



User's Guide

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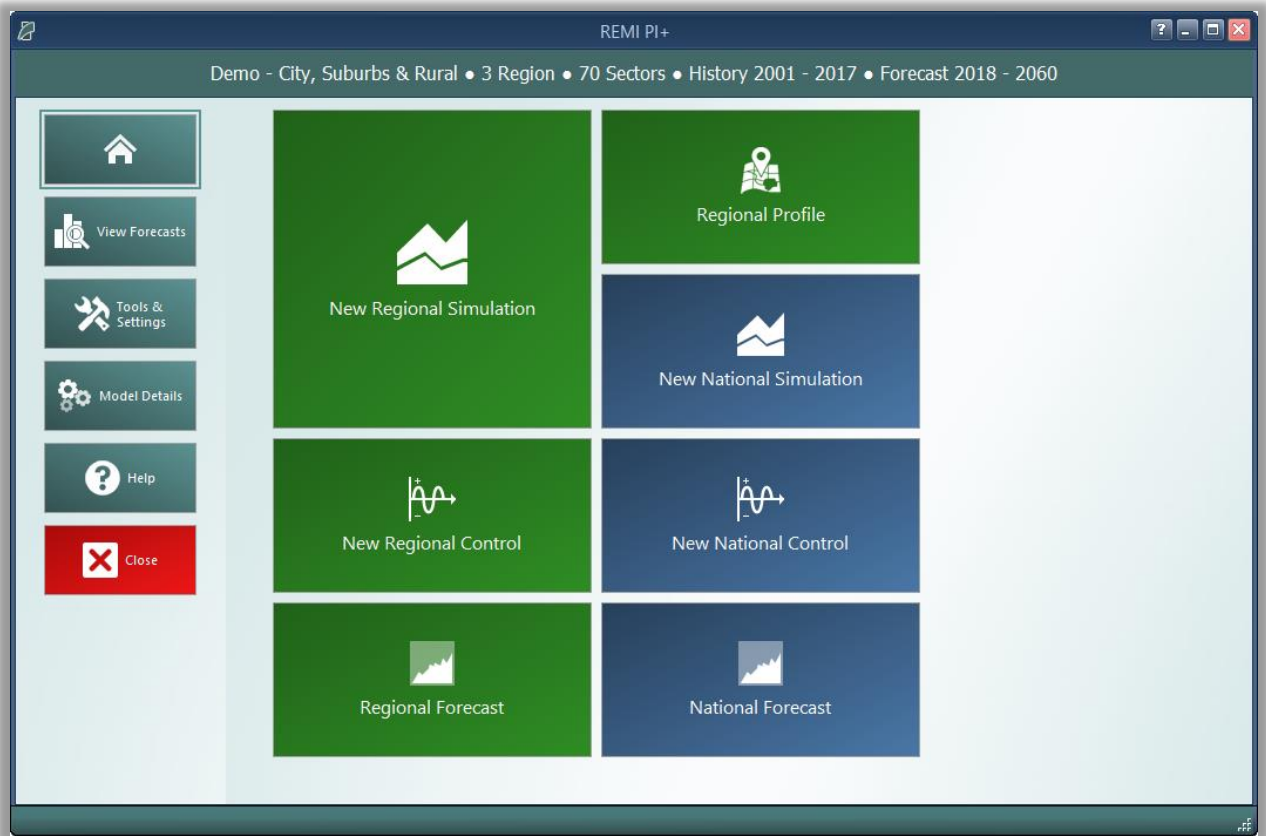
I. Introduction

This user's guide is intended to serve as a broad overview of the software interface of PI+ version 2.3. Contained within this document are descriptions and screenshots that map out the overall layout of the application and also highlight some of the specific functionality available in different areas of the product. Given the large number of changes to many parts of PI+ in recent version upgrades, including a major restructuring of the forecast file system and a complete redesign of the results, we at REMI hope that this guide will be useful during the process of learning the updated software.

II. Overview of the PI+ Home Window

The main PI+ application window is the initial jumping off point for all analyses performed with the REMI model. This home window is the central location for creating and managing forecasts, changing general settings, making customizations, examining detailed information specific to your model regions, and finding in-software support material. There are five major sections to the home window, each accessible via tiles located on the left-hand side of the screen.

Figure 1: PI+ Home Window



Home Screen

The first section of the home window, which will be the first thing seen once PI+ has finished launching, is the home screen. The home screen's purpose is to provide quick and simple access points for starting your use of the REMI model to simulate policy change. By clicking on the appropriate tile, you are able to start creating any one of the four types of forecasts available in PI+: regional simulations, national simulations, regional controls, and national controls. In some cases, you may be prompted to choose a baseline for your new forecast from the Forecast List. Your new forecast will open in a separate window, called the Forecast Window.

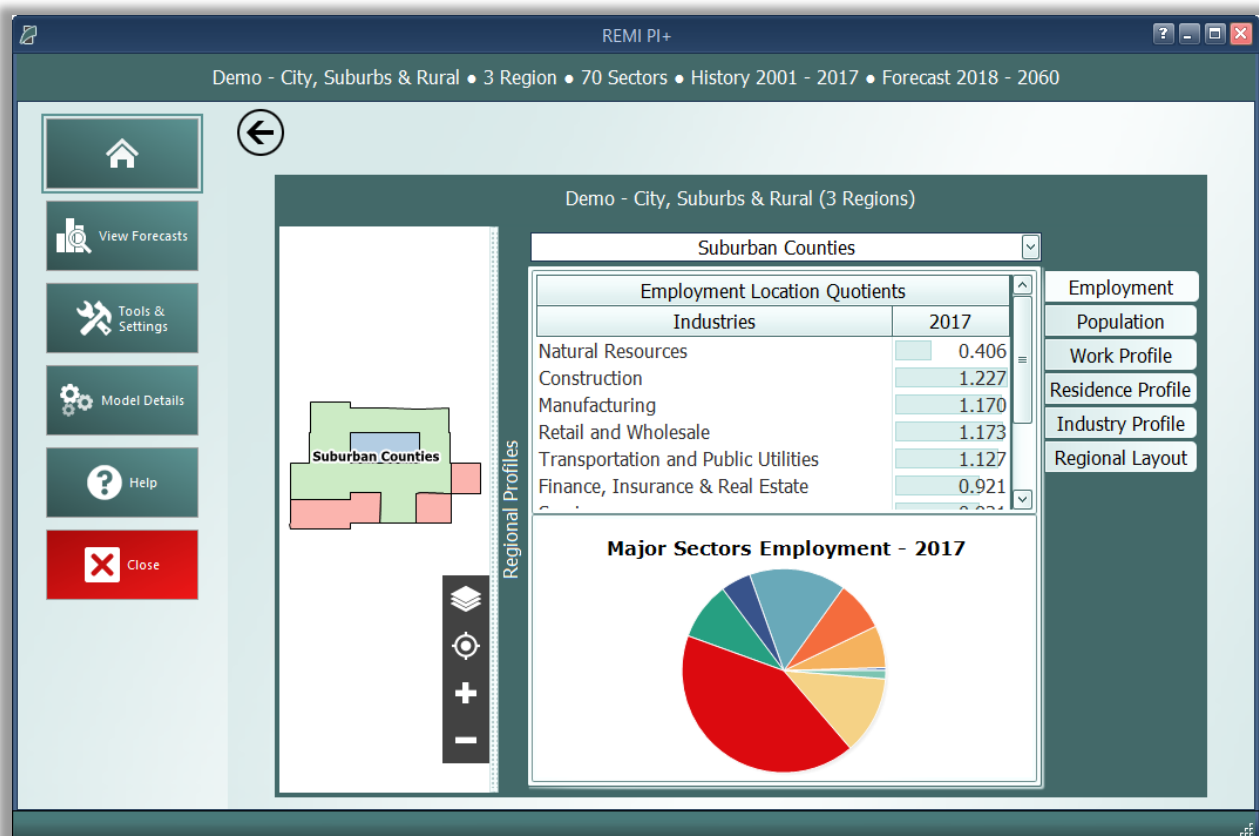
If you are interested in exploring REMI's default control forecasts that form the basis of your model, you can dig directly into the data by clicking on the "Regional Forecast" or "National Forecast" tiles. The selected forecast will be opened in a special Forecast Window that shows only the Results section. Some specific tables, maps, and data visualizations have been specially chosen to display REMI's baseline forecasts and provide informative profiles of the national and regional economies.

Another way of examining baseline data and visualizing differences between your model regions is to visit the Regional Profile tool, also accessed from the home screen by clicking on the "Regional Profile" tile.

Regional Profile

The Regional Profile tool features a combination of a regional map with several tabs of tables and charts describing last-history-year data for major economic and demographic concepts for each region. This tool is useful for learning about the specific economic and demographic characteristics of your model regions. Many of the tables contain location quotients, which make it easy to identify unique regional attributes in comparison to national averages. Additionally, our newly updated map is capable of displaying an internet-based OpenStreetMaps layer using the Map Layers button, which could prove useful for investigating regional geography.

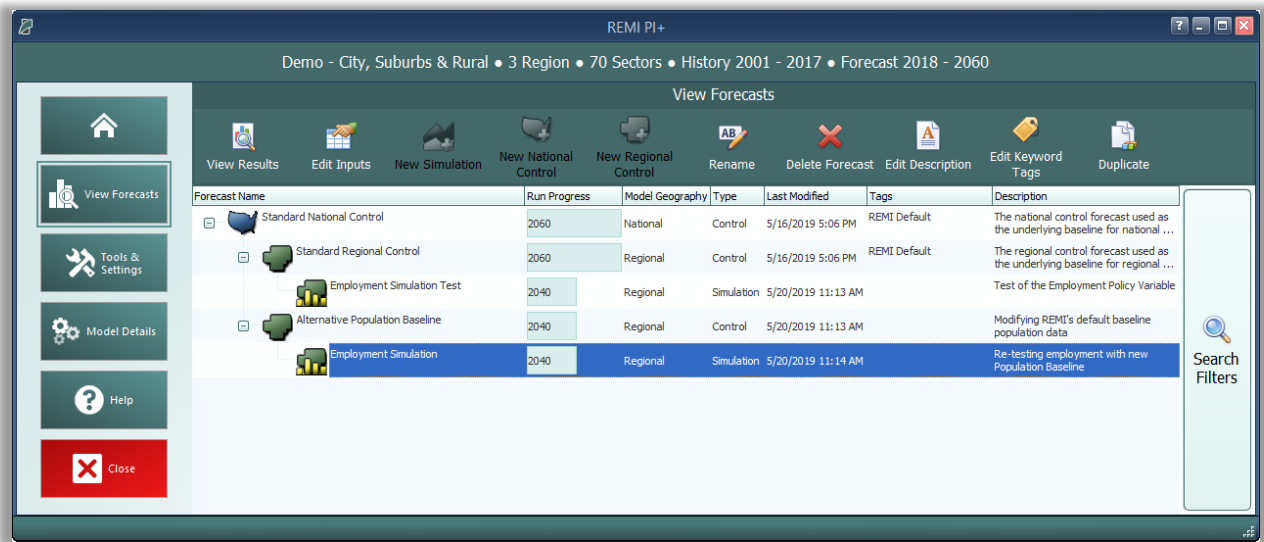
Figure 2: Regional Profile



Forecast List

The Forecast List, accessed by clicking on the “View Forecasts” tile, is the central location for everything to do with forecast management. PI+ no longer operates in a workbook-based manner. Instead of opening singular workbooks that each may have contained multiple forecasts, we have moved to an approach of always providing visible access to every forecast at the same time on the Forecast List. Forecasts are not opened automatically, so large lists of forecasts will not inherently cause any increased operating overhead for PI+. We hope that this new file management system will result in less file management work for users and fewer instances of forecasts being lost if errors occur.

Figure 3: Forecast List



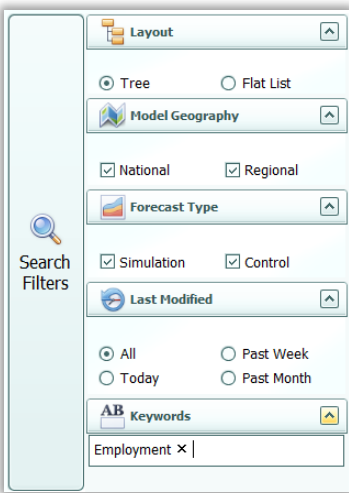
The Forecast List organizes forecasts in a tree structure. Each forecast appears underneath its parent baseline control, with the Standard National Control and Standard Regional Control at the top. Selecting a forecast in the list will activate buttons above the list depending on the forecast selected and what options are available to it. For control forecasts, buttons for creating new control or simulation forecasts will become active depending on the type of control forecast selected. All forecasts in the list can be opened for viewing in their respective Forecast Window. Depending on whether a forecast being opened already has been run, the Forecast Window will open to either the Inputs List or the Results section.

Other actions can be taken for forecasts on the Forecast List are renaming, deleting, adding or editing a description, adding or editing keyword tags, and duplicating. Tags and descriptions are new features that should be useful for organizing your forecasts now that they are all contained in the same place. For further ease of use when the forecast list becomes long, we have added search filters that can quickly hide all forecasts that you are not currently interested in seeing.

Search Filters

Clicking on the right-hand “Search Filters” panel on the Forecast List pops open a set of useful options for filtering down the list of known forecasts. There are filters for viewing only national or regional forecasts, for hiding all simulations or all controls, for seeing only forecasts modified within a recent time period, and lastly, an auto-complete search filter for retrieving forecasts with information matching the search terms.

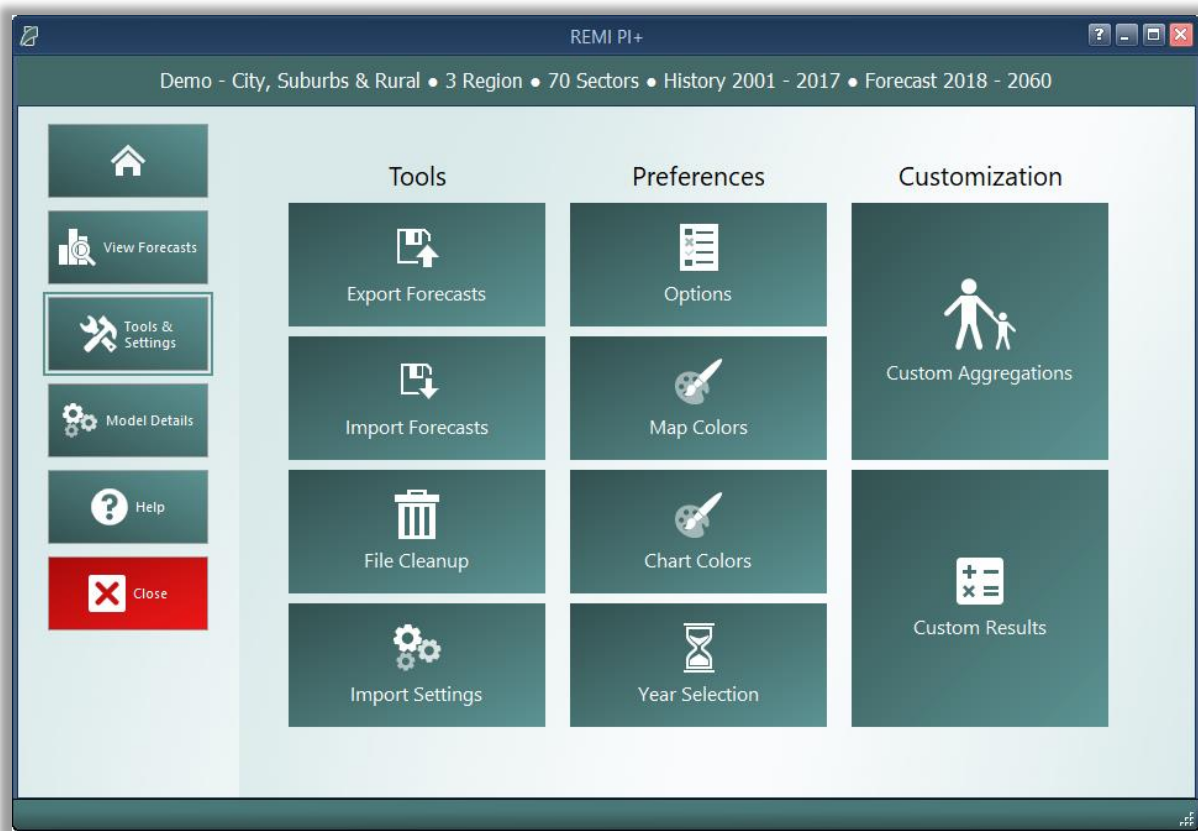
Figure 4: Search Filters



Tools & Settings

The Tools & Settings section of the main window contains, as the name suggests, several tools and settings that will likely be useful at some point in your use of PI+.

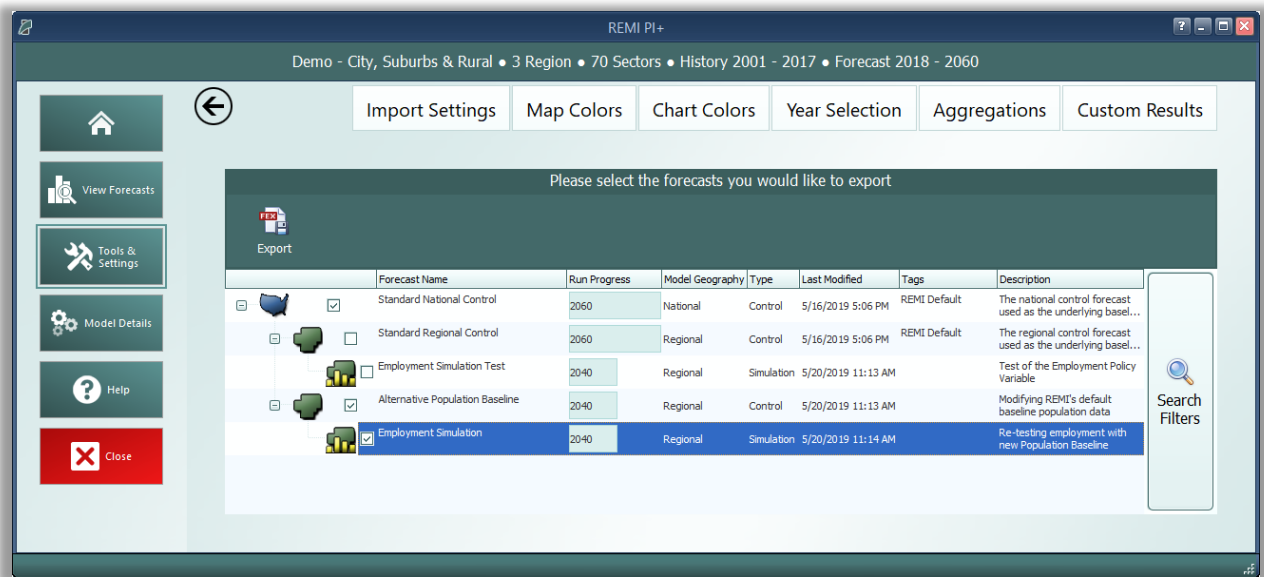
Figure 5: Tools & Settings



Exporting and Importing Forecasts

Perhaps most important among the various tools and settings available on the Tools & Settings screen are the forecast export and import features. Due to our new system of automatically managing forecast files, it is no longer possible to simply pass along a “.RWB” workbook file to other users or to REMI for support because a given installation of PI+ will not know about forecasts in files that it did not create itself. The solution to this is our new export and import features. The corresponding tiles are located under the “Tools” heading. The export feature will allow you to select any forecasts you want to share and package them up in a single file that can be imported by another user with the same PI+ model. Exported forecasts will be contained within a new “.FEX” file format. When selecting forecasts for export, be aware that any parent control forecasts are required to be exported as well and will be automatically checked off.

Figure 6: Forecast Export



File Cleanup

Another file management feature is the forecast backup file. Each time a forecast is saved, a backup file is created as well so that there is something to fall back in case the file is corrupted or lost when it is next used. If you end up with too many backup files in the Workbooks subdirectory of your model folder or if you find that you would like to attempt to access a backup, you can use the File Cleanup feature. The File Cleanup dialog will determine how many forecast files exist that are unknown to PI+ as either backups, exports that have yet to be imported, or any other forecast files and allow you to deal with them by either deleting or importing them.

Options

The options menu consists of several non-crucial settings. You can change the PI+ color scheme, select an alternative tile navigation design, decide whether exported files should automatically open, allow for PI+ to use the Internet to retrieve OpenStreetMaps data, supply a sound file for use as an indicator alert that PI+ has finished running a forecast, and select from several alternative industry labelling forms that include NAICS codes.

Map Colors

The map colors interface allows for selecting what colors the map should use when it displays results. To select your preferred color option, choose it from the gallery and click the “Save as Default” button. Custom

colors ranges can be created by using the “Add New” button. Three-color ranges are offered for ease of viewing both positive and negative results on the same map while two-color ranges work better for black-and-white printing.

