the User must evaluate the projected trends against reasonable expectations, in order to spotlight possible problems in the model development that require adjustment. For example, a sudden drop in smoking prevalence in the absence of a major policy change or a sharp break in attributable death trends are likely indicators of an error in model development.

The User should scan IX. Troubleshooting the SimSmoke Model to be sure that common modeling errors are not being overlooked. Further, PIRE researchers are available to review model output and may detect problems overlooked by the User. PIRE researchers should be consulted, in particular, if the User is calibrating a model or is considering changing policy parameter values.

Conducting Sensitivity Analysis

Of course, no model can be expected to predict perfectly. There will always be uncertainty, and sensitivity analysis is often used as a way to express the uncertainty surrounding a simulation model. Sensitivity analysis is conducted to show how changing key parameters or assumptions affect *SimSmoke* outcome. For example, demonstrating how outcomes change over a plausible range of values of key parameters is a common process used to show how robust the model predictions are to the different parameters.

We have made it possible to change the effect sizes of each policy (or policy parameters) without understanding all the programming in the policy pages. On the Index Page in the Model Options section, the third link is "Policy Effect Size Options." Selecting this link on the Index page takes the User to a new screen that provides a list of the effect sizes for each policy as currently programmed. Using the policy adjusters, it is relatively easy to change the default policy effect sizes in the model, and then go to the relevant output pages (Tables and Graphs) to check the new results. To date, tables have not been established to consider the sensitivity analysis for different policy effect sizes. The user will need to cut and past the relevant results to develop their own tables.

Besides policy effect sizes, sensitivity analysis may be conducted for other key parameters or assumptions of the model. Some examples are:

- ❑ Changing the general level of first year cessation, relapse or initiation rates. This can be done by generally elevating these parameters, or allowing for a trend over time.
- ❑ Changing the general level of the fertility or mortality rates. This can be done by generally elevating these parameters, or allowing for a trend over time.
- ❑ Allowing for a change in population trends, e.g., due to immigration.
- ❑ Changing the time pattern of policy effects, e.g., the years following policy in which reductions in smoking rates occur at various magnitudes.

All of these changes can be made, but procedures are currently not set up within *SimSmoke* for conducting these analyses. PIRE researchers strongly suggest that no such changes be made without consulting with PIRE first. Changes to policy parameters can have unexpected effects on the model predictions. These effects may produce faulty model output, which may not be immediately apparent to new Users of *SimSmoke*.

Presenting Results

SimSmoke predictions may be presented in a number of ways. Most simply, direct Users of the program can examine model output within the *SimSmoke* program itself. The default output compares a modified policy scenario to the status quo policy scenario. The graphs and tables may be copied and pasted into another Excel workbook or a different software format. This process allows for the simultaneous examination of more than one modified policy scenario with the status quo policy scenario — on the same graph or in the same table.

Thus, saved output may be the default graphs and tables, or new tables and graphs created by the User. In either case, saved output can be used to support an oral presentation or in the publication of public health, policy, or advocacy literature.

It is not advisable to send the *SimSmoke* model as an email attachment due to the program size. Further, because novice Users of *SimSmoke* will not have the training in model development, inadvertent changes to baseline population, smoking data, or policy scenarios may result in new and unintended model output.

Inclusion of Table 5 in a written presentation of *SimSmoke* output is advisable to document the data sources of the model.

Section Four. Adjustments to the Model

VIII. CALIBRATION AND VALIDATION

Calibration and validation help improve the fit of the model and provide an indication of its validity. The longer the policy tracking period (i.e., the longer the duration between the base year selected for the model and the current or recent year from which *SimSmoke* begins its projections), the greater the potential to validate and calibrate the model, and thus the stronger the foundation on which the *SimSmoke* projections rest.

Entering policy data that are as complete and accurate as possible during the tracking period strengthens subsequent *SimSmoke* projections. However, there are many possible reasons why even strong policy data during the tracking period is not sufficient to project actual smoking rates. For example:

- There may be problems with the smoking rate measures (especially the initiation and cessation measures), or initiation and cessation may have changed over the tracking period due to some policy not included in the model or some non-policy factor.
- There may be policies not taken into account in the model, such as local smoke-free air regulations or local programs not included in the state/nation level measures.
- The policy measures or effect sizes used in the model may not be appropriate due to some special circumstances in the state/nation.
- Tobacco control policies may have different effects on different subgroups of the population, important effects that are not captured in the policy parameters assumed in the model.
- Interactions between separate tobacco control policies, while assumed to be important, may have not been adequately studied through empirical research and are thus not incorporated in *SimSmoke* in full reflection of reality.

An iterative (and often complex) process of validation and calibration over the tracking period may adjust for gaps and inadequacies in a Projection Model, even though empirical data may be missing.

Validation tests the *SimSmoke* model specification (i.e. the selected policy values) over a specific time period to determine how well the chosen model specification fits trends observed in other data sources. If a sufficient number of years are available, the user may divide the tracking period into two, and then calibrate over the first period and validate over the second period. Otherwise, the user should just use the tracking period to validate.

The Past Policy Options page may be used in the validation/calibration process to look at the influence of particular policies on model outcomes over the tracking period. Holding all but one policy value constant at base year levels during the tracking period and examining the actual levels of a single policy during the tracking period can be useful in assessing the role of the selected policy in predicting turning points in trends.

For example, all states in the United States experienced a large increase in price around 1998-1999, which according to *SimSmoke* would lead to predictable changes in smoking rates,

especially among youth. Since there were no major changes in other tobacco control policies, all policy values may be held at their base year levels during the tracking period *except the price*. The change in price would reflect the real world increases over time. If the model output does not indicate a drop in smoking rates following the 1998-1999 price increases that is within reasonable ranges of the actual drop in smoking rates relative to trend, this process would highlight a need to calibrate the model, with changes mostly likely needed in the tax/price module.

Calibration is a technique whereby values of key inputs (e.g., fertility rates, smoking initiation or cessation rates) or policy parameters are adjusted over a specified time period to more accurately fit trends in outcomes predicted from the model to those observed from an outside source, e.g., reliable data sources or studies.

Some tobacco control policies, notably excise taxes, are represented by specific values that generally apply evenly across the state/nation. As the User experienced through the process of completing Data Entry 9, other tobacco control policies require a degree of estimation in developing parameter values for the *SimSmoke* model. The selected values in Data Entry 9 thus include an element of error, which may result in predicted smoking rates over the tracking period that do not match results from surveys. The Past Policy Options page is the place to adjust past policy values, thus calibrating the model to independently estimated smoking prevalence.

The methods for calibrating the model are discussed below. It is advisable to make minor adjustments to a single policy at a time, evaluating and recording the impact on model output. Final adjustments may consist of an array of policy changes that, as a package, yield model output that more closely mirrors outside survey estimates.

For both the validation and calibration processes, a variety of difference measures can be used to determine "goodness of fit" of the model. The most common of these is the *mean square error criterion*, but others may be equally relevant (e.g., the mean absolute error, or various bias measures).

Choosing the Calibration or the Validation Path

The validation and calibration process is an art as much as a science. Users are advised to consult with PIRE researchers before undertaking this process. To illustrate what is entailed, Figure 4 presents the decision tree of the validation and calibration process.

The first decision point is whether there are sufficient data (measured in terms of the number of years tracked in the model) entered into *SimSmoke* to undertake calibration of the model. Generally, at least 10 years of data are necessary to calibrate the model. The reason that so long a tracking period is necessary is that, to calibrate the model, the User will split the tracking period in half. Essentially, the first half of the tracking period is used to calibrate the model, while the second half is used to validate the model.

Figure 4. Model Validation and Calibration
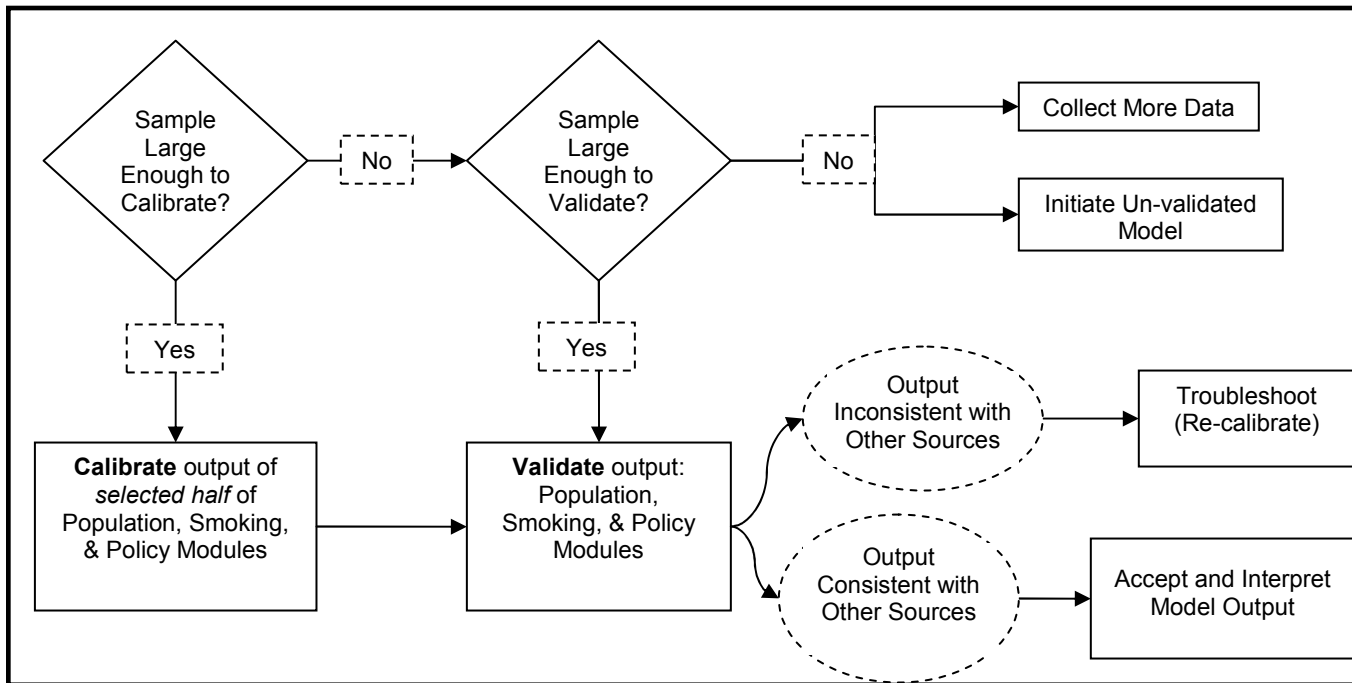
Calibration, in General

With at least 10 years of data available and a split sample, the User should examine the first half of the sample in comparison to outside data sources, adjusting data inputs as necessary. This process is described below, separately, for the population, smoking, and policies modules.

