Benefit-Cost Analysis of Communities That Care: Appendix

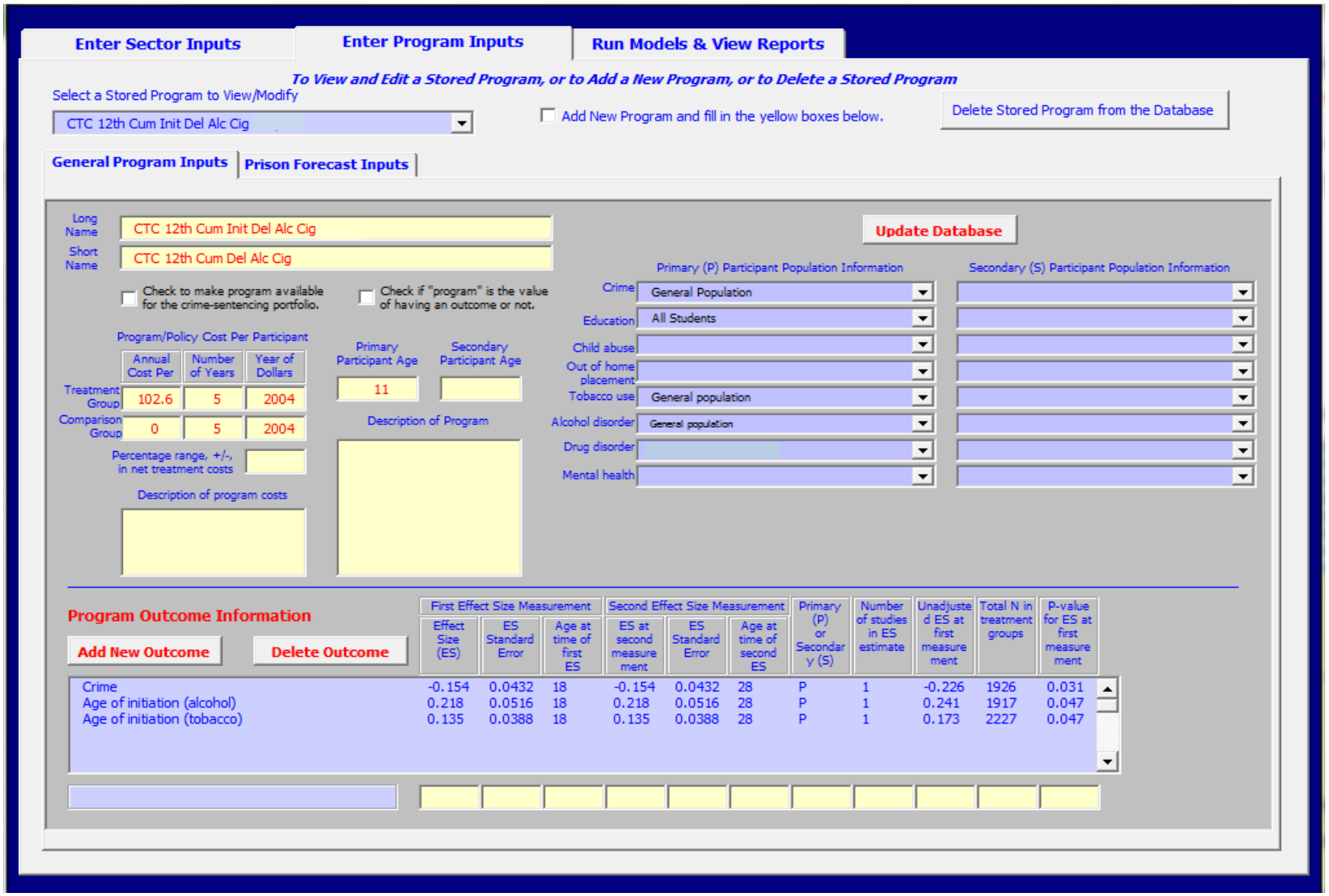
The benefit-cost analysis (BCA) reported in this study was performed with a BCA software tool developed by the Washington State Institute for Public Policy (WSIPP) to help policymakers understand which programs are effective in improving public outcomes and what return on investment taxpayers could expect from investing public dollars in these interventions. The tool is capable of conducting benefit-cost analyses for programs in 10 areas: general prevention, crime, K-12 education, child maltreatment, substance abuse, mental health, public health, public assistance, employment and workforce development, and health care. The model takes a prevalence-based approach, estimating benefits that derive from the relationship between improved outcomes today and future prevalence of behaviors, disorders, or events that have economic impact.

The purpose of this appendix is to provide additional detail about the parameters that generated the results reported in the paper. We present a series of screen shots from the tool that show (a) where we input data pertaining to CTC's costs and significant effects on delinquency, alcohol use, and cigarette use initiation; (b) sector inputs that generate benefits from each CTC effect; and (c) the report summarizing the BCA results produced by the model and tool. Our purpose is not to reproduce WSIPP's extensive technical appendix. Thus, we do not provide detail about the model's complex computational routines and algorithms that utilize inputs and estimate benefits. For that detail, we recommend that readers turn to WSIPP's detailed technical appendix (Washington State Institute for Public Policy 2013) describing the benefit-cost model used in our analysis. WSIPP's recently updated appendix (Washington State Institute for Public Policy 2014) may also be of interest.

Program Inputs

Figure 1 is a screen shot of the **Program Inputs** screen, where users enter information about the intervention on which the BCA will be performed. Here, as in other screens, pale yellow boxes designate places where users can enter information. In the *Long Name* and *Short Name* boxes in the upper left, we entered the name under which program information will be stored so that it can be analyzed by the tool. In the *Program/Policy Cost Per Participant* section, we entered the average CTC intervention cost per year, reported that the intervention lasted 5 years, and that the cost data were entered in 2004 constant dollars. We also reported in the *Primary Participant Age* box that participants were age 11 when the intervention started. In the *Primary (P) Participant Population Information* section, we selected "General Population" or "All Students" in the Crime, Education, Tobacco use, and Alcohol disorder boxes to indicate that CTC was a universal intervention applied to a general population of students. In the *Program Outcome Information* we reported CTC's significant intervention effects on delinquency (crime), alcohol use initiation, and tobacco use initiation found at Grade 12. To enter this information, we selected the relevant outcome from a list generated from the *Add New*

Figure 1. Program Inputs Screen.



Outcome button and then entered appropriate values in the boxes below *First Effect Size Measurement*. The model requires *Second Effect Size Measurements* to run properly; we were instructed to hold effects constant over time. The P under *Primary (P) or Secondary (S)* inputs indicates that effects were on the primary participants in the intervention. The remaining boxes to the right are for informational purposes only. We reported the unadjusted effect sizes found at Grade 12, the number of CTC participants who had not initiated delinquency, alcohol use, or tobacco use at Grade 5 baseline, and the *p*-values associated with each adjusted effect.

Outcomes and Links

Figures 2a - 2d illustrate the quantitative relationships, or effect sizes (ES), between intervention outcomes and related outcomes that have economic value. The left hand side of the screen shows a list of outcomes that can be monetized by the tool, and the ES and related standard errors (SE) on the right side of the screen represent the estimated causal relationship between the selected outcome and each monetization area. Values are based on WSIPP's meta-analyses of research studies linking outcomes to each monetization area. The values represent factors by which benefits generated from the selected outcome are multiplied. Although users can adjust ES and SE values in the pale yellow boxes on the bottom of the box, we used the model's default values in our CTC BCA.

Figures 2a and 2b show *The effect of the selected outcome: Crime* on areas that are monetized in the software tool. Crime is highlighted in the box on the left. The outcomes in the box on the right illustrate the direct (ES, = 1) and indirect (ES < 1) economic consequences of crime on the tool's monetization areas. For example, intervention effects on crime (i.e., delinquency initiation) lead directly to effects on crime costs (ES = 1). Intervention effects on crime also have a smaller effect on high school graduation (ES = -.393), which results in indirect effects on the economic consequences of high school graduation, i.e., higher lifetime earnings and, as shown in Figure 2b, health care cost savings. The effect sizes show that earnings or health care benefits that follow from improved high school graduation rates are multiplied by 0.393 to reflect that they are an indirect effect of reductions in crime.

Figures 2c and 2d show, respectively, the effects of age of alcohol use initiation and age of tobacco use initiation on monetization areas. The model includes only indirect effects of these outcomes operating through their relationships to subsequent disordered alcohol use or regular tobacco use. As shown in Figure 2c, age of initiation of alcohol use has an effect of -.02 on subsequent alcohol disorder, which has economic consequences in the form of lower earnings, property losses, and increased health care costs. Figure 2c also shows that age of initiation of alcohol has a very small effect on crime. However, to avoid potential doublecounting of crime benefits, CTC's direct effect on crime "trumps" the indirect effect on crime that follows from effects on age of initiation of alcohol use. Consequently, the BCA includes only those crime benefits that result from CTC's intervention effect on delinquency initiation. Figure 2d shows

Figure 2a. Outcomes and Links Screen: Crime.

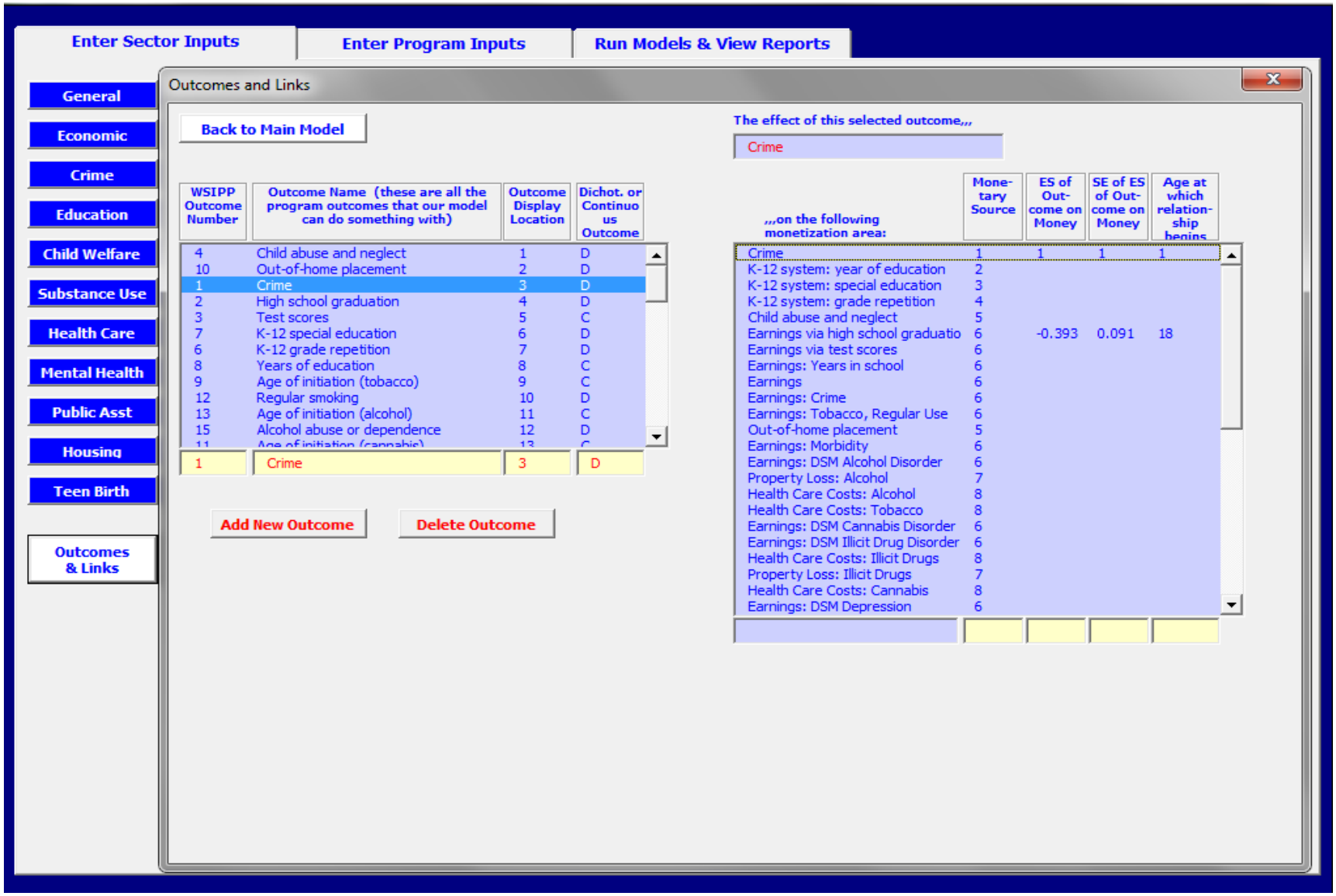


Figure 2b. Outcomes and Links Screen: Crime (continued).