Figure 7: Map Colors

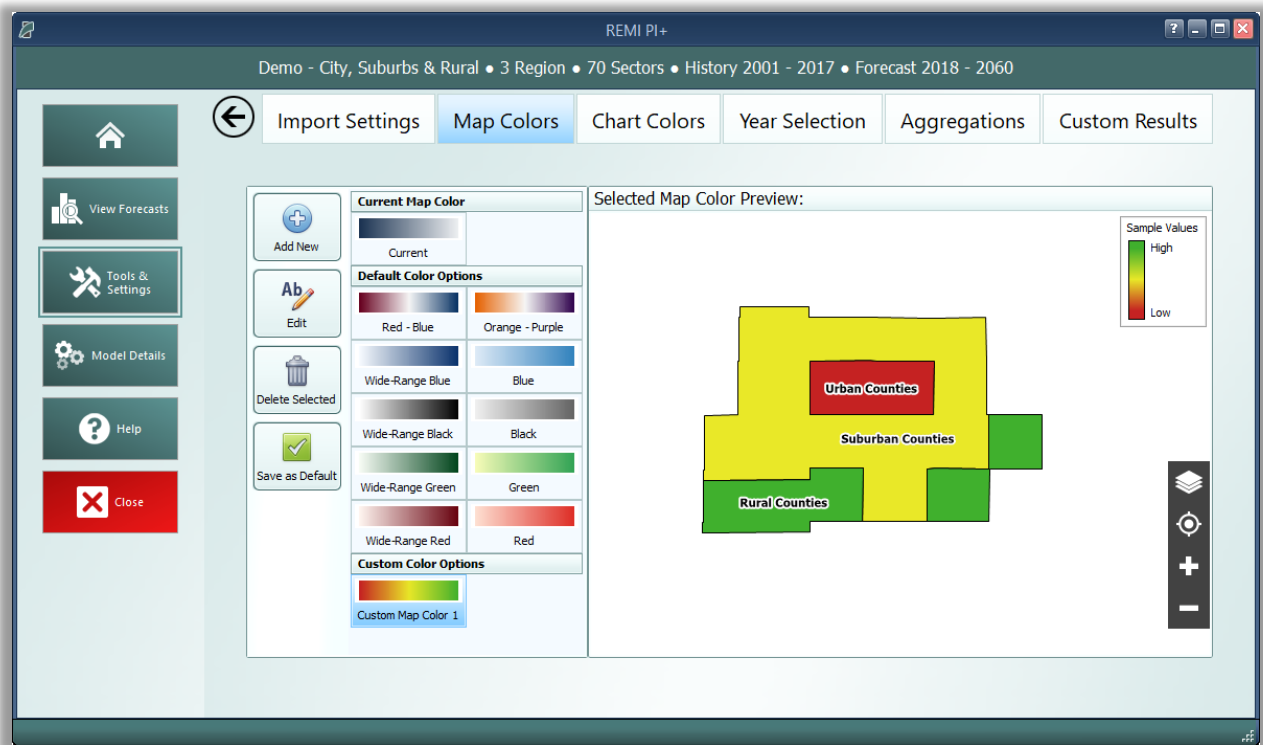


Chart Colors

Similarly to map colors, the Chart Colors Selection screen allows for selecting the default palette to be used by the charts on the results. It also includes a tool for creating custom color palettes. Colors can be selected to add to a palette using a color selector tool or by entering RGB or HEX codes.

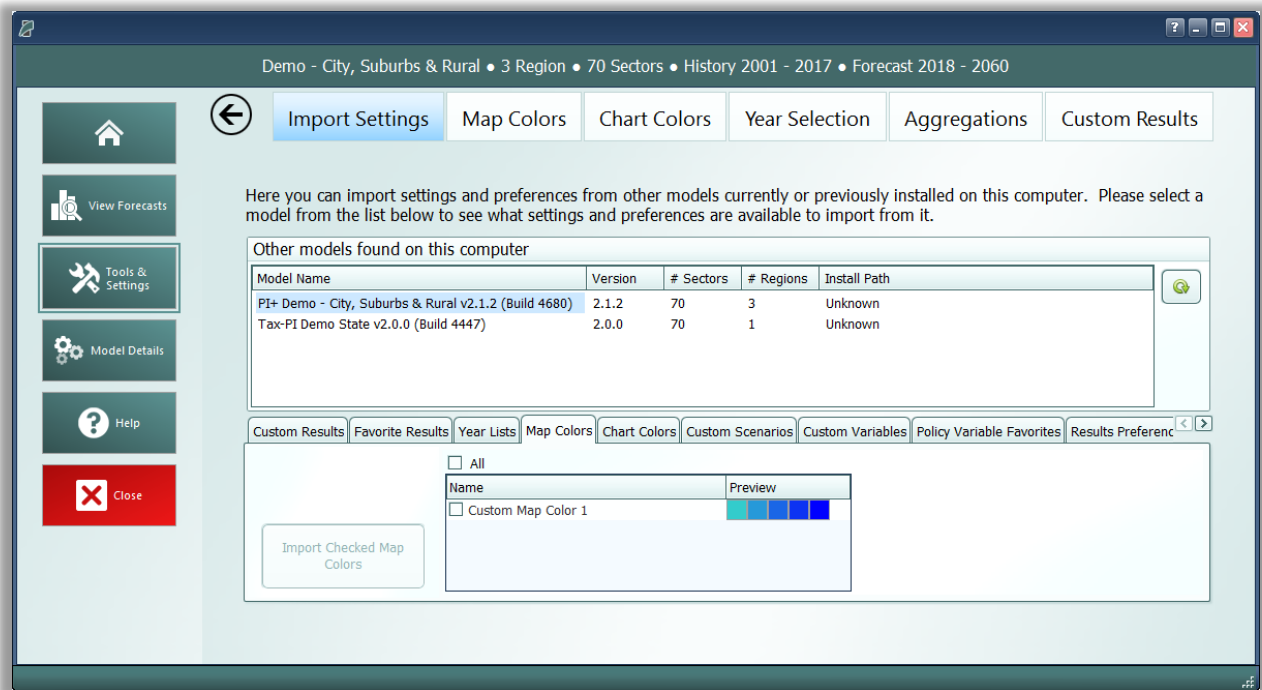
Year Selection

The Year Selection screen is used to build lists of years for use on the results. Saved year lists that you create can later be applied to result visualizations such that only the years included in the list are shown. This feature is useful if you are only interested in viewing certain years of results and would prefer to have a saved list rather than filtering the years shown by visualizations manually.

Import Manager

Use the Import Manager to import settings and preferences from other REMI models installed on your computer. Select from a list of installed models and use the viewer below it to see what user settings from that model are available for import. If a tab is disabled, that means that there are no user settings from that model available for import. Certain settings may require additional settings to be imported to work properly, such as importing a favorite result table with custom result variables. The favorite result will not display the custom result if it is not also imported.

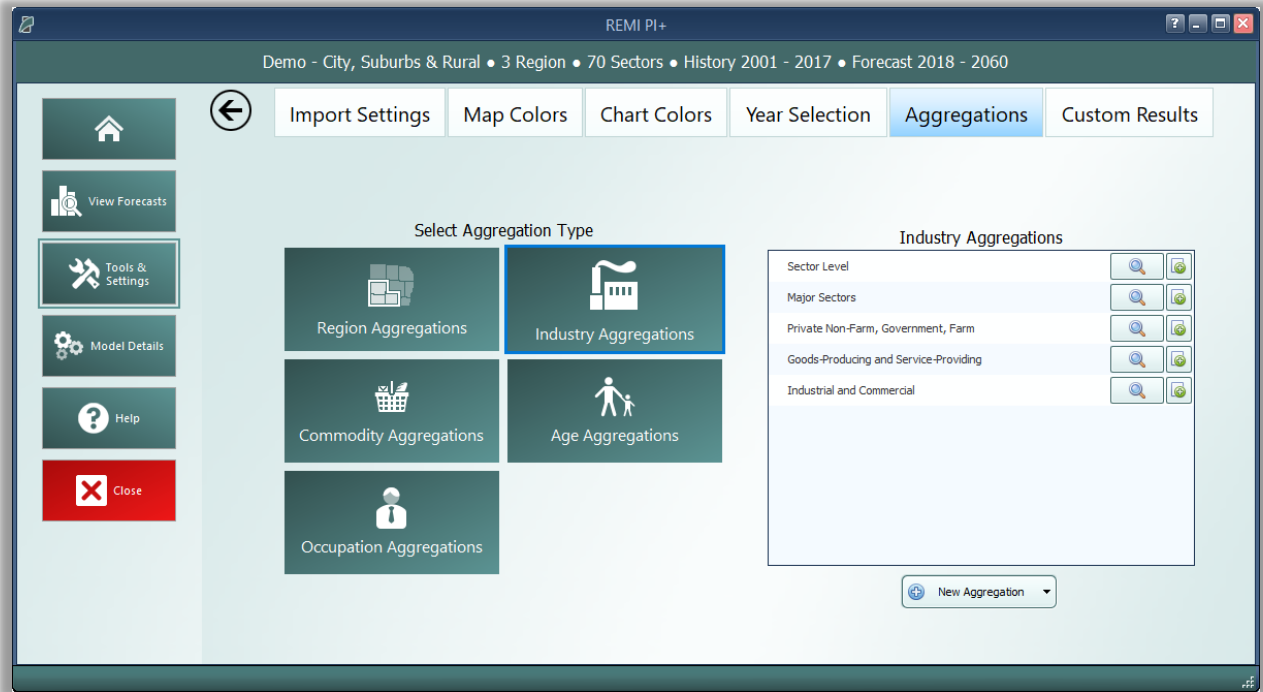
Figure 8: Import Manager



Aggregation Manager

Aggregations are groupings of details including regions, industries, commodities, occupations, and ages. They have been thoroughly integrated into the model with respect to both policy variable creation and the results. Aggregations save time when you are interested in only certain details or when you would like to define your own customized structuring of all the details. The Aggregation Manager allows you to create aggregations for each of the five supported detail types. Aggregations that you import from other models using the Import Manager appear here.

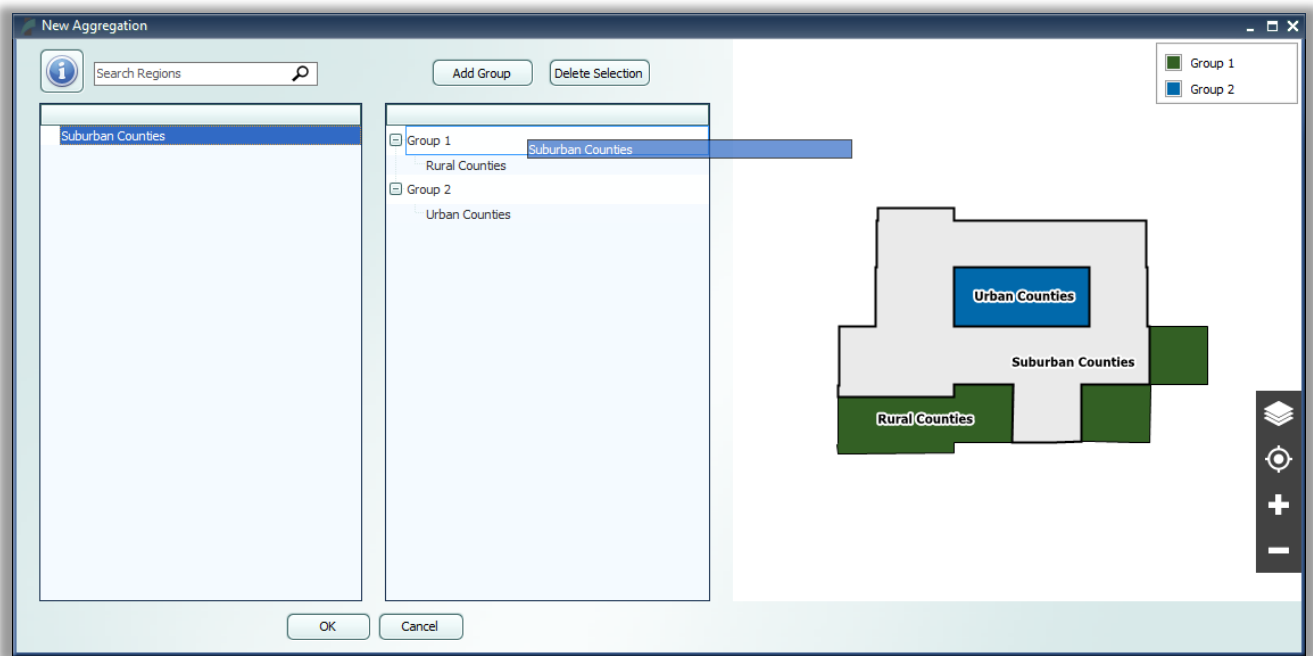
Figure 9: Industry Aggregation Manager



For most of the detail types, you will find some default aggregations built by REMI. You can view these default aggregations to see how they categorize details and also duplicate them if you would like to make a small change. For making a completely new aggregation, click the “New Aggregation” button at the bottom of the aggregation list. Depending on your model and the detail type, you may be prompted to choose what level of detail you would like to use in building the aggregation. For example, a 70-sector model would be able to create industry aggregations using the default 70 sectors or, optionally, using 23 sectors instead.

Creating a custom aggregation will open the Aggregation Editor. To build an aggregation using the Aggregation Editor, simply create some groups using the “Add Group” button, give them meaningful names, and then drag details from the left-hand list box onto the groups. In long lists of details, it may be useful to use the search box to filter the list. Groups and details can be deleted by selecting them and clicking the “Delete Selection” button, and details can be moved between groups or back to the left-hand list box by dragging. There are additional detail-moving features located in the right-click menu. Using the Aggregation Editor to create a region aggregation includes a map as an additional tool. Regions listed in either list box can be selected using the map (hold shift while dragging to multi-select on the map) and the map also serves to visually indicate how your regions are being aggregated.

Figure 10: Region Aggregation Editor



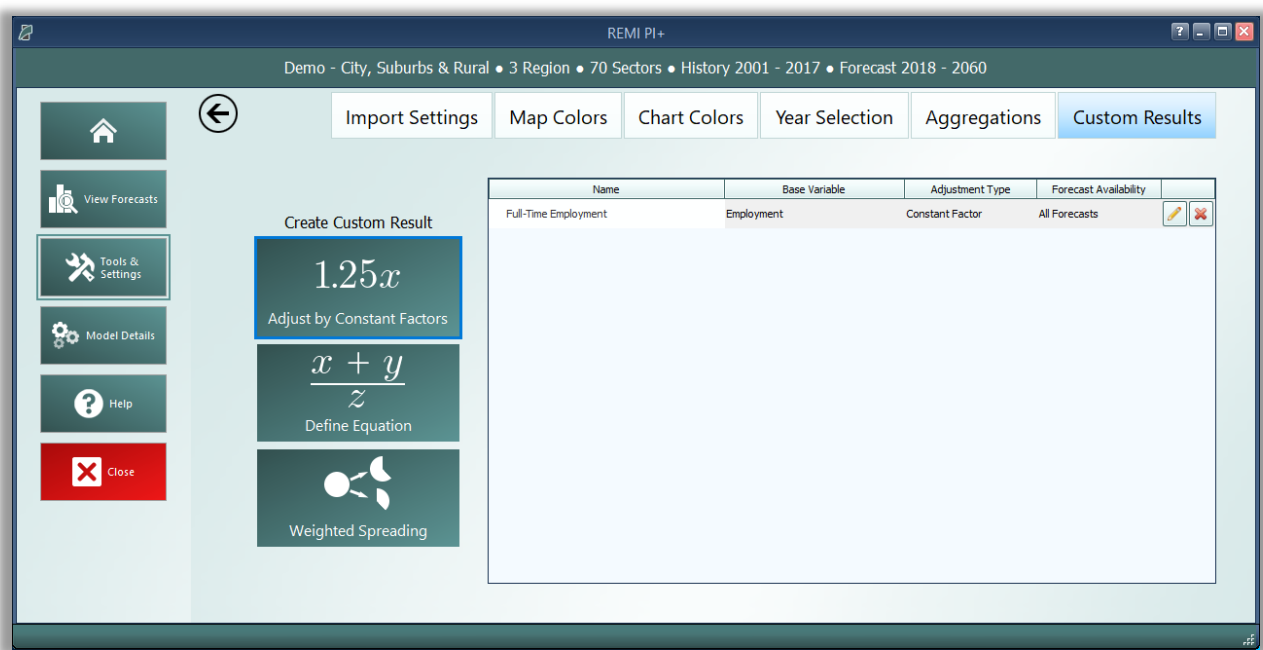
Once finished, the aggregation will appear on the Aggregation Manager’s list and can be given a name. This saved aggregation will now be available when creating policy variables with the same detail type. Instead of selecting from the regular detail list, you will be able to select from groups you created when building the aggregation. In some cases, where policy variables only allow a subset of the full detail list (such as industry policy variables that exclude farm and government industries), your aggregation will be automatically filtered to remove excluded details and groups containing only excluded details. Similarly, results can also be displayed at the level of your aggregation groups rather than the regular detail list.

Custom Results

Custom results allow users to create new result variables by performing operations on the default results or other custom results. There are three methods to create custom results: Adjust by Constant Factors, Define Equation, and Weighted Spreading. All three types of custom results can be created through the Custom Results Manager shown in Figure 11. When you select a method under “Create Custom Result,” a Custom Result Builder window appears where you can specify how your result is calculated.

The Custom Results Manager lists your custom results along with their method type, the original result that was adjusted (called the “base variable”) and which types of forecasts can display the variable. The manager also has several right-click options, including one to change the name and description of a custom result. The rightmost column of the manager contains buttons to edit and delete custom results.

Figure 11: Custom Results Manager



Adjust by Constant Factors

Use this option to create custom results by making an additive or multiplicative adjustment to a result, as shown in the Custom Result Builder in Figure 12. Specify the base variable by searching for the result in the Base Variable text box or by selecting from the list, where other custom results that are compatible with this option are listed first. After selecting a base variable, a list of detail dimension will appear. Toggling on/off the individual detail dimensions will modify the shape of the grid for entering constant factor values. Select an adjustment factor to specify if the adjustment will be additive or multiplicative. Optionally, you can specify units for your custom result, otherwise the new custom result will display the same units as their base variable. Important information on custom result units can be found in the “Custom Result Units in Forecasts” section.

In forecast results, constant factors will act on the base variable after the base has been converted to the units specified in the forecast. For additive factors, this means that if a GDP-based custom result of 1 billion dollars has an additive constant factor of 2, the custom result will be displayed as 3 billion if the results are displayed in billions of dollars, and as 1,002 million if the results are displayed in millions of dollars.)

Figure 12: Creating a Constant Factor Custom Result

The screenshot shows the 'Custom Result Builder' window with the 'Constant Factor Adjustment' tab selected. The 'Base Variable' is set to 'Employment'. The 'Custom Result Units' field is empty. Under 'Detail Dimensions', the 'Region' checkbox is checked, while 'Industry' and 'Year' are unchecked. The 'Adjustment Operator' is set to 'Additive'. A table under the 'Values' section shows constant factors for three regions: Urban Counties (0.000), Suburban Counties (0.000), and Rural Counties (0.000). At the bottom are 'Save' and 'Cancel' buttons.

Region	Value
Urban Counties	0.000
Suburban Counties	0.000
Rural Counties	0.000

You can add your custom result to your model by clicking “Save,” at which point the Custom Result Builder will suggest a name and description for your custom result that you can edit as shown in Figure 13.

Figure 13: Naming and Describing a Custom Result

The screenshot shows the 'Save Custom Result' dialog box. It prompts the user to provide a name and description for the new custom result. The 'Name' field contains 'Adjusted Employment'. The 'Description' field contains a suggested description: 'This is a custom constant factor adjustment result. It is based on the Employment variable and has been adjusted additively by a set of constant factors along the Industry dimension.' At the bottom are 'OK' and 'Cancel' buttons.

Define Equation

Use this option to define custom results by an equation where a base variable acts on another variable, which is called the “interacting variable.” In simple cases, you can combine two result variables using a mathematical operator. To produce more complex results, you can create custom results that reference other custom results by selecting them as base and/or interacting variables. An example of this is given in the “Example Custom Results” document.

As shown in Figure 14, first select a base variable that will be the first term in the equation by searching for the result in the Base Variable text box or by selecting from the list, where other custom results that are

compatible with this option will be listed first. You can then select an interacting variable that is compatible with the base. The units of the interacting variable are automatically selected based on those of the base variable, and can also be changed in some cases.

Depending on the base and interacting variables you chose, you might be able to select from addition, subtraction, multiplication, or division operators. The equation previewer will display the equation that defines the new custom result. Based on the variables and type of interaction, a unit for the new custom result will be suggested that you can edit.

