Theory and Practice of Fiscal Sustainability Analysis

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Question of Interest

- Is the financial structure of jurisdictions (federal, state, and local) sustainable?
- Definition of sustainability (Dictionary.com)
  - The ability to be sustained, supported, upheld, or confirmed

Essence of the Question

- Will the growth in a jurisdiction's revenues be sufficient to sustain desired growth in expenditures?
- Formally

$$Fiscal\ Balance_t = Revenue_t - Expenditures_t$$

$$Revenue_t = \mu Revenue_{t-1} dt + \sigma Revenue_{t-1} dW_{t-1}$$

$$Expenditures_t = \nu Expenditures_{t-1} dt + \tau Expenditures_{t-1} dW_{t-1}$$

Issues

- Stochastic process
  - Must estimate trend and volatility
- Breaks
  - Abrupt change in trend
    - "Regime shifts"
  - Discrete level changes in *Revenue, Expenditure*
    - Infrastructure investment
    - Exogenous events
- No *a priori* sense of a "Breaking Point" in fiscal balance

Existing Work

- "Indicators"
  - Selected ratios
    - Brown's Ten Point Test (1993)
    - Maher & Nollenberger (2009)
  - Usually measured at one or a few points in time
  - Trends
    - ICMA's Financial Trend Monitoring System (Groves and Valente, 1986, 1994)
- Issues
  - Static
    - No measurement of trend or volatility
    - Exception is FTMS which at least attempts to capture trend
  - Not empirically verified
    - Exception is recent paper by Gorina, Maher, and Joffe (2018)

Our Approach

- Explicit modeling of stochastic process
  - Forecast development
    - Generates estimates of trend and volatility
    - Generates standard errors
  - Simulation of system to estimate risk of fiscal balance falling below specified levels

PROJECT 1: AFFORDABILITY OF SMALL COMMUNITY WATER SYSTEMS

Research Question & Data

- Question: Is it affordable (sustainable) for very small communities to make water infrastructure investments? (EPA contract)
- Unit of analysis is municipality
  - All municipal governments in EPA Region 7 states (Iowa, Kansas, Missouri, Nebraska)
- Data from US Census Bureau, American Community Survey