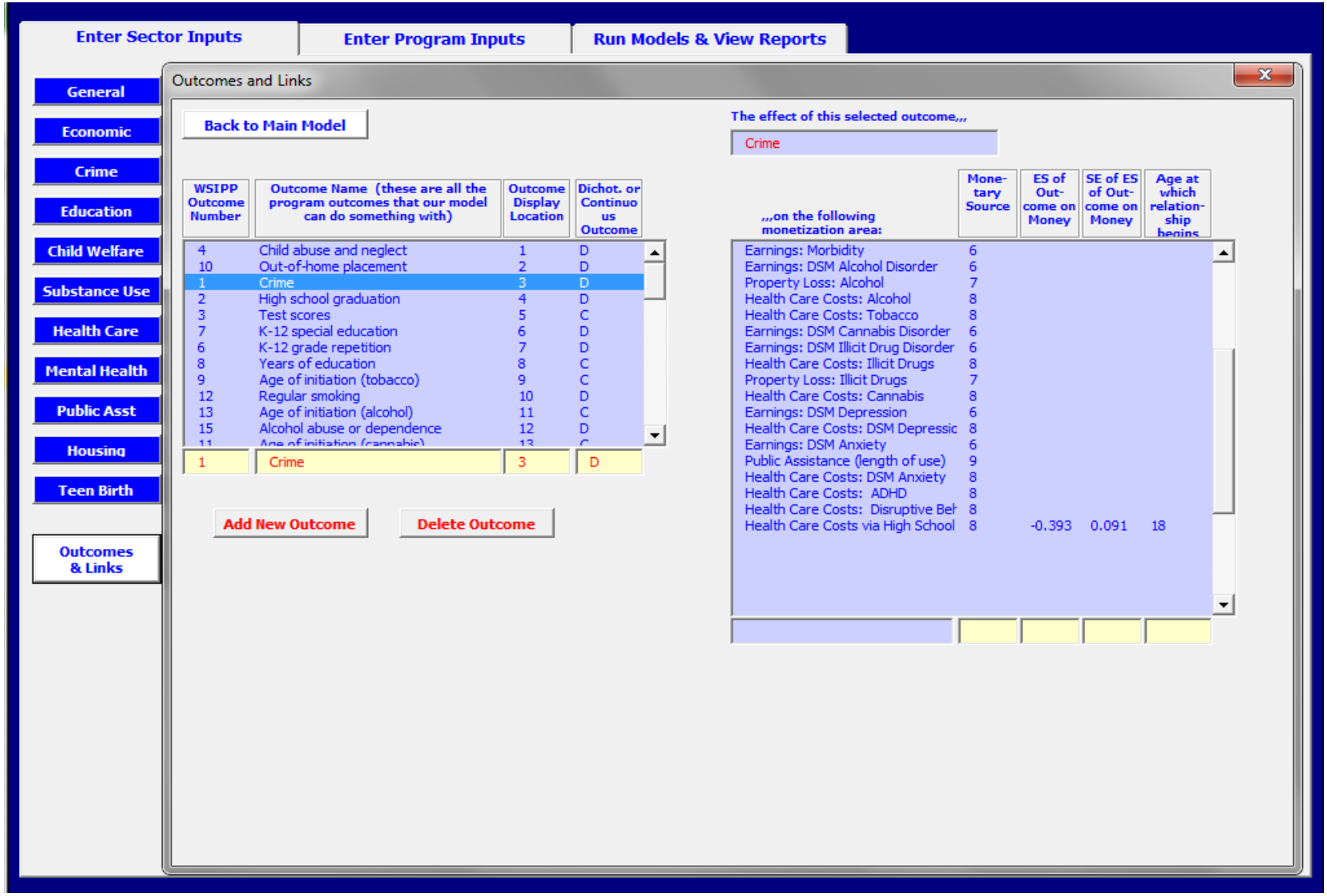


Figure 2c. Outcomes and Links: Age of Initiation (Alcohol).

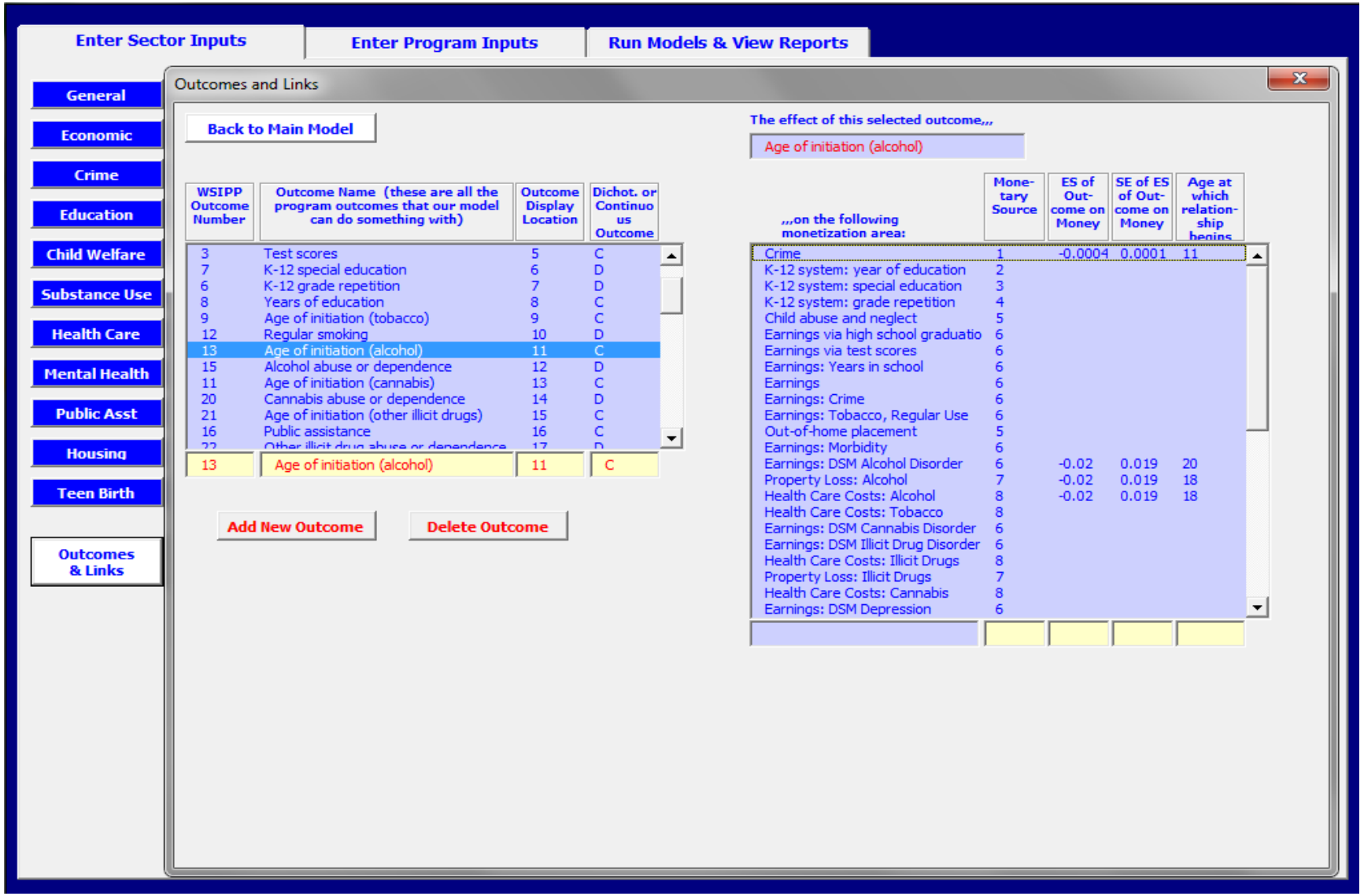
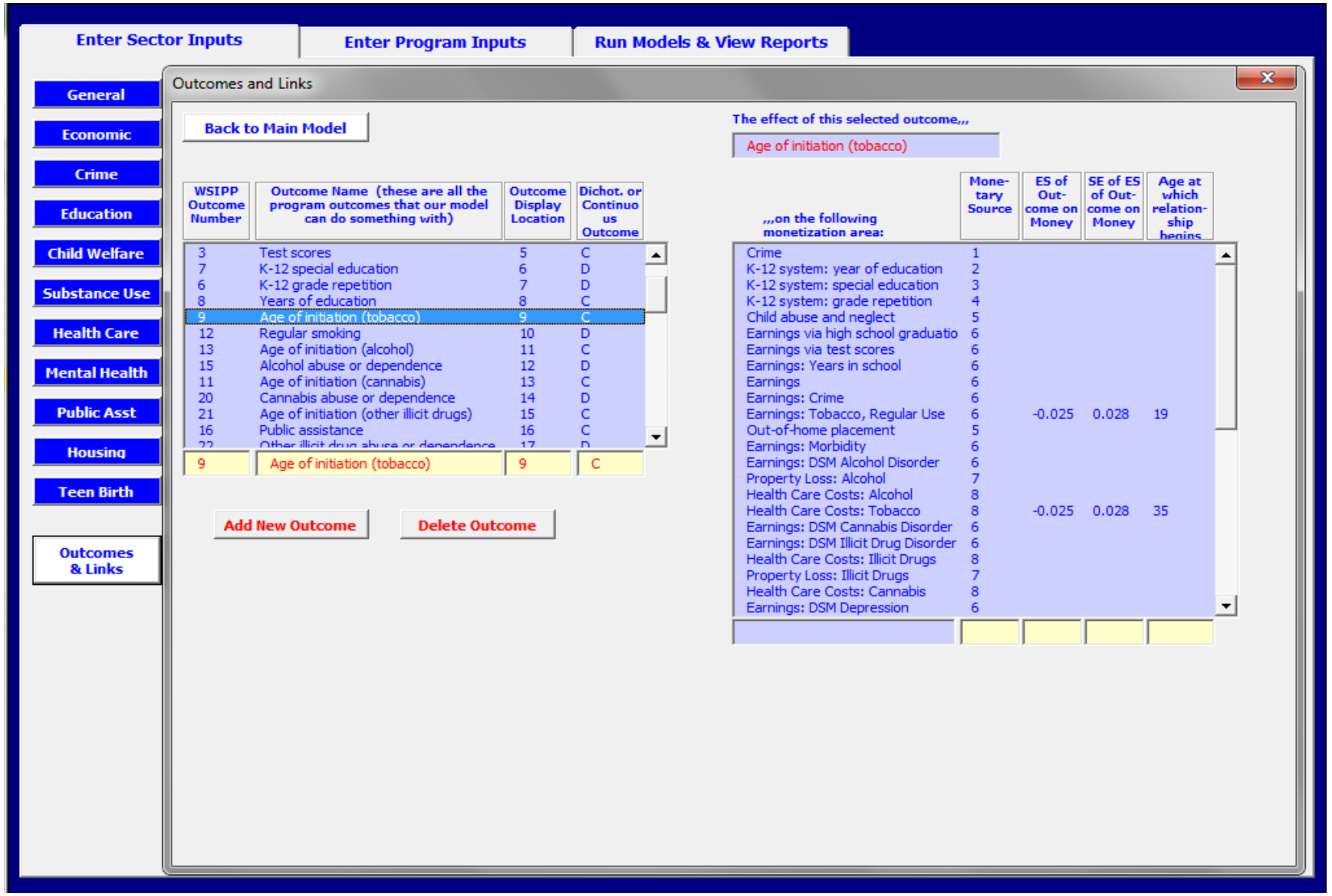


Figure 2d. Outcomes and Links: Age of Initiation (Tobacco).



that age of initiation of tobacco use has indirect economic consequences because of its relationship to subsequent regular use (ES = -.025). Regular tobacco use has economic implications for earnings and health care costs, which are monetized in the model.

Sector Inputs

Crime. Figures 3a - 3d illustrate parameters related to the monetization of crime benefits. In general, the model estimates criminal justice system and victimization costs that are avoided when crime is reduced; the unit change in crime that results from an intervention is based on the intervention effect size. Seven major types of crime are considered, and their costs over the lifecycle, including the probability of recidivism and related costs, are estimated. Four sets of parameters, which are shown on four tabs, drive lifecycle benefits estimates: **Per Unit Costs, Resource Use, Offender Populations,** and **Victimization.**

Figure 3a is a screen shot of the **Per Unit Costs** tab. These costs are incurred when crimes are committed, convictions occur, and resources are used over time; conversely they are avoided when crime is reduced because of prevention. The tab shows the *Marginal Operating Costs* of seven major types of crime for police, courts and prosecutors, juvenile and adult incarceration, and crime victims. The latter consist of tangible as well as intangible costs. *Capital Costs* and *Miscellaneous: Percent Paid by State* are also reported. The *Cost Variance for Per Unit Justice and Victim Costs* at the bottom of the table define the extent of variation in costs to be considered in Monte Carlo analysis.

Figure 3b is a screen shot of the **Resource Use** tab, which displays parameters related to resources used when the seven types of crime are committed. The *Probability of Resource Use* box shows the likelihood that resources will be used when a particular type of crime is committed. The *Number of Years of Use Per Resource* shows how long resources are needed when they are actually used. The *Change in the Length of Stay (in years) for Each Subsequent Sentence* accounts for the fact that resource use is extended when recidivism occurs, but only for adult offenders in the WSIPP model. The bottom box, *Age when a juvenile is tried as an adult*, directs the model to use the appropriate set of crime costs given the age of prevention program participants since costs of juvenile and adult offending vary.

Figure 3c is a screen shot of the **Offender Populations** tab. The purpose of the parameters on this screen is to estimate the probability of future crime and convictions over the life course; prevention programs that have effects on crime or delinquency reduce this probability and the costs that ensue. The model also estimates the probability of recidivism over a 15-year period once a conviction occurs. Probabilities vary with the type of population under consideration, i.e., offender versus non-offender populations. *Select the type of population group to View/Modify* reflects the population selected on the **Program Inputs** screen shown in Figure 1. For CTC, the population is a general non-offender population. *Number of years follow-up* indicates that crime, resulting recidivism, and convictions are captured for 35 years, or through

Figure 3a. Sector Inputs: Crime – Per Unit Costs.