Figure 14: Creating a Custom Equation Result

Custom Result Builder

Custom Equation Definition

Base Variable	Output	Select From List
Base Variable Units	Billions of Fixed (2012) Dollars	Change Units
Interacting Variable	Gross Domestic Product (GDP)	Select From List
Interacting Variable Units	Billions of Fixed (2012) Dollars	Change Units
Interaction Operator	<input type="radio"/> Addition <input checked="" type="radio"/> Subtraction <input type="radio"/> Multiplication <input type="radio"/> Division	
Combined Result Units	Billions of Fixed (2012) Dollars	

$$[New\ Custom\ Result] = (SUP_i - TGNPFD)$$

For Industry i

Click variables to view descriptions

Save Cancel

Similar to constant factor custom results, you can click the “Save” button to save, name, and write a description for this custom result.

Weighted Spreading

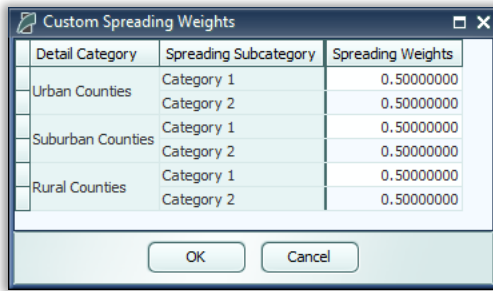
Use this option to create custom results where you divide a base variable into subcategories with specific weights. As shown in Figure 15, specify the base variable by searching for the result in the Base Variable text box or by selecting from the list, where other custom results that are compatible with this option will be listed first. Select a detail dimension to spread and check the ‘Year’ box if you want to enter different spreading weights for each year. You can choose whether to create the same subcategories under detail by toggling “Synchronize Subcategories” on or off. Click on subcategory names to edit them. You can specify your spreading values as a percentage in the bottom chart of the Custom Result Builder, or as a proportion in the grid of user-created subcategories that will appear when you click “Open In Grid,” as shown in Figure 16. In the grid, you can also paste values and use the calculator feature. If you are using synchronized subcategories, you can specify a Dimension Label for your subcategories that will appear as a header in forecast tables.

Figure 15: Creating a Weighted Spreading Custom Result

The screenshot shows the 'Custom Result Builder' window with the 'Weighted Detail Spreading' tab selected. The 'Base Variable' is set to 'Employment'. The 'Spreading Dimension' is set to 'Region' (with 'Total', 'Industry', and 'Year' as options). The 'Dimension Label' is set to 'Dimension Label (Optional)'. The 'Spreading Tools' section includes 'Synchronize Subcategories', 'Add Subcategories', 'Delete Subcategories', and 'Open In Grid'. The 'Spreading Categories and Weights' section displays a table with three main categories: 'Urban Counties', 'Suburban Counties', and 'Rural Counties'. Each category has two subcategories, 'Category 1' and 'Category 2'. The 'Spreading Weight' for each category is 100.00%, and for each subcategory, it is 50.00%.

Detail Category	Spreading Weight
<input checked="" type="checkbox"/> Urban Counties	100.00%
Category 1	50.00%
Category 2	50.00%
<input checked="" type="checkbox"/> Suburban Counties	100.00%
Category 1	50.00%
Category 2	50.00%
<input checked="" type="checkbox"/> Rural Counties	100.00%
Category 1	50.00%
Category 2	50.00%

Figure 16: Input Grid



The image shows a dialog box titled "Custom Spreading Weights". It contains a table with three columns: "Detail Category", "Spreading Subcategory", and "Spreading Weights". The table has six rows of data. Below the table are "OK" and "Cancel" buttons.

Detail Category	Spreading Subcategory	Spreading Weights
Urban Counties	Category 1	0.50000000
	Category 2	0.50000000
Suburban Counties	Category 1	0.50000000
	Category 2	0.50000000
Rural Counties	Category 1	0.50000000
	Category 2	0.50000000

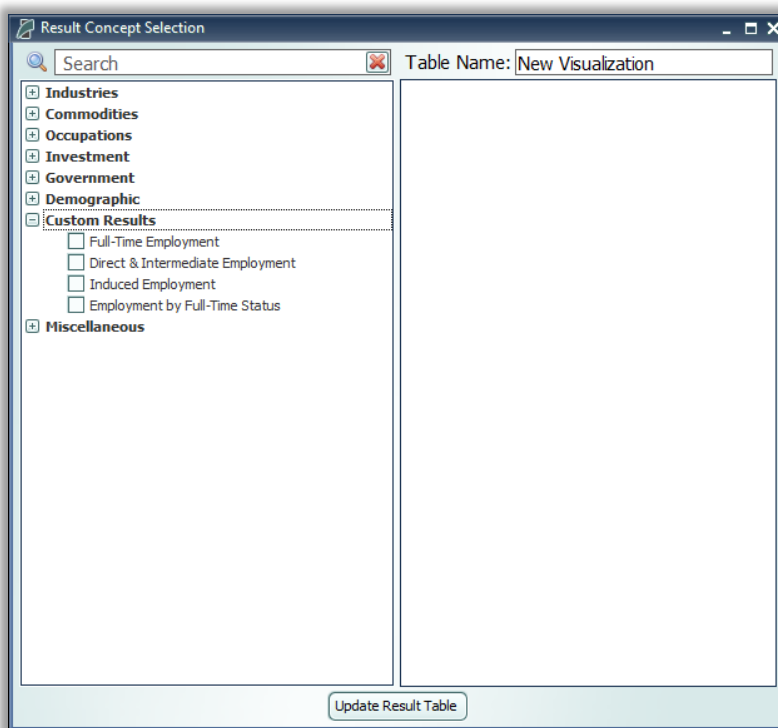
The total spreading weights for each set of subcategories is displayed in a heading. You can, if desired, instantly change a subcategory value so that the total adds up to 100% by right clicking on that value and selecting “Balance Total.”

Similar to constant factor custom results, you can click the “Save” button to save, name, and write a description for this custom result.

Viewing Custom Results in Forecasts

You can view custom results in a compatible forecast by adding them to a Favorite. When selecting results to be shown in a Favorite, click on the “Custom Results” category to see the custom results available as shown in Figure 17.

Figure 17: Adding Custom Results to a Favorite



While you can display both constant factor and custom equation results with other results, you can only display weighted spreading results in a visualization alone.

Custom Result Units in Forecasts

Numbers in constant factor results are given in the same units as their base variable. If you choose to use a custom unit label, the label will not change to reflect the units the model actually gives the results in. For example, as shown in Figure 18, if, in a forecast that displays jobs in thousands, you display a constant factor result with an Employment base variable and units that you have named “Number of People,” the model will give the custom result in thousands, but the units will be labeled “Number of People.” As shown in Figure 19, you will have to change the forecast’s display units or rename the units label for the results and units label to match. Constant factor results without a custom units label will display with the same label as their base variable, which will change to match the units in which results are given.

Figure 18: Constant Factor Result Displayed with Jobs Given in Thousands

	Category	Units	2018
	Adjusted Employment	Number of People	1.840
	Employment	Thousands (Jobs)	1.840

Figure 19: Constant Factor Result Displayed with Jobs in Given in Individuals

	Category	Units	2018
	Adjusted Employment	Number of People	1840
	Employment	Individuals (Jobs)	1840

As shown in Figures 20 and 21, neither the units labels nor the units in which custom equation results are given will change to match settings in the forecast. For example, a custom equation where Output in billions of fixed 2012 dollars is divided by Employment in thousands will give results in billions divided by thousands with the units label “Billions of Fixed (2012) Dollars per Thousands (Jobs).” If you change the forecast settings to display currency in millions, neither the numbers nor the units label in the custom equation result will change.

Figure 20: Custom Equation Result with Currency Units Set to “Billions of Current Dollars”

	Category	Units	2018
	Output per Employee	Billions of Fixed (2012) Dollars per Thousands (Jobs)	0.045
	Output	Billions of Current Dollars	0.084

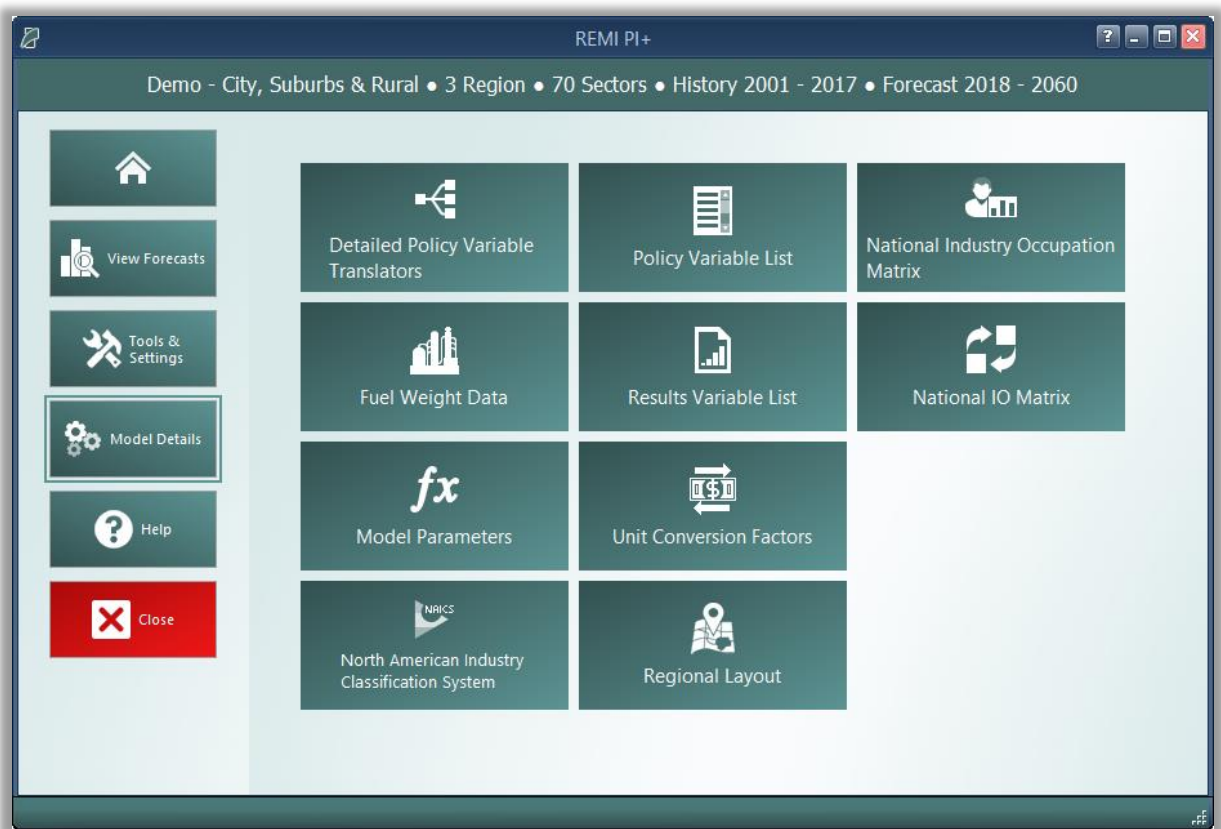
Figure 21: Custom Equation Result with Currency Units Set to “Millions of Current Dollars”

Category	Units	2018
Output per Employee	Billions of Fixed (2012) Dollars per Thousands (Jobs)	0.045
Output	Millions of Current Dollars	84.404

Model Details

The fourth section of the PI+ Home Window is the Model Details screen. This area contains a variety of detailed data as well as other information like lists of all possible variables, your model region layout, and industry sectors cross-listed with NAICS codes.

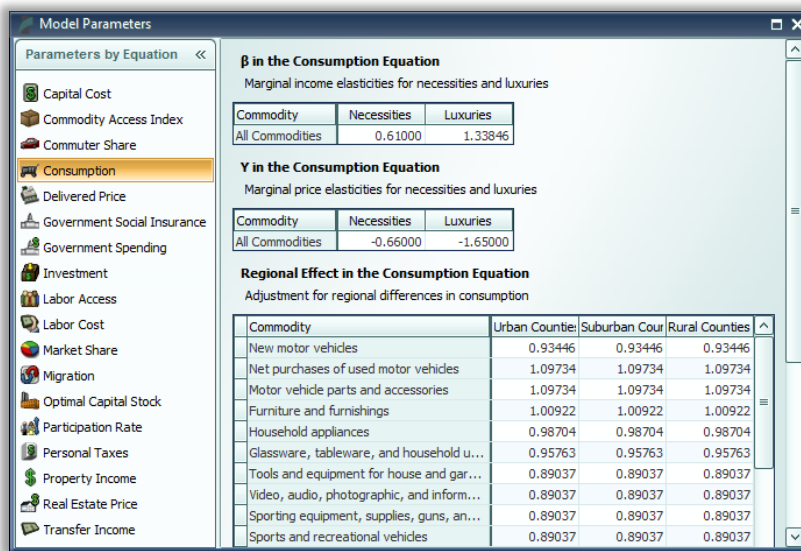
Figure 22: Model Details



Model Parameters

The Model Parameters window displays the values of all parameter constants used in REMI’s equations for your specific model. The window is arranged so that each model equation has its own tab containing all relevant parameters. Descriptions are provided to explain the significance of each parameter in its equation.

Figure 23: Model Parameters



Model Parameters

Parameters by Equation <<

- Capital Cost
- Commodity Access Index
- Commuter Share
- Consumption**
- Delivered Price
- Government Social Insurance
- Government Spending
- Investment
- Labor Access
- Labor Cost
- Market Share
- Migration
- Optimal Capital Stock
- Participation Rate
- Personal Taxes
- Property Income
- Real Estate Price
- Transfer Income

β in the Consumption Equation
Marginal income elasticities for necessities and luxuries

Commodity	Necessities	Luxuries
All Commodities	0.61000	1.33846

γ in the Consumption Equation
Marginal price elasticities for necessities and luxuries

Commodity	Necessities	Luxuries
All Commodities	-0.66000	-1.65000

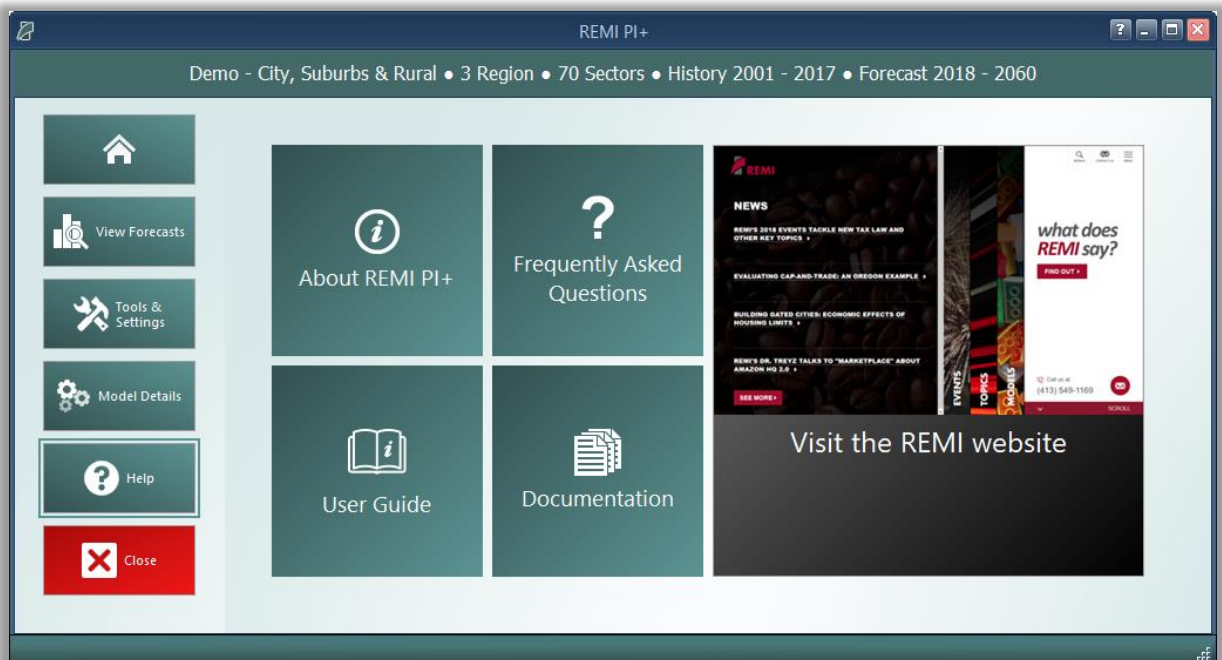
Regional Effect in the Consumption Equation
Adjustment for regional differences in consumption

Commodity	Urban Counties	Suburban Counties	Rural Counties
New motor vehicles	0.93446	0.93446	0.93446
Net purchases of used motor vehicles	1.09734	1.09734	1.09734
Motor vehicle parts and accessories	1.09734	1.09734	1.09734
Furniture and furnishings	1.00922	1.00922	1.00922
Household appliances	0.98704	0.98704	0.98704
Glassware, tableware, and household u...	0.95763	0.95763	0.95763
Tools and equipment for house and gar...	0.89037	0.89037	0.89037
Video, audio, photographic, and inform...	0.89037	0.89037	0.89037
Sporting equipment, supplies, guns, an...	0.89037	0.89037	0.89037
Sports and recreational vehicles	0.89037	0.89037	0.89037

Help Center

The final section of the home window is the Help center. Here you will find several useful sources of information that can help answer questions about the PI+ software or the underlying REMI model.

Figure 24: Help Center



Software Information

The “About” window displays information about your installation of PI+. It contains version, model, and build ID numbers as well as information that could be useful for a REMI support situation such as information about applied patches and some statistics pertaining to your computer’s memory usage.

Frequently Asked Questions

The FAQ window contains answers to common questions about using PI+. Questions and answers are grouped by topic and provide insight into important REMI model concepts, detail some best-practices for policy variable usage, explain the options available when running a forecast, and give tips for troubleshooting errors.

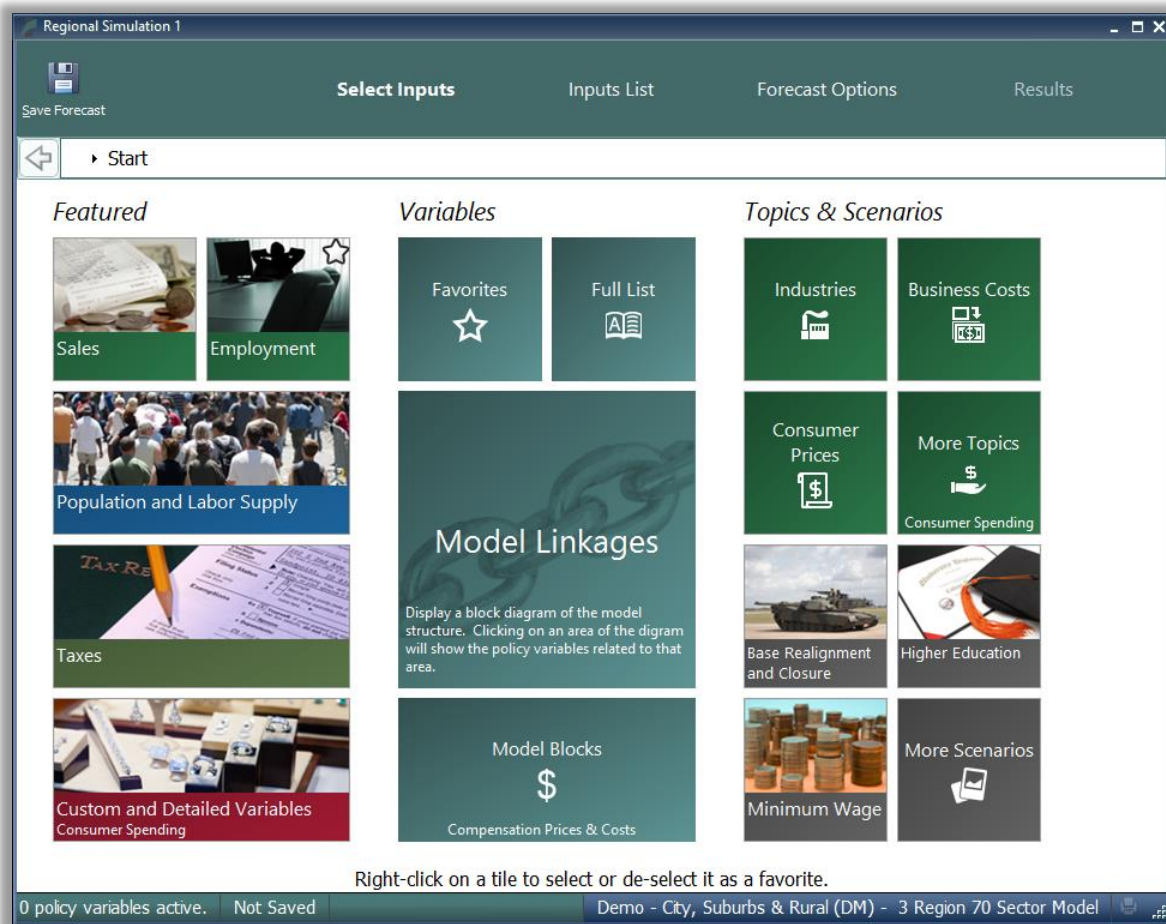
Documentation

The documentation viewer is a built-in PDF viewer that provides easy access to all documentation files that are shipped with your model. From the documentation viewer, you can print as well as easily open our Documentation folder if you’d like to copy or share our documentation files. Specific documentation pieces that are worth noting are the PI+ Changes file, which briefly outlines a history of major changes between PI+ versions, and the PI+ Overview file which provides an in-depth description of data, software, and methodology changes made for the current version. The rest of our documentation focuses on REMI’s model equations, data sources, estimation procedures, and industry and occupation layouts.

