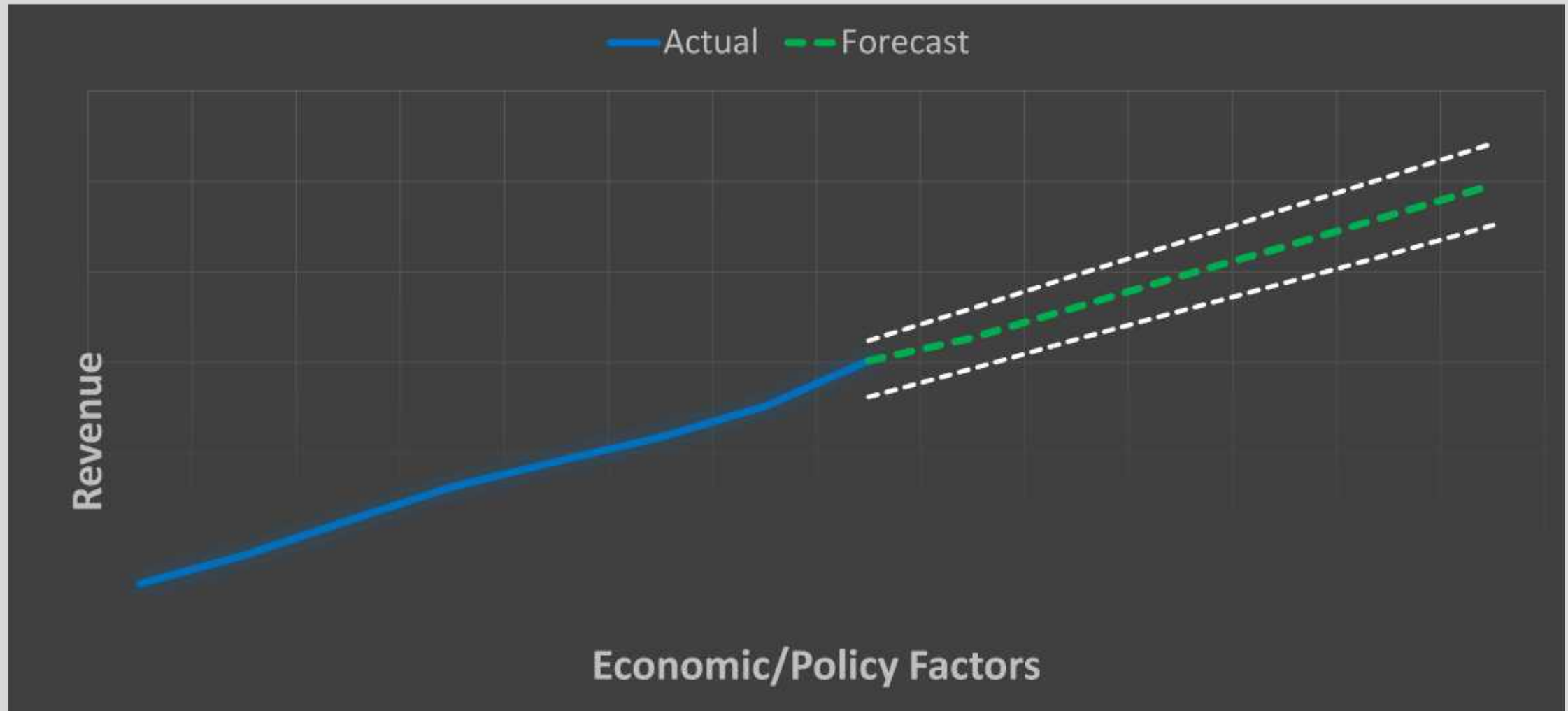


Nonrandom Thoughts on Revenue Forecasting

*Do not look back.
You are not going
that way.*

NCSL Fiscal Analysts Seminar
Columbus, OH
October 10, 2019

Revenue Forecasting



Forecasting Best Practices

- Know the tax
- Clean the data
- Plot the data
- Use an appropriate forecasting approach
- Disaggregate if you can
- Evaluate your model and its estimation results
- Revisit and refine your assumptions