Definition of Affordability

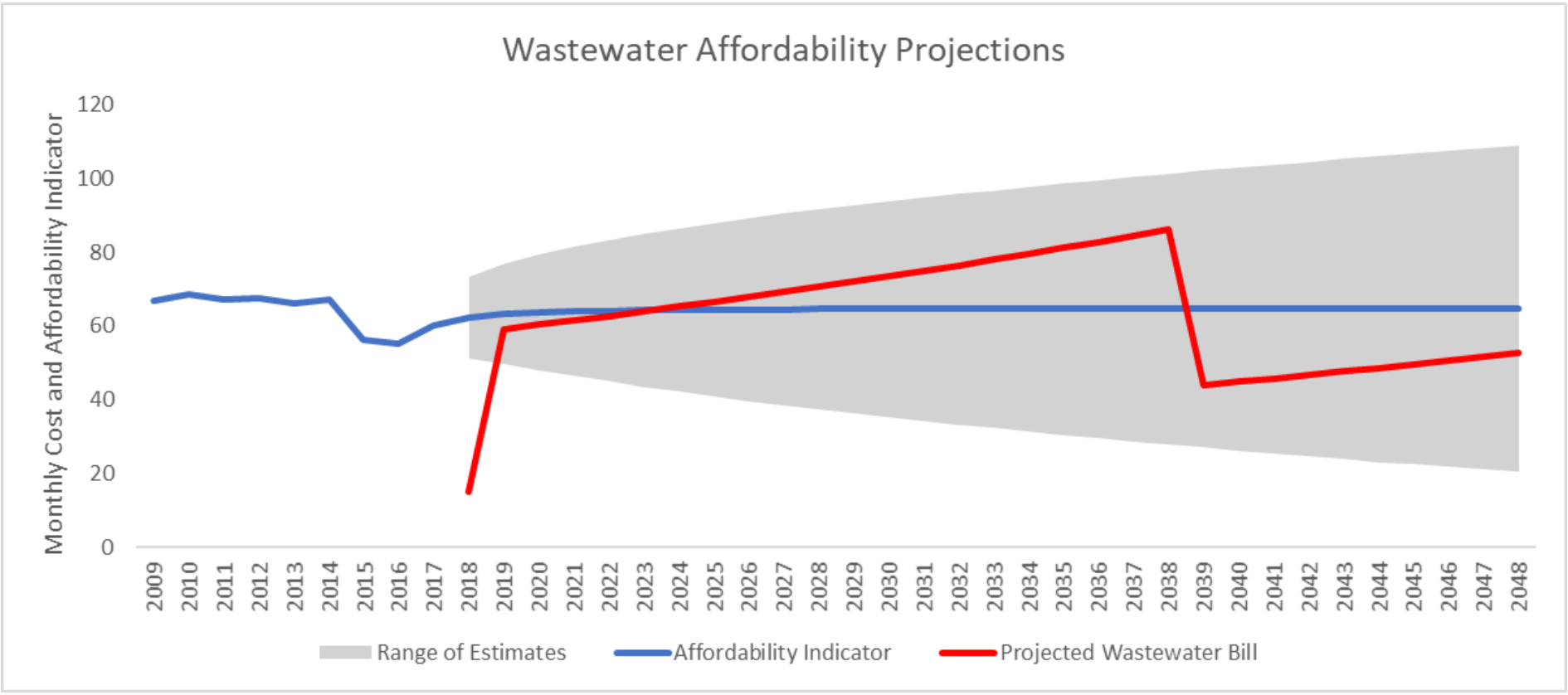
- EPA Definition of Affordability
  - Average Drinking Water Bill ≤ 2.5% of Median Household Income (MHI)
  - Average Wastewater Bill ≤ 2.0% of MHI

Econometric and Simulation Model

$$MHI_{it} = f(MHI_{it-1}, POPN_{it}, PERCHS_{it}, PERCBACH_{it}, MANUSHARE_{it})$$

$$POPN_t = \varpi_1(\beta_0 + \beta_1 time_t + \varepsilon) + \varpi_2\left(\frac{\sum_{n=1}^{3} POPN_{t-n}}{3}\right)$$

Example Output



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STUDY 2: FISCAL SUSTAINABILITY OF ILLINOIS MUNCIPALITIES

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Research Question & Data

- Question: Are Illinois municipalities' finances sustainable?
- Unit of analysis is municipality
  - Stratified sample of Illinois communities
- Data from Comprehensive Annual Financial Reports, US Bureau of Economic Analysis, US Bureau of Labor Statistics

Forecasting System

- Economic variable VAR

$$\boldsymbol{Y_t} = c + \boldsymbol{\Pi_1 Y_{t-1}} + \cdots + \boldsymbol{\Pi_p Y_{t-p}} + \boldsymbol{e_t}$$

