

# **A STUDY ON IMPROVING MONTANA'S PERSONAL INCOME TAX REVENUE PROJECTIONS**

A Report Prepared for the  
Revenue & Transportation Interim Committee

By  
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September 25, 2015



## INTRODUCTION

The Legislative Fiscal Division (LFD) works to provide the legislature with the best unbiased analysis possible, including revenue forecasts. To this end, the LFD continually strives to improve accuracy of forecasting analysis and methodologies. In the last interim, the LFD revenue analysis focused on corporate income tax; as a result of the [analysis](#), the corporate income tax estimate was adjusted to remove inherent bias found in the estimating process.

The LFD's current focus—based on continued legislative interest throughout the 2015 legislative session and the September 2014 [State Tax Revenue Forecasting Accuracy](#) report by Rockefeller Institute of Government—has shifted to personal income tax. The purpose of this report is to review the Rockefeller report and provide detailed analysis for Montana, as well as highlight proposed research by the LFD for improvement of the personal income tax forecast accuracy.

## EXECUTIVE SUMMARY

This report evaluates Rockefeller's analysis of all states' revenue forecasting with specific emphasis on Montana. Montana revenue may be more difficult to estimate due to four main factors—a lack of a relatively stable broad-based sales tax, an economy with a reliance on natural resources which creates a more volatile revenue streams, a smaller economic base which again raises volatility, and biennial forecasts. However, other states appear to do a consistently better job of forecasting despite having at least some of the same challenging issues. The two sources that stand out for further consideration from the Rockefeller analysis are personal income tax and corporate income tax.

As highlighted in the introduction, the LFD conducted a thorough analysis of the corporate income tax forecasting error over last interim to gain insight into potential bias associated with the estimating methodology. Results showed that the model tended to underestimate revenues by about 8% per year in each of the forecast years, which is consistent with the Rockefeller report findings. The LFD has already used our analysis to remove the bias from the corporate income forecast.

Now shifting the research focus to the personal income tax forecast, the LFD has identified a preliminary list of topics for further research, which is detailed on page 8 of this report. Highlights include

- Incorporating cash flow trends
- Extending the Rockefeller work on naïve modeling (defined on page 6 of this report)
- Implementing methodologies from other states
- Developing confidence intervals for IHS econometric variables that are used as inputs

## INTRODUCTION TO THE ROCKEFELLER REPORT

The Rockefeller Institute of Government, in partnership with Pew Charitable Trusts, published a technical report on [State Tax Revenue Forecasting Accuracy](#) in September 2014. The Rockefeller report's intent was to understand and articulate the impact of revenue volatility, forecast timing, and estimating processes on overall revenue estimate accuracy. While the report steers readers away from using the report as a tool for ranking comparative accuracy among states' forecasts due to noise in the data and exogenous influences (see [page 8](#)), the information in the report may allow for internal analysis and review of potential forecast bias.

## EXECUTIVE SUMMARY OF THE ROCKEFELLER REPORT

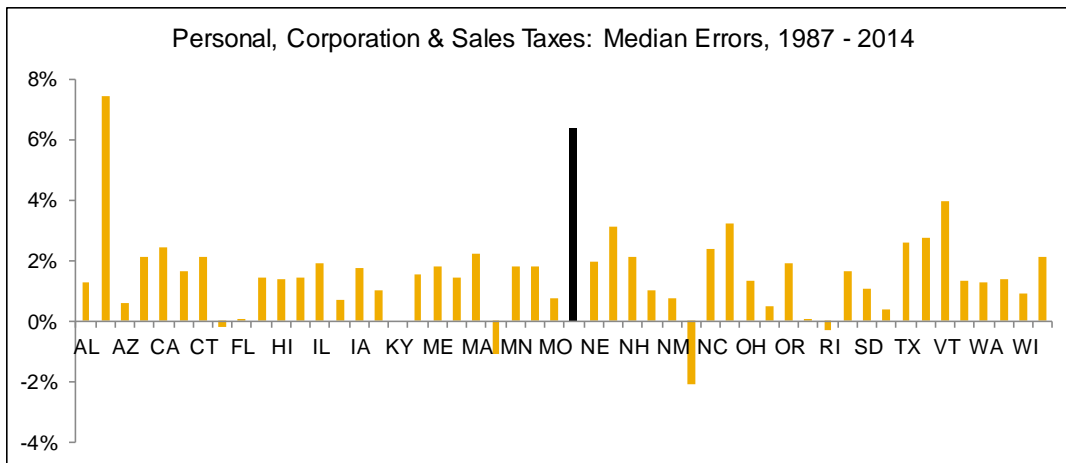
The Rockefeller report assesses the forecasting accuracies of the states based on three tax types: personal income, corporate income and sales taxes. The Rockefeller analysis is based on data from the National Association of State Budget Officers (NASBO) fall surveys from 1987 through 2013; the LFD analysis also includes data from the fall 2014 survey for a total of twenty-eight years of data.

The relative weights of these three tax types in states' budgets varies substantially; Montana, with its lack of a less volatile broad-based sales tax, is primarily graded with respect to the forecast accuracy of the two more volatile tax sources. Census data on state tax collections is used to calculate weighted errors.

As in the Rockefeller report, the forecasting error is defined in this report as the error—actual minus estimated collections—divided by the actual collections. This produces a percentage error that is positive if revenue is underestimated and negative if revenue is overestimated.

The median error of the three tax types combined over the twenty-eight year period is shown for each state in the following graph. The data shows that based on the three tax types, most states tend to slightly underestimate revenue, with the 50-state median being an underestimate of 1.4%. Montana—shown in black—has a larger median underestimate at 6.8% than any state besides Alaska.

Throughout the charts in this report, Montana values are indicated in black when compared with other states' values; black is also used to show actual collections versus estimates within Montana.



#### A Note on NASBO Data

While the analysis in this report and the Rockefeller report consistently relies on the NASBO data, it is important to note that there may be inconsistencies within that data source. A good example of reporting inconsistency is highlighted in the sales tax section detail in the appendix, where the types of taxes reported as Montana's sales taxes have changed over time.

Conversations with the lead analyst in Wisconsin revealed their concerns with the consistency of the Wisconsin data stream; this led to a detailed in-house comparison of the Montana data as reported by NASBO and the data contained in various post-session fiscal reports. All but two numbers in the personal income data were confirmed (the source for the NASBO 2007 and 2010 figures is unclear). There were some reporting inconsistencies, especially in the earlier years of the data, although those differences don't appear to significantly change the forecasting errors for those years. More importantly, there was a shift in the reported forecast years: from 1996 to 2008, the NASBO data reflects the estimates from the last twenty-four months of Montana's thirty-month forecast; from 2009 to 2014, the NASBO data uses the estimates from the first eighteen months.

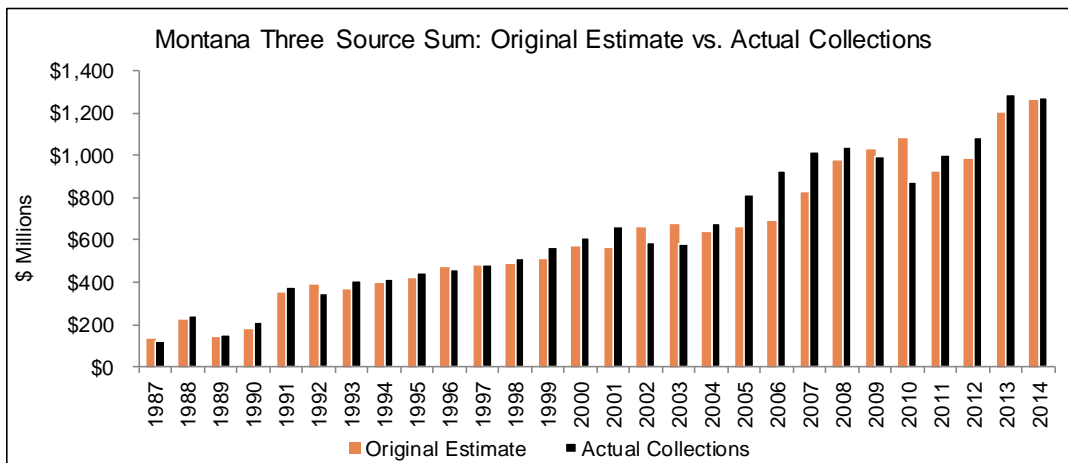
Overall, the Rockefeller report's conclusion likely wouldn't change much for Montana; the median error for personal income was barely lower: a 6.4% underestimate based on a consistent post-session data stream versus the 6.6% underestimate based on the NASBO data. Wisconsin similarly noted that their overall accuracy ended up close to that based on the NASBO data. However, these two examples suggest that a note of caution may be in order as the Rockefeller report's implications are assessed for specific states.