III. Overview of Forecast Windows

The process of creating a forecast takes place within a Forecast Window. The three main aspects of working with a forecast: specifying policy variables, running the forecast, and viewing the results, each take place on separate screens of the Forecast Window and are accessed using the navigation links along the window's header panel. At any time, your forecast and its contents such as policy variables and customized result visualizations can be saved using the "Save Forecast" button which is always located at the upper left of the screen on the header panel. Forecast windows are now separate entities from the main application window and thus multiple forecasts can now be open simultaneously, with each accessible via a button on the Windows taskbar.

Figure 25: Forecast Window



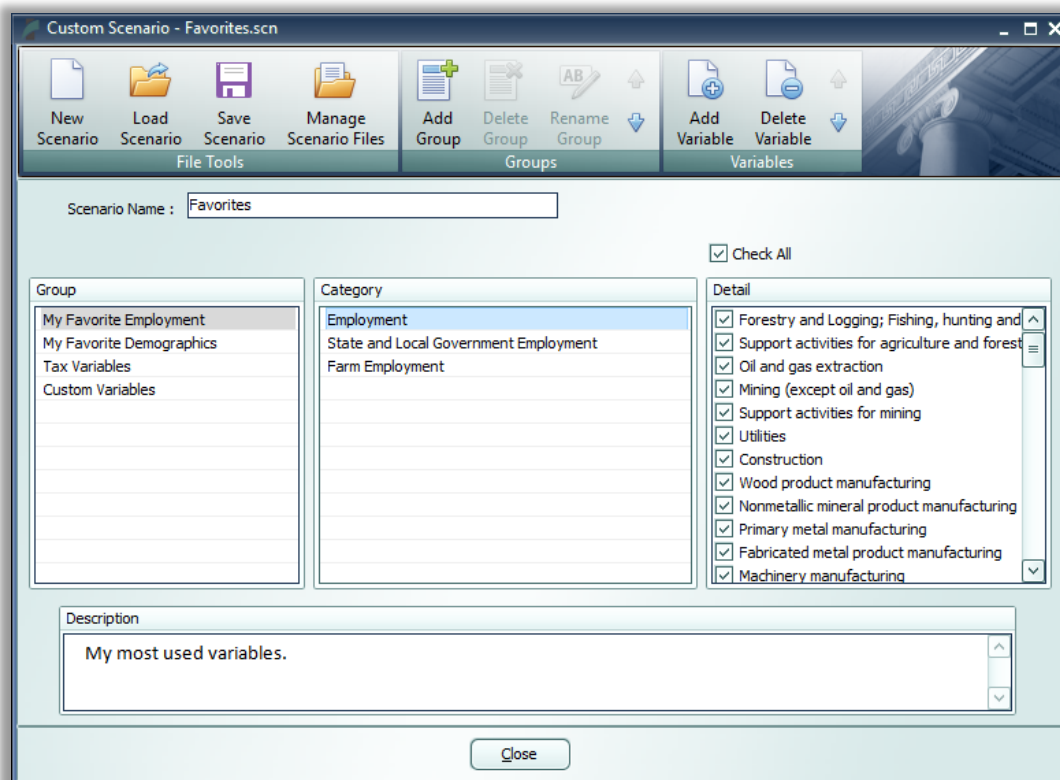
Select Inputs

The first screen that will be visible when creating a new forecast is Select Inputs (shown in Figure 26). This tile-based interface is the jumping off point for choosing what policy variables to add to the forecast. Each

tile represents some number of policy variables which will be opened in the Policy Variable Selector, whether it is a single variable like in the case of the Employment tile or a group of related policy variables like with the Business Costs or various Scenario tiles. At the forefront of the input selection screen, the Featured section highlights variables and topics that are likely to be used most often. Alternatively, the Model Linkages and Model Blocks tiles offer ways of accessing policy variables by area of the REMI model structure where they fit in. If you'd prefer to see all variables that are available for your forecast, the Full List tile will open all variables in the Policy Variable Selector.

If there are certain policy variables that you are likely to frequently use together and they are not already grouped by one of REMI's scenarios, you might consider using the Custom Scenario editor to build your own. This editor, found under the "More Scenarios" tile by clicking "Custom Scenarios", allows for creating multiple groups of policy variables where each variable can also have its list of details filtered down to remove ones that won't be useful. The custom scenario can be given a name, description, and saved using the controls on the editor. Saved custom scenarios are given their own tiles in the "Custom Scenarios" section of the Select Inputs screen.

Figure 26: Custom Scenario Editor



In order to make your most-used policy variables and custom scenarios even more accessible, you can make use of the Favorites section. Right-clicking any tile will save it to your Favorites (indicated with a star), where they can then be dragged into any customized order.

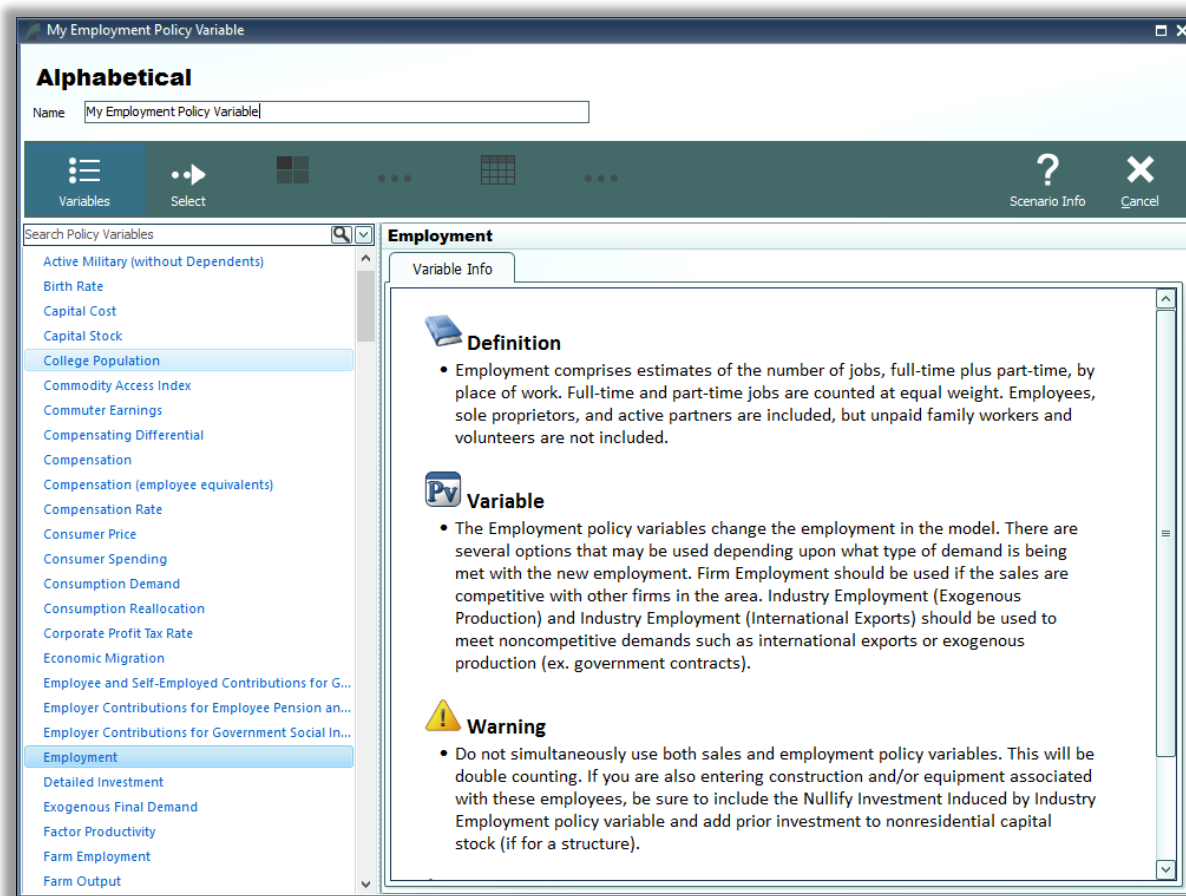
Policy Variable Selector

Clicking on a tile that represents some number of policy variables will open up the Policy Variable Selector window. This window is split into three tabs (“Variables”, “Details”, and “Edit Values”) that each represent a step in the process of defining exactly how your policy variables will enter into the model. At any time, you can name your policy variables using the editor at the top of the window. You can also click the “Scenario Info” button to see a description of the scenario you have open.

The first tab on the Policy Variable Selector contains the variable list. This screen is where an individual policy variable is selected for editing. The contents of the variable list are determined by what group of variables was previously chosen. Only one variable can be selected for editing at a time, but once you finish creating a variable, you can always go back to the variable list tab to start working with another. In cases where you accessed the Policy Variable Selector using a tile that represents just a single variable, this section will be skipped since there is no selection to be made. If the number of available variables is large, it may be helpful to use the search field for filtering the list down by variable name or description.

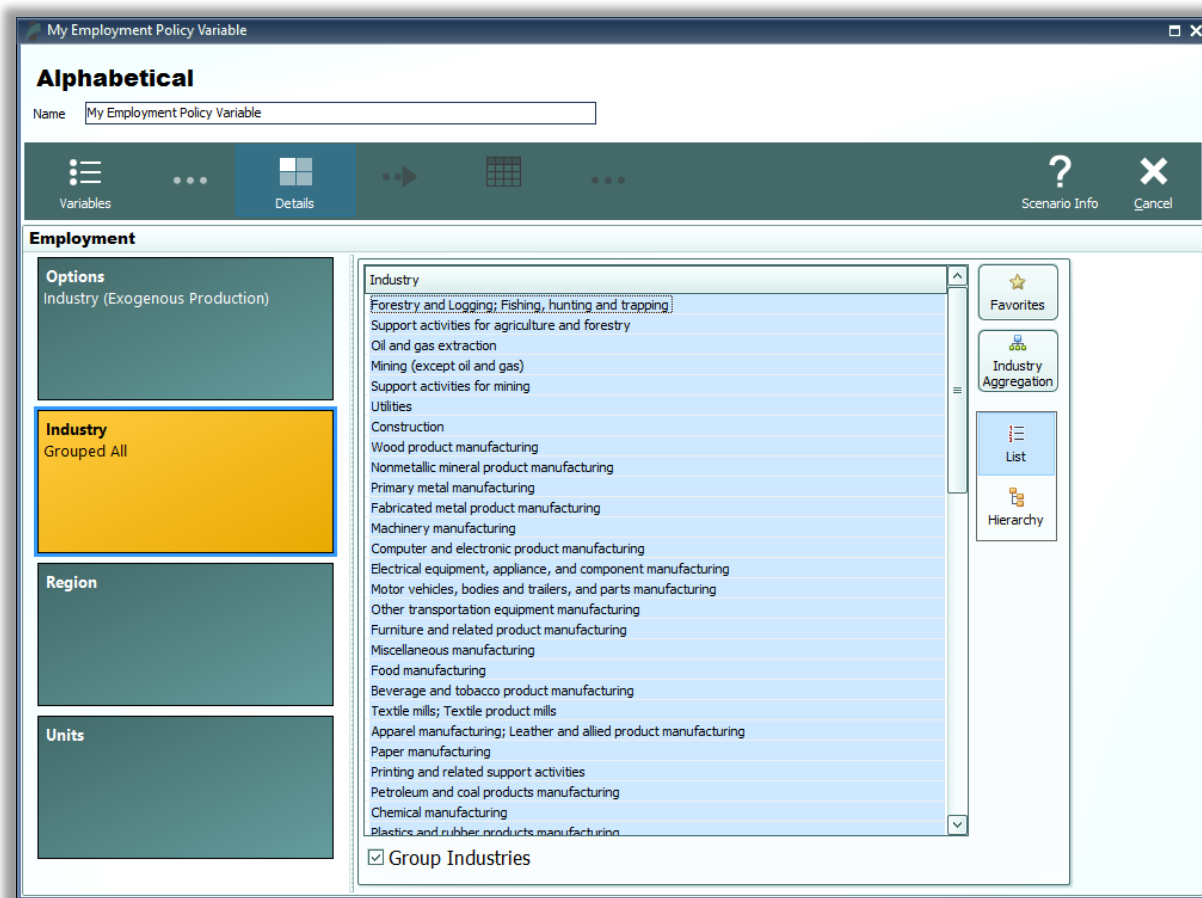
Clicking a variable in the list will display information about it and its options. In some cases, a diagram may be available that depicts how the selected policy variable interacts with other variables and how it fits into the REMI model. Once you have decided what variable to choose, clicking the “Select” arrow button on the window’s header panel will move the variable to the Details tab to begin editing.

Figure 27: Policy Variable Selector – Variable List Tab



The Details tab is where you specify what the exact form of the policy variable should be. Different variables have different sets of details that must be filled out before the variable can be added to your forecast. Each type of detail information that must be specified will be represented by a tile on the left-hand side of the screen. Clicking one of these tiles will allow you to fill out some information describing your policy variable and can be done in any order. Most policy variables will require you to at least specify the regions it should affect and the unit type of the values. In the specific case of the Employment policy variable, shown below in Figure 28, option and industry details are also required. Options only exist on some policy variables, they allow for choosing exactly how the variable should interact with other parts of the model. Selecting industry details for the Employment variable depicted below controls what industries will be impacted by the policy variable's changes to employment levels.

Figure 28: Policy Variable Selector – Details Tab (In Progress)



There are several ways to select specific details from the various types of detail lists, which include regions, industries, commodities, occupations, and ages. The first way is to select them from the simple flat list view. Hold down the Ctrl key to select multiple details one at a time or Shift to select a range of details all at once. If you would like to apply the same policy change to multiple details, it is helpful to check the “Group Industries” or equivalent checkbox below the detail list. This will put all of the details into a single variable rather than creating separate variables for each selected detail.

Another way of selecting details is to use the hierarchical view. Simply click the “Hierarchy” button to the right of the detail list to see a hierarchical tree structure with checkboxes as the selection mechanism. This view is useful for selecting multiple related details all at once. For example, you could check the “Manufacturing” tree item to capture all manufacturing sub-industries. The final way to select details is to click the “Aggregation” button and select a custom or pre-defined aggregation, discussed in the “Aggregation Manager” section. Selecting an aggregation will repopulate the flat and hierarchical detail lists with the aggregated detail groups contained within the chosen aggregation. Similar to the detail grouping checkboxes, creating a variable with an aggregated detail will cause the inputted year values to be spread among the individual regions, industries, commodities, occupations, or ages as it enters the model.

Figure 29: Policy Variable Selector – Details Tab (Completed)

My Employment Policy Variable

Alphabetical

Name: My Employment Policy Variable

Variables Details Add to Editor Scenario Info Cancel

Employment

Options
Industry (Exogenous Production)

Industry
Grouped All

Region (1)
Suburban Counties

Units
Percent

Select a Unit Type

☒ Share of Employment
☐ Units
☐ Thousands

Scale

☐ Proportion
☒ Percent

Once the unit type and the rest of the options on the policy variable have been specified, you will be able to click the “Add to Editor” button to move the variable into the value editing spreadsheet. The number of created policy variables will be displayed as a badge on the “Edit Values” button that becomes enabled once at least one variable has been added. One policy variable will be created and added to the spreadsheet for each combination of details specified on the Details tab. If you chose to check any of the grouping check boxes or chose to use aggregations, then all of those grouped details will be combined into one variable, which is depicted below for the industry dimension.

Figure 30: Policy Variable Selector – Value Editor

My Employment Policy Variable

Alphabetical

Name: My Employment Policy Variable

Variables Details Edit Values Add to Inputs Calculator Spreader Scenario Info Cancel

	Category	Detail	Region	Units	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
I	Employment	Industry (Exogenous Production): Detail...	Suburban Counties	Percent	5	5	5	5	5	5	5	5	5	5

Options

Industry (Exogenous Production)

Details

- Forestry and Logging; Fishing, hunting and trapping
- Support activities for agriculture and forestry
- Oil and gas extraction
- Mining (except oil and gas)
- Support activities for mining
- Utilities
- Construction
- Wood product manufacturing
- Nonmetallic mineral product manufacturing
- Primary metal manufacturing
- Fabricated metal product manufacturing
- Machinery manufacturing
- Computer and electronic product manufacturing
- Electrical equipment, appliance, and component manufacturing
- Motor vehicles, bodies and trailers, and parts manufacturing
- Other transportation equipment manufacturing
- Furniture and related product manufacturing
- Miscellaneous manufacturing

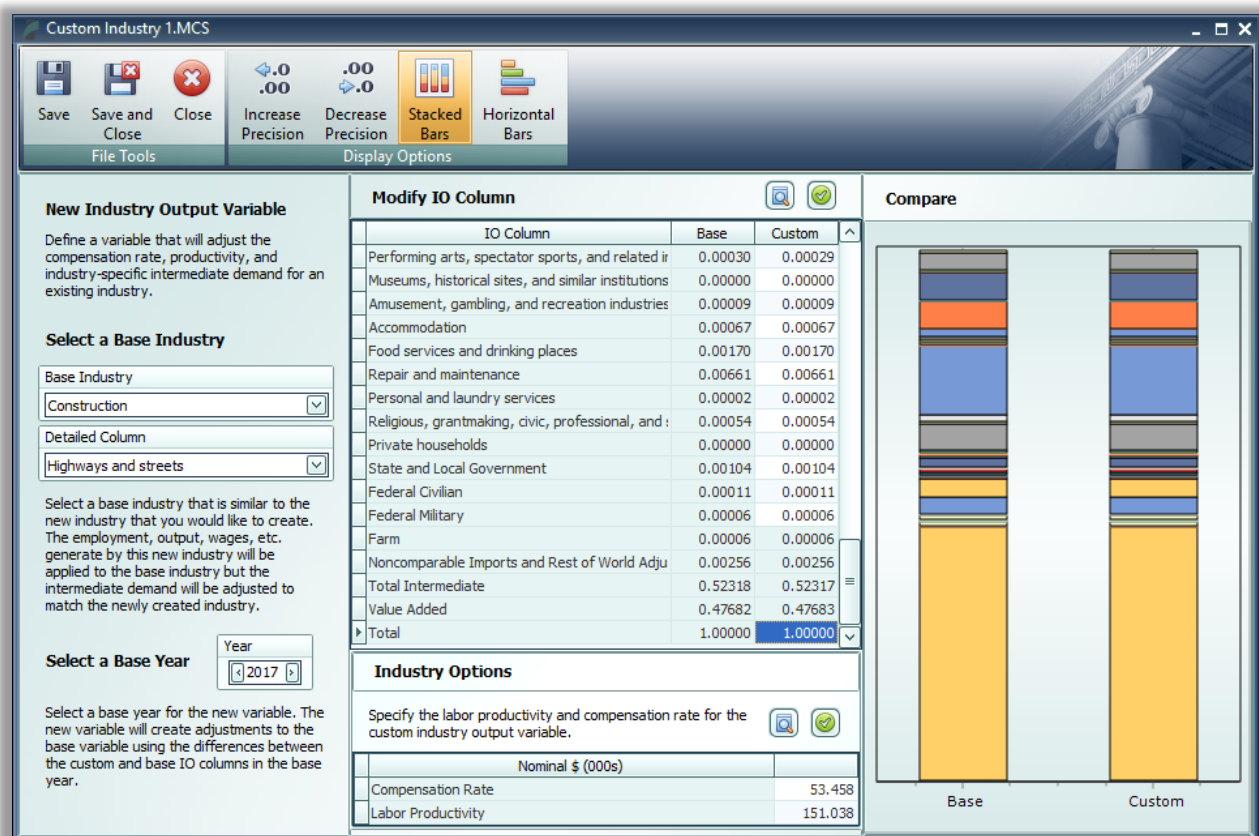
The editor will allow you to input values for each policy variable in each year. You can change the region and units by clicking on those cells in the spreadsheet, which contain combo-box editors. The Calculator and Spreader tools located on the top right of the navigation panel are useful for inputting more complicated series of values. If you need to change more options on your variable, you can click the “Redefine Details” button marked with a left-facing arrow. Variables can be deleted using the adjacent button that is marked with an “X”. Once finished, add your variables to the forecast’s Inputs List screen by clicking the final arrow button, “Add to Inputs”. Submitted variables will appear on the Inputs List together in a group with the name specified on the Policy Variable Selector.

