

Estimating Tax Base Volatility in Minnesota

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Tax Base Volatility

- Volatility measures the variation between expected (trend) growth and actual growth
- The traditional measure of volatility is the standard deviation (σ)
- In a normal distribution, 68% of values fall within $\pm 1 \sigma$ of the mean and 95% fall inside $\pm 2 \sigma$'s

Why Is Volatility Important?

- More volatile (higher σ) tax systems will have larger surpluses and deficits
- Tax system volatility helps determine how large a budget reserve is needed
- Volatility can be adjusted by changing either the proportion of revenue derived from each tax or the volatility of individual taxes

How We Measured Volatility

- Focused on tax base, not revenues
- Analyzed growth rates, not \$ amounts
- Computed yearly deviations from trend growth for components of the tax base
- Combined volatilities for each component of the tax base to produce an estimate of the system-wide volatility
- Covariances taken into account



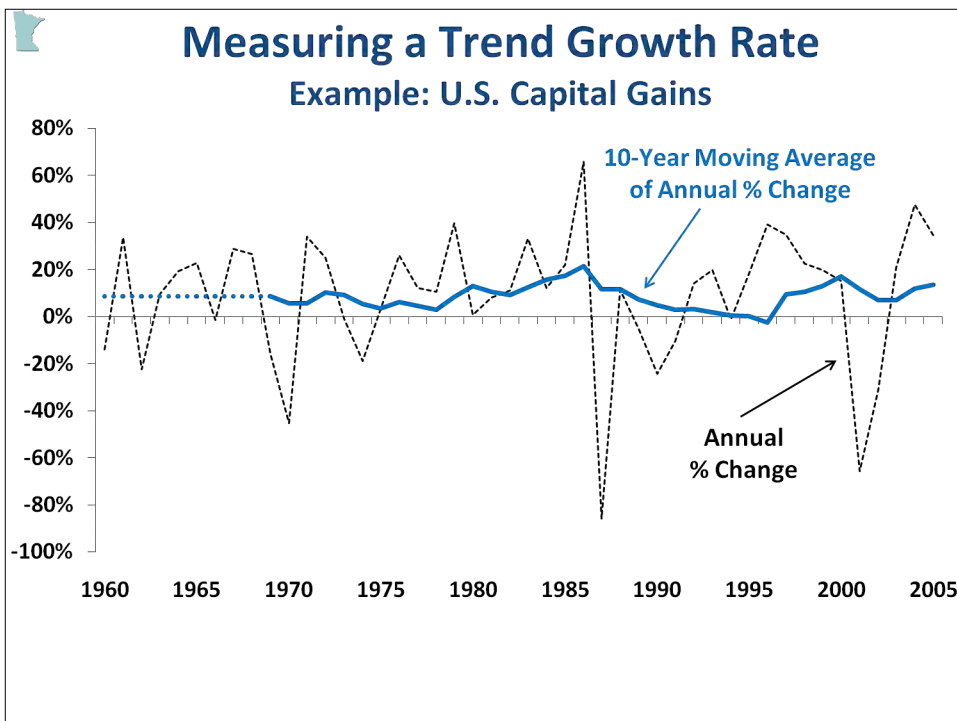
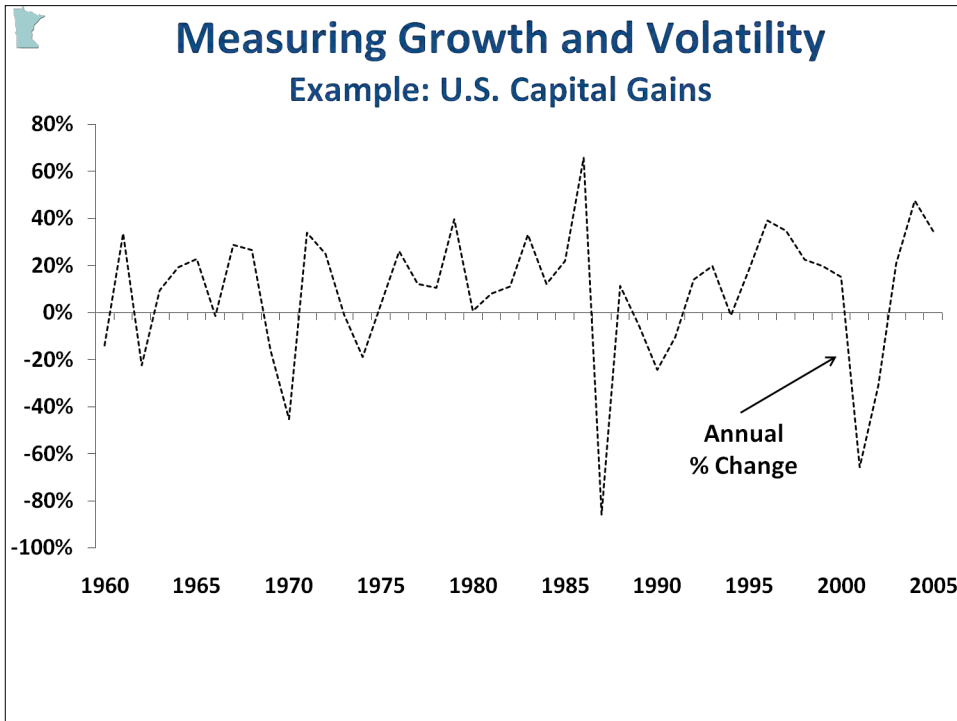
Questions

