



FTA Revenue Estimating Conference

Matt Schoeppner, Economist, State of Minnesota

Tampa, Florida

September 30, 2015

How Much Is Enough?

Prevailing Revenue Volatility & State Rainy Day Funds

2009 - 2011

TwinCities.com
PIONEER PRESS

It doesn't have to be this way, Minnesota

By Kevin Goodno and Jay Kiedrowski

POSTED: 01/25/2009 12:01:00 AM CST

MINNPOST

Minnesota's rainy day fund is drained, and now we're in a budget storm

By Sharon Schmickle | 02/15/10

★ StarTribune

Editorial: How to manage a volatile state budget

Without change, deficits will persist, report says.

JANUARY 12, 2009

The New York Times

Minnesota Government Shuts in Budget Fight

By MONICA DAVEY JUNE 30, 2011

THE WALL STREET JOURNAL

Fitch Cuts Minnesota From Triple-A

By KELLY NOLAN July 7, 2011

★ StarTribune

Minnesota's bond rating downgraded

By rachelsb | SEPTEMBER 23, 2011 - 7:58PM

2013 - 2015

MINNPOST November forecast brings good news for Minnesota — but proceed with caution

By Christina Wessel | 12/06/13

StarTribune No reason not to support a higher Minnesota budget reserve

The required level of cushion hasn't been updated since 2001, even as the general fund has grown by 59 percent.

By Richard Cohen | MARCH 10, 2014

StarTribune A healthy budget reserve is state's shock absorber

"Give it back" sounds good — until revenues drop.

By Editorial Board Star Tribune | MARCH 28, 2014

StarTribune Minnesota puts money in the bank, raising reserves to highest level ever

Blog post by Rachel E. Stassen-Berger | JULY 1, 2014

StarTribune Keep building state's reserve fund

Economic news is good, but state revenues remain volatile.

By Editorial Board Star Tribune | JULY 16, 2014

MPRnews S&P: Minnesota's fiscal picture brightening, top debt rating may return

MPR News Staff · Aug 5, 2015

StarTribune Wyoming looks to Minnesota in setting its rainy-day fund

By Ricardo Lopez | SEPTEMBER 19, 2015

How Much Is Enough?

Prevailing Revenue Volatility & State Rainy Day Funds

- Most state governments (incl. Minnesota) use rainy day funds (RDFs) to cushion against fiscal stress caused by changing economic conditions and tax policy preferences.
- Yet public finance literature offers little guidance on the amount of RDF savings a state needs.
- Our method provides a comprehensive empirical method for estimating an appropriate size RDF based on prevailing cyclical volatility of a state's revenue system.



Key Motivations

We draw on the motivation that state RDFs are not a one-size-fits-all solution.

Instead:

- **Changing economic conditions and tax policy choices are unique among states.**
- **Growth, volatility, and diversity characteristics underlying state revenue streams are inherently different.**
- **Appropriate state RDF considerations require state-specific focus in a comprehensive and time-varying manner.**



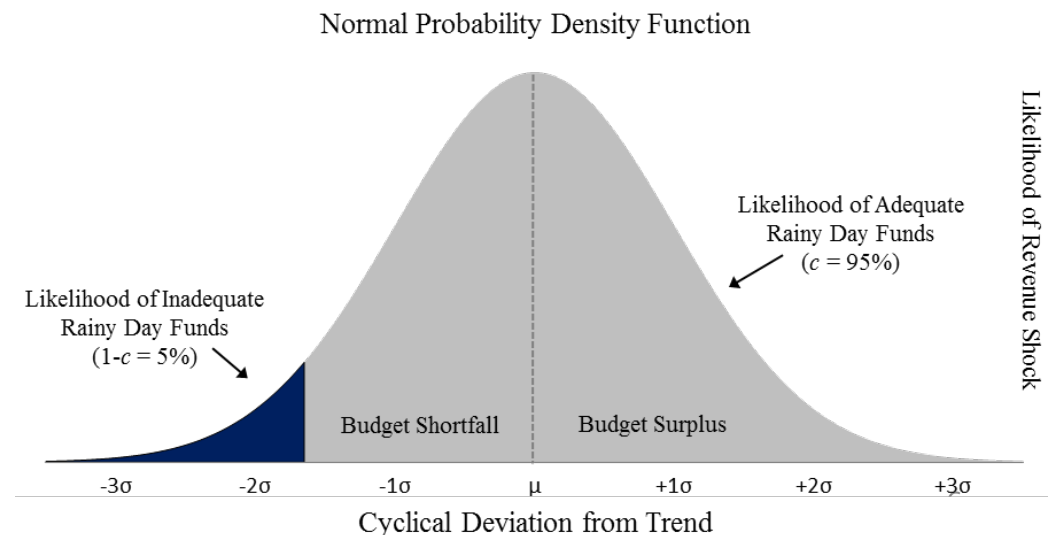
Conceptual Framework

We construct a normal probability density function of state general fund revenues.

- Scale parameter σ is estimated using a time-varying portfolio formula. This integrates dynamic measures of composition, diversification, and volatility for detailed revenue components:

$$\sigma_{P,t} = \sqrt{\sum_{i=1}^N \sum_{j=1}^N w_{i,t} w_{j,t} \rho_{ij,t} \sigma_{i,t} \sigma_{j,t}}$$

- Systematic changes in portfolio σ are quantified in four steps.



Outline

1. Design

- Empirical Considerations
 - Time Period
 - Measuring Techniques
- Minnesota's Tax System
 - Description
 - Data Sources



2. Process & Results

- **Step 1: Detach Cyclical Deviation from Long-term Trend Growth Rate**
Method: Hodrick-Prescott filter
- **Step 2: Measure Time-Varying Cyclical Volatility.**
Method: Integrated Generalized Autoregressive Conditional Heteroskedasticity (IGARCH) model
- **Step 3: Measure Time-Varying Covariation between Components**
Method: Integrated form of Dynamic Conditional Correlation (DCC) model
- **Step 4: Quantify System-Wide Volatility Over Time**
Method: Portfolio Standard Deviation Formula

3. Compute Appropriate Size Rainy Day Fund

Design:

Empirical Considerations

- **Analyze 50-year period: 1963 to 2013**
- **Values are in nominal dollars**
 - Most of the state's tax provisions are based on current dollar values of income, profits, and goods and services
 - Converted to growth rates using log-differences (stationary)
- **Examine tax base (not revenues)**
 - Difficult to obtain a series of state revenue data uninfluenced by changes to tax law over time
 - Key objective is to provide guidance on policy options available to mitigate major responses to most economic disturbances
- **Use national data (not state)**
 - Availability of detailed state-level economic data is limited
 - National data serve as an appropriate proxy for state activity



Design:

Minnesota's Tax System (Description/Data Sources)

Major Sources of Revenue:

1. Individual Income Tax

Analyze 6 different personal taxable income types (before deductions) from IRS's *Statistics of Income (SOI)*

- Salaries and wages
- Taxable interest
- Ordinary dividends
- Net capital gains
- Business-related income
- All other taxable income

2. General Sales Tax

Analyze 5 purchase categories from the *National Income and Product Accounts (NIPAs)* of the Bureau of Economic Analysis (BEA)

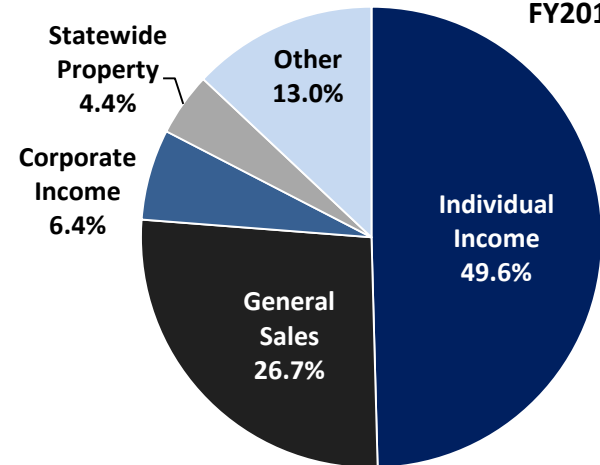
- Consumer spending on non-auto durable goods
- Non-durable goods subject to tax
- Investment and government consumption
- Household operation services
- Other services subject to tax

3. Corporate Income Tax - Pre-tax domestic corporate profits from the BEA *NIPAs*

4. Statewide Property Tax - Implicit price deflator for state and local government consumption expenditures and gross investment from the BEA *NIPAs*

5. Other Revenue & Tax Portfolio Shares – Derived from U.S. Census Bureau's *State Government Finance statistics* (adjusted for major changes in tax rates and bases).

Minnesota Non-Dedicated General Fund Revenue
FY2014-15



Empirical Strategy & Results

Step 1: Detach Cyclical Deviations from Long-Term Trend

Method: Hodrick-Prescott Filter

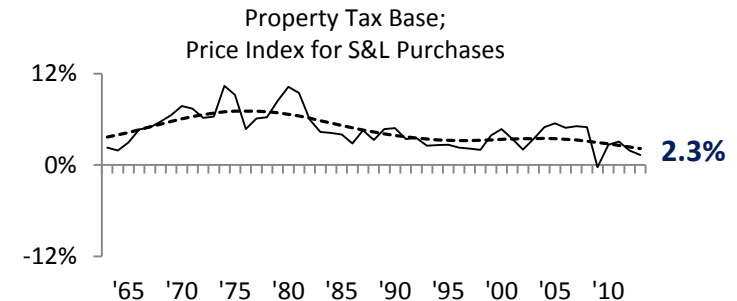
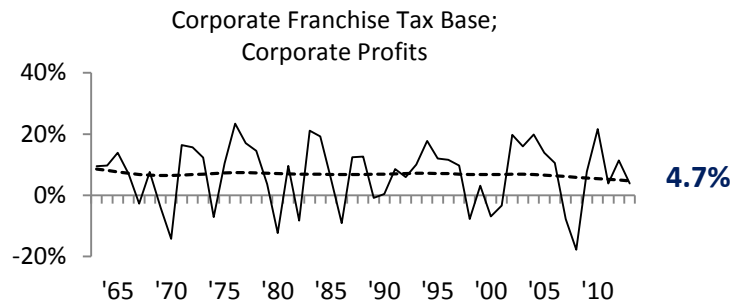
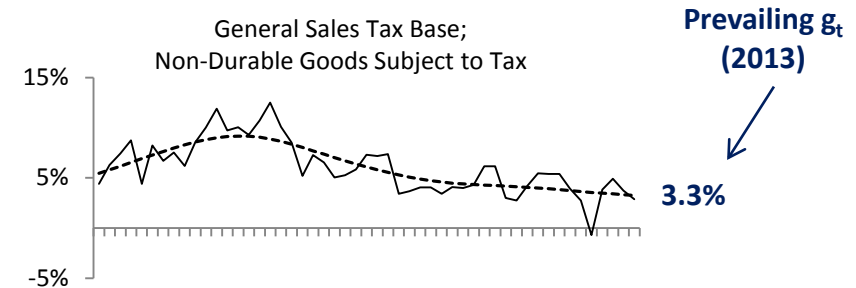
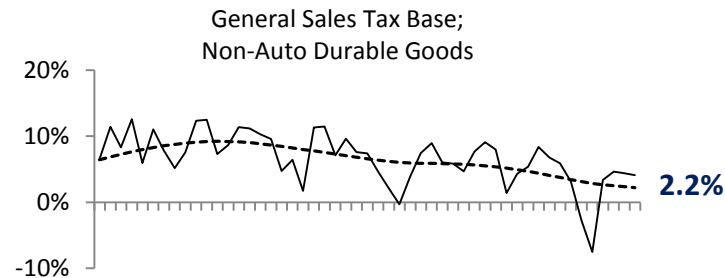
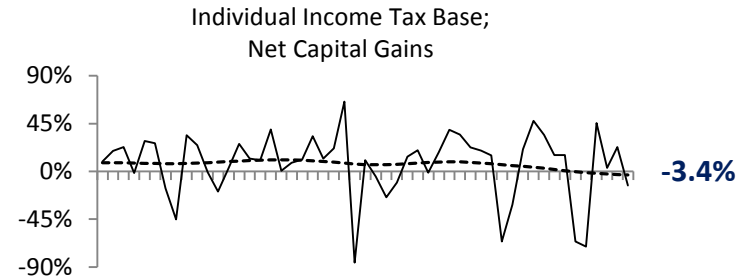
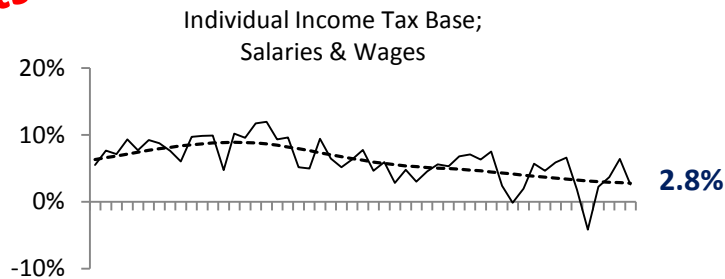
Growth Characteristics of Components in Minnesota's Tax Base: 1963 to 2013

Sample
of Results:

Growth Rate

— First Difference of the Log (TAX)

----- Trend Growth Rate (g)