Custom Variables

There are a handful of special policy variables available only to regional simulations that are known as custom variables. These variables are much more customizable than regular policy variables because they allow for modifications to be made to the input-output (IO) table data that dictates how the variable will affect different parts of the economy within the model. There are custom variables for Industry Output/Sales, Government Spending, Investment Spending, Consumer Spending, Imports, Exports, and Tourism Spending. These variables can be found under the “Custom and Detailed Variables” tile in the Featured section of the Select Inputs screen and also can be added to a custom scenario. Custom variables can be created, edited, and deleted from the Policy Variable Selector’s Details tab once a particular type of

custom variable has been selected. Creating a new custom variable opens the Custom Variable Editor, which looks slightly different and has various options depending on which type of custom variable is being created.

Figure 31: Custom Variable Editor – Industry Output/Sales



On the left-hand panel of the Custom Variable Editor are variable-specific options and instructions. These options typically involve specifying information about what base data you would like to associate with the custom variable such as the base year, base industry, commodity or government spending category, and so on. The base IO column data resulting from your choices is what you are able to subsequently modify using the central IO Column editor in order to finish specifying the custom variable. Additional customizations are available for certain types of custom variables, such as the options for adjusting compensation rate and labor productivity of custom industries, as shown in Figure 31.

To aid in constructing your custom IO column, the chart on the right-hand side of the screen, which can be toggled between stacked-bar and horizontal-bar views, helps visualize the differences between the base and custom IO columns. Additionally, using the button marked with a magnifying glass in the IO column editing area, IO column reference data for each forecast year can be viewed as a table or chart and can be auto-

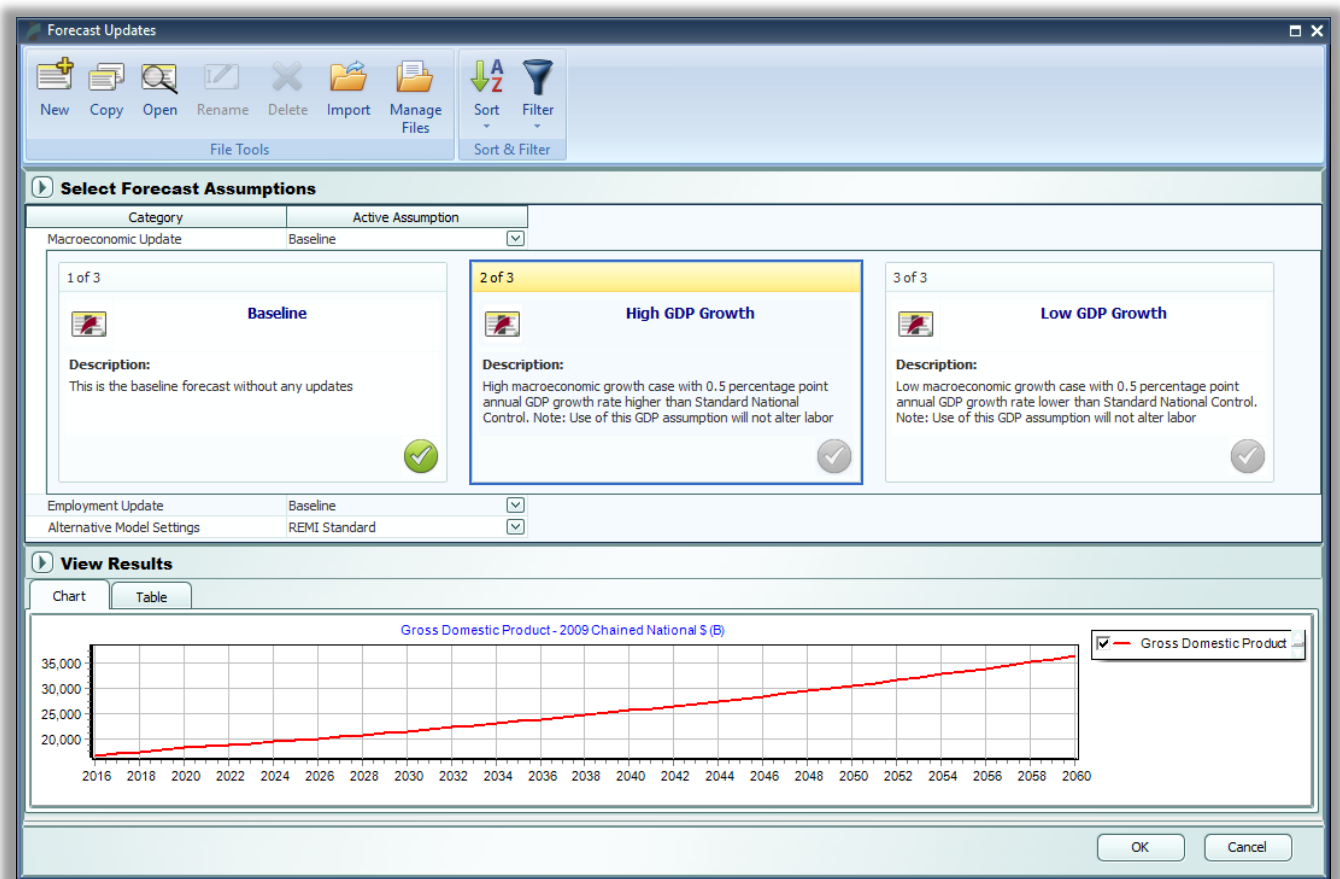
filled into the custom column editor. The Custom Industry Output/Sales variable editor also has reference information for national and regional compensation rates and labor productivity. The right-click menu of the custom column editor has an “Apply Remainder” option (except when editing Industry Output/Sales, for which Value Added captures the remainder), which can prove useful as the IO column needs to total to one. If there are issues with any of your custom values, the button usually displaying a green checkmark in the corresponding section of the editor will change and instead warn you of the problems with what you have entered.

Once you have finished your custom variable, simply save it and subsequently use it as you would a normal policy variable. Saved custom variables appear in the Details tab of the Policy Variable Selector once you have selected that same category of custom variable. Be aware that custom variable files should not be transferred between versions of PI+ because each new release includes an updated IO table. This means that the values you attached to the custom variable will vary from the base data not only in the way that you intended them to, but also due to our updates affecting the base IO table.

Model Assumptions

In addition to directly entering policy variables, a forecast can also be changed from its baseline by another type of input: customized model assumptions. Model assumptions can only be added to control forecasts. There are five categories of model assumptions, some of which are applicable only to regional controls and some only to national controls. All five categories of model assumptions are handled by the Forecast Updates window shown in Figure 32. This window shows all of the available assumption types that can be modified for the current forecast. Each assumption type has at least one default assumption, called either the Baseline or REMI Standard assumption. Some types of assumptions have other pre-defined choices available. Figure 32 shows two such alternative Macroeconomic Update assumptions, representing higher and lower GDP growth scenarios compared to the baseline forecast. The tools menu along the top of the window has buttons for opening each assumption to view its data, copying an assumption for customization, and creating a brand-new assumption to start from scratch. You can also rename and delete assumptions and import assumption files from past versions. To select a non-baseline assumption, whether it is a REMI alternative or custom-made, just click the checkmark button on the assumption’s card. Some types of assumptions will feature a visualization consisting of a chart and table that depict how the selected assumption affects the relevant concept.

Figure 32: Forecast Updates Manager



Employment Update

Employment updates are accessible for national and regional control forecasts and allow for calibration of a forecast to alternative by-industry employment data. You can enter employment values at different industry levels and in different units using the options at the top left of the form. You can also change how you enter values for the region dimension using the region combo-box. Regardless of the options specified, data must be entered for every industry. To check the default employment values for any of these combinations of industry, region, and unit views, open the “Reference” tab. You can also enter a description of your customized employment update in the text field at the bottom of the window.

Figure 33: Employment Update

Employment Update - New Employment Update 1

Options

Industry Aggregation: None

Units: Thousands of Employees

Employment Update

The Employment Update allows you to calibrate the forecast to alternative employment data by industry. (Note that you must enter data that covers all industries, not just some.) You need to include data for the last history year because your data source may be based on a different employment concept. In order to accommodate this, PT+ calculates the percent change of your

Update **Reference** Region Aggregation: None Flat View: ☒ Region: Urban Counties

Region	Employment Sector	Units	2017 REMI	2017	2018	2019
Urban Counties	Forestry and Logging; Fishing, hunting and tr.	Thousands of Employees	0.002			
Urban Counties	Support activities for agriculture and forestry	Thousands of Employees	1.798			
Urban Counties	Oil and gas extraction	Thousands of Employees	1.417			
Urban Counties	Mining (except oil and gas)	Thousands of Employees	1.209			
Urban Counties	Support activities for mining	Thousands of Employees	0.001			
Urban Counties	Utilities	Thousands of Employees	1.272			
Urban Counties	Construction	Thousands of Employees	47.267			
Urban Counties	Wood product manufacturing	Thousands of Employees	1.093			
Urban Counties	Nonmetallic mineral product manufacturing	Thousands of Employees	0.429			
Urban Counties	Primary metal manufacturing	Thousands of Employees	0.683			
Urban Counties	Fabricated metal product manufacturing	Thousands of Employees	1.800			
Urban Counties	Machinery manufacturing	Thousands of Employees	5.109			
Urban Counties	Computer and electronic product manufacturi	Thousands of Employees	2.589			
Urban Counties	Electrical equipment, appliance, and compone	Thousands of Employees	2.369			
Urban Counties	Motor vehicles, bodies and trailers, and parts	Thousands of Employees	0.631			
Urban Counties	Other transportation equipment manufacturin	Thousands of Employees	15.546			
Urban Counties	Furniture and related product manufacturing	Thousands of Employees	1.541			
Urban Counties	Miscellaneous manufacturing	Thousands of Employees	4.134			

Description

OK Cancel

Population Update

Population updates are available only for regional controls. This type of assumption can be used to adjust regional population levels. Similar to employment updates, options for controlling the level of the details can be found at the top left of the window. Using these options, alternate population values can be entered by race and by gender, or for all races and both genders together. Different age groupings, unit types, and region groupings are also available. Again, reference values can be found on the “Reference” tab and a description can be added for the update.

Figure 34: Population Update

Population Update - New Assumption 1

Options

- ☒ Race Ages:
- ☒ Gender Units:
- ☐ Direct Employment Response

Population Update

Population Update is a tool for adjusting the population in the control forecast. The model will try to match the values entered here by adjusting the amenity variable to change the economic migration to reach the desired population level. Then the population will be reallocated using the international migration and retired migration policy variables.

Update **Reference** Region Aggregation: Flat View: ☒ Region:

Region	Race	Gender	Age	Units	2018	2019	2020	2021	2022
Urban Counties	White-NonHispanic	Male	Age 0	Thousands of People	3.971				
Urban Counties	White-NonHispanic	Male	Age 1	Thousands of People	4.068				
Urban Counties	White-NonHispanic	Male	Age 2	Thousands of People	3.961				
Urban Counties	White-NonHispanic	Male	Age 3	Thousands of People	3.882				
Urban Counties	White-NonHispanic	Male	Age 4	Thousands of People	3.906				
Urban Counties	White-NonHispanic	Male	Age 5	Thousands of People	3.846				
Urban Counties	White-NonHispanic	Male	Age 6	Thousands of People	3.858				
Urban Counties	White-NonHispanic	Male	Age 7	Thousands of People	3.887				
Urban Counties	White-NonHispanic	Male	Age 8	Thousands of People	3.824				
Urban Counties	White-NonHispanic	Male	Age 9	Thousands of People	3.773				
Urban Counties	White-NonHispanic	Male	Age 10	Thousands of People	3.700				
Urban Counties	White-NonHispanic	Male	Age 11	Thousands of People	3.769				
Urban Counties	White-NonHispanic	Male	Age 12	Thousands of People	3.911				
Urban Counties	White-NonHispanic	Male	Age 13	Thousands of People	3.868				
Urban Counties	White-NonHispanic	Male	Age 14	Thousands of People	4.010				

Description

OK Cancel

Macroeconomic Update

The Macroeconomic Values Update allows you to calibrate a national forecast to alternative macroeconomic data by component. Using the options, you can enter values based on final demand, personal income, or a combination of final demand and personal income. Changing the level of the GDP type in the combo-box allows you to specify the level of final demand detail you wish to enter. You can also check “Rescale Nominal Values and Price Index” to enter a different inflation assumption, check “Unemployment Rate” to change the national unemployment rate assumption, or check “Labor Productivity Growth” rate to change the average labor productivity growth rate. There is also an “Adjust GDP” tool for automatically applying a percent change to the baseline macroeconomic values. Just like the other update types, you can always check the baseline values on the “Reference” tab and add a description.

Figure 35: Macroeconomic Update

Macroeconomic Update - New Macroeconomic Update 1

Options

☒ Final Demand Level: 19 Major GDP Components

☐ Income

☐ Rescale Nominal Values and Price Index

☐ Unemployment Rate

☐ Labor Productivity Growth Rate

Macro Update

The Macroeconomic Values Update allows you to calibrate the national forecast to alternative macroeconomic data by component. You can enter values based on final demand, personal income, or a combination of final demand and personal income. Changing the GDP type allows you to specify the level of final demand detail you wish to enter. You can also check Rescale Nominal Values and Price Index to enter a different inflation assumption, check Unemployment Rate to change the national unemployment rate assumption, or check Labor Productivity Growth rate to change the average labor productivity growth rate.

Apply a percent change to baseline

Adjust GDP 0.00% Apply

Update **Reference**

Category	Variable Name	Units	2017 REMI	2017	2018	2019	2020
Personal Consumption Expenditures	Motor Vehicles and Parts Consumption	Billions Chained 2012\$	507.200				
	Furnishings and Durable Household Equipmen	Billions Chained 2012\$	360.400				
	Recreations Goods and Vehicles and Other Du	Billions Chained 2012\$	716.100				
	Food and Beverages Purchased for Off-premi	Billions Chained 2012\$	938.900				
	Clothing and Footwear Consumption	Billions Chained 2012\$	382.900				
	Motor Vehicle Fuels, Lubricants, and Fluids Co	Billions Chained 2012\$	420.894				
	Fuel Oil and Other Fuels Consumption	Billions Chained 2012\$	25.424				
	Other Nondurable Goods Consumption	Billions Chained 2012\$	1045.100				
	Services Consumption	Billions Chained 2012\$	8184.505				
Private Fixed Investment	Residential Private Investment	Billions Chained 2012\$	611.100				
	Nonresidential Structures Private Investment	Billions Chained 2012\$	517.500				

Description

Add description for this assumption.

Save As Cancel

National Demographic Assumptions

National Demographic assumptions allow for modifying various demographic aspects of a national forecast. Alternate values can be entered for birth rates, survival rates, international migration, and participation rates. These custom national demographic values must be entered by gender, race, and individual age group. A description of a national demographic assumption can be added using the text field on the top left of the form.

Figure 36: National Demographic Assumption

International Migration - New Migration Assumption 1

Description: Add description for this assumption.

Demographic Assumptions: Enter values into the grid to create a new demographic assumption. be added to the assumptions list and can be activated to change th demographic forecast. Enter a description that can be displayed on

Gender	Race	Age	2018	2019	2020	2021	2022	2023	2024	2025
Male	White-NonHispanic	Age 0	0	0	0	0	0	0	0	0
		Age 1	0	0	0	0	0	0	0	0
		Age 2	0	0	0	0	0	0	0	0
		Age 3	0	0	0	0	0	0	0	0
		Age 4	0	0	0	0	0	0	0	0
		Age 5	0	0	0	0	0	0	0	0
		Age 6	0	0	0	0	0	0	0	0
		Age 7	0	0	0	0	0	0	0	0
		Age 8	0	0	0	0	0	0	0	0
		Age 9	0	0	0	0	0	0	0	0
		Age 10	0	0	0	0	0	0	0	0
		Age 11	0	0	0	0	0	0	0	0
		Age 12	0	0	0	0	0	0	0	0
		Age 13	0	0	0	0	0	0	0	0
		Age 14	0	0	0	0	0	0	0	0
		Age 15	0	0	0	0	0	0	0	0

Save As Cancel

Alternative Model Settings

Different pieces of the REMI model's structure are linked together in certain ways as our best means of approximating of how the real economy generally works. In some cases, you may find that the model would better match a particular real-world scenario if some of these connections behaved differently or were removed altogether. Using the Alternative Model Settings, you can do just that by changing certain settings that control various interacting parts of the model. Depending if you are creating a national or regional control, there are different settings that are available. Certain pre-defined alternative sets of settings exist that REMI has found to be useful in the past. When making your own custom alternate model settings, simply toggle any of the on-off switches to enable or disable that particular model response. A few settings are actually parameters to model equations that can be modified. Each of these has an alternative set of values that can be viewed and selected for substitution. The default housing price and land price coefficients can also be substituted for custom values. Any setting that has been changed from the REMI default value will be highlighted for easy differentiation. Information buttons containing setting descriptions are present next to every setting.

Figure 37: Alternative Model Settings

Alternative Model Settings - New

Output and Demand

- ☒ Investment Response to Capital Stock
- ☒ Transfer Payment Response to Population
- ☐ Alternative Investment Response to the Level of Activity
- ☐ Government Spending Response to GDP
- ☒ Property Income Response to Population
- ☒ Local Consumption Response to Income and Prices
- ☒ Commodity Access Index Response to Intermediate Inputs Access
- ☐ Government Spending Response to Population
- ☐ Alternative Commuter Response (Fixed Shares)

Compensation, Prices, and Costs

- ☒ Housing Price Response to Population and Income
- ☐ Compensation Response to Labor Market Conditions

Labor and Capital Demand

- ☒ Labor Access Index Response to Industry and Occupation Access
- ☒ Labor Intensity Response to Relative Factor Costs

Population and Labor Supply

- ☐ Economic Migration Response to Expected Income
- ☒ Participation Rate Response to Expected Income

Market Shares

- ☒ Exports To Rest Of World Response To Production Costs

Parameters

Housing Price Coefficients

- ☐ Standard
- ☒ Alternative
- ☐ Custom

Nonresidential Land Price Coefficients

- ☒ Standard
- ☐ Alternative
- ☐ Custom

Compensation Equation Coefficients

Demand Price Elasticities

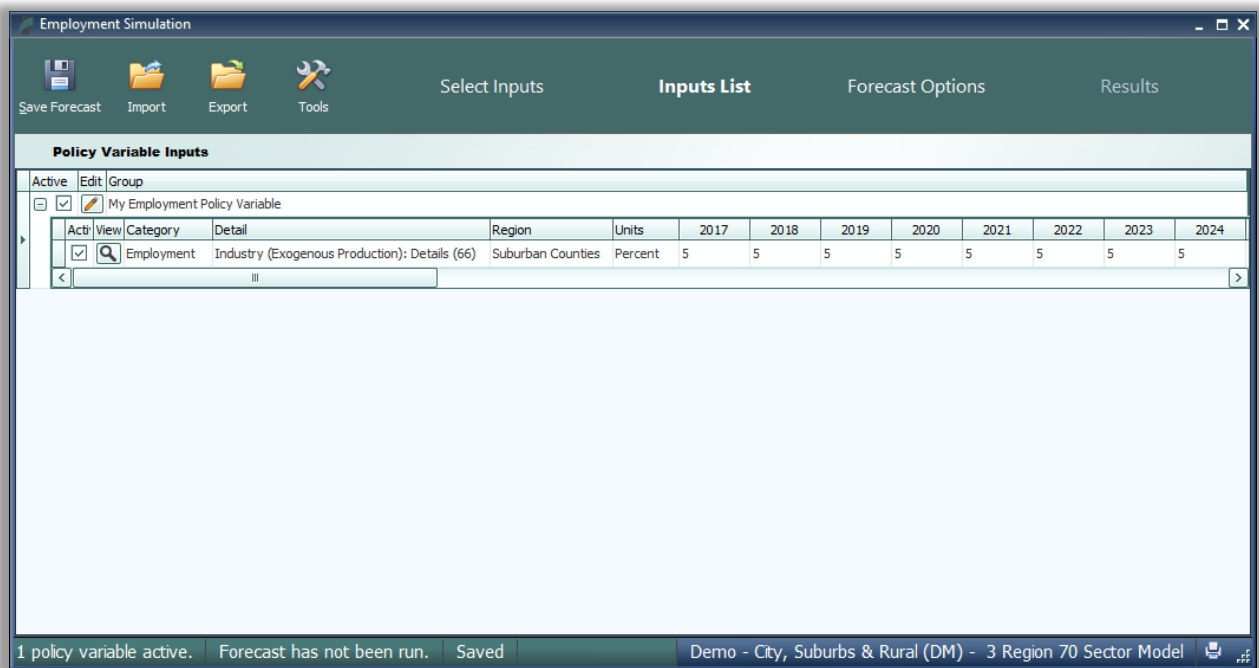
Highlighted if Different from REMI's Defaults

OK Cancel

Inputs List

The Inputs List is a screen that displays the policy variable groups and contained policy variables that will be included as inputs to the model as it runs. Expand any group to see the variables inside. Unchecking a check box in the “Active” column of the list will exclude the corresponding variable or variable group from the forecast run. Another feature of the Inputs List is the ability to inspect the converted versions of a given policy variable. While there are many different ways to specify any particular policy variable, only one format can actually be used by the model, so conversion is necessary. Clicking on the magnifying glass icon on a policy variable in the Inputs List will open this converted variable window. The “Tools” button stationed on the header of the Inputs List provides some useful functionality for selecting, merging, and deleting groups of policy variables from the list. Finally, any model assumptions that have been added to the forecast will also be displayed on this screen alongside a button for quickly editing them.

