REMI PI+ v1.7

(changes from PI+ v1.6R)

Major Economic Data Sources

Employment

County	BEA LAPI (sector industries; 2001-2013)[1]
	BLS QCEW (summary industries; 1990-2013)[2]
	CBP (detail industries; 2012)
State	BEA SPI (summary industries; 1998-2013)[3]
	BLS QCEW (summary industries; 1990-2013)
	CBP (detail industries; 2012)
National	BEA SPI (summary industries; 1998-2013)[3]
	BLS QCEW (summary industries; 1990-2013)
	CBP (detail industries; 2012)
	BLS EP (detail industries; 1993-2012 and 2022)[4]

Wages

County	BEA LAPI (total; 2001-2013)
	BLS QCEW (summary industries; 1990-2013)
	CBP (detail industries; 2012)
State	BEA SPI (summary industries; 1998-2013)
	BLS QCEW (summary industries; 1990-2013)
	CBP (detail industries; 2012)
National	BEA SPI (summary industries; 1998-2013)
	BLS QCEW (summary industries; 1990-2013)
	CBP (detail industries; 2012)

Personal Income and Earnings

County	BEA LAPI (components and summary industries; 2001-2013)
State	BEA SPI (components and summary industries; 1998-2013)
National	BEA SPI (components and summary industries; 1998-2013)

[1] The BEA Local Area Personal Income (LAPI) series used for PI+ v1.7 is based on their 11/20/2014 release. The estimates for 2001-2006 are based on the 2002 North American Industry Classification System (NAICS). The estimates for 2007-2010 are based on the 2007 NAICS. The estimates for 2011 forward are based on the 2012 NAICS.

[2] Initial estimates of county-level 70 sector employment and wage data for the states of Michigan and Nevada were provided by the University of Michigan.

[3] The BEA State Personal Income (SPI) series used for PI+ v1.7 is based on their 03/25/2014 release for the years 1990-1997 and their 09/30/2014 release for 1998 forward. The estimates for 1990-2006 are based on the 2002 North American Industry Classification System (NAICS). The estimates for 2007-2010 are based on the 2007 NAICS. The estimates for 2011 forward are based on the 2012 NAICS. Estimates for 1998 forward reflect the results of the comprehensive revision to the national income and product accounts (NIPAs) released in July 2013.

[4] The BLS Employment Projections (EP) data used for PI+ v1.7 is based on their 12/19/2013 release.

	BLS EP (components; 1993-2012 and 2022) RSQE (components; 2014-2017)[5]

Compensation

County	BEA LAPI (components and summary industries; 2001-2013)
State	BEA SPI (components and summary industries; 1998-2013)
National	BEA SPI (components and summary industries; 1998-2013)

Commuter Flows

County to County	BEA (gross flow of earnings by county; 1990-2013) BEA (total number of workers commuting between counties of residence and counties of work; 1990, 2000) BEA (commuting patterns between counties of work and counties of residence by major industry; 2000)

Technology Matrix

National	BLS (detail sectors; 1993-2012 and 2022)

Final Demand

National	BEA (components; 1990-2013) RSQE (components; 2014-2017)[5] BLS EP (components and industry value added; 1993-2012, 2022)

Occupation Matrix

National	BLS EP (employment by industry and occupation; 2012 and 2022)

Major Demographic Data Sources

Population

County	BEA (total; 1990-2013)
County	Census (age, sex, race; 1990-2013)

Demographic Components of Change

County	Census (1990-2013)

Labor Force

County	BLS (total; 1990-2013)

Natality Rates

Nation	Census (1999-2100)

Birth Rates

State	CDC (1990-2013)

[5] The 20 November 2014 forecast from RSQE is used for PI+ v1.7.

Survival Rates

Nation	Census (1999-2100)

Net International Migrants

Nation	Census (1999-2100)

Participation Rates

Nation	BLS (1990-2050)

Active Military

Base	DoD (total; 1994-2009)
Nation	DoD (total, sex, race; 1990-2013)

Military Dependents

Nation	DoD (total; 1990-2005)

Prisoners

County	Census (sex,race,facility; 1990; 2000; 2010) Bureau of Justice Statistics (50 largest jail jurisdictions mapped to counties; 1990-2013) Bureau of Prisons (facilities mapped to counties; 2005-2013) Various state-specific correctional websites

Updated State and Local Government Spending Equations (w/state fixed effects)

State and local government spending is not only affected by changes in population, but also restricted to revenue sources, many of which are affected by economic conditions (measured by GDP).

