Adding Value to Revenue Forecasts Using Econometric Techniques: A Comparison to Naïve Forecasting Methods

Bob Cox
Bob.cox@ky.gov
Deputy Executive Director, Governor's Office for Economic Analysis
Commonwealth of Kentucky
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Why Bother to Compare?

- Having a metric for comparison allows for forecast evaluation
- Allows for more efficient allocation of resources

Admitting Our Professional Bias

If prediction is the ultimate aim of all science, then we forecasters ought to award ourselves the palm for accomplishment, bravery or rashness.…We [economists] are better than anything else in heaven and earth at forecasting aggregate business trends—better than gypsy tea-leaf readers, Wall Street soothsayers and chartist technicians, hunch-playing heads of mail-order chains, or all-powerful heads of state.

Paul Samuelson

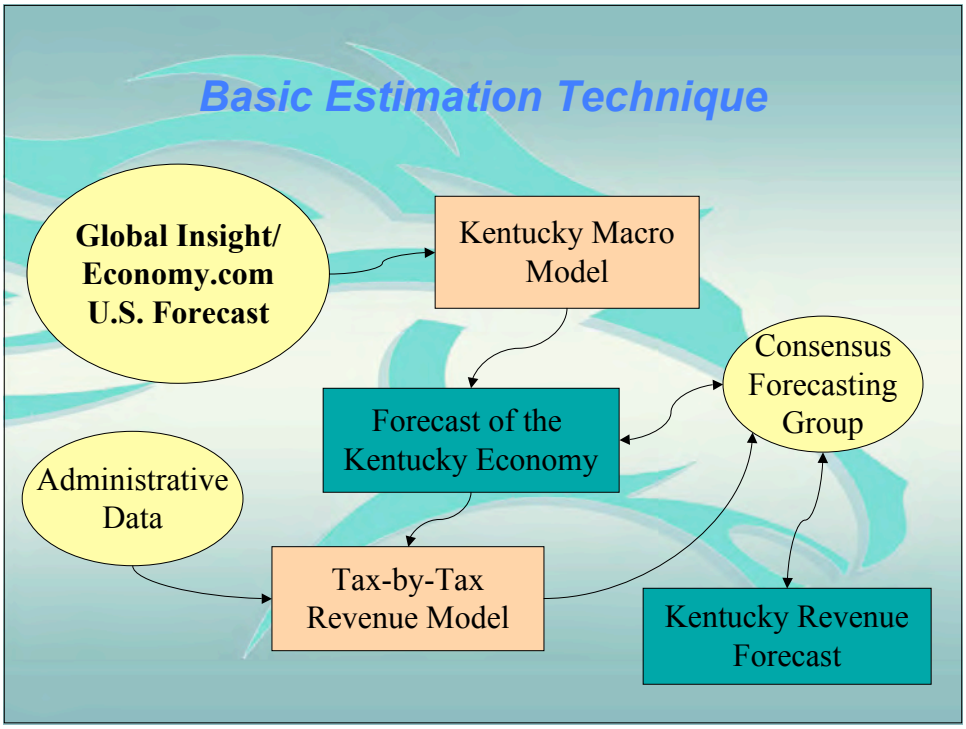
Admitting Our Professional Bias

Since we are forecasting economic variables, why not use econometric techniques?

What is Naïve Forecasting?

- Naive forecasting (NF) techniques are quantitative forecasting tools that use only the historical data of the variable being forecasted in the analysis. Therefore, all other influences that may impact on the variable are excluded from the analysis and the forecast.
- NF provides a convenient way to generate quick and easy forecasts for the short time horizon.
- Forecast is not affected by environment.
- The forecast will miss turning points.

Basic Estimation Technique



Different Specifications Used to Produce Specific Tax Revenue Estimates

- Time Series Regressions
- Vector Autoregressions
- ARIMA (may be considered by some to be a “naïve” model)
- Naïve models for minor taxes

Output From Models Is Presented to Consensus Forecasting Group

- Forecast may be modified by staff
  - Add factors
  - Selection of particular model or combination of models
  - Administrative insight
- Forecast may be adjusted by CFG

Possible Causes for Error

- Historical data from BEA and BLS
- Exogenous variables that drive the tax forecast
  - DRI/Global Insight
  - MAK
- Model misspecification

Naïve Forecasting Techniques for Comparison

- Elasticity models
  - $\%\Delta X/\%\Delta Y$
  - Not really naïve, but frequently used in lieu of econometric forecasts

Five- and Ten-Year Averages

- Length of periods used is arbitrary
- Equal weight placed on values at any point of the relevant 10-year period
- Beginning and ending points rule in 5-year linear growth
- Analyst abandons attempt to pick turning points

Naïve Forecasting Options

- **NF1: Naïve forecast based on elasticity**
  - **Ten-year average annual elasticity**
  - **Kentucky's personal income forecast from MAK**
  - **Data as available at time of original forecast**
  - **Seasonally adjusted data**
- **NF2: Naïve forecast based on average growth**
  - **Average growth over past ten years**
  - **Data as available at time of original forecast**
  - **Seasonally adjusted data**

Naïve Forecasting Options (continued)

- **NF3: Naïve forecast based on five-year growth**
  - **Measured as % change between beginning and ending points**
  - **Data as available at time of original forecast**
  - **Seasonally adjusted data**