Figure 38: Inputs List

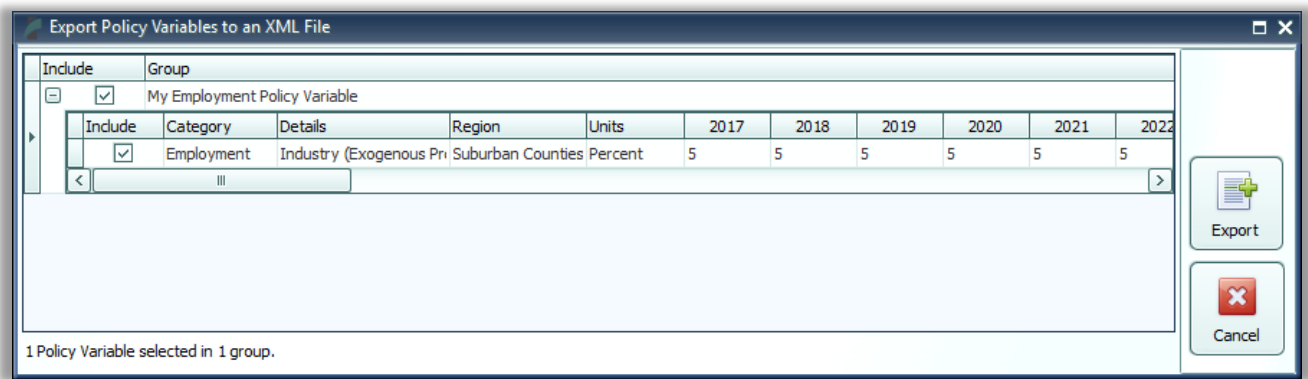


The policy variable import and export buttons are also located on the inputs list. Clicking the “Export” button will open the Export Center, which provides functionality for selecting which of the existing policy variables should be exported. Likewise, clicking the “Import” button launches a file selection dialog, which, once completed, opens the Import Center. The Import Center offers similar selection functionality to the Export Center, but also has additional options for merging, duplicating, and clearing values from variables found in the export file.

Policy Variable Export and Import Centers

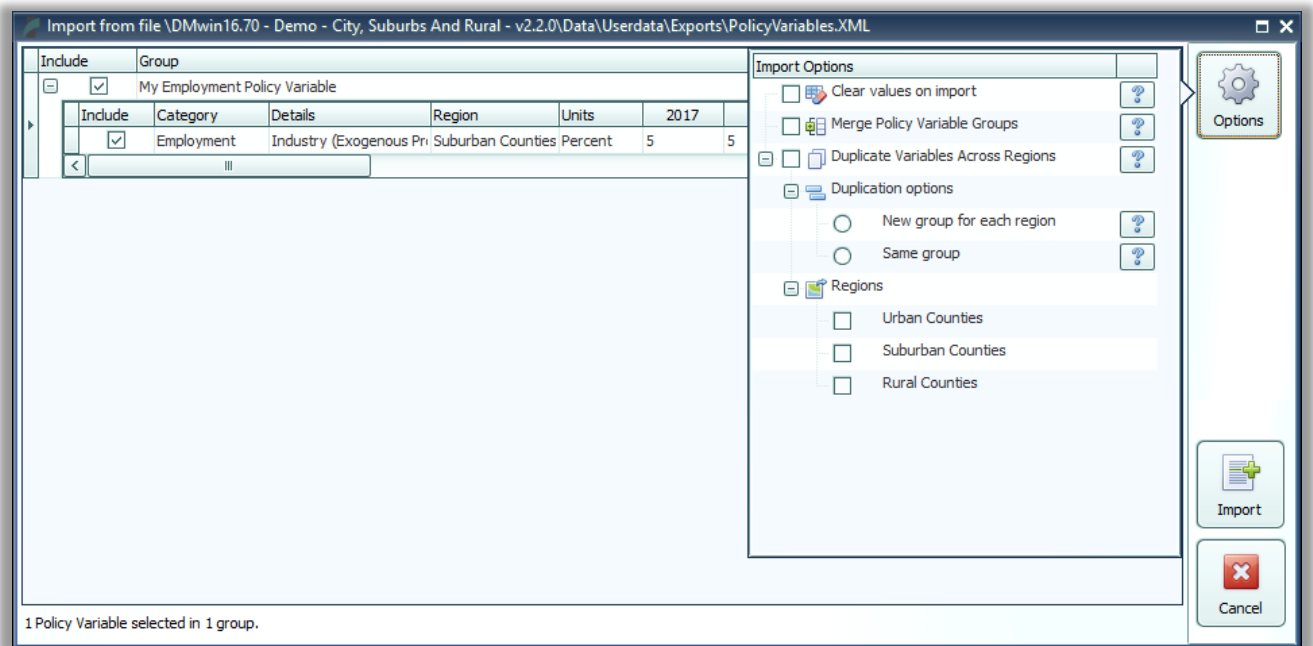
The Export and Import Centers are similar windows that provide a method for deciding which user inputs contained in the present forecast should be exported to a file or imported from a file, respectively. Simply check or uncheck checkboxes in the “Include” column to include or exclude variables.

Figure 39: Export Center



Our current policy variable export files use the flexible XML format to store the wide variety of options that can be associated with all of our different types of policy variables. Unfortunately, XML files are not easily manipulated by hand or by third-party software. As such, when working with large numbers of variables for repeated forecast runs, we recommend creating one or more templates using the PV Selector and the policy variable group merging tool and exporting them. A template would then be a large policy variable group containing all of your required variables in the correct order and with the desired options to match the format of your values. Each use of a template then just becomes a task of opening the variable group in the PV Selector and pasting in values, rather than attempting to replicate the complex structure of the policy variables in our export files, which would be highly error-prone.

Figure 40: Import Center

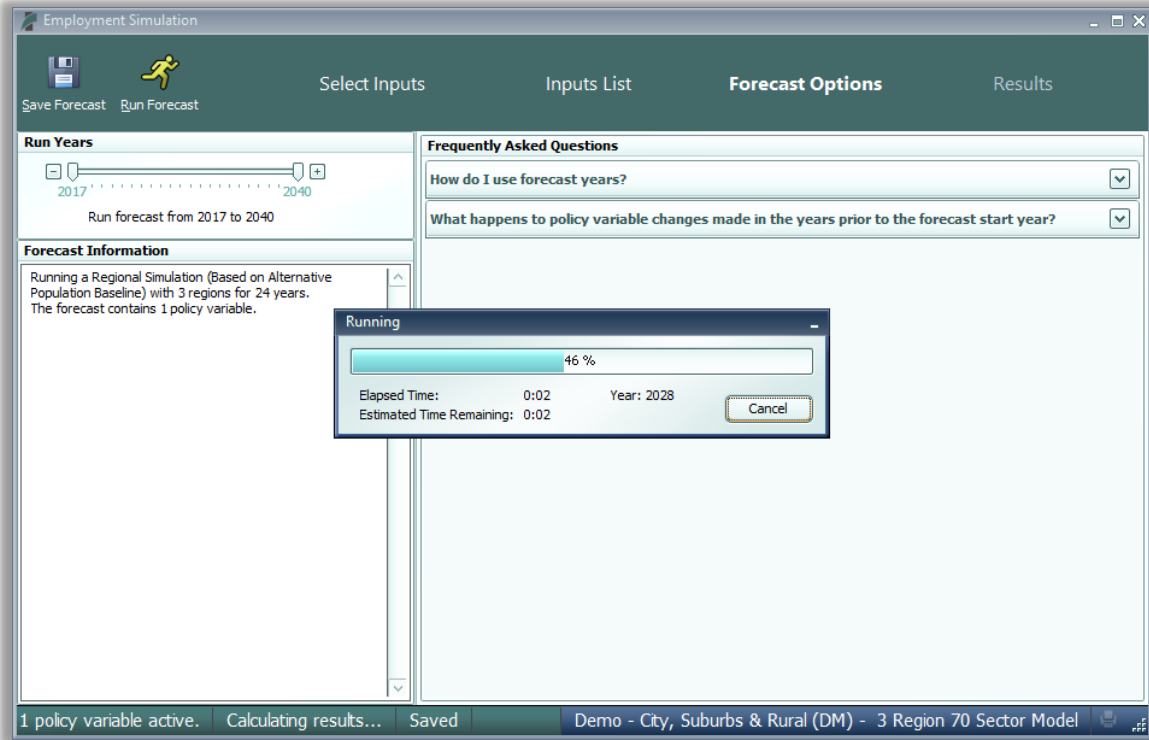


Importing with the Import Center follows roughly the same process as exporting, but with more options. There are options for merging policy variable groups, clearing the values out of the variables, and duplicating variables across all or some of your model regions. In addition to the most straightforward form of importing: from an exported XML policy variable file, you can also import policy variables from a REMI workbook file and from several legacy import file formats. Use caution with legacy formats, as your old variables may not perfectly map to new variables.

Forecast Options

Running a forecast takes place on the Forecast Options screen. Once you have finalized your policy variable inputs, you should make some final decisions about how the forecast should run. Depending on the type of forecast, some different options will be available including closure options and iteration settings. Regardless of the forecast, there will be frequently asked questions and answers about the available run options right on this screen. The “Run Years” selector shows what years the forecast will run for. Not all forecast years up to 2060 will be available in all cases. If your forecast has a parent baseline control, only the years for which that control has run will be available. Once you have chosen your options, settings, and run years, simply click the “Run Forecast” button and the model will begin calculating results, as indicated by the pop-up run progress window.

Figure 41: Forecast Options



Results

The Results section of PI+ contains all of the results of the forecast run that were produced by the REMI model. Result data are displayed in tables, maps, and a wide variety of chart-types. The main navigation bar, on the left side of the window, provides a means for accessing all of the different categories of result visualizations that have been created by REMI. These groupings put results together by concept and help to break up the huge amount of data into more manageable sections.

There are five layouts that are used for arranging visualizations among the different categorized sections of the Results screen. The first, which is visible in Figure 42, is the gallery layout mode. In gallery mode, one visualization takes up the majority of the space on the screen and the remaining visualizations belonging to the same group are previewed on a scrolling list of tiles on the right-hand side of the screen. This tile list can be dragged with the mouse, scrolled by mouse wheel, and scrolled by hovering your mouse near the top or bottom visualization and clicking on the arrow buttons that appear. Clicking on any preview tile will slide that visualization into the central, focused view.

Figure 42: Results – Gallery Mode



The next three visualization layout types each look quite different, but all function in very similar ways.

The Model Linkages view, shown in Figure 43, consists of an interactive diagram that depicts the various links that interconnect different parts of the economy in the REMI model. Any of the outer or inner blocks of the diagram, when clicked, will bring forward a group of related results tables.

Other result categories use tile and list layout modes. These two organizational modes simply contain a list of concepts, hierarchically structured in the case of list mode, where each concept has its own tile or list item that links to the corresponding result table. Examples of these two modes are displayed in Figure 44 and Figure 45.

Model Linkages, tile mode, and list mode share similar functionality once you have selected a concept for viewing of its results. Depicted in

Figure 46, you can see that the selected result table is shown by itself as part of a tabbed view. The tab bar along the top of the visualization area allows for quickly switching to view any of the other tables included in the same model block, tile group, or list section. The tab bar can be scrolled left and right using the respective on-screen arrow buttons. To go back to the starting view, use the back button on the top left. There is also a row mode which can show multiple rows of visualizations with multiple visualizations on each row.

The fifth and final layout used on the results screen is row mode that is used on the customizable Favorites section of the results. As shown in Figure 47, tables and visualizations appear to the right of their group name and description. To enlarge a visualization for further viewing, click the button with four direction arrows on the top right corner of any visualization. You can shrink the visualization to return to the rest of the rows view by clicking the top right button again.

Figure 43: Results – Model Linkages

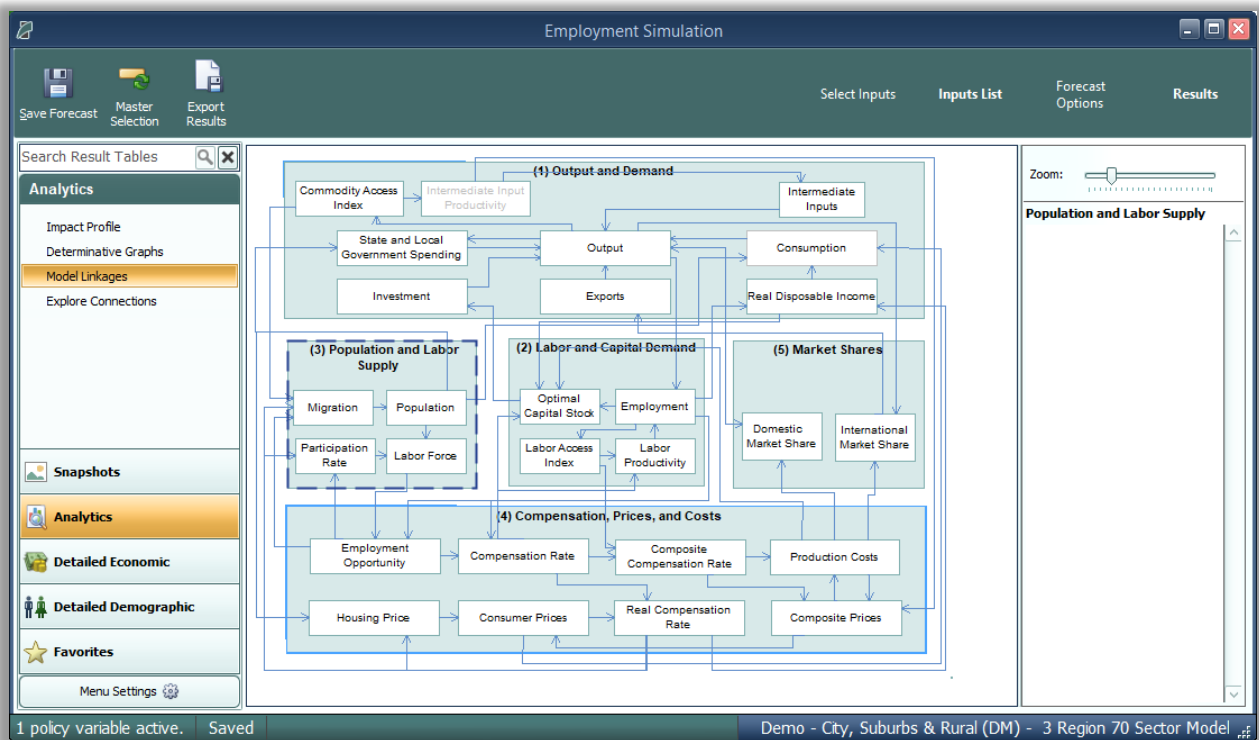


Figure 44: Results – Tile Mode

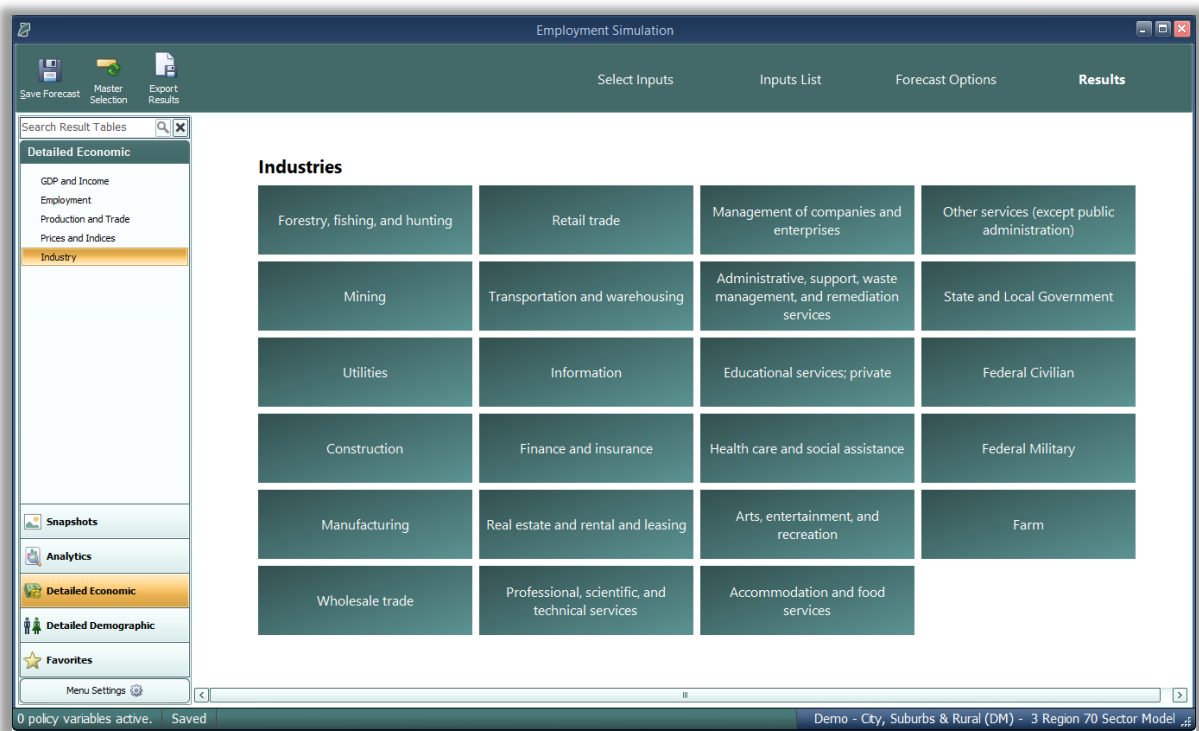


Figure 45: Results – List Mode

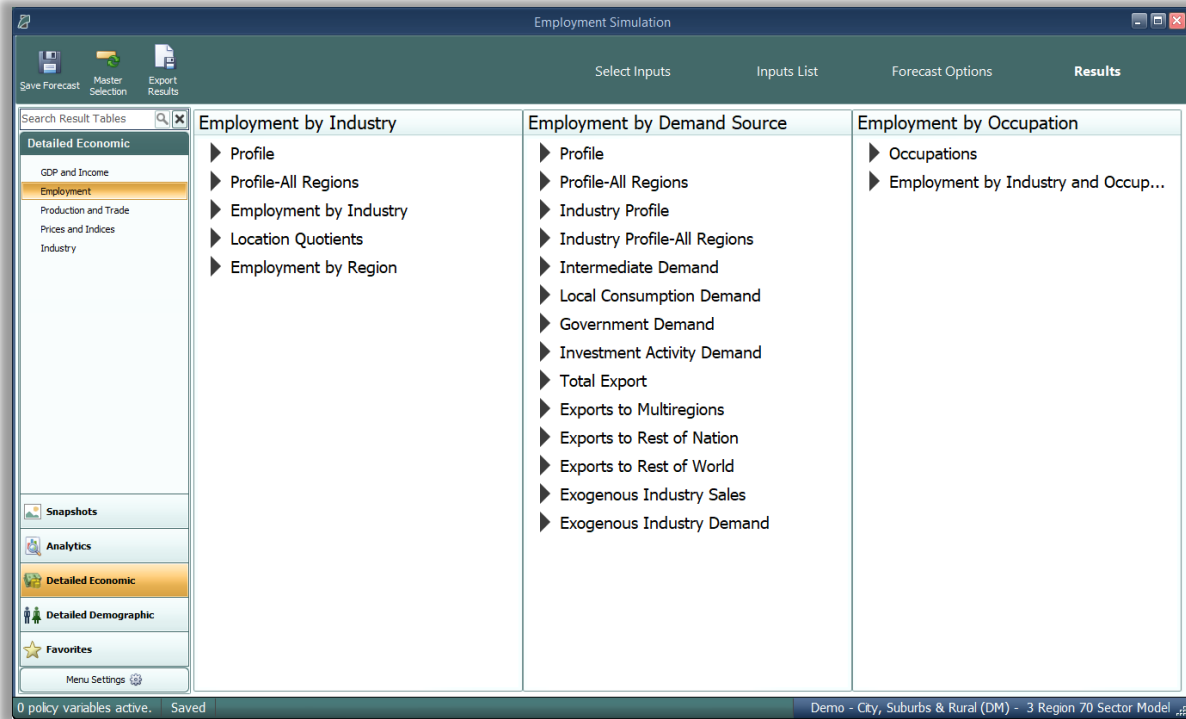


Figure 46: Results – Tabbed View

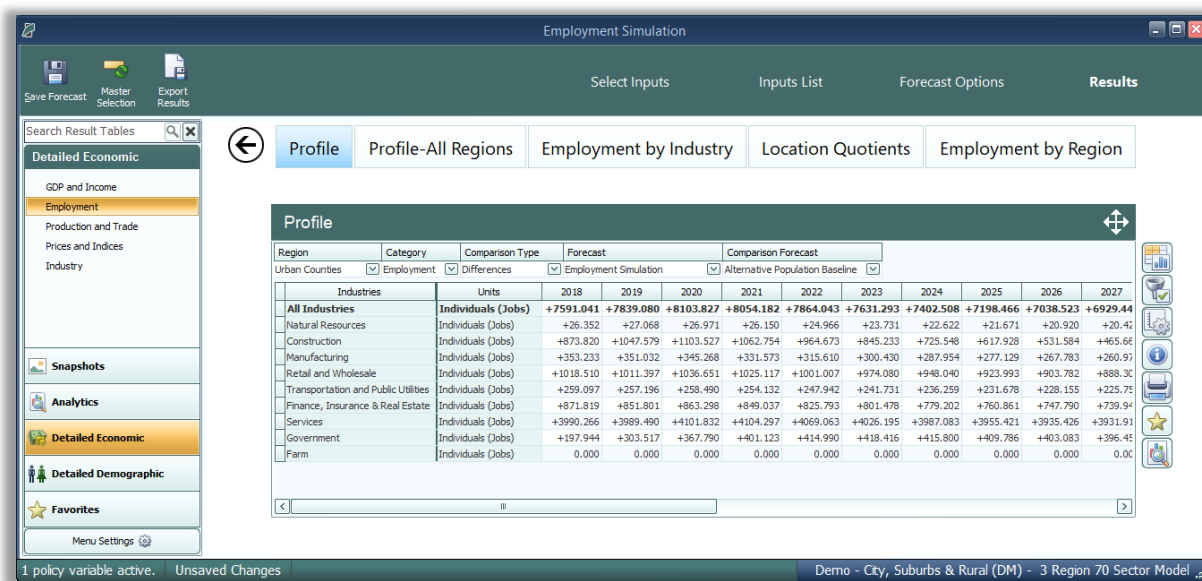


Figure 47: Results – Rows View



Favorites

The Favorites section is intended to allow users to build their own preferred tables, charts, and maps and arrange them however they would like. Favorites are saved and can be viewed for every forecast that you run. To add a new favorite group, select the “Favorites” group on the main navigation bar and click on the “Add a New Favorite” button. After prompt to name the new favorite group, a table creation tool will launch.

