The WHO Tobacco Tax Simulation Model

WHO TaXSiM

User Guide

WHO/NMH/PND/18.3

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Suggested citation. The WHO tobacco tax simulation model: WHO TaXiM user guide. Geneva: World Health Organization; 2018 (WHO/NMH/PND/18.3). Licence: CC BY-NC-SA 3.0 IGO.

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Acknowledgements. The WHO TaXSiM project was led by Mark Goodchild and Tony Nicklen, with contributions from Evan Blecher, Alberto Gónima, Roberto Iglesias, Patricio Marquez, Nigar Nargis, Jeremias Paul Jr., Anne-Marie Perucic, Jean Tesche, Robert Totanes, and Ayda Yurekli.

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I. Introduction

Background

Tobacco taxation is the most effective tobacco control measures available to governments throughout the world and is thus one of the six core tobacco demand reduction interventions recommended in the WHO Framework Convention on Tobacco Control (WHO FCTC). Tobacco taxation is also referred to as a 'win-win' policy because it helps generate extra tax revenue for the government, while at the same time reducing tobacco consumption.

The major concern of Ministry of Finance officials when designing and implementing changes to the tobacco tax system is to generate reliably higher tax revenues. Other concerns such as employment, illicit trade, and public health all play a more or less important role depending on the political economy of the country. Generally speaking, public health should be accorded a higher priority, especially as higher tax rates are consistent with the primary revenue generation objective. This health objective is reflected strongly in the Sustainable Development Goals (SDGs) endorsed by United Nations General Assembly in 2015. Tobacco taxation will be a key instrument that countries will need to achieve SDG target 3.4 - to reduce premature mortality from NCDs by one third – and SDG target 3.a – to strengthen country-level implementation of the WHO FCTC.

Many high income countries and nearly all low and middle income countries still have the opportunity to substantially increase their tax rates and revenues from tobacco products. This is because tax rates on tobacco products in many of these countries tend to be quite low to begin with, and the consumer demand for tobacco products is relatively price inelastic – even in lower income countries. Strong tax administration is key to designing, implementing and monitoring effective tobacco tax systems, and this often requires administrations to build-up their level of technical and analytical capacity.

WHO and Tobacco Taxation

The Tobacco Control Economics team within the Department for the Prevention of Noncommunicable Diseases of WHO has been working collaboratively with Ministry of Finance officials in countries around the world to improve the efficiency and effectiveness of their tobacco tax system, promote public health, and generate sustainably higher tobacco tax revenues at least over the short-to-medium term. As noted in the *WHO Technical Manual on Tobacco Tax Administration* (http://www.who.int/tobacco/publications/tax_administration/en/), many countries have overly complicated tax systems for tobacco products, which are prone to tax avoidance by manufacturers and that fail to meet both the public health and revenue generation objectives of the government.

WHO's work in this area of technical support to countries has therefore focused first on improving the analytical capacity of finance officials, and secondly on improving the administration capacity to implement successful tobacco tax reforms. The WHO Tobacco Tax Simulation (TaXSiM) model has been a key analytical tool in support of this work. Originally, the models were developed on an ad hoc basis with each country that WHO worked with on tobacco taxation. These ad hoc models served to inform the development in 2013 of a beta version of the web-based TaXSiM model.

The model was designed for users that have at least some basic working knowledge of tobacco taxation, and enables them to describe the current market and tax situation for domestically consumed cigarettes by each brand and market segment (e.g. cheap versus premium brands), and then to predict the impact of tax changes on the retail price of cigarettes, cigarette consumption, excise and total tax revenues generated by each brand and market segment over the following year. The objectives of model were to:

- Create an administrative database that can be periodically updated by finance officials and other users (economists, researchers) enabling them to assess the shape and dynamics of the cigarette market.
- Quantify the expected impact of proposed policy changes on the cigarette market with an emphasis on tobacco tax revenues, under a set of logical, evidence-based assumptions about the market's behaviour.
- Enable finance officials and other users to assess the impact of tax or market changes more effectively and then to develop corrective actions where appropriate.

Since being launched in 2013, this beta version of the TaXSiM model has been tested and applied across different forums including regional workshops and country-level engagements by WHO and other tobacco control partners. Feedback from these applications has served as the basis for an updated version of the TaXSiM model that has now replaced the beta version on WHOs website. The model contains a number of new features including:

- Baseline and simulation forecast of number of adult smokers and adult smoking prevalence rate.
- The inclusion of figures highlighting key aspects of the cigarette market both at baseline and simulation.
- Numerous changes to the beta version making the updated model TaXSiM more user-friendly.
- WHO has also developed a beta version of a multi-year model which allows the user to assess the impact of a 3-4 year roadmap for tobacco tax reform.

Basic Data Needs

The WHO TaXSiM model is a data intensive tool that requires detailed information on the sale quantity and retail price of different brands of cigarettes. This type of data is usually available to Ministry of Finance and other government officials. Alternatively, there may be market survey data available, even just for different segments of the market (e.g. cheap, mid-price, premium). Of course, the more detailed the available data, the more precise and extensive can be the analysis.

Information on all indirect taxes applicable to tobacco products needs to be collected. These include excise taxes, Value-Added Taxes, sales taxes, import duties, if applicable, and any other related surcharges or cesses. Note indirect taxes do not include the corporate income tax paid by manufacturers. Detailed information about each country's tobacco tax system in 2016 can be found at http://www.who.int/tobacco/global_report/2017/appendix-ix/en/

The updated model also needs country-level data about the adult population and adult smoking prevalence. Data on adult population is available from several sources including https://esa.un.org/unpd/wpp/. Country-level data on adult smoking prevalence is available from http://www.who.int/tobacco/global_report/2017/appendix-xi/en/.