Empirical Strategy & Results

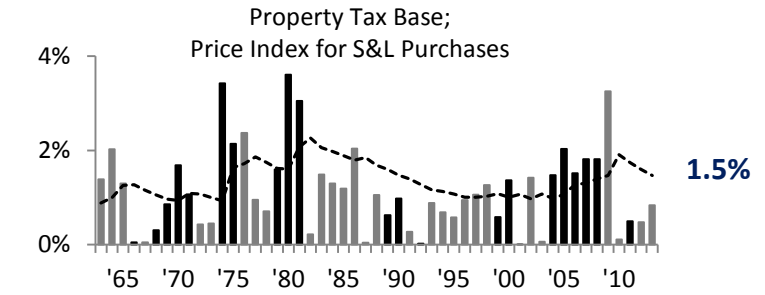
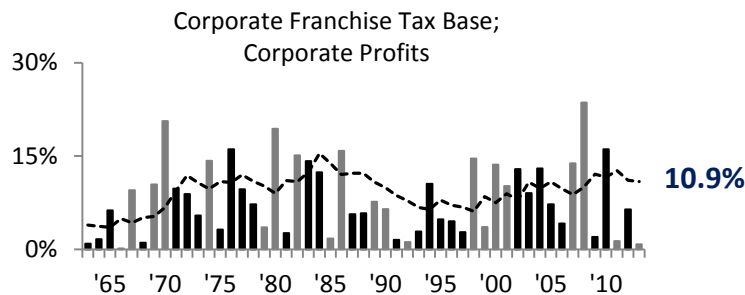
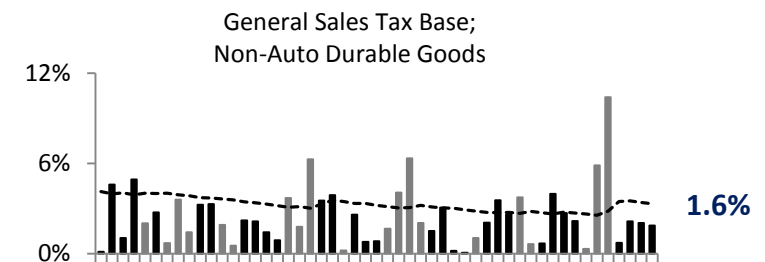
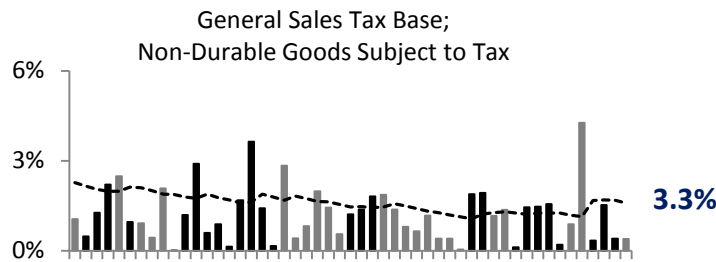
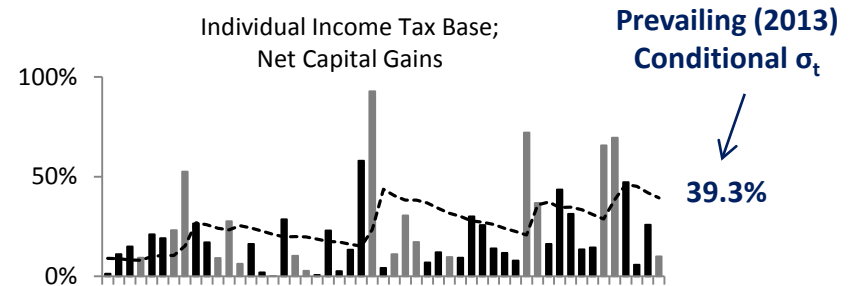
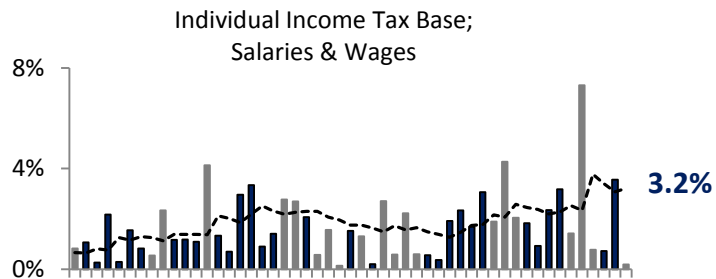
Step 2: Construct a Time-Varying Measure of Cyclical Volatility

Method: Integrated Generalized Autoregressive Conditional Heteroskedasticity (IGARCH) model

Volatility Characteristics of Components in Minnesota's Tax Base: 1963 to 2013

Absolute Value of Cyclical Deviations (CYC)
 (Black = Positive Deviation; Gray = Negative Deviation)

Conditional Standard Deviation (σ)



Sample
of Results:

Degree of Volatility

Empirical Strategy & Results

Step 3: Measure Time-Varying Covariation between Components

Method: Integrated form of Dynamic Conditional Correlation (INT-DCC) model

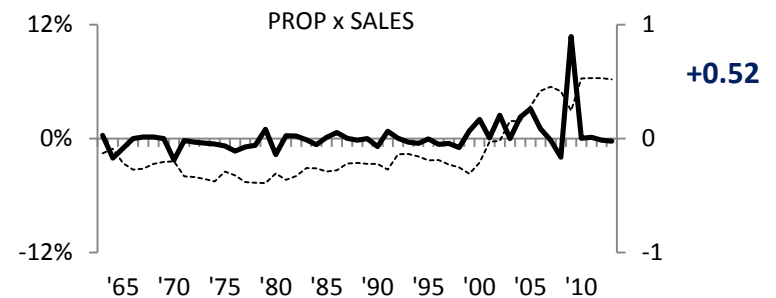
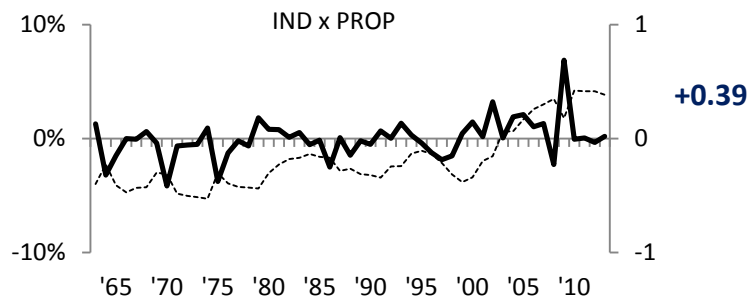
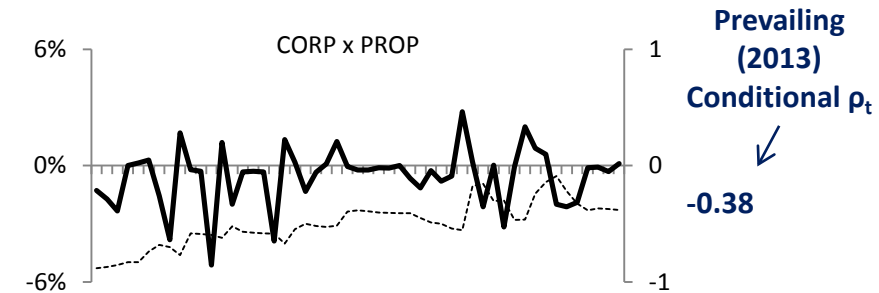
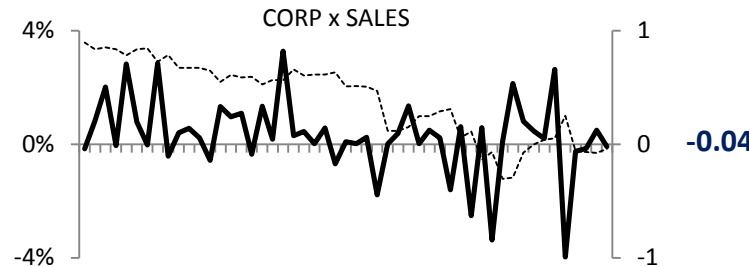
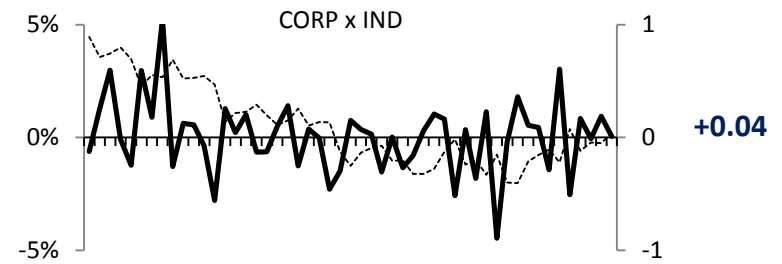
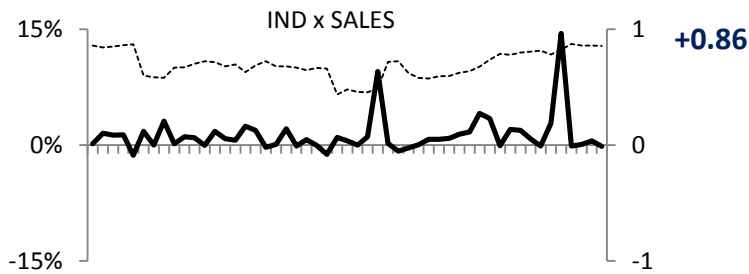
Conditional Correlation between Components in Minnesota's Tax Base: 1963 to 2013

— Product of Standardized Residuals; Left Axis

----- Conditional Correlation (ρ); Right Axis

Sample
of Results:

Degree of Covariation

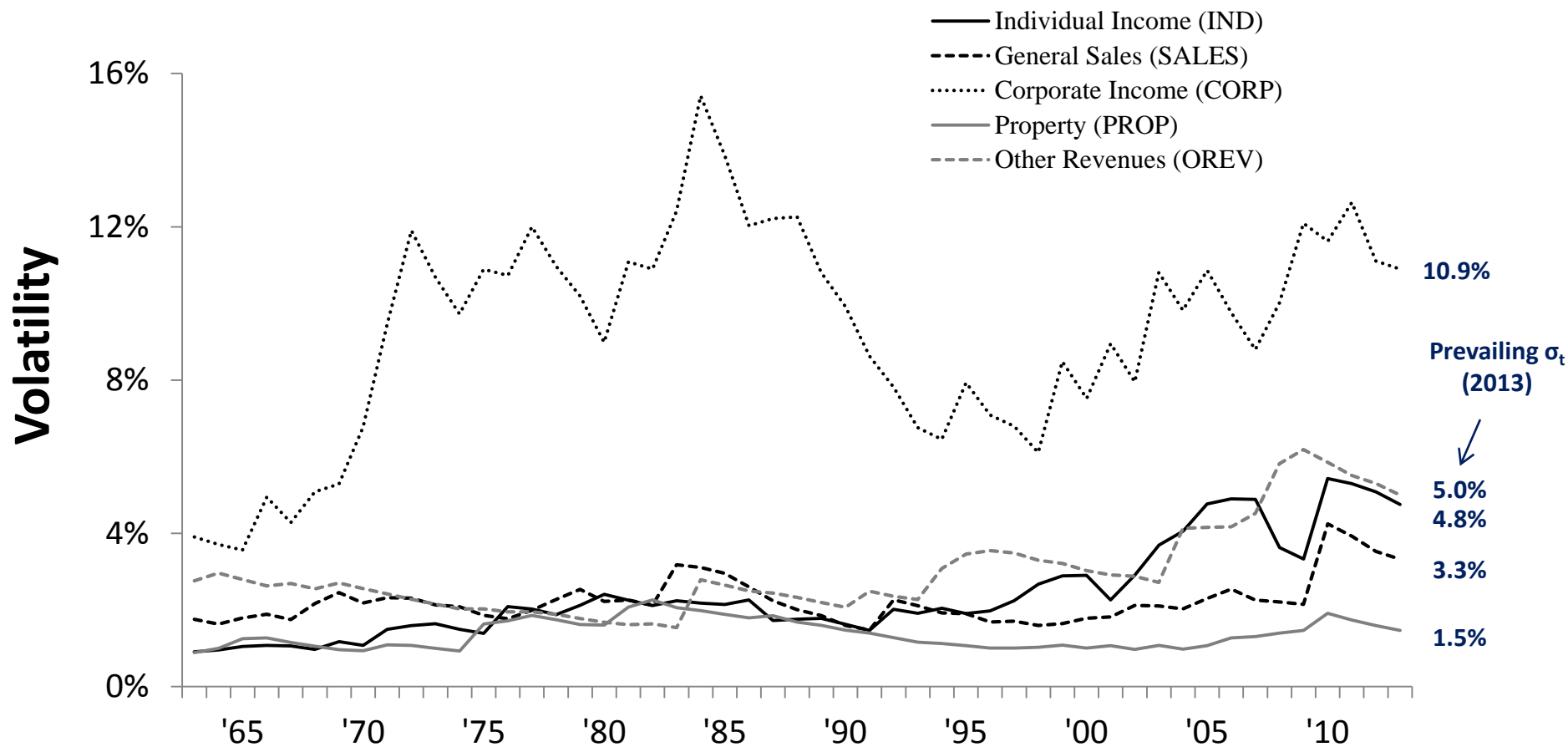


Empirical Strategy & Results

Step 4: Quantify System-Wide Volatility Over Time

Method: Portfolio Standard Deviation Formula

Time-Varying σ of Major Components in Minnesota's General Fund Tax Base: 1963 to 2013



