

Forecast Accuracy by Tax Category: Do Perceptual Forecasts Increase Accuracy?

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Introduction:

- Recently empirical examinations of forecasting strategies have been published.
- There seems to have been a broad perception that various judgmental approaches resulted in better forecasts than statistical models alone.
- The revenue forecasting process in Nebraska has elements of both statistical and judgmental forecasts.
- These are some (very) preliminary results.

Introduction:

- In Nebraska, forecasts are developed using a “Delphi-Lite” approach.
- The Nebraska Economic Forecasting Advisory Board is a nine-member board tasked with making an advisory forecast of tax revenues.

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 - The agencies use the same US macro forecasts for the driver variables.
 - The agencies each produce two forecasts using two forecast services

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 - Each agency presents its forecasts to the Board and answers questions.
 - The Board members discuss the forecasts, and current economic conditions.
 - The Board forecasts net Sales and Use, Individual Income, Corporate Income, Miscellaneous, and total net revenue for each fiscal year of the relevant forecast horizon, and if necessary, revisits forecasts by tax category.

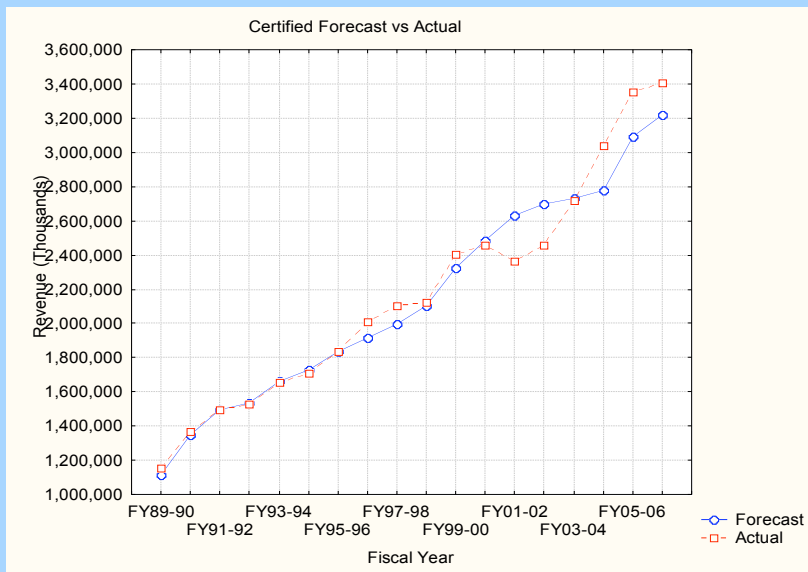
Introduction:

- This general approach has been used since 1985; however, it has been subject to some modifications. Forecasts are fairly consistent from FY1989-90 onward.

Forecast Results

**PERFORMANCE OF NEFAB ORIGINAL CONSENSUS FORECASTS
FY89-90 TO FY06-07 (\$1,000s)**

| FISCAL YEAR | NEFAB TOTAL NET REVENUE FORECAST | TOTAL NET REVENUE ACTUAL | DIFFERENCE BETWEEN FORECAST & ACTUAL | PERCENT ERROR BETWEEN FORECAST & ACTUAL |
|---------------------------------------|----------------------------------|--------------------------|--------------------------------------|---|
| FY89-90 | 1,110,883 | 1,152,710 | 41,827 | 3.77% |
| FY90-91 | 1,345,558 | 1,367,077 | 21,519 | 1.60% |
| FY91-92 | 1,495,503 | 1,492,355 | -3,148 | -0.21% |
| FY92-93 | 1,537,264 | 1,524,662 | -12,602 | -0.82% |
| FY93-94 | 1,662,548 | 1,653,752 | -8,796 | -0.53% |
| FY94-95 | 1,729,902 | 1,705,490 | -24,412 | -1.41% |
| FY95-96 | 1,834,289 | 1,836,741 | 2,452 | 0.13% |
| FY96-97 | 1,917,983 | 2,009,604 | 91,621 | 4.78% |
| FY97-98 | 1,993,835 | 2,105,451 | 111,616 | 5.60% |
| FY98-99 | 2,102,910 | 2,123,869 | 20,959 | 1.00% |
| FY99-00 | 2,326,348 | 2,403,925 | 77,577 | 3.33% |
| FY00-01 | 2,480,701 | 2,456,862 | -23,839 | -0.96% |
| FY01-02 | 2,631,848 | 2,365,509 | -266,339 | -10.12% |
| FY02-03 | 2,694,851 | 2,456,400 | -238,451 | -8.85% |
| FY03-04 | 2,731,975 | 2,718,727 | -13,248 | -0.48% |
| FY04-05 | 2,775,479 | 3,037,194 | 261,715 | 9.43% |
| FY05-06 | 3,092,258 | 3,352,188 | 259,930 | 8.41% |
| FY06-07 | 3,216,895 | 3,408,332 | 191,437 | 5.95% |
| FY07-08 | 3,389,186 | | | |
| Average Error (Absolute Value) | | | | 3.74% |



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- Research indicates that adding judgment or “domain knowledge” to a statistical forecast, the judgment will improve forecast accuracy.

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- Does adding judgment or “domain knowledge” to a statistical forecast improve forecast accuracy?
- If the Board’s forecasts are more accurate than the agencies’ statistical forecasts, the Board forecasts will have a lower Mean Squared Error (MSE) than the agencies’ forecasts.