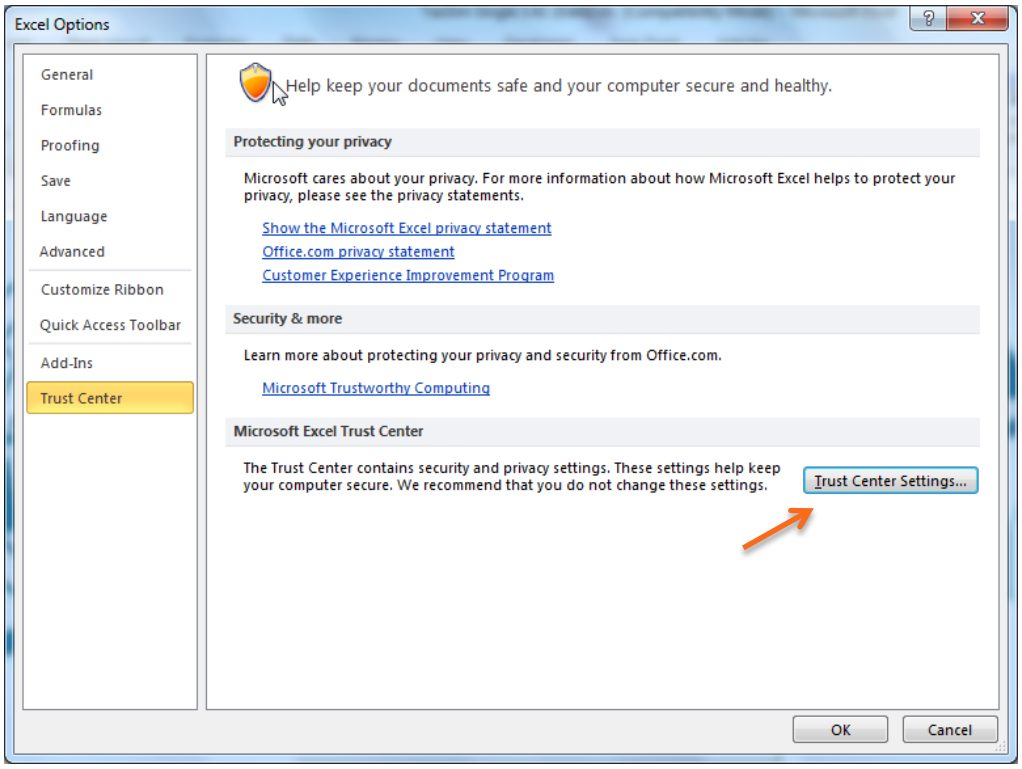
II. Getting Started

Downloading

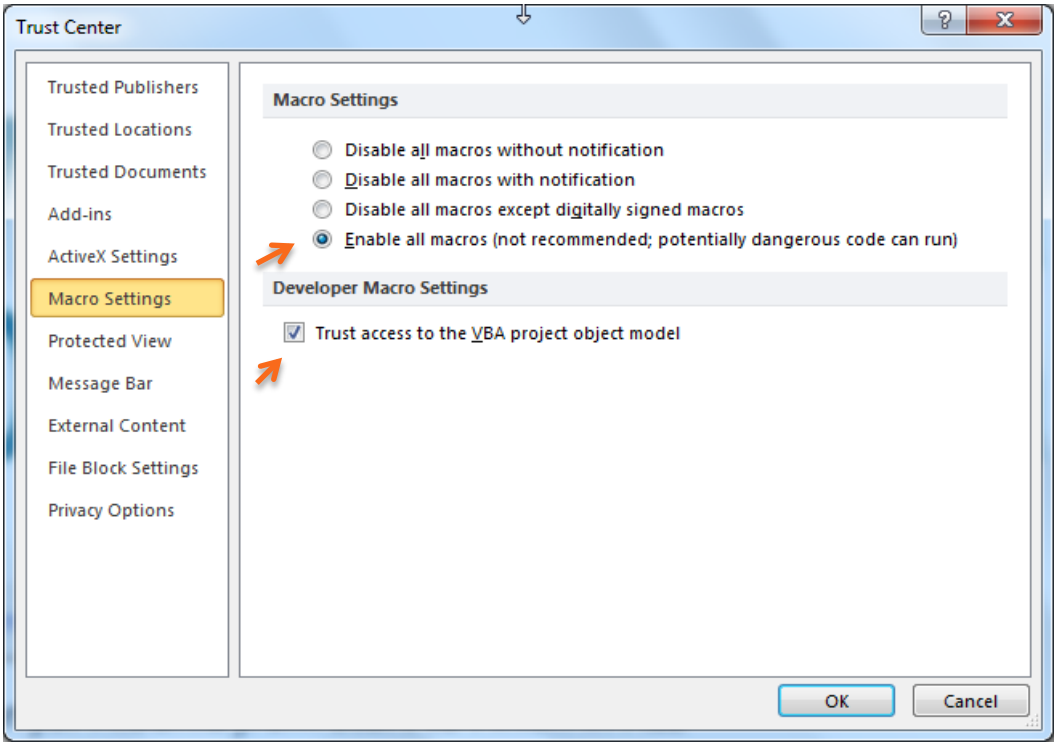
Visit the following web page, http://who.int/tobacco/economics/taxsim/en. Near the bottom of the page, select the link to download the WHO TaxSim.xls and this will open a dialog box to choose whether to open or save as you require. It is recommended you save with a relevant name for the tax system you are creating so that you can save and return to this system for amendments or keep multiple versions with different scenarios.

Initial Set Up

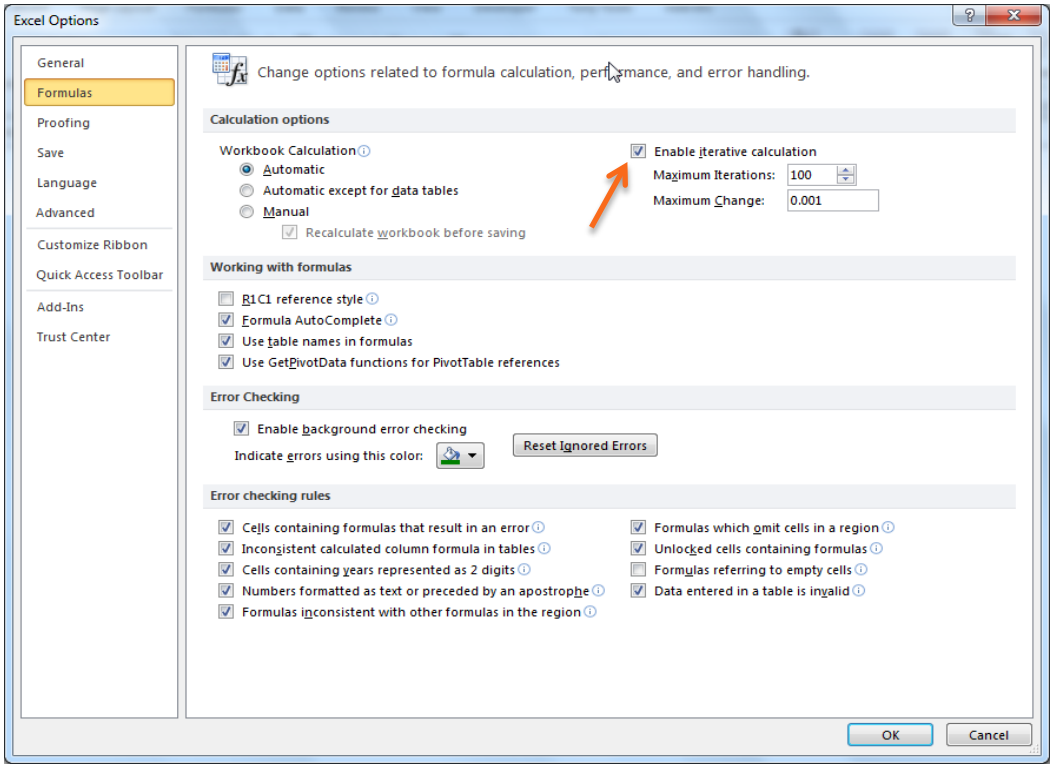
Before you open the Excel File downloaded above, please ensure that Excel is configured correctly. Depending on the version of Excel you are using select File, then Options, then Trust Center to get the following menu.



Then, on the right select the button saying Trust Center settings. This will bring up a new form as below. On the left hand side select Macro Settings and ensure that all macros are enabled and that the box to Trust access to the VBA project object model is checked as below.



