Long-Term Projections Tools: From UPED to REMI

Overview

Beginning with the 2004 Baseline, the Governor's Office of Planning and Budget will use the REMI model to produce the official long-term projections for the State of Utah and its counties. The REMI model replaces the UPED model, which has been used since the early 1970s to produce Utah's projections and to conduct alternative scenario analysis to aid in state and local planning activities.

Introduction

In 2002, the State of Utah instituted a significant change in the way it projects population and employment. It switched from using the Utah Process Economic and Demographic (UPED) model to using a model from Regional Economic Models Incorporated (REMI) to produce the official long-term baseline projections. The adoption of the REMI model will enable the state to continue to provide high quality projections to analysts and decision-makers.

Models and Modeling

In order to make educated decisions about how to allocate scarce resources to competing demands, it is necessary for decision-makers to have the best possible information about what the future may hold. Forecasts allow the analysis of future periods given historical trends. These forecasts help frame the debate of how we plan for the future and can extend to any time period.

Models potentially provide an effective way to evaluate different policy issues. The primary purpose of a model is to represent as accurately as possible what is happening in the "real world." Because the world is so complex, it is impossible to create a model that perfectly reflects the numerous interactions that occur. A model, therefore, is essentially a simplified representation of reality.

Models can range from verbal statements, to diagrams, graphs, and physical models, to mathematical models. Each design has its benefits depending on its application and on what it is meant to represent. For quantitative analysis of population characteristics, mathematical models are the preferred method of representing reality. Mathematical models are useful because they: (1) allow for easy manipulation, (2) are unambiguous, (3) provide the opportunity for computation, and (4) are useful in analyzing trends and making forecasts. They consist of relationships between independent and dependent variables that are expressed in the form of an equation. In complex models, these equations are interdependent, with a change in one causing changes in others.

Models can also be either static or dynamic. In static models, a change in an independent variable directly causes a change in one or more dependent variables, but these changes only occur in a single time period. If an analyst wishes to study multiple time periods, he or she must re-run the data through the model, thus increasing the possibility of error. The benefit of dynamic models is that they allow for recursive (repeating) changes. Thus, an analyst has the ability to introduce a change to an independent variable and analyze the effects in many different time periods.

The UPED Model

The UPED model is a combination of a three-component cohort population model and an economic base employment model. It produces projections of population, components of population change (births, deaths and migration), households, labor force, and employment at the Multi-County District (MCD), or regional level. The UCAPE and CASA models are supporting models to the larger UPED model, and they allocate the UPED population, components of population change, and employment to counties. County or MCD values are aggregated to yield the projection for the State of Utah.

UPED's Historical Significance

Utah has a long tradition of developing long-term economic and demographic projections. The University of Utah's Bureau of Economic and Business Research (BEBR) conducted two studies in the late 1960s that laid the groundwork for the production of long-term projections in Utah and for the subsequent use of the UPED model. These reports, entitled *Population Projections: Utah and Utah's Counties*, and *Utah Input-Output Study: Projections of Income, Employment, Output and Revenue*, were a joint effort between BEBR and the State of Utah to study methods of creating and using projections.

The projection studies in the late 1960s led the way for an organized effort to encourage cooperation and smart planning in the State of Utah. In the early 1970s, the Office of the State Planning Coordinator began the development of a collaborative project, entitled The Utah Process, to bring all state agencies together to think about planning. The project received funding from the Department of Commerce's Office of Regional Economic Development and from the Four Corners Regional Commission. In 1972, the Governor's Office issued a report on the development of the project that documented the progress to that point.

According to the report,[1] the goal of the Utah Process development project was to create a means through which state government planning coordination could be achieved. Furthermore, the federal government sponsors wanted the project to be based on previous research and development, and for the process to be easily adaptable to the governments of other states. A vital component of planning coordination is the ability to discuss alternate futures and the implications of actions taken today. Accordingly, the project directors understood the importance of being able to model these alternative scenarios.

While the UPED model eventually became the official impact analysis model of the Utah Process, it was not envisioned as the official model from the beginning of the project. Originally, project directors intended to use a different impact model entirely. In the original Utah Process Proposal the authors stated that a different model, the Regional Economic Model (REM), would be used. The REM model was being developed by the Center for Business and Economic Research at Brigham Young University, and a modified version of the REM model was intended to be the central analytical tool in the Utah Process. Once developed, however, the characteristics of the REM model were so different from what was required for the Utah Process that the model had to be abandoned altogether. Instead, the staff determined that it was necessary to create a separate model specifically designed to meet the needs of the Utah Process. This custom model became known as the Utah Process Economic and Demographic Impact Model.