> ➢ If inspection of the first half of the sample indicates *consistency* with an outside data source, the User should proceed to validate this finding by comparing the second half of the sample to the outside data source. Consistency with an outside data source will lead the User to accept and interpret the model output.

> ➢ If inspection of the first half of the sample indicates *inconsistency* with an outside data source, the User should adjust data inputs *within the first half of the tracking period* as necessary. Once this has been accomplished with some degree of confidence, the User should proceed to validate this finding by comparing the second half of the sample to the outside data source. Inconsistency with an outside data source will lead the User to return to the process of calibration and troubleshooting.

Validation, in General

If there are not 10 years of data available to initiate a process of calibration, the User may assess whether there are sufficient data to undertake validation of the model. Generally, at least 5 years of data are necessary to validate the model. Consistency with an outside data source will lead the User to accept and interpret the model output. If the output is inconsistent with an outside data source, and troubleshooting does not improve the results, the User is advised to openly note the challenges of validation when presenting *SimSmoke* results, to deflect criticism.

If the User does not have 5 years of a tracking period, there are two options:

➢ The User may decide to collect more data (either by moving the base year of the model further into the past or by slowing development of the model to allow for the addition of passing years into the tracking period.

➢ The User may proceed to use and interpret the output of the un-validated model. In the latter case, the User is advised to openly note the absence of validated when presenting SimSmoke results, to deflect criticism.

As noted, calibration and validation constitute a complex, iterative process, and expert guidance is advised should the User wish to undertake this process.
The population, smoking, and policy modules can be validated or calibrated, independently or in concert, as described below. Generally, the population model should be validated first. The order and ability to validate the smoking and policy modules depends on the extent of policy change and whether there is a period of sufficiently little policy change to independently validate the smoking model.

Validating / Calibrating the Population Module

The population model can be compared to the actual population estimated over the tracking period or to future projections to determine how well the population model predicts. When examining future values, projections of *SimSmoke* are compared to projections from another source. Projections of state/nation populations are often available on websites. The model can be validated against the entire population or particular age/gender groups. Typically, validation/calibration is conducted first for the adult population and then, data permitting, particular age/gender groups.

Should the User's purpose be to calibrate the model, adjustments can be made to the base population, to the fertility or mortality rates, or by incorporating some excluded factor such as immigration to generate *SimSmoke* population estimates that more closely mirror estimates from an outside data source. Calibration of the population model is best undertaken under the direction of a demographer familiar with local data sources and the fertility and mortality rates of the selected population. The section Population Module also discusses possible adjustments to the population model.

Validating / Calibrating the Smoking Module

More central to tobacco control is validation/calibration of the smoking outcomes. Typically, the model outcome used to validate or calibrate the model is the estimated smoking prevalence, but other outcomes such as smoking initiation rates, smoking cessation rates, or lung cancer deaths may also be used. Typically, validation/calibration is conducted first for the adult population and then, data permitting, particular age/gender groups.

The smoking module is central to projecting *long-term changes in smoking rates in the absence of policy change*. In *SimSmoke*, the smoking module generally tends to project relatively constant future trends in smoking rates in the absence of policy change. Noticeable changes in trend (i.e., turning points in trend) generally reflect major changes in one or more policies.

To validate the model for the smoking prevalence outcome, predictions from the model that take into account all policies implemented during the tracking period are compared to actual levels and trends in smoking rates. However, if one or more policies are changing, it may be difficult to distinguish long-term changes in smoking rates from changes in policy. When there is a major policy change, it may be advisable to validate/calibrate during the time period around the major policy change first (examining percentage changes in smoking rates). Once this task is complete, distinguishing long-term trends in smoking rates can be better accomplished for validation purposes.

> ### *Reminder*
> In validating against smoking outcomes, it is important that the measure from the outside source is comparable to the outcome as measured from the model. For example, if smoking prevalence in the model is based on having smoked 100 cigarettes in one's lifetime and currently smoking, it is best to calibrate/validate against the same measure.

As well as indicating problems with the model, the estimates for levels or trends may differ because of differences in how the smoking outcome is measured, bias in the outside measure/study, or due to sampling variation in the outside source. Since the estimates at any point in time may reflect differences in how the surveys are conducted, it is most useful to focus on percentage changes in the rates over time. For example, while exact smoking rates may differ, if the percentage change in smoking prevalence (between the base year and the last year of the tracking period) is similar to the corresponding percentage change from survey data, *SimSmoke* is accurately tracking the trend in smoking.

If *SimSmoke* predictions are consistent with an outside data source, the survey data are said to validate the *SimSmoke* model. If *SimSmoke* predictions markedly differ from an outside data source, the model needs to be calibrated. The User may directly adopt the outside survey estimates of smoking prevalence (or another indicator) as accurate and modify values in *SimSmoke* during the tracking period to affect predictions going forward. Alternatively, the User may adjust *SimSmoke* values over time based on percentage changes calculated from the survey data. Calibration of the smoking model is best undertaken under the direction of an epidemiologist familiar with local data sources and smoking rates of the selected population.

Validating / Calibrating the Policy Modules

Failure to project trends in outcomes, especially smoking rates indicated by another survey source, may be due to problems in the policy module instead of the smoking module. In *SimSmoke*, the smoking module generally tends to project relatively constant future trends in smoking rates and other outcomes. Noticeable changes in trend (i.e., turning points in trend) generally reflect major changes in one or more policies. It is useful to focus on years which appear to mark changes in trends to gauge the policy modules. If survey data illustrate a sharp change in smoking prevalence, the User should examine *SimSmoke* estimates over the same period for sharp changes in trend that mirror the survey source.

If many policies are changing and/or if policy changes are small, it may be difficult to detect which policy may be the source of the problem. A large, single policy change may be easier to trace, especially one that has a strong impact or can be expected to affect a particular population (e.g., youth). Failure to predict well may reflect two disparate problems: one, how the policy is measured and/or two, the expected effect of the policy as programmed into *SimSmoke*. In checking for the former problem, the User should check the section Policy Module.

To assess the potential of the latter problem, the User may evaluate the expected effect of each policy as programmed into *SimSmoke*.   Appendix B describes the policy parameters, or the policy "effect sizes", that are currently programmed in *SimSmoke,* as well as their origins. If the User has information about a specific difference in policy effects for the selected study population (e.g., if the sociocultural environment has compounded a smoking ban to produce unusually high cessation rates), the User may wish to modify selected policy parameters to reflect that difference. Alternatively, it may be that a range of different policy effect sizes are plausible, and it may be desirable to check how these different policy parameters affect the ability of the model to predict. In conducting the policy analyses, it is useful to use the Policy Effect Size Options page (as described in Conducting Sensitivity Analysis) to change policy effect sizes and check the fit. It may be found that a particular effect size appears to improve the model relative to the default policy parameters in programmed into *SimSmoke*.

While Users are advised not to change the policy parameters as programmed, it is also possible to make these changes directly. PIRE researchers strongly suggest that no such changes be made without consulting with PIRE first. Changes to policy parameters can have unexpected effects on the model predictions. These effects may produce faulty model output, which may not be immediately apparent to new Users of *SimSmoke*.

Saving a New Calibrated *SimSmoke* Model

In most cases, the User will never save over the original Excel file that reflects the original population, smoking, and policy data entry. As noted elsewhere, an exception is if the User is attempting to calibrate the model. In this case, the User would not want to lose the basic data entry that has already been completed, but might want to save the calibration work that has been done, e.g., because the specification of data has been changed to improve the model. To save a calibrated model (whether it is still in an exploratory stage or is a completed model), the User should use the *Save As* option in the *File* menu from the Excel drop down menu or toolbar. As a result, both the original *SimSmoke* model (e.g. "Maryland.xls") and the calibrated *SimSmoke* model (e.g. "Maryland_Calibrated.xls") will exist as independent files.

IX. TROUBLESHOOTING THE SIMSMOKE MODEL

Troubleshooting is an inevitable task in simulation modeling. Some of the work may be integral to creating the model, i.e., in terms of validation and calibration (described in Calibration and Validation).

Other problems may arise. This list is not meant to be exhaustive, and you are urged to contact researchers at PIRE with any problems that are not listed below. Some common problems and tips follow:

- *When new data has been entered or a cell value is changed, the screen flickers repeatedly and seems stalled for a few seconds before settling into the expected page.*

  SimSmoke contains extensive programming code that often links more complicated actions to a simple change made by the User. When Excel is activating the necessary program code, the screen will sometimes flicker and there will be a delay of a few seconds until the programming code has been completely read and carried out.

- *Clicking on hyperlink or a button does not immediately transfer the User to the selected page.* The multiple calculation pages and programming code that form the technical foundation of a *SimSmoke* model often need time to run through the full range of coded instructions. This means that there is sometimes a delay in response to a selected hyperlink or button.

  Additionally, the User may have the Excel program set to *autosave* at a regular interval. Autosaving such a large program takes time and may interfere with regular functions while it is ongoing.