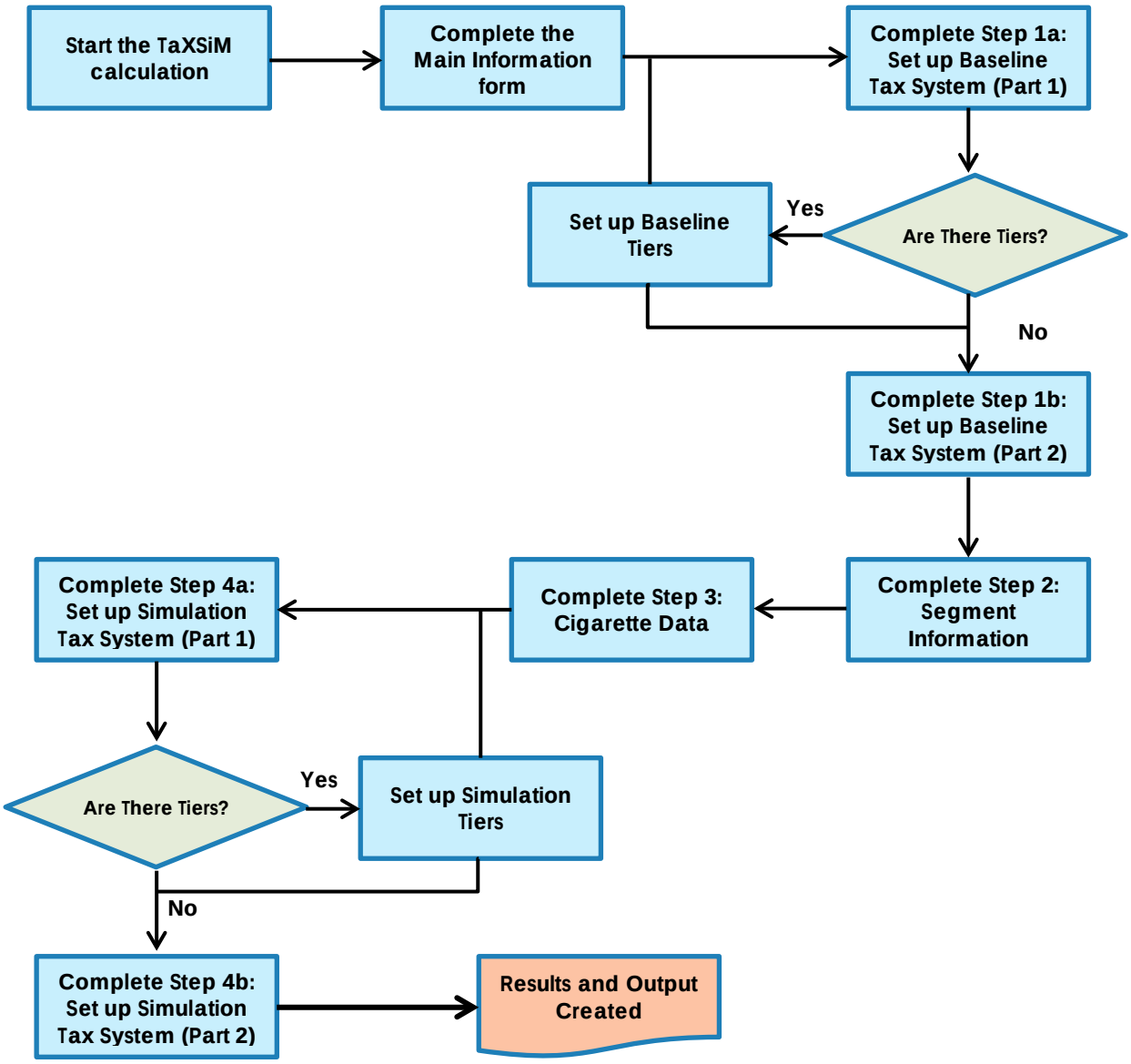
Return to the excel options screen above and select formulas on the left hand side and ensure that calculation is set as automatic and the tick box to allow iterative calculations is checked as below.



III. Using the Single Period Model

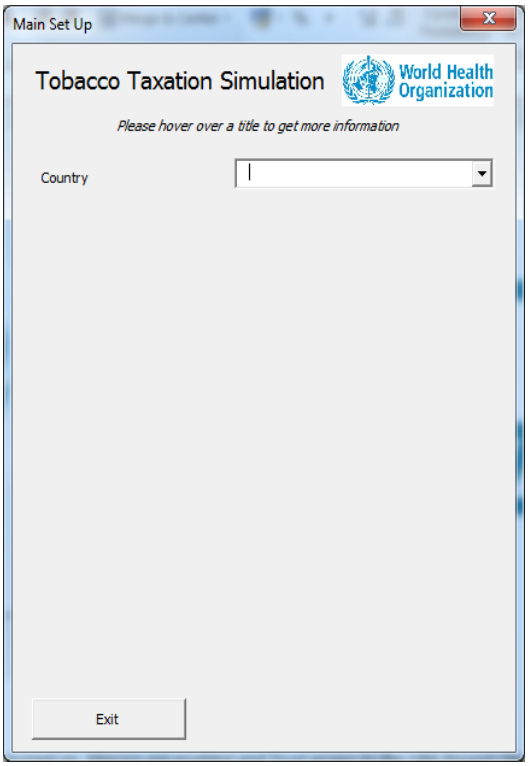
Overview of the Process

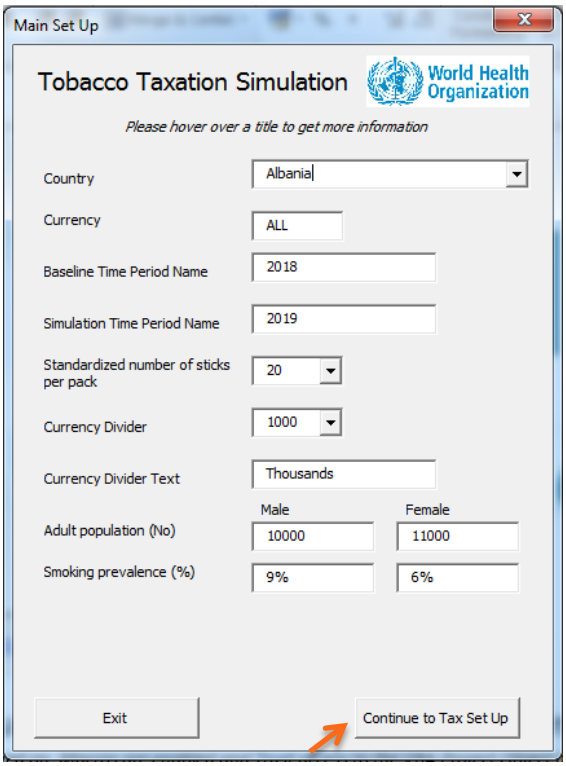
As we can see from the flow diagram below, it is a fairly straight forward step by step process with 2 areas of choice that will take us to an additional process that will set up Tiers (if required). Fundamentally, the steps are 1) Set up the static data, 2) Define the Baseline tax system, 3) Define the Simulation tax system and lastly 4) Calculate and Report the results.



The Main Screen

Upon opening the excel file for the first time, a user form will automatically open as below on the left. This will just have a drop down box to select the country you are doing the analysis for. If you populate the country then the currency will appear and be automatically populated (this can be changed) and a text box for the starting period name will appear. This is a step by step process to enter required field then the next field appears. This continues until you have completed all fields. The form will look something like below on the right.