Know the Tax

- **Understand the tax being forecast**
 - Study the law
 - Study the regulations
 - Stay up-to-date with administrative and court rulings
- **Understand the structure of the tax**
 - The tax base – exclusion, exemptions and deductions
 - The net tax – tax rates and credits
- **Understand collections procedures**
 - These are what produce the revenue data

Clean the Data

❖ Data cleaning process

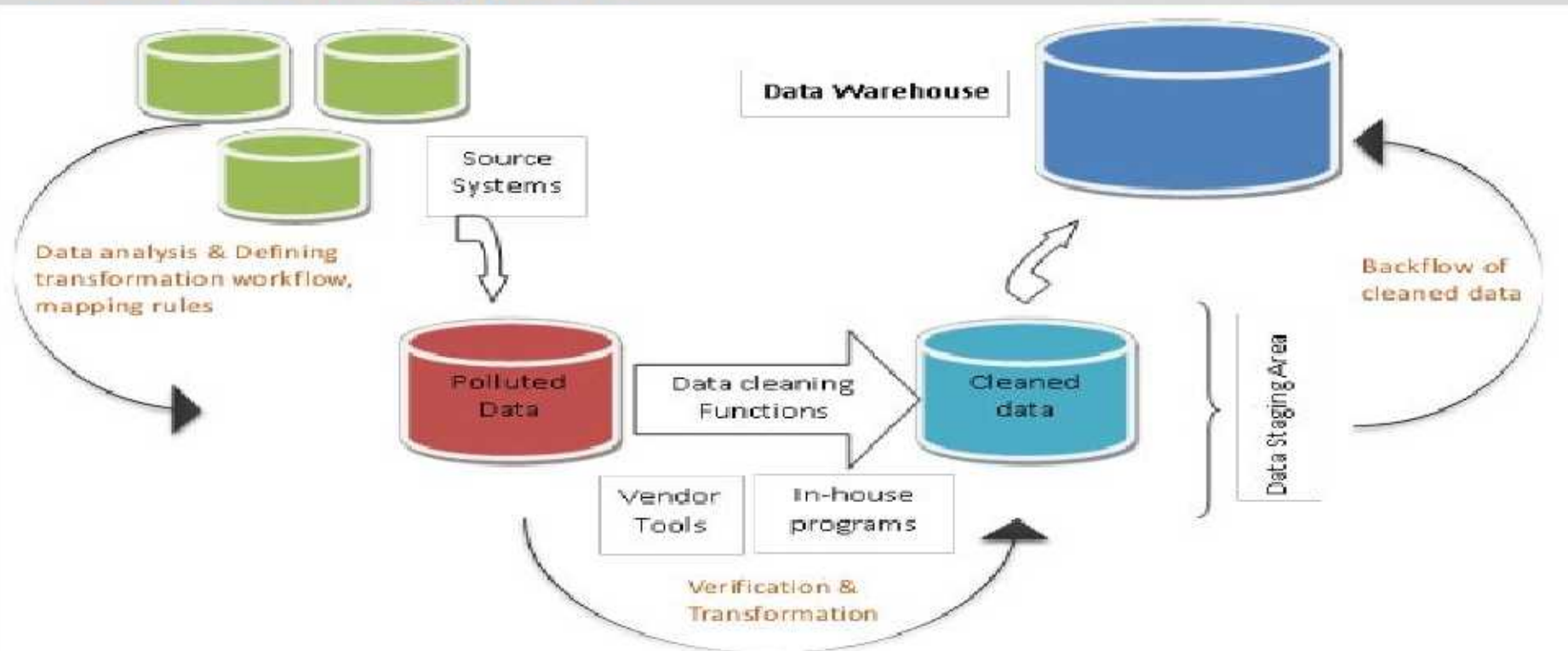
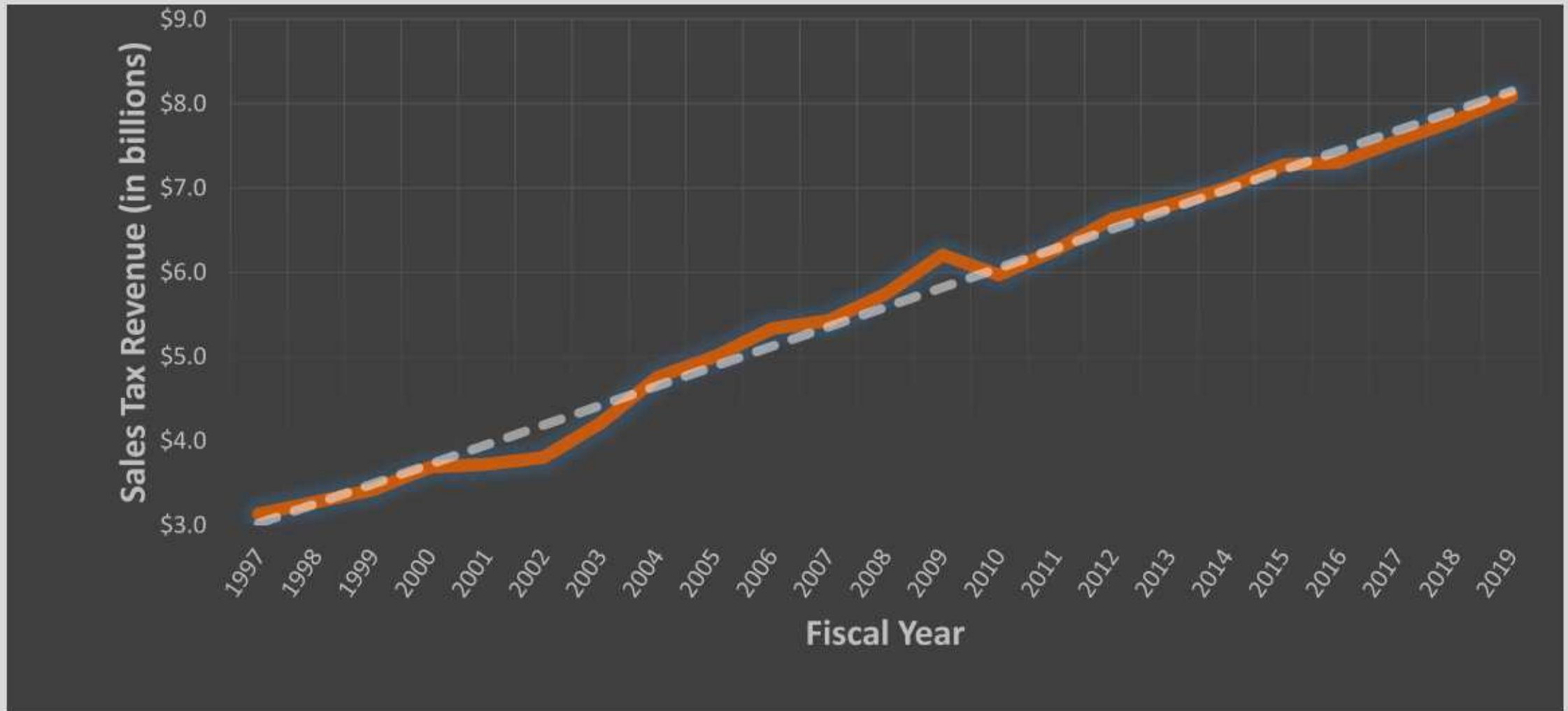