Empirical Strategy & Results

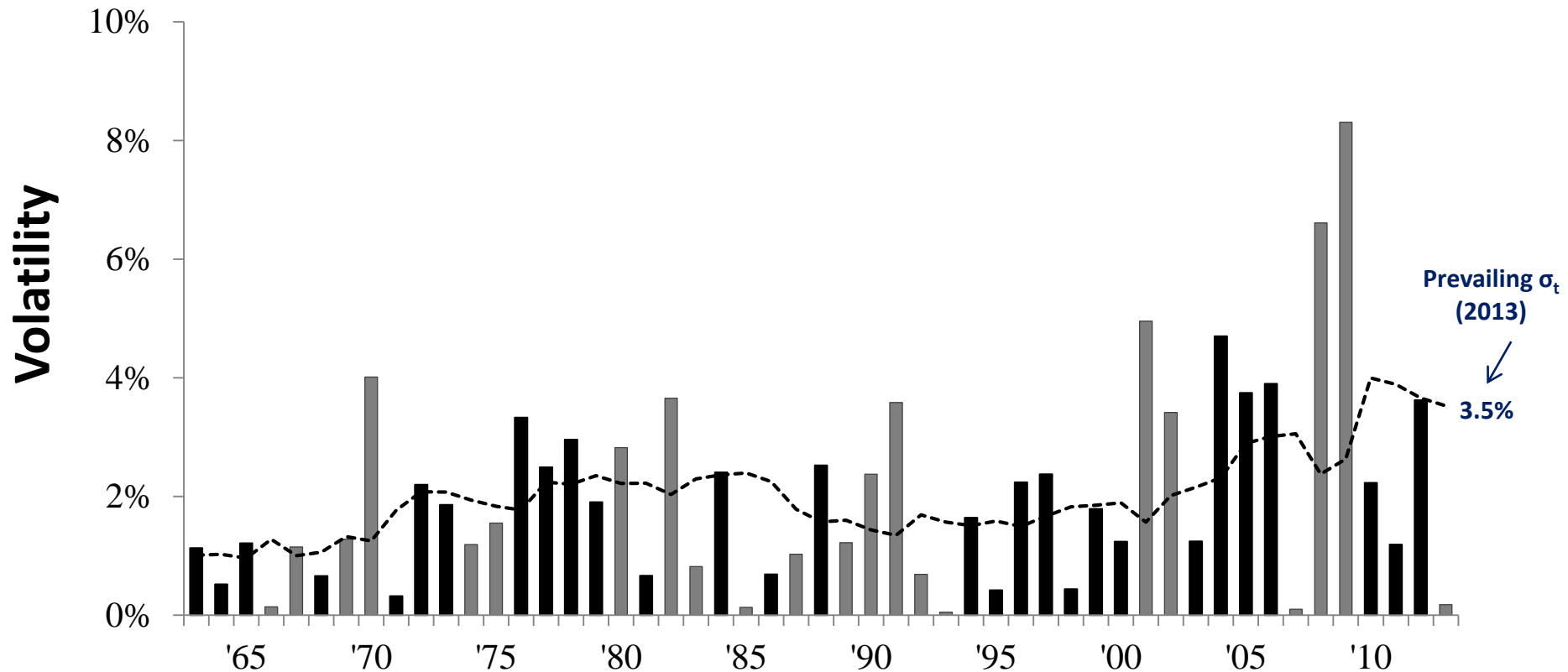
Step 4: Quantify System-Wide Volatility Over Time

Method: Portfolio Standard Deviation Formula

Volatility Characteristics of Minnesota's Total General Fund Tax Base Portfolio: 1963 to 2013

■ Absolute Value of Cyclical Deviations (CYC)
(Black = Positive Deviation; Gray = Negative Deviation)

----- Time-Varying Standard Deviation (σ)



* Calculated as the weighted sum of log differences less the weighted sum of trend growth rates.

Appropriate Size Rainy Day Fund?



Over time, an increasingly volatile tax base can have meaningful implications for long-term state budget planning.

To protect against the prevailing level of risk, an appropriate size RDF can be calculated:

- 1. Convert estimated tax base volatility ($\sigma = 3.5\%$) to revenue volatility ($\sigma = 4.2\%$)**
Reason: Progressivity in MN's individual income tax; elasticity w/ respect to tax base ≈ 1.27
- 2. Choose confidence level: % of outcomes RDF protects against shock (e.g. 95%)**
- 3. Multiply prevailing volatility measure by critical z-value ($4.2\% * 1.645 = 6.9\%$)**
Note: One-tailed critical z-value for 95% confidence level (normal distribution) = 1.645
- 4. Scale for number of years: $\sigma\sqrt{years}$ ($6.9\%\sqrt{2} = 9.8\%$ of annual revenues)**
Note: MN budgets on a two-year basis

Method demonstrates that a state RDF of *9.8% of annual revenues* will sufficiently protect against cyclical risk—w/ 95% confidence—during most recent two-year budget period.

Summary



- **Consider role of revenue volatility in context of state RDFs**
- **Estimate appropriate RDF size for Minnesota by constructing a normal pdf of unexpected shocks to state revenues:**
 - Scale parameter estimated using a portfolio σ
 - Integrates measures of volatility, diversification, and composition
 - Examine detailed components of state's tax base
- **Evaluate portfolio σ in the dynamic context of time (1963-2013):**
 - Annual measures of portfolio σ are quantified in 4 steps, including IGARCH process
 - Consideration of state RDF size can then be based on prevailing conditions
- **Results:**
 - Minnesota's tax base has grown more volatile since the late 1990s.
 - Attributable to increasingly unstable components, such as wages, forms of individual investment income, and corporate income. The changing composition and less short-run diversification are also contributing factors.
 - State rainy day reserve of 9.8% of annual revenues would adequately protect against cyclical economic risk.