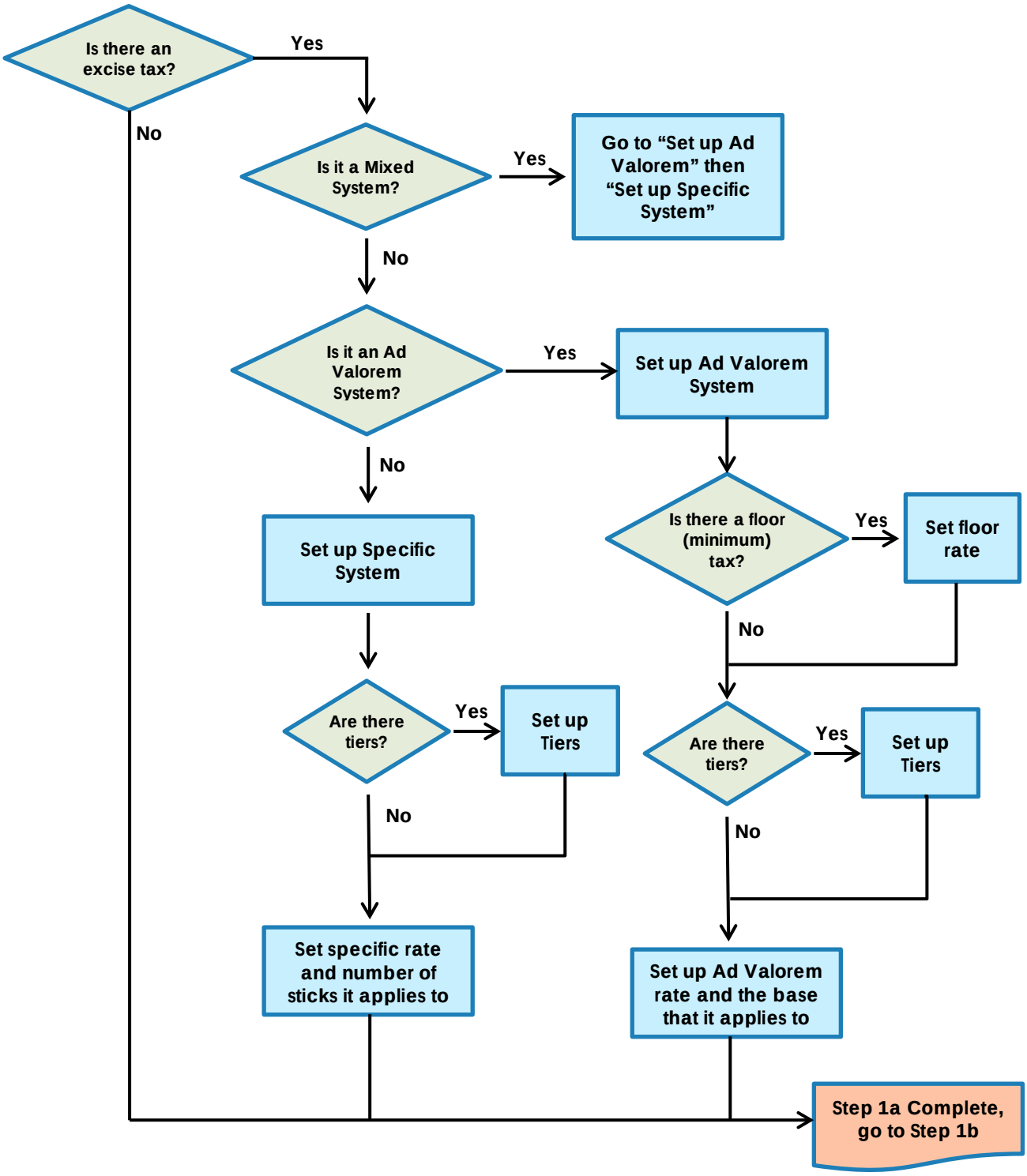


The majority of the information required is self-explanatory except for the currency divider. The currency divider allows you to add a number to divide every currency value by that so that when results are shown in the output they will be in manageable in terms of number of figures needing to be shown. The currency divider text allows you to add a description that will be shown in the summary titles. For the example above, "1,000,000" would only be displayed as "1000" with the title ALL (Thousands).

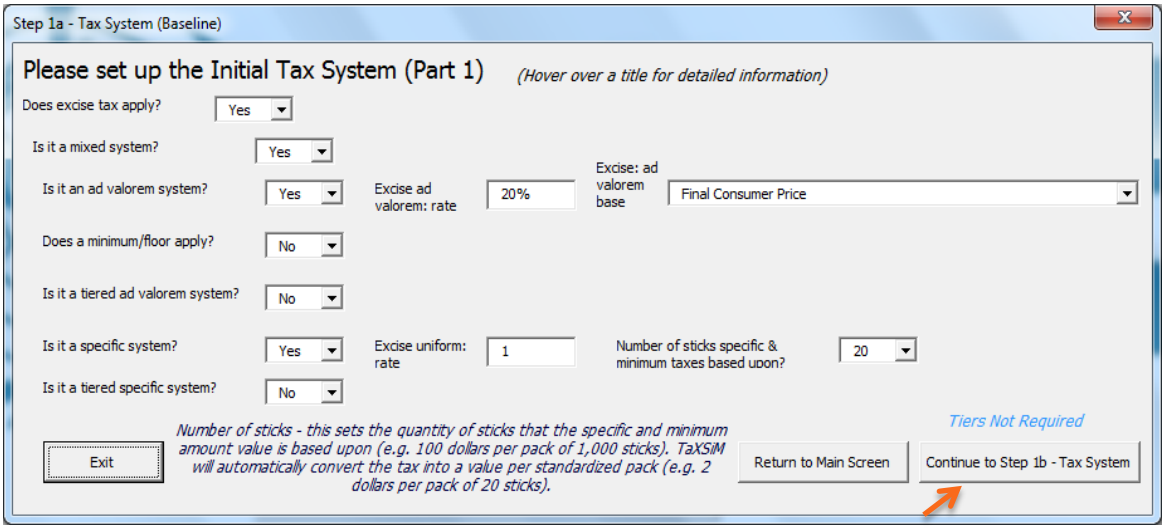
At this point, if you are happy with the data entered you can press the "Continue to Tax Set up" button and it will take you to the next screen. Please note you cannot continue until all fields have been filled but you can return to this point if you need to make changes.