$$\boldsymbol{Y} = \begin{Bmatrix} PCPI \\ Wages \\ Empl \end{Bmatrix}$$

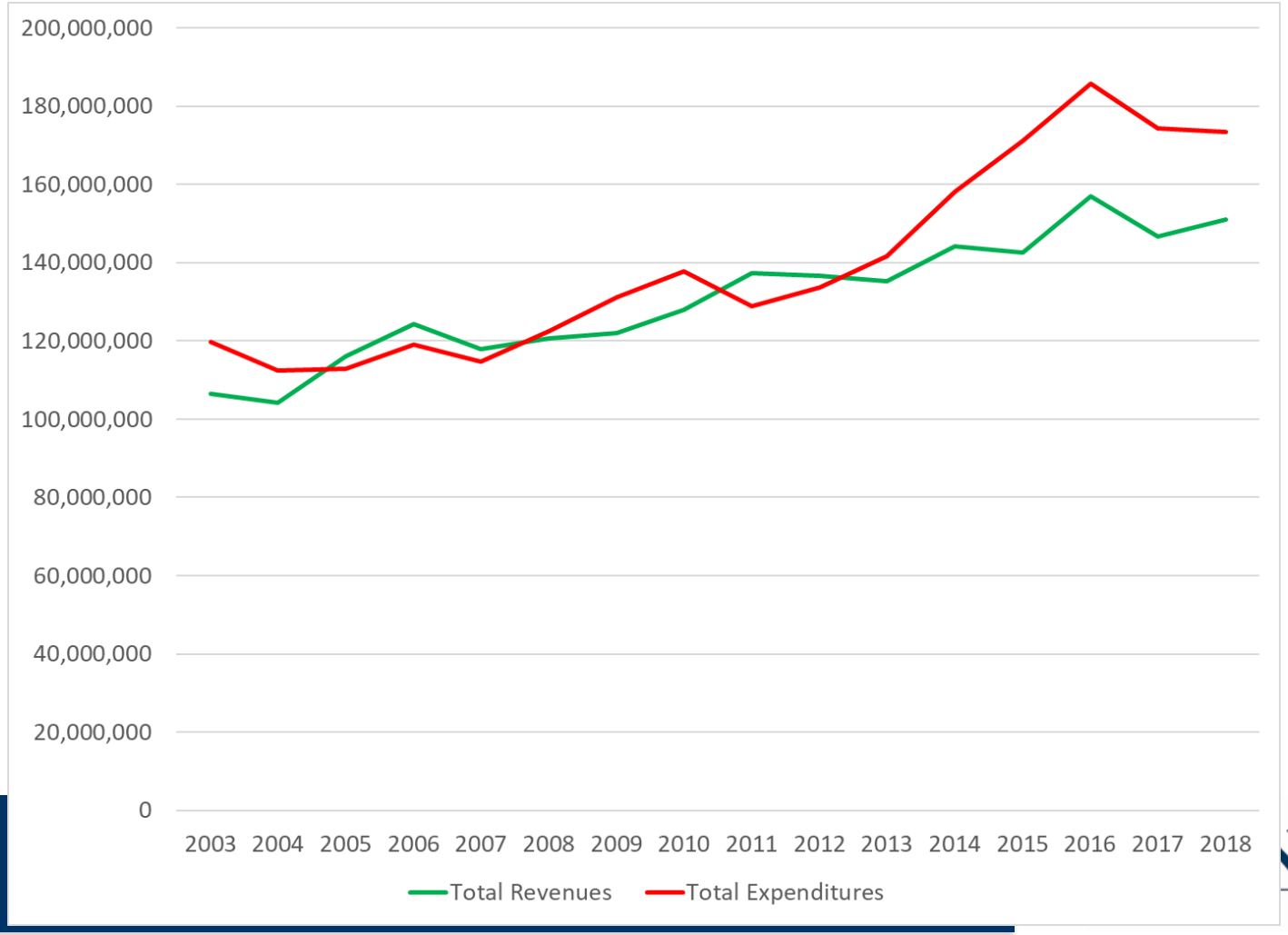
- Financial variable VAR with exogenous variables

$$\boldsymbol{Y} = \begin{Bmatrix} PropVal \\ Taxable \\ IG\ Rev \\ Other\ Rev \\ TotExp \end{Bmatrix}, \boldsymbol{X} = \begin{Bmatrix} \widehat{PCPI} \\ \widehat{Wages} \\ \widehat{Empl} \end{Bmatrix}$$

Example

- City of Springfield, IL
- Randomly selected from “large” city group
- Economic data available from 2001-2017
- Financial data available from FY 2003-2018
  - Governmental Funds