Thank You

MATTHEW SCHOEPPNER

651.201.8048 | MATTHEW.SCHOEPPNER@STATE.MN.US

ECONOMIST | MINNESOTA MANAGEMENT & BUDGET



THOMAS F. STINSON

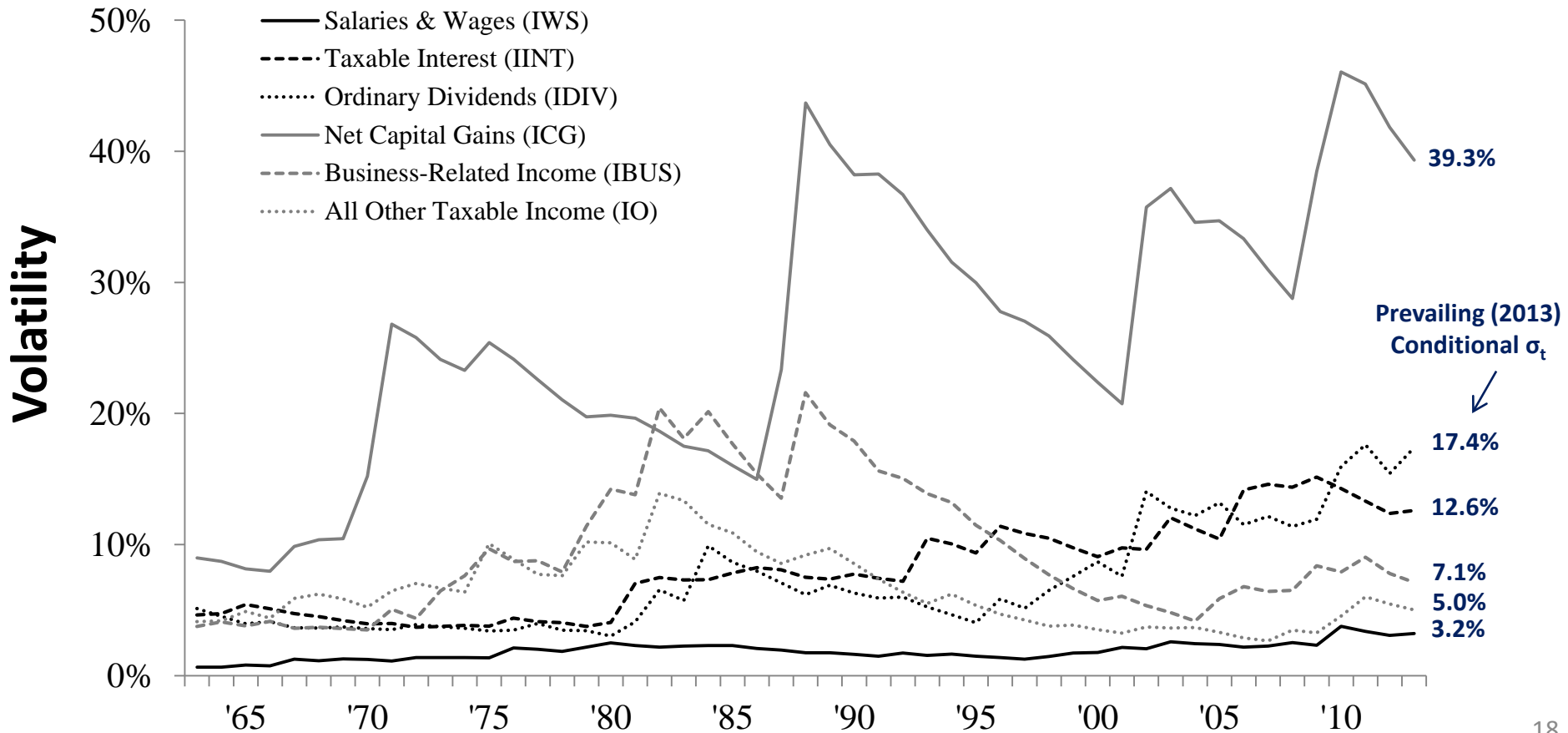
612.625.1217 | TSTINSON@UMN.EDU

PROFESSOR | DEPARTMENT OF APPLIED ECONOMICS
UNIVERSITY OF MINNESOTA



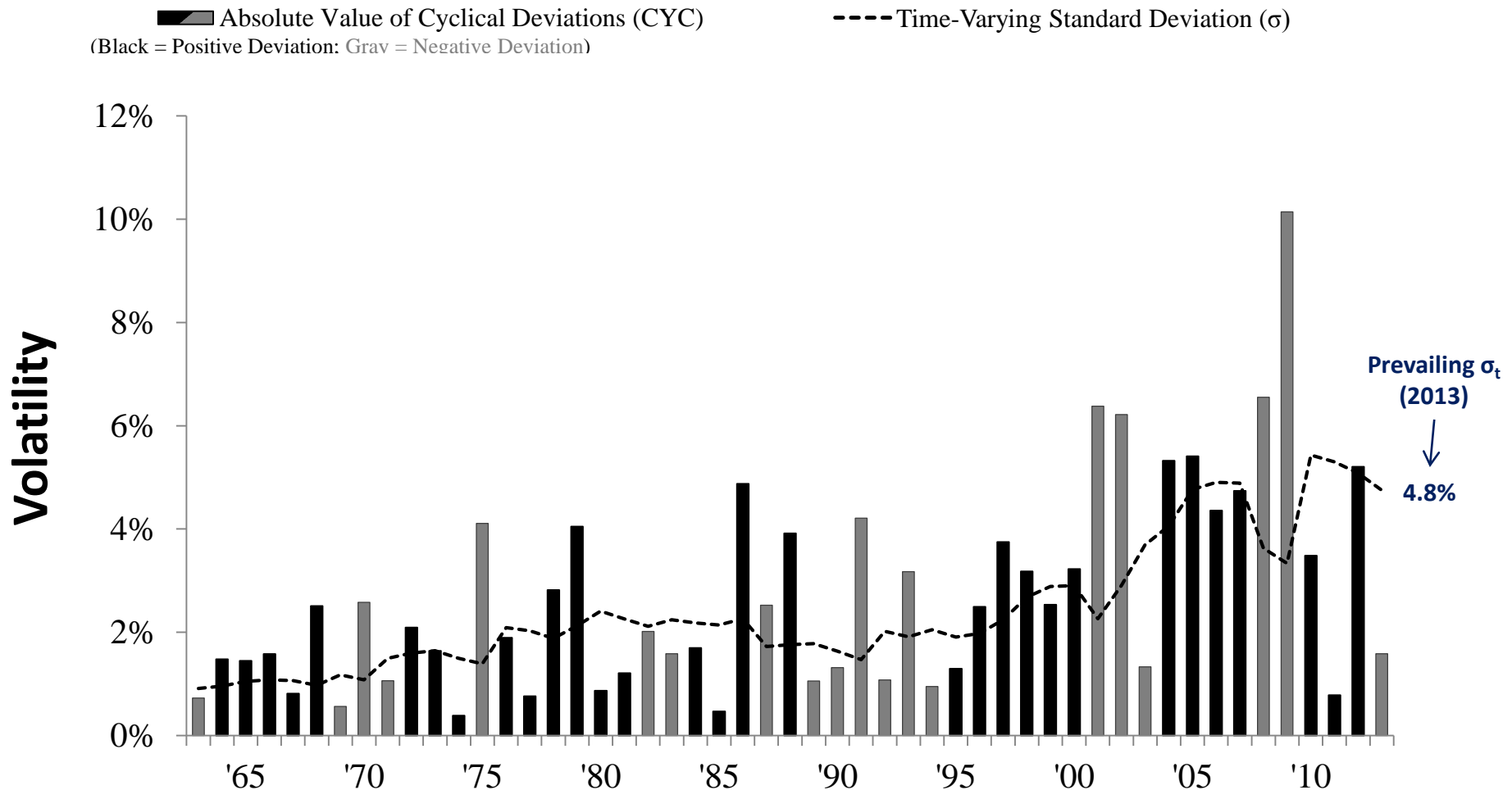
Supplemental Charts/Data

Time Varying σ of Minnesota's Individual Income Tax Base Components: 1963 to 2013