Setting Up the Baseline Tax System (Steps 1a & 1b)

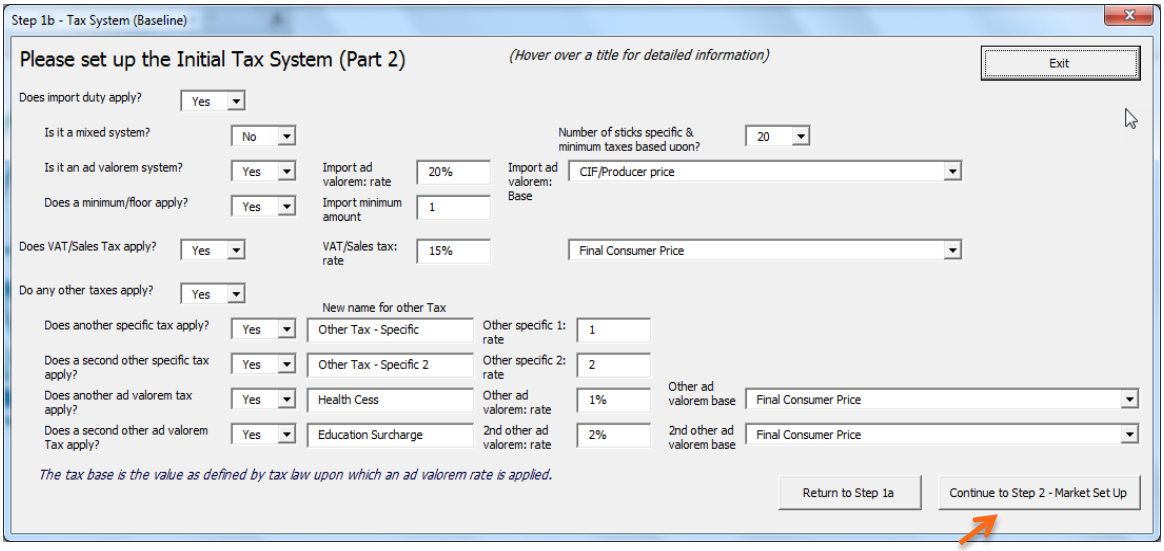
This step is purely for setting up the Excise tax for the Baseline system. Again this is a step by step process that is easily illustrated with a flow diagram.



As we can see the only decision at this point is whether it is a mixed system or not. If it is not, then you specify whether it is ad valorem (with the various options of floor or tiers for the ad valorem option) or specific only. The form will open up the correct fields given your choices. Once complete you will get a form looking something like the following. Once all the correct fields have been entered then the "*Continue to step 1b*" button will appear and you can procced Step 1b.

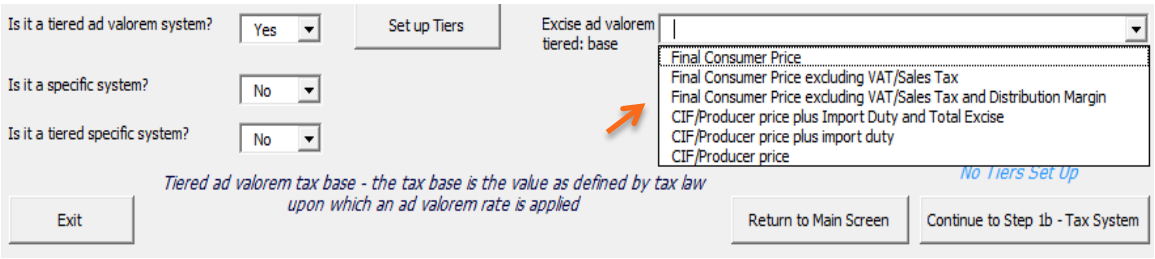


The second part of the first step allows other taxes such as Import Duty, VAT/Sales tax and any other taxes to be set up. Import Duty follows the same process as Excise and can be mixed, specific or ad valorem with the possibility of having a floor but not a tiered rate. VAT/Sales Tax can only be an ad valorem. There is also the possibility of including up to 4 other taxes (2 ad valorem and 2 specific) reflecting, for example, the application of surcharges or cess in addition to excise. Ultimately, Step 1b will look like the following if every field is used. Note you can also include name of any the other taxes as appropriate (e.g. health cess, education surcharge, etc.)

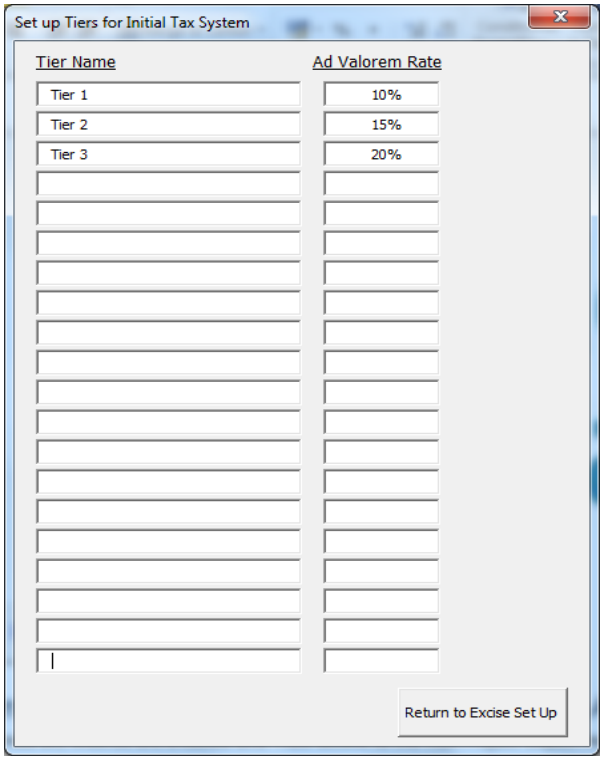


Setting Up Tiers

If a tiered system is required in Step 1a for an ad valorem system then you select yes in the drop down box a button as shown below will appear next to it with a drop down box to select the base for this system.



When you press the button, a new form will open up as follows. This allows the creation of tiers.

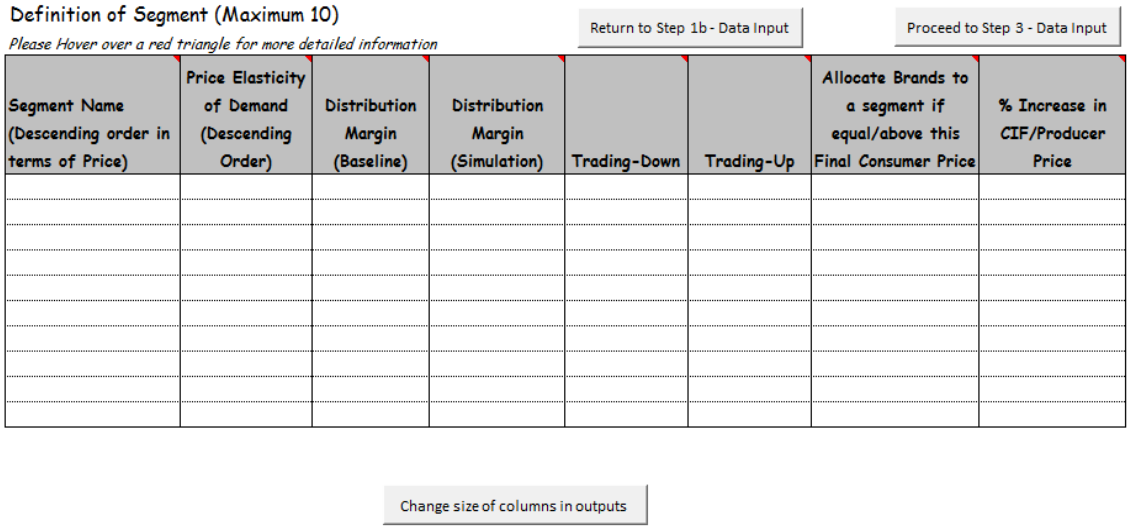


Give each tier a name and a rate and press the button at the bottom of the screen and this will check what you have entered and return you to the set up if all correct. Please note this can also be set up in step 4a if required. The tiers you have set up here will be updated in step 3 and can be allocated to any brand of cigarette as required.