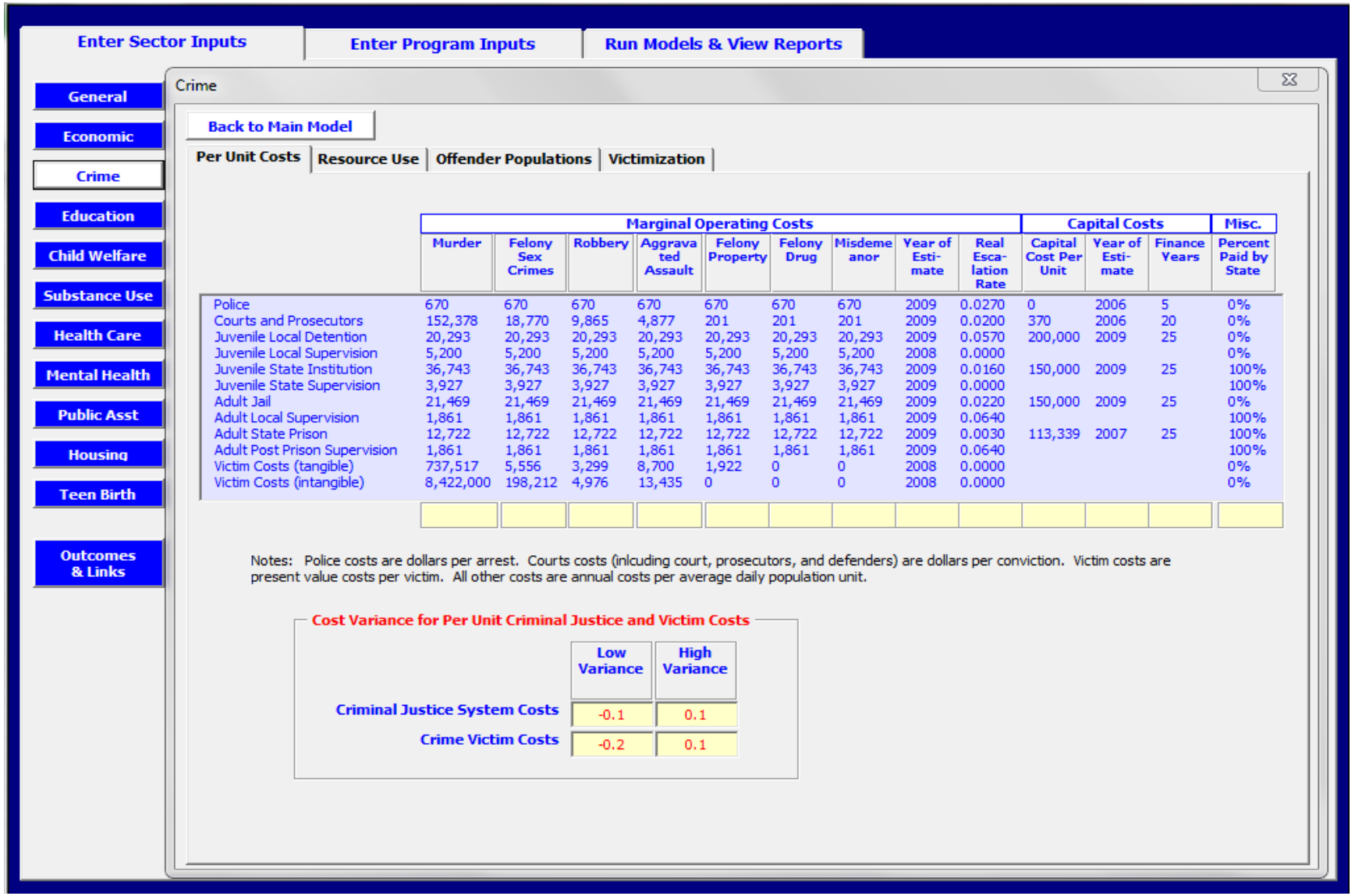


Figure 3b. Sector Inputs: Crime – Resource Use.

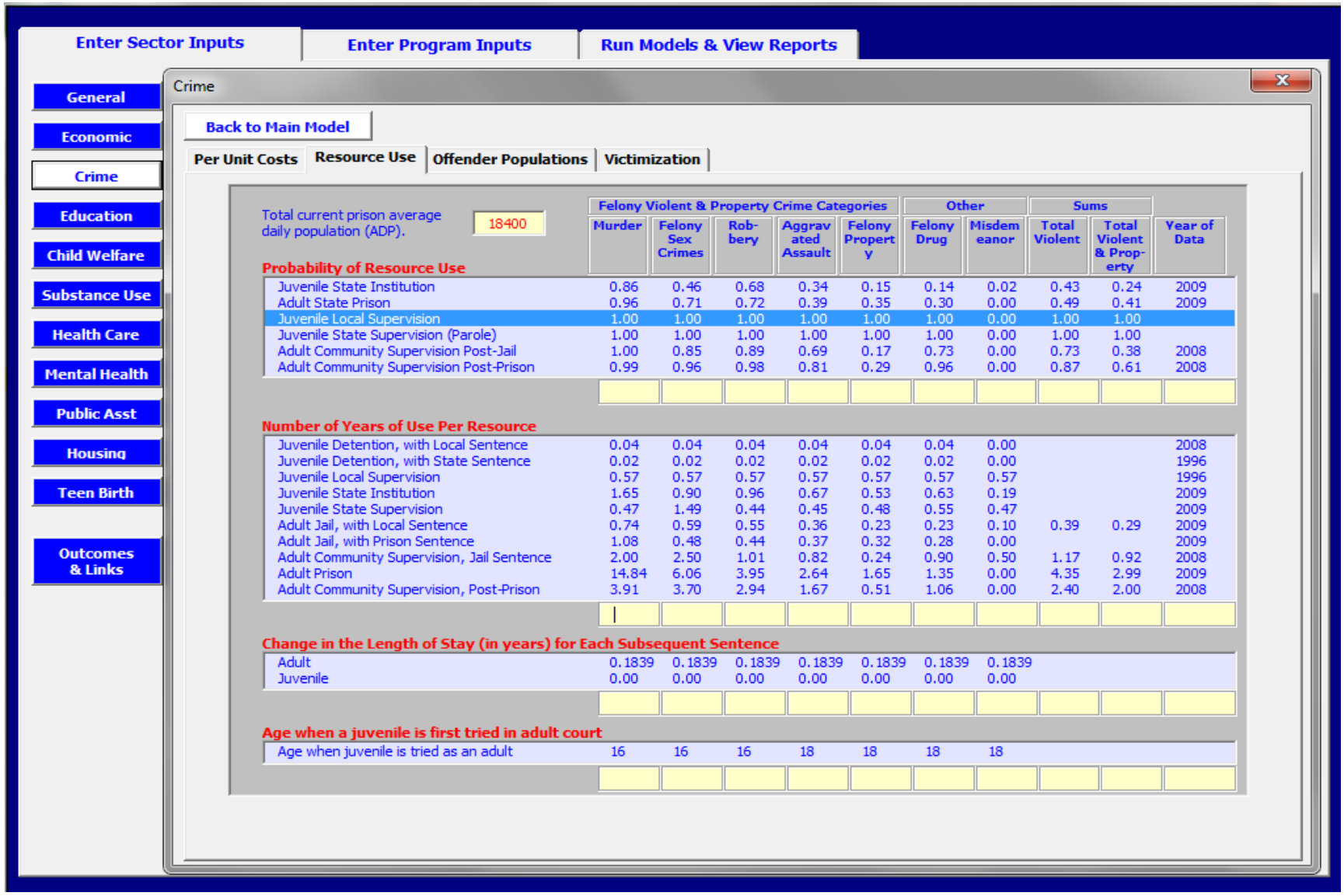
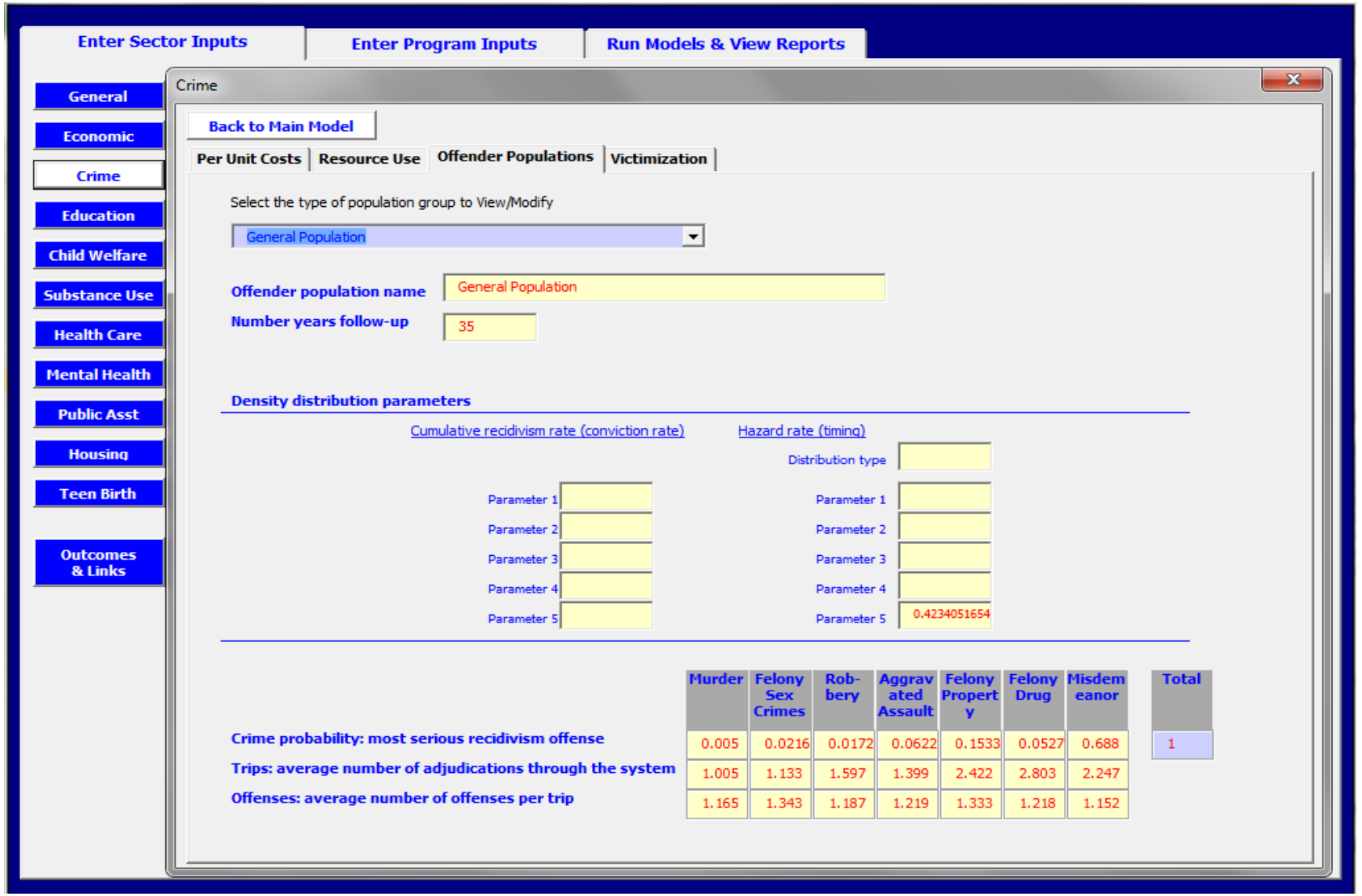


Figure 3c. Sector Inputs: Crime – Offender Populations.



age 53 for the 12th graders (average age 18) for whom CTC intervention effects were found. The *Hazard rate (timing)* parameter is used to generate a probability density distribution showing when convictions are likely to occur in the 35-year follow-up period. The box at the bottom shows parameters related to convictions and recidivism in a general population of offenders. *Crime probability: most serious recidivism offense* shows the likelihood that each of the seven crime categories will be the most serious of those. *Total average number of adjudications through the system* shows how many times each particular type of crime results in adjudication. *Offenses: average number of offenses per trip* captures that criminal justice system convictions are often for more than one offense.