- *Changes to the Basic Policy Options page are interfering with changes made to the Advanced Policy Options page.*

  SimSmoke is programmed to copy changes made to the Basic Policy Options page onto the first projection year of the Advanced Policy Options page, and then to copy these values throughout the projection period as constants. Changes made to the Basic Policy Options page are *not* independent of the Advanced Policy Options page. However, it should be noted that while changes made to the Advanced Policy Options page do not overwrite the selections on the Basic Policy Options page, the projections in the Tables and Graphs draw on the selected Advanced Policy Options, not the Basic Policy Options.

Appendix A.   *Navigating the SimSmoke Excel File*

As described in the Overview to this Manual, the Index Page is the primary navigation page in the *SimSmoke* Excel file, although navigation from one page to another is made possible in some sections by red arrows directing the User forward or backward. The Index Page is copied in its entirety here for reference.

Model Options

      Data Entry / Starting a new model

      Demographic Choices

      Policy Modeling Choices

      Policy Effect Size Options (this page should not be changed without consulting with the model developer)

Model Output

      Graph 1. Smoking prevalence

      Graph 2. Smoking attributable deaths

      Table 1. Smoking prevalence under status quo and specified policy scenarios

      Table 2. Number of smoking attributable deaths under status quo and specified policy scenarios

      Table 3. Smoking prevalence: MPOWER recommended policies

      Table 4. Attributable Deaths: MPOWER recommended policies

      Table 5. Compilation of sources of data used in model

Data Entry Pages

      Data Entry 1. Baseline population by age and gender

      Data Entry 2. Fertility rates per 1000 women by age

      Data Entry 3. Mortality rates by age

      Data Entry 4. Economic data

      Data Entry 5. Smoking prevalence by age and smoking status

      Data Entry 6. First year cessation rate by age

      Data Entry 7. Relapse rate by age and year(s) since quitting

      Data Entry 8. The relative total mortality and disease-specific mortality risks attributable to smoking

Data Entry 9. Policy levels for tracking period

Calculations (these pages are password protected, as changing these formulas could cause errors in the program)

Calculation 1. Number of total attributable deaths

Calculation 2. Number of disease attributable deaths

Calculation 3. Adjustments to smoking initiation rates

Calculation 4 Adjustments to tax policy parameters

Calculation 5. Adjustments to tobacco control campaigns policy parameters

Calculation 6. Adjustments to advertising ban policy parameters

Calculation 7. Adjustments to health warnings parameters

Calculation 8. Adjustments to youth access policy parameters

Calculation 9. Adjustments to smoke free air policy parameters

Calculation 10. Adjustments to cessation treatment policy parameters

Calculation 11: Adjustments to income effect

Calculation 12. Calculation of death rate by smoking status and age

Calculation 13. Calculation of death rate due to specific disease by age and smoking status

Calculation 14. Calculation of number of never smokers by age

Calculation 15. Calculation of number of smokers by age

Calculation 16. Calculation of number of ex-smokers of less than one year by age

Calculation 17. Calculation of number of ex-smokers of one year by age

Calculation 18. Calculation of number of ex-smokers of two years by age

Calculation 19. Calculation of number of ex-smokers of three years by age

Calculation 20. Calculation of number of ex-smokers of four years by age

Calculation 21. Calculation of number of ex-smokers of five years by age

Calculation 22. Calculation of number of ex-smokers of six years by age

Calculation 23. Calculation of number of ex-smokers of seven years by age

Calculation 24. Calculation of number of ex-smokers of eight years by age

Calculation 25. Calculation of number of ex-smokers of nine years by age

Calculation 26. Calculation of number of ex-smokers of 10 years by age

Calculation 27. Calculation of number of ex-smokers of 11 years by age

Calculation 28. Calculation of number of ex-smokers of 12 years by age

Calculation 29. Calculation of number of ex-smokers of 13 years by age

Calculation 30. Calculation of number of ex-smokers of 14 years by age

Calculation 31. Calculation of number of ex-smokers of 15 years by age

Calculation 32. Calculation of number of ex-smokers of more than 15 years by age

Calculation 33. Calculation of cumulative impact of policies on initiation rate

Calculation 34.   Calculation of cumulative impact of policies on first year cessation rate

Calculation 35. Calculation of cumulative impact of policies on smoking prevalence rate

Calculation 36. Population check

Appendix B.   Technical Model

Although the data on population, smoking rates and policies implemented in prior years are specific to Nation/state models, most of the calculations used in *SimSmoke* rely on common mathematical relationships that are explained below. The mathematical relationships discussed in this Appendix for the most part would be the same for every *SimSmoke* model.

Modifications can be made in the mathematical equations in *SimSmoke*, e.g., to include the role of migration in the population model, or to include transitions to smoking in the smoking model, or to modify policy modules to address institutional issues in a particular nation. Because simulation modeling is an art, however, some of the calculations (used in past *SimSmoke* models and in the User's current modeling effort) may involve judgment calls. Where judgment calls may be necessary, the choices made in developing past *SimSmoke* models are described, in order to provide guidance to the User's current modeling effort.

The EXCEL *SimSmoke* model is developed in five parts:

1. The *Population Module* starts with the population for a particular year and projects forward using birth rates and death rates.

2. The *Smoking Rate Module* starts with the number of never-smokers, current smokers and ex-smokers and projects forward using smoking initiation rates, cessation rates, and relapse rates.

3. The *Smoking Attributable Death Module* uses the smoking prevalence along with standard attributable risk measures to estimate the number of total deaths attributable to smoking

4. The *Policy Modules* set the level for different smoking-related policies (Taxes, Clean Air, Mass Media, Youth Access, and Advertising Bans/Warning Labels), which, in turn, affect initiation, prevalence, and cessation rates. This Appendix discusses the general structure of all the policy modules and their relationship to the smoking module. The next Appendix discusses the mathematical structure and issues surrounding each of the individual policy modules.

5. The *Per Capita Consumption and Quantity Modules* begin with per capita consumption and survey data on quantity smoked and use the *Smoking Rate* and *Policy* modules to estimate future levels of quantity smoked.

This Appendix describes the Technical Model for each of these modules in the current version of the model. In this Appendix, the choices made in developing the U.S. *SimSmoke* model (base year 2002) are described in order to provide guidance to the User's current modeling effort. As always, the User should contact PIRE researchers if further guidance is required.

1. Population module

SimSmoke is built first on a demographic model. The population distinguished by age starts in the base year (2002 in the U.S. *SimSmoke* model, but the base year should be customized by the User). Employing a discrete first-order Markov process, the population evolves over time with a constant fertility rate (leading to births) and death rates (with some portion of the population dying at each age). We do not consider immigration or changes in racial ethnic composition for the purposes of the population module, but modifications can be made to incorporate these factors.

Mathematically, the total population (*Pop)* is distinguished by time period **t** and age **a** (and is further distinguished in the model by gender and racial ethnic group). Mortality rates (*MR)* are distinguished by age and gender. The number of newborns depends on first year deaths rates and fertility rates (*Fert)* of females by age with the assumption of equal birth rates for males and females. Births through the first year (age 0) for each gender are:

$$Pop_{t,0} = 0.5*(1-MR_0)* \Sigma^a (Pop_{t,a,1} * Fert_a), \text{ where } t=1,\ldots,20; a=14,\ldots,49$$

After the first year, the population evolves as:

$$Pop_{t,a} = Pop_{t-1,a-1} * (1 - MortRate_a)$$

2. Smoking module

SimSmoke next divides the population in the base year into (1) never smokers, (2) smokers and (3) 16 categories of ex-smokers (n=1,…,16+) corresponding to years since last smoking. After the base year, individuals are classified as never smokers (designated by **ns**) from birth until they initiate smoking or die, according to:

$$Neversmokers_{t,a} = Neversmokers_{t-1,a-1} * (1 - MortRate_{a,ns})*(1\text{-Initiation rate}_a)$$

Through age 24, the number of smokers (designated by **s**) is tracked as:

$$Smokers_{t,a} = Smokers_{t-1,a-1}*(1 - MortRate_{a,s})$$
$$+Neversmokers_{t-1,a-1}*(1 - MortRate_{a,ns})*Initiation\ rate_a$$

Since smoking rates level typically level off by age 24 [36], initiation in the model occurs until age 24. Due to empirical challenges in measuring initiation, quitting and relapse before age 24 (when there is a greater degree of experimentation), and to insure stability and internal consistency of the model, initiation rates at each age are measured net of quitting. Specifically, net initiation is measured as the difference between the smoking rate in a given age group and the smoking rate of the previous age group. Once a smoker, individuals continue in that category until they quit or die. Upon quitting, an ex-smoker may re-enter the smoking category through relapse.

Cessation is tracked from age 24, since the relative risks of mortality from smoking are not discernable for those who quit smoking before that age [33] Cessation rates in the first year are distinguished by age and gender, but relapse rates in later years are only distinguished by years since quitting (i.e., the age and gender of the ex-smoker is assumed to be unrelated to relapse

rates). Cessation rates and relapse rates are measured as described in Chapter 4.

After age 24, smokers are tracked as:

$$Smokers_{t,a} = Smokers_{t-1,a-1}*(1 - MortRate_{t,a,s})*(1\text{-}Cessation\ rate_a)$$
$$+\ \Sigma^{16}_{n=1}\ Ex\text{-}smokers_{t-1,a-1,n}*(1 - MortRate_{t,a,n})*(Relapse\ rate_{a,n})$$

First year ex-smokers are determined by the first year cessation rate applied to surviving smokers in the previous year. Individuals who have been ex-smokers for n= 2,…,15 years, are defined as:

$$Ex\text{-}smokers_{t,a,n} = Ex\text{-}smokers_{t-1,a-1,n-1}*(1 - MortRate_{a,n})*(1\text{-}Relapse\ rate_{a,n-1})$$

For individuals who have ceased smoking for more than 15 years, we add to the above equation the ex-smokers from the previous year who had quit at least 15 years ago and have not died or relapsed in the previous year.