The same process is followed if the tiered excise system is specific in nature.

Setting Up the Segment Data (Step 2)

Once the Baseline taxation system is defined, we need to define how the brands will be grouped and what economic factors and rates will be applied to each. The Step 1b form will close down and you will be returned to a screen like an excel sheet to input the data as shown below. Please refer to the glossary for a more complete description of each of the titles.



Once you type a name in the first row of the Segment name column you will notice that Distribution Margins and Trading up and down will be auto populated with default values. These can be changed at any time.

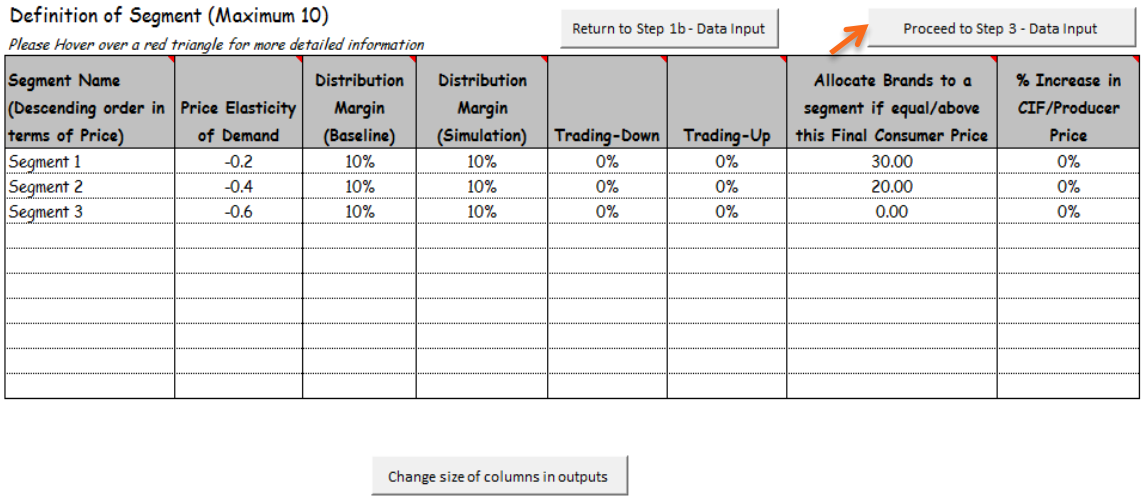
Next, complete the Price Elasticity of Demand. This can be done as you enter each segment name or at the end when you have completed all the segment names. Please note that elasticity parameter must be within the range -0.1 to -1.2. Ideally the elasticities entered should be based on empirical studies at the country-level or regional level. For example, evidence suggests that the price elasticity of demand for cigarettes in low-and-middle incomes countries tends to be higher than the price elasticity of demand in high income countries.

Change the Distribution Margins and trading up/down rates as required.

The "Allocate Brands to a segment if equal/above this Final Consumer Price" column will be used again in Step 3. This does not need to be completed but if it is, cigarette brands will be automatically allocated to their appropriate segments. The value for the last segment must always be zero to ensure that all brands are allocated.

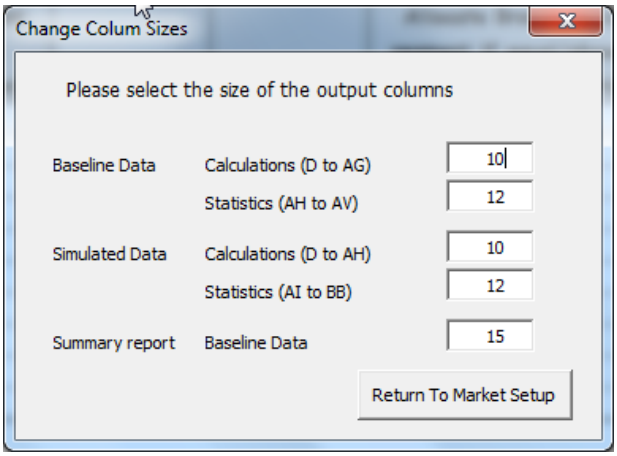
The last column is "% Increase in CIF/Producer Price". This allows for the CIF/Producer Price of any segment to change, for example in line with inflation, from the Baseline period to the Simulation period if required.

Once all data has been completed you will see a screen looking like the following. Click the proceed to step 3 button to proceed to the next step. There is a verification process at this point. You can return to any of these steps and change data whenever you like, but cannot proceed to the next step until everything is set up correctly.



Changing the Size of the Output Columns

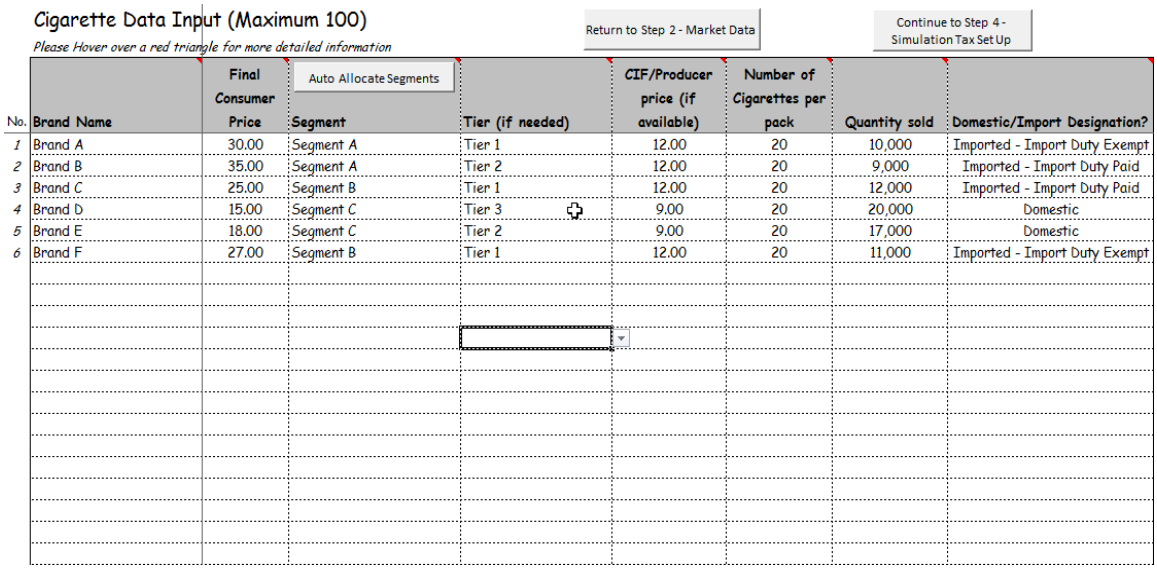
Below the table for defining the market segments there is a button labelled "Change size of columns in output". If this is pressed it will bring up the following form.



By changing the values in here you can automatically adjust the width of the outputs when they are produced at the end. This allows adjustments for large values and different screen resolutions.