Figure 3. Data Cleaning Process

Plot the Data



Use an Appropriate Forecasting Approach

Naive

Expert

Judgmental

Extrapolative

Trend

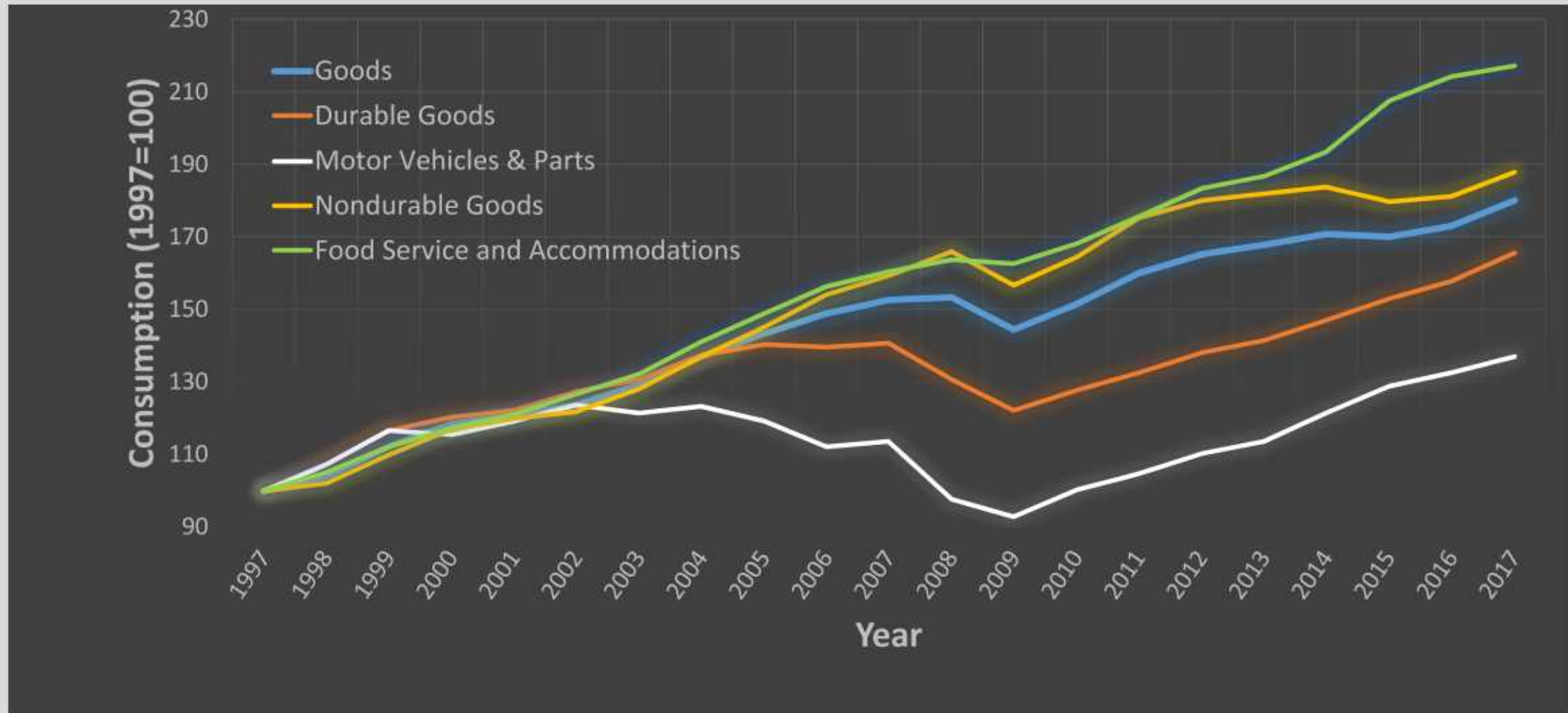
Univariate

Associative

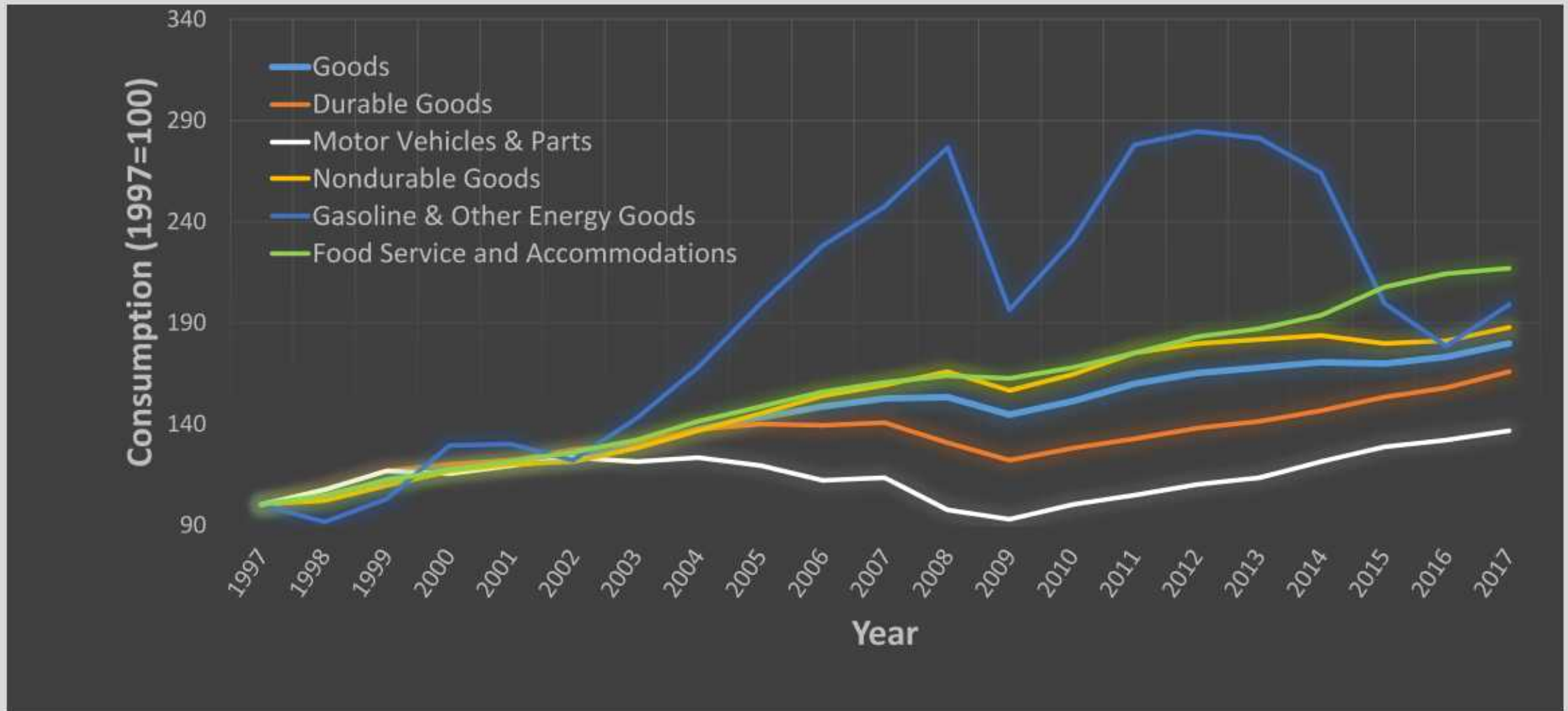
Multivariate