Springfield Governmental Funds Revenue & Expenditures



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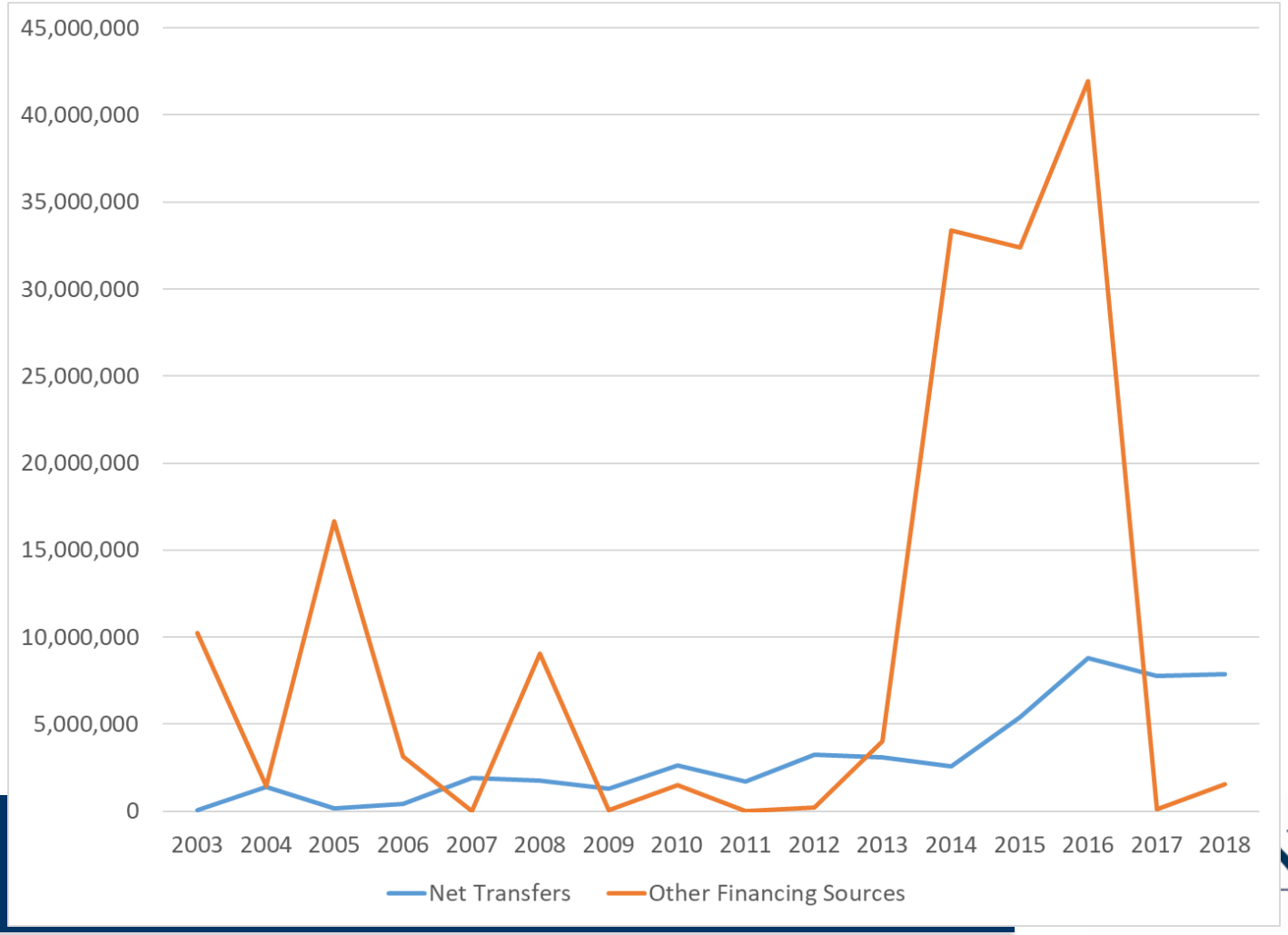
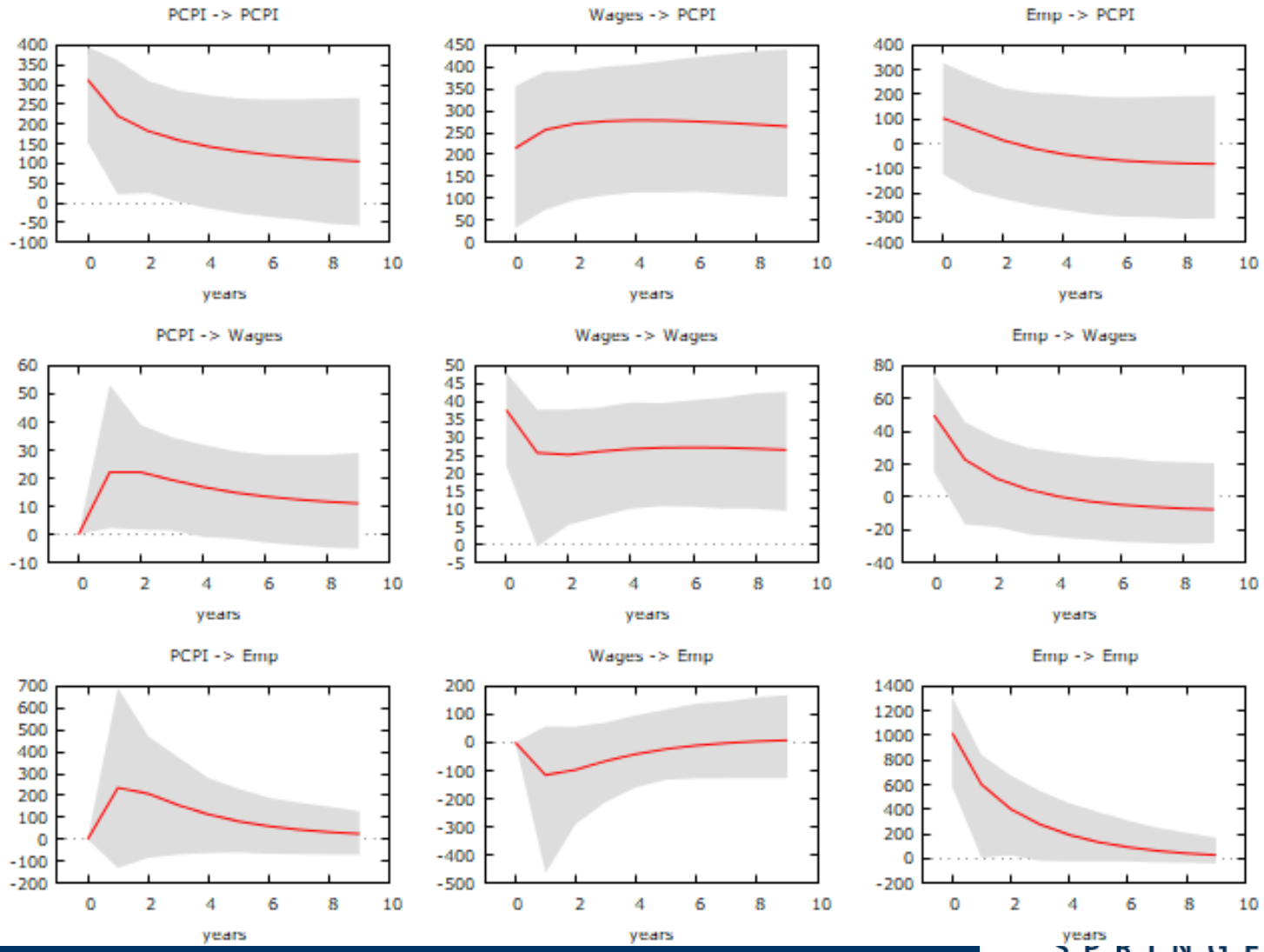