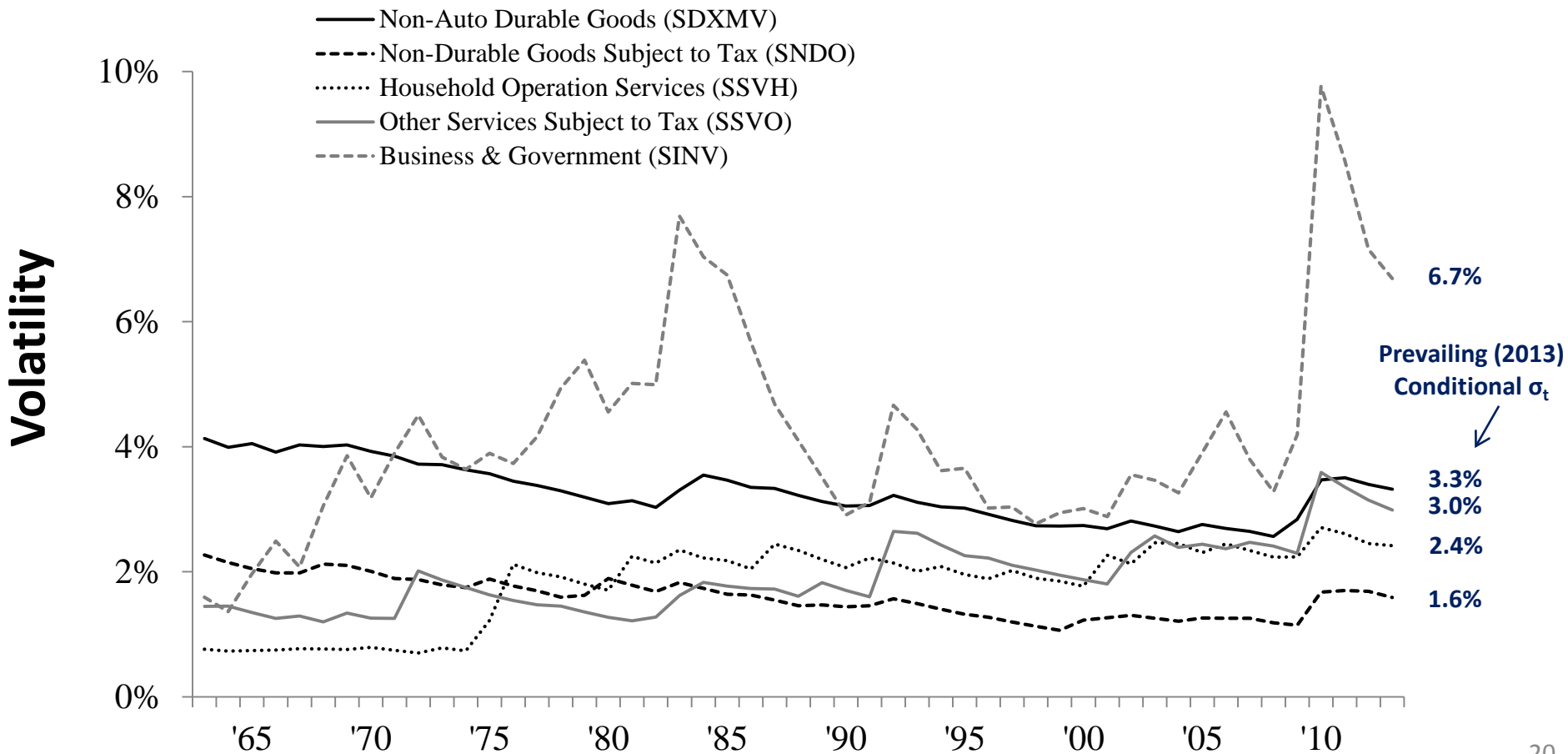
Supplemental Charts/Data

Volatility Characteristics of Minnesota's Individual Income Tax Base Portfolio: 1963 to 2013



Supplemental Charts/Data

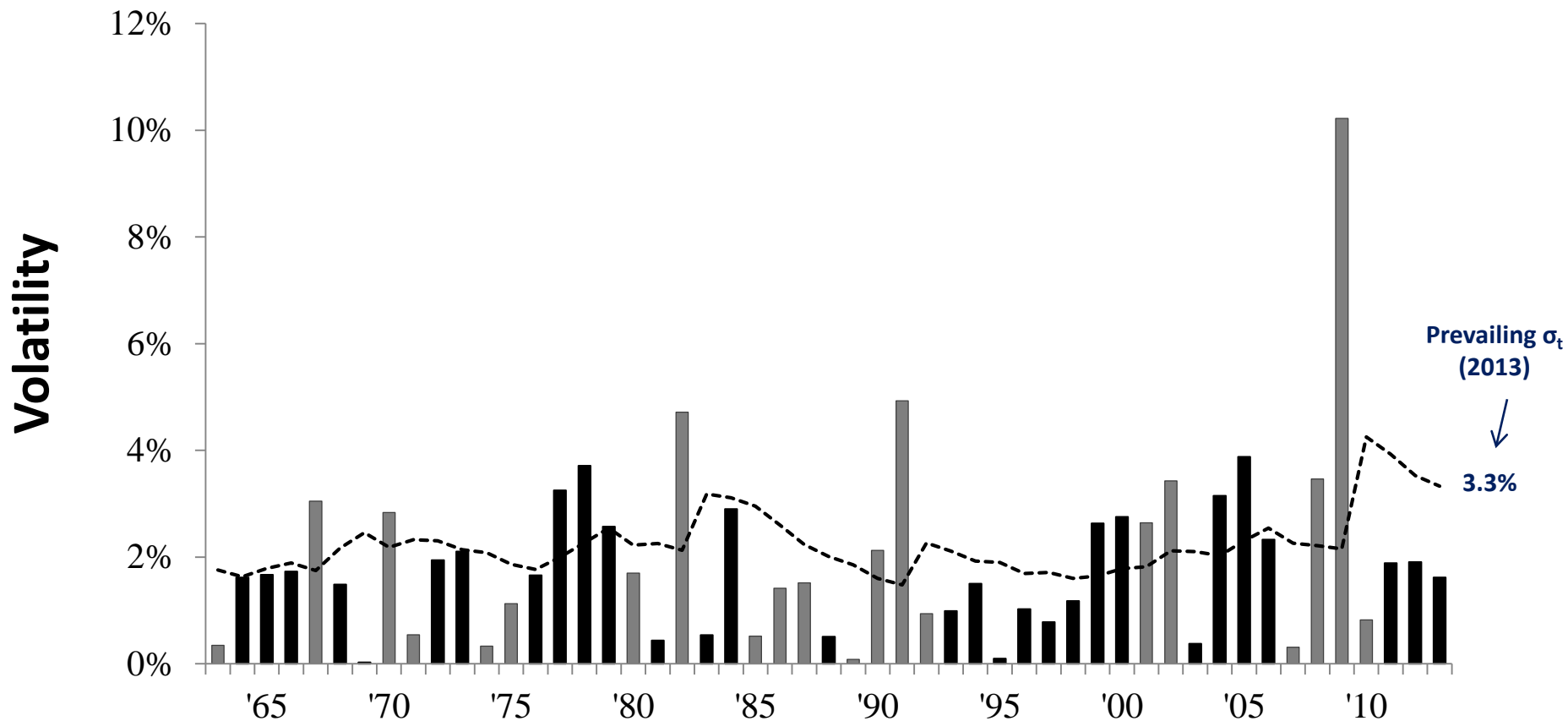
Time Varying σ of Minnesota's General Sales Tax Base Components: 1963 to 2013