Econometric

Disaggregate If You Can

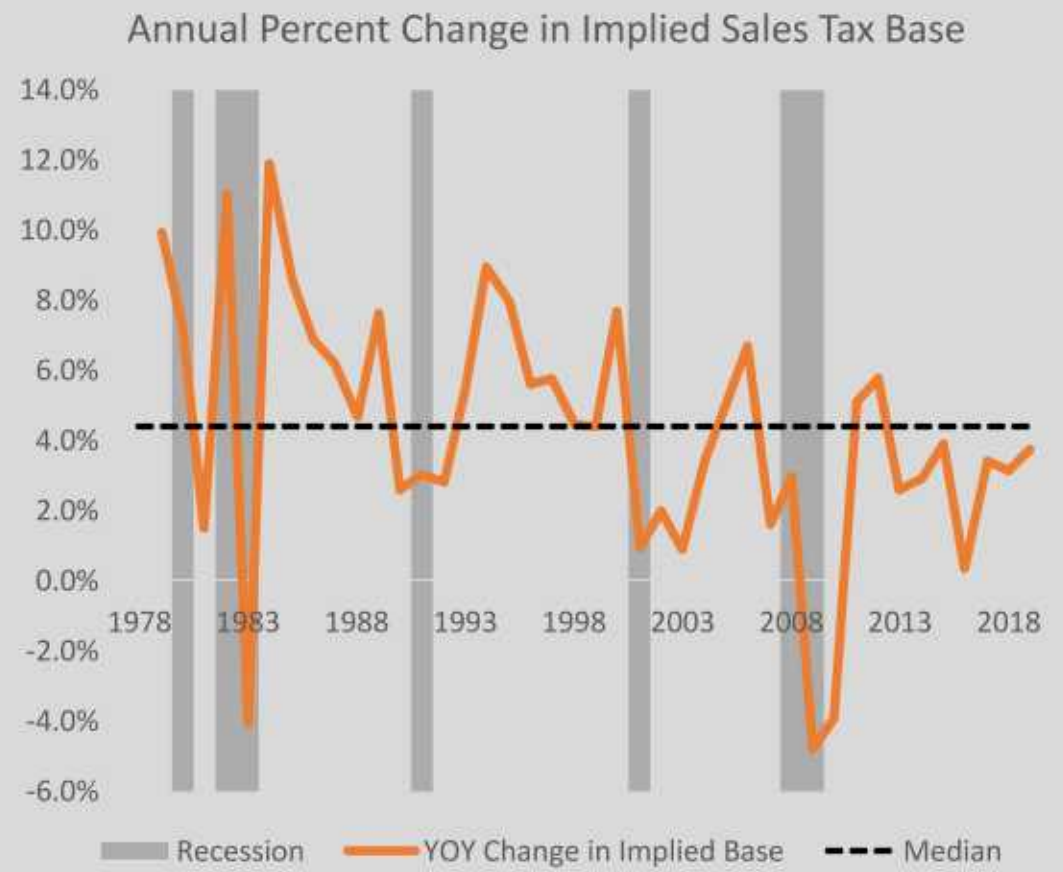
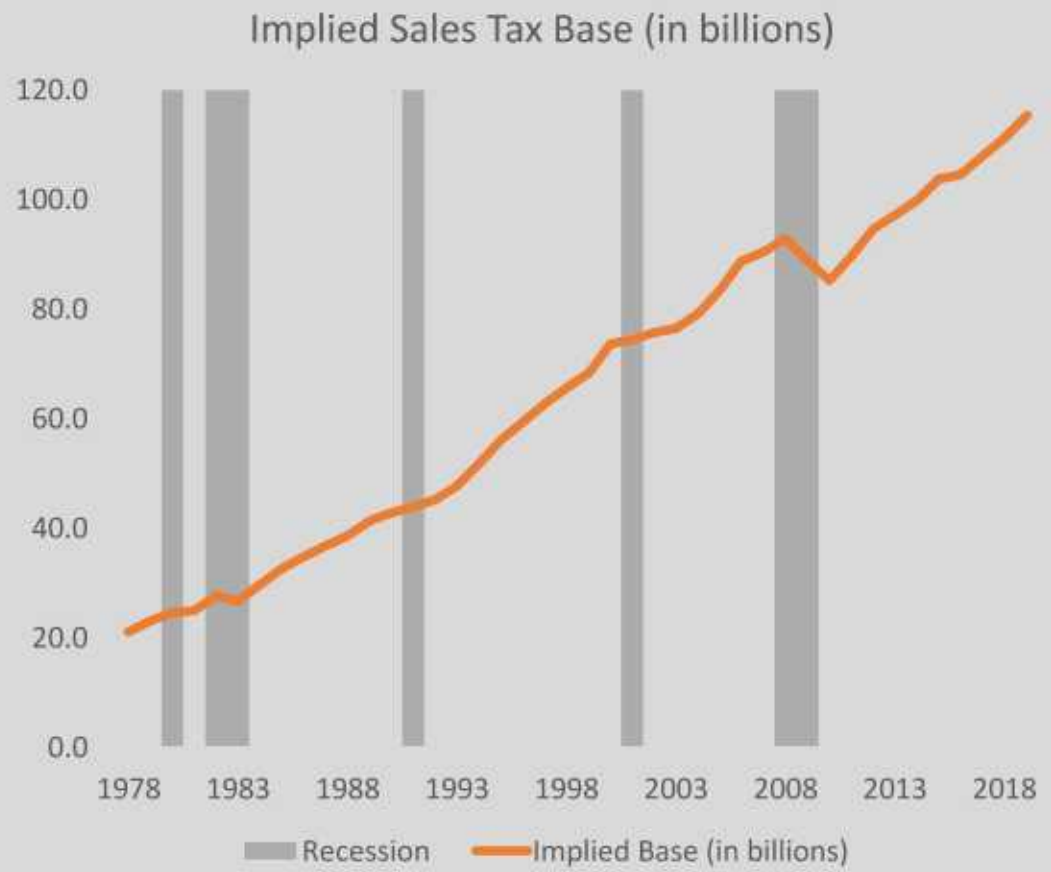


