Short Run and Long Run Elasticity of Massachusetts Sales Tax : Cointegrating Error Correction Model

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MA Sales Tax History

- Sales Tax was adopted in 1968 @ 3%
- 5% in 1975
- And 6.25% in 2009
- Massachusetts sales tax base is not very broad
- MA doesn’t tax services

Massachusetts FY2022 Tax Collections

	FY 22 YTD Actual Collections	Share
	(in $ millions)	
Income Tax	**24,337**	**59%**
Sales Tax - Regular	6,317	15%
Sales Tax - Meals	1,337	3%
Sales Tax -Motor Vehicle	1,113	3%
Sales Tax - Total	**8,765**	**21%**
Corporate & Business Tax	**5,069**	**12%**
All Others	**2,934**	**7%**
Total	**41,105**	**100%**

Tax Policy Objectives in General

- Simplicity
- Efficiency
- Equity
- Revenue Sufficiency (**Reduce Revenue Variability**)

Data, Methodology, and Dynamic Ordinary Least Squares (DOLS) and Cointegrating Error Correction Model

- Sales Tax Data (1980-2022)
  Massachusetts Department of Revenue
- Massachusetts Gross State Product
  Bureau of Economic Analysis (BEA)
- GDP Deflator
  Federal Reserve Bank of St Louis

- DOLS and Cointegrating Error Correction Model
- Stock, James and Watson, Mark W, (1993), A simple estimator of cointegrating vectors in higher order integrated systems, Econometrica , 61(4) :783-820.
- Tax Base Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics

  Donald Bruce, William F. Fox and M. H. Tuttle

Southern Economic Journal Vol. 73, No. 2 (Oct., 2006), pp. 315-341 (27 pages)

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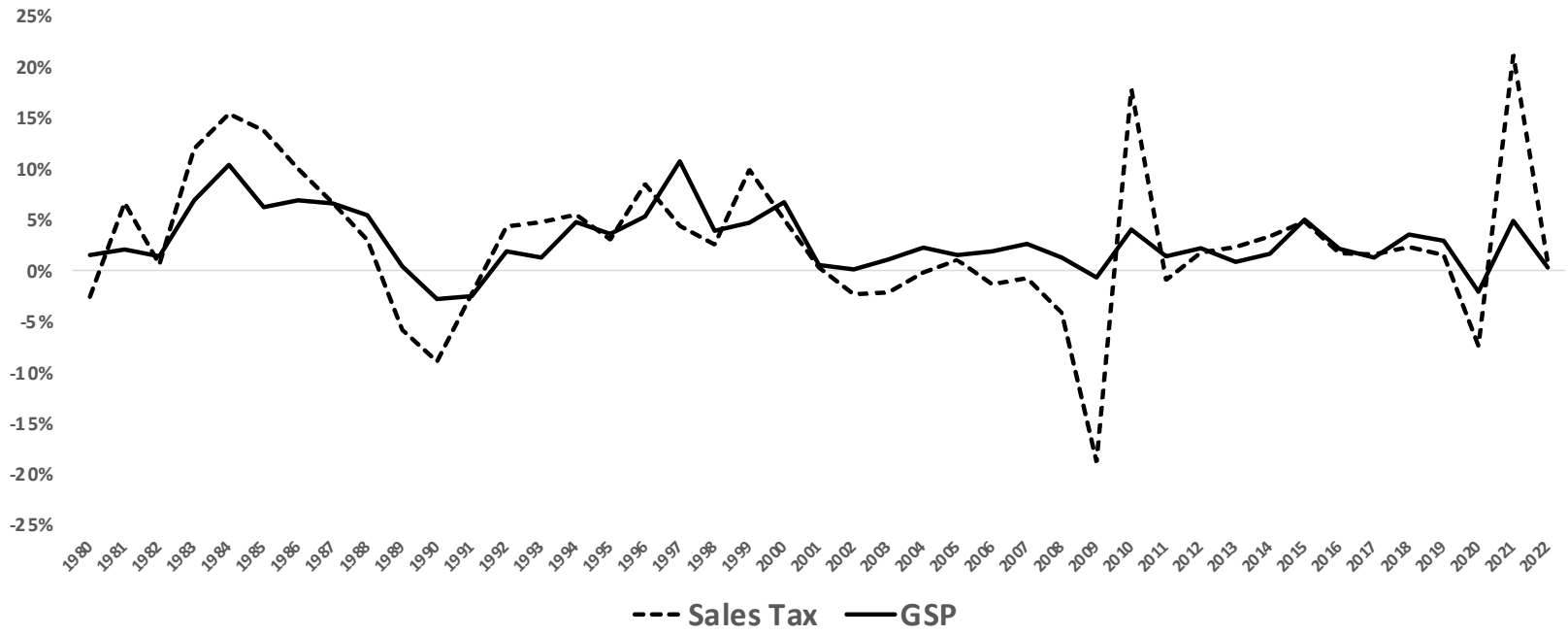
Massachusetts Sales Tax and Gross State Product (Annual Growth Rates) 1980-2022