## FORECAST ACCURACY AS MEASURED BY THE ROCKEFELLER REPORT

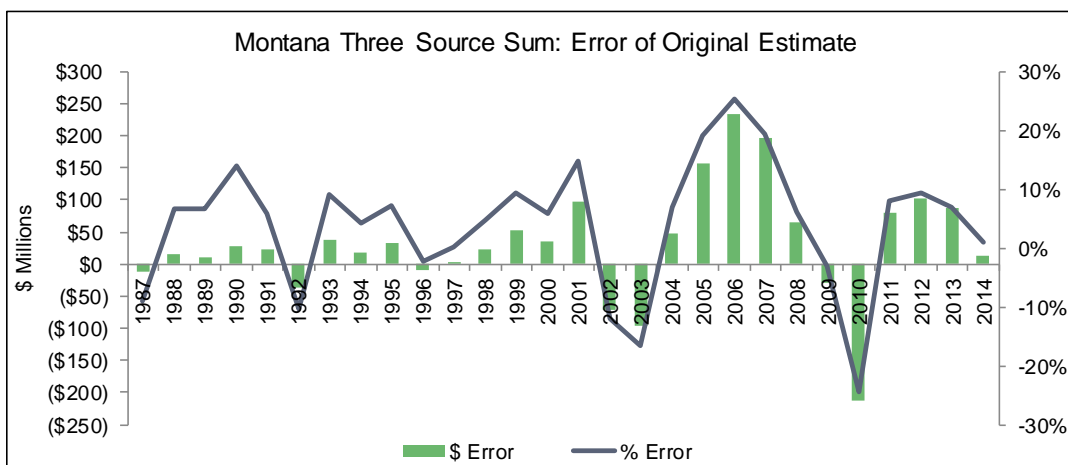
This section highlights the overall revenue forecasting accuracy as measured by the Rockefeller report based on the sum of three tax types—personal income tax, corporate income tax and sales tax—and compares Montana's forecast error by year with the median of other states' errors by year. Detail by tax type is provided in the appendix.

### Sum of Three Taxes

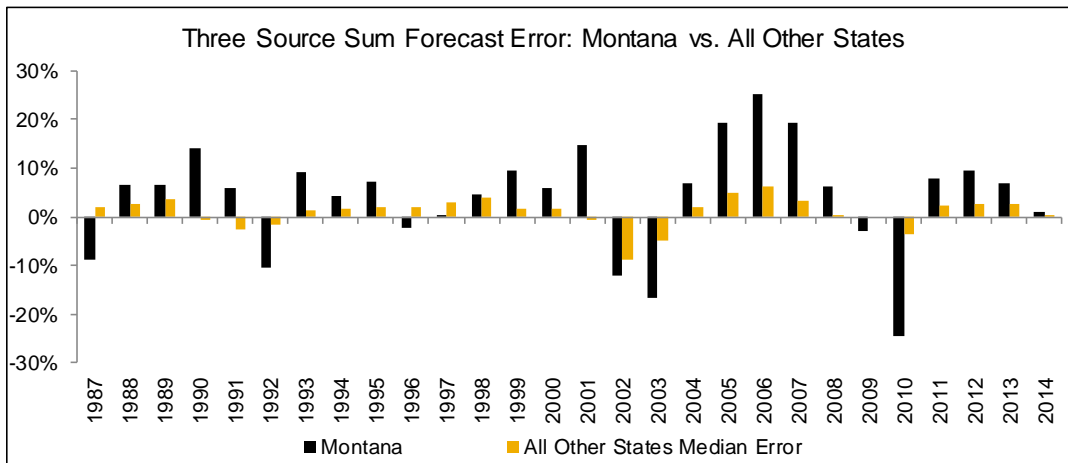
The chart below shows final collections compared to the original estimate for the sum of Montana personal income, corporate income and sales taxes since 1987.



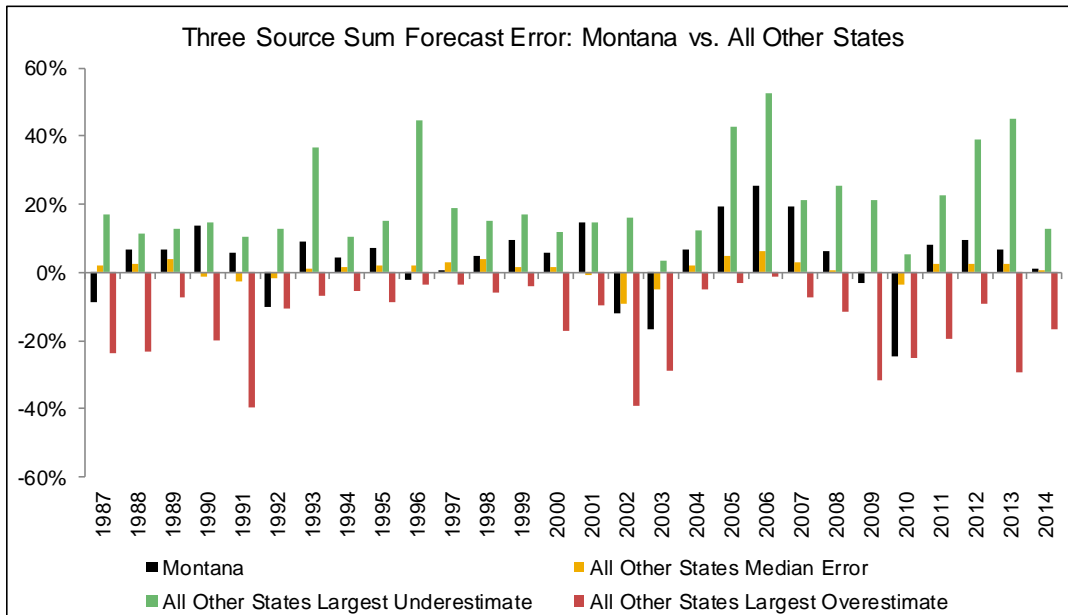
The figure below illustrates the error of the original three source sum estimate by amount (on the left axis) and as a percentage (on the right axis).



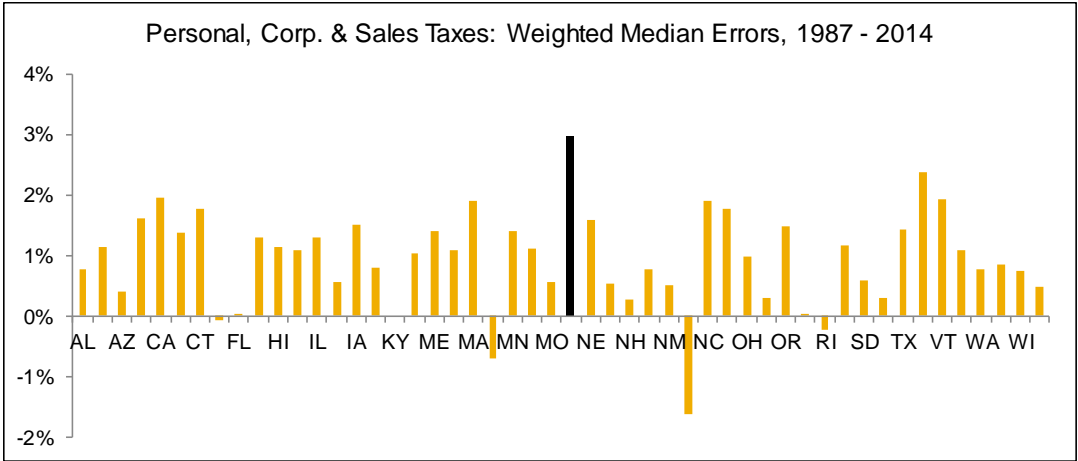
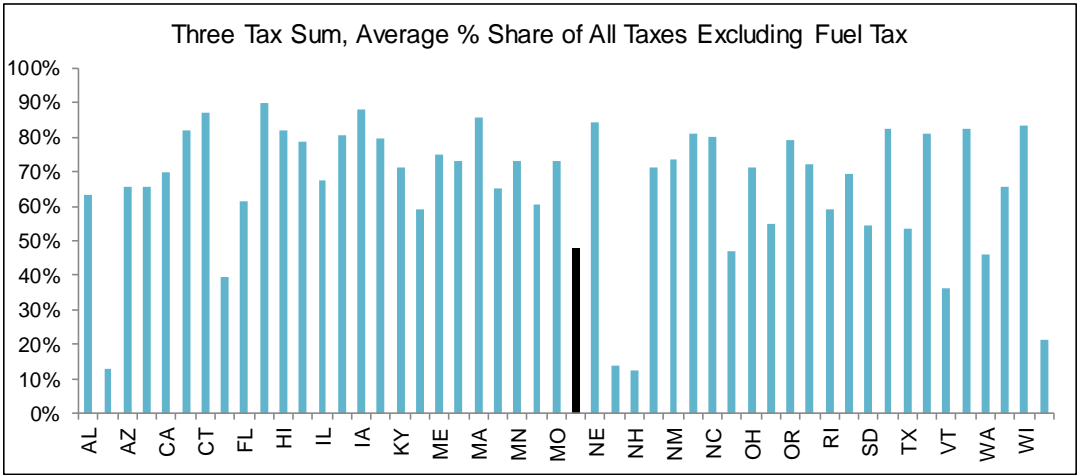
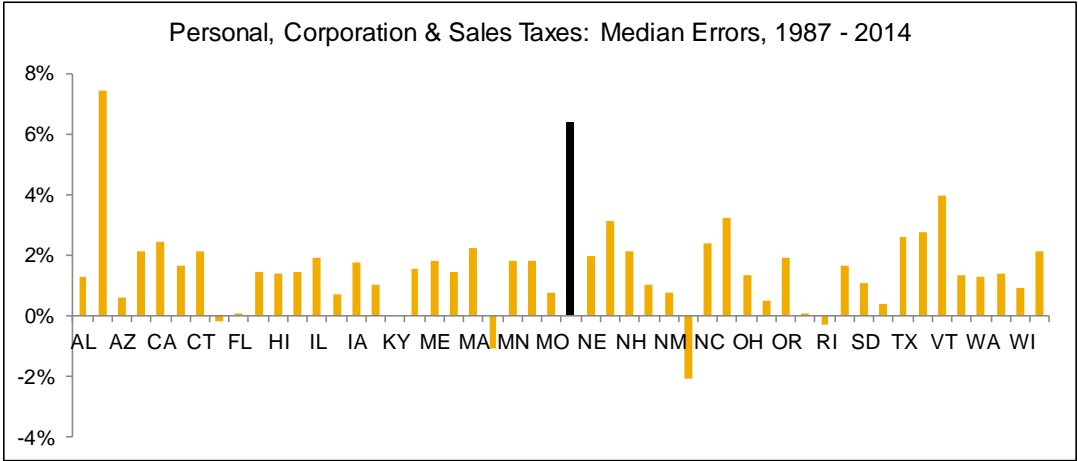
The first graph on the next page compares the Montana three source sum forecast error to median three source sum error of all other states. Note, however, that the magnitude of the median error benefits from the pooling of all other states' errors; i.e., large errors in either direction do not impact the median value.