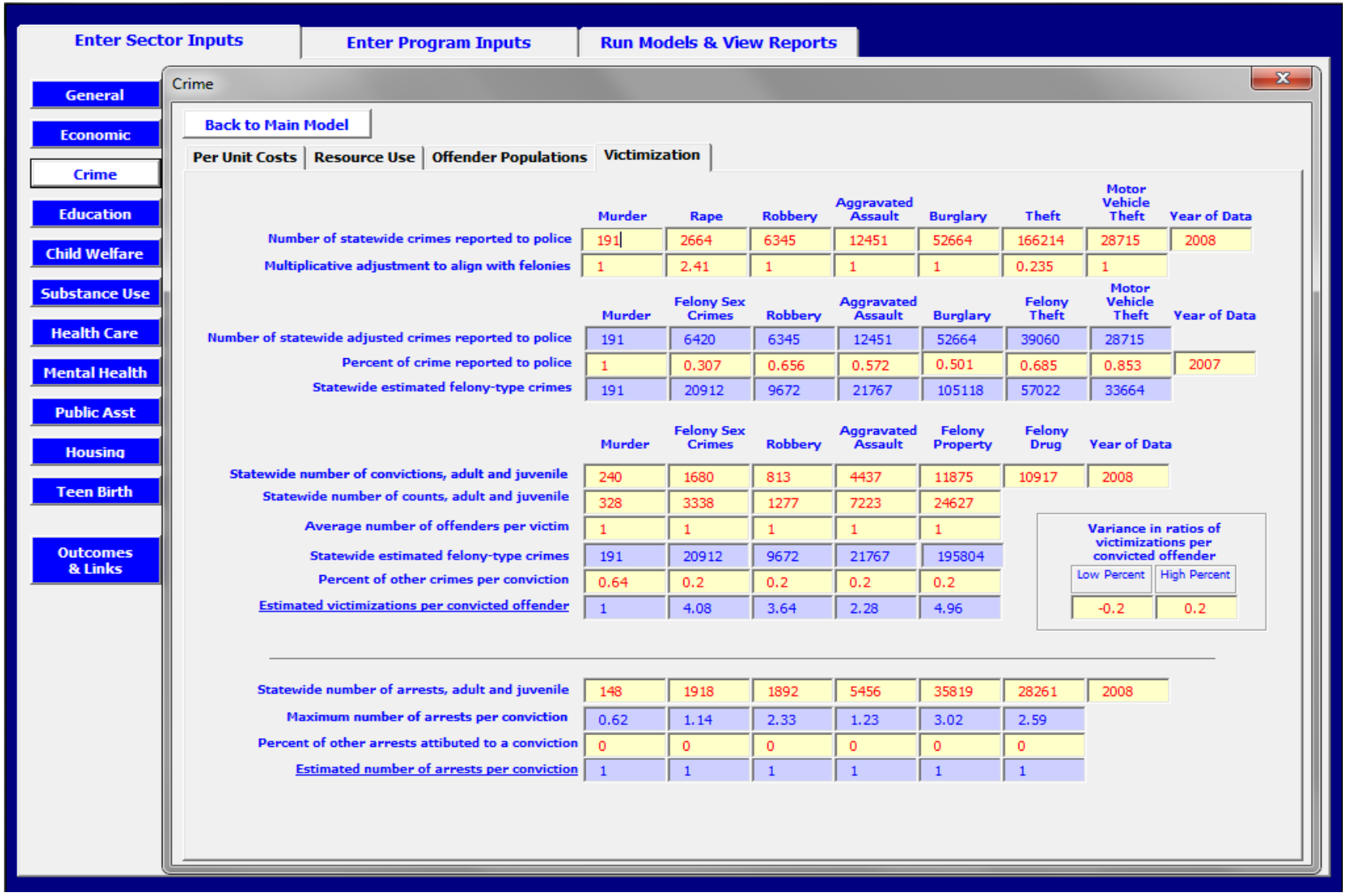
Figure 3d is a screen shot of the **Victimization** tab. The parameters on this tab generate an estimate of the number of victimizations per convicted offender for the seven major types of crime; when prevention programs reduce crime and subsequent convictions, victimization and related costs are avoided. The pale yellow boxes on the tab are inputs, while the blue boxes are calculations. The *Number of statewide crimes reported to police* reflects annual crimes for each major type of crime. Two categories, rape and theft, do not align with felony definitions. WSIPP adjusts rape upwards to align with the more inclusive definition, while theft is adjusted downward to include only thefts valued at more than $750. The adjustment factors are shown in the *Multiplicative adjustment to align with felonies*, and the two lines are multiplied together to produce *Number of statewide adjusted crimes reported to police. Percent of crime reported to police* reflects that many crimes go unreported but are not victimless. The *Number of statewide adjusted crimes reported to police* is divided by the *Percent of crime reported to police* to produce *Statewide estimated felony-type crimes*.

The next set of rows contains inputs and calculations that produce *Estimated victimizations per convicted offender* for each major crime type. The numerator, estimated victimizations, starts with *Statewide number of counts, adult and juvenile*, and assumes one victimization per count. However, because there may be more than one crime committed by each convicted offender, the model makes an adjustment. The *Statewide estimated felony-type crimes* less *Statewide number of counts, adult and juvenile,* is multiplied by 20% and added to the *Statewide number of counts, adult and juvenile.* The model makes an additional adjustment to account for the possibility of more than one offender per victim by multiplying the previous sum by the inverse of the *Average number of offenders per victim.* Finally, the resulting estimate of victimizations is divided by the *Statewide number of convictions, adult and juvenile,* to yield *Estimated victimizations per convicted offender*.

At the bottom of the screen, WSIPP reports arrest information and relates it to convictions. At this point, the model does not use this information in benefits calculations.

Crime benefits monetized by the software tool are the result of complex algorithms that take into account parameters across the four crime sector inputs screens. We encourage

Figure 3d. Sector Inputs: Crime – Victimization.



interested readers to turn to pages 53 – 57 of the technical appendix (Washington State Institute for Public Policy 2013) for additional information about how these assumptions drive crime benefits.

Substance Use. The **Substance Us**e sector inputs tabs contain parameters that drive benefits from alcohol, tobacco, cannabis, and other drug use disorders. In general, the epidemiological information presented on each tab allows the prevalence of disordered or problematic substance use at each age of the lifecycle to be estimated. Intervention effects result in lower prevalences of disordered or problem use over time, and these reductions lead to economic benefits due to fewer premature deaths, higher labor market earnings, lower health care costs, and, for some outcomes, lower rates of property loss. The parameters that generate benefits from each category of problematic substance use are identified on the associated tab.

Figure 4a is a screen shot of the **Alcohol** tab**.** The *DSM Alcohol Use Disorders – Epidemiology* box contains inputs that allow the probability of having an alcohol disorder at any age to be estimated; in the CTC BCA, the estimates are for a general population. The information in the *Annual Alcohol Attributed Deaths* box allows estimation of the probability of dying from an alcohol use disorder. The probability varies with age, and the model calculates distinct rates for five different age groups. The *DSM Alcohol Use Disorders: Monetary Consequences* box contains parameters related to earnings (Labor Market Parameters), health care (Hospital-related Parameters, Emergency Department-related Parameters, and Treatment Parameters), and property loss (Traffic Crash-related Parameters) benefits to be calculated.

Figure 4b is a screen shot of the **Tobacco** tab. It is structured like the **Alcohol** tab, and displays epidemiological information related to regular tobacco smoking, statistics related to premature death from regular tobacco smoking, and other monetary consequences of regular tobacco smoking. Treatment Parameters were not included in this version of the WSIPP model, but placeholders were incorporated so that information could be included in a later iteration of the model.

As with crime benefits, benefits from intervention effects on the initiation of alcohol and tobacco use are the result of complex algorithms performed by the software tool. They are described on pages 71 – 79 of the technical appendix (Washington State Institute for Public Policy 2013).

Indirect Effects on Education. As noted above, CTC's intervention effect on delinquency initiation has implications for high school graduation, which in turn affects future earnings and health care expenditures. Figure 5 is a screen shot of the **Education Sector** tab. The parameters on this tab drive benefits from improvements in educational attainment and other educational outcomes. In the CTC BCA, *Causal link Between Graduating from High School and Lifetime Earnings Gains (Mode): All Students* was used in estimates of benefits from increased high school graduation. The modal value of 1 indicates that higher earnings for high school

Figure 4a. Sector Inputs: Substance Use - Alcohol Use Disorders.

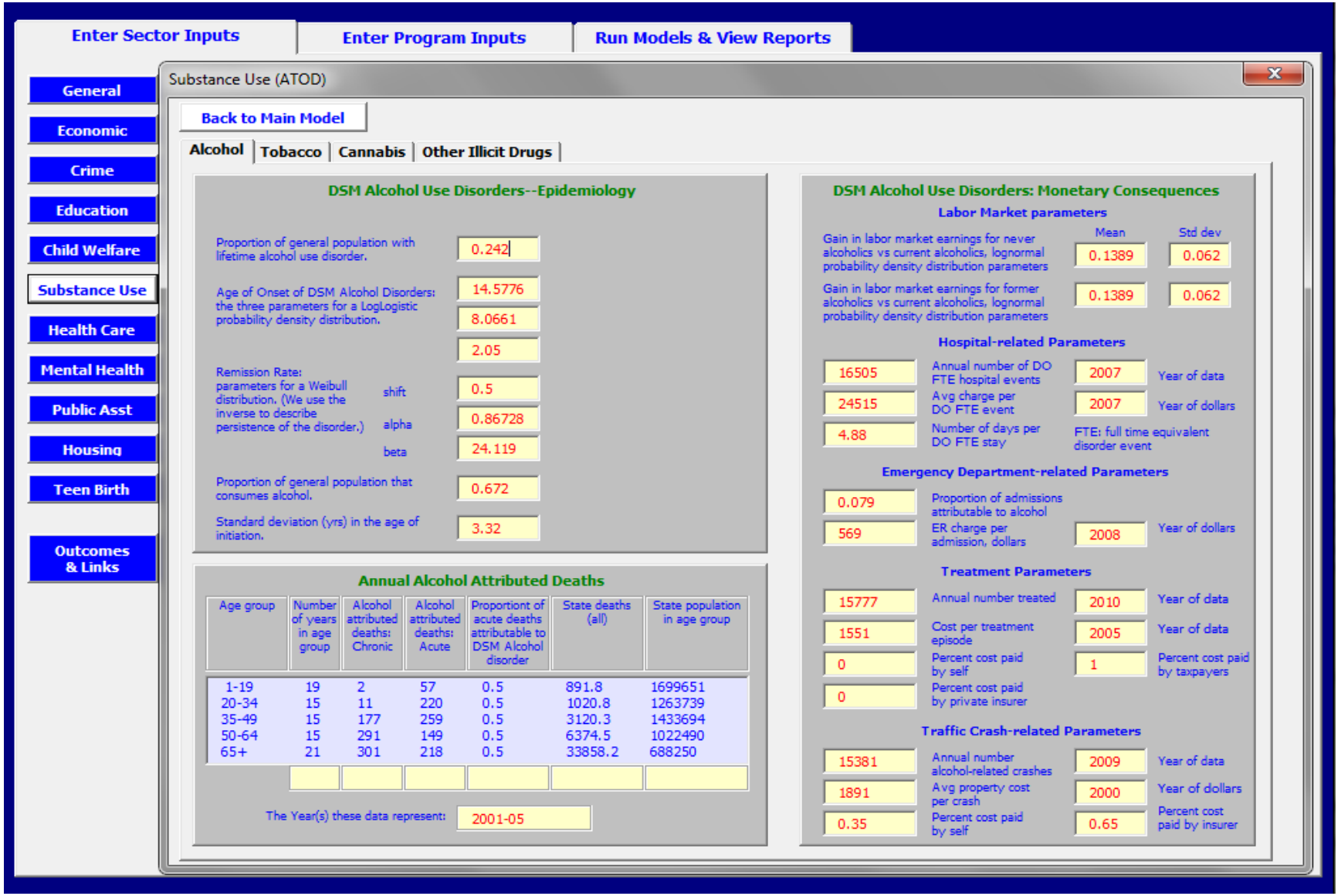


Figure 4b. Sector Inputs: Substance Use – Regular Tobacco Use.