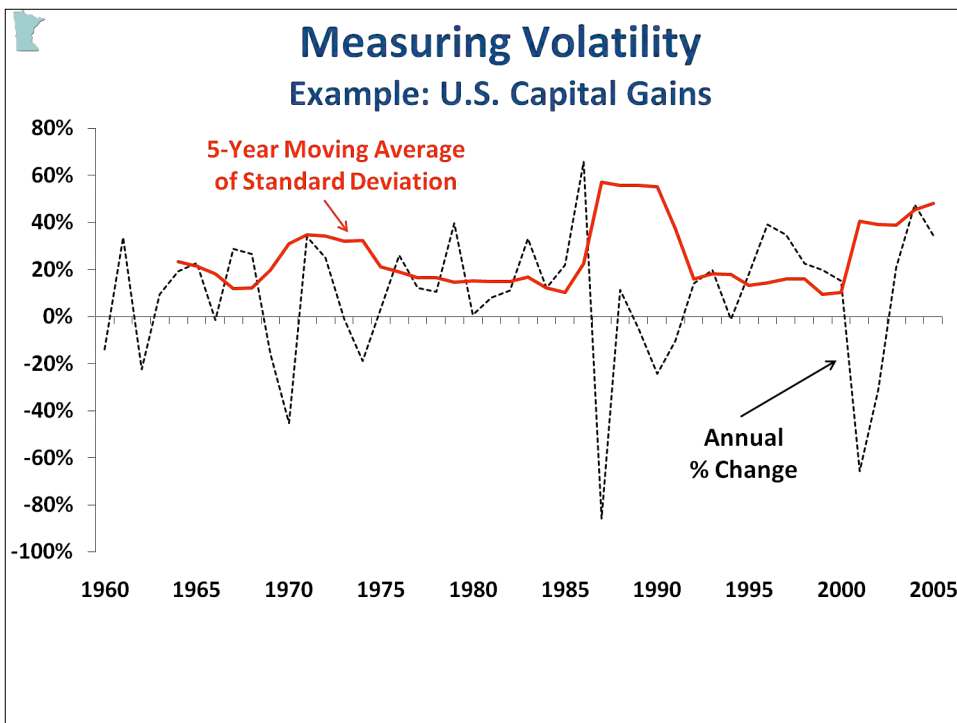
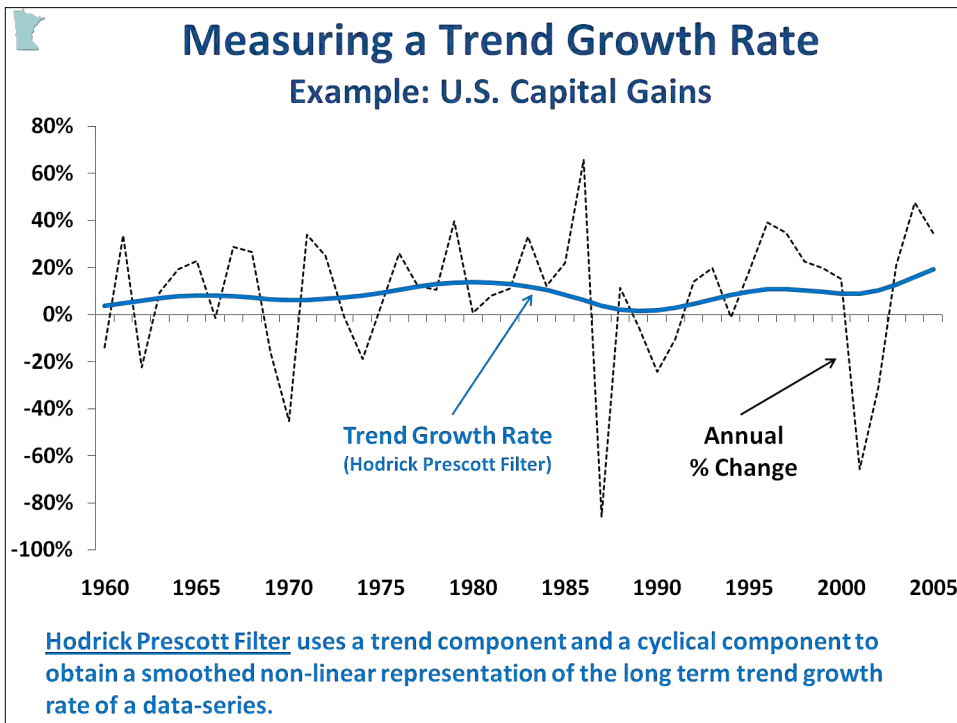
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- 2) Has the volatility of MN's tax system changed over time?
- 3) Can volatility be reduced by re-weighting the tax mix towards less volatile revenue sources or by changing the volatility of existing revenue sources?
- 4) How large a budget reserve is needed?