The figure below compares the Montana forecasting error and the median error of all other states with the largest under- and overestimates of the other states.



The three charts below attempt to illustrate the relative importance of the three source sum—personal income tax, corporate tax, and sales tax—estimating error to a state's overall revenue position. This is done by weighting the median error shown in the first chart by the percentages in the second chart; the result is the weighted median error over the twenty-eight year period illustrated in the third chart. The weighted data shows that based on the three tax types, most states tend to slightly underestimate revenue, with the 50-state median being an underestimate of 0.9%. Montana has the largest weighted median underestimate at 3.0%, more than any other state.



# LFD ANALYSIS FOR MONTANA

## Measuring Forecasting Difficulty

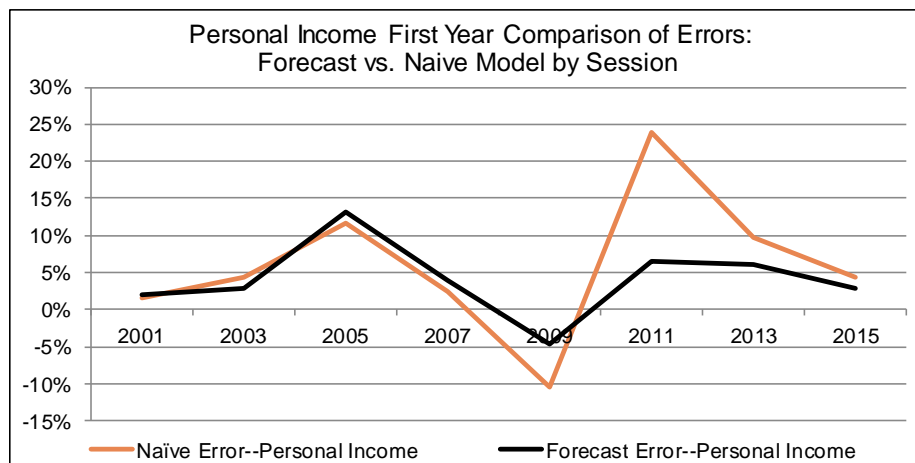
The Rockefeller report highlights the difficulty in comparing forecasting accuracy across states and over time. Reasons for the challenge are detailed on page 13 of [State Tax Revenue Forecasting Accuracy](#). In order to make consistent comparisons, the authors of that report built “naïve models”—exponential smoothing models based on ten previous years of historical data. The results in the Rockefeller report were aggregated over states, so individual states’ measure of forecasting difficulty isn’t available. However, the report notes

“Forecast difficulty appears to be greater in smaller states and in resource rich states, suggesting that the larger actual errors seen in those states is not simply an indication of bad forecasting, but that there is something about those states that has made revenue harder to forecast in those states.”

The same exponential smoothing analysis was performed in-house on Montana’s largest volatile sources: personal income tax, corporate income tax, and oil & natural gas taxes to gain insight into the relative forecasting difficulty of the three sources. The data for the analysis is the historical collections from the state accounting system. Naïve model results are compared to the forecasts obtained from the post-session fiscal reports.

## LFD Analysis: Naïve Modeling Results for Personal Income Tax

The chart below compares the personal income naïve model and actual forecast errors for an estimate one year into the future. As noted in the Rockefeller analysis, the naïve model has larger errors than the actual forecast during turning points in the economy. Although the first-year errors for personal income are large, the errors for out years and for corporate income and oil & natural gas are much larger; see the appendix for further detail.



The black line on chart above shows that the first year forecast of personal income has missed actual collections by an average of about 5%. Furthermore, nearly all of the errors have been underestimates of actual collections—i.e., the errors are positive. This suggests that the forecasting method has been biased. Similarly, there is a positive bias using the naïve model, likely indicating that the bias is attributable to factors other than analyst or legislative policy decisions.

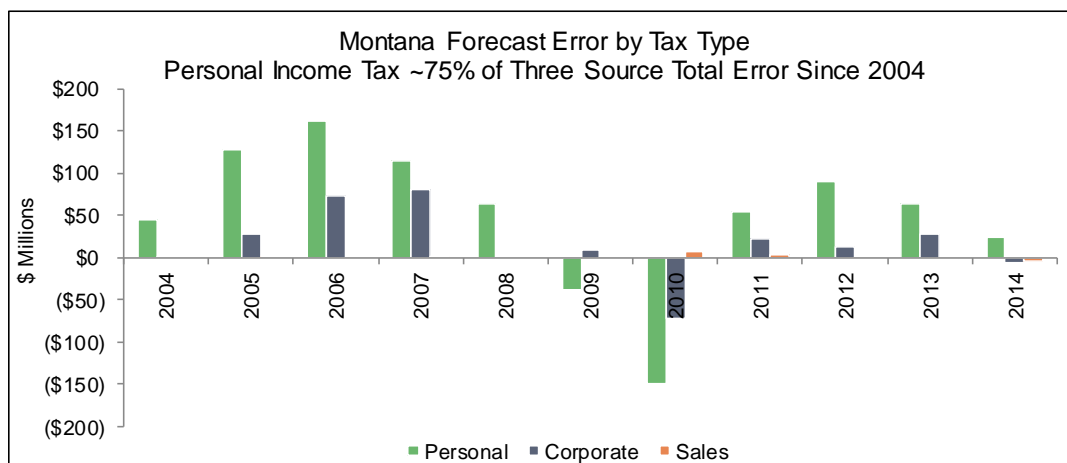
## IMPROVING FORECAST ACCURACY

The findings of the Rockefeller report, particularly as they relate to Montana’s forecasting accuracy, parallel a series of current LFD research projects focused on improving forecast accuracy, and provide fresh insight into alternative methodologies. Research conducted last interim by the LFD on



the corporate income tax uncovered an underestimating bias in the modeling process. The results of that analysis were used to remove the inherent bias for the 2017 biennium baseline forecast.

The current focus—based on the Rockefeller report analysis and continued legislative interest throughout the 2015 legislative session—has shifted to personal income tax. As illustrated below, three-quarters of Montana's forecast error for the three revenue sources considered in Rockefeller report is due to personal income tax.

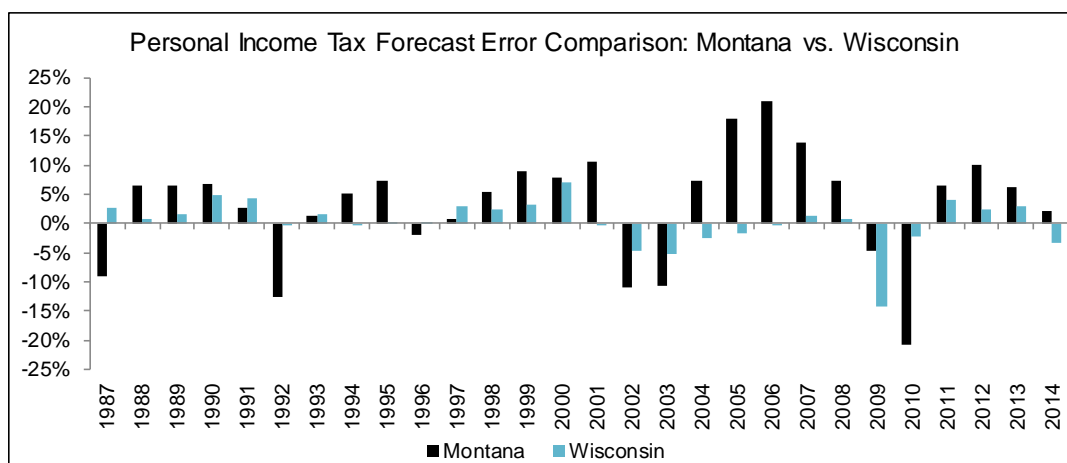


The median forecast error for Montana personal income tax is significantly larger than that of most states, while the median forecast error for Montana corporate income tax is more comparable to other states' corresponding error and has been addressed already through last interim's research. See the appendix for details of forecast accuracy by state by tax type. Improving the personal income tax forecast accuracy is essential to improving the overall forecast accuracy. Examining other (more accurate) states' methodologies may provide ideas for improvement.

## Personal Income Tax: States to Watch

It is likely more desirable to have a slight under-estimate than an over-estimate, within the constraint of minimizing the error. Several states have median under-estimates of less than 1%: Arizona, Indiana, Louisiana, Rhode Island, Virginia, and Wisconsin.

Of these, the historical forecast errors of Wisconsin also have a low variance, which means that over time, the forecast errors have been less volatile than the other states in the list. The chart below compares the personal income tax forecast errors of Montana and Wisconsin. The median error of Wisconsin is 0.7%, while that of Montana is 6.4%; the median for all states is 1.6%.



## Cash Flow Analysis is a Key Element of Wisconsin Modeling

Like Montana, Wisconsin relies on the econometric data provided by IHS and produces a thirty-month estimate for revenues. Their methodology for developing the personal income tax, however, is substantially different. Montana essentially uses a bottom-up approach: a personal income tax simulation model is used to forecast calendar year personal income tax liability for all residents by applying modeled growth rates to each resident taxpayer's income and deduction items. The result is a forecast of calendar year state personal income tax liability for each resident, the sum of which produces a statewide forecast of personal income tax liability for each year. The statewide forecast of calendar year resident liability is adjusted for the growth in resident and non-resident taxpayers, and converted to a fiscal year basis.