The table creator features a full list of every result concept available to the current type of forecast, sorted by detail category. Use the search bar to filter down the long list. Selected concepts will be displayed in the list on the right for ease of keeping track of what has been selected, removing any no-longer-wanted concepts, and lastly, for specifying further information about selected concepts in certain situations. More information will be required when multiple concepts are chosen to be added to a table and they do not all have the same detail category, for example if one variable has industry details and another has age, race, and gender details. In this case, the resulting visualization will need to display values for each concept and a fixed individual detail, like Employment – Construction rather than general Employment with a combo-box filter for switching the industry. Each selected detail can come from an aggregation, if desired, and ultimately will be added to the finished table as separate line item.

After a new favorite group is created, it will appear in the Favorites section of the main navigation bar. When the favorites group is selected, two buttons will appear next to it, one to delete the group and one to open the “Favorites Editor”. The Favorites Editor can be used to customize the favorites group. It can be

used to add, remove, or reorder visualizations and change the layout style. Visualizations can also be arranged in groups which will have a different effect depending on the layout type. In gallery mode, each group will appear on a separate tab, in row mode each group will appear in a separate row, in list mode each group will appear in a different column, and in tile mode each group will form a separate tile group.

Figure 48: Favorites Editor

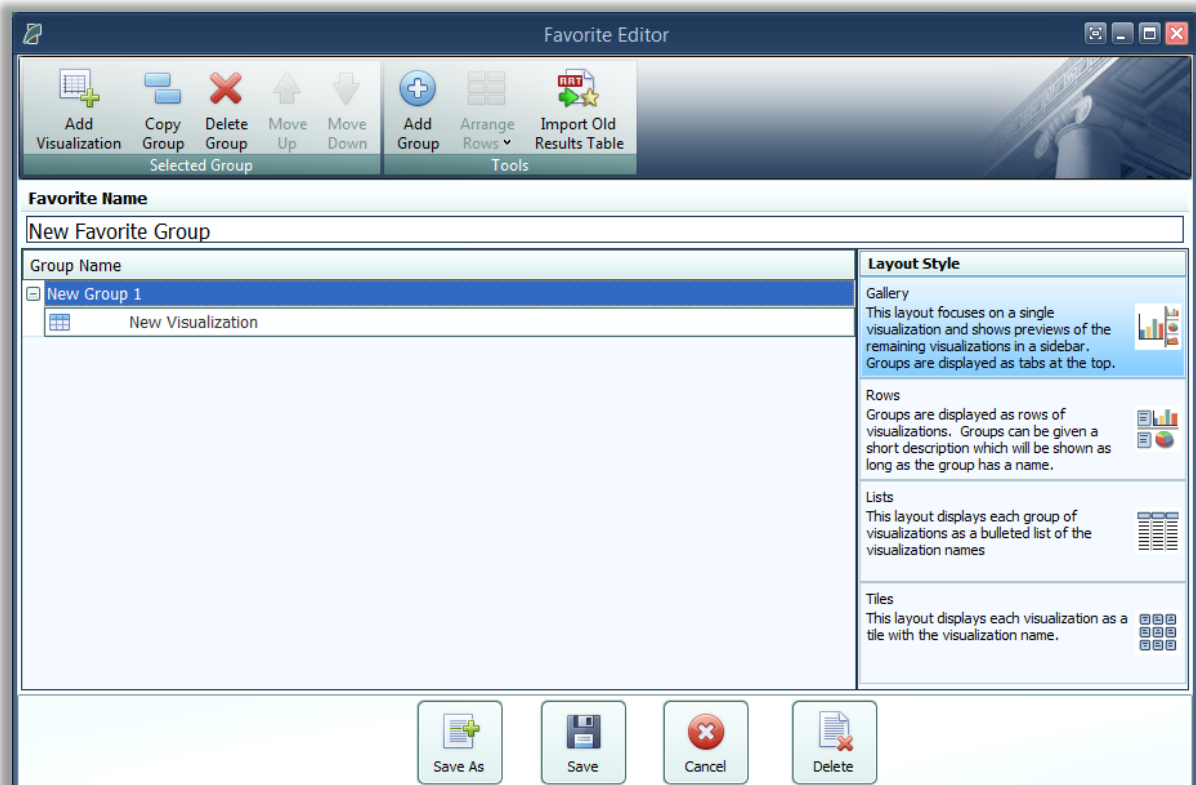
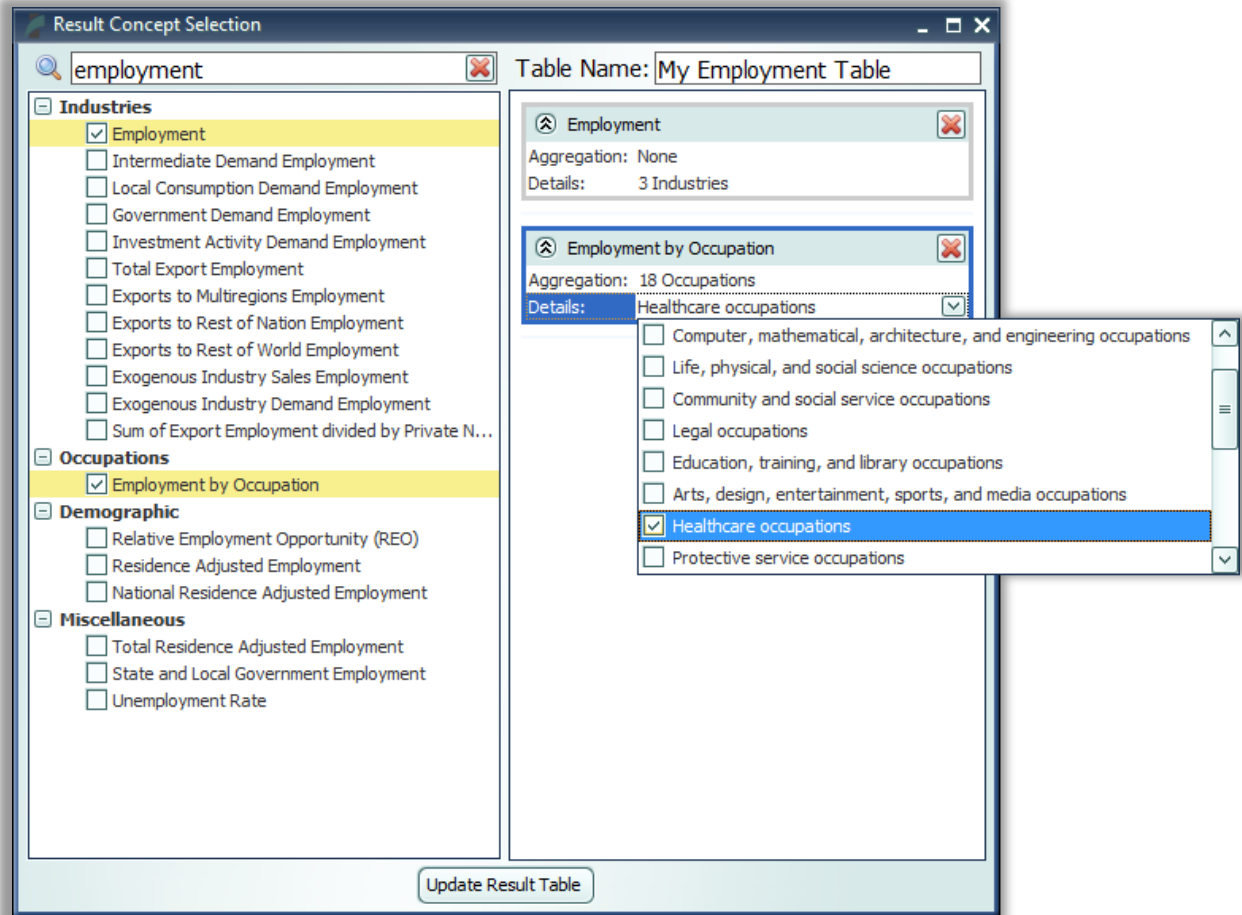


Figure 49: Result Table Creator

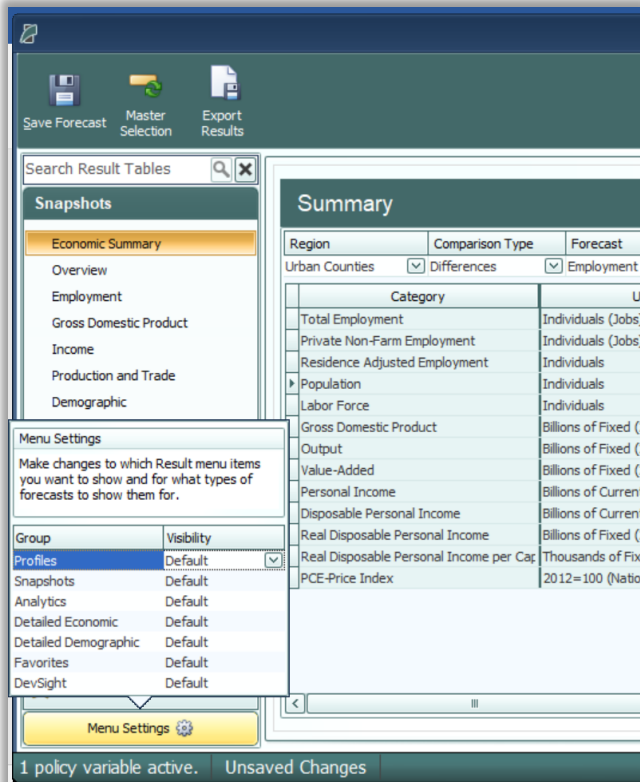


Favorite visualizations have a button on their title header panel that will let you re-open the table creator to adjust their contained data. There are several more options for Favorites that are described in the section below in the context of the many options available for interacting with visualizations.

Results Preferences

You can change what types of options are visible in the main navigation bar by clicking “Menu Settings” at the bottom of the bar, as shown in Figure 50. Using the dropdown menus, each group of options can be specified to appear in all forecasts, no forecasts, control forecasts, or simulations. The “Default” setting will revert an option to the forecasts it appears in when you first begin using the model (e.g., Profiles and Snapshots will only be visible in controls and simulations, respectively.)

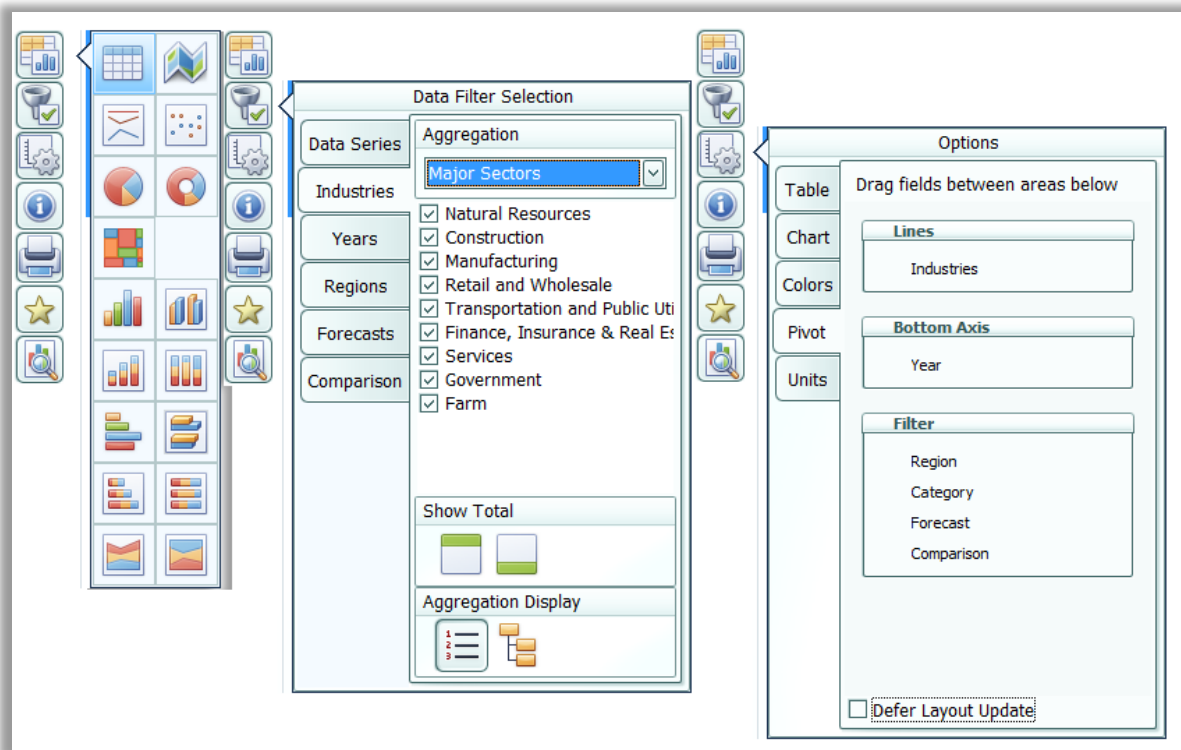
Figure 50: Menu Settings



Interacting with Visualizations

As you navigate the results and click around on visualizations, you will notice that a group of six buttons consistently appears to the right of the most recently selected data visualization. These buttons provide important ways of interacting with the selected visualization. The first three buttons each open pop-up menus that respectively allow for changing the chart-type, modifying the included data, and updating the visualization's settings. The fourth button opens a pop-up text field containing a description of the result concepts currently included in the visualization and the fifth adds a copy of the selected visualization to the Favorites. The last button will open the visualization in the "Explore Connections" tool.

Figure 51: Data Visualization Interaction Buttons and Menus



The chart-type menu lets you switch a visualization between showing a table, map, or fifteen different types of charts. Once you have selected a chart-type option, another menu will open that lets you choose between each of the different ways your data could fit into the new type of chart, with visual previews of each of the available configurations.

If you want to change what data is being shown on a visualization, look in the data selection menu accessed using the second button from the top with the filter icon. This menu has several tabs that each focus on a separate aspect of the data included in the visualization. In the data series tab, you can toggle whether any of the included data series are visible in the chart, remove them altogether, and add new data series using the result table creator. On the other tabs, which vary depending on what details are associated with the data series being displayed, you can change what details are being shown. You can choose to hide or show each region, year, comparison forecast, comparison method, and other detail. There are also options for changing the aggregation level of the displayed details, adding totals, and introducing hierarchy to the layout of the result table in order to see values for multiple aggregation levels at the same time.

The options menu, shown furthest to the right in Figure 51, has a few more options for modifying the current visualization. For certain chart-types you can choose to enable sorting, pick alternate color schemes, and change the decimal precision of listed values. You can also change the displayed units and use the pivoting tool to restructure the chart entirely by dragging different dimensions of the result data into the different

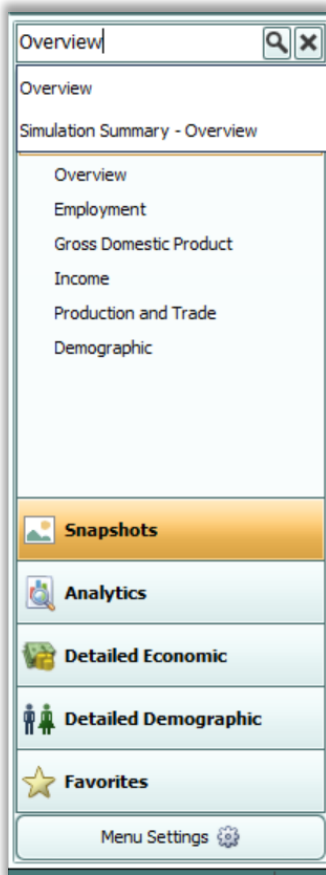
pivot-able destinations afforded by the chart-type. For example, in the pivot menu shown above, industries are currently being displayed down the rows of a table, years along the columns, and the remaining detail types in the filter combo-boxes. This can be altered in any way by dragging these data dimensions between the different groups, although putting too many dimensions onto the rows or columns of a table or either of the two axes on a chart might cause the visualization to take a very long time to finish updating.

There are several other ways of interacting with and modifying visualizations outside of the main visualization buttons. Master selection, which is located at the top of the window on the header panel, should be turned on when you would like to make changes to all visualizations at once such as changing the focused region or selecting the visible years. Another useful feature is the full-screen button. This button can be found on the top right corner of any visualization's title area and will toggle full-screen mode for that visualization. When viewing charts or maps, a 'Show Table' button appears next to the full screen button that will show a table of values that correspond to the displayed chart or map.

Searching for Result Tables

Toward the top left corner of the results screen is a search bar where you can search for names of tables and visualizations in your forecast. The results search is intended to be used to search for entire tables and visualizations rather than individual result variables.

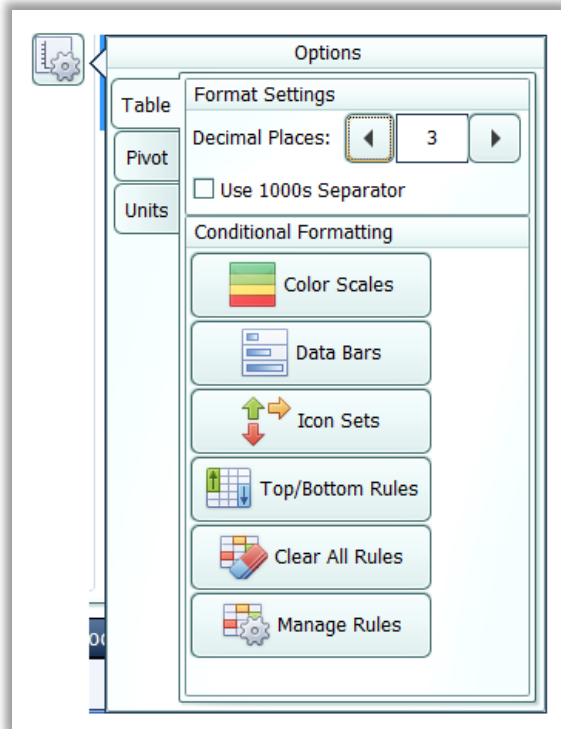
Figure 52: Results Search



Conditional Formatting

You can use conditional formatting to visually categorize results in tables. You can find conditional formatting in any forecast by clicking the “Options” button to the right of any table and viewing the “Table” tab. You will be able to choose color scales, data bars, or icons to automatically categorize your results into low, mid-range, and high categories. You can also click on “Top/Bottom Rules” to choose to highlight the top or bottom ten results in your table, all results that are above or below average, or all results that are in the top or bottom tenth percentile of the table. Tables will automatically clear themselves of all conditional formatting when you navigate away from them.