[1] Bigler, C., Bowman, R. S., Kirk, D. C., and Weaver, R. (1972). *Report on the Development of the Utah Process: A Procedure for Planning Coordination Through Forecasting and Evaluating Alternative State Futures*. Salt Lake City, UT: State Planning Coordinator, Office of Governor Calvin L. Rampton, 1-2.

The original purpose of the UPED model was not to produce the "official" long-term projections for the State of Utah and its counties. Its purpose was to provide a means for evaluating a number of alternative futures and thus enabling the discussion of these futures. Indeed, in the early 1970s there did not even exist an official, or baseline projection. However, from the very beginning, the UPED model became a constant work in progress. In the development report alone, project directors cited a number of improvements to the model that would make it more responsive to regional changes and able to produce economic and demographic projections with greater precision.

By the mid 1970s, the State Planning Coordinator's Office was using the UPED model to produce alternative futures in the Utah Process. Each alternative future was composed of one or more plausible events of an economic, demographic, political, social, or environmental nature which significantly altered courses and conditions within the state or its regions and thus changed the demands placed on public resources.[2] Because the analysis of alternative futures was the primary focus of the Utah Process, the production of "official" baseline estimates was not emphasized at first.

The 1975 report, *The Utah Process Alternative Futures*,[3] emphasizes this point. The report even criticized traditional computer models available at that time for being poorly designed in terms of their ability to respond to an analysis of alternative futures, saying: "The reason for this deficiency is that such models have been designed to extrapolate past trends to produce 'one best estimate' projections." The authors further argue that these projections will inevitably be wrong and they cannot be used to project the impacts of events which represent shifts away from past trends. The report did present a baseline projection of population and employment (called Alternative Future Zero), but the authors emphasized that this baseline represented only one possible alternative future. There was neither an attempt to imply that the baseline projection represented the most likely future, nor was there an attempt to use the baseline projection as an official projection for the State of Utah.

By 1980, the UPED model had undergone extensive revisions and refinements, expanding its ability to produce detailed population and employment projections.[4] These refinements, along with the desire for more coordinated statewide planning, provided an impetus to make the baseline projections the official projections of Utah state government. In December 1978, Governor Scott Matheson directed state agencies to use the population projections provided by the State Planning Coordinator's Office.[5] The argument in favor of using the baseline as the official projections was that for many applications, a "best guess," or most likely projection is required.

By the mid 1990s, the UPED model had become a very complex model with intricate connections and programs to perform different functions. In fact, the UPED model had become part of a larger, "Demographic and Economic Model System."[6] The model system was composed of many data sets, data manipulation programs, and the three models related to the overall UPED model. The model system included: (1) fifty-nine programs for accessing and manipulating various data sets, (2) twenty-two programs for accessing and manipulating the model outputs, and (3) twelve utility programs for checking and evaluating the model outputs during the production stage of the projection process. Virtually all of the programs were written in FORTRAN programming language.

Because of the complexity of the model, and because of concerns about the ongoing maintenance of such a complex system, in 2001 GOPB created a UPED Steering Committee to review the status of the UPED model and to make recommendations about possible alternatives to the model. After considering all the issues related to updating the UPED model, the Steering Committee recommended that GOPB switch to the REMI model for the production of the official long-term projections for the State of Utah.

The REMI Model

The REMI model first began development in 1977 as the Massachusetts Economic Policy Analysis (MEPA) model under the direction of George Treyz, an economics professor at the University of Massachusetts.[7] The model was so successful that a version of it was developed for the National Academy of Sciences. In 1980, George Treyz created Regional Economic Models, Incorporated (REMI) to maintain and market the model that he developed. Today, REMI has the ability to develop a model for each state and each county in the United States. The company is even branching outside of the borders of the U.S., creating models for Western Europe and Eastern Asia. REMI can also create either a single region model, where changes in the geographic region do not affect any other regions, or a multiple region model, in which changes in one geographic region can induce changes in the other regions of the model. The Utah Governor's Office of Planning and Budget has several REMI models for the production of its long-term projections. It has a single-region model for the state as a whole, a multi-region model that encompasses each of the 29 counties in the state, and a single region model for each of the counties in Utah individually. These three methods of analysis allow analysts to consider a variety of factors when producing the projections.