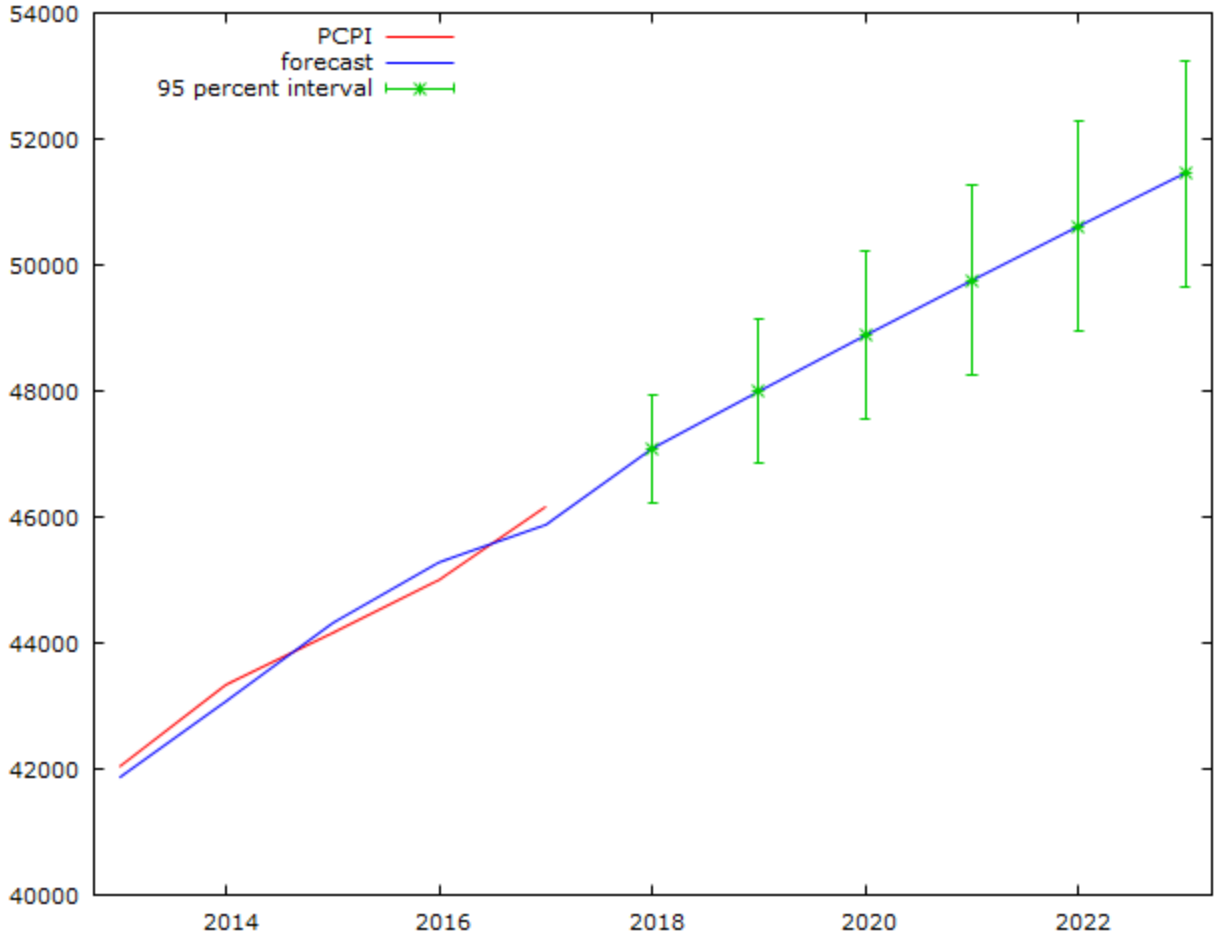
Springfield Other Financing Sources