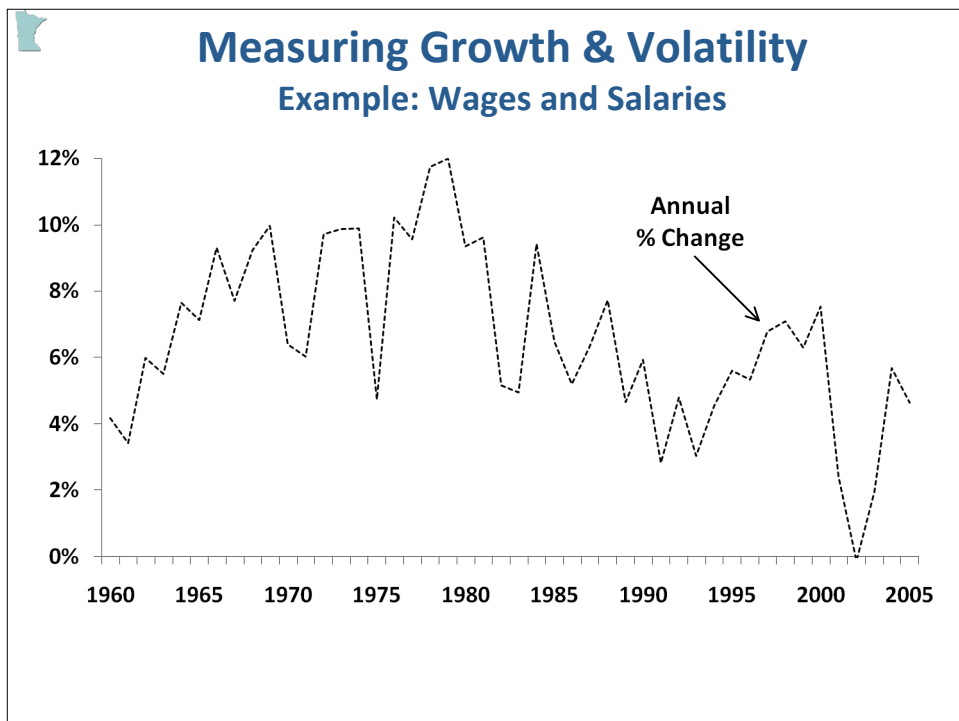
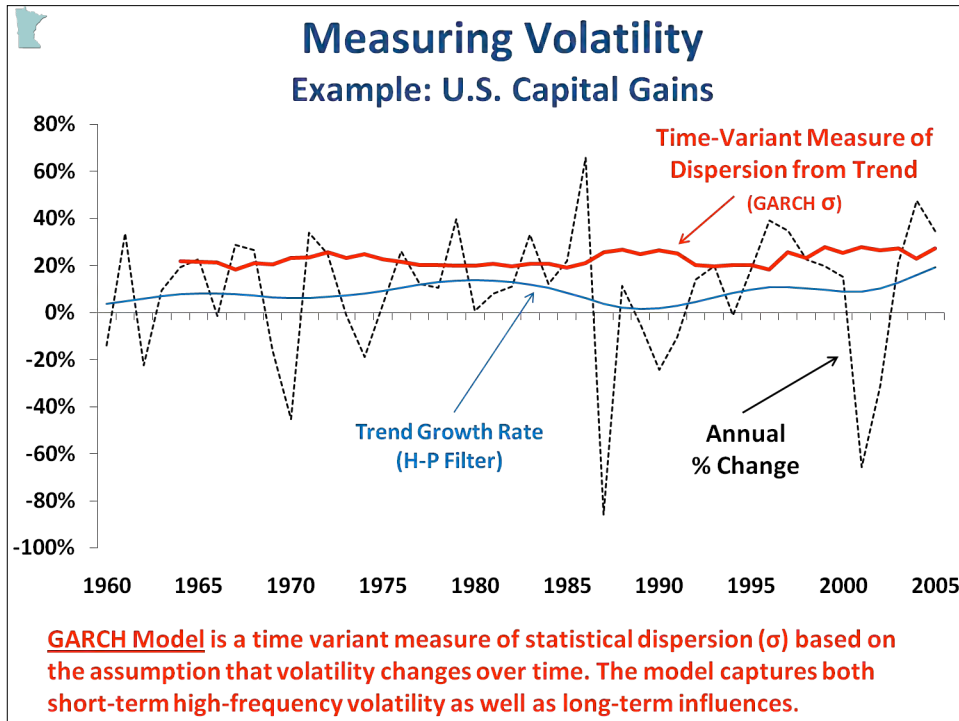