State and local government demand were estimated separately assuming than the response to changes in GDP will be different. The estimates were based on the moving average of GDP per capita (relative to the nation) instead of the current year's GDP per capita (relative to the nation).

See *Government Spending Equation Estimation_v1_7.pdf* for detailed documentation.

Updated Relative Housing Price Equation (w/county fixed effects)

The housing price equation predicts the response in housing price to changes in housing demand. In time period t, the change in relative housing price from the previous time period is determined by changes in relative real disposable personal income and changes in regional population as share of the national population. ε_1 and ε_2 are the elasticities that were estimated.

Regional level housing prices do not respond identically to the same amount of housing demand change. Housing price is also affected by the supply side. Because of different levels of supply constraints in regional economies, there are great differences in housing price responsiveness across regions. To capture the regional heterogeneity in regional housing price responses, we also estimated regional scaling factors with updated state and MSA data and scale the income and population elasticities to the regional level. A scaling factor greater than 1 indicates that the housing price of the area is more elastic than the national average given a certain change in housing demand; a scaling factor less than 1 indicates inelastic regional housing price relative to the national average.

See *Housing Price Equation Estimation_V1_7.pdf* for detailed documentation.

Updated Consumption Equation

The consumption equation takes into account seven effects that influence regional consumption. We re-estimated the age composition effect, the regional effect, and the elasticities for the marginal income effect and the marginal price effect.

See *Consumption Equation Estimation_V1_7.pdf* for detailed documentation.

Addition of New Labor Productivity/Access Policy Variables

Issue: in the REMI model, a productivity increase often leads to short-term job losses, with long-term gains.

- Job losses – due to fewer workers needed to satisfy demand
- Job gains – increased market shares based on a lagged response lead to more output and more employment

In most cases, this is appropriate, but may not be in other cases.

Example:
- New transit line opening
- Planned regulatory change

In these cases, changes in market share may be immediate due to business and individual responses.

Alternative labor productivity and labor access policy variables will have an immediate effect on market shares, instead of a lagged effect.

Labor Productivity – Lagged Market Share Response (share)
Labor Productivity – Immediate Market Share Response (share)
Labor Access Index – Lagged Market Share Response (share)
Labor Access Index – Immediate Market Share Response (share)
Occupational Training – Lagged Market Share Response (number)
Occupational Training – Immediate Market Share Response (number)
Commuting Costs (TranSight) – Lagged Market Share Response (proportion)
Commuting Costs (TranSight) – Immediate Market Share Response (proportion)

Overall the short-term results are very different, but the longer-term impacts are essentially the same.

Incorporation of BEA Regional Price Parities

BEA recently introduced a new dataset of Regional price parities (RPPs) - regional price levels expressed as a percentage of the overall national price level for a given year. The price level is determined by the average prices paid by consumers for the mix of goods and services consumed in each region. The RPPs are calculated using data from the Bureau of Labor Statistics' (BLS) Consumer Price Index (CPI) program and the Census Bureau's American Community Survey (ACS). The dataset currently covers states, metropolitan statistical areas, and state metro/nonmetro portions for the years 1998-2012.

The state level data has been incorporated into the county historical database by normalizing REMI's estimate of state PCE's (calculated based on a weighted average of the applicable

county PCE's as estimated by REMI's equations) with BEA's RPPs for 2008-2012. The 2008 adjustment factor for each county within a state has been applied back to 1990, and the 2012 factor applied to 2013.

Expanded Property Income Components

The model now incorporates historical State Property Income data from the BEA to expand Property Income into its components of Personal Dividend Income, Personal Interest Income, and Rental Income of Persons. The state shares are applied to applicable County Property Income in order to estimate the component shares at the county level.

Each component is now forecasted independently (with the same equation previously used but with a potentially different national trend).

Policy variables have been added for each component.