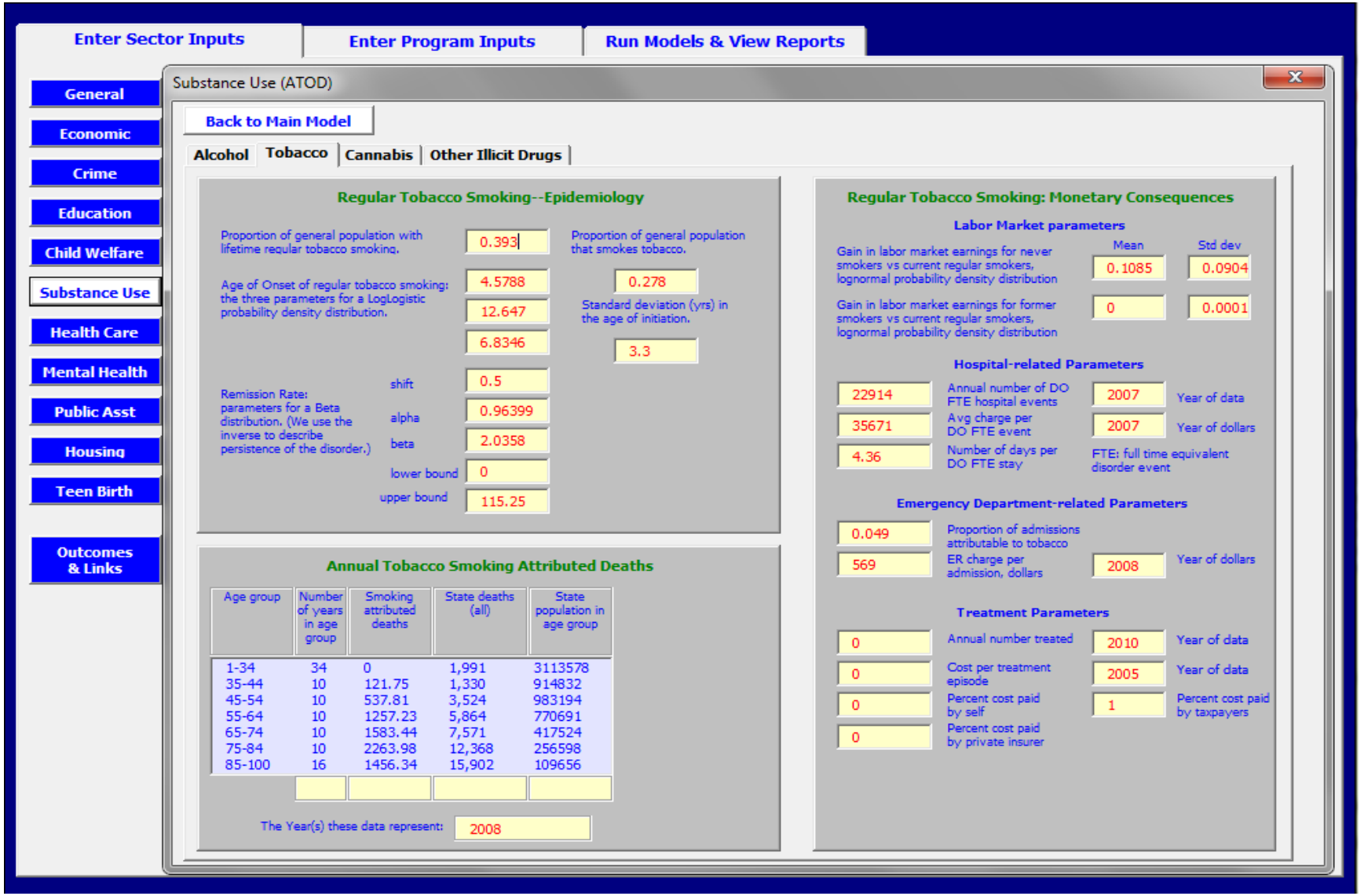
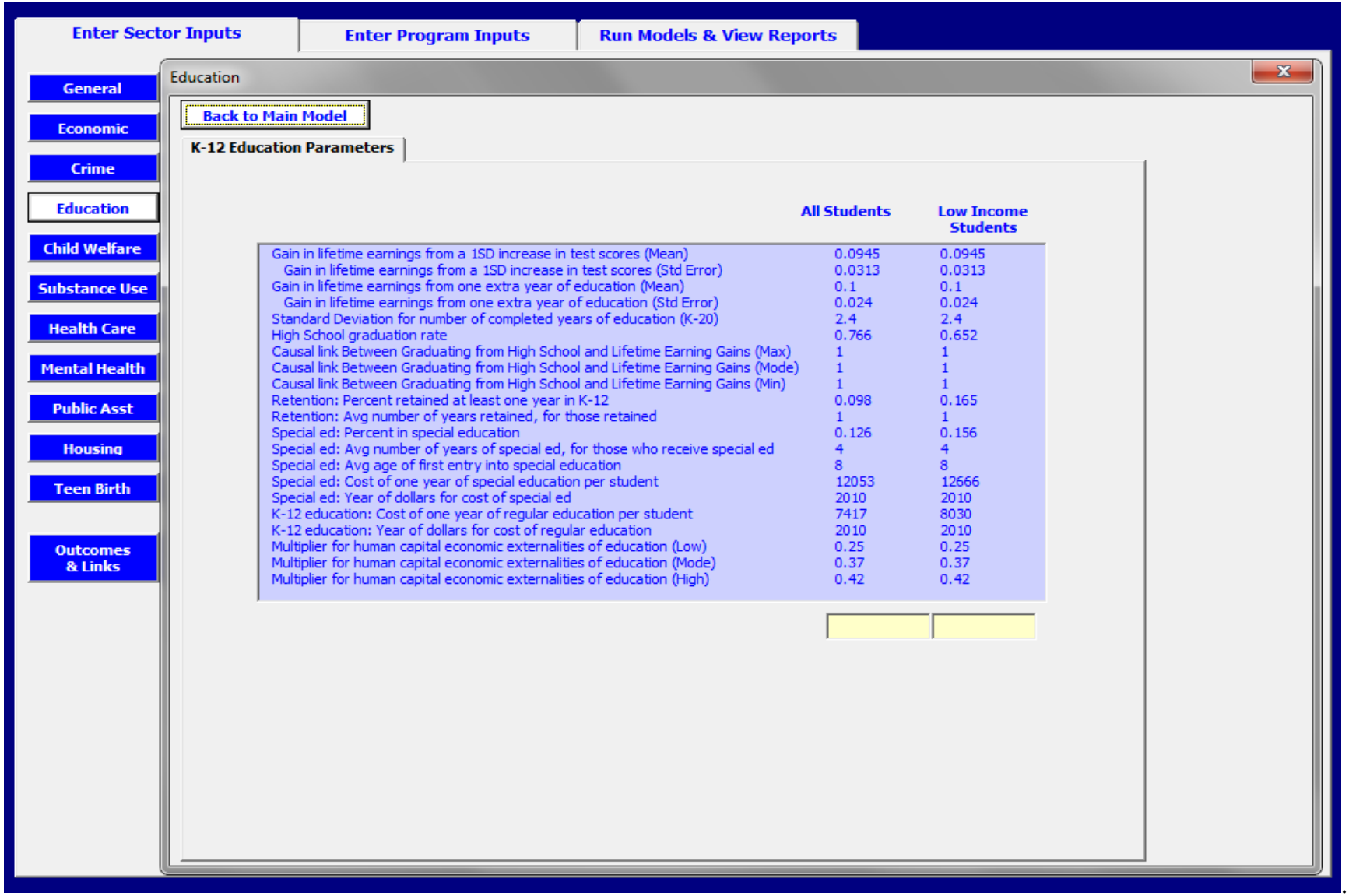


Figure 5. Sector Inputs: Education.



compared to non-high school graduates are fully attributable to high school graduation. The maximum and minimum values do not vary, so all Monte Carlo analyses use the modal value of 1. The *Multiplier for human capital economic externalities of education (Mode): All Students* was also included in our analyses to reflect that better educated individuals influence the productivity of their co-workers. The multiplier varied from a low of .25 to a high of .42 in Monte Carlo analyses.

Figure 6 is a screen shot of the **Health Care Sector** tab. The parameters on this tab are used to estimate benefits from health care that result from CTC's indirect effects on increased educational attainment and also from reductions in disordered substance use or regular tobacco smoking. The left hand side of this tab shows total *State Personal Health Care Expenditures* by category, as well as the percentage paid by participants, taxpayers, and private insurance companies. Below is the modal real escalation rate in health care costs, as well as the low and high values used in Monte Carlo analysis. The *Average hospital cost to charge ratio* shown at the bottom captures the fact that hospital charges differ from actual hospital costs. The top right side of the tab shows *Emergency Department-related Parameters, annual*, including the percentage paid by participants, taxpayers, and private insurance companies. Parameters used to estimate *Average Medical Costs, by educational attainment,* and related health care benefits are shown in the middle and bottom of the right side of the tab.

Other Parameters

Parameters shown in the **General** and **Economic** Sector Inputs tabs also affected the CTC BCA results. Screen shots of the five **General** inputs tabs are shown in Figures 7a - 7e. Figure 7a, **Base Year for Dollars,** shows that our analysis results are presented in 2011 dollars, the most current available. Figure 7b, **Discount Rate,** shows that a modal discount rate of 3.5% is used in analysis, but the rate varies from 2% - 5% in Monte Carlo analysis. Figure 7c, **Demographic,** contains population and CDC Life Table data. These data contribute to the calculation of premature death from disordered alcohol use and regular tobacco smoking. Figure 7d, **VSL,** contains parameters related to the value of a statistical life, which contributes to the calculation of benefits from premature death. On the right hand side of the screen, average medical and social security costs per person over the life cycle are shown. Figure 7e, **Deadweight Cost,** shows that a modal value of $.50 per tax dollar in welfare loss is used in the model, but the values range in Monte Carlo analysis from $0 - $1.

Figures 8a - 8d are screen shots of the four **Economic** inputs tabs. Figure 8a, **Inflation Index,** shows annual values of the two inflation indices used in the model: the Implicit Price Deflator for Personal Consumption Expenditures and, for health care, the CPI All Urban Consumers - Medical Care. Figure 8b, **Earnings and Benefits,** shows annual earnings information at each age of the lifecycle, as well as annual real escalation rates for earnings. Information for calculating fringe benefits is shown at the bottom of the tab. The information on

Figure 6. Sector Inputs: Health Care.

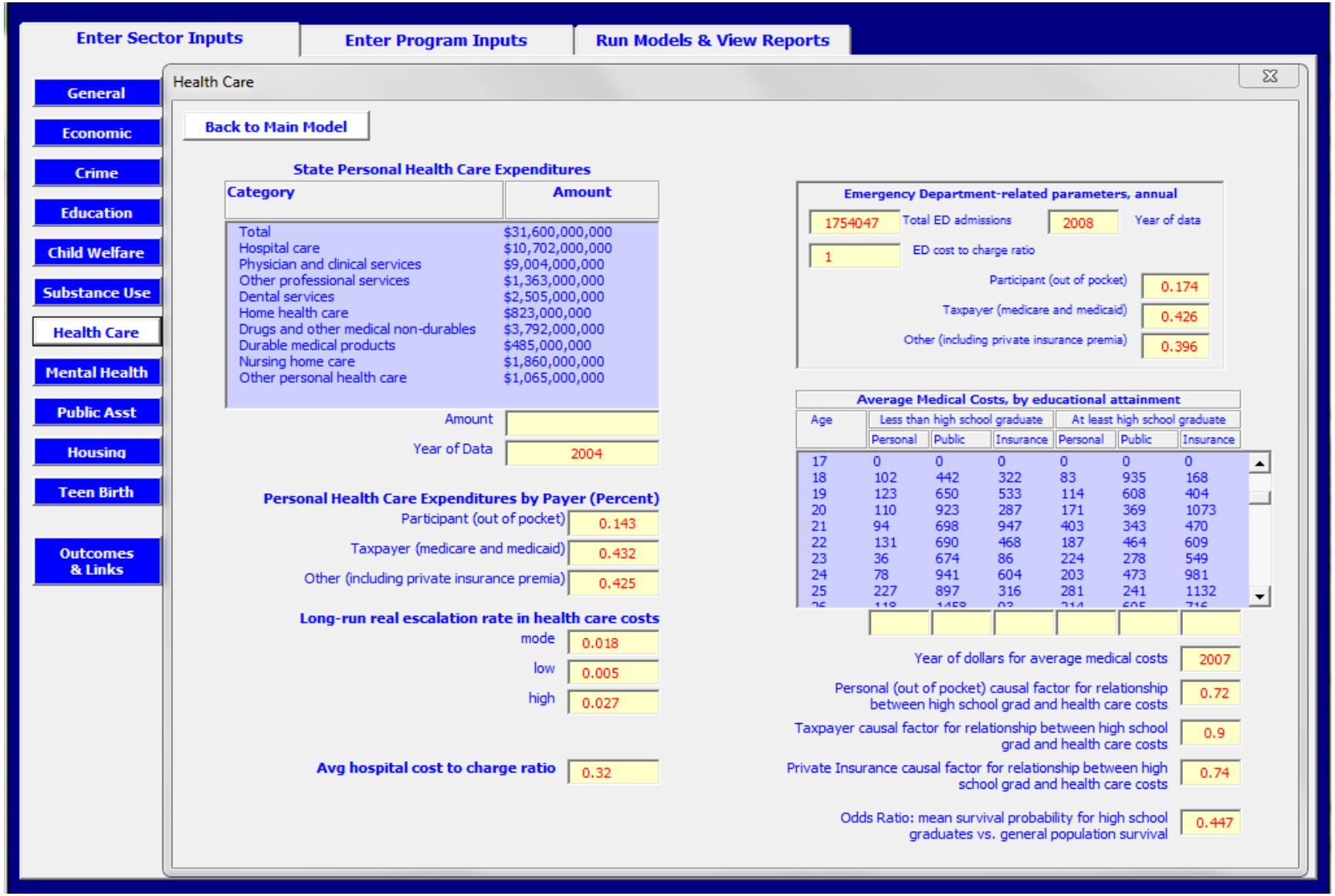


Figure 7a. General Inputs: Base Year for Dollars.