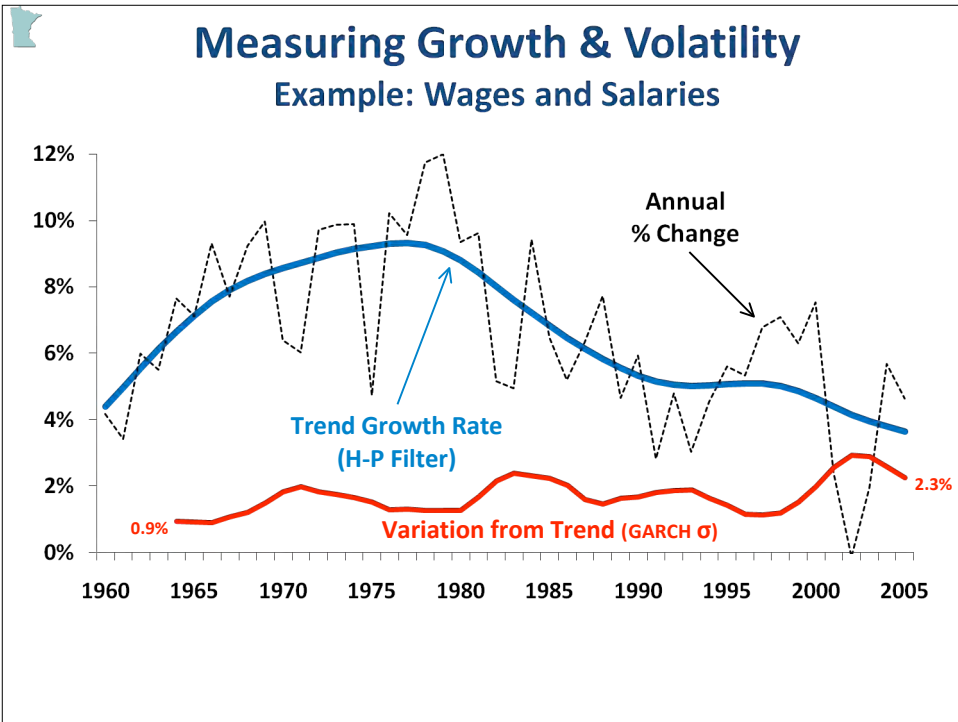
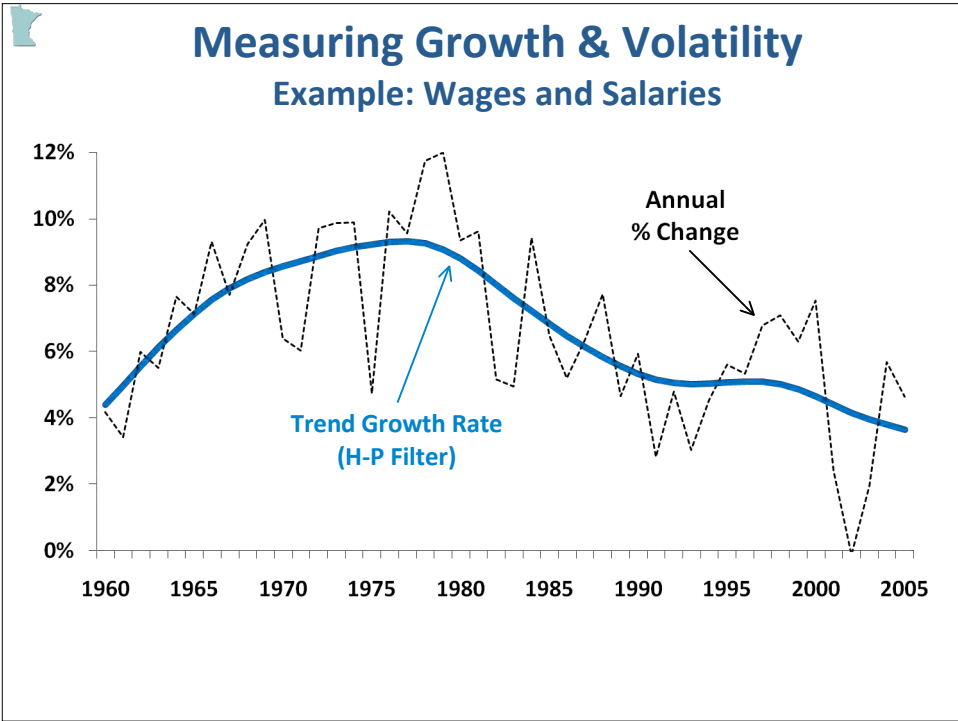
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Volatility Calculation Summary

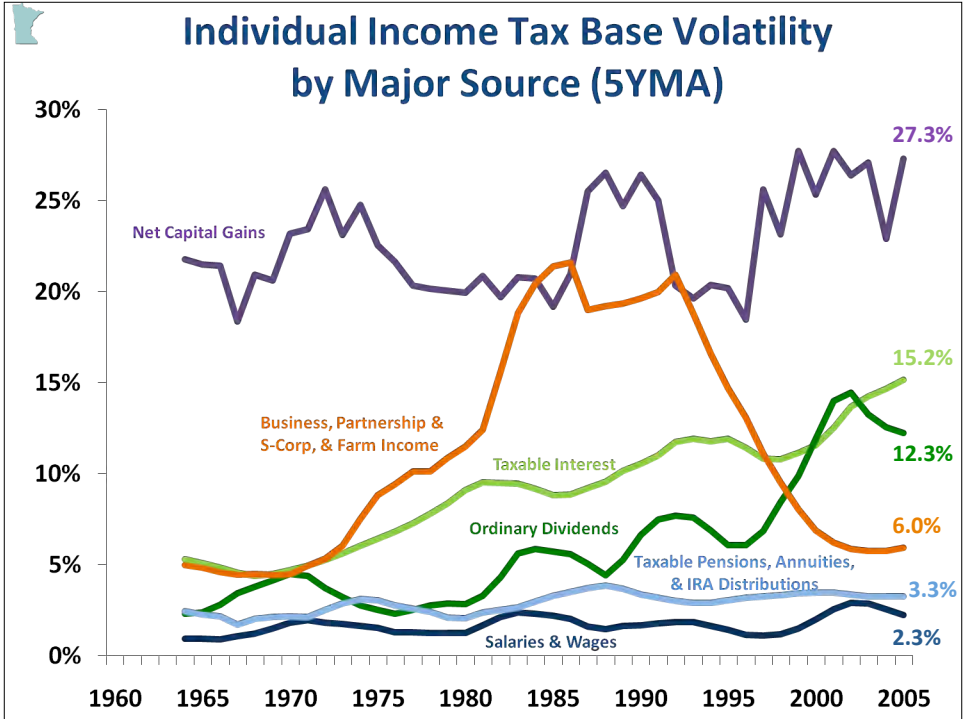
- H-P Filter estimates trend growth rate
- GARCH model estimates volatility (σ) from trend growth rate over time
- Markowitz's modern portfolio theory (MPT) used in volatility estimate
 - Portfolio Trend Growth Rate: weighted sum of the individual component's growth rates
 - Portfolio Volatility: weighted sum of the variances and covariances of the individual components