Wisconsin uses more of a top-down approach: their personal income tax estimate is built from a cash flow basis, with withholding growth informing wage and retirement income growth rates, and quarterly estimated payments informing the growth of non-wage income sources. Adjustments are made for several large state tax credits.

## Next Steps

The LFD is committed to continually reevaluating and improving revenue estimating methodologies with the aim of increasing future accuracy. Significantly improving Montana's overall revenue forecasting accuracy will likely be a project that extends over several forecasting cycles. Continuing the statistical approach of last interim's corporate tax research, the focus will now be on the personal income tax forecast. A preliminary list of topics as follows:

- Research Wisconsin's use of fiscal year cash flow data with the aim of implementing a similar technique at least for comparative purposes
- Investigate the possibility of using the bias indicator suggested by naïve modeling to "unbias" the forecast—or at least reduce the amount of bias
- Use more historical data in naïve models with an aim toward incorporating the results into the revenue estimating process
- Develop upside and downside risk bounds based on naïve modeling
- Consult other states with high levels of accuracy—Arizona, Indiana, Louisiana, Rhode Island, and Virginia—to understand their forecasting processes, and potentially apply some methodologies to Montana
- Examine "April surprises" across states with respect to wage income versus non-wage income using the Statistics of Income available from the IRS to evaluate whether Montana's personal income make-up varies substantially compared to other states
- Extend last interim's analysis of the relative forecasting accuracy of IHS econometric variable that are used as inputs into the personal income tax model

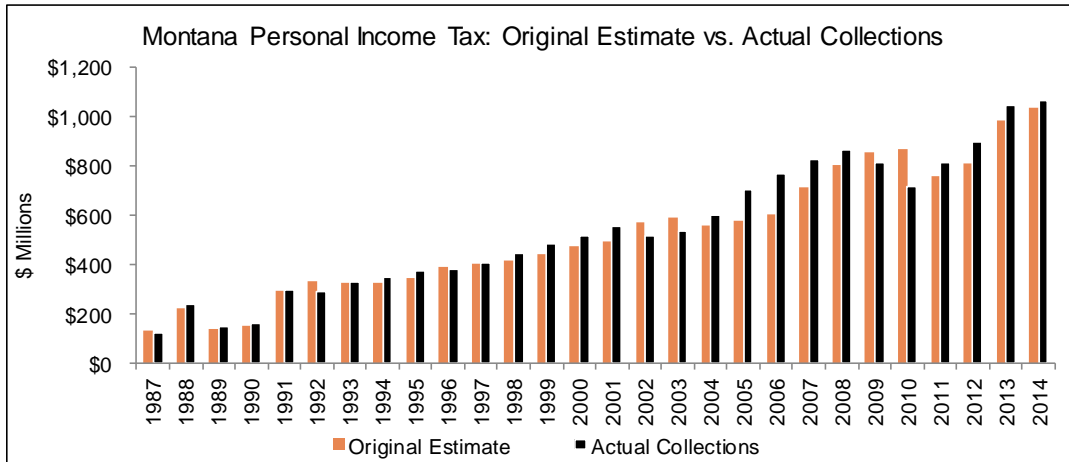
As analysis into these topics progresses, the goal will be to produce trial runs of the new methodologies at the presentation of the Revenue Trend Update in December and the 2019 Biennium Outlook in June. Depending on the early results of the new methods, some new methods could be integrated into the revenue estimate that will be presented to the Revenue & Transportation Interim Committee in November 2016.

# APPENDIX

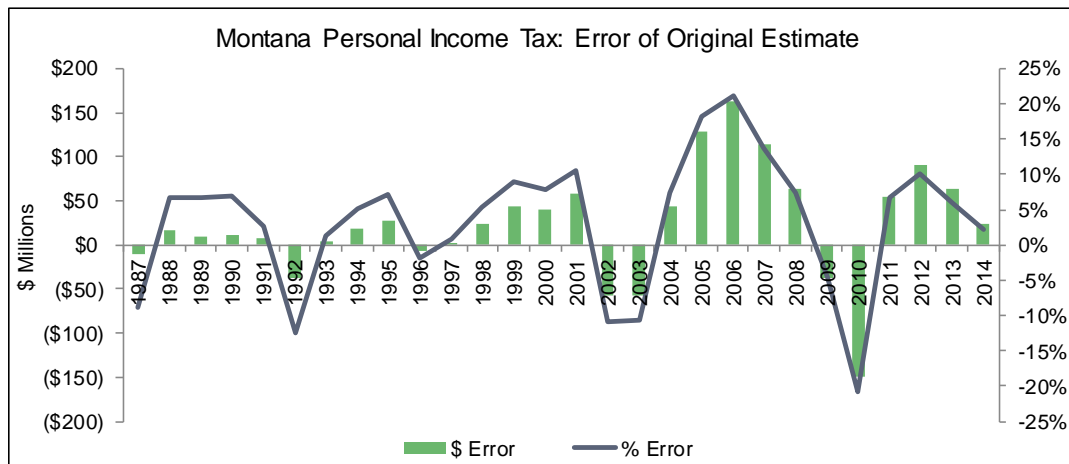
## ACCURACY DETAIL BY STATE BY TAX TYPE

### Personal Income Tax

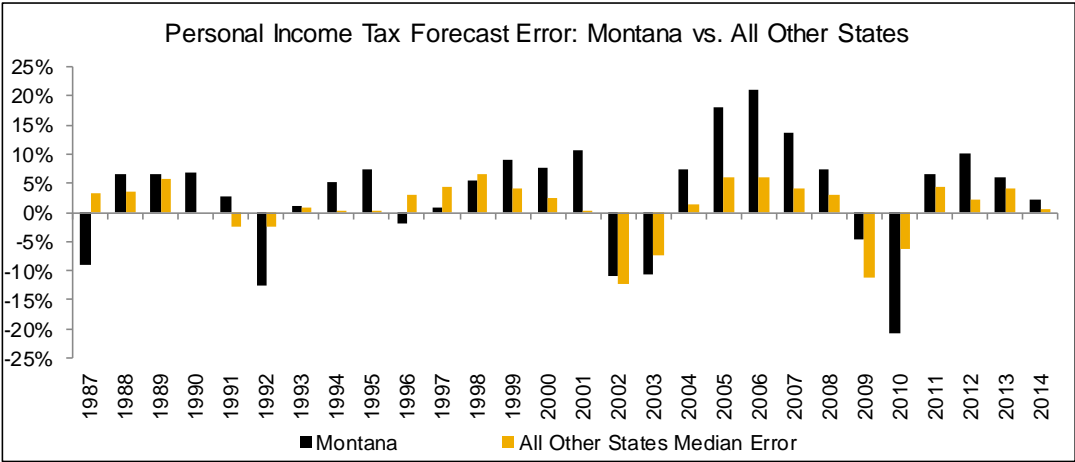
The chart below shows final collections compared to the original estimate for Montana personal income tax since 1987.



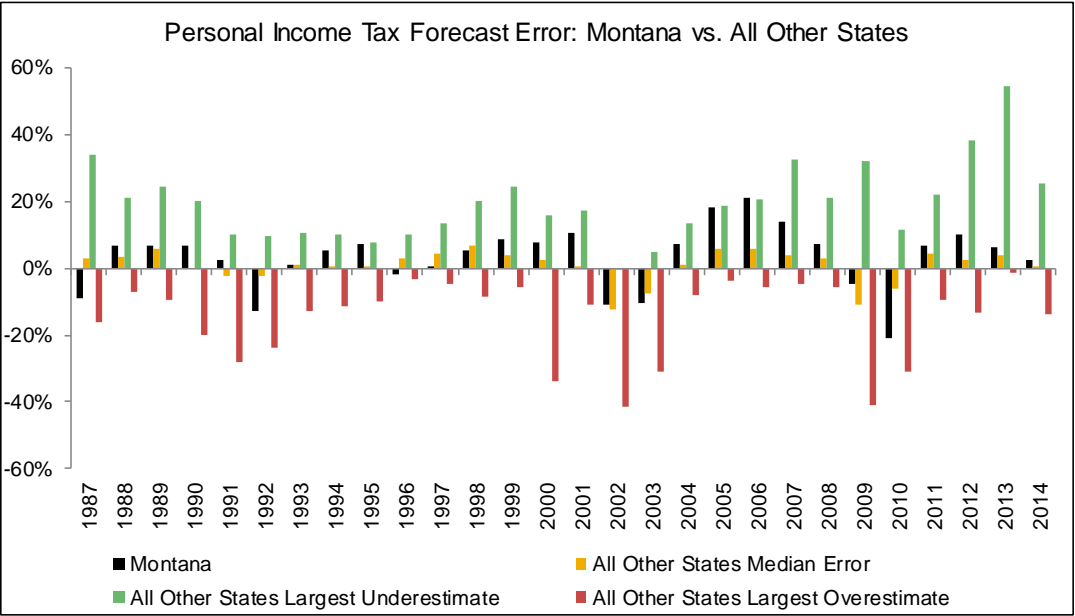
The following graph illustrates the error of the original estimate by amount (by the green bars measured on the left axis) and as a percentage (by the gray line measured on the right axis). The Rockefeller report notes, “The 2005-07 years were a golden period of revenue overages in most of the country.” Montana may have been further impacted by the implementation of [SB 407 \(2003 Session\)](#), which included several large changes to the personal income tax.