More Reason to Disaggregate





Disaggregating to Understand What Drives Growth and Volatility



Growth and Volatility Estimates

Tax Base	Long Run Change	Short Run Change
Implied Sales Tax Base (1978-2019)	0.853	1.094
BEA State Personal Consumption Expenditures (1997 - 2017)		
Goods Net of Food for Off-Premises Consumption	0.784	1.105
Household Furnishings & Equipment	0.562	1.153
Recreational Goods & Vehicles	0.708	0.959
Gasoline & Other Fuel Goods	1.353	3.746
Implied Personal Income Tax Base (1978-2019)	0.933	1.699
SOI State Tax Stats (1996 – 2016)		
Federal Taxable Income	0.770	1.542
Wages and Salaries	0.691	0.929
Capital Gains	0.234	7.741

Evaluation of the Revenue Model



$$S = a + b_Y Y + b_T T$$

S = Sales Tax Revenue

Y = Personal Income

T = Sales Tax Rate

In-Sample Evaluation of Model Results

Model Statistics

- R-square
- F-test
- Coefficients
- t-tests

Model Diagnostics

- Heteroskedascity
- Serial correlation
- Multicollinearity

Evaluating Potential Forecast Error

In-Sample Testing

- Use the entire sample
- $\text{Error} = (\text{Actual}) - (\text{Predicted})$
- Mean Pct. Error
- Mean Absolute Pct. Error

Out-of-Sample Testing

- Use part of the sample
- $\text{Error} = (\text{Actual}) - (\text{Simulation})$
- Mean Pct. Error
- Mean Absolute Pct. Error

Evaluating Actual Forecast Error

- **Forecast Error**
 - $\text{Error} = (\text{Actual}) - (\text{Forecast})$
- **Estimating Model Error and Variable Error**
 - Forecast Simulation
 - Model error
 - Variable error

Refining Assumptions About Predictors

Predicted

Sales Tax Revenue

Predictors

Pers. Income*

Sales Tax Rate

Pct. Pop 65+

Housing Starts

$$S = a + b_Y Y^* + b_T T + b_P P + b_H H$$

S = Sales Tax Revenue

Y^* = Personal Income Net of Transfer Payments

T = Sales Tax Rate

P = Population 65 and Older

H = Single-Family Housing Starts



Thank You

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