3. Smoking-Attributable Deaths Module

Smoking-attributable deaths in the *SimSmoke* model are predicted using standard attribution measures based on smoking prevalence rates and the total mortality risks of smokers and ex-smokers relative to non-smokers. Specifically, the relative risks of smokers and ex-smokers and the death rate of a particular age group are used to distinguish the death rates of never smokers, smokers, and ex-smokers. The number of smokers (**s**) at each age is then multiplied by [the smoker death rate (**DR$_s$**) minus the never smokers death rate (**DR$_{ns}$**)] to get the excess deaths due to being a smoker, as follows:

$$Excess\ Deaths = \Sigma^n\ [Smokers_a * (DR_{a,s}\text{-}DR_{a,ns})]$$

The same procedure is applied to each ex-smoker group using ex-smoker death rates. The results are summed over smoker and ex-smoker groups for all ages to obtain the number of smoking attributable deaths for a particular year.

To estimate death rates, $DR_{a,s}$, for each smoking group **s** and never smokers **ns** were calculated for each age group and gender a using relative risks ($RR_{a,s}$) and death rates (DR_a). The death rate of an age group can be expressed as:

$$DR_a = Neversmokers_{a,ns}*DR_{a,ns} + Smokers_{a,s}*DR_{a,s} + \Sigma^n\ (Ex\text{-}smokers_{a,n}*DR_{a,n})$$

Because $RR_{a,s} = DR_{a,s}/DR_{a,ns}$ and similarly for ex-smokers, and $RR_{a,ns}=1$, and rearranging terms, the death rate for never smokers becomes:

$$DR_{a,ns} = DR_a / (Smokers_{a,s}*DR_{a,s} + \Sigma^n\ (Ex\text{-}smokers_{a,n}*DR_{a,n}))$$

For any smoking group **s*** (of either smokers or ex-smokers), we multiply both sides by $DR_{a,s*}/DR_{a,ns}$ to obtain the death rate:

$$DR_{a,s*} = DR_{a.g}* RR_{a.s*} / (Smokers_{a,s}*DR_{a,s} + \Sigma^n\ (Ex\text{-}smokers_{a,n}*DR_{a,n})$$

As described above, we then take the difference between each smoking group death rate and the never smoker death rate and then multiply the excess death rate times the number of individuals

in that smoking group and sum over the different age and gender groups and smoking groups to obtain total smoking attributable deaths.

4. Policy modules (overview)

In separate policy modules, we examine the effect of tax changes, smoke-free air laws, marketing restrictions, health warnings, tobacco control campaign/mass media policies, and cessation treatment policies. In some models, we also include school education policies and strategies to reduce youth access to cigarettes. The original policy parameters in *SimSmoke* used to generate the predicted effects are based on thorough reviews of the literature and the advice of an expert panel. These parameters have been reviewed by the IOM committee in the US and either accepted or modified, and are for countries reviewed by experts in other countries when feasible. In the case of cessation treatment and school education policies, significant changes have been made in the structure of the original *SimSmoke* policy modules. These policy parameters (effect sizes) are discussed in Appendix C. In this section, we discuss only the general structure of how policies affect smoking rates in *SimSmoke.*

The effects of policies are calculated in percentage terms relative to the initial rates:

PR= (post-policy rate - initial rate)/initial rate
where PR<0. For most policies, their greatest effect is generally in the first few years in which the policy is in effect. These are modeled as a permanent additive effect on smoking prevalence, i.e.:
Smokers$_{t,a}$ * (1+PR$_{i,t,a}$)
for policy **i** at year **t** in which the policy is first implemented and which may vary by age **a**. While the effect may be spread over several years, we generally model these initial effects as occurring in the first year that the policy is in effect.

If the policy is maintained, the effects of the most policies (the exception being cessation treatment policies) are maintained through modification in the initiation rates. The effects may be the same or differ from the prevalence effects. The percentage reduction is applied from the years **t+1** and during which the policy is in effect to the initiation rate as follows:

Initiation rate$_a$ *(1+PR$^I_{i,a}$)

The prevalence effects of the policy may be enhanced over time through increases in the first year cessation rate as follows:
Cessation rate$_a$ *(1-PR$^C_{i,a}$)
First year quit rates continue to be elevated for each of the policies (except youth access and school education policies), because policies create stronger incentives to quit (e.g., prices are higher or places to smoke become more restricted) and reduce the quantity smoked per smoker so that quitting is more likely among those who smoke less. We generally assume that relapse rates are unaffected by the policy, except insofar as the amount of relapse increases in proportion with the added amount of cessation.

Unless otherwise indicated, the same proportionate effect of a policy is applied to the prevalence, initiation and cessation rates when a new policy is implemented and maintained. When a long-

standing policy is reversed, it is sometimes assumed that only initiation and cessation rates are affected, i.e., the effects of a policy are asymmetric in terms of implementation of a proactive policy and the scaling back of that policy. We expect that individuals who have quit and maintained cessation over a reasonable period of time are unlikely to relapse when the policy is abandoned, although future initiation rates will be higher and cessation rates will be lower. Policy effects may also vary by age. For example, some policies are directed at and are expected to primarily affect youth.

When more than one policy is in effect, there may be synergies built into the model as described below. Otherwise, it is generally assumed that there are constant proportional reductions, i.e., *(1+PR$_i$)*(1+PR$_j$)* for policies **i** and **j**. This formulation implies that the relative effect of a policy is independent of other policies in effect, but the absolute reduction is smaller when another policy is in effect (due to the reduction in smoking rate from the other policy).

3. Per Capita Consumption (PCC) and Quantity Modules

Some models incorporate quantity smoked and per capita consumption. These outcomes are tracked over time the same as smoking rates.

The model begins with the measured level of PCC in the base year. In future years, PCC is projected adding the annual percentage changes in its components, calculated as:

$$PCC_{t+1} = PCC_t(1+ \%\Delta PCC)$$

where %ΔPCC is the percentage change in PCC between t and t+1. Since PCC equals smoking prevalence multiplied by the average quantity smoked per smoker, we decompose PCC into quantity and prevalence changes using the relationship:

$$\%\Delta PCC = \%\Delta Prev + \%\Delta Quantity$$

Substituting in that equation for each of the components, we predict future levels of PCC as:

$$PCC_{t+1}=PCC_t*(1+ \%\Delta Prev_{stat\ quo,t} +\%\Delta Prev_{pol,t} +\%\Delta Quantity_{t.stat\ quo}+\%\Delta Quantity_{t.pol})$$

As a census of all sales, PCC does not distinguish by age. Since the effects of policy on prevalence differ by age in *SimSmoke,* we weight the age-specific policy parameters by the proportion of smokers in each age group ages 18 and older to obtain a "policy adjuster" for all adults. The %ΔPrev$_{stat\ quo,t}$ and %ΔPrev$_{pol,t}$ parameters, as described above and more fully in Levy et al.,[17] are already incorporated in *SimSmoke* . The policy adjuster and status quo growth parameter are described below.

Modeling Quantity Changes

Quantity is modeled as varying by age and gender. Parallel to the modeling of smoking prevalence, quantity trends are modeled in terms of percentage changes in quantity, where the percentage change in Quantity between years t and t+1 is decomposed into status quo and policy changes, or:

$$\%\Delta \text{Quantity} = \%\Delta \text{Quantity}_{\text{stat quo}} + \%\Delta \text{Quantity}_{\text{pol}}$$

Status quo changes are characterized as gradual, long-term trends in quantity smoked due to cohort effects, changes in the demographic composition of smokers, and differential cessation rates. Long-term changes may reflect past policies, such as how different smoking cohorts having different intensity and cessation patterns reflecting the policies that were in effect when they initiated smoking. We distinguish policy-induced changes as the more abrupt changes that occur as a result of implementing a new tobacco control policy or set of policies. Similar to policy-induced changes in prevalence, the bulk of the changes may be expected to occur within a well defined period following the change in policy, although longer term effects may also ensue through changes in initiation, cessation and relapse rates.

The policy effect parameters are based on studies which directly relate variations in quantity to variations in tobacco control policies, while status quo effect parameters are measured based on long-term trends in the average quantity smoked after controlling for the effects of policy. Few studies examine long-term trends in quantity smoked. A recent study[37] examines the role of policies in quantity trends in the United States between 1974 and 1990, when policy changes were largely confined to changes in price. For the period 1990-2003, a downward trend in quantity of 0.5% per year was found after controlling for price (the major source of policy change).

A literature review[37] found that studies of taxes, clean air/worksite restrictions, and media campaigns indicate with considerable consistency that quantity smoked and prevalence respond similarly in percentage terms to variations in policy, although some evidence from clean air studies indicates that the effects on quantity may be slightly dampened as those who become lighter smokers quit. Based on the literature, we create a policy effect adjuster for quantity (hereafter referred to as the "policy adjuster") that relates the policy-induced quantity changes, which are new to *SimSmoke*, to the policy-induced changes in the prevalence rate that are already in *SimSmoke*. We use a policy adjuster of 100% of the prevalence policy effect (i.e., the same percentage policy effect on quantity as on prevalence). The policy adjuster parameters are applied only to the price, clean air and media policies.

Calibration and Validation of the PCC/Quantity Module
Because PCC data is available for each year, we used that data to calibrate and validate the model. For the US, we split the sample, using the years 1993-1998 to calibrate the model and the years 1999-2004 to validate the model. To calibrate (1993-1998), the predicted values of PCC were compared using a mean square error criterion to actual levels of PCC over the parameter ranges for the two quantity parameters (the policy adjuster and the status quo quantity growth parameter). We then search over the range between the best fitting parameters to develop a "best fit" model. To validate, we compare the results of both the best fit and alternative models to actual levels of PCC over the 1999-2004 period.