Some Additional Work to Prepare Time Series for Estimation to avoid Spurious Regression

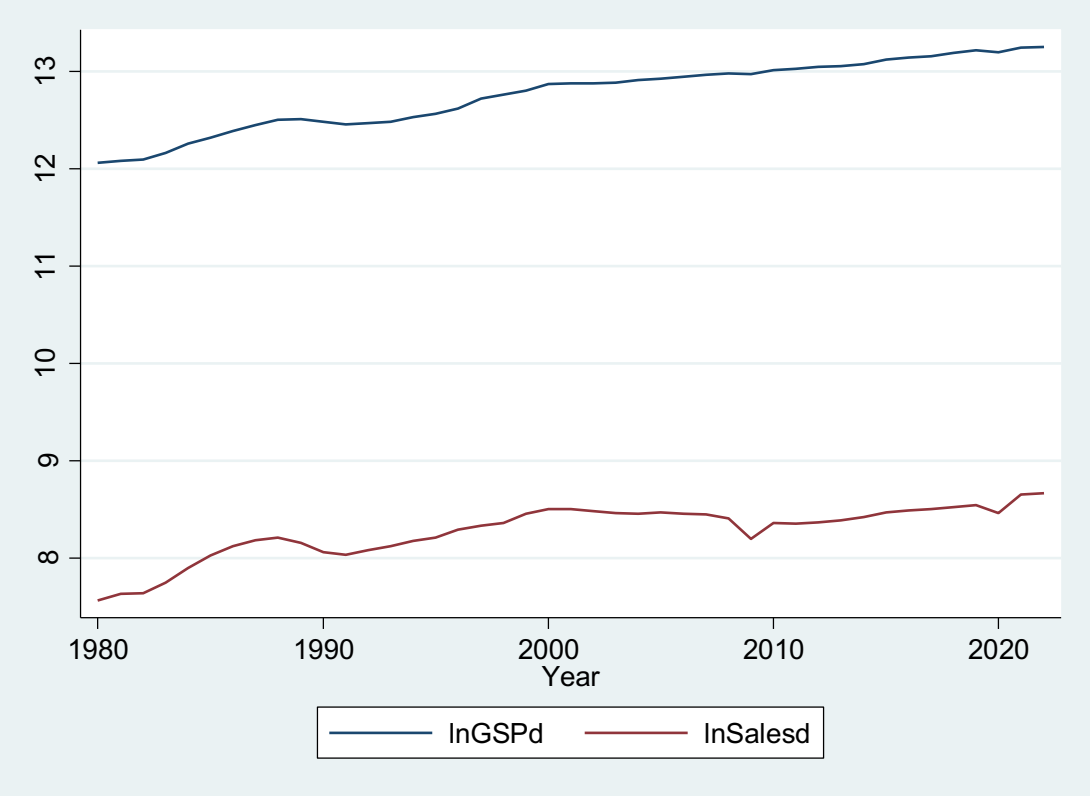
- Unit Root Test

  Augmented Dickey Fuller Test to confirm data are stationary

  Most times series are non-stationary, but differenced series are stationary.

- Engel Granger Test for Cointegration
- Cointegration is a statistical method used to test the correlation between two or more non-stationary time series in the long run or for a specified period. The method helps identify long-run parameters or equilibrium for two or more variables.

LNGSPD (differenced log of GSP) Vs LnSalesD (differenced log of sales



Long Run Elasticity:

$$R_t = f(I_t) \quad (1)$$

$$R_t = \beta_0 + \beta_1 I_t + \sum_{g=-j}^{+j} \gamma_g \, \Delta I_{t+g} + \omega_t \quad (2)$$

$\frac{\partial R_t}{\partial I_t} = \beta_1$ **, is the Long Run Elasticity**

Symmetric Short Run Elasticities:

$$R_t - R_t^* = \varepsilon_t = R_t - \beta_0 - \beta_1 I_t \quad (3)$$

$$R_t - R_{t-1} = \alpha_0 + \alpha_1 (I_t - I_{t-1}) + \alpha_2 \varepsilon_{t-1} + \mu_t \quad (4)$$

$\frac{\partial \Delta R_t}{\partial \Delta I_t} = \alpha_1$**, is the short-run symmetric tax Elasticity.**

$\frac{\partial \Delta R_t}{\partial \varepsilon_{t-1}} = \alpha_{2,}$ ***is* the adjustment parameter gives the percentage of disequilibrium that is removed in every period.**

Asymmetric Short-Run Tax Elasticities:

$$\Delta R_t = \alpha_0 + \alpha_1 \Delta I_t + \theta_1 (D_t * \Delta I_t) + \alpha_2 \varepsilon_{t-1} + \theta_2 (D_{t-1} * \varepsilon_{t-1}) + \varphi_t \quad (5)$$

$\frac{\partial \Delta R_t}{\partial \Delta I_t} = \alpha_1 + \theta_1$ **; if** $D_t = 1$