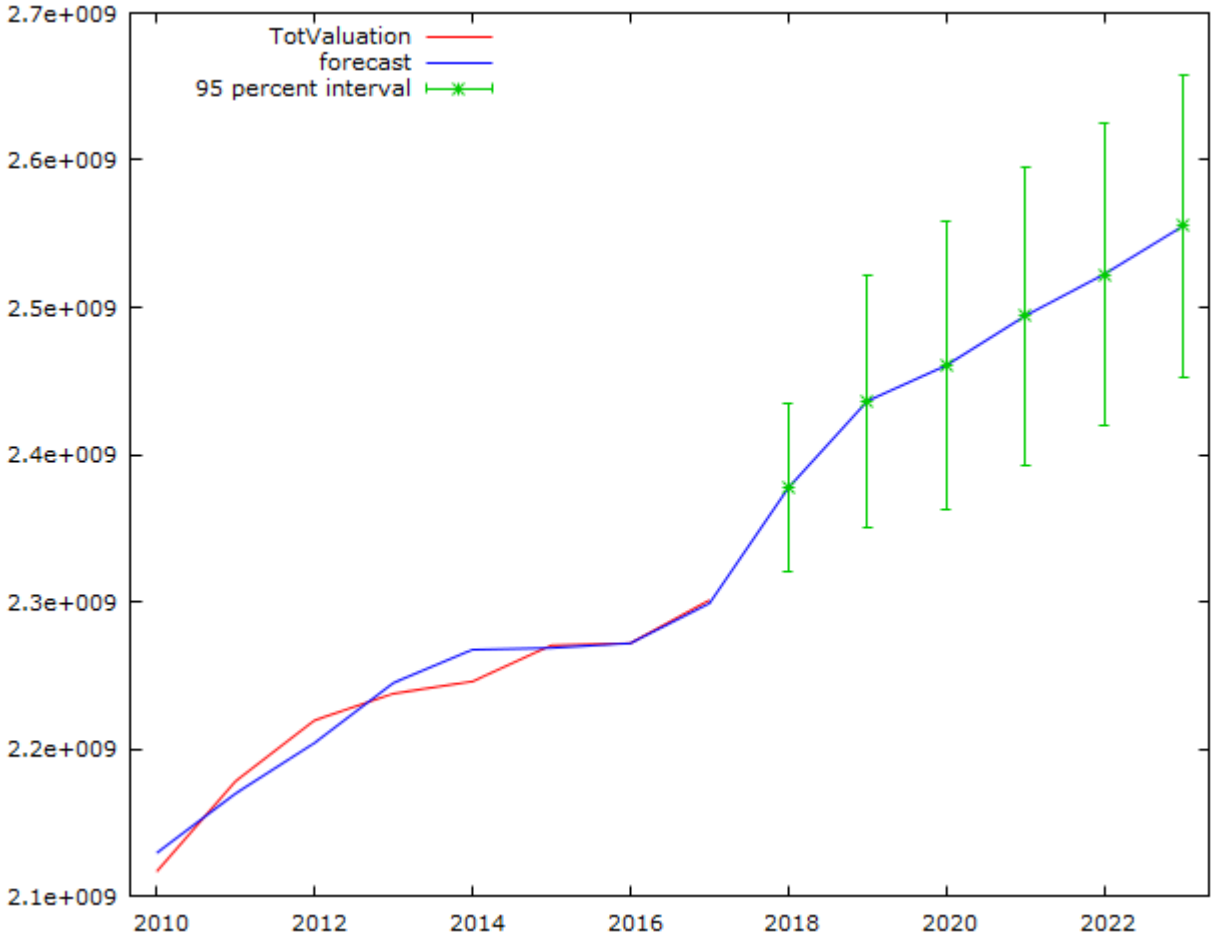
Economic VAR Results



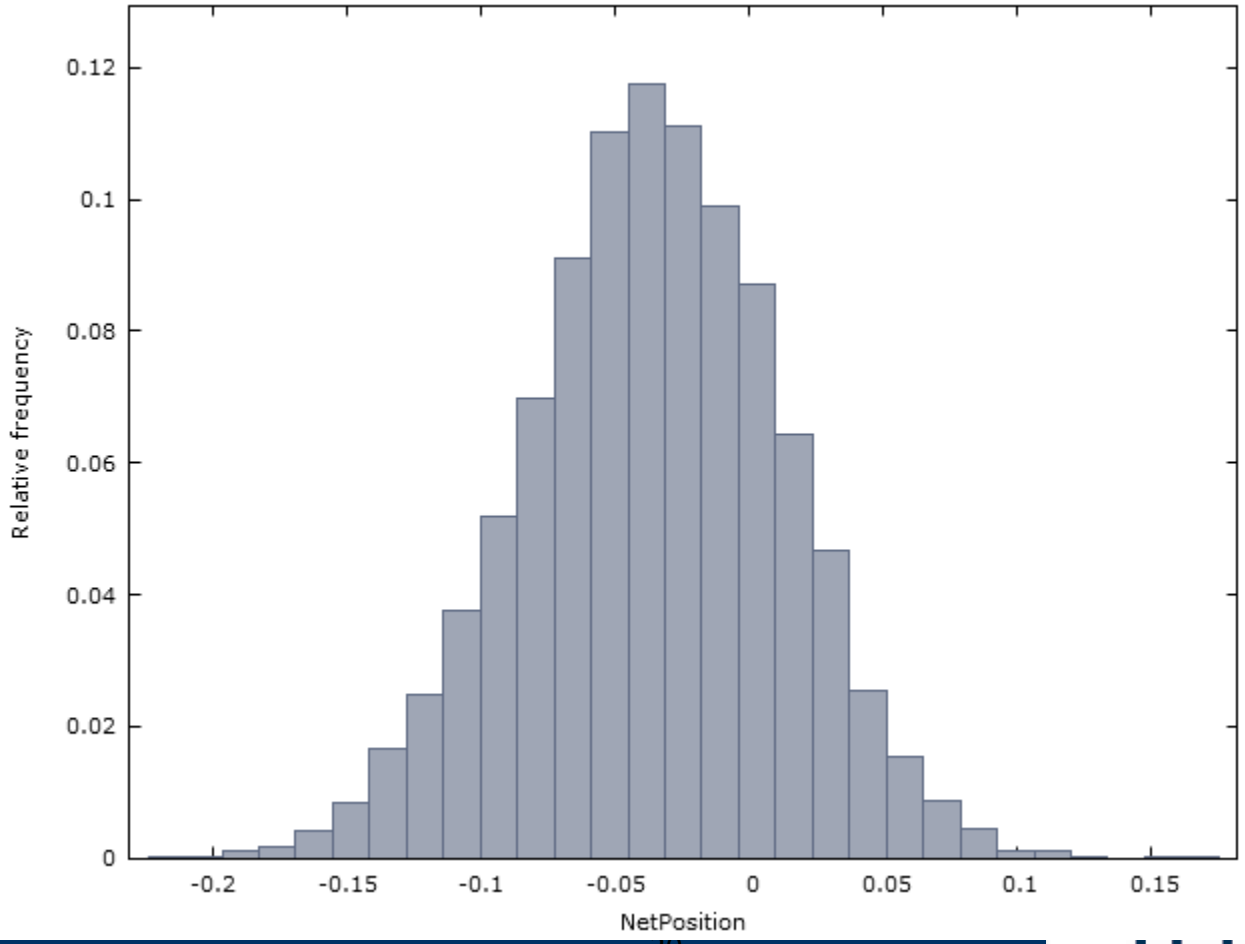
Forecast Example - PCPI



Forecast Example – Total Property Valuation



Results – Simulated 2019 Net Position



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Baseline Results

	2019 Net Position	2020 Net Position	2021 Net Position	2022 Net Position	2023 Net Position
Mean	-3.58%	-20.96%	-40.42%	-62.58%	-86.69%
Standard Deviation	4.80%	7.01%	8.63%	10.07%	11.45%
Prob. < -10%	9.45%	94.32%	100.00%	100.00%	100.00%
Prob. < -20%	0.06%	54.89%	99.32%	100.00%	100.00%

Results with 1% Sales Tax

	2019 Net Position	2020 Net Position	2021 Net Position	2022 Net Position	2023 Net Position
Mean	4.54%	-3.57%	-13.69%	-26.27%	-40.74%
Standard Deviation	4.30%	6.24%	7.64%	9.01%	10.12%
Prob. < -10%	0.05%	15.30%	68.49%	96.52%	99.90%
Prob. < -20%	0.00%	0.39%	20.32%	75.41%	98.19%

Summary

- We argue for a more explicit modeling of the financial
  - Similar to “pro forma” modeling in private sector businesses
- Benefits
  - Provides more information
  - More intellectually honest
- Drawbacks/Weaknesses
  - Requires some sense of “breaking point”
  - Can generate too much information
  - Illusion of specificity