The REMI model is very similar to the UPED model, in that it combines economic and demographic components in order to produce a complete picture of the complex relationships that exist in a society. Its ability to capture these complex relationships makes REMI fairly unique among models of economic and demographic growth. This detail is also why REMI is one of the most widely used custom models in the nation. REMI's clients include a variety of federal government agencies, as well as state and local governments, and private organizations.

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2 Reeve, R., and Weaver, R., (1974). *Report on the Development and Implementation of the Utah Process Land Use and Tax Base Model (UPLAND)*. Salt Lake City, UT: State Planning Coordinator, Office of Governor Calvin L. Rampton, 1.

3 Office of the State Planning Coordinator. (1975). *The Utah Process Alternative Futures: 1975 - 1990*. Salt Lake City, UT: Office of Governor Calvin L. Rampton, 1-3.

4 Weaver, R., Hachman, F. C., Wilcox, A. S., and Reeve, T. R., (1980). *UPED79: Report on Revisions of the Utah Process Economic and Demographic Model (UPED)*. Salt Lake City, UT: Bureau of Economic and Business Research, University of Utah & Utah State Planning Coordinator's Office.

5 Utah Office of Planning and Budget. (1985). *Revised 1984 Baseline Projections: Executive Summary*. Salt Lake City, UT.

6 Reeve, T. R., and Perlich, P., (1995). *State of Utah Demographic and Economic Projection Model System*. Salt Lake City, UT: Governor's Office of Planning and Budget, 5-7.

7 Lanzillo, J., Larson, M., Treyz, G. I., and Williams, R. E. (1985). *The Massachusetts Economic Policy Analysis Model Track Record: 1977 - 1983*. Amherst, MA: School of Management, University of Massachusetts.

Model Overview

The REMI model has been extensively documented and widely tested over the years. It has been subject to many technical analyses of its abilities, and the documentation of the model has been subject to peer review. The REMI model is a structural model, which means that it includes cause-and-effect relationships among the different parts. The basic assumptions underlying the model are that households maximize utility and that producers maximize profits. It has foundations in many modeling approaches, including input-output, economic base, neoclassical general equilibrium, Keynesian, macro-modeling, economic geography, segmented labor market analysis, econometric modeling, and cohort-component modeling.[8,9]

There are five basic model blocks in the REMI model. The major blocks are: (1) output and demand; (2) labor and capital demand; (3) population and labor force; (4) wages, prices and costs; and (5) market shares. These blocks provide the foundation upon which the model linkages are built. Different parts of the REMI model are interrelated, as illustrated by the figures in this chapter. According to REMI:

> The output and demand block consists of output, demand, consumption, investment, government spending, exports, and imports, as well as feedback from output change due to the change in the productivity of intermediate inputs. The labor and capital demand block includes labor intensity and productivity as well as demand for labor and capital. Labor force participation rate and migration equations are in the population and labor force block. The wages, prices, and costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the wage equations. The proportion of local, inter-regional and export markets captured by each region is included in the market shares block.[10]

The interaction of all the parts of the model come together to provide the basis for preparing baseline forecasts and for conducting alternative scenario analysis based on differences from the baseline. Furthermore, because of the model's dynamic properties, it has the ability to reflect changes that either increase or decrease over time. This is especially helpful when conducting scenario analysis of alternative futures.

The models GOPB uses to produce the official baseline long-term projections for the State of Utah and its counties were custom designed by REMI. Not only do they incorporate regional data from national sources such as the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor Statistics, and the U.S. Census Bureau, the models also specifically include locally produced data. For instance, historical population data is from the Utah Population Estimates Committee, and birth and death data is from the Utah Department of Health.

Furthermore, even though the official REMI model does not include data on households, because this information is important to Utah data users, and because GOPB specifically requested it, REMI incorporated household data into Utah's model.

Conclusion

The State of Utah has a long history of producing detailed and accurate long-term projections. The UPED model enabled analysts to consider various scenarios in order to evaluate the future ramifications of actions taken today. While GOPB switched the model it uses to produce Utah's long term projections, the overall process of producing projections remains the same. The adoption of the REMI model will ensure that Utah's official long-term projections maintain their high standards of quality and accuracy for many years to come.