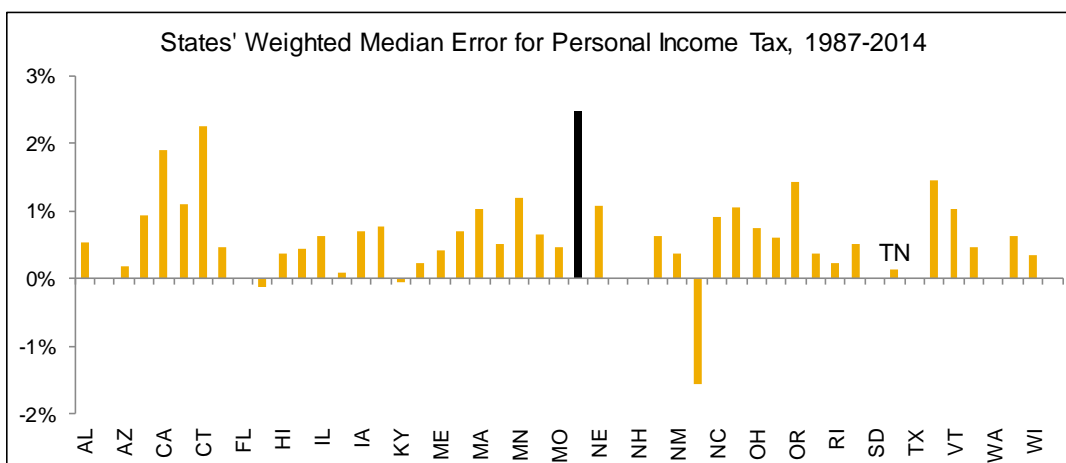
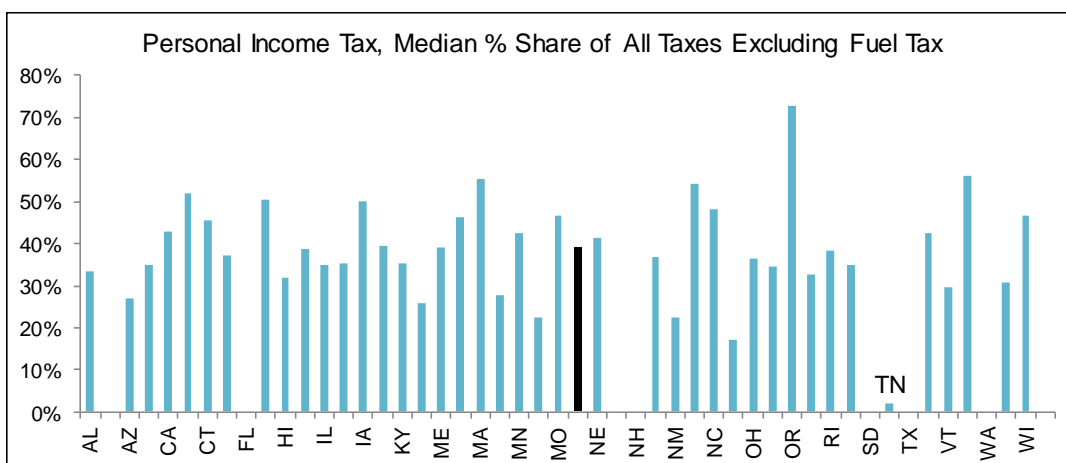
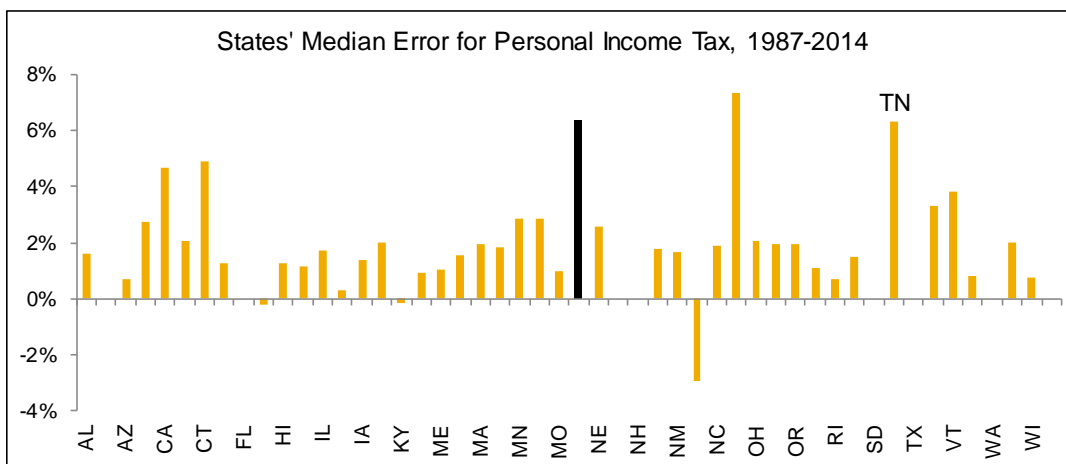
The following chart compares the Montana personal income tax forecast error to the median personal income tax forecast error of all other states with a personal income tax. The substantial underestimates of the period 2005-2007 are easily seen; in most other years, the Montana forecast error is much closer to the median of other states.



The figure below gives some perspective to the Montana forecasting error and the median error of all other states by including the largest under- and overestimates of the other states. Over the twenty-eight year period, there have been significant forecasting errors by various states. Note that in 2006, Montana’s underestimate was larger than that of any other state.

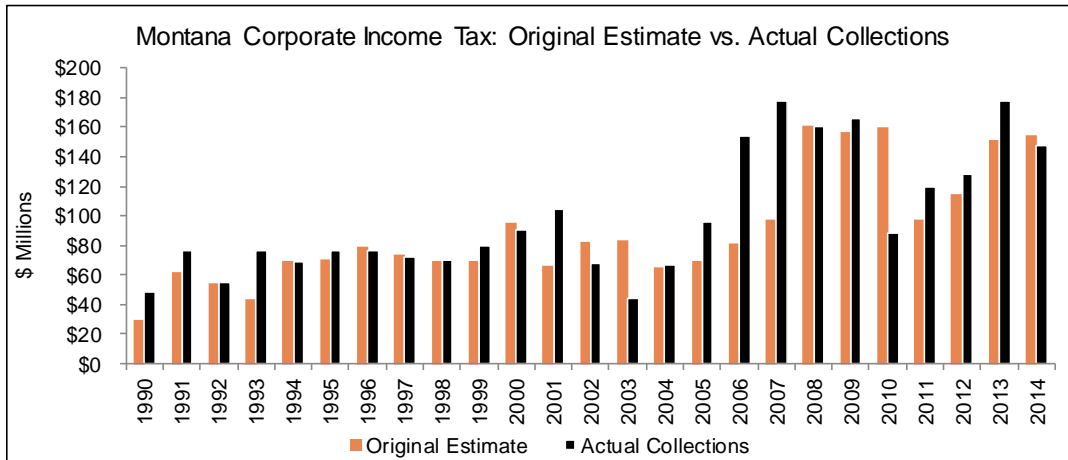


The purpose of the three charts below is to understand the relative importance of the personal income tax estimating error to a state's overall revenue position. This is done by weighting the median error shown in the first chart by the percentages in the second chart; the result is the weighted median error over the twenty-eight year period illustrated in the third chart. For example, Tennessee has the third largest median error in the first chart. However, personal income tax accounts for around 3% of Tennessee's tax base as shown in the second chart. Therefore, the weighted median error as depicted in the third chart is quite small. In contrast, Montana has the largest weighted median error of all states with a personal income tax.

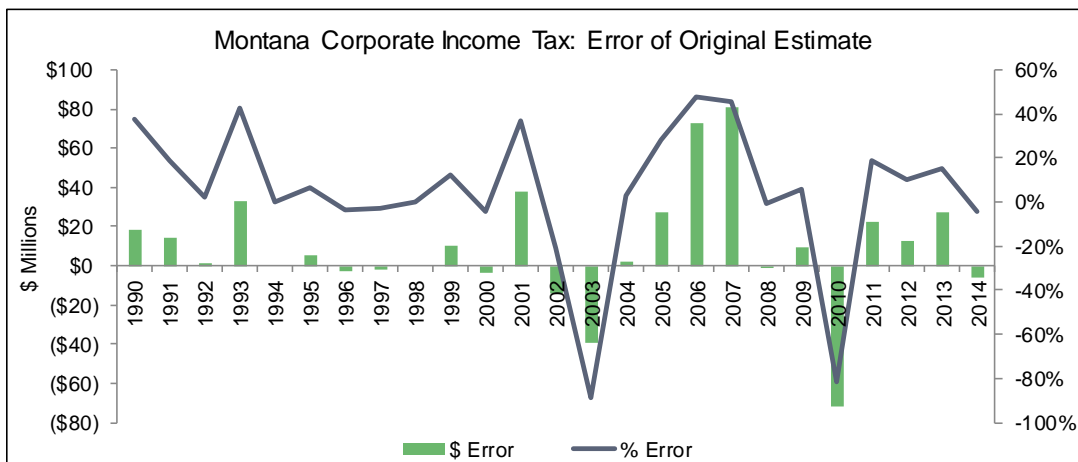


## Corporate Income Tax

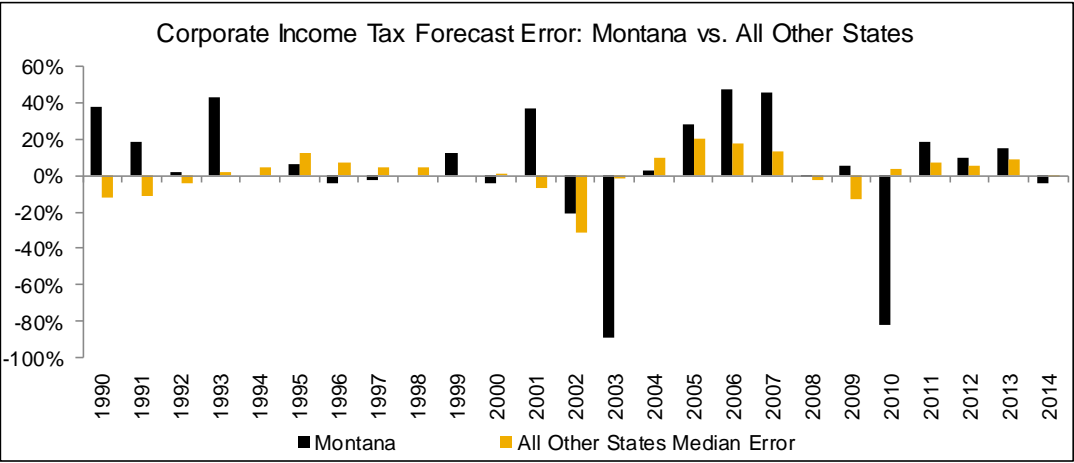
The chart below shows final collections compared to the original estimate for Montana corporate income tax since 1990.