$\frac{\partial \Delta R_t}{\partial \varepsilon_{t-1}} = \alpha_2 + \theta_2$**; if** $D_t = 1$

The total disequilibrium removed after t periods is given by $1-(1+\alpha_2)^t$**.**

Case for Asymmetric Elasticities

- Generally, by design, the short-run asymmetric elasticity is lower when the current total sales tax revenue is below its long-run equilibrium than when it is above equilibrium, provided $\theta_1 > 0 \; and \; statistically \; significant \; in \; equation \; 5$

a. <u>When current total sales tax is below its long-run trend and adjusting from below</u>:

- With any change in GSP, consumption other than exempt items (food and prescription drugs) will slowly adjust to its long-run equilibrium during the recovery period. Consumers are hesitant to buy big-ticket items like automobiles, washers, dryers, televisions, and other home and yard equipment. Consumers will slowly adjust to taking vacations and spending on social events.

<u>b. When current total sales tax is above its long-run trend and adjusting from above</u>:

- With any change in GSP, consumption other than exempt items (food and prescription drugs) will decline and adjust to its long-run equilibrium during the contractionary period. Tax revenue starts falling as consumers start cutting spending on big-ticket items like automobiles, washers, dryers, television, and other home and yard equipment. Consumers will potstone/curtail their vacation plans and spending in social events.

Estimation Results

	Long Run		Symmetric Short Run		Adjustment Parameter	
Tax Type	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Sales Tax	**0.644**	**0.000**	**1.729**	**0.000**	**-0.243**	**0.007**

	Asymmetric Short Run							
	Tax Elasticity				Adjustment Parameter			
	When Current Revenue Value is Below Long Run Equilibrium		When Current Revenue Value is Above Long Run Equilibrium		When Current Revenue Value is Below Long Run Equilibrium		When Current Revenue Value is Above Long Run Equilibrium	
Tax Type	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
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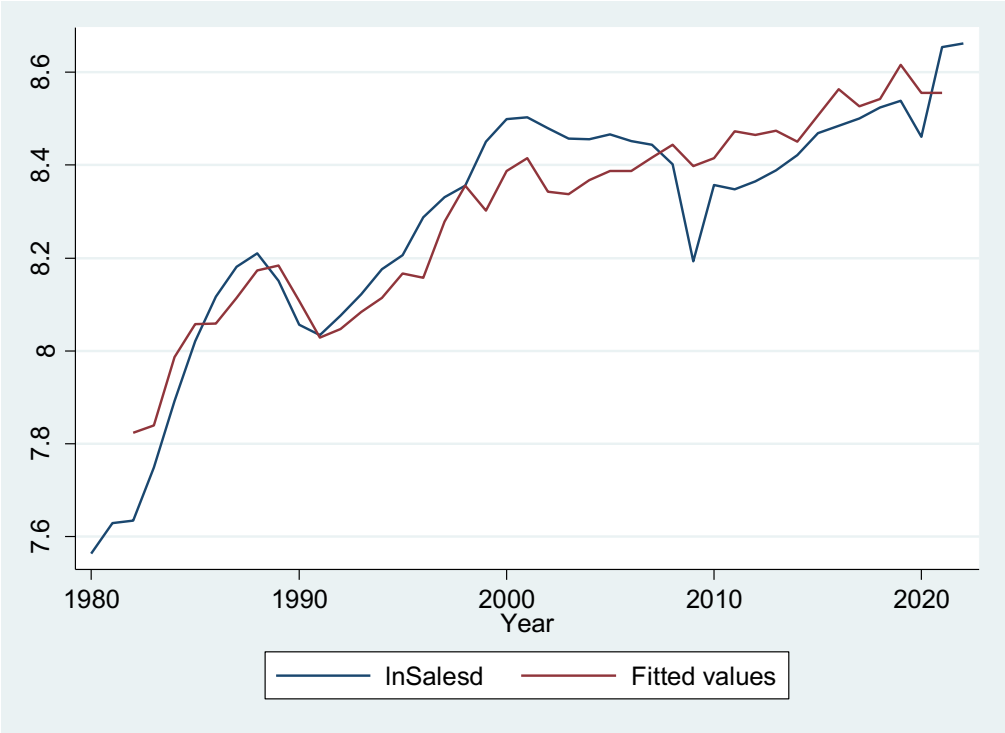
Actual vs. Predicted Value Sales Tax



Some Policy Options to Reduce Revenue Variability in General

- Impose Sales Tax on food items-reduce variability but compromise equity
- Eliminate tax expenditure items : credits, exemptions, exclusions, preferential treatments, deductions
- Proportional income tax system (may help revenue sufficiency) but increase variability (rely on high income earners) –MA “millionaires” tax; tax rate of 9% (5%+4%) for income > $1M thresh-hold went into effect in 2023.
- Use General funds for budgetary purpose only to avoid unnecessary cuts during economic slowdowns
- Rainy Day Funds - $7.2 billion in FY 2023 in Massachusetts.

Thank You!
Any Questions?

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