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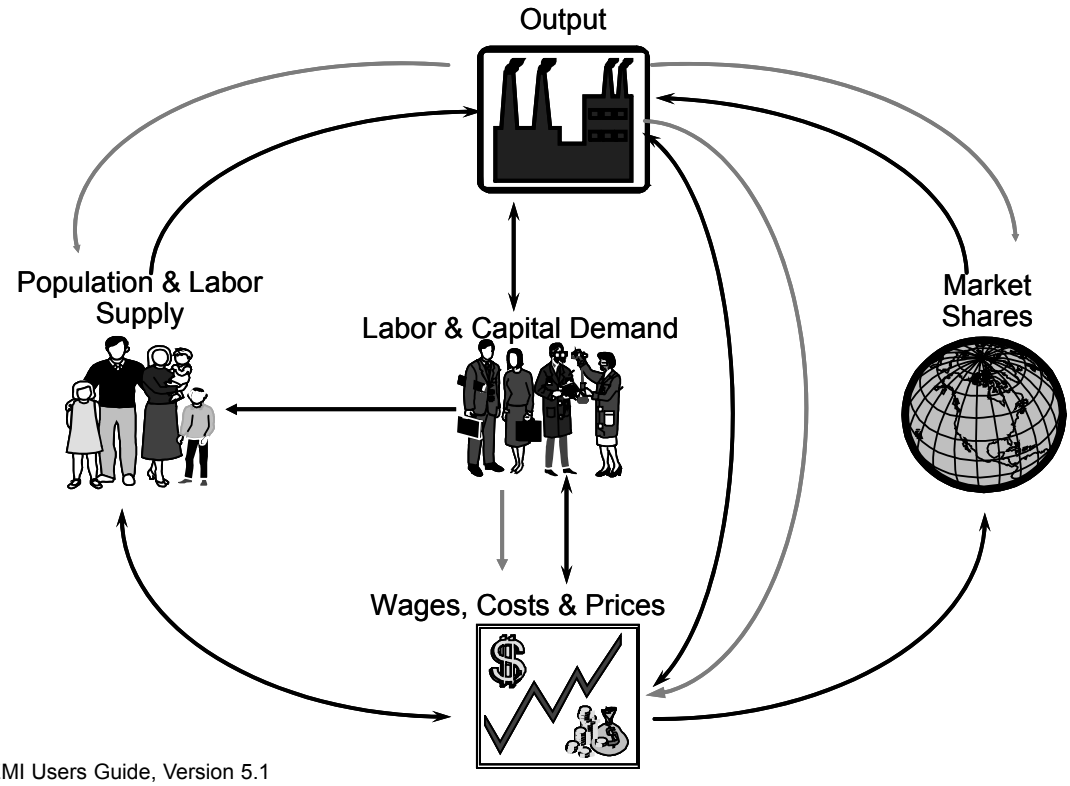
8 Treyz, G. I. (1980). "Design of a multiregional policy analysis model." *Journal of Regional Science*. 20(2).

9 Treyz, G. I., Rickman, D. S., and Shao, G. (1992). "The REMI Economic-Demographic Forecasting and Simulation Model." *International Regional Science Review*. 14(3).