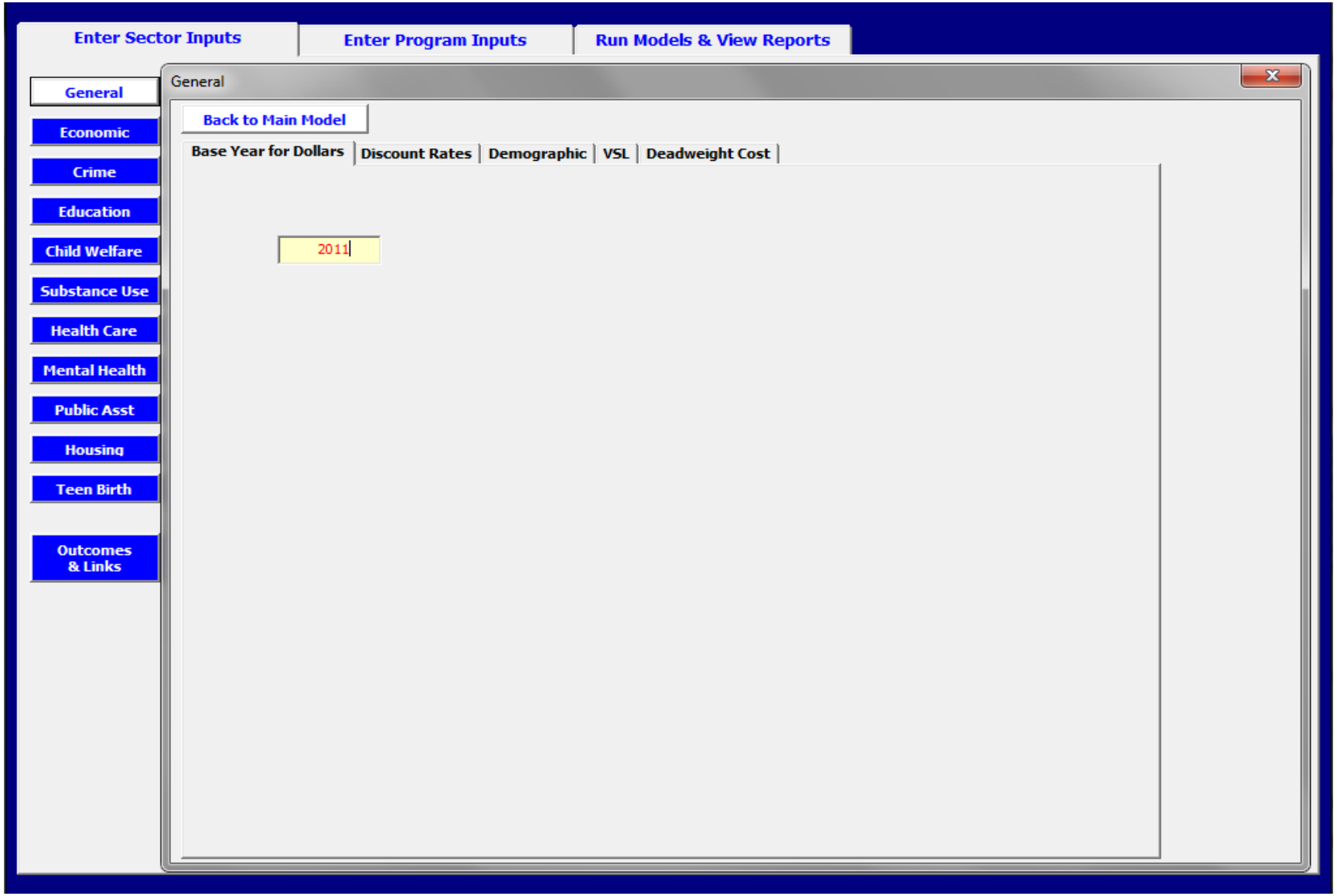


Figure 7b. General Inputs: Discount Rates.

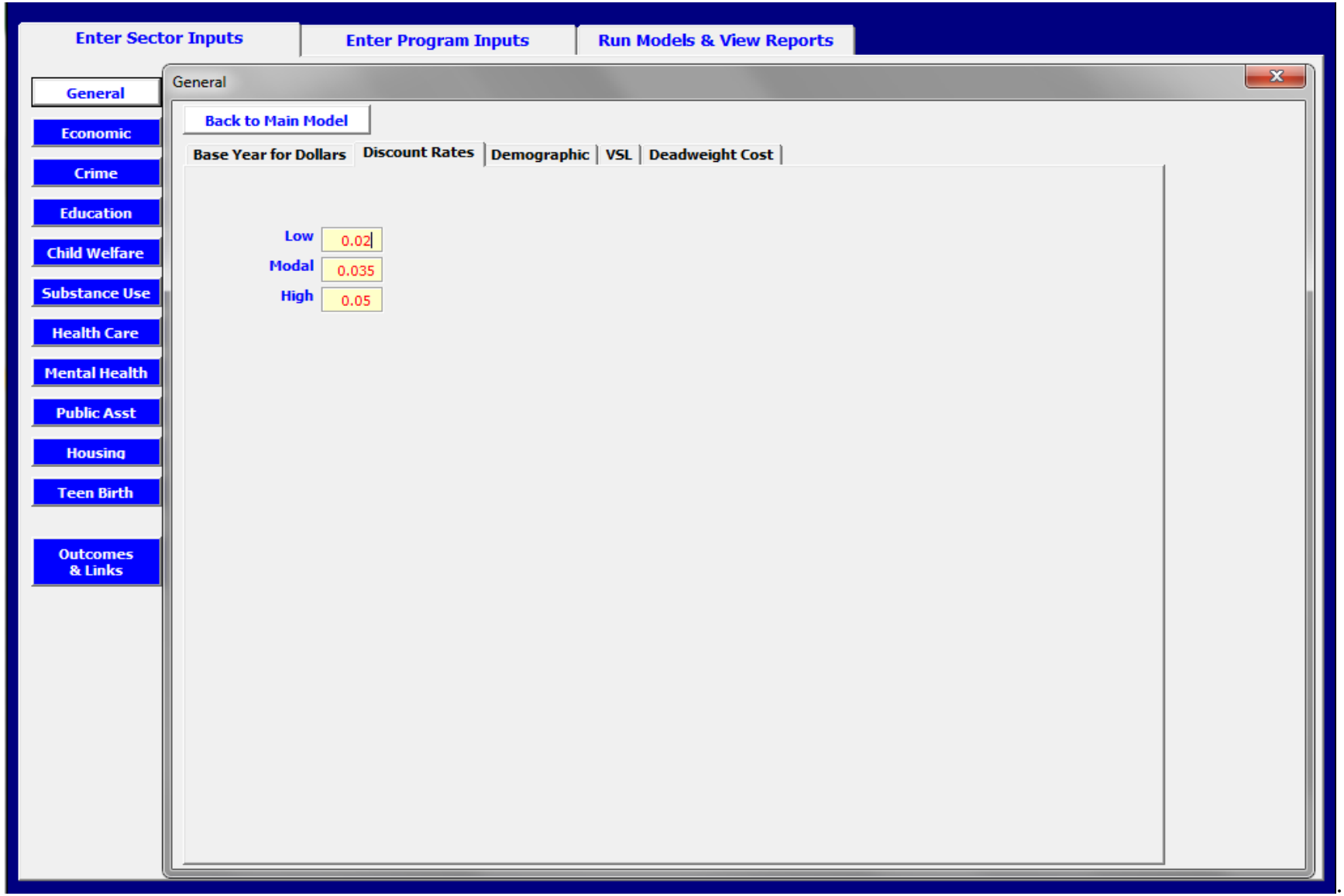


Figure 7c. General Inputs: Demographic.

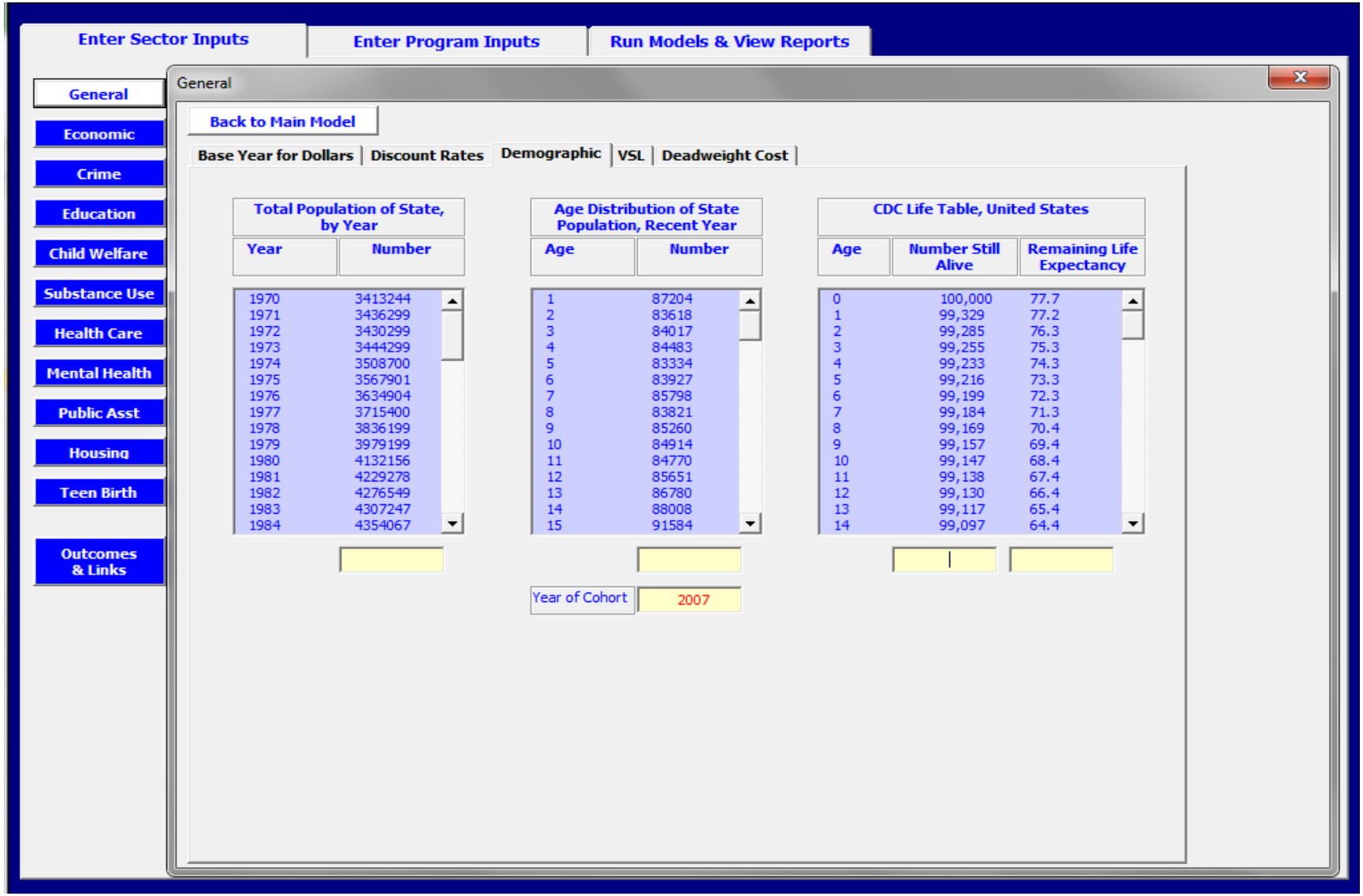


Figure 7d. General Inputs: VSL.

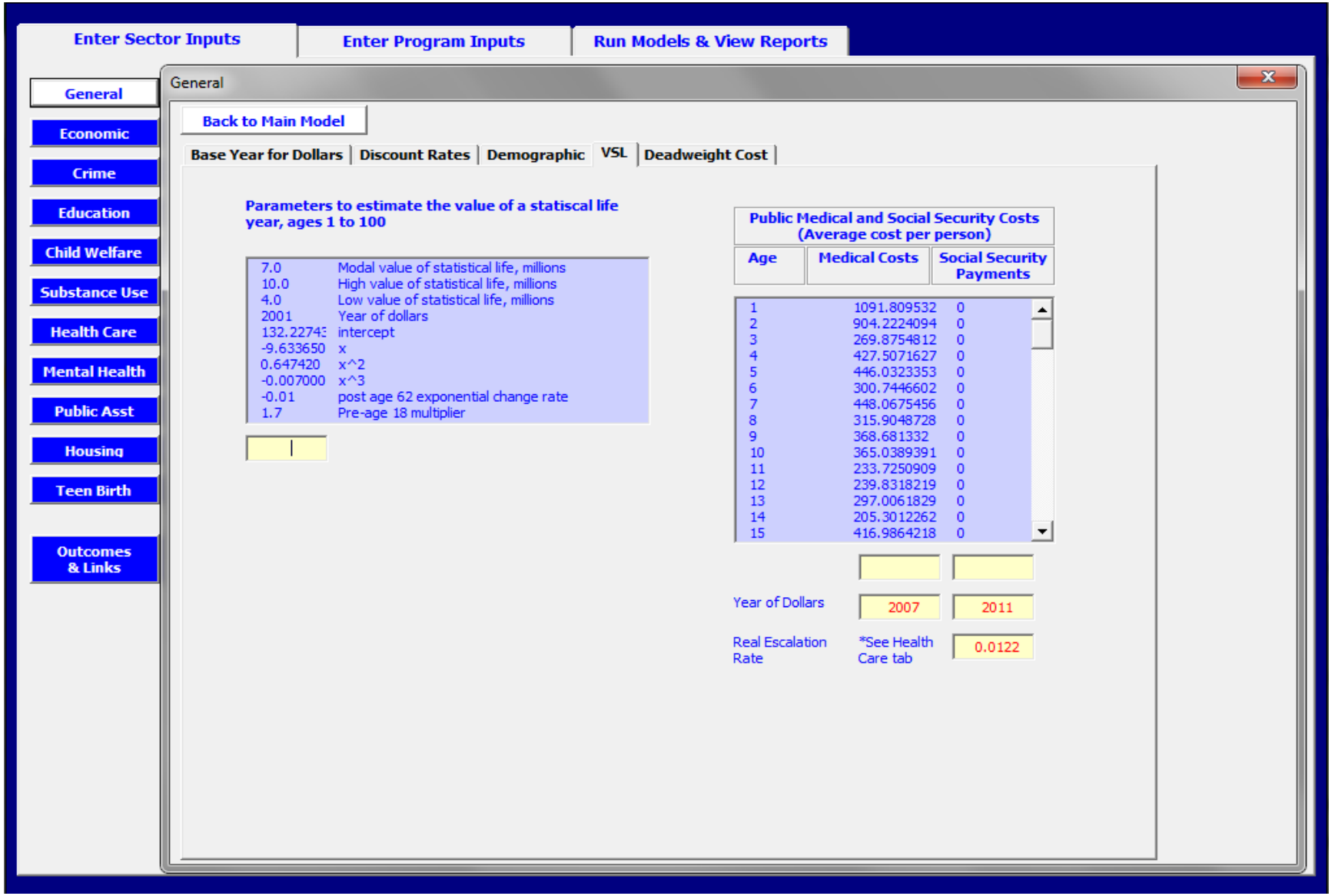


Figure 7e. General Inputs: Deadweight Cost.