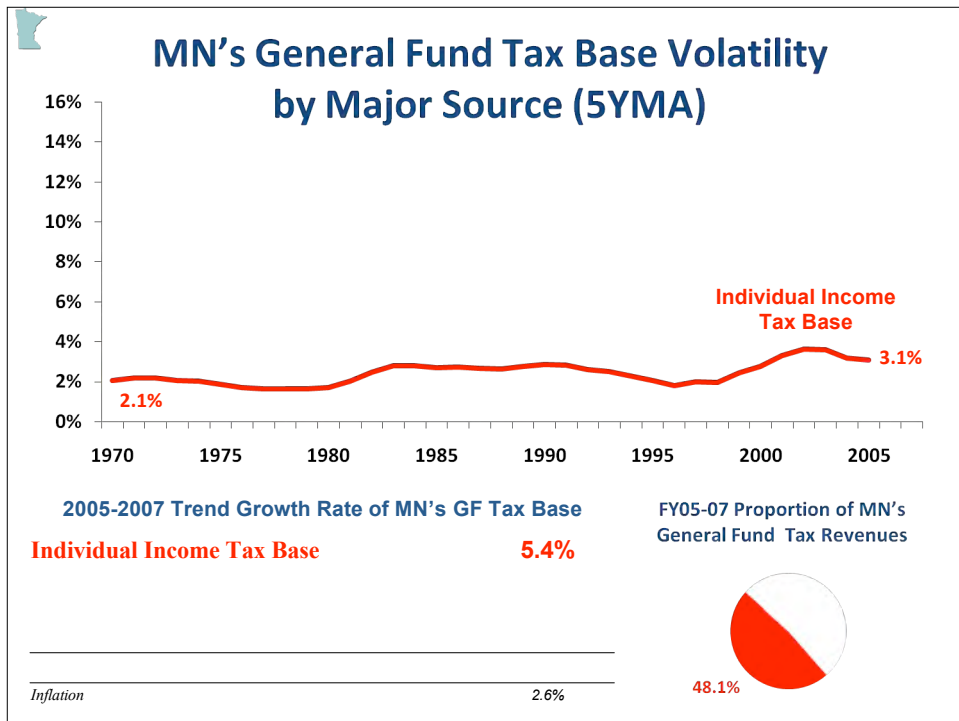
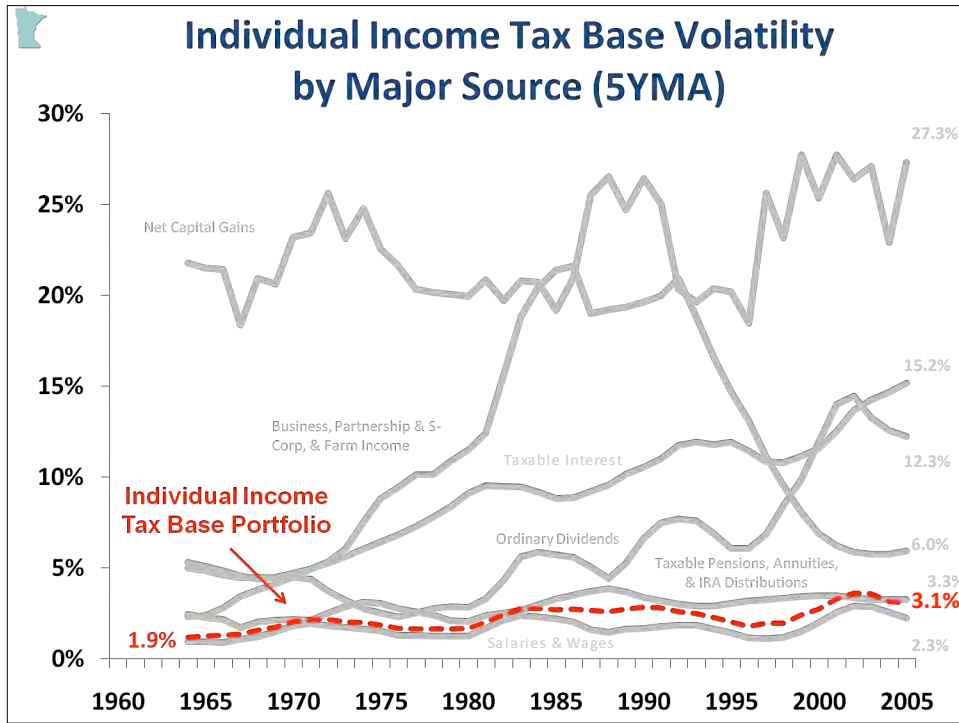
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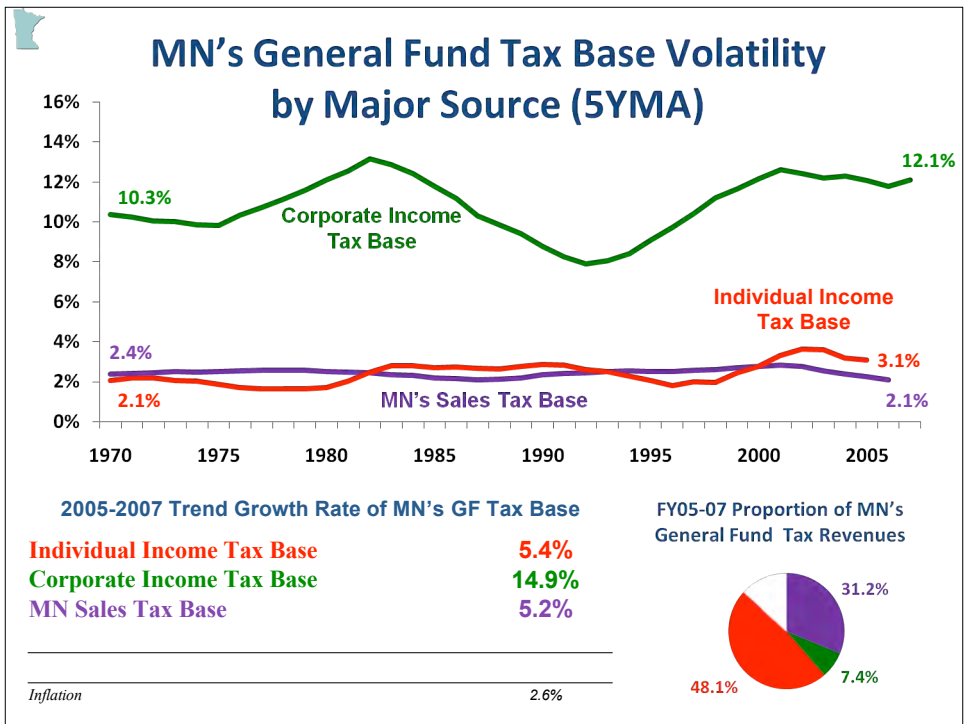