Figure 53: Conditional Formatting



Impact Ranking Tool

The impact ranking tool is a feature of forecast charts that can show where in the economy a policy will have the greatest or least impacts. To view charts that show the impact ranking tool by default, go to the Analytics panel in the forecast results and select the Impact Profile option. Over the top of the chart, click on the “Ranked” tab as shown in Figure 55. As shown in Figure 54, the tool will appear as a menu where you can select how many ranked items to show and what year of impacts to reference. For other charts, the tool can be made visible by clicking the “Options” button, navigating to the “Chart” tab, and selecting the order in which impacts should be displayed as shown in Figure 56. Impacts are ordered by magnitude (e.g., an impact of -5 jobs will be considered greater than an impact of 2 jobs.) Impact ranking is not available for certain chart types.

Figure 54: Impact Ranking Tool

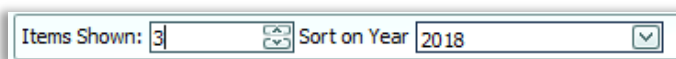


Figure 55: Ranked Visualizations

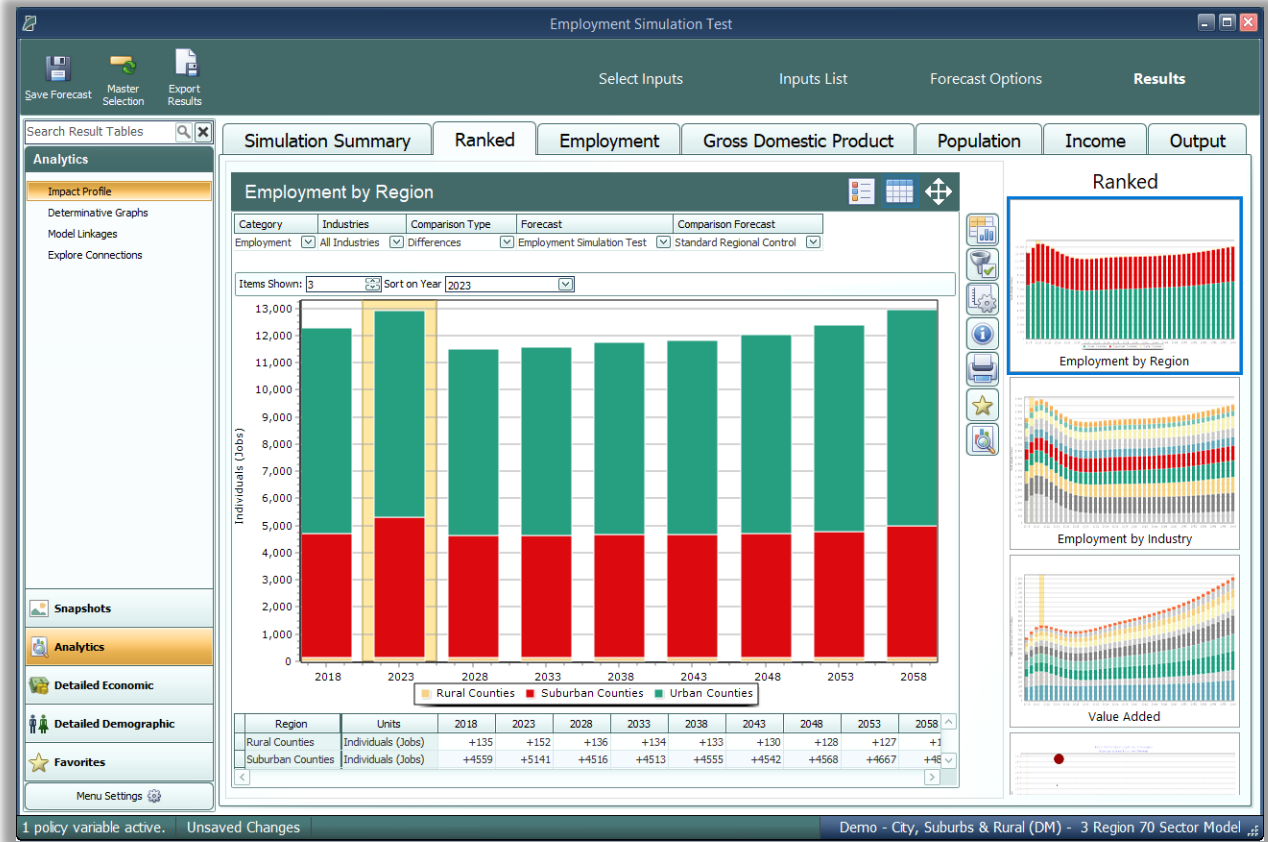
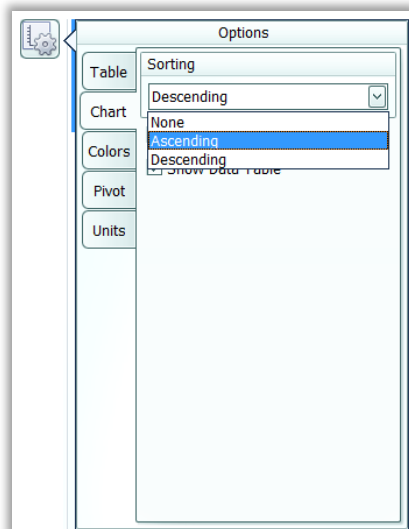


Figure 56: Making the Impact Ranking Menu Visible



Connections Explorer

The Connections Explorer is designed to allow you to go through the REMI model step-by-step to see the effects of individual policy variables. It will show you a policy variable or result that you have selected along with the other variables in the model that are connected to it. The Connections Explorer can be accessed in the Results section of regional forecasts by going to the Analytics panel and selecting “Explore Connections” as shown in Figure 57 or by clicking the “View in Explorer” button to the right of any result visualization as shown in Figure 58.

Figure 57: Opening the Connections Explorer

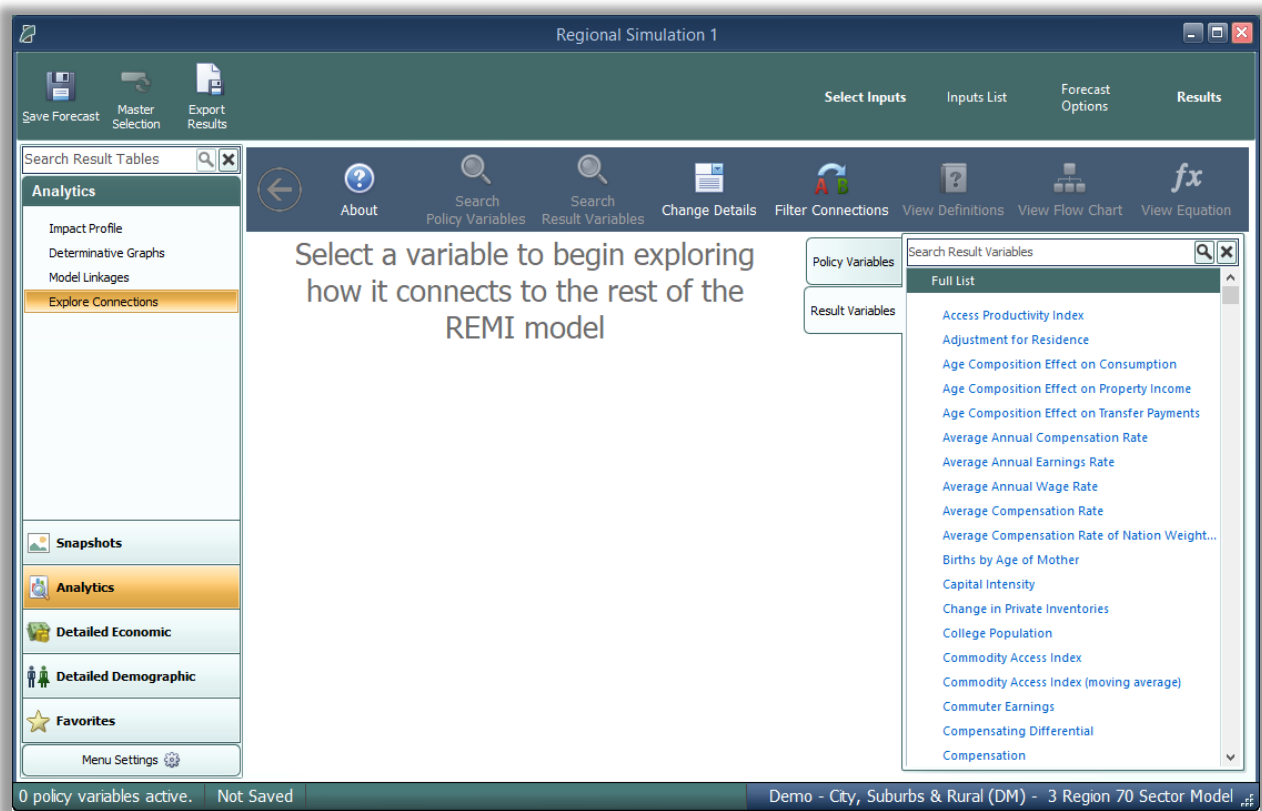
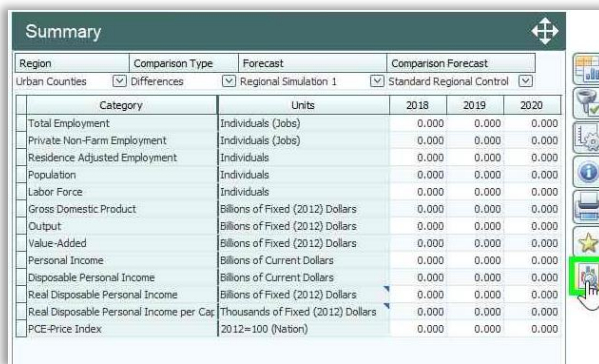


Figure 58: View in Explorer

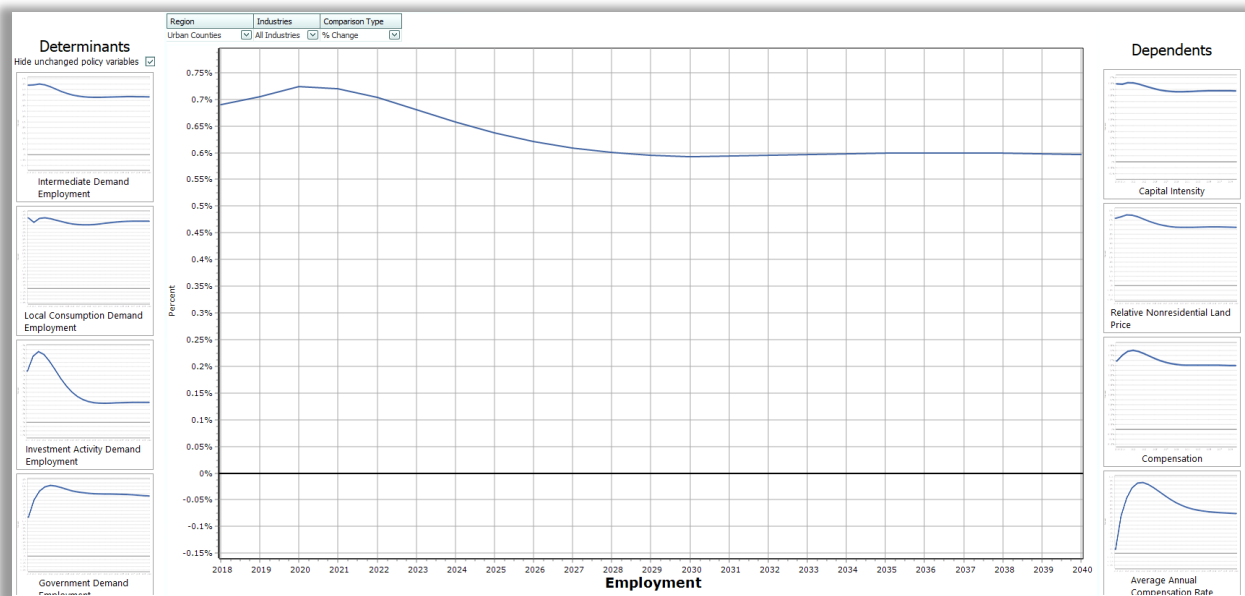


Region	Comparison Type	Forecast	Comparison Forecast
Urban Counties	Differences	Regional Simulation 1	Standard Regional Control

Category	Units	2018	2019	2020
Total Employment	Individuals (Jobs)	0.000	0.000	0.000
Private Non-Farm Employment	Individuals (Jobs)	0.000	0.000	0.000
Residence Adjusted Employment	Individuals	0.000	0.000	0.000
Population	Individuals	0.000	0.000	0.000
Labor Force	Individuals	0.000	0.000	0.000
Gross Domestic Product	Billions of Fixed (2012) Dollars	0.000	0.000	0.000
Output	Billions of Fixed (2012) Dollars	0.000	0.000	0.000
Value-Added	Billions of Fixed (2012) Dollars	0.000	0.000	0.000
Personal Income	Billions of Current Dollars	0.000	0.000	0.000
Disposable Personal Income	Billions of Current Dollars	0.000	0.000	0.000
Real Disposable Personal Income	Billions of Fixed (2012) Dollars	0.000	0.000	0.000
Real Disposable Personal Income per Cap	Thousands of Fixed (2012) Dollars	0.000	0.000	0.000
PCE-Price Index	2012=100 (Nation)	0.000	0.000	0.000

As shown on Figure 59, the Connections Explorer contains graphs of policy and result variables over the forecast period. Clicking on the graph of a variable you are interested in will enlarge it. Once your variable is enlarged, the feature also displays a “Determinants” column that lists any variables that directly affect your variable and a “Dependents” column that lists any variables that your variable directly affects. To make changes to the details that are displayed for each variable, you can make changes to the dropdown menus just above the visualization. You can also make changes to the details displayed and the detail aggregations used by clicking the “Change Details” button on the top bar.

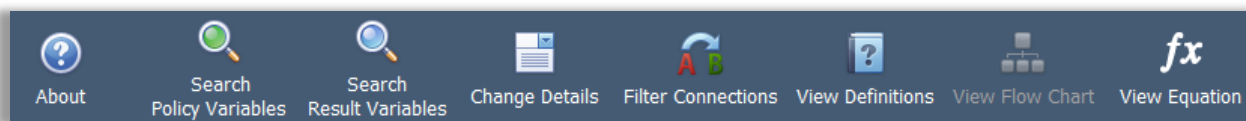
Figure 59: Viewing a Variable in the Connections Explorer



To search for a specific policy variable, click the “Search Policy Variables” button on the top bar as shown in Figure 60. You will be able to search for available policy variables with the search bar or choose from the list. The policy variables that are active in your simulation are listed first. Similarly, to search for a

specific result variable, click the “Search Result Variables” button next to Search Policy Variables. You will be able to search from available result variables with the search bar or choose from the list.

Figure 60: Top Bar of the Connections Explorer

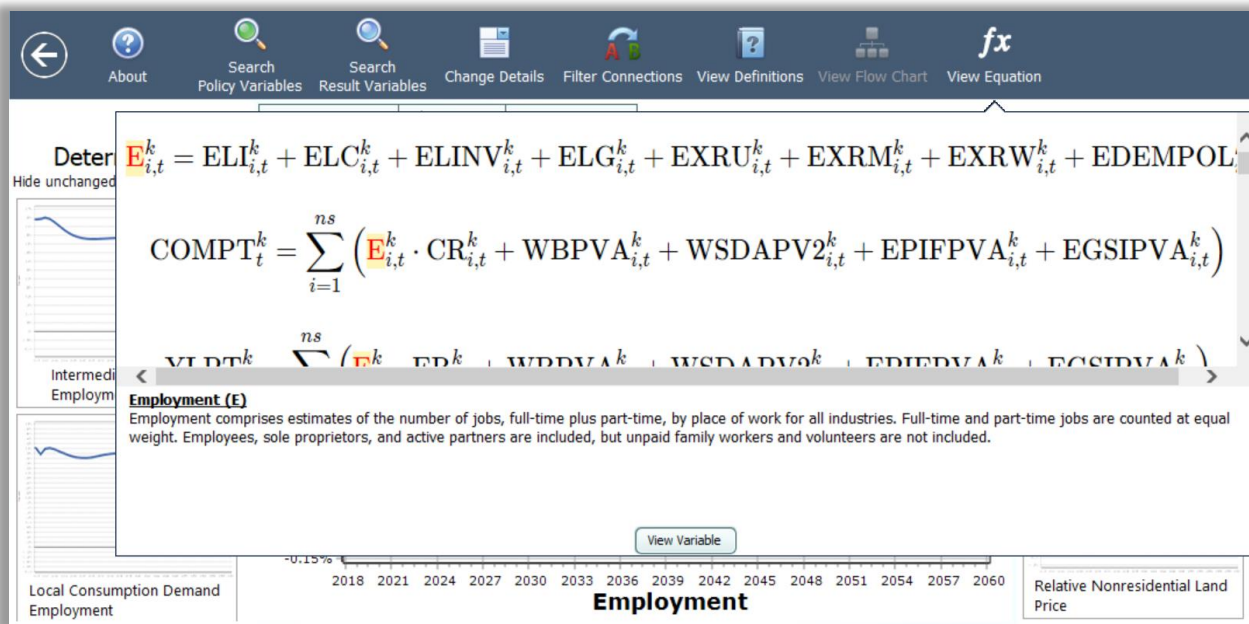


To see how REMI defines variables, click the “View Definitions” button on the top bar. This will show you the definition of the variable you are currently viewing along with the definitions of any determinant or dependent variables being shown.

Equation Viewer

To see model equations that involve your variable, click on the “View Equation” button on the top bar as shown in Figure 61 to open the Equation Viewer. Your variable that you are currently viewing will be shown in red. You can click on any variable in the equations to view its name, definition, and in some cases a “View Variable” button that will show you the graph of that variable along with its determinants and dependents.

Figure 61: Equation Viewer



Stepping Through the Model

To view one of your variable's determinants or dependents, click on that variable in the relevant column. The visualization of that variable will be enlarged, and the Determinants and Dependents columns will be replaced with your new variable's determinants and dependents. To return to your old variable, simply search through the relevant column, where it will be outlined in blue. By clicking on determinants and dependents, you can “step through” the model and the interactions between variables.

Connections Filter

To automatically map out relationships between any two variables, click on the “Filter Connections” button on the top bar to access the Connections Filter, which is a search feature for linkages between specific variables. Type the starting and ending variables for the paths you want to map out. The Connections Filter will show a connections map which will represent up to 12 of the shortest paths between the two variables. Paths that are more than 20 variables long will not be shown. Use the scroll bars to scroll across the connections map. To view the entire map at once, press the “Zoom Out” button in the top left corner of the map. To begin tracing through the paths between your starting and ending variables, click the “Apply Filter” button below the connections map as shown in Figure 62. You will then be shown your starting variable, and will be able to step through the paths that were shown on the connections map, with all other variable relationships filtered out. When you are done with the Connections Filter or would like to see all possible determinants and dependents for your variable and not just the ones found on the connections map, bring up the Connections Filter again and click the “Remove Filter” button.

Figure 62: Connections Filter



Purpose of the Connections Explorer

The Connections Explorer shows you connections between policy variables and results, but in simulations with multiple policy variables active, it cannot isolate the effects of each policy variable. Exploring the effects of multiple policy variables at once will make the cause and effect relationships between policy variables and results become unclear and confusing, since there is no way of seeing which effect was caused by each policy variable. Because of this, we recommend using the Connections Explorer on simulations with a single policy variable active. The policy variable should be applied to only 1 region, 1 industry, 1 commodity, etc. A specific example of how the Connections Explorer can be used to solve issues in a policy analysis is given in the documentation.

Exporting Results

In order to export forecast results from PI+, you will need to locate the “Export Results” button on the navigation header bar, between the save and options buttons. This button launches the “Data Export Center”, which is the home for all result exporting. The interface of the export center has options for deciding what content should be exported, as well as the export file format, and some additional settings. When exporting multiple visualizations to an Excel Workbook, visualizations are each placed on a separate spreadsheet tab.

Figure 63: Result Export