Supplemental Charts/Data

Volatility Characteristics of Minnesota's General Sales Tax Base Portfolio: 1963 to 2013

■ Absolute Value of Cyclical Deviations (CYC) - - - Time-Varying Standard Deviation (σ)
(Black = Positive Deviation; Gray = Negative Deviation)

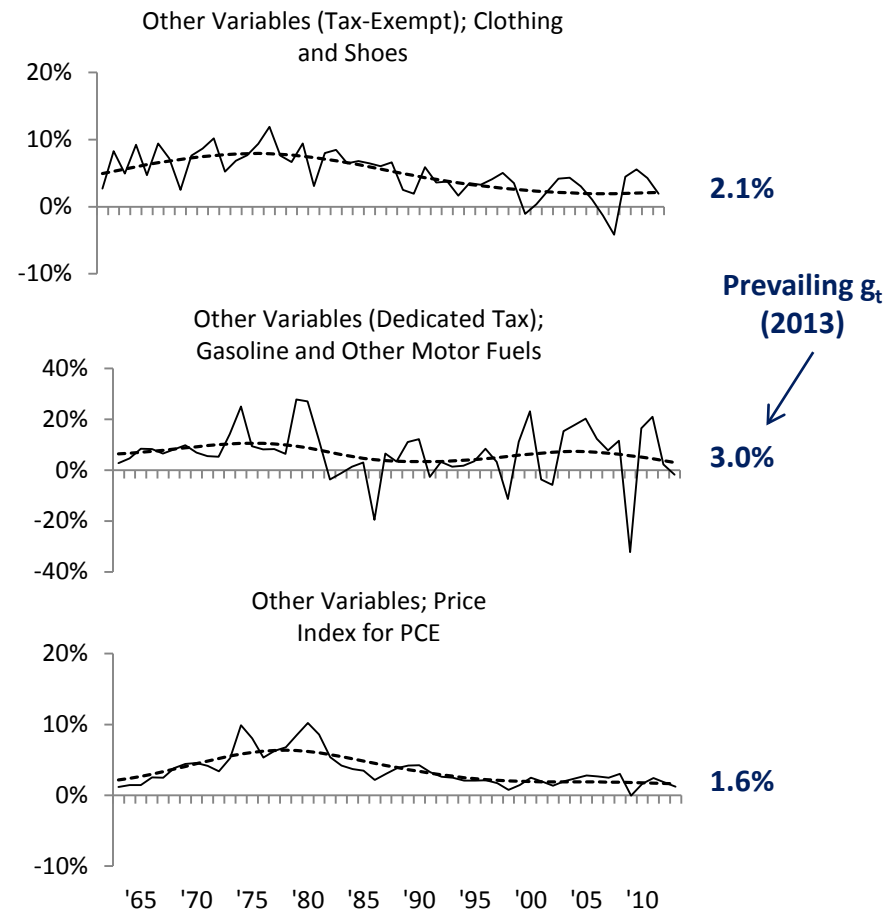
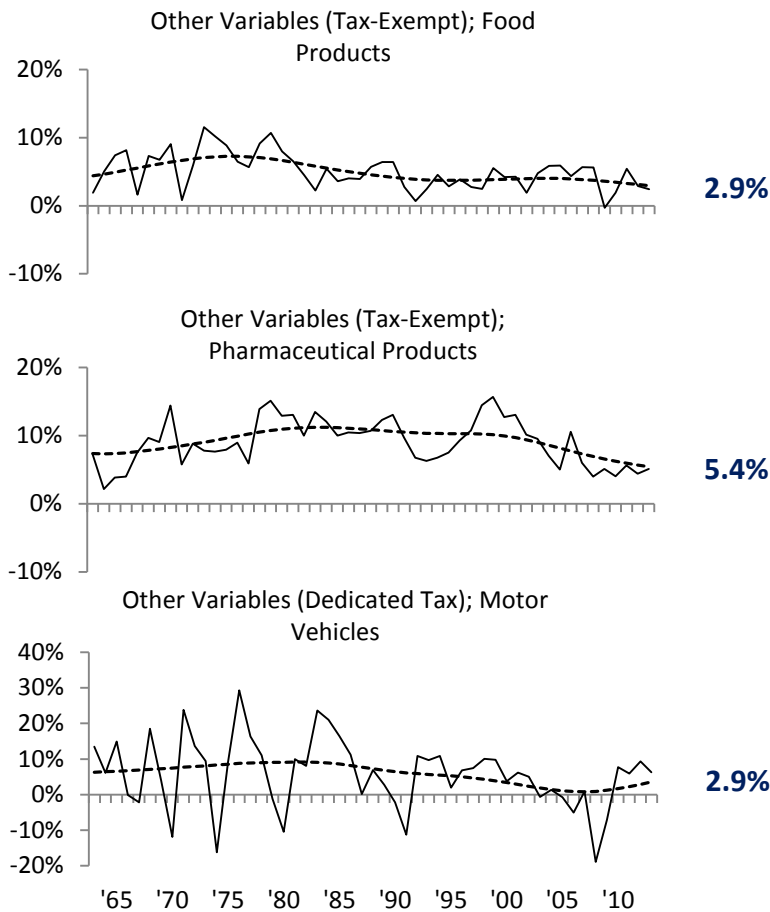


Supplemental Charts/Data

Growth Characteristics of Supplementary Variables: 1963 to 2013

— First Difference of the Log (TAX)

----- Trend Growth Rate (g)



Supplemental Charts/Data

Volatility Characteristics of Supplementary Variables: 1963 to 2013

 Absolute Value of Cyclical Deviations (CYC)
 (Black = Positive Deviation; Gray = Negative Deviation)

 Conditional Standard Deviation (σ)