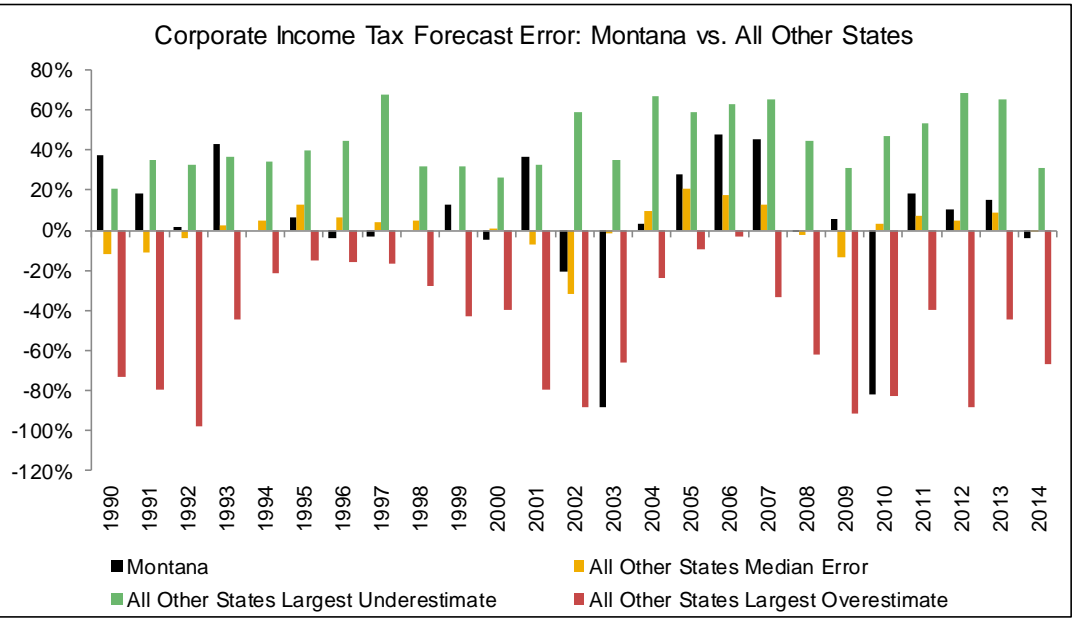
The following graph illustrates the error of the original corporate income tax estimate by amount (by the green bars measured on the left axis) and as a percentage (by the gray line measured on the right axis). Montana law allows corporations to carry back current year losses for three years, and carry forward losses for up to seven years. The carry back provision may result in magnifying a downturn to the extent that corporations file amended prior year tax returns that include current year losses, and are thereby owed a refund of taxes paid in those previous years.



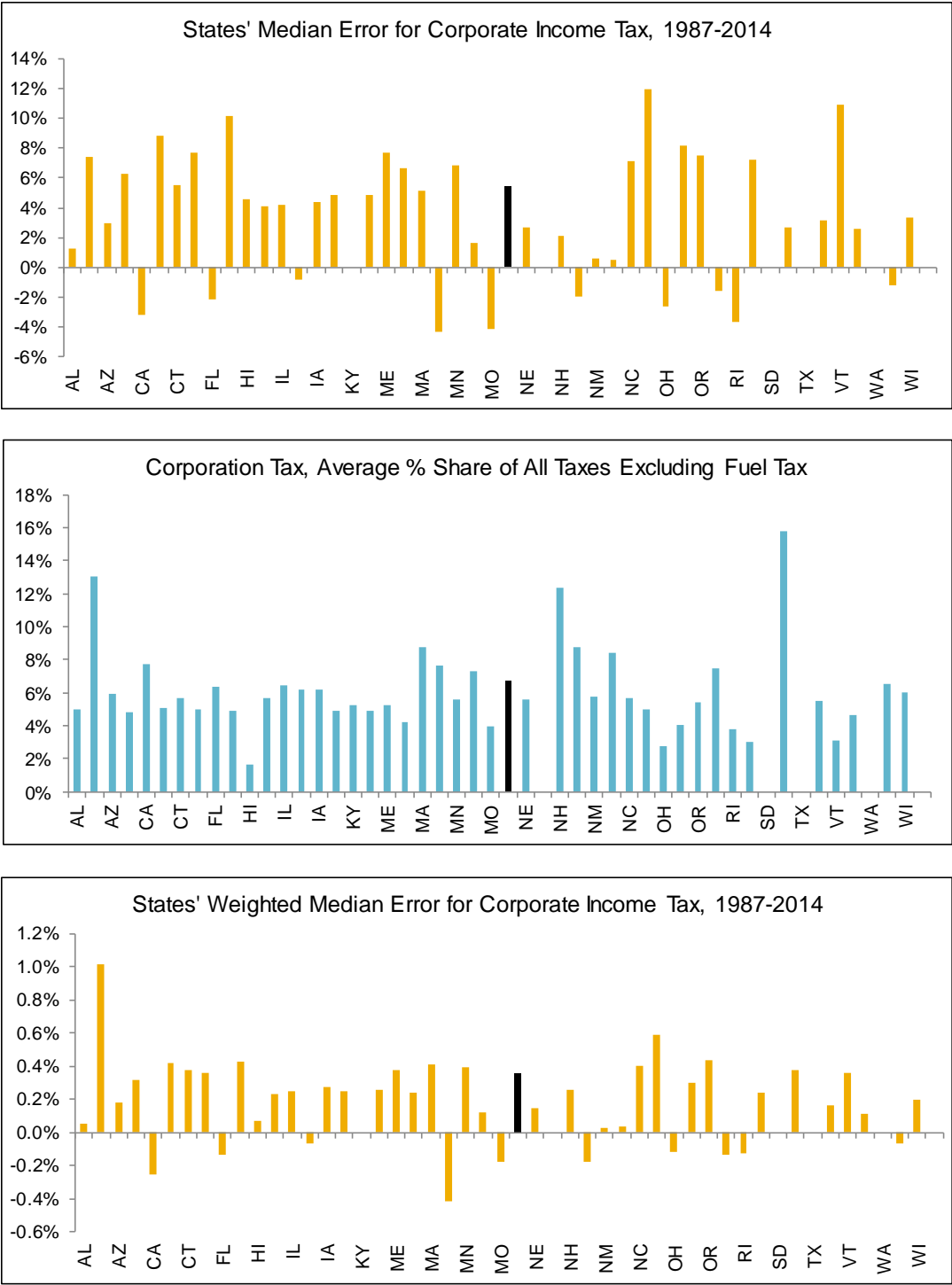
The following graph compares the Montana corporate income tax forecast error to the median corporate income tax forecast error of all other states with a corporate income tax.



The figure below repeats the information in the chart above and includes the largest under- and overestimates of the other states.



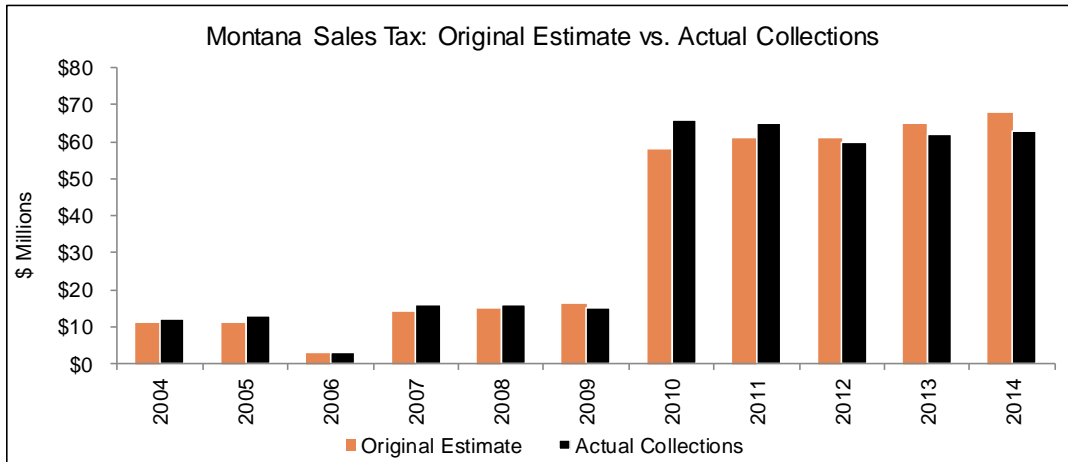
The three charts below illustrate the relative importance of the corporate income tax estimating error to a state's overall revenue position. As before, the median error shown in the first chart is weighted by the percentages in the second chart; the result is the weighted median error over the twenty-five year period illustrated in the third chart. As the third chart shows, Montana's weighted median error for corporate income tax is in line with that of other states.