July 31, 2006

Appendix C.   Policy (Effect Size) Parameter Values

This appendix summarizes the literature and preliminary modeling work that underpin the policy parameter values used in the most current version of the policy modules of *SimSmoke*, which has been developed as a full U.S. model with 2002 as the base year. Policy values represent the size of the effect of each selected policy characteristic on smoking prevalence. Because some of the policy effect sizes have been insufficiently studied through empirical research, many of the values described below were derived by a panel of experts overseeing the development of *SimSmoke,* including a recent panel of the Institute of Medicine.[38]

We note that part of the intent of the model is to encourage studies specifically for the state or nation, especially when such studies are lacking. These studies may then provide the basis for improving parameter estimates. The User's feedback on the appropriateness of policy values currently used in *SimSmoke* is important to PIRE researchers. If you have feedback, please contact PIRE researchers.

The model is set up to do sensitivity analysis on "Policy Effect Size Options" worksheet. If the User is interested in modifying the parameter values based on information specific to the particular Nation/State for which the *SimSmoke* model is being developed, the first step would be to develop reasonable estimates consistent with the structure of the model. While the User may make modifications directly in the parameter page of the model, but the parameters need to be within acceptable ranges. Some discussion of relevant ranges can be found in Levy et al. (2007).

PIRE researchers may be able to provide valuable guidance in that process or may suggest that PIRE undertake those modifications on the User's behalf. At a minimum, it is extremely important that PIRE know if the User is making modifications, and that any modifications to the default policy parameters are noted in any report referring to the new *SimSmoke* model, as these changes would render comparisons to other *SimSmoke* models more complex.

The policies are described and their effects listed in the Table below. Following is a description of parameters and structure of each of the policy modules. For a more detailed discussion, see papers listed in the last Appendix, recognizing that some of the modules have been modified as new information has become available.

Table 1. Policy Specifications and Effect Sizes Used in MPOWER SimSmoke

POLICY	SPECIFICATION	EFFECT SIZE (% Effect)*	Aware-ness Parameter	Rural/ Adjustor
Tax/Price Policy				
Retail price of cigarettes applied to past policies	Price in MPOWER for 2006 as modified using EIU data for other years	Based on nation-specific price elasticities, vary by age, applied to tracking period	no	no
Tax (total) as a percent of Price as applied to future prices	Tax percentage for total taxes used in MPOWER	Same price elasticities, higher taxes are passed along to consumers, applied to future rates	no	no
Smoke-Free Policies				
Type				
Smokefree ban in all indoor workplaces	MPOWER by Type	6%	1.5	yes
Ban in indoor offices only	MPOWER by Type	4%	1.5	yes
Ban in health facilities, universities, govt. facilities (2 of 3)	MPOWER by Type	2%	1.5	yes
Restaurants: Smoke free in all indoor areas	MPOWER by Type	1%	1.5	yes
Pubs and bars: smokefree	MPOWER by Type	0.5%	1.5	yes
Other Places: Smokefree	MPOWER by Type	0.5%	1.5	yes
Enforcement	MPOWER: 0-10	25% of above effect depends on % enforcement (out of 10)		
Publicity	Based on level of tobacco control funding	25% of above effect depends on publicity from tobacco control campaigns		

Tobacco Control Campaigns				
Well funded media/tobacco control campaign	Meets requirements for a medium level campaign, plus have per capita expenditures > $0.50 USD per capita, or strong media and local campaigns	6.5%	1.5	yes
Moderately funded media/tobacco control campaign	Meets requirements for a low level campaign, plus have more than 10 tobacco control employees or per capita expenditures > $0.10 USD per capita, or repeated multi-media campaign	3.3%	1.5	yes
Low funded media/tobacco control campaign	A national agency and at least some level of funding and/ or some employees, or intermittent media campaign	1.0%	1.5	yes
Other policies in place	if 2 of 3 = tax.> 50%, workplace ban, advertising ban, or either health warning or cessation	half of above effects if not = 1		
Marketing Bans				
Ban on direct and indirect marketing	MPOWER: score = 4	Prev. reduced 5%, cess increased by 3% and init. reduced by 6%.	2	no
Ban on advertising	MPOWER: score = 3	Prev. reduced 3%, cess increase 2% and init reduced by 3%.	2	no
Partial ban on advertising	MPOWER: score = 2	Prev. reduced 1%, cess not affected, init reduced by 1%.	2	no
No restrictions	MPOWER: score = 1	no effect		
Enforcement	MPOWER: 0-10	50% of the above effects depends on % enforcement		

Health Warnings				
Very strong health warnings	MPOWER: score = 4	Prev reduced 2%, cess increased 10% and init reduced 2%.	2	no
Strong health warnings	MPOWER: score = 3	Prev reduced 1.5%, cess. is increased 5% and initiation is reduced 1%.	2	no
Mild health warnings	MPOWER: score = 2	Prev. is reduced 1%, cess. is increased 1% and initiation is reduced 0.5%.	2	no
No warnings	MPOWER: score = 1			
Cessation Treatment Policies				
Availability of Pharmacotherapy				
NRT	MPOWER: 1 if NRT is provided by either general store or pharmacy w/ Rx, 2 if NRT is provided by general store or pharmacy (no Rx required). Otherwise 0.	Prev. reduced 0.667% and cess. increased 4% if available at general store and half that amount if prescription only		
Buproprion	MPOWER: 1 if Buproprion is provided by either general store or pharmacy with or without Rx, otherwise 0.	Prev. reduced 0.334% and cess. increased 2% if available at general store and half that if prescription only	1.5	yes
Financial coverage of treatments (including pharmacotherapy and behavioral therapy)				
Hospitals	MPOWER: 0 = None, 1 = Yes in some, 2 = Yes in most	Indicator: If 2=0.25, if 1= 0.125		
Offices of health professionals	MPOWER: 0 = None, 1 = Yes in some, 2 = Yes in most	Indicator: If 2=0.25, if 1= 0.125		
Community	MPOWER: 0 = None, 1 = Yes in some, 2 = Yes in most	Indicator: If 2=0.25, if 1= 0.125		
Other	MPOWER: 0 = None, 1 = Yes in some, 2 = Yes in most	Indicator: If 2=0.25, if 1= 0.125		

		If indicator >= 1 and well publicized, prev. reduced 2.25%, and cess increased 12%	1.5	yes
Quitline	MPOWER: 0 = None, 1 = Yes	Prev. reduced 0.5%, and cess. increased 5%	1.5	yes
Brief Interventions	Percent of Physicians providing advice	Prev. reduced 0.5%, and cess. increased 10%	1,5	Yes
Comprehensive Cessation Treatment Policy (all of above)	Complete reimbursement of pharmaco- and behavioral treatments, quitlines, and brief interventions	2.6% reduction in prevalence, 50% increase in cessation rate	1.5	Yes
Youth Access Restrictions				
Strongly enforced & publicized	Compliance checks conducted 4 times per year per outlet, penalties potent and enforced, and with heavy publicity and community involvement	Prev and init. reduced 30% for age < 16 Prev and init. reduced 20% if ages 16,17		
Well enforced	Compliance checks are conducted regularly, penalties are potent, and publicity and merchant training are included, but there is little community support	Prev and init. reduced 15% for age < 16 Prev and init. reduced 10% for ages 16 & 17		
Low enforcement	Compliance checks are conducted sporadically, penalties are weak, there is little merchant awareness and minimal community participation	Prev and init. reduced 3% for age < 16 Prev and init. reduced 2% for ages 16 & 17		

* Unless otherwise indicated, the effects are on prevalence in the first year, and on initiation and first year quit rates during the years that the policy is in effect. Note that actual effects will depend on policies previously in effect.
** Affects prevalence and first year quit rates only
Prev= smoking prevalence rate, Cess.= first year cessation rate, Init. = initiation rate

Direct modifications are made in some of the policy effects for individual countries, especially as they relate to LMICs relative to HICs. Two main types of adjustments that pertain primarily to LMICs are made using scale factors. The first, **URBAN** ($> 0, \leq 1$), is for the degree of

urbanization and is generally meant to capture difficulties in reaching populations that are in more rural areas. This variable is measured as [(1-the percent of economy in rural trades [agriculture] in a country/percent of economy in rural trades) / (1- the percent of the economy in agriculture the U.S.)], based on information from the CIA FactBook (www.theodora.com). Because less than 1% of the economy in the U.S. is employed in agriculture, we omit the denominator (implying a value of one). The other scale factor, **AWARENESS** ($\geq$ 1) is for the potentially a greater impact of awareness about the dangers of smoking in countries where such information is at a lower base level than in the U.S. The level of **AWARENESS** depends on the policy, as designated below. The level of **AWARENESS** is applied to LMICs where information is less well-disseminated than in HICs. These scale factors are applied multiplicatively, so that the effect sizes become *(1+URBAN$_i$* *AWARENESS$_i$* *PR$_{i,a}$)* for the prevalence and initiation effects and *(1+URBAN$_i$* *AWARENESS$_i$* *PR$_{i,a}$)* for the cessation effect.

Taxation Policies

In the tax module,[10] price increases are modeled as age-specific constant proportional effects on prevalence, initiation, and cessation rates.[10] Based on economic theory, cigarette use is determined by the changes in the retail price relative to the prices of other goods, as measured by the participation (i.e., prevalence) demand elasticity, i.e., the percentage change in consumption from a 1% increase in price. Based on the studies that distinguish by age, the US *SimSmoke* assigns a price elasticity of -0.4 for individuals below age 18, -0.3 for those ages 18 to 24, -0.2 for those ages 25 to 34, and -0.1 for those ages 35 and above. Based on additional evidence and the increasing importance of internet sales, the elasticity estimates have been lowered since our earlier work.[10] Sensitivity analysis is conducted at 75% to 125% of the parameters.

The current policy parameters are based on U.S. studies. Studies indicate larger effects for lower income states. However, some of the effect of increased tax may be eroded by leakages. Some examples of leakages that may be important in state and national models include:

- Smuggling across state lines or country borders
- Internet purchases
- Substitution between different brands or types of cigarettes, when different tax rates are imposed
- Other types of related products, including untaxed cigarettes (e.g., greater use of homegrown, roll your own tobacco). Other leakages may occur if there are other tobacco products (e.g., smokeless tobacco, pipes) that are untaxed or taxed at lower rates.