Setting Up the Cigarette Data (Step 3)

Like Step 2 this will feel more like a normal excel worksheet. If there is a large amount of data you can copy directly from another source easily. This step is to set up the specific details of all brands of cigarettes and will look like the following when correctly completed.



Cigarette Data Input (Maximum 100)

Please Hover over a red triangle for more detailed information

Return to Step 2 - Market Data

Continue to Step 4 - Simulation Tax Set Up

Auto Allocate Segments

No.	Brand Name	Final Consumer Price	Segment	Tier (if needed)	CIF/Producer price (if available)	Number of Cigarettes per pack	Quantity sold	Domestic/Import Designation?
1	Brand A	30.00	Segment A	Tier 1	12.00	20	10,000	Imported - Import Duty Exempt
2	Brand B	35.00	Segment A	Tier 2	12.00	20	9,000	Imported - Import Duty Paid
3	Brand C	25.00	Segment B	Tier 1	12.00	20	12,000	Imported - Import Duty Paid
4	Brand D	15.00	Segment C	Tier 3	9.00	20	20,000	Domestic
5	Brand E	18.00	Segment C	Tier 2	9.00	20	17,000	Domestic
6	Brand F	27.00	Segment B	Tier 1	12.00	20	11,000	Imported - Import Duty Exempt

The Brand Name, Final Consumer Price, CIF/Producer Price, Number of cigarettes per pack and quantity of packs sold are fairly straight forward. More detailed description of the designation can be found in the glossary.

Each brand must have a corresponding segment to enable it to be linked to the broader market segment parameters such as the price elasticity of demand. If a range of prices has been set up in step 2 then the "Auto Allocate Segments" button at the top of the column can be pressed and will allocate the brands accordingly. Please note that this will overwrite any existing segments that have been allocated but individual brands can be changed afterwards for any exceptions.

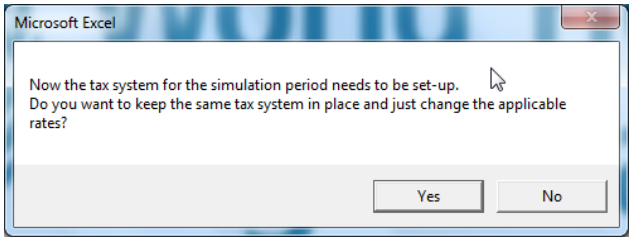
The Tier column is only required if tiers have been set up in either steps 1a or 4a. This must be manually assigned if there is a tiered system for each brand.

The last column determines the origin of the brand which, in turn, can determine how it is treated for taxation purposes. Again, please refer to the glossary for a more complete description. Basically, import duties are not payable on domestic and import duty exempt brands.

Once you have completed the necessary brands press the "Continue to Step 4a" button and a systems check will be completed before you can proceed. Please note you can return to this data screen and amend brands at any time.

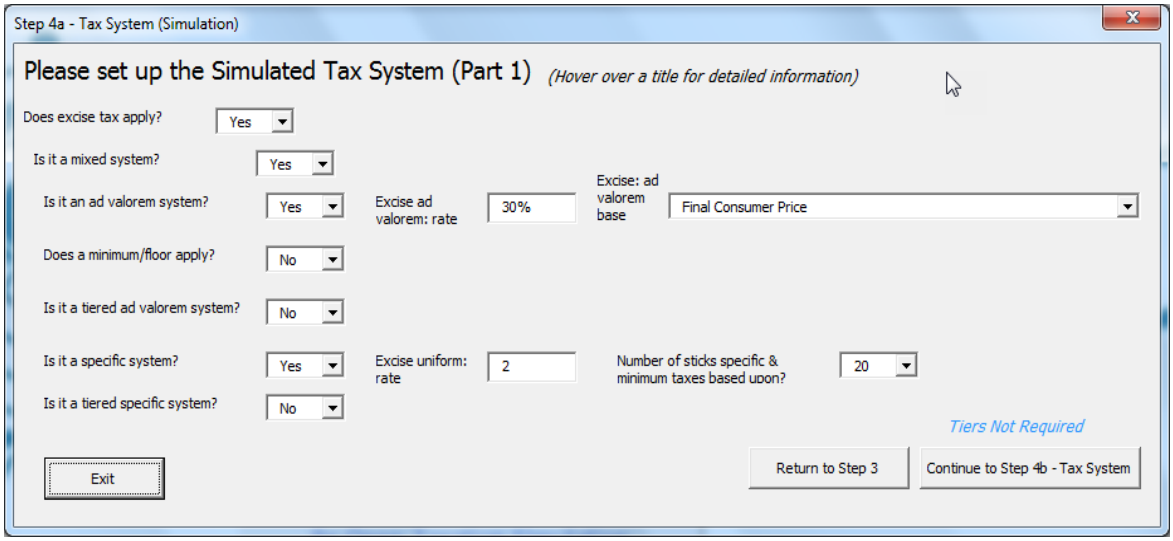
Setting Up the Tax System for the Simulation (Steps 4a & 4b)

The following message will appear prior to creating the new tax system for the simulation period.



If you select Yes, Steps 4a and 4b will be populated with exactly the same taxation system as in Steps 1a and 1b. The level of the existing tax rates can then be adjusted as required. Alternatively, by selecting no, you can create an entirely different tax system for the simulation period.

The Simulation set up is exactly the same as the Baseline system detailed in steps 1a and 1b. Proceed to enter or change the tax system as needed.



Calculating and Reporting the Results

Once you have successfully completed steps 1 through 4a you will come to the last screen, 4b. At the bottom right will be a button “Calculate and report the results” Once you press this, the system will calculate the results and create a new spreadsheet containing the results without any formulas. With large tax systems or slow computers this can take up to a minute but generally is less than ten seconds.

A message box saying "Results have been exported" will be displayed. Press okay and the results will be in a new file that will contain four worksheets:

Baseline Results: A full breakdown by brand and market segment of the relevant results for each part of the Baseline tax system you created.

Simulation Results: a similar breakdown as the Baseline worksheet, but with the results reflecting the Simulation tax system and market parameters such as the price elasticity of demand.

Summary Report: Breakdown by market segment for the most relevant information comparing the Baseline to the Simulation Tax Systems. This will also contain a description of the Baseline and Simulation tax systems that have been set up.

Graphs: A graphical representation of the key indicators for each market segment in both Baseline and Simulation.

If you are happy with these results, the file can be saved. At any time you can return to the original set up and make changes. However if a change is made the saved results file may be out of date and will need to be deleted.

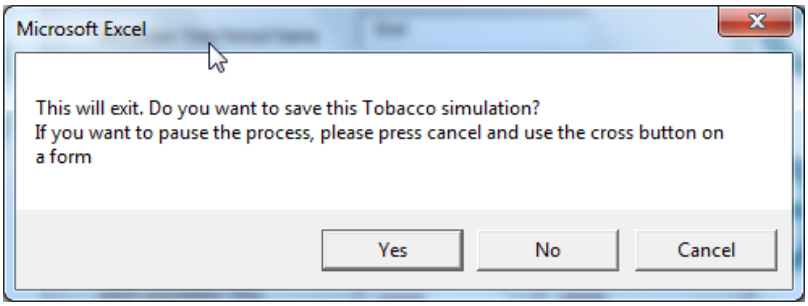
Saving, Editing, and Closing

A distinction must be made here between the Taxation Simulation main file where inputs are made and calculations are completed ("The Application") and the results calculated and exported ("The Results").