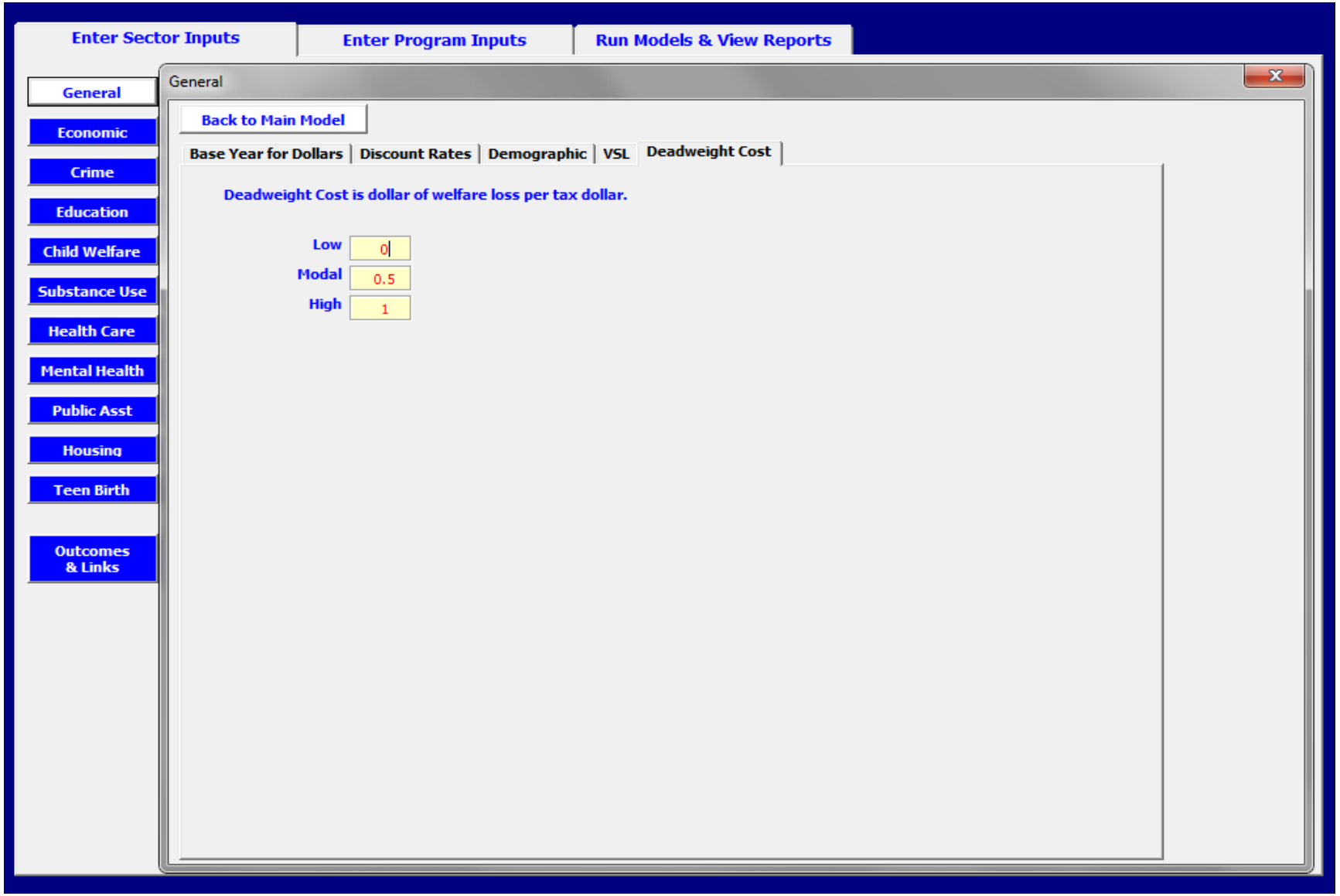


Figure 8a. Economic Inputs: Inflation Index.

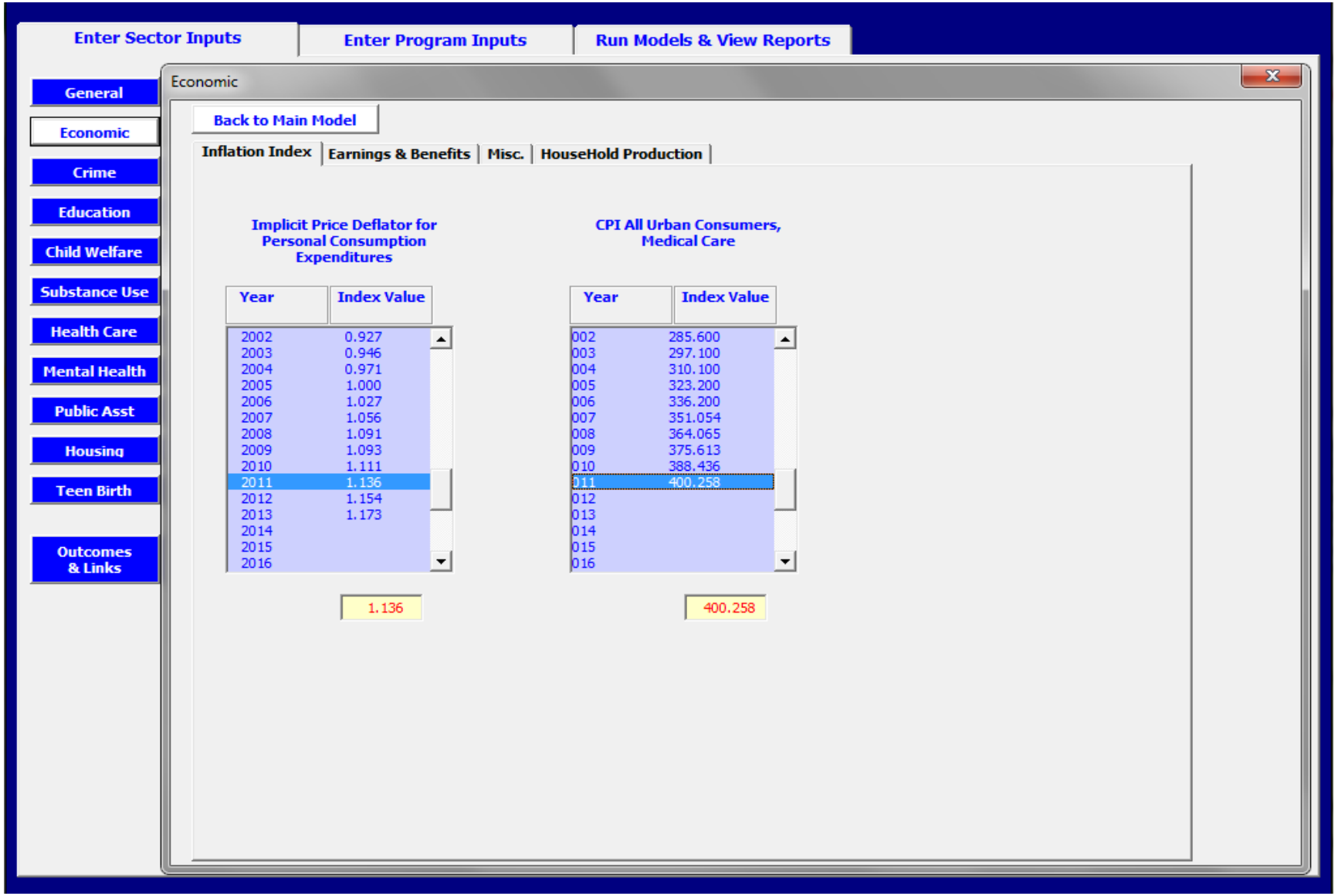
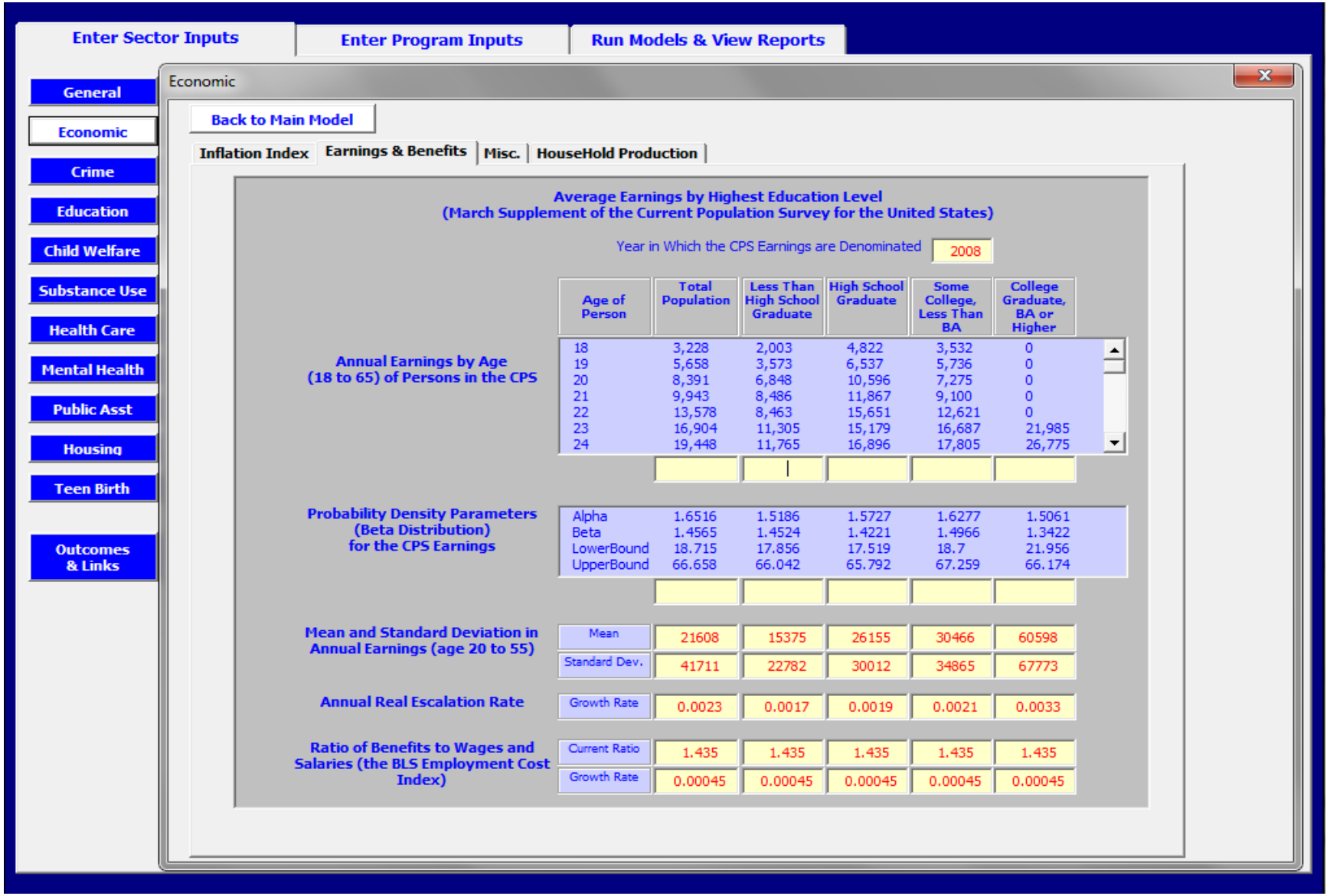


Figure 8b. Economic Inputs: Earnings & Benefits.



Age of Person	Total Population	Less Than High School Graduate	High School Graduate	Some College, Less Than BA	College Graduate, BA or Higher
18	3,228	2,003	4,822	3,532	0
19	5,658	3,573	6,537	5,736	0
20	8,391	6,848	10,596	7,275	0
21	9,943	8,486	11,867	9,100	0
22	13,578	8,463	15,651	12,621	0
23	16,904	11,305	15,179	16,687	21,985
24	19,448	11,765	16,896	17,805	26,775

Alpha	1.6516	1.5186	1.5727	1.6277	1.5061
Beta	1.4565	1.4524	1.4221	1.4966	1.3422
LowerBound	18.715	17.856	17.519	18.7	21.956
UpperBound	66.658	66.042	65.792	67.259	66.174

Mean	21608	15375	26155	30466	60598
Standard Dev.	41711	22782	30012	34865	67773
Growth Rate	0.0023	0.0017	0.0019	0.0021	0.0033
Current Ratio	1.435	1.435	1.435	1.435	1.435
Growth Rate	0.00045	0.00045	0.00045	0.00045	0.00045

this tab is used to calculate earnings benefits that result, for example, from increased high school graduation or reductions in disordered substance use. Figure 8c, **Miscellaneous,** shows the model's Real Cost of Capital and Total Effective Tax Rate, which are applied, respectively, to capital costs and earnings estimates. Figure 8d, **Household Production,** is used to capture lost household production related to premature death.