Each of these factors could affect elasticities. The User may adjust the parameter values in red for how much the price changes in response to the tax or the prevalence elasticity to reflect these circumstances. Alternatively, enforcement against smuggling and other types of tax evasion may be explicitly modeled using a set of equations, e.g., similar to the underlying model for youth access enforcement.

The tax policy module in *SimSmoke* follows the MPOWER Report and specifies the tax in percentage terms relative to the retail price. In keeping with the recent recommendations under MPOWER, we generally consider the effect of increasing excise taxes to 70% of the retail price. In some cases, we consider higher tax rates, because the non-tax portion of price is low relative to the standard of living. In countries where the tobacco industry or government monopoly sees

potential for future growth, the non-tax portion may be kept low to encourage growth in the number of smokers.

The taxation effect works through price. In SimSmoke, the effect of price depends on price elasticities (obtained from relevant studies), which are assumed to be constant in SimSmoke. The formula for constant price elasticity, **E**, is defined in terms of the price, **P**, and quantity, **Q**, both distinguished by their new level, designated by subscript **n**, and their initial level, designated by subscript **t**. The formula is written as:

$$E = [(Q_{t+1} - Q_t)/(Q_{t+1} + Q_t)]/[(P_{t+1} - P_t)/(P_{t+1} + P_t)], \ E < 0.$$

To solve for Q_t, the equation is rewritten as:

$$[(Q_{t+1} - Q_t)/(Q_{t+1} + Q_t)] = E*[(P_{t+1} - P_t)/(P_{t+1} + P_t)]$$

Denoting $\Delta = E*[(P_{t+1} - P_t)/(P_{t+1} + P_t)]$, the equation can be solved for

$$Q_{t+1} - Q_t = \Delta(Q_{t+1} + Q_t), \ \text{or}$$
$$Q_{t+1} = Q_t *(1 + \Delta)/(1 - \Delta).$$

Since we focus on participation rates, **Q** translates to the number of smokers for relatively small changes in population. In order to distinguish the effects for different periods, let Δ_t denote the effects of a price change between periods **t** and periods **t-1**. Let $\delta_t = (1+\Delta_t)/(1-\Delta_t)$, then

$$Q_{t+1} = \delta_t * Q_t.$$

The elasticities vary by age based on U.S. data (as described in the text) and are scaled by country relative to the U.S., usually in terms of overall elasticity (participation and conditional quantity), depending on the type of elasticity available. For example, the average overall elasticity for the U.S. is 0.4.[39]

Actual prices adjusted for inflation are used for the tracking period. Future price changes occur through tax increases, which are specified as a portion of price. Future inflation adjusted prices are assumed constant in the absence of a tax change.

The model assumes that prices increase in absolute terms with the amount of the cigarette tax, based US evidence[40] and evidence from other countries.[41] Let T_t be the tax rate as expressed as a percent of price in period **t**. To derive future prices, we first estimate the price net of taxes, **PNT,** as the retail price, P_t, multiplied by (1-**T**) for the last year before projection. Assuming that the factory price (after adjusting for inflation), the import and value added tax and the average percent markup by the manufacturers and foreign tobacco firms remains constant, the amount of the total tax will be equal to **T**/ (1-**T**) times the price net of taxes [42]. Then the retail price can be re-written:

$$\mathbf{P_t} = PNT + PNT *T_t/(1-T_t),$$

where the second term is the amount of the price that is taxed. We assume that the net of tax price remains constant and that prices increase by the amount of the tax, so that the new price is obtained by substituting the new tax T_{t+1} for $\boldsymbol{T_t}$ in the second term.

Taxes on cigarettes may include value added taxes, import taxes and excise taxes. We generally ignore import taxes in our analysis, since they are rare or a small percent of price. Excise taxes apply only to cigarettes and may be implemented in percentage terms, i.e., ad valorem taxes, or fixed amounts per unit, i.e. specific taxes. In our analysis, the value added tax (VAT, in percentage terms) is held constant, since it applies to all goods, not just cigarettes, and it is applied to excise taxes as well as the price net of taxes. Consequently, it amplifies the effect of an excise tax increase, so that the excise tax as a percent of price diminishes when price adjusts to a new level. Consequently, two cases can be considered: 1) where the excise tax is increased to 70%, but after adjustment of the VAT no longer equals 70%, and 2) where the excise tax is further adjusted, after allowing for the effect of the VAT, so that it equals 70% of the final retail price. When the effect of the VAT is incorporated, the VAT is included in $\boldsymbol{T_t}$ in calculating the price net of tax and amount of the tax. To exclude the amplifying effect of total taxes, the user can only include excise taxes in $\boldsymbol{T_t}$ in calculating both the price net of tax and the amount of the tax.

Smoke-Free Air Policies

Three types of smoke-free air policies (worksite, restaurant and bars, and other public places) are included in MPOWER *SimSmoke*, with the effect of worksite further distinguished by its stringency. Worksite bans are distinguished corresponding to data provided in the MPOWER Report as: 1) partial as designated by a ban in 2 of the 3 types of facilities: health, university, and government facilities, 2) ban in indoor offices only, and 3) ban in all indoor workplaces (including offices and other indoor workplaces, universities, and government). These policies are cumulative, i.e., inclusive of the previous policy, with the MPOWER target policy a complete ban. Consistent with the MPOWER Report, the model distinguishes only a total restaurant ban and a total ban in bars and restaurants. The MPOWER model includes a ban in pubs and bars. The model includes bans in other public places, based on the corresponding MPOWER variables, public transport, and supplementary information. An enforcement index is based on the MPOWER Report, whereby enforcement is scored between 1 and 10, with 10 the highest level. In addition, publicity is directly dependent on the level of tobacco control campaigns.

The basis for these estimates is described in Levy et al.[15,43,44] For worksites, the effect size is consistent with Fichtenberg and Glantz [45] after converting their 3.8 percentage point prevalence reduction into relative terms and scaling for percent of the workers affected. Effects of similar or larger impact in relative terms have been observed in recent studies for Italy,[46] Korea,[47] Norway,[48] Finland[49] and Spain.[50] The effects of bans in restaurants, bars and other public places, and of enforcement have received little attention.

Since the effect size parameters are based on studies for industrialized nations with high employment rates, adjustments are made based on agricultural employment and the labor participation rate specific to the nation. Effects for worksite and restaurant laws were scaled back by as much as 40% when a high percentage of the working population is involved in agriculture

or is unemployed. However, the effects were increased by a factor of 1.5 for LMICs without previously active tobacco control policies, due to the greater potential to affect attitudes towards smoking (e.g., through increased knowledge about the dangers). Sensitivity analysis is conducted at 0% to 200% of the value for the information and urbanization effect.

For LMICs, the effects are adjusted downward by using the URBAN index to account for the percent of the population not affected due to lower rates of labor working in indoor workplaces and increased by 50% in a country in an LMIC without previously active tobacco control (then **AWARENESS** = 1.5, and otherwise = 1). In addition, while half of the effects occur automatically through passage of the law (e.g., due to a change in norms), the other half of the effects depend on enforcement ($0 \leq$ **ENF** ≤ 1, using the MPOWER index=1,…10 divided by 10 to be scaled to 1) and a publicity index based on tobacco control spending (= .5 if no tobacco control spending is low or non-existent, 0.75 if tobacco control spending is medium, and 1 if tobacco control spending is high).

Letting *SFL'* equal the effect size of type **k** for a HIC with high enforcement and publicity, the effect SFL_i for country **i** is:

$$SFL_{i,k} = SFL_k' * URBAN_i * AWARENESS_i * 0.5 (1+ENF_i*PUB_i).$$

The User's evaluation of enforcement (for inclusion in the model) may depend on local attitudes and behaviors. In some countries, a strict worksite ban may not be enforceable to any significant degree. In that case, even a strict ban may not have any effect. The social acceptance is likely to depend on the percentage of indoor workers who smoke and attitudes toward smoking in public. The effects of the policy may also depend on the other policies in effect, since other laws may increase public acceptance of the law. The size of effects for worksite laws may be adjusted downward if the law is unlikely to be accepted or enforced.

The size of effects may depend on other factors not in the *SimSmoke* model, such as:

- The percent who work indoors. In rural areas, clean air laws are likely to be of little consequence, since workers, often agricultural workers, work outdoors. The effects of a worksite law would then depend on the percent of the population that lives in rural areas and whether that rural population has different smoking rates than the urban population. There is an urban/rural adjustor to adjust for whether the percent of rural/agricultural worker is greater than in the US (about 2% of workers).

- Percent privately covered: The impact of a new clean air law may also depend on the percentage of the population already covered by private restrictions. When worksite laws are enacted, smokers in firms already subject to smoking restrictions have probably already been influenced by the restriction, but the new law may impose stricter requirements than those previously adopted by the firm and the public sanctioning of restrictions may change public attitudes, thereby increasing compliance.

- Labor participation, especially among females, may also influence the effect of laws. While these are not characteristics that the User currently can enter into the *SimSmoke* model, this additional discussion is intended to help the User assess the relevance and

impact of the selected Clean Air Law options.

In some older versions of SimSmoke, smoke-free air laws in schools are considered. The effects of these laws, however, are not well known, and are expected to be small.

Mass Media

The mass media policy module is based a model of the effect of media campaign expenditures on smoking prevalence.[12] Media expenditures must be high enough for messages to reach potential smokers and quitters a sufficient number of times, but after a threshold additional expenditures show diminishing returns. The effects of media campaigns also depend on other policies that are currently in place. In particular, many states have comprehensive programs, as well as local programs and cessation treatment programs. These can also be accompanied by tax increases. These other programs create added publicity which reinforces the messages of the media campaign, thus having more potential to change attitudes toward smoking. The model distinguishes policies aimed at the entire population and those aimed primarily at youth.