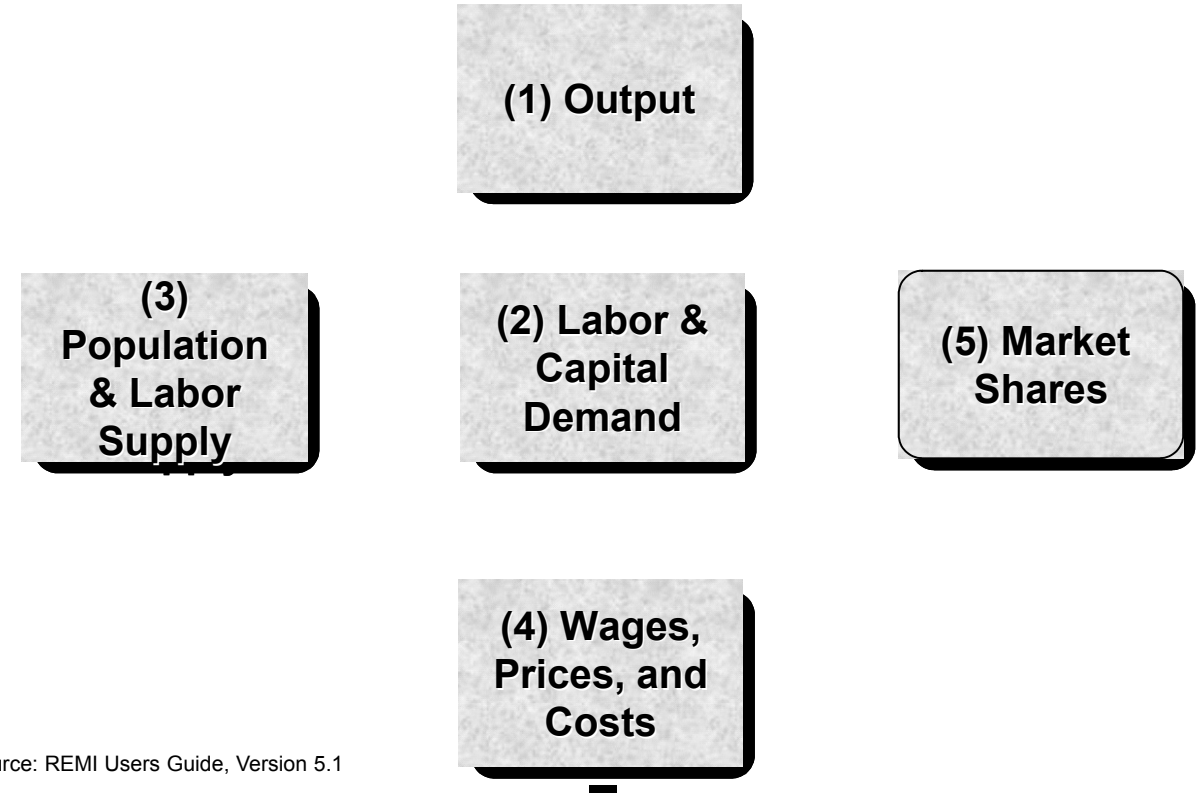
10 Regional Economic Models, Incorporated. (2002). *REMI Policy Insight Model Documentation: Version 5.1*. Amherst, MA, 7.