Expanded Transfer Payment Components

The model now incorporates historical County Personal Current Transfer Receipts based on 21 detailed components.

- Current transfer receipts of individuals from governments
  - Retirement and disability insurance benefits
    - Social Security benefits
    - Other retirement and disability insurance benefits
  - Medical benefits
    - Medicare benefits
    - Public assistance medical care benefits
    - Military medical insurance benefits
  - Income maintenance benefits
    - Supplemental security income (SSI) benefits
    - Earned Income Tax Credit (EITC)
    - Supplemental Nutrition Assistance Program (SNAP)
    - Other income maintenance benefits
  - Unemployment insurance compensation
    - State unemployment insurance compensation
    - Other unemployment insurance compensation
  - Veterans benefits
  - Education and training assistance
  - Other transfer receipts of individuals from governments
- Current transfer receipts of nonprofit institutions
- Current transfer receipts of individuals from businesses

Each component is now forecasted independently (with the same equation previously used but now based on four major types of transfer payment, and with a potentially different national trend).

Policy variables have been added for each component.

Historical Data Modifications

County residence-adjusted employment is calculated based on estimated commuter data when not inconsistent with the flow of residence adjusted income reported by the BEA.

County output by industry is now estimated based on the county's earnings share of the nation instead of the county's compensation share of the nation when the earnings share is greater than the compensation share.

County nonresidential investment and equipment investment is now estimated based on the county's employment weighted by capital use share of the nation instead of the county's construction industry employment share of the nation. County residential investment is now based on the county's disposable income share of the nation instead of the county's construction industry employment share of the nation.

Software Changes to allow for Automatic Parallelization

Key parts of the 64-bit version of the model have been converted into multi-threaded code in order to utilize multiple processors (cores/threads) simultaneously in a shared-memory multiprocessor computer.

The maximum number of threads will be detected automatically upon model use. The larger the model in terms of sectors and regions, the larger the savings in run time. Here are some sample run time comparisons on a computer with Intel® Core™i7-2600 CPU @ 3.4GHz processor (4 cores, 8 threads):

Model	Sectors	Regions	Single CPU (seconds)	Parallelized (seconds)	GAP
Uwin12.23	**23**	**29**	**34**	**30**	**12%**
Fwin12.23	**23**	**67**	**127**	**83**	**35%**
SCwin12.70	**70**	**4**	**17**	**11**	**35%**
Wwin12.70	**70**	**23**	**220**	**79**	**64%**
Mwin12.70	**70**	**83**	**1,934**	**564**	**71%**

NEBwin12.70	**70**	**93**	**2,200**	**608**	**72%**
AFwin12.160	**160**	**4**	**65**	**40**	**38%**
Wwin12.160	**160**	**23**	**538**	**162**	**70%**
NGCwin12.160	**160**	**65**	**4,099**	**1,110**	**73%**
				Overall Average	**52%**

New National Demographic Forecast Option

The national demographic forecast may now be adjusted by the user.

Changes to national demographic variables will flow through to the regional model.

However, changes to the national demographic forecast will not automatically lead to endogenous changes in the economic forecast.

New National Forecast Assumptions Module

Alternative National Forecast Assumptions have been developed and included for use in the REMI model (both demographic and economic).

Users may now select from predefined "assumption" datasets, or create their own, and generate a new national control forecast.

Model Calculations and Results Expanded to Double Precision

Previously, the REMI model used Single Precision, which is approximately 8 significant decimal digits. Double Precision uses approximately 16 significant digits.

Use of double precision will eliminate the "noisy" results (wavering up and down year to year without apparent reason) sometimes seen when a small change is introduced in a relatively large region.

New Year Selection Dialog

A new year selection dialog allows for custom year lists to be named and stored for later use. You can also assign one of the custom year lists to be the default instead of the current 'forecast

years' list. To try the feature out, just open a control and click on "Years/Edit Custom Year Lists…" in the ribbon.

Software Changes to allow for Future "Internationalization"

The model application has been modified to more easily allow for international compatibility (alternative language display for the user interface and data inputs and outputs).

Localization (translating the user interface and resources into different languages) will not be done by REMI, but could be provided to REMI for inclusion in an Internationalized version of the application.