The MPOWER report provides information on whether there is a national tobacco control strategy and goals, as well as the number of employees and overall budget for tobacco control. We use the budget information to compute the per capita expenditures in U.S. dollars. Three levels are specified for tobacco control campaigns. To qualify for a low level campaign, there must be a national agency and a positive level of funding and/or employees. To qualify for a medium level campaign, the nation must meet the requirements for a low level campaign, plus have either more than 10 employees devoted to tobacco control or per capita expenditures over $0.10 USD per capita. To qualify for a high level campaign, the nation must meet the requirements for a low level campaign, plus have per capita expenditures over $0.50 USD per capita. In developing the measures, we considered supplementary information on the extent of campaigns and national and local organization.

The intent of this model is not only to capture the establishment of an organized tobacco control campaign, but also the impact of funded programs. An important part of most campaigns is the level of communication through media and other sources, including publicity generated and local programs. Information on funding for media campaigns was not available, but the model incorporates synergies arising from publicity surrounding other tobacco control policies, such as taxes. An *Other Policies* variable is computed with a value of 1 if 2 of the following 4 policies are in are in effect: the tax is greater than 50% of the retail price, a complete workplace ban, at least a complete advertising ban (=3 or 4), or at least strong health warnings (=3 or 4), and otherwise has a value of 0.5.

The degree of urbanization affects the ability to reach rural populations through the media and even local campaigns, and is taken into consideration in examining the effect of tobacco control spending. However, the level of awareness is expected to be low in LMICs that have not had prior policies, and for those countries is accorded a value of 1.5. For tobacco control spending at level **k** at effect size *TC'* in a HIC, the effect for country **i** is:

$$TC_{i,k} = TC_k' * URBAN_i * AWARENESS_i$$

SimSmoke uses an effect size of 6.5%. A moderately funded campaign yields an effect size of 3.25%, and a low funded campaign yields an effect size of 1%. Without other policies in place, the effects are reduced by half. Because previous studies are for HICs, adjustments are made for the degree of urbanization (based on the percent of workers in agriculture) to reflect the ability to reach potential smokers and the initial level of awareness (with scale factor 1.5). Sensitivity analysis is conducted at 50% to 150% of these values.

The early California, Massachusetts and Arizona (after the first year) campaigns directed their efforts to all ages. In Massachusetts, where price stayed constant, there was a 6% reduction in prevalence with no price change and similar effects are implied for California after netting out prices [51]; [52]. Farrely et al.[53] estimated that tobacco control expenditures at high levels (including an intensive media campaign) would reduce per capita tobacco consumption (which includes prevalence and quantity smoked per smoker) by 8%, and a more recent study by the same authors yields larger effects on prevalence.[54] A recent review,[55] a meta-analysis[56] and several recent studies[57-60] results that are broadly consistent. Studies generally have not been able to distinguish the effect of media campaigns from other aspects of comprehensive programs.

SimSmoke distinguishes a highly publicized media/comprehensive campaign as publicized heavily on TV and other media, a moderately publicized media campaign as publicized sporadically on TV and in at least some other media and local programs, and a low publicity campaign as publicized only sporadically. Using a formal model [12] that provides the relationship between per capita expenditures and reductions in smoking prevalence, *SimSmoke* predicts that highly publicized mass media campaigns directed at all smokers yield a 6% reduction in smoking prevalence, which increases over time to as much as 7%. In the absence of other policies, the effects are halved.

The effectiveness of different media may differ from state to state or nation to nation, hence the categories of what constitutes a larger scale campaign may need to be modified for particular countries. Advertising content may also affect campaign success. Effectiveness is likely to depend on:

- The characteristics of the targeted population, including educational level of the population. In particular, campaigns may be targeted to particular populations

- The content of the campaigns. The more successful interventions employ a "social marketing approach" in which multiple themes are directed at specific demographic groups, followed by consumer testing and feedback, and responsiveness to that feedback.

- The media available to reach smokers. In less developed nations, television and other media may be less accessible to particular populations (e.g., rural populations).

- Prior campaigns. In less developed countries, ads with informational content may be more effective if the population has not been sufficiently exposed to prior educational policies. As indicated above, past policies in effect other than media campaigns may also influence effectiveness.

The effectiveness parameters may be changed to reflect how effectively the content is developed and coordinated with other tobacco control policies. The current level of knowledge about

smoking risks in the population may also affect the impact of media campaigns. For example, the early campaigns in the US following the first Surgeon's General's Report had a large impact.

Marketing Restrictions

Four levels of marketing restriction policies are distinguished: none, minimal, moderate, and comprehensive. The effects differ for prevalence, cessation, and initiation, and also depend on enforcement.

While a lower degree of urbanization may reduce the effectiveness of advertising by making it more difficult to reach those in rural areas, Blecher (2008) found that the effects of comprehensive bans are at least 4 times as great in LMICs as in HICs. In the model, this phenomenon is attributed to lack of awareness of the dangers of smoking and anti-smoking attitudes. The effect in the LMICs is doubled relative to HMICs. As for smoke-free laws, a total lack of enforcement reduces the impact by half ($0 \leq$ **ENF** ≤ 1, using the MPOWER index $= 1 \ldots 10$ divided by 10 to be scaled to 1). For marketing restrictions at a level **k** for HICs with high enforcement designated as MR', the effect for country **i** will be:

$$MR_{i,k} = MRK_k' * AWARENESS_i * 0.5 (1+ENF_i).$$

For advertising bans to be effective, they must be comprehensive. If the ban is limited to a small number of media, tobacco manufacturers will use other media. The range of possible media is broad (television, radio, print, billboard, in-store displays). The effect sizes for marketing bans are based on a review by Levy et al.,[44] relying primarily on the more comprehensive studies by Saffer and Chaloupka [61] and updated by Blecher [62]. For HICs, a comprehensive ban was found to reduce per capita consumption by 6.5% in HICs, but was found to reduce per capita consumption in LMICs by 23.5%, with a 13.5% reduction for a limited ban. With a complete ban on direct and indirect marketing in a HIC, *SimSmoke* reduces prevalence by 5%, increases cessation by 3% and reduces initiation by 6%. With a moderate policy, prevalence is reduced by 3%, cessation is increased by 2% and initiation is reduced by 3%. With a minimal policy, prevalence is reduced by 1%, cessation is not affected and initiation is reduced by 1%. The effects are doubled for LMICs. Sensitivity analysis may be conducted at 50% to 150% of these values. The effects of enforcement have not been studied. Like for smoke-free laws, the effects in *SimSmoke* are scaled back for incomplete enforcement (the effects are halved when MPOWER value of enforcement is zero).

The effect of advertising bans will depend on their degree of comprehensiveness. The effectiveness of different media may differ from state to state or nation to nation and hence the categories of what constitutes "comprehensive" may need to be modified for particular models. Increasingly important are in-store advertisements, promotion logos on non-cigarette products (e.g. shirts), and sponsorships of sports events, television programs, and internet advertising.

Health Warnings

The health warnings model consists of the level of strength of the health warnings. The MPOWER report provides 4 levels for health warnings: no policy, minimal policy (< 30% of the principal display area of the pack), moderate policy (a warning that covers at least 30% of the principal display area of the pack, and includes 1 to 7 of the seven pack warning criteria outlined

in the Technical Note of Appendix II), and complete policy (a warning that covers at least 50% of the principal display area of the pack and includes all seven pack warning criteria (including graphic warnings) outlined in the Technical Note I as well as a ban on deceitful terms).

Because this policy is geared toward the dangers of smoking, the level of initial awareness is expected to play an important role. For LMICs, the effects are doubled due to the lower initial level of awareness (**AWARENESS** =2 in that case, **AWARENESS**= 1 otherwise). For effect size *HW'* at level **k** for health warning in a HIC, the effect for country **i** is:

$$HW_{i,k} = HW_k' * AWARENESS_i.$$

SimSmoke smoking reduces prevalence and initiation by 1%, increases cessation by 5%. Adding a moderate policy, prevalence is reduced by 0.75%, cessation is increased by 2.5% and initiation is reduced by 0.5%. Adding a minimal warning, prevalence is reduced by 0.5%, cessation is increased by 1%, and initiation is reduced by 0.5%. In an LMIC without previously implemented strong tobacco control policies, these effects are doubled, because of the lack of knowledge and antismoking norms. Sensitivity analysis is conducted at 50% to 150% of these values.

Evidence on the effects of health warnings is provided in Levy et al. [44] in conjunction with stronger results in more recent articles.[63-70] Nevertheless, knowledge on the effects of health warnings on cessation and initiation is mostly indirect (e.g., on quit attempts or desire to quit). With a complete policy of strong health warnings in a HIC (i.e., an MPOWER value of 4) relative to no warning,

Warning labels may be made more effective when used to reinforce other programs, especially media policies. They may also have greater effects if they affect other imagery. Other imagery appears to be an important part of the marketing of tobacco companies, and warnings might be made more effective by also instituting advertising bans that require that cigarette manufacturers eliminate brand logos, brand colors and information other than the brand name and government-mandated information (i.e., plain packaging).

Cessation Treatment Policies/Programs

The MPOWER cessation treatment demand reduction model has three sub-measures: financial coverage of treatments, quitlines, and pharmacotherapy (PT) availability.