The application contains all of the base data and can be changed at any time to try different scenarios. The results, when they are exported, will only be for that scenario and the taxation system used will be written at the bottom of each summary. You can return to the application and change the taxation system, export the results again and see the impacts of this change.

Please note that you do not need to complete all steps before exiting the application. At any point you can press the red cross at the top right of any form. This will close the form and leave you in excel at a starting screen (as below) so that you can view other files or continue other work.

If you wish to continue setting up your data you can press the "Re-Open Taxation Simulation" button. If you are finished at this point you can close your excel file as normal and save or not. Alternatively if you still have the forms open you can return to the Main set up Screen and press the Exit Button. This will give you the following options which will be the same as closing with the forms closed as a normal excel operation.



If you have saved data, when you re-open your saved application it will immediately open up with the Main set up form with the data you have previously input. You can continue or return through any of the steps to edit data or change tax systems and recalculate and report the results as you wish. It is always recommended that you save these results with a different file name to the original application if you wish to keep multiple scenarios.

IV. Using the Multi Period Model

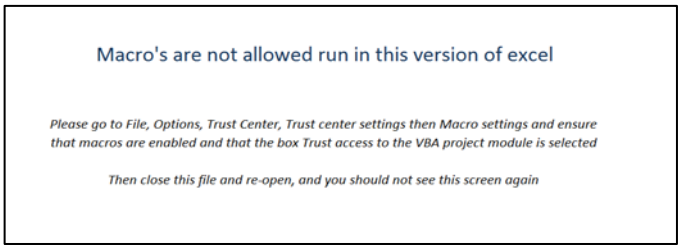
The multi period model is an extension to the original model, which allows for 3 Simulation Periods (i.e. a three-year roadmap). This is a new excel spreadsheet from the single period model and must be used separately. The process from the Main screen through from Steps 1a to 4b is exactly the same as the single period model and the above user guide can be used.

The only change will be in the main setup; there will 2 additional fields to name the new simulation periods. After step 4b there will be four additional forms to complete. These follow exactly as steps 1a and 1b but will be labelled 5a and 5b for the second Simulation time period and 6a and 6b for the third Simulation time period. These will be completed in exactly the same way and the procedures for steps 1a and 1b can be used.

Once you calculate the results you will see the two additional worksheets for these new Simulation periods and the summary and graphs will have additional bars/columns for the new simulation periods.

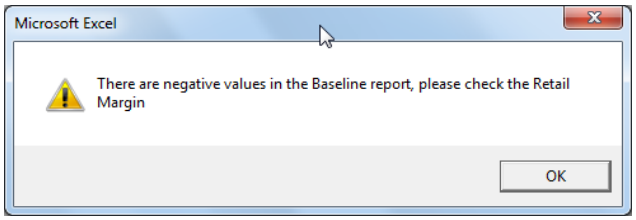
V. Troubleshooting

Macro Warning Page



After opening the excel file, if you get an opening screen as above it means that excel has not been set up correctly. Please refer to the getting started section (Section II) and change the settings to allow all macros.

Negative Retail Margin



If you have finished the whole process and calculated the result and you get the message above pop up, then the most likely cause is that the Final Consumer Price for this brand has been set too low or the Producer Price is too high. In the output created find the brand that as a negative value as below.

	Segment Tier	CIF/Producer price	Importer / Producer Margin	Distribution Margin	Import Duty - Uniform Specific	Total Import Duty	VAT/Sales Tax	Excise - Uniform Ad Valorem	Total Excise	Total Taxes	Final Consumer Price	Change in Final Consumer Price
		(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(ALL / 20)	(%)
	Segment A	12.00	4.81	2.09	0.94	0.94	0.00	1.04	1.04	1.98	20.88	3.06%
	Segment B	12.00	9.83	2.69	1.02	1.02	0.00	1.34	1.34	2.37	26.88	3.57%
	Segment C	9.00	5.09	1.66	0.00	0.00	0.00	0.83	0.83	0.83	16.57	1.18%
	TOTAL	**10.58**	**6.39**	**2.06**	**0.52**	**0.52**	**0.00**	**1.03**	**1.03**	**1.55**	**20.58**	**2.36%**
Brand												
Brand A	Segment A *Tier 1*	12.00	-5.98	0.71	0.00	0.00	0.00	0.35	0.35	0.35	7.08	1.18%
Brand B	Segment A *Tier 2*	12.00	17.10	3.66	2.00	2.00	0.00	1.83	1.83	3.83	36.59	4.54%
Brand C	Segment B *Tier 1*	12.00	8.50	2.65	2.00	2.00	0.00	1.32	1.32	3.32	26.47	5.88%
Brand D	Segment C *Tier 3*	9.00	3.90	1.52	0.00	0.00	0.00	0.76	0.76	0.76	15.18	1.18%
Brand E	Segment C *Tier 2*	9.00	6.48	1.82	0.00	0.00	0.00	0.91	0.91	0.91	18.21	1.18%
Brand F	Segment B *Tier 1*	12.00	11.22	2.73	0.00	0.00	0.00	1.37	1.37	1.37	27.32	1.18%

Then re-start the process and at step 3, check that the prices have been inputted correctly for that brand of cigarettes or adjust prices and margins.

VI. Glossary

Term	Definition
Ad Valorem tax	A tax levied on selected products based on value, such as retail selling price, the manufacturer's (or ex-factory) price, or the CIF price
CIF Price	Cost, insurance and freight. Declared cost of imported product inclusive of insurance and freight.
Distribution Margin	Cost and profit margins of wholesalers and retailers (i.e. the whole distribution chain).
Domestic	A locally produced brand (i.e. not subject to import duty).
Excise Tax	Tax or duty imposed on the sale or production of selected products, such as tobacco products.
Final Consumer Price	Price paid by the consumer (also often called Retail Price).
Import Duty (or import tax)	A tax imposed on selected imported products, such as tobacco products
Imported - Import Duty Exempt	An imported brand that is not subject to import duty (e.g. the country of origin is within a duty free zone).
Imported - Import Duty Paid	An imported brand that is subject to import duty.
Minimum/Floor	Ad valorem tax is applied unless the value of the tax is less than a specified minimum amount, at which point a specific tax applies instead
Mixed System	A tax that includes both a specific tax component and an ad valorem tax component; also referred to as mixed tax or hybrid tax
Price Elasticity of Demand	The percentage change in consumption resulting from a 1% increase in the final consumer price.
Producer Price	Manufacturers price including cost and profit margins.
Retail Margin	Cost and profit margin of retailers.
Smoking prevalence rate	Means the percentage of the adult population that smokes.
Specific tax	A tax levied on selected products based on quantity, such as number of cigarettes or weight of tobacco
Tiered tax	A tax applied at different rates to different variants of a given product, based on various factors such as price, product characteristics, or production characteristic.
Trading Down / Up	To shift consumption between higher and lower priced brands in response to price increases
VAT/Sales Tax	A tax imposed on a wide variety of products (domestic and imported), based on the value added at each stage of production or distribution