State Tax Revenue Growth and Volatility

Gary C. Cornia and Ray D. Nelson

Macroeconomic conditions and tax structures jointly determine the growth and volatility of state tax revenues. Since a variety of economic conditions exist among states, government policymakers should carefully anticipate and consider the possible impacts of proposed tax reform and revenue enhancements on the long-term growth and volatility of their unique tax revenue portfolios. In the short run, states generally cannot alter the volatility and growth rates of their economies. They can, however, change the composition of their tax portfolios to minimize the effects of the business cycle on their fiscal health. For this reason, state officials need to consider the natural tendencies of their economies when formulating tax policy. For example, states with volatile economies might want tax portfolios that minimize the impact of national macroeconomic trends; those with stable economies might consider adopting more aggressive tax portfolios that optimize their tax revenue growth/volatility combinations. (JEL H21, H72, R51)

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In recent years, state legislators and governors faced difficult budget deliberations caused by revenue shortfalls. News reports repeatedly identify and chronicle the dire fiscal conditions faced by most states. Dadayan and Boyd (2009) report record drops in tax revenues and describe historically difficult budgeting conditions. Unfortunately, if the patterns continue, states will yet face severe budgeting challenges beyond the official end of the national recession. These challenges will be especially acute if a sluggish labor market recovery and renewed banking sector stress persistently retard sales and income tax receipts.

Gamage (forthcoming) identifies a recurrent pattern of state fiscal crises. He describes how states often broaden tax bases or raise tax rates during recessions to maintain commitments made during prosperous periods. When the economy begins to recover, states experience budgetary relief as tax revenues grow. Eventually, the higher rates and broader bases generate significant increases in tax revenues and often lead to new or broader financial commitments. However, when the economy lapses into recessionary conditions, these commitments inevitably contribute to higher levels of budgetary stress. The resulting budget deficits once again challenge state officials to find new revenue sources and cut expenditures.

Sobel and Wagner (2003) suggest that, when changing the tax code to generate additional revenue, government officials and public policymakers should consider the implications of such revisions on the long-run expected growth and volatility of tax revenues. Highly volatile taxes or taxes with high income elasticities are useful when trying to balance a budget but create substantial challenges when the economy contracts. What increases rapidly during an economic expansion also falls precipitously during an economic contraction. The resulting challenge of revenue shortfalls during a downturn is especially acute in the current eco-

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nomic and political environment. Although economic discussions of taxes almost always include consideration of the important principles of equity, efficiency, and economic development, the goal of balancing budgets currently trumps almost every other policy dimension.

Two main factors affect the growth and volatility of state tax revenue receipts over the business cycle. First, the uniqueness of each state's economy ultimately affects its growth and volatility. Second, a state's choice of taxes, tax base, and tax rates can alter the revenue growth and volatility inherent in its economy. Because macroeconomic conditions vary so widely among states, subnational government officials must wisely consider the growth and volatility of their unique tax portfolio to minimize future fiscal challenges.

Legislative and executive tax policy can benefit from answers to the following research questions:

(i) How can state economic growth and volatility be accurately measured and consistently compared?

(ii) How do alternative revenue sources contribute to the growth and volatility of revenues generated by state tax portfolios?

(iii) How do state economies and tax portfolios interact to determine tax revenue growth and volatility?

The paper proceeds as follows. Analysis of the three questions first considers patterns in the U.S. business cycle and subsequently focuses on the variety of economic conditions experienced by individual states. Examination of the growth and volatility of individual tax sources, especially sales, income, and property taxes, suggests their potentially differing effects on revenue growth and stability. Inquiries into tax volatility are guided by building on the literature initiated by Groves and Kahn (1952). Two illustrations then demonstrate how knowledge of tax revenue growth and volatility can be incorporated into budgeting decisions and public policy. Because the growth and volatility of tax receipts likely depend on economic conditions and tax policy, the analysis of historical patterns helps identify best practices among states. Such analysis can potentially help decisionmakers know which growth and volatility characteristics have helped states weather the current fiscal storm. Finally, the analysis here makes practical recommendations based on a summary of empirical findings and research conclusions.

This article uses simple graphical constructs to summarize extensive data resources. Hopefully, this approach will foster insights that government officials and budget analysts might find useful in their tax reform and budget balancing efforts. Of course, more sophisticated statistical models are possible and appropriate for future work. The simplicity of the graphical tools and data exploration philosophy pioneered by Tukey (1977) and refined by Tufte (2001), however, increases the probability that policymakers and their respective professional staffs will use the findings of the present research effort. In the past, similar graphical communication has proven very successful and influential in helping executive and legislative branch officials understand empirical findings critical for tax policy.

HISTORICAL BACKGROUND

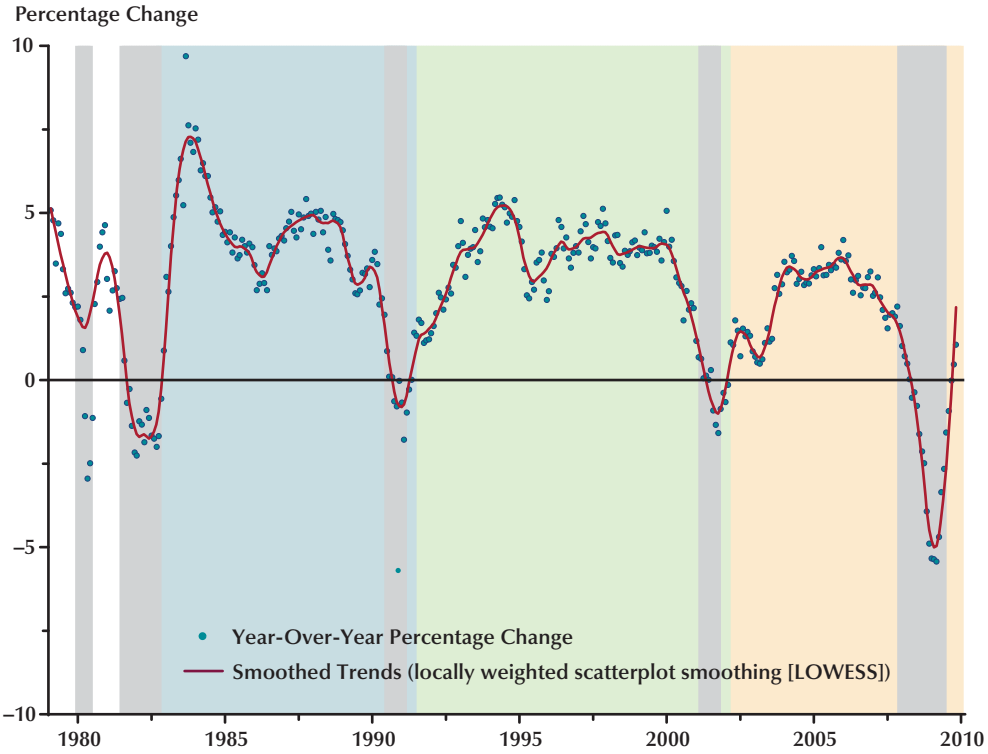
Holcombe and Sobel (1997) and Crain (2003) emphasize the importance of including the expected growth rates and volatility of revenues and expenditures whenever conducting fiscal analysis. Their comments suggest that the first step in understanding revenue growth and volatility is to consider the macroeconomic background that generates the revenue streams.

Recent Macroeconomic Patterns

Researchers commonly focus on the National Bureau of Economic Research (NBER) Business Cycle Dating Committee's declarations when studying business cycles. NBER leading, coincident, and lagging indicators establish the beginning, end, and duration of national expansions and recessions. The NBER cycle analysis works well at the national level. However, because state business cycles do not synchronize perfectly with national patterns, state-level measures are needed to make interstate business cycle comparisons. Fortunately, the Federal Reserve Bank of Philadelphia publishes monthly coincident indexes that measure each state's economic activity in a consistent fashion.

Figure 1

The U.S. Business Cycle and Year-Over-Year Growth Rate of the National Coincident Index (1979-2009)



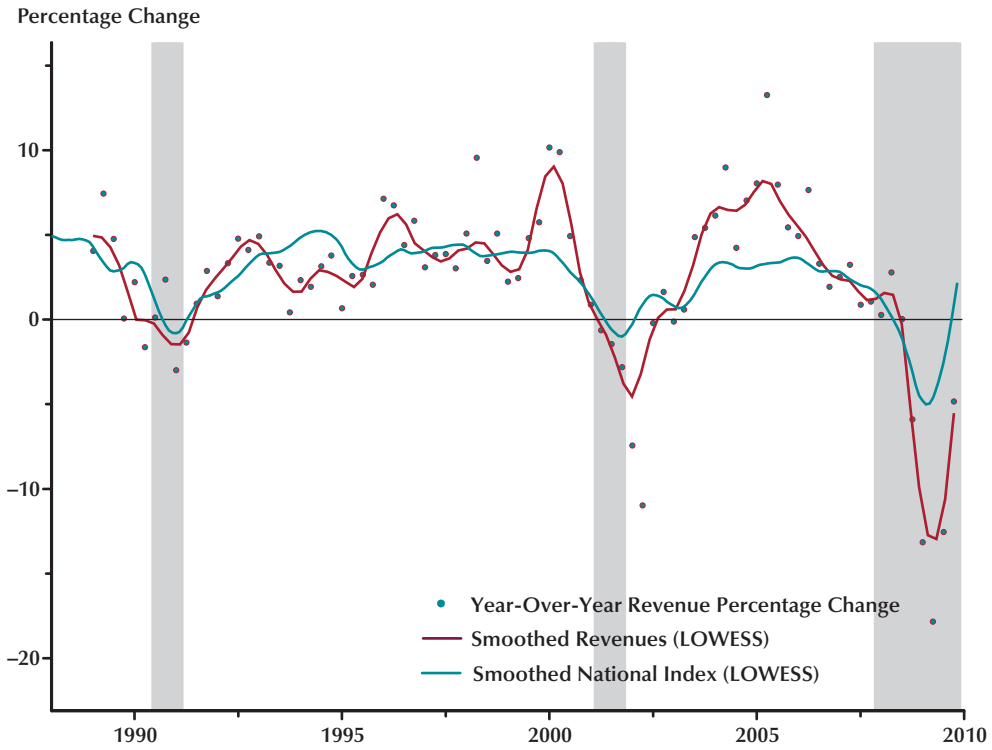
SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes.

The Philadelphia indexes provide insightful indicators for anticipating state tax revenues. The methodology implemented by the Philadelphia Fed builds on the pioneering work of Stock and Watson (1989). Crone and Clayton-Matthews (2005) adapt this methodology to state-level data. They collapse (i) nonfarm payroll employment, (ii) average hours worked in manufacturing, (iii) the unemployment rate, and (iv) real wage and salary disbursements into a single index by using a dynamic single-factor model. The method uses a Kalman filter to extract a major component from each of these four different time series. With this approach the trend for each state's index is set to the trend of its gross state product. With careful implementation, the long-term growth in a state's index closely tracks the state's overall business-cycle patterns. Because the model and the input variables are consistent across all 50 states, the resulting state indexes are comparable.

The Philadelphia Fed also constructs a national coincident index that provides growth and volatility data for the U.S. economy—a useful starting point for evaluating the potential influences on total state receipts. Figure 1 shows the year-over-year growth rate in the national coincident index. The five recessions shown vary significantly in their severity and duration. According to NBER business cycle dating protocol, a very brief and mild recession began in July 1990 and ended in March 1991. Once a vigorous expansion began, the economy accelerated into the longest post-World War II expansion on record.

Figure 2

Total State Tax Revenues Over the Business Cycle: Year-Over-Year Growth Rates (1989-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Similarly, another brief and mild recession began during March 2001 and officially ended in November 2001. In contrast to the previous business cycle, the economy did not recover rapidly after that recession. The figure, which reflects the large emphasis on labor market conditions in the Philadelphia Fed index, show that a jobless recovery continued almost two years after the recession officially ended.

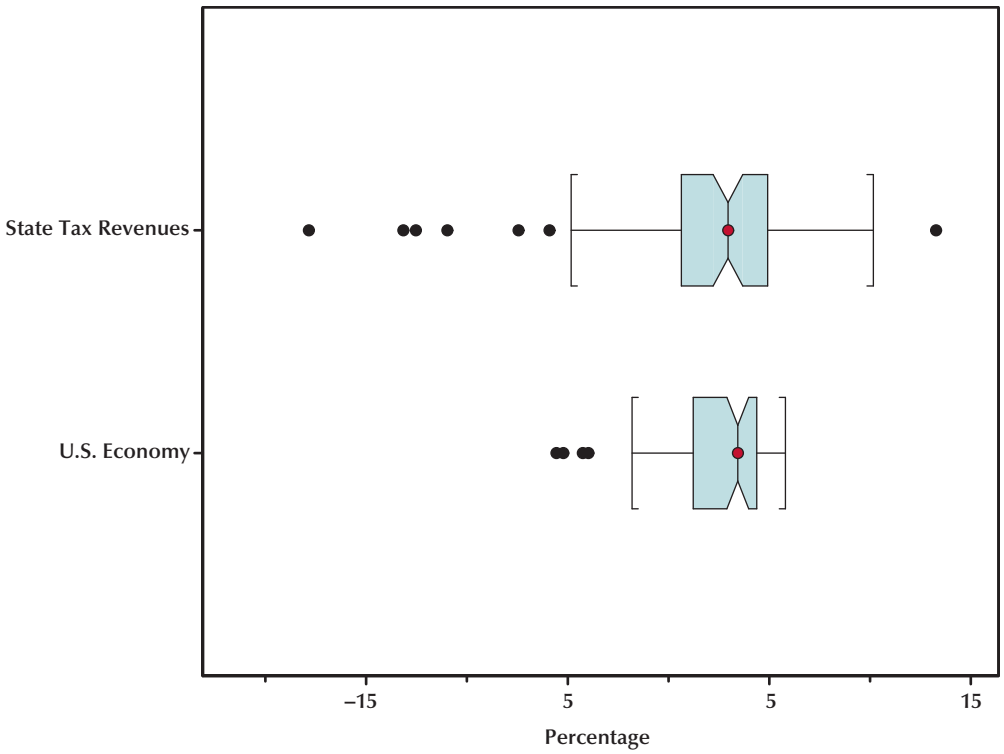
The present recession that according to the NBER began in December 2007 is noteworthy because of its depth and length. The national coincident index did not fall below the previous year's level until a few months after that start date. The depth of the fall is the worst since the Great Depression. Because of the prominent weighting of labor markets in the index, it reflects the millions of jobs lost since the beginning of the recession. The depth of the decline makes some economists pessimistic about the time it will take for labor markets to return to employment levels achieved during the previous expansion.

State Tax Revenues and the Business Cycle

Total state tax revenues as estimated by the Census Bureau show the current fiscal dilemma faced by many states. Figure 2 demonstrates how total state tax revenues vary over the business cycle. The blue line corresponds to the rate of change in the year-over-year national coincident index shown in Figure 1. Adjusting each tax revenue time series by the Personal Consumption Expenditure Index gives real rates that are comparable to the

Figure 3

State Tax Revenues versus the U.S. Economy: Year-Over-Year Growth Rates in Quarterly Observations (1989-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

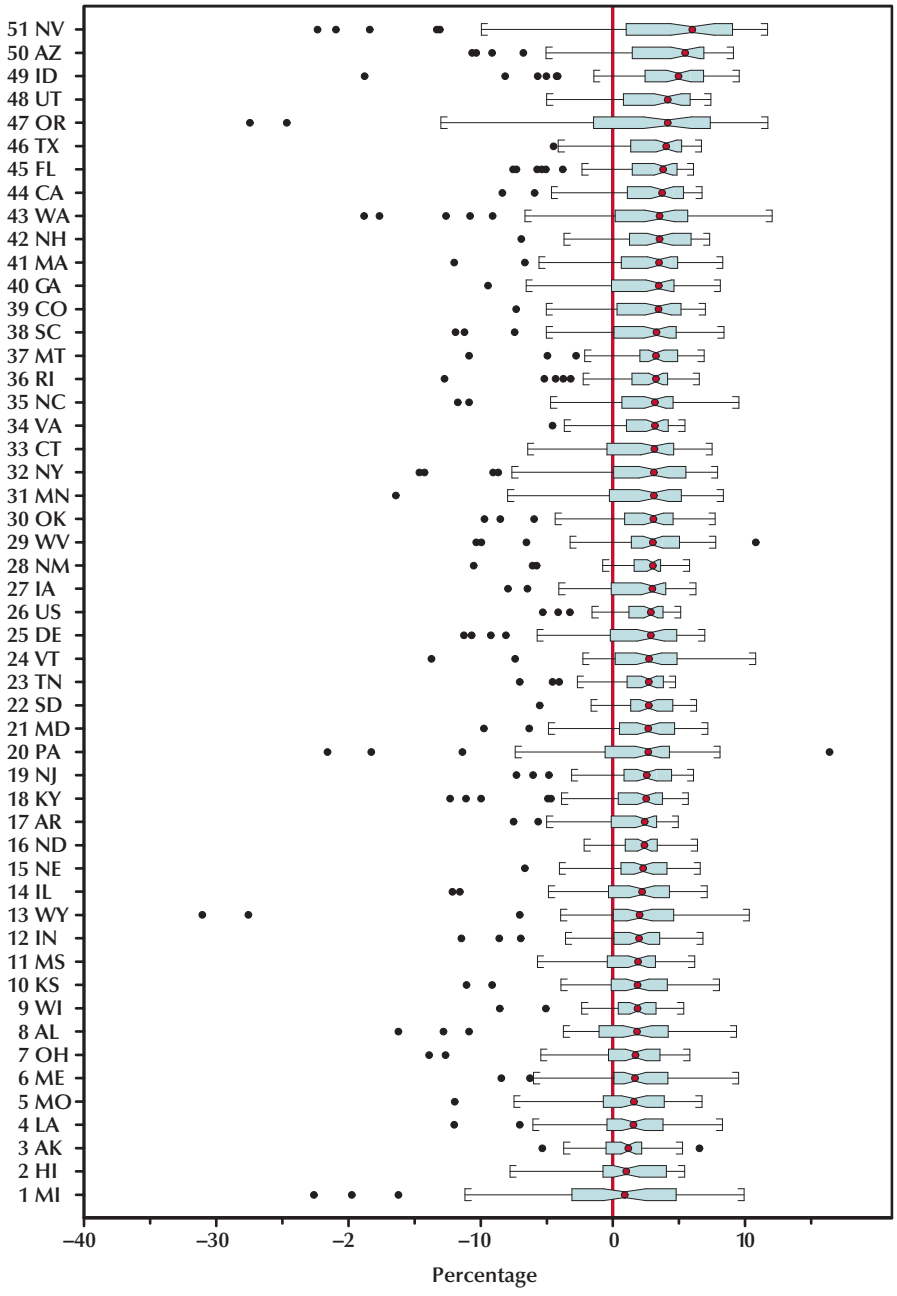
real national coincident index growth rates. Interestingly, state tax revenues, shown in red, declined more rapidly than the U.S. economy (as depicted by the national coincident index) in each business cycle. In the recession that began in 1991, neither the magnitude nor duration of declines in revenues were significant enough to cause severe budgeting challenges. As would be expected, revenues increased over the entire record-long expansion of the Clinton administration, at times at a rate well in excess of that for the U.S. economy. However, during three different periods, revenues declined at a rate greater than that for the U.S. economy.

In the recovery from the 2001 recession, the U.S. economy grew slowly and the labor market struggled to improve. This jobless recovery undoubtedly translated into the slow growth in state tax revenues. Eventually, tax receipts accelerated rapidly and even exceeded growth in the U.S. economy substantially until partway through the next recession. During one quarter, the year-over-year growth rate for total state tax revenues exceeded 15 percent. During the most recent recession, state tax revenues decreased dramatically relative to the U.S. economy, which corresponds to the unprecedented, record-breaking decline mentioned by Dadayan and Boyd (2009).

The box plots in Figure 3 facilitate comparison of the distributions of the changes in state tax revenues and the U.S economy. These plots succinctly summarize the location and spread of each distri-

Figure 4A

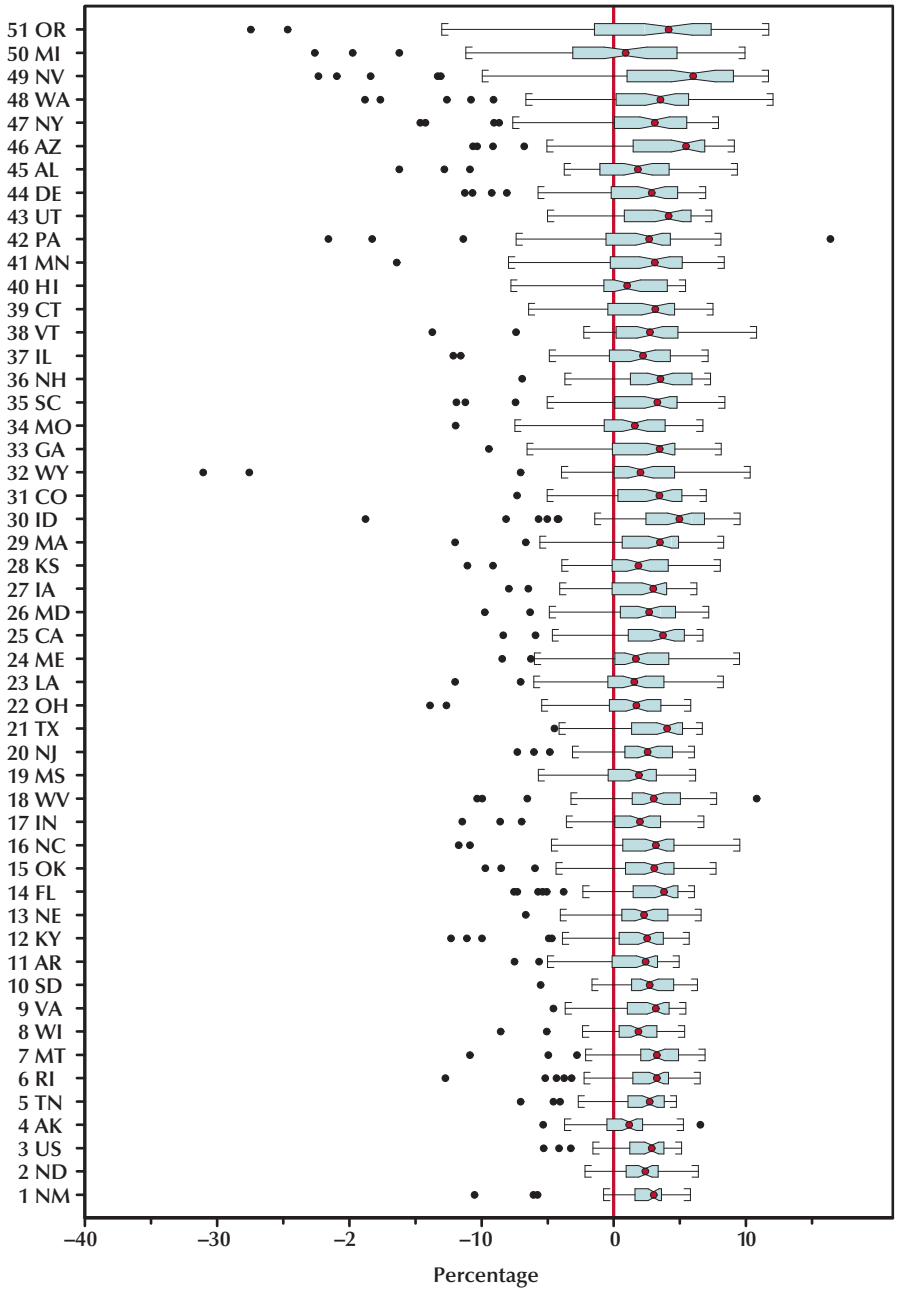
State Economies: Year-Over-Year Growth Rates in Monthly Coincident Indexes Ranked by Median of Percentage Change (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes.

Figure 4B

State Economies: Year-Over-Year Growth Rates in Monthly Coincident Indexes Ranked by Interquartile Range of Percentage Change (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes.

bution by using first, second, and third quartiles. The median of the distributions is depicted by the dot in the middle of the notched box. The length of the box depicts the interquartile range (IQR), the difference between the third and first quartiles, and is one measure of the distributions' spread. Put another way, the middle 50 percent of observations lie in the range encompassed by the box. The whiskers give another measure of the spread and bracket all observations within 1.5 * IQR distance from the sides, or hinges, of the box. In the revenue box plot, the large and small observations outside the whisker boundaries are classified as outliers and correspond to quarters when revenue either fell precipitously or grew rapidly.

Figures 2 and 3 support the conclusion that the average rates of change in state tax revenues and the U.S. economy are equal but more volatile for revenues. First, in Figure 3, the middle (median) of the box plot for revenues is slightly less than that for the economy. Second, half of the increases in revenue exceed the largest increase in the economy. This means that the size of state governments increased relative to the U.S. economy during the period 1994-2009. The box plots also suggest that growth of revenues is more volatile and negatively skewed than growth of the economy. Both the width of the IQR and the length of the whiskers show that revenues have a bigger spread than the economy. Although revenues and the economy both have extreme increases and decreases as indicated by the outliers, the negative skewness conclusion for revenues follows because the number of extreme declines in revenues exceeds that for the economy. The fact that measures of state tax revenue growth and volatility both exceed similar measures for the U.S. economy suggests that state budgets are very exposed and susceptible to potential economic downturns.

Individual State Growth and Volatility During the National Business Cycle

To make budgeting and policy recommendations for individual states, it is important to question whether national patterns generalize to individual states. Another interesting investigation explores the possible trade-off between growth and volatility (Groves and Kahn, 1952). Previous work by Crain (2003) investigates whether the expected return and risk trade-off found in financial markets similarly applies to the relationship between a state's economic growth and volatility and its tax revenues.

The box plots in Figures 4A and 4B lead to relevant observations about the growth and volatility of individual state economies. The plots depict the distribution of year-over-year percentage changes in the Philadelphia coincident index for each individual state and for the U.S. economy. The two plots differ only in their criterion for ranking. Figure 4A is ranked by the median growth rate of the coincident index for each state.

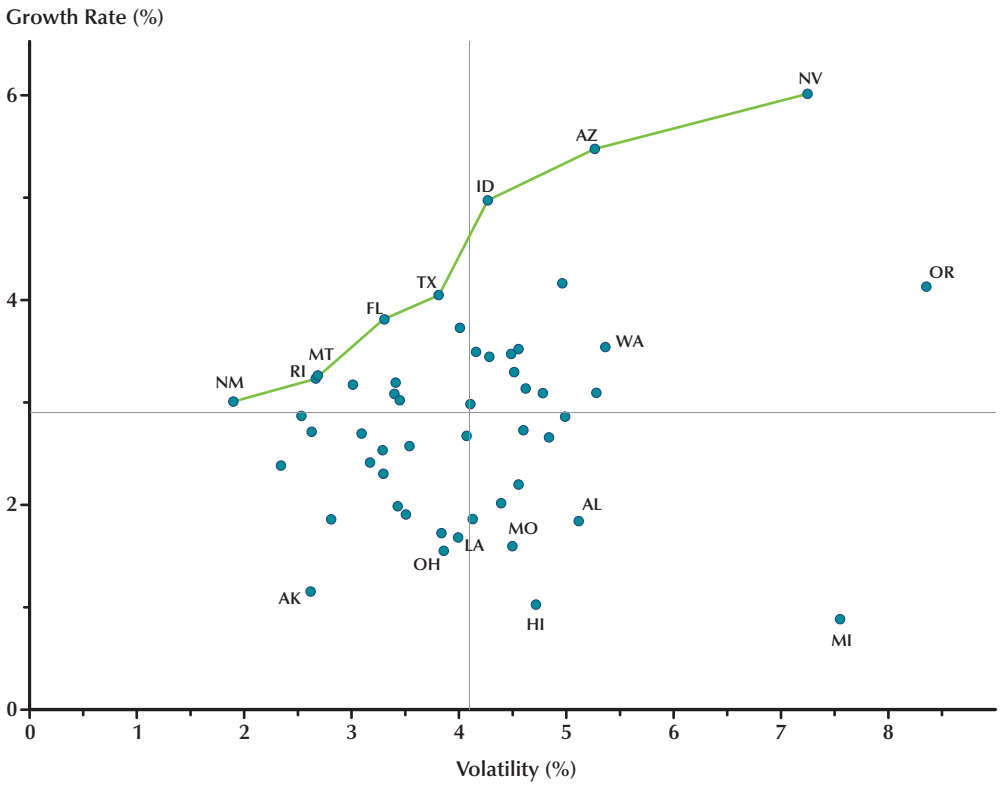
As would be expected, in Figure 4A the United States ranks in the middle (26th) simply because it is the weighted average of all states. Because of the number of extreme negative observations during the current recession, all of the means tend to pull toward the left side of the box and whisker diagram. This is consistent with a negatively skewed distribution for the rates of change. The number of negative outliers shows that all states suffered at least some extreme declines in their economies during the period 1995-2009.

The box plots in Figure 4B focus on volatility rather than growth. Figure 4B presents the same information as in Figure 4A, except each state is now ranked by the IQR rather than the median. Figure 4B identifies Oregon, Michigan, Nevada, Washington, and New York as having volatile economies. As expected, the United States, a portfolio of all states, has low volatility. New Mexico, North Dakota, Alaska, Tennessee, and Rhode Island also have relatively stable economies. Michigan is especially noteworthy because it has a negative average growth rate. Three large negative quarters for Michigan pull the mean significantly down from the median. It is also interesting that its spread shown by its IQR and the length of the whiskers imply that the Michigan economy is also very volatile. Michigan does not have the benefit of a high growth rate to compensate for its high volatility. This contrasts with the high-growth and high-volatility combinations evident for Oregon, Washington, and Nevada.

Despite the attention California receives in the popular press, its economy does not exhibit extreme

Figure 5

The Growth-and-Volatility Efficiency Frontier for State Economies: Year-Over-Year Percentage Change in Monthly Coincident Indexes (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes.

volatility, even though it does have a very high growth rate. As expected because of their geographical proximity, Washington and Oregon seem to exhibit similar characteristics. Two states that heavily depend on energy extraction, Wyoming and Alaska, have low growth rates. Alaska, however, does not endure the same extreme variability in economic growth that Wyoming does. Texas distinguishes itself with its desirable combination of high growth and low volatility.

The Efficiency Frontier for State Economies

Figure 5 shows growth and volatility of state economies combined into a single scatter plot. This graph is very similar to that often derived in finance to analyze the efficiency frontier for security markets. The corresponding measurements from the finance discipline are expected return and volatility. Figure 5, using the same data used for Figures 4A and 4B, plots the median return and IQR for each state. It is preferable to have high growth with low volatility. The reference lines that divide the graph into growth/volatility quadrants are based on the median growth rate and median standard deviation. States on the efficiency frontier, those with the best growth and volatility combinations, dominate the states below them (those with lower growth) and to the right of them (those with higher volatility).

The following states distinguish themselves by having economies on the efficiency frontier: New Mexico, Rhode Island, Montana, Florida,

Texas, Idaho, Arizona, and Nevada. States that seem to have inferior combinations of low growth and high volatility are Michigan, Alabama, Hawaii, and Missouri. Alaska, Ohio, and Louisiana fit into the low-growth/low-volatility quadrant. Some states that have widely reported and especially acute fiscal challenges—California for example — surprisingly have relatively stable economies and moderate growth rates.

DIVERSITY AMONG STATE TAX PORTFOLIOS

The second determinant of state tax revenue growth and volatility comes from the characteristics of individual taxes. Each state selects its own set of revenue sources, which it combines into its tax portfolio. In addition, each state chooses its tax base and corresponding tax rates.

The Constitution of the United States allows substantial freedom for states to adopt different tax schemes. The variety of adopted tax policies reflects a wide spectrum of political preferences among state populations. The state of Oregon, for example, has resisted adopting a retail sales tax. This contrasts with a neighboring state, Washington, which has a retail sales tax but no income tax. Even among the 44 states that have a retail sales tax, its implementation is far from uniform. Retail sales tax rates range from below 4 percent to double digits. Sales tax bases also show similar variety. About 75 percent of states exempt food purchases from the retail sales tax. The desire to mediate the regressive nature of the retail sales tax motivates this exemption. In many cases, however, the food exemption eventually leads to higher rates on the remaining taxed goods. In most states, the retail sales tax base includes very few services; however, some states tax many services.

State individual income tax has a similar pattern of heterogeneity. A few states do not impose any such income tax. Those states with an individual income tax choose a variety of tax rates and bases. In general, most states start with the federal income tax as the base but adopt different levels of exemptions and deductions. Marginal tax rates range from under 5 percent to over 10 percent. Some states have income brackets taxed at different rates, whereas others apply one rate to all taxable income. These differences in tax bases and rates cause state tax revenues to respond in a variety of ways to macroeconomic changes.

A standard theme in state tax design is to keep tax bases as broad as possible while keeping tax rates as low as possible. Many believe that broad bases and low rates generate less revenue growth during economic upswings but also result in smaller revenue shortfalls during economic downturns.

Although state tax portfolios vary significantly, most states rely on some combination of sales, individual income, and property taxes. Because property taxes primarily finance local governments, meaningful consideration of this potential revenue source requires expanding the tax revenue definition to include all state and local taxes. Otherwise, the resulting analysis would give a distorted view of the property tax.

Growth and Volatility of Individual State Taxes

As mentioned, business cycle phases cause state governments to regularly alter their tax structure. Frequent and substantial changes to tax codes influence the growth rate and volatility of tax sources. Although calculating growth and volatility estimates based on a uniform tax policy would yield accurate and informative results, such ideal data unfortunately do not exist. It is true that one might try collecting fiscal note analyses for individual states to adjust for their tax rate and base changes. Such an approach, however, suffers from accuracy and feasibility concerns. The inherent inaccuracy of fiscal note estimates can itself potentially bias growth and volatility estimates. Even if fiscal notes were totally accurate, however, the diversity of state analytical procedures would likely make the task of collecting such data impractical.

For this reason, when interpreting and comparing growth and volatility estimates for various taxes, it is important to remember that (i) the growth rates and risk of each tax depend on the inherent characteristics of the tax category and (ii) the estimates also include the propensity of government officials to alter the tax structure. As shown subsequently, major and frequent changes to the tobacco

tax base and rate significantly influence the mean and standard deviation of tax revenues. For this reason, it is important to use resistant statistics (such as medians and IQRs, as used here) to describe the historical distribution of rates of change. These statistics can effectively exclude extreme rate and base changes from the estimation process.

With the aforementioned caveats in mind, first consider possible differences in the growth and volatility of individual taxes as measured by traditional location and scale measures. The box plot in Figure 6A depicts the distribution of year-over-year changes in quarterly observations in the major tax categories reported by the Census Bureau. The categories in the box plot are ranked according to the median percentage change in total revenue. Taxes on alcoholic beverages and motor fuels have low growth rates. These two taxes are also very stable and provide states and local governments with a steady revenue source. Unfortunately, these taxes represent a very small portion of most states' general revenues.

Motor license taxes include vehicles and drivers. As shown in Figures 6A and 6B, this category has the third-lowest growth rate among the 10 revenue categories. Measuring the volatility as a standard deviation unfairly labels this tax revenue source as relatively more volatile. The box and whiskers, based on the resistant IQR statistics, indicate much less volatility. Three extremely large outliers shown in Figures 6A and 6B unduly influence the estimated standard deviation. A combination of population growth and licensing fee increases likely explains the extreme increases in revenue. Less explainable is the one quarter of significant decline.

The corporate income tax is especially problematic in state budgeting because of its high volatility. Interestingly, its high volatility is not associated with a high growth rate. From a similar point of view used to analyze financial markets, this is a high-risk revenue source without compensation provided by higher expected growth.

The "All Other" tax category exhibits high positive skewness. This probably results from attempts by legislative and executive branches to search for "low-hanging fruit" to augment tax revenues and help balance budgets during economic downturns.

As mentioned, the retail sales and gross receipts tax is a very significant revenue source for state and local governments. As shown in Figures 6A and 6B, it grows moderately relative to other tax revenues and is also reasonably stable. It does have a couple of very negative growth quarters. The mean for this category is probably influenced by a series of three quarters of significantly large declines. In some states, the sales tax generates over 50 percent of state revenues. In most states, however, the sales tax is less than 40 percent of total state revenues.

It is difficult to characterize how tobacco taxes respond to the growth and volatility of the business cycle because the tax rate on these products has increased so rapidly during the period covered by these data. Tobacco taxes show extreme positive growth rates. This surely reflects significant increases in tax rates applied to tobacco products. For this reason, the median and IQR rather than the mean and standard deviation much better summarize the growth and volatility of tobacco tax revenues.

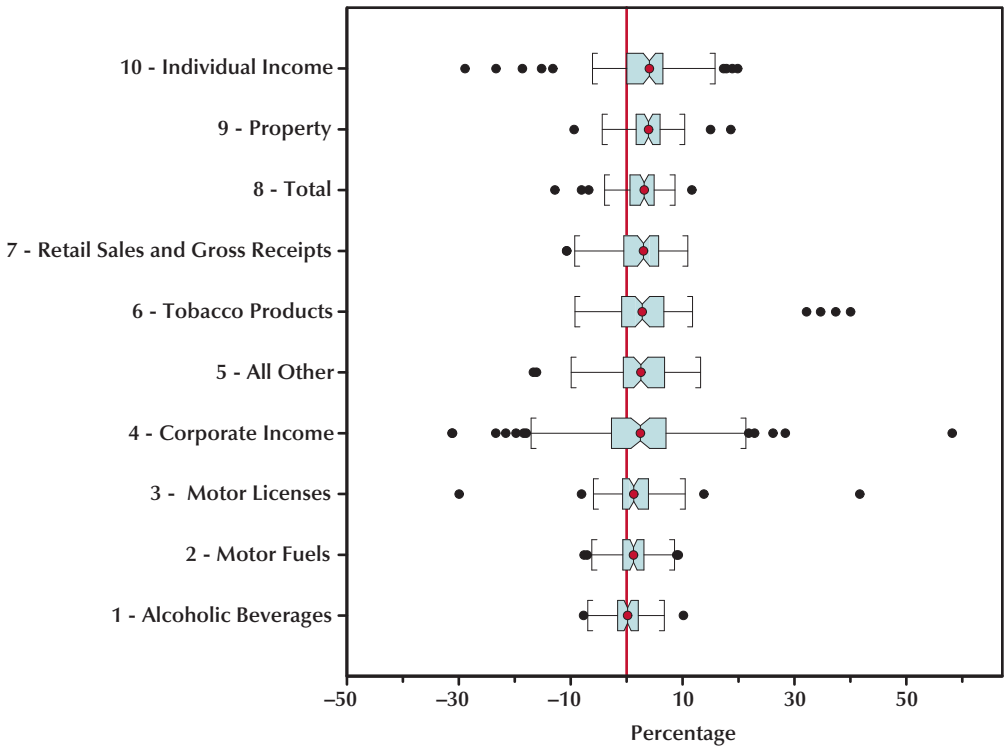
As mentioned, individual income taxes also constitute a very important source of revenue for state and local governments. Their growth rate exceeds that of the retail sales and gross receipts taxes. It is also much more volatile. This volatility is undoubtedly the source of many of the current budgeting challenges faced by state and local governments. Notice the large number of outliers, which correspond to negative rates of growth during the current recession. The significant number of positive deviations possibly encouraged state and local governments to increase their government expenditures and base budgets.

The property tax is mainly used to finance local government. Its combination of high growth and low volatility make it a very attractive revenue source. Its high growth rate is undoubtedly related to the real estate bubble that existed during the early part of this century. If real estate prices continue to decline, however, the growth rate of the property tax could decline commensurately.

Consider now the diversification potential for states of including multiple revenue sources within their tax portfolio. Combining the nine tax categories in Figures 6A and 6B gives a portfolio with

Figure 6A

State and Local Taxes: Year-Over-Year Growth Rates in Quarterly Revenues Ranked by Median of Percentage Change (1989-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

the eighth-largest growth rate and third-smallest volatility, respectively. This seems to indicate that states with a combination of taxes would tend to decrease the volatility of tax revenues without sacrificing expected growth. This result is consistent with the principles used to achieve diversification in financial market portfolios.

The Efficiency Frontier for Individual State Taxes

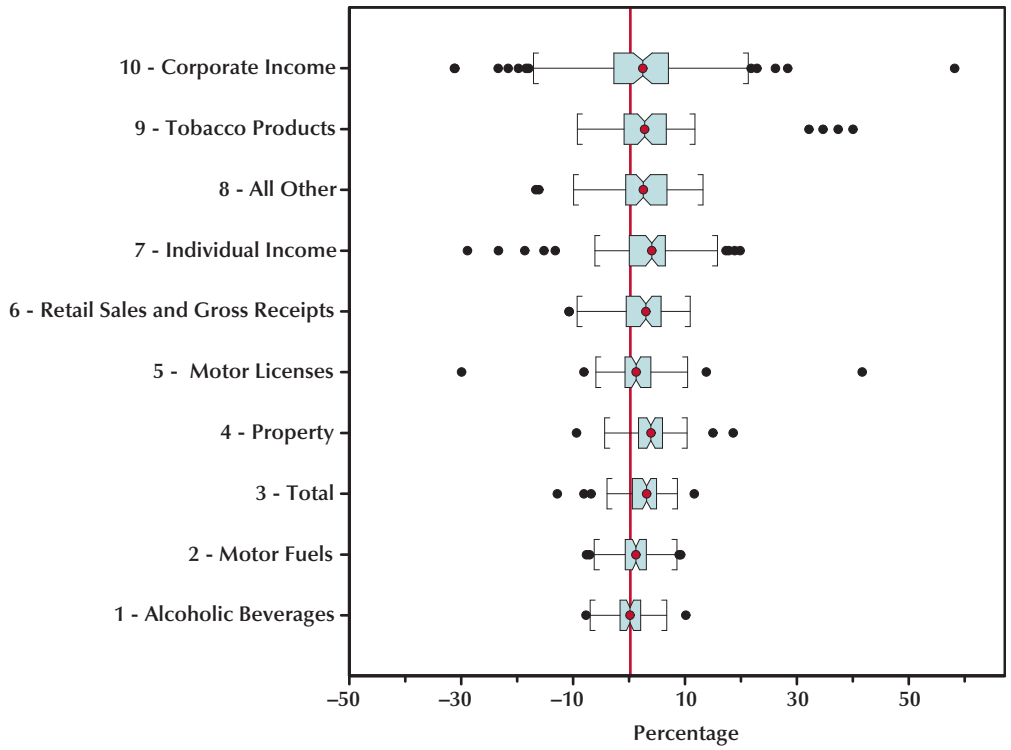
Figure 7 plots the growth and volatility measures for each tax category based on the median growth rate and IQR for each category. Once again, the combination of low volatility and high growth is superior. Alcoholic beverages, motor fuels, property, and individual income exhibit this combination and all lie on the efficiency frontier. Interestingly, the portfolio of total taxes would also lie on the efficiency frontier. Individual income tax, as mentioned, has both high growth and high volatility. This contrasts with the retail sales and gross receipts taxes, which have relatively lower growth and volatility. The inferiority of the combination of low growth and high volatility for the corporate income tax is apparent by the tax's far placement from the efficiency frontier.

State Tax Portfolios

Figure 8 documents the diversity among state tax portfolios. Based on the fiscal 2008 total tax receipts as reported by the Census Bureau, the figure shows proportions of revenue derived from each potential tax resource.

Figure 6B

State and Local Taxes: Year-Over-Year Growth Rates Ranked by IQR of Percentage Change (1989-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

This figure highlights the importance of sales and income taxes at the state level, which individually or together are significant components in all state tax portfolios. Several states derive a substantial amount of revenue from the "All Other" category, including the energy-extraction states of Alaska and Wyoming, as well as North Dakota, Delaware, Montana, and New Hampshire.

The ranking in Figure 8 is based on each state's Herfindahl-Hirschman Index, which is calculated as

$$H = \sum_{i=1}^{N} s_i^2,$$

where s_i is the revenue share of the ith tax. New Hampshire, Montana, Vermont, and Delaware have balanced portfolios. Alaska, Florida, South Dakota, Nevada, Washington, Texas, Tennessee, Hawaii, and Oregon are largely dependent on a single tax source and do not have diversified tax portfolios.

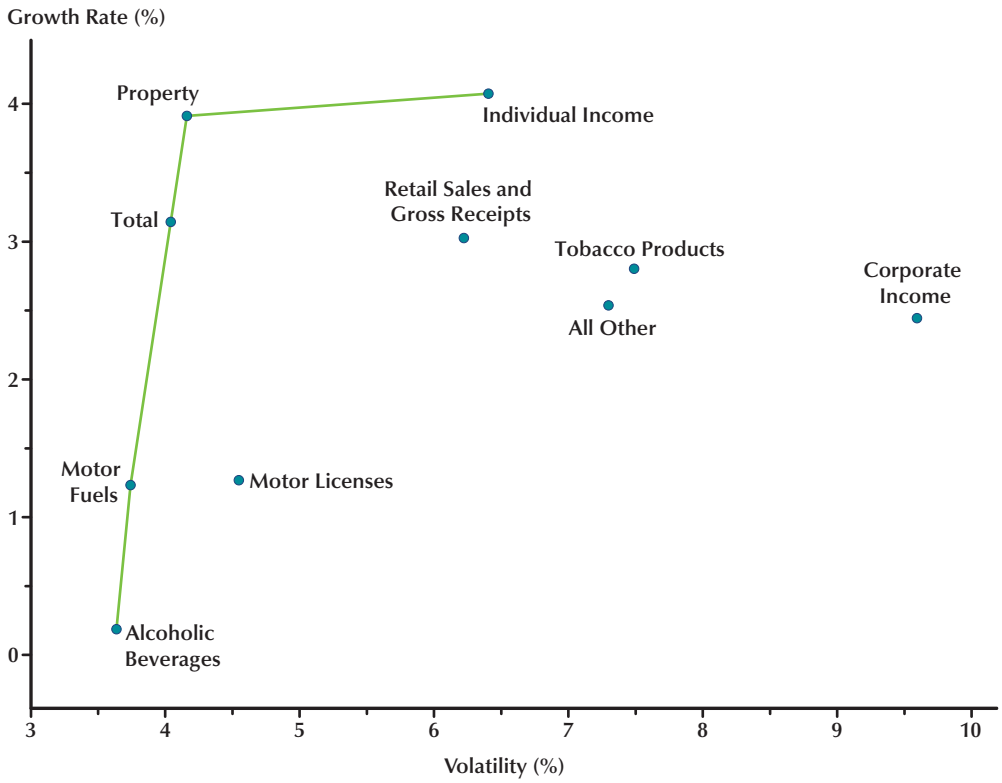
GROWTH AND VOLATILITY PATTERNS OF STATE TAX REVENUES

Thus far the empirical investigation reveals a variety of state economic reactions to different phases of the business cycle. As discovered, unique characteristics of each state's economy strongly influence the observed historical growth and volatility combinations. Likewise, different types of taxes exhibit distinctive combinations of growth and volatility.

Although each state has limited influence over the economic structure that determines its reaction

Figure 7

The Growth-and-Volatility Efficiency Frontier for State Tax Revenues: Year-Over-Year Percentage Change in Quarterly Revenues (1988-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

to the business cycle, it can choose the components that it includes in its tax portfolio. Volatility can also be influenced by changes in the tax structure that alter either the tax rate or base. The discussion now turns to how each state's economy, together with its tax portfolio, has affected its historical state revenue growth and volatility combinations.

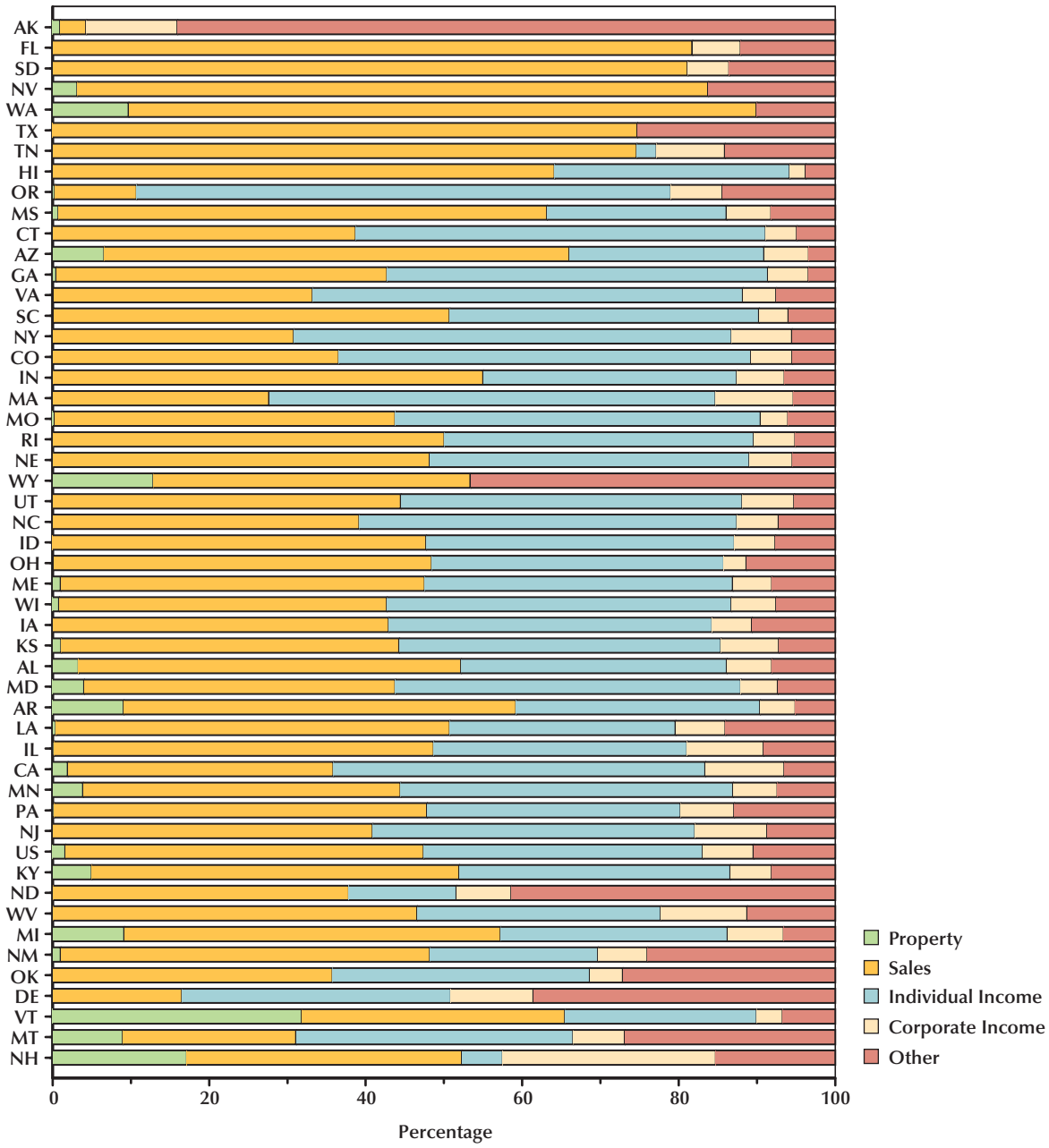
Growth Rates and Volatility

The distributions of year-over-year changes in real revenues for each state are summarized in the box plots in Figure 9. Similar to other figures, Figure 9A is ranked by median growth rates and Figure 9B by IQRs. Before considering individual states, note the large number of positive and negative outliers in Figures 9A and 9B compared with those in Figures 4A and 4B. Whereas economic growth rates in Figures 4A and 4B are dominated by negative outliers from the large recent economic declines, tax revenue growth rates in Figures 9A and 9B achieve more balanced, symmetrical combinations of extreme positive and negative values. Observe, however, the dominance of Alaska in determining the scale of Figures 9A and 9B.

The box plots in Figure 9A show that many of the high-growth states are located in the western region of the United States. It also appears that two energy-intensive states, North Dakota and Wyoming, achieve significantly large growth rates. The contrast between Oregon and Washington revenues is noteworthy. Washington is a low-growth state and

Figure 8

State Tax Portfolios: Proportions of Total 2008 Tax Revenues Ranked by the Herfindahl-Hirschman Index

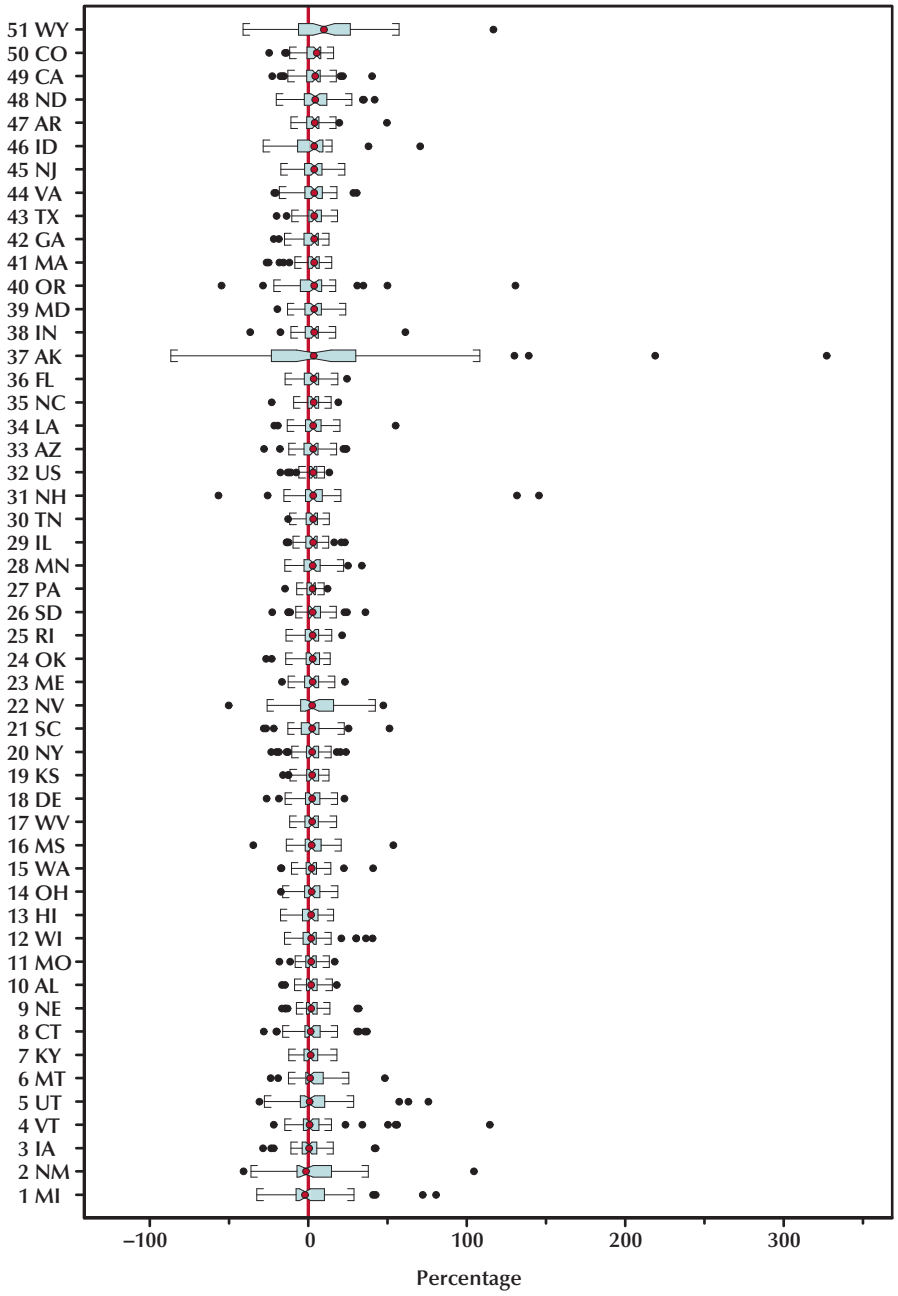


NOTE: Ranked from least to most diverse.

SOURCE: Census Bureau Annual State and Local Government Tax Revenue.

Figure 9A

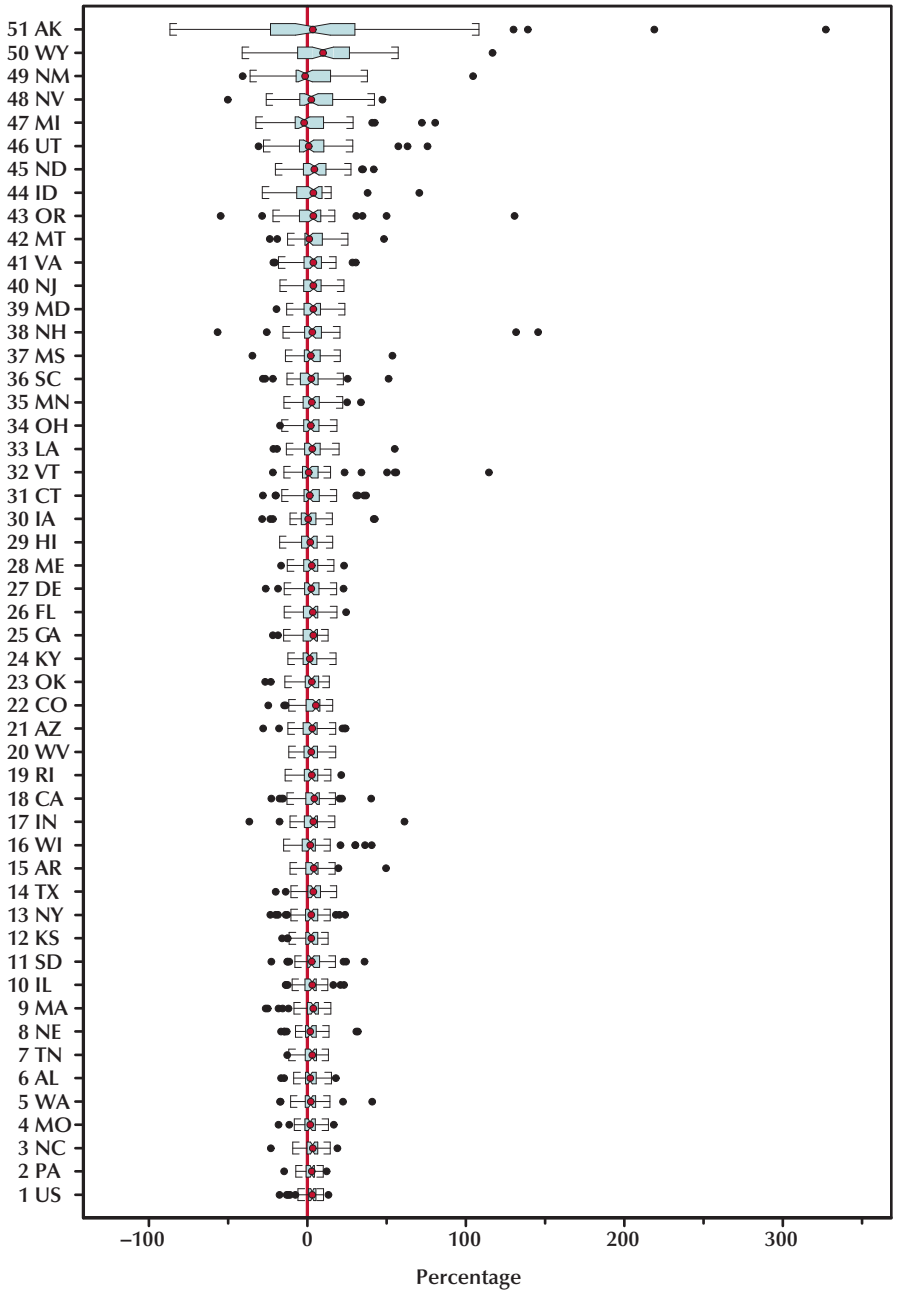
State Tax Revenues: Year-Over-Year Growth Rates in Quarterly Tax Receipts Ranked by Median of Percentage Change (1995-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 9B

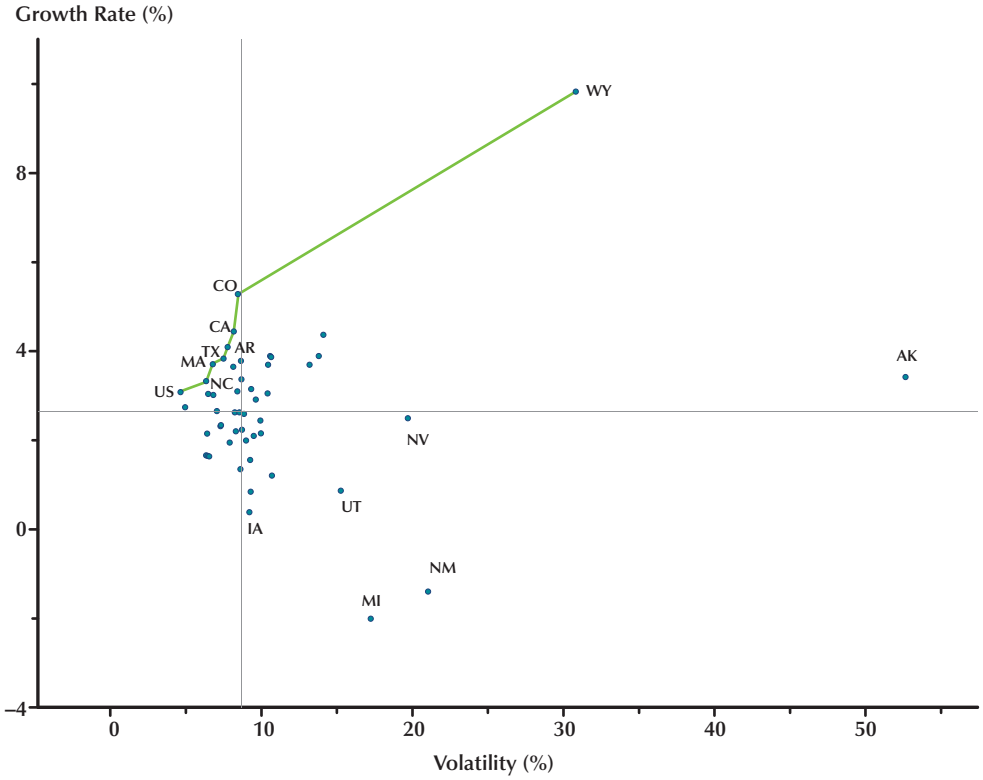
State Tax Revenues: Year-Over-Year Growth Rates in Quarterly Tax Receipts Ranked by IQR of Percentage Change (1995-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 10

The Growth-and-Volatility Efficiency Frontier for State Tax Revenues: Year-Over-Year Percentage Change in Quarterly Total State Tax Receipts (1995-2009)



SOURCE: Census Bureau Quarterly State and Local Government Tax Revenue.

depends heavily on the sales tax. Oregon, its neighbor, is a high-growth state because it depends on the individual income tax. Thus we see that tax structure might strongly influence the growth rate.

Figure 9B ranks states by the volatility of their tax revenues as measured by the IQR and shows that the western states with high growth rates also have high levels of variability. This is especially true for Alaska and Wyoming. Interestingly, Texas is not as volatile. As expected because of diversity, the U.S. aggregate of total state revenues is not very volatile. The highly stable tax receipts of Tennessee are probably influenced by its dependence on the retail sales tax rather than the individual income tax.

The Efficiency Frontier for State Revenues

Figure 10 plots the growth and volatility of state tax revenue based on the medians in 9A and IRQs in Figure 9B, respectively. The line in Figure 10 identifies those states with efficient combinations. As mentioned, Wyoming has both a high growth rate and high volatility and finds itself on the efficiency frontier. Colorado, California, Arkansas, and Texas seem to achieve relatively higher growth rates without incurring significantly more volatility. Other states that distinguish themselves by being on the efficiency frontier are Massachusetts and North Carolina. This raises an interesting future research question about the combinations of economic and tax structure characteristics that generate

tax revenues with desirable growth and volatility attributes.

AD HOC OBSERVATIONS OF INDIVIDUAL STATES

Ad hoc comparisons give some insight into tax policies that can exacerbate or moderate a state's dependence on the business cycle. They can also highlight potential practices that might moderate the adverse effect of low-growth and/or highly volatile state economies on tax revenues.

In Figures 11 to 23, summary diagrams for selected states offer insight into best practices. Panel A compares the growth rates of the given state's tax receipts (green), its economy (red), and the national economy (blue). The box plots in Panel B compare the distributions of the rates of change for these same three categories. The scatter plots in Panels C and D show how the given state's growth and volatility compared with the growth and volatility of all other individual state economies and tax structures, respectively. Panel E shows the composition and balance of the given state's tax portfolio.

First, consider Texas (Figure 11), which distinguishes itself by having both its economy and tax revenues on the efficiency frontier. Both exhibit medium growth and volatility (Panels C and D, respectively). Its economy closely follows the national pattern, which is evident in the time-series graph (Panel A) and the box plots (Panel B). Its tax portfolio depends primarily on the sales tax; however, "other" revenues also contribute significantly to total state revenues (Panel E). This tax portfolio places Texas's revenues in the moderate-growth and moderate-volatility category (Panel D).

Neither the Arkansas (Figure 12) nor Tennessee (Figure 13) economies reach the efficiency frontier (Panels C), but their tax portfolios give them improved combinations of growth and volatility that put their tax revenues on the efficiency frontier (Panels D, respectively). Both economies closely mimic the national growth pattern (Panels A). Interestingly, their tax portfolios differ (Panels E): Arkansas depends on a combination of property, sales, individual income, corporate income, and "other" tax categories. This combination keeps Arkansas's tax revenues from being placed with its economy in the low-growth/low-volatility quadrant, by supporting a higher relative growth rate without adding too much additional volatility. Tennessee depends primarily on the sales tax.

For Nevada (Figure 14), a high growth rate and high volatility place its economy on the efficiency frontier (Panel C). Nevada's dependence on the sales tax without any income tax (Panel E) significantly hinders the growth rate of its tax revenues but, surprisingly, does not commensurately decrease its volatility. The result is an inferior combination of low growth and high volatility (Panel D).

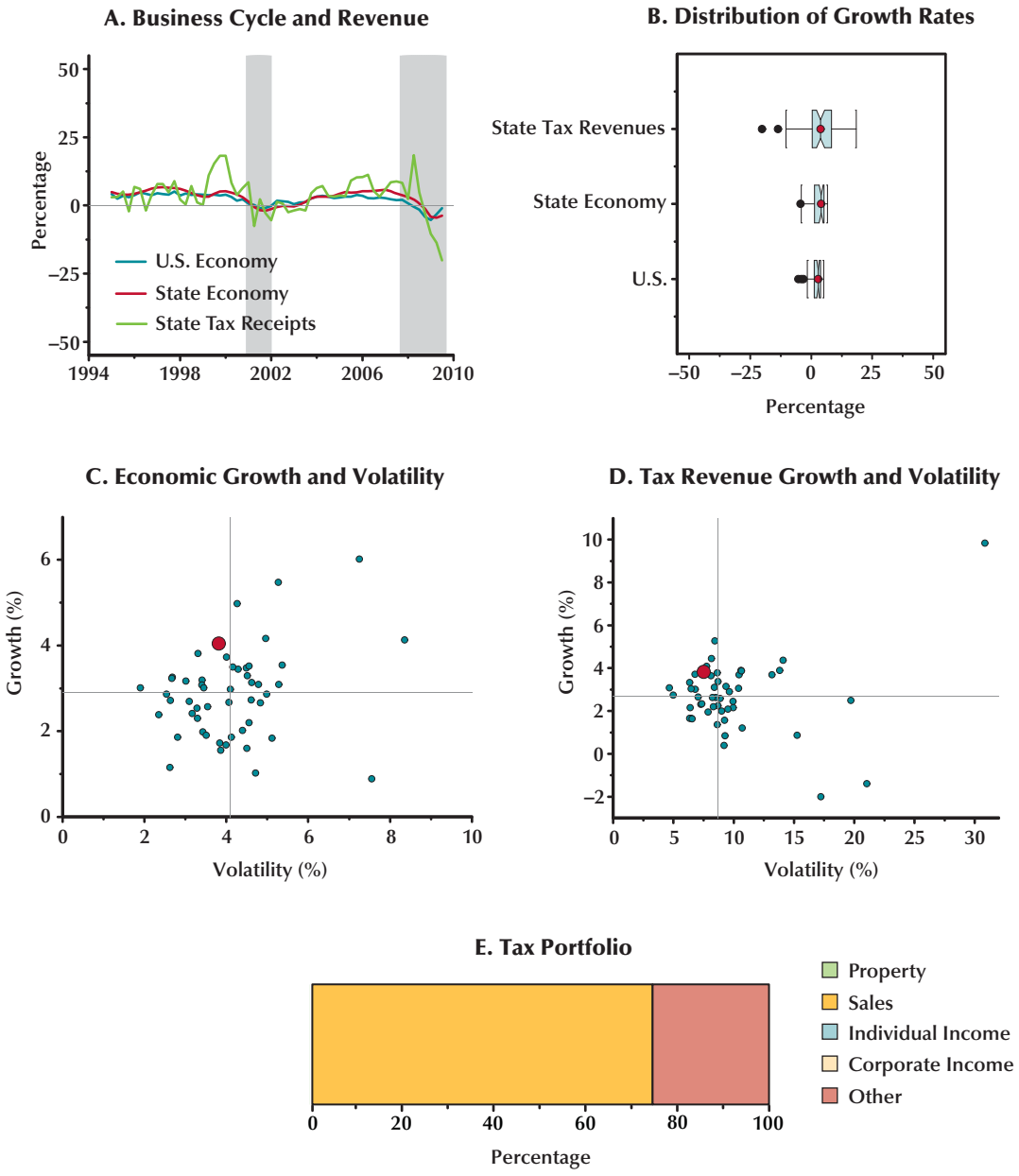
North Dakota (Figure 15) has a tax portfolio that generates higher growth and volatility relative to other states (Panel E). Its economy does not follow the national pattern as closely as the previously discussed states. Sometimes its growth rate exceeds that of the national business cycle and sometimes it is lower. North Dakota does not seem to have experienced the extreme declines that occurred in many other states during the Great Recession. North Dakota's tax portfolio is balanced and depends on sales, individual income, and "other" taxes.

The macroeconomic challenges in Michigan (Table 16) strongly influence its tax revenue. As mentioned, it is the only state with negative average economic growth. The low economic growth and corresponding high volatility (Panel C) have created severe fiscal challenges. Even though Michigan has a balanced dependence on sales and income taxes (Panel E), its tax system seems to exacerbate the revenue challenges, as its tax revenues remain in the unfavorable low-growth/high-volatility quadrant (Panel D).

As mentioned, Washington and Oregon (Figures 17 and 18) provide an interesting comparison in tax policy. They have similar economies that are more volatile than the national economy but that also have higher expected growth rates than other state economies. Oregon's economy is slightly more volatile than Washington's. This dissimilarity lies mostly in each state's reliance on one major tax. Oregon depends primarily on the individual income tax, Washington on the retail sales tax (Panels E, respectively). The growth and volatility of each state's tax revenue shows the

Figure 11