Creative Analyst Can Use Other Naïve Methods

- Straight line (no growth)
- Moving average
- "Any model that uses the minimum amount of effort and manipulation to prepare a forecast" – Institute of Business Forecasting

Data Issues: Revenue Adjustments

- Statutory changes (tax increases or decreases) not known at time of estimate
- Non-economic or one-time events
  - Tax amnesty
  - Windfalls gains or losses
    - (e.g., capital gains)
    - or costs (court decisions)

Annual Data

Absolute Percent error

U.S. Real GDP: Absolute Percentage Errors

	FY01	FY02	FY03	FY04	FY05	FY06
DRI/GI	7.4%	0.1%	5.7%	5.5%	12.6%	12.0%
NF1 (elasticity)	na	na	na	na	na	na
NF2 (Ten-year avg. growth)	13.6%	12.5%	4.4%	5.6%	7.6%	8.5%
NF3 (5-year linear growth)	6.6%	3.5%	0.9%	1.3%	12.8%	12.3%

U.S. Personal Income: Absolute Percentage Errors

	FY01	FY02	FY03	FY04	FY05	FY06
CFG	2.7%	0.1%	2.2%	3.5%	8.1%	7.3%
NF1 (elasticity)	na	na	na	na	na	na
NF2 (Ten-year avg. growth)	9.7%	8.4%	0.0%	0.8%	2.4%	3.8%
NF3 (5-year linear growth.)	1.6%	2.2%	7.3%	8.8%	9.5%	10.3%

Adjusted General Fund: Absolute Percentage Errors

	FY01	FY02	FY03	FY04	FY05	FY06
CFG	2.4%	9.5%	4.4%	3.5%	6.0%	8.5%
NF1 (elasticity)	5.1%	12.9%	6.2%	6.3%	5.0%	7.9%
NF2 (Ten-year avg. growth)	0.9%	6.4%	8.9%	7.7%	3.6%	7.4%
NF3 (5-year linear growth.)	1.2%	7.2%	6.5%	4.9%	3.8%	8.1%

Adjusted Sales Tax: Absolute Percentage Errors

	FY01	FY02	FY03	FY04	FY05	FY06
CFG	1.9%	3.8%	0.7%	0.4%	0.5%	1.1%
NF1 (elasticity)	2.0%	3.7%	1.2%	1.8%	0.4%	1.0%
NF2 (Ten-year avg. growth)	0.9%	1.8%	2.0%	1.8%	1.8%	1.4%
NF3 (5-year linear growth.)	0.8%	1.9%	1.5%	1.2%	0.6%	1.8%

Adjusted Individual Income Tax: Absolute Percentage Errors

	FY01	FY02	FY03	FY04	FY05	FY06
CFG	1.9%	3.8%	4.2%	4.2%	2.3%	2.3%
NF1 (elasticity)	2.0%	3.7%	3.9%	3.3%	2.1%	2.6%
NF2 (Ten-year avg. growth)	0.9%	1.8%	5.6%	5.2%	0.3%	0.6%
NF3 (5-year linear growth.)	0.8%	1.9%	5.4%	5.2%	2.5%	4.1%

Biennial Data

Mean Absolute Percent Error

General Fund: Mean Absolute Percentage Error, Biennial-basis

	FY01-FY02	FY03-FY04	FY05-FY06
CFG	5.9%	3.9%	7.3%
NF1 (elasticity)	9.0%	6.3%	6.5%
NF2 (Ten-year avg. growth)	3.6%	8.3%	5.5%
NF3 (5-year linear growth)	4.2%	5.7%	6.1%

Sales Tax: Mean Absolute Percentage Error, Biennial-basis

	FY01-FY02	FY03-FY04	FY05-FY06
CFG	8.2%	1.6%	2.4%
NF1 (elasticity)	8.3%	4.3%	2.1%
NF2 (Ten-year avg. growth)	3.9%	5.5%	4.8%
NF3 (5-year linear growth)	3.9%	3.8%	3.7%

Individual Income Tax: Mean Absolute Percentage Error, Biennial-basis

	FY01-FY02	FY03-FY04	FY05-FY06
CFG	6.4%	10.4%	6.2%
NF1 (elasticity)	7.0%	8.9%	6.4%
NF2 (Ten-year avg. growth)	3.6%	13.4%	1.2%
NF3 (5-year linear growth)	6.9%	13.1%	9.0%

Conclusions

- We don't fare as well as I had initially hoped
- Controversy over adjusted or unadjusted data will persist, since analyst may be instrumental in estimating magnitudes of adjustments
- Naïve forecaster faced with dilemma of choosing a particular method a priori

Conclusions

- Results may not be robust over time
- All forecasts are easier if data are consistent and well-behaved
- *"Always look back. You may learn something from your residuals. Usually one's forecasts are not so good as one remembers them; the difference may be instructive."*

  – Paul Samuelson

Conclusions

"Every drop helps", the old farmer said, as he spat into the pond. One does the best one can on the most pressing problem that presents. And if, after you have done so, your next moves are down a trajectory of diminishing returns, then still it is optimal to follow the rule of doing the best that there is to do. Besides, at any time a Schumpeterian innovation or Darwinian mutation may occur to you, plucking the violin string of increasing return.

Paul Samuelson