Figure 80
REMI Model Structure Economic Geography Linkages



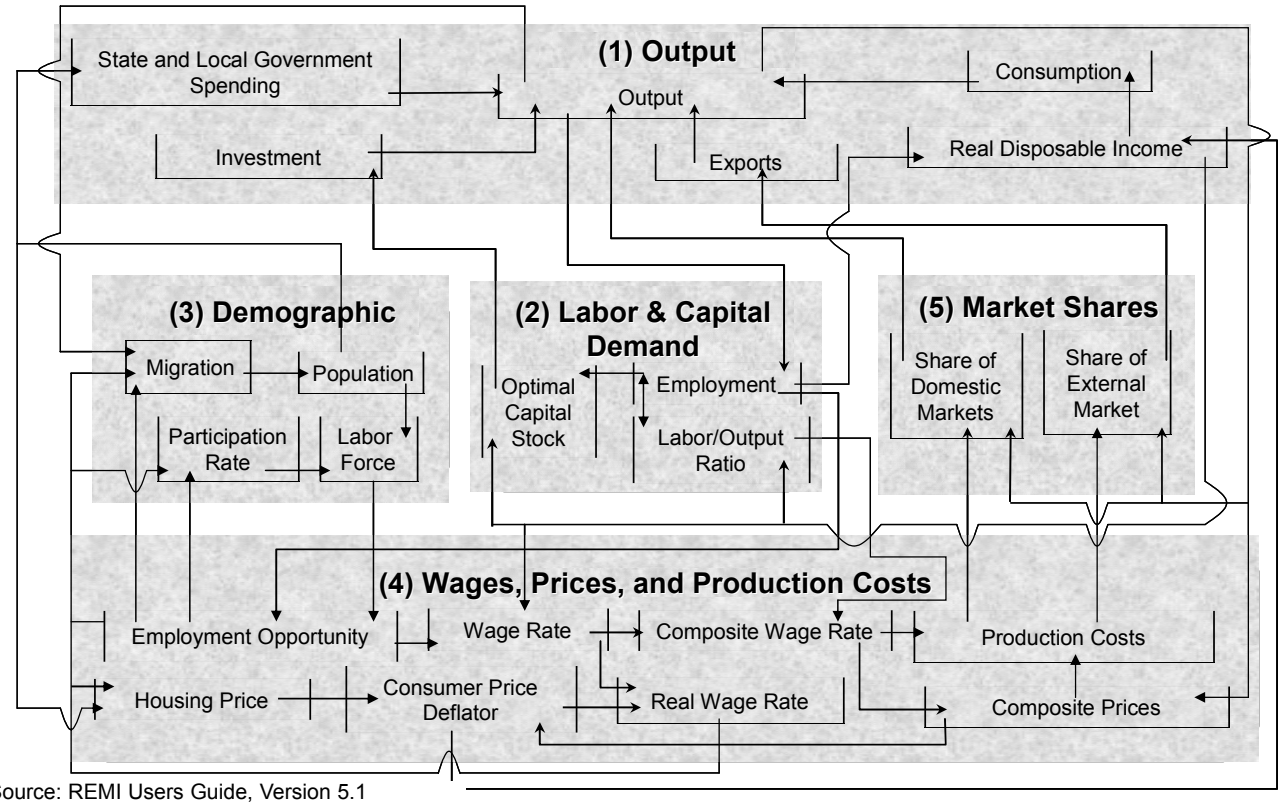
Source: REMI Users Guide, Version 5.1

Figure 81
REMI Basic Model Blocks



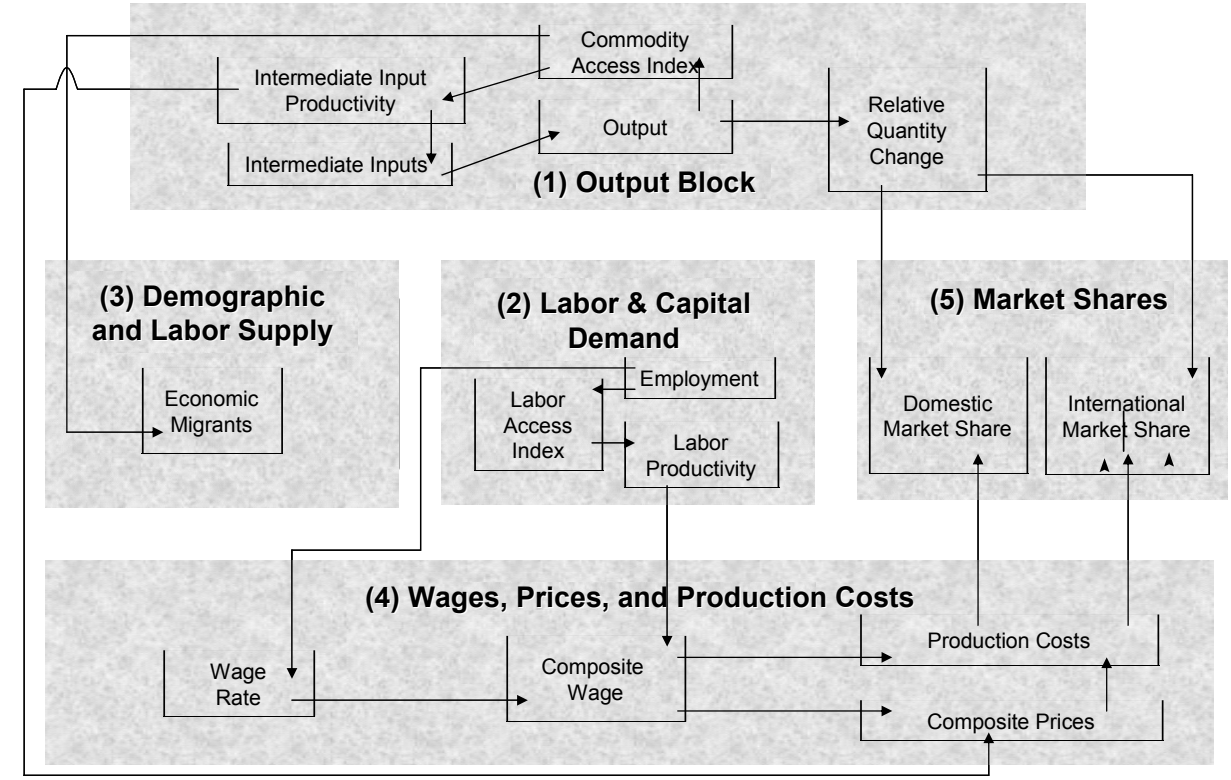
Source: REMI Users Guide, Version 5.1

Figure 82
REMI Model Structure



Source: REMI Users Guide, Version 5.1

Figure 83
Economic Geography Linkages



Source: REMI Users Guide, Version 5.1