The new PT availability sub-policy option corresponds to the information in the MPOWER Report regarding whether nicotine replacement treatment (NRT) and/or Buproprion are available and where they may be obtained. The availability indicators are first developed separately for each PT by setting them equal to:

PT1 = 2 if NRT is yes, 0 if no
PT2 = 1 if Buproprion is yes, 0 if no

When pharmacotherapy is available, the MPOWER Report distinguishes whether each PT is available in a general store or pharmacy and if a prescription (Rx) is required. We do not

distinguish effect sizes (they are each assigned a value 1) by these sources except when NRT is only available by prescription. Since access is thus more limited, the NRT variable is multiplied by 0.5, indicating that the effect is reduced by 50%. To get an overall effect, the indicators for NRT and Buproprion (PT1 and PT2) are summed and divided by 3 to obtain an overall indicator with a value between 0 and 1 that is used to scale the percentage effect of the new treatment availability sub-policy. If the value of the sub-policy is 1 (the policy is effect in full), then prevalence is reduced by 1.0% (0.667% for NRT and 0.334% for buproprion) in the first year of the policy (which is roughly equivalent to the effect of 15% of smokers using either or both of the PTs with a 10% average success rate net of relapse in the first year) and the pre-policy cessation rate is increased by 6% in all years after the first (equivalent to quit attempts increased by 30% due to new PT users with those users having a 20% first year success rate). Therefore, there is no effect on initiation. The parameters are based on U.S. studies by Shiffman et al.,[71] Hyland et al.,[72] and Reed et al.[73]

Unlike in previous *SimSmoke* models, treatment coverage does not distinguish pharmacotherapy and behavioral therapy, but rather focuses on where the treatment is provided. We followed the MPOWER Report that distinguishes place of provision of cessation treatments by the following: primary care facilities, hospitals, offices of health professionals, community and other. For each location, we designate a value of score for each of the above locations: 0 = None, 1 = Yes in some, and 2 = Yes in most. We then sum the scores. The highest possible score is 10, but a full effect is designated if at least 4 of the 5 places have indicated yes, whereby a score of 8 is for the full effect. To scale to 1, we multiply by 0.125 (1/8). That indicator is used to scale the effect of the financial coverage of treatment sub-policy. A synergistic effect of publicity on financial coverage is captured by whether there is a high or mid-level tobacco control campaign. Initiation rates are assumed to be unaffected by this measure. With a high-level campaign, prevalence is reduced by 2.25% in the first year of the policy, and the cessation rate is increased by 12% in all future years. In the absence of a high- or mid-level media campaign, the effects are reduced by 25%. The effects are consistent with those in previous versions of *SimSmoke* [3,13,35,44,74]. Some recent evidence from Brazil [75] and Great Britain [76] provide results consistent with those effects.

Previously the financial access sub-policy in *SimSmoke* included the level of publicity, which is no longer an option in this module. The level of publicity is now automatically set based on the level of tobacco control campaigns. The effect of publicity on financial coverage of treatment is (1- 0.25 *(1- publicity)); where publicity = 1 if a high level tobacco control campaign, 0.5 if medium level, and 0.25 if low level)) so that the effects of treatment availability are scaled as much as a 25% reduction by this variable if publicity is less than high (equivalent to an additional 15% of smokers using treatment with a 15% success rate net of relapse) in the first year of the policy and the cessation rate is increased by 12% (equivalent to quit attempts increased by 40% with the new treatment users having a 30% first year success rate) in all years after the first.

In the MPOWER Report, quitlines are distinguished only by whether the population has access to a toll free quitline. In previous versions of *SimSmoke*, quitlines were distinguished by TYPE of quitline. We now enable the user to input supplementary information regarding whether the quitline is passive, active without follow-up or active with follow-up, with corresponding values of 1, 2 and 3 respectively. A default value for TYPE 2 (an active quitline without follow-up) is designated if no information is provided. In previous versions of *SimSmoke*, we also

distinguished whether there was no cost NRT provided to callers, which is now excluded. The effect of quitlines also depends on publicity, which uses the same equation as for the financial access sub-policy.

In *SimSmoke*, the effect of a quitline depends on publicity, using the same equation as for the financial access sub-policy. Based on a recent review,[3] prevalence is reduced by 0.5% in the first year of the policy, and the cessation rate is increased by 5% in all years after the first. When the quitline is not active with follow-up, the effectiveness is reduced by (1- 0.5*TYPE/3). The MPOWER Report best case is only active quitlines.

In chapter 2 of the MPOWER Report, health care provider involvement is emphasized as a key element for successful cessation treatment services, but no information is provided in the MPOWER Reports on its level. This policy would involve at minimum a brief intervention by health care providers to advise and assist in cessation, and in more advanced forms would involve follow-up, training of the providers, charting, reminder systems, and integration with other services (quitlines, web-based cessation, and financial access). We include the health care provider involvement option as supplementary information provided by the user with a default value of zero, and the ability to scale the variable by between zero and one. The value should reflect the level of involvement, with 1 designating a required (or adequately subsidized) intervention with follow-up by all health care providers and with cessation treatment training, reminder systems and integration. When fully implemented alone (a value of one), prevalence is reduced by 0.5% in the first year (equivalent to an additional 5% of smokers making a quit attempt with a 10% average success rate net of relapse) and the pre-policy cessation rate is increased by 10% (equivalent to quit attempts increasing by 50% with the new treatment users having a 20% first year success rate) in all years after the first.

When more than one of the sub-policies is implemented, the effects are additive with the following exceptions. As in previous versions of SimSmoke, the effect of quitlines with NRT is reduced by 25% if there is also a policy of complete financial coverage of treatment, because NRT is then made available at no cost through other sources. In addition, a synergistic effect occurs between sub-policies 1-3 (which all provide for more treatment use) and brief interventions, as health care providers encourage treatment uses that have become more readily available. Brief intervention then increases the effect of sub-policies 1, 2 and 3 on prevalence by 10% and on the cessation rate by 30%. When all sub-policies are implemented, smoking prevalence is reduced by 4.75% and the first year cessation rate is increased by 39.3%. For each of the above parameters, sensitivity analysis is conducted at 50% to 200% of these values. We double the upward effect, due to the potential for improved outcomes through better coordination of the provision of treatment through health care provider involvement, use of websites, and coordination of the different elements of the system. [3,77]

We allow for less effect if the country is rural because of less access to health care in rural areas, but we allow for a 50% greater effect in countries where awareness of health dangers is low. Thus, with effect size *CTP'* for cessation treatment policies in an HIC, the effect in country **i** is

$$CTP_{i,k} = CTP_k' * URBAN_i * AWARENESS_i$$

Most studies examine the effectiveness of particular types of cessation treatments and do not consider the effectiveness of the policies (e.g., access, encouraging brief interventions, and

encouraging or providing quitlines). Factors that may influence the effectiveness of cessation treatment policies include:

- The general access to health care in the population
- The way in which health care is provided, e.g .through government or private, or a combination of the two
- The extent to which health care is developed, especially the ability to affect the provision of treatment through the organization of health care.
- Characteristics of the population, especially the ability to pay for treatment and the ability to inform the population about the existence of policies and their importance.

Youth Access

The youth access module considers the effect of self-service and vending machine bans, and three components of retail compliance (compliance checks, penalties, and merchant awareness/ community mobilization). The module also takes into account that, as retail sales to youth are reduced, youth switch to non-retail sources such as theft, older peers and parents.

The model considers three levels of enforcement: strongly enforced & publicized (compliance checks are conducted frequently and regularly, penalties are potent and enforced, and with heavy publicity and community involvement), well enforced (compliance checks are conducted regularly, penalties are potent, and publicity and merchant training are included, but there is little community support), and weak enforcement (compliance checks are conducted sporadically, penalties are weak, there is little merchant awareness and minimal community participation). With a strongly enforced and well publicized program, *SimSmoke* incorporates a 20% reduction in youth smoking prevalence for 16-17 year olds when all policies are in full force [78,79]. The effect for 10-15 year-olds is 1.5 times that for 16 and 17 year-olds. The well enforced and low enforcement policies, respectively, yield 50% and 10% of the effect. These policies work through the prevalence and initiation rate, but do not affect cessation. Because there is considerable controversy and some reviews find no effect of school education policies, we recommend that sensitivity analysis considers bounds from 0% to 200% of the effect sizes provided above.

Youth access policies, like clean air laws, may depend on anti-smoking attitudes that engender support for the policy. Therefore, it may be important for there to be other policies in effect, such as high taxes, advertising bans and anti-tobacco media campaigns before such policies are effective. They are also likely to depend on the percent of cigarettes that young smokers currently obtain through store purchases (vs. from parents, older peers, or theft).

School Education and Youth Media Programs

School education policies consist of well tested programs applied through middle and high school. These programs have been shown to be more effective when accompanied by sustained media campaigns directed at youth. The effect sizes are based primarily on studies using the 30-day prevalence measure of smoking, which are assumed to ultimately lead to reductions in established smoking. The parameters are based on the review of school programs in a recent IOM report.[38]

Since the model is in terms of established smokers, the effect of school based programs has been developed in terms of their ultimate effect on initiation rates into established smoking. Based on the review of school programs, it is estimated that sustained school programs alone reduce smoking rates by 10%, and by 20% if accompanied by a sustained media campaign. The 10% incremental effect of media campaigns, reflects the synergies from implementing the campaign in conjunction with the educational programs, and is thus higher than the effect of a youth campaign alone. These effects are modeled as across the board reductions in initiation rates at all ages through age 24 applied to males and females. Because there is a lag between the programs and their ultimate effect on initiation, we assume that the program affects initiation rates of youth through age 15 in the first year that the program is in effect, through age 16 the second year that the program is in effect, and one additional age each for year of implementation through age 24, the last age of initiation.

Some versions of SimSmoke consider campaigns directed only at youth, such as media/comprehensive campaigns in the states of Florida and a national campaign (the Legacy campaign in the US). Recent studies obtained results that were broadly consistent with the effects found for adult campaigns, one for state campaigns [80] and for the Legacy campaign[81] We estimate that youth-oriented campaigns lead to a 6% reduction in youth prevalence. We do not consider the effect on smokers ages 18-24 and on those ages 25 and above, due to the lack of studies.

Because current educational programs are generally not implemented in a consistent manner, using well tested formats and continuously applied throughout middle and high school, it is assumed that they have no measurable effect. There have, however, been youth campaigns in effect, through the national (Legacy) campaign and various state campaigns, as described above. The education policy would, therefore, have the entire effect described above, but the effect of media campaign would only reflect the difference between the current campaigns and the additional effect from having the campaigns in conjunction with the educational campaign.

Because there is considerable controversy and some reviews find no effect of school education policies, we recommend that sensitivity analysis considers bounds from 0% to 200% of the effect sizes provided above.

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