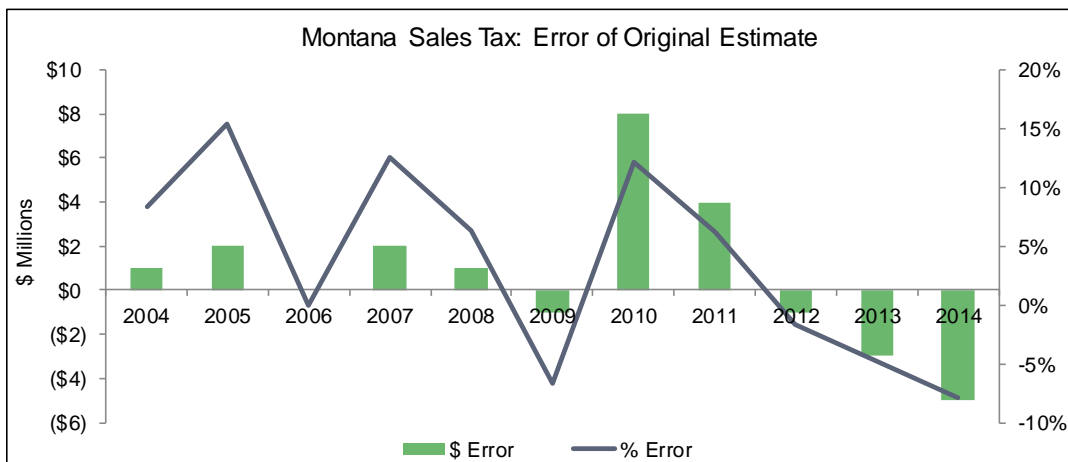


## Sales Tax

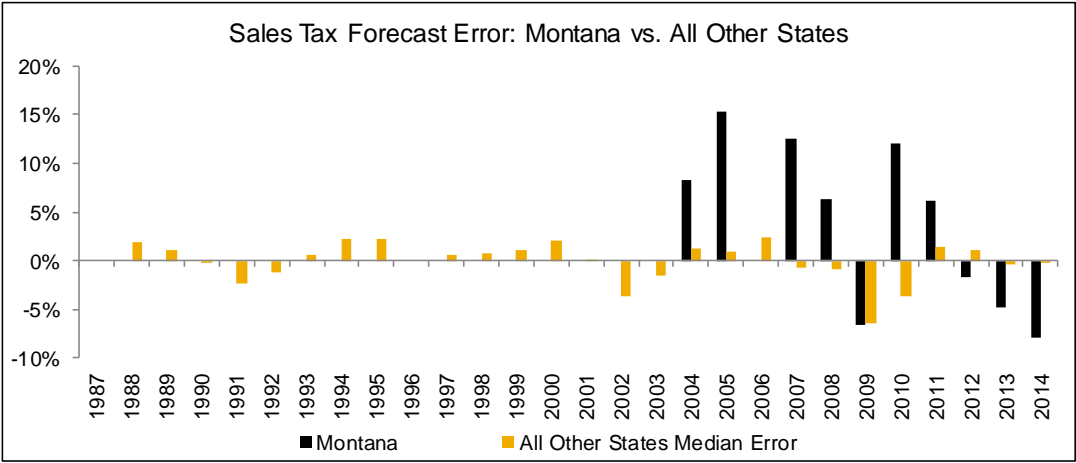
The chart below shows final collections compared to the original estimate for Montana sales tax since 2004. Montana does not have a broad-based sales tax like most other states. The data from the NASBO surveys is clearly inconsistent in the selected tax sources that are identified as sales tax. The years 2004-2005 and 2007-2009 include lodging and rental car taxes. Only rental car tax is included in 2006. For 2010-2014, selected sales taxes are lodging, rental car and telecommunications taxes, nursing facilities fees and public institution reimbursements.



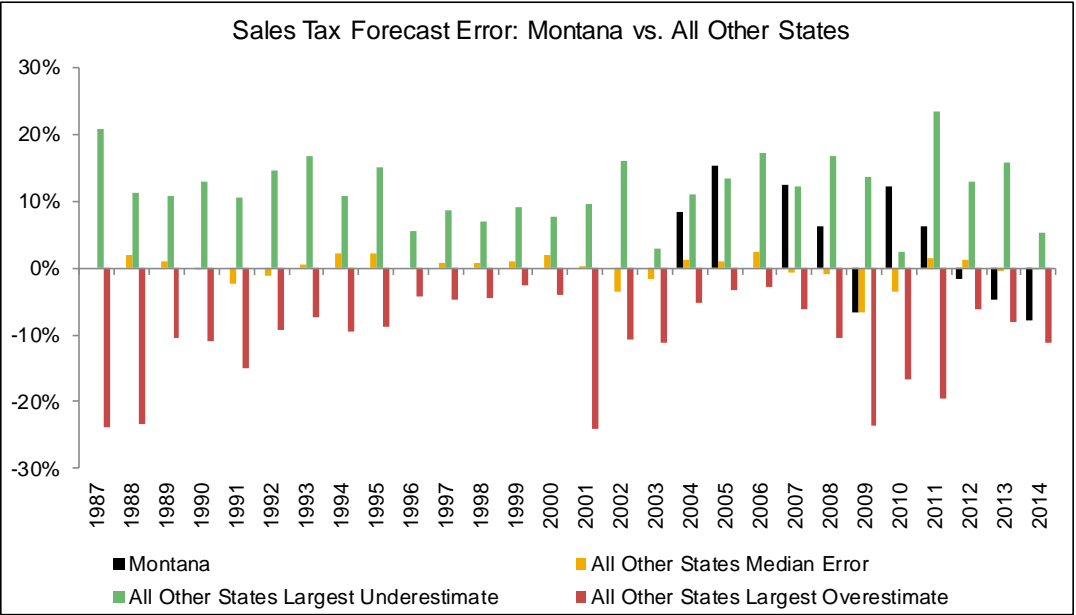
The following graph illustrates the error of the original sales tax estimate by amount (by the green bars measured on the left axis) and as a percentage (by the gray line measured on the right axis).



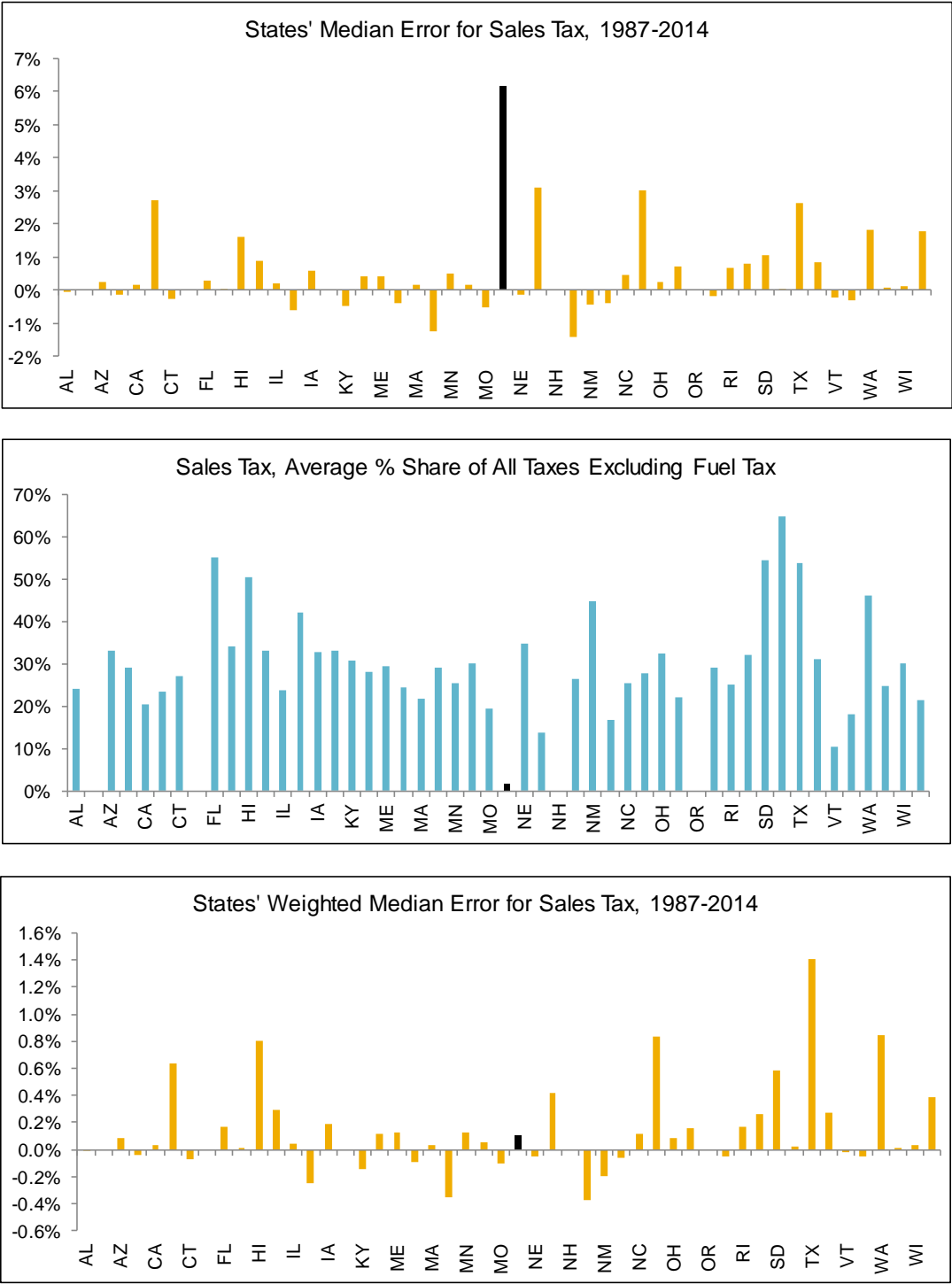
The following graph compares the Montana sales tax forecast error to the median sales tax forecast error of all other states with a sales tax.



The figure below repeats the information in the chart above and includes the largest under- and overestimates of the other states. Notice that the spread between the largest positive and negative errors is smaller than that of personal or corporate income taxes.



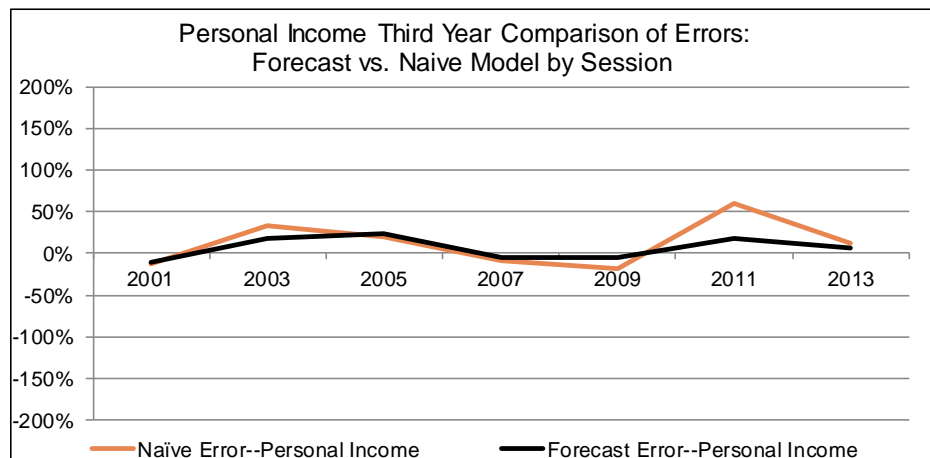
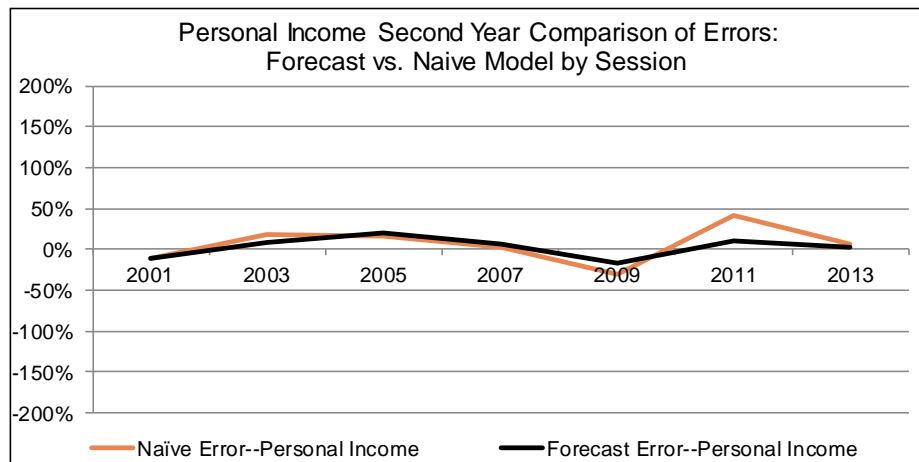
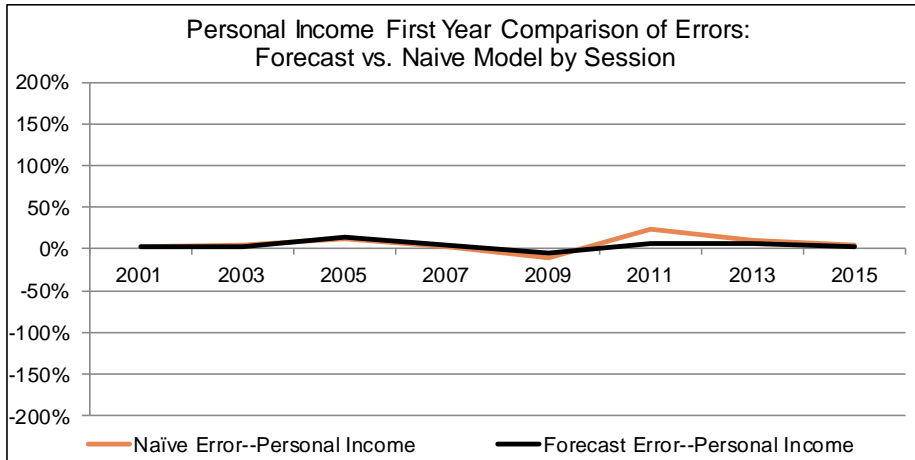
The three charts below illustrate the relative importance of the sales tax estimating error to a state's overall revenue position. As before, the median error shown in the first chart is weighted by the percentages in the second chart; the result is the weighted median error over the twenty-eight year period illustrated in the third chart. As the third chart shows, Montana's weighted median error for sales tax is quite small relative to that of many other states. Across all states, the lower sales tax errors result in reduced weighted errors compared to personal or corporate tax errors.



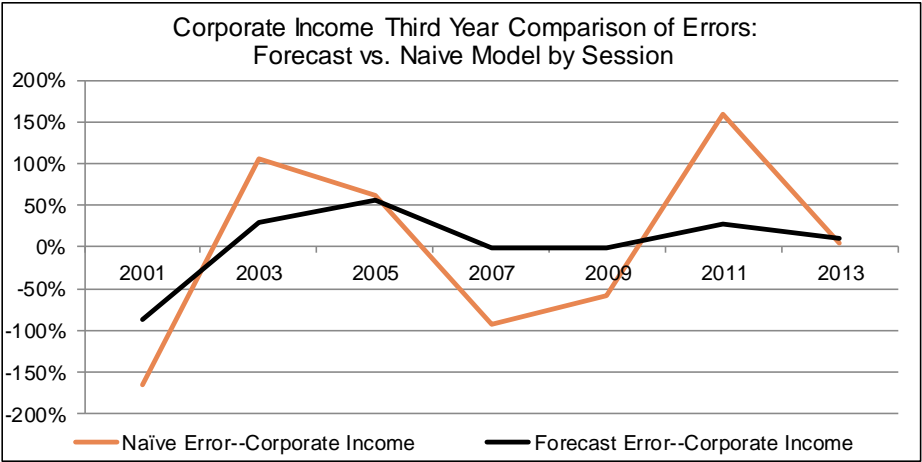
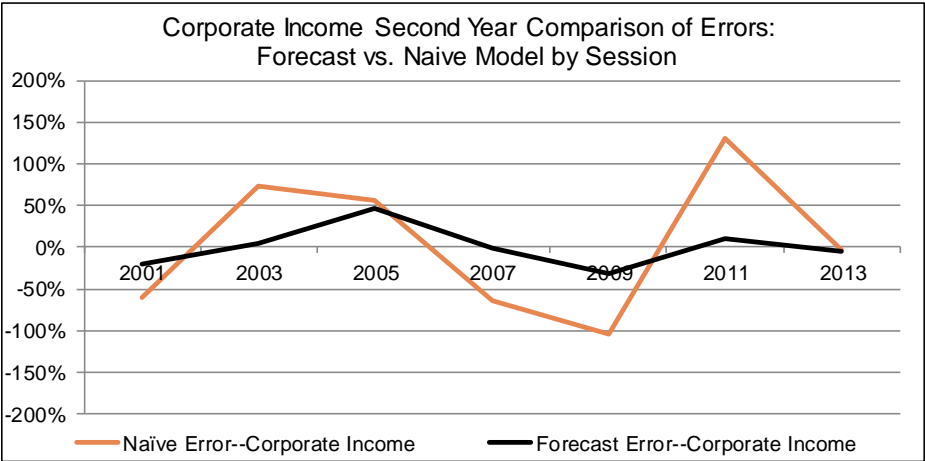
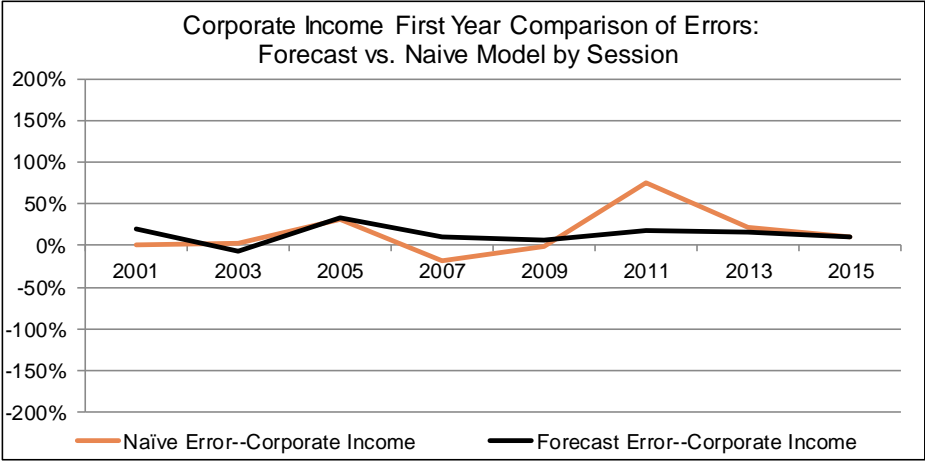
## NAÏVE MODELING DETAIL

The figures in this section show the naïve modeling results for Montana's three most volatile large sources—personal income tax, corporate income tax, and oil & natural gas taxes—for each of the three forecast years by legislative session. Two things to note: the vertical axis is the same on all charts to allow for easy comparison, and the naïve model is particularly inaccurate for corporate income tax and oil & natural gas taxes, indicating the relative difficulty of accurate forecasting for those sources.

### Personal Income Tax



# Corporate Income Tax



# Oil & Natural Gas Taxes