Run Models & View Reports

Figure 9 is a screen shot of the **Run Models & View Reports: Main Model** tab. In the boxes on the left hand side of the screen, we selected for analysis CTC 12th Cum Init Del Alc Cig, the name given on the **Program Inputs** screen (Figure 1). We ran 1,000 Monte Carlo simulations, the maximum allowed, and included deadweight cost of taxation considerations in our analysis. The right hand side of the screen summarizes the BCA results. The *Expected Case* box summarizes total benefits and costs, lists benefits to major stakeholders, and also includes CTC's net present value (NPV), benefit-cost ratio, and internal rate of return. The *Risk Analysis* graph charts the NPVs generated from each of the 1,000 Monte Carlo simulations. The boxes below the chart show that the NPV was greater than zero in each of the 1,000 runs. The *Components of the Benefits* box at the bottom details the source of the benefits summarized for the *Expected Case.* The values in this box are generated from the parameters described in previous sections of this appendix, e.g., Program Inputs, Crime Sector Inputs, Substance Use Sector Inputs, General Inputs. We note that the values shown here reflect WSIPP's conservative approach to adding benefits generated from multiple effects described in the paper. For example, CTC's effects on delinquency, alcohol use, and tobacco use initiation all have implications for future earnings, but to avoid double counting, only the largest earnings value, the $1,767 from delinquency, is included in the BCA summary.

Discounted Cash Flows. The software tool generates and temporarily stores additional detailed information, including annual non-discounted cash flows by stakeholder. To determine the years to investment breakeven reported in Table 4 of the paper, we discounted program investments and cash flows at a 3.5% discount rate. We summed discounted program costs and discounted total benefits in each year to yield annual discounted cash flows. Next, we calculated cumulative discounted cash flows by summing the annual discounted cash flows. Cumulative cash flows became positive, reflecting the investment breakeven point, in year 9.

References

Washington State Institute for Public Policy. (2013). *Benefit-cost technical manual: Methods and user guide*. (Document No. 13-10-1201b). Olympia, WA: Author.

Washington State Institute for Public Policy. (2014). *Benefit-cost technical documentation*. Olympia, WA: Author.

Figure 8c. Economic Inputs: Miscellaneous.

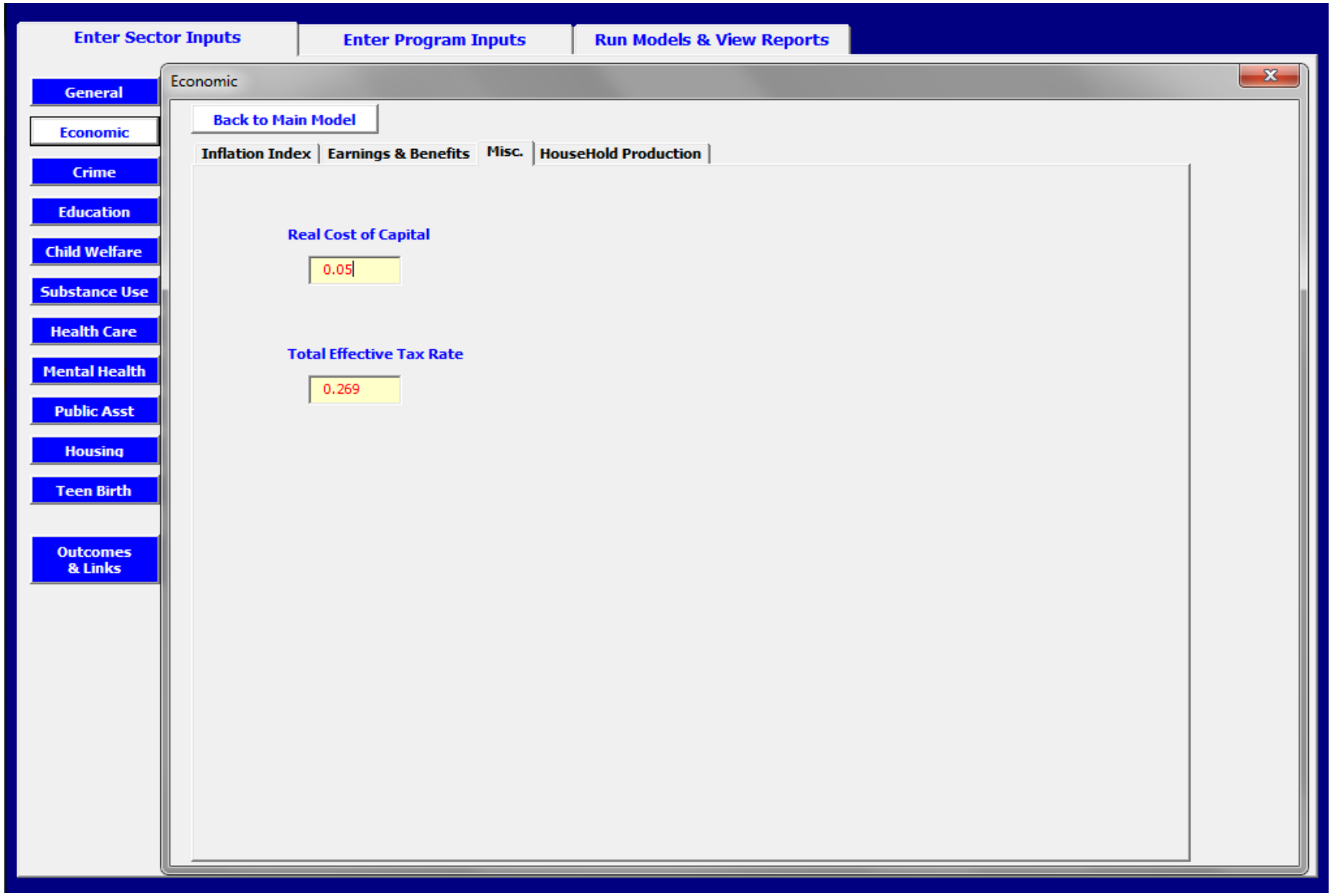


Figure 8d. Economic Inputs: Household Production.

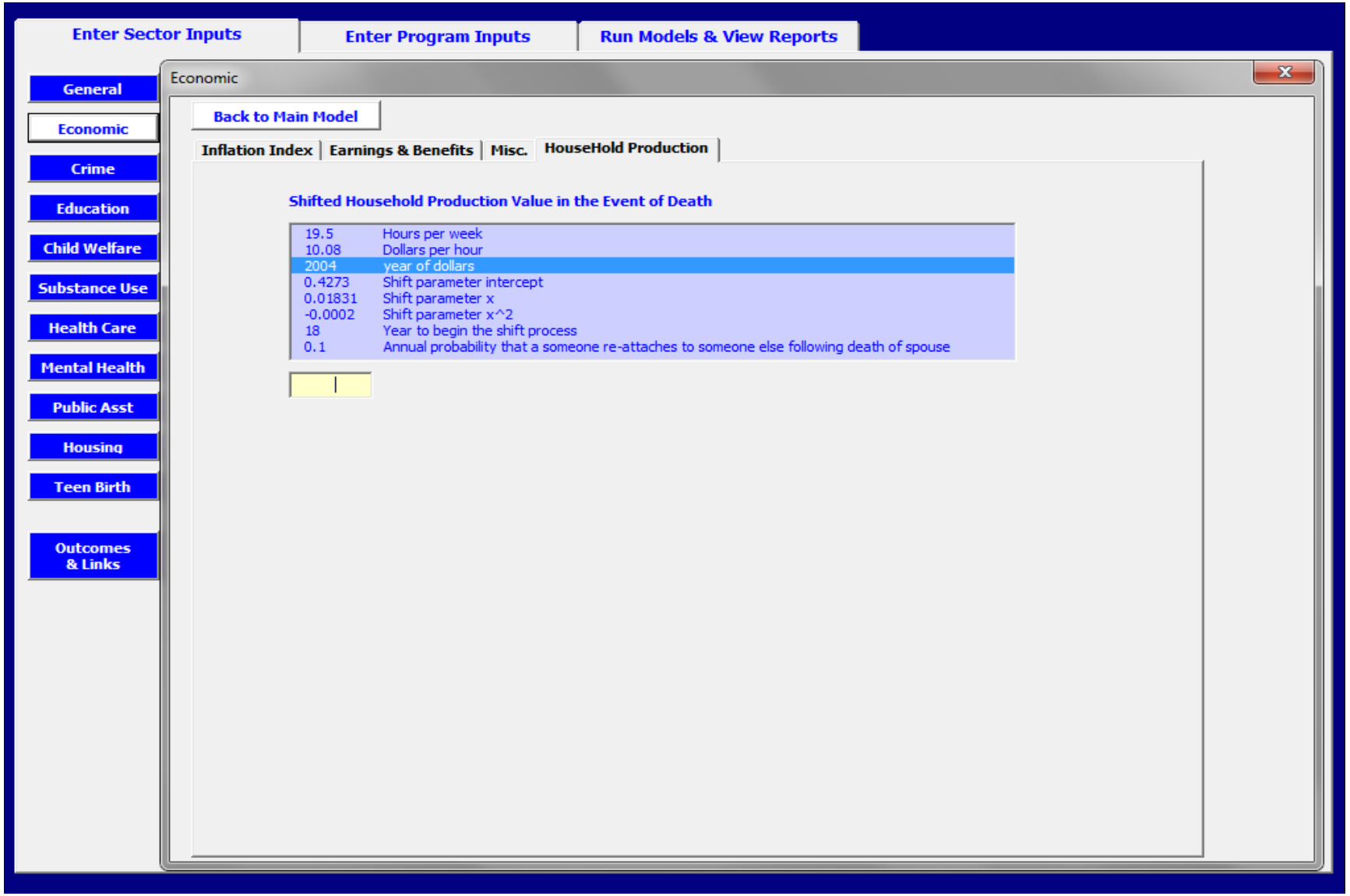
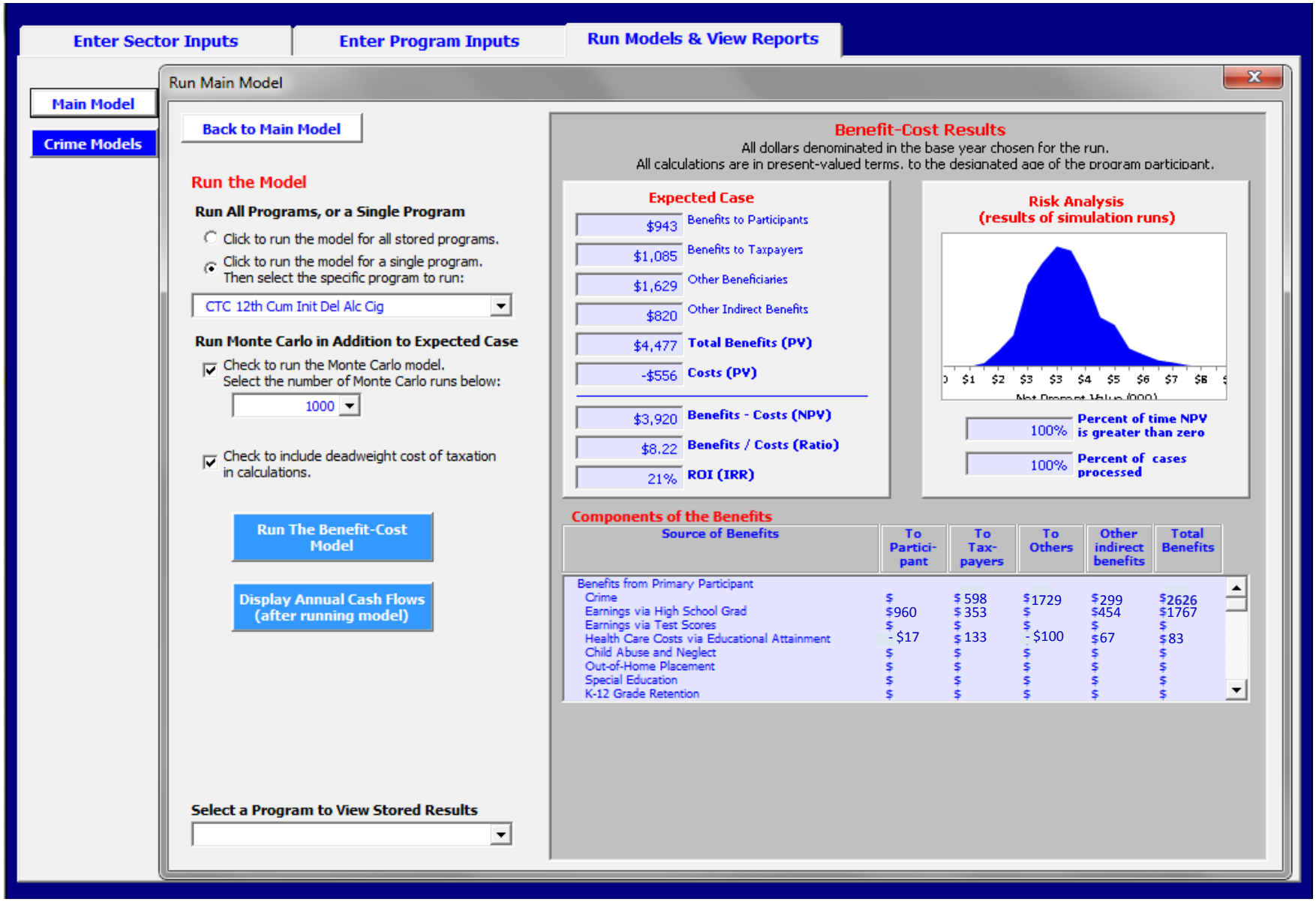



Figure 9. Run Models and View Reports: Main Model.