



# How to Study Volatility: Strategies for Understanding Revenue Uncertainty

Across the country, state revenue has become increasingly volatile, confounding the best efforts of officials and policymakers to make forecasts and keep budgets in balance. To help states better manage this uncertainty, The Pew Charitable Trusts recommends that policymakers periodically study their states' economic and revenue volatility. Such analyses can help states develop policies for rainy day funds that smooth budgets throughout the business cycle and align with each state's objectives and characteristics.

## Understanding revenue volatility

Volatility is unique to each state. There are several ways to understand the drivers of volatility and how much they affect a revenue portfolio. Regardless of the method a state chooses, a quality volatility study should accomplish the following goals:

1. **Study the state's full revenue portfolio.** A volatility study should examine all significant revenue streams used to fund core government operations, including those beyond the state's general fund. A comparison of trends in revenue collections for each stream will help leaders understand where the state's money comes from, how much each revenue stream contributes to the coffers, and how those streams react to business-cycle fluctuations.

*For example: Wyoming's revenue is spread across a wide array of volatile streams ranging from sales and usage taxes to excise taxes on mineral extraction. But not all of these revenue streams feed into the general fund, a point noted by the state's Legislative Service Office in its 2014 Revenue Volatility and Savings Analysis. Had Wyoming's study been limited to the general fund, it would have overlooked the volatility in the major revenue streams that are used to fund K-12 education and other essential programs and services.*

2. **Exclude policy-driven volatility.** Increases or decreases in tax rates can cause sudden, dramatic shifts in tax revenue that would lead to inflated measures of volatility. To every extent possible, analysts should isolate and control for volatility that results from policy changes so they can focus on the effects of the economy on revenue.

*For example: As part of a periodic review of their savings target, economists from Minnesota Management and Budget analyze the state's revenue volatility over the past 50 years. They examine the state's taxable base, as opposed to actual revenue collections, excluding the effects of any policy change. This avoids inflating their volatility estimates, and Minnesota lawmakers are able to make better-informed decisions for the state's budget reserve and cash flow accounts.*

3. **Examine long-term trends and changes in volatility.** State budgets are often debated in the context of the previous year's collections and spending, but this can fail to account for underlying changes in the economy. Short-term examinations are likely to be influenced by shocks in state revenue or abnormal events. By adopting a long-term perspective for volatility studies, states can learn how their revenue has performed through multiple business cycles and identify which lessons can be applied in the future.

*For example: Utah is required by statute to perform a thorough examination of the state's revenue every three years. As a part of this study, state economists examine 15-year revenue trends across several major tax types and analyze actual or projected revenue, the cyclical components of projected revenue, and associated trends. By adopting a long-term approach, the state is able to observe how its revenue performs throughout the business cycle and in response to varying economic conditions, leading to more informed budgeting decisions.*

- 4. Measure volatility as a standard deviation.** Standard deviation is a statistical calculation that can reveal the degree to which tax revenue typically fluctuates. This measure should focus on annual growth (i.e., year-over-year percentage changes) rather than dollar amounts in order to control for the impact of population growth, inflation, and other factors that increase revenue over time. Standard deviation analysis allows for direct comparisons between revenue shifts years and even decades apart. More importantly, this approach makes it possible for a state to understand how volatile its revenue system is. A high value means the state experienced dramatic swings above or below the average annual change in tax revenue, while a low score suggests the state's tax revenue was highly predictable and stable from year to year.

*For example: California's Legislative Analyst's Office conducted a volatility study that includes an overview of California's tax volatility over the past 24 years. The report examined volatility as the standard deviation of annual percentage changes in overall tax revenue and the major individual revenue streams. The office was able to discuss the drivers of volatility, analyze how various policy options would affect revenue volatility, and offer policy recommendations for lawmakers.*

## Additional considerations

**Include as many years of historical data as available in the analysis.** As with any other statistical analysis, more data allows for more precise estimates and a better understanding of the revenue process. A volatility study should include historical revenue for all years for which quality data are available.

**Utilize a dynamic standard deviation or apply weighting to volatility in more recent years.** Although a standard deviation is the best single statistic available for measuring volatility, it weights all observations the same. That means it considers revenue changes from 30 years ago to be as informative as those from two years ago. Analysts should utilize measures of standard deviation that are allowed to vary over time or otherwise make efforts to weight recent values more heavily in their analyses. As a part of their annual review of their reserve funds, state economists with Minnesota Management and Budget estimate a time-varying standard deviation of the state's volatility to inform their savings target.

## Technical assistance by The Pew Charitable Trusts

In addition to publishing research on state fiscal policy, Pew works with states to examine revenue volatility to inform reserve fund policies, evaluate current reserve fund designs and structures, and mitigate the effects of volatile revenue with dynamic, evidence-based reserve fund practices. By request, Pew can assist with state-specific policy design by performing scenario-based analyses, drafting or advising on legislation, or offering testimony.

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