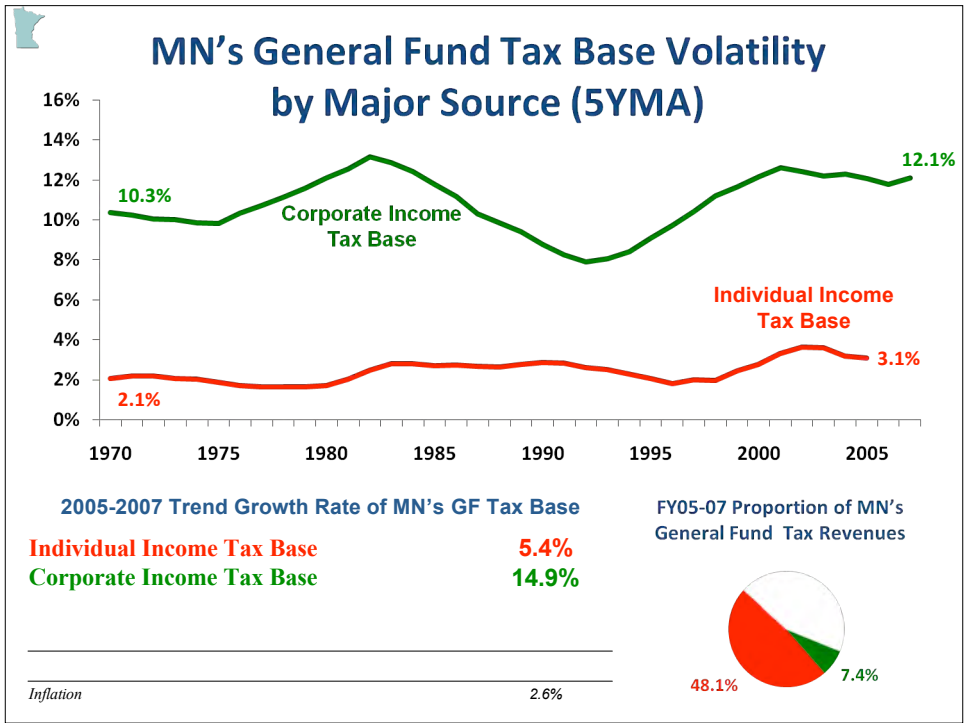
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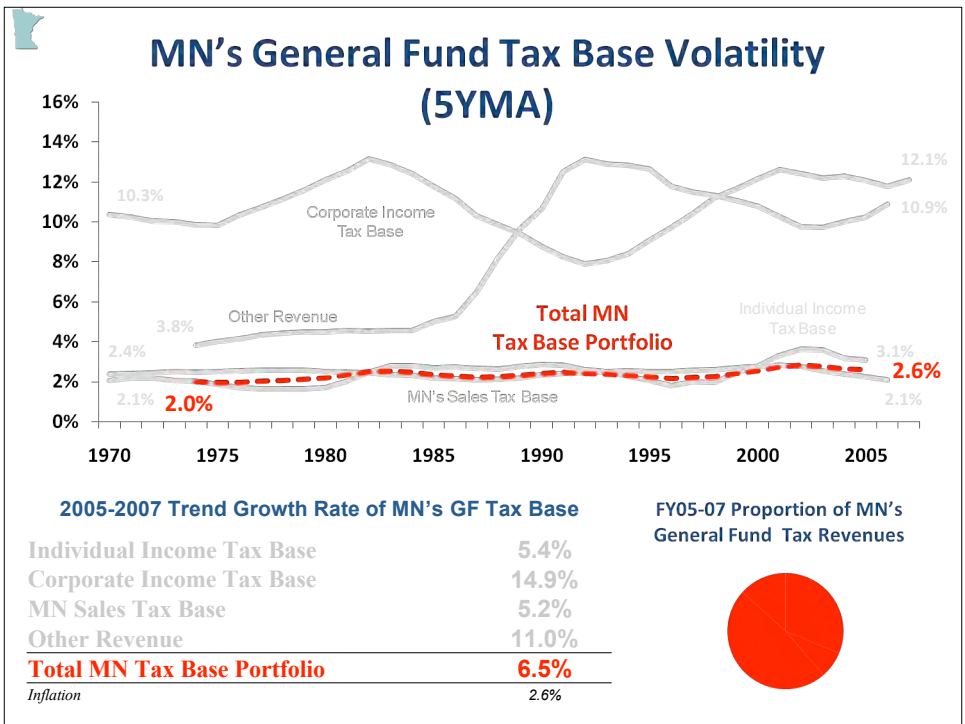
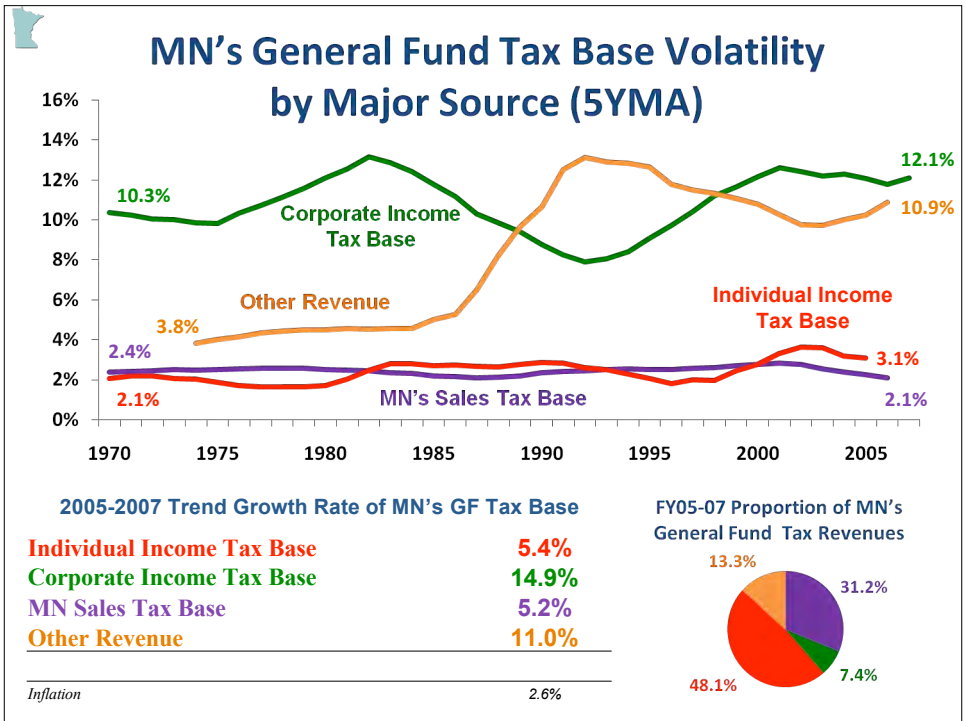
MN Tax Portfolio Data: 4 Major Revenues

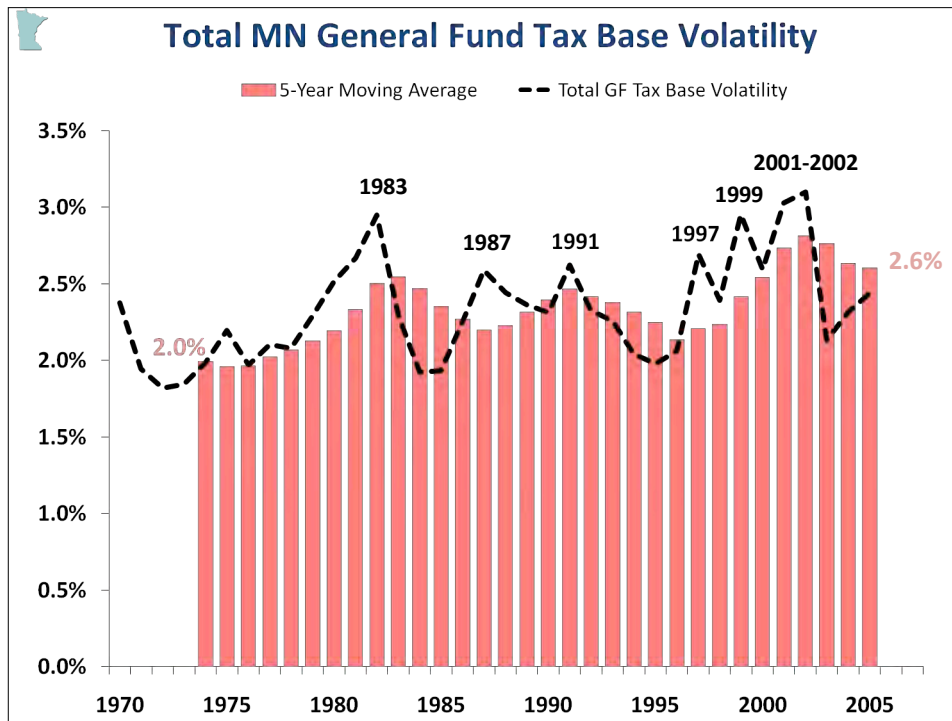
- **Individual Income Tax: 7 income types**
(Source: IRS SOI)
- **General Sales Tax: 19 purchase types**
(Source: BEA NIPA tables)
- **Corporate Income Tax: domestic profits**
(Source: BEA NIPA tables)
- **Other Taxes and Non-Tax Revenue**
(Source: U.S. Census)











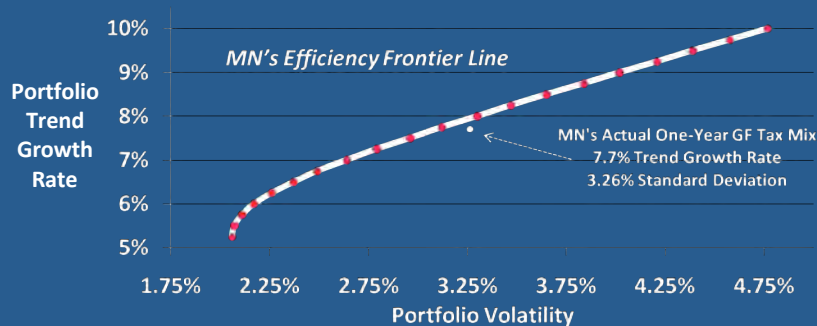
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Portfolio Theory Suggests Using a Tax System that Minimizes Volatility for a Given Growth Rate



- Given the trend growth rate, variance, and covariance of each major tax, an Efficiency Frontier Line (EFL) can be estimated
 - The EFL shows combinations of taxes that provide the lowest volatility for each growth rate
 - Points below the frontier are suboptimal.

Actual vs. Efficient MN One-Year Tax-Mix Given the Current Trend Growth

	Actual FY 2005-2007 Portfolio	Efficient Tax Mix Portfolio	Percent Change
Trend Growth Rate	7.70%	7.70%	-
Volatility (Standard Deviation)	3.26%	3.09%	-5.2%
Share of Total Tax Revenue			
General Sales	31.2%	60.3%	+93.3%
Corporate Income	7.4%	13.1%	+77.0%
Individual Income	48.1%	9.2%	-80.9%
Other Revenues	13.3%	17.4%	+30.8%
<i>Total</i>	100.0%	100.0%	

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Calculating the Appropriate Size for Minnesota's Budget Reserve

- Convert annual estimated tax base volatility ($\sigma = 2.6\%$) to General Fund revenue volatility ($\sigma = 3.03\%$)
- Choose failure rate: Percent of time deficit exceeds budget reserve (1 in 20, 5%)
- Multiply annual revenue volatility estimate by the critical failure rate value ($3.03\% * 1.645 = 4.98\%$)
(critical value for a 5% one tail z test = 1.645)
- MN budgets on a 2 year basis. Biennial reserve found using the same procedure but for two years.



Results

- Budget reserve based on trend forecast:
 - 5.0% (\$870M of FY06) for first (one) year
 - 4.1% (\$1.4B of FY06-07) for biennium
- Biennial estimates vary depending on treatment of successive events (years)
- Average volatility may understate potential shortfalls in economic downturns
- Budget reserve depends on history of forecast errors and failure rate chosen



Conclusions

- **Minnesota's tax base has grown more volatile**
- **Tax base volatility appears to increase during economic downturns**
- **Modest reductions in tax system volatility could be obtained, but dramatic tax rate changes would be required**
- **At current levels of volatility a biennial budget reserve of 4.1% (\$1.4B of FY06-07 revenues) would be appropriate**

Thank You

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