Forecast Results:

Comparison of Forecasts: Total Net Revenue

Mean of all Agency Forecasts Presented to Forecasting Board and Certified Board Forecast

(Thousand Dollars)

| FISCAL YEAR | AGENCY MEAN | CERTIFIED TOTAL | TOTAL NET | ROOT Mean Squared Error | |
|---------------------|-------------------------------|-------------------------|-------------------|-------------------------|------------------|
| | FORECAST TOTAL NET REVENUE | NET REVENUE FORECAST | REVENUE ACTUAL | AGENCY MEAN | CERTIFIED |
| FY2006-2007 | 3,213,962 | 3,216,895 | 3,408,332 | 194,370 | 191,437 |
| FY2005-2006 | 3,094,414 | 3,092,258 | 3,352,188 | 257,774 | 259,930 |
| FY2004-2005 | 2,826,674 | 2,775,479 | 3,037,194 | 210,521 | 261,715 |
| FY2003-2004 | 2,732,708 | 2,731,975 | 2,718,727 | 13,980 | 13,248 |
| FY2002-2003 | 2,612,298 | 2,593,526 | 2,456,400 | 155,898 | 137,126 |
| FY2001-2002 | 2,632,061 | 2,631,848 | 2,365,509 | 266,553 | 266,339 |
| FY2000-2001 | 2,489,848 | 2,480,701 | 2,456,862 | 32,986 | 23,839 |
| FY1999-2000 | 2,333,999 | 2,326,348 | 2,403,925 | 69,926 | 77,577 |
| FY1998-1999 | 2,105,911 | 2,102,911 | 2,123,869 | 17,959 | 20,958 |
| FY1997-1998 | 1,991,987 | 1,993,835 | 2,105,451 | 113,465 | 111,616 |
| FY1996-1997 | 1,917,983 | 1,917,983 | 2,009,604 | 91,622 | 91,621 |
| FY1995-1996 | 1,804,435 | 1,817,000 | 1,836,741 | 32,306 | 19,741 |
| FY1994-1995 | 1,713,779 | 1,729,902 | 1,705,490 | 8,289 | 24,412 |
| FY1993-1994 | 1,670,077 | 1,662,549 | 1,653,752 | 16,325 | 8,797 |
| FY1992-1993 | 1,519,817 | 1,520,500 | 1,524,662 | 4,845 | 4,162 |
| FY1991-1992 | 1,509,925 | 1,495,000 | 1,492,355 | 17,570 | 2,645 |
| FY1990-1991 | 1,354,527 | 1,345,558 | 1,367,077 | 12,550 | 21,519 |
| FY1989-1990 | 1,114,715 | 1,110,883 | 1,152,710 | 37,995 | 41,827 |
| SUM ROOT MSE | | | | 1,554,931 | 1,578,509 |

Forecast Results:

- The sum of the MSE is lower for the Agencies' forecasts, which implies that the Board did not add directly to the accuracy of the total net revenue forecast over the FY1989-90 to FY2006-07 period.
- What about the MSE of the forecasts by tax category?

Forecast Results:

- MSE for the other components of the revenue forecast.
 - The MSE of the average of the four agency forecasts only beat the Board on in one tax category.
 - The Board is better on everything but Sales & Use tax, the tax with the least variable base.
 - There appears to be a limit to the benefits of judgment.

Comparison of Sum of Root Mean Squared Error:

Certified Forecasts FY1989-90 - FY2006-07

| Forecast Tax Category | Mean Agency Forecasts | Board Forecast |
|-----------------------|-----------------------|----------------|
| Total Net Revenue | 1,554,931 | 1,578,509 |
| Sales & Use Tax | 327,682 | 345,553 |
| Individual Income | 1,109,131 | 1,105,181 |
| Corporate Income | 320,041 | 306,204 |
| Miscellaneous | 268,916 | 250,061 |

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- One problem is the impact of legislation on the “certified forecast.”
 - The Board sets a forecast, and the final forecast is modified to account for new legislation through the fiscal note process.
 - Therefore the certified forecast for the current fiscal year, is a collaboration between the Board and the agencies.
- The October forecast does not have the adjustment problem, as all new legislation is accounted for in this forecast.

October Forecast Results:

**Comparison of Sum of Root Mean Squared Error: October Forecasts
FY1989-90 through FY2006-07**

| Forecast Tax Category | Mean All Agency | Mean LFO-NDR Primary | Mean LFO-NDR Secondary | Mean NDR | Mean LFO | Board Forecast |
|--------------------------|--------------------|-------------------------|---------------------------|-------------|-------------|-------------------|
| Total Net Revenue | 1,025,024 | 1,053,676 | 1,001,073 | 950,615 | 1,107,098 | 1,030,320 |
| Sales & Use Tax | 264,495 | 280,362 | 264,818 | 282,628 | 247,516 | 283,404 |
| Individual Income | 755,072 | 766,254 | 746,281 | 672,225 | 839,983 | 736,986 |
| Corporate Income | 241,523 | 240,031 | 240,031 | 236,298 | 266,873 | 239,847 |
| Miscellaneous | 189,405 | 184,675 | 181,230 | 182,926 | 197,912 | 151,452 |

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Final Thoughts:

- Benefit of the Board in forecasting process also has an indirect benefit. The Board *tends* to reduce the effect of politics on the forecast.
- Can a relationship between the predictability of the forecasted series and the benefit of judgment be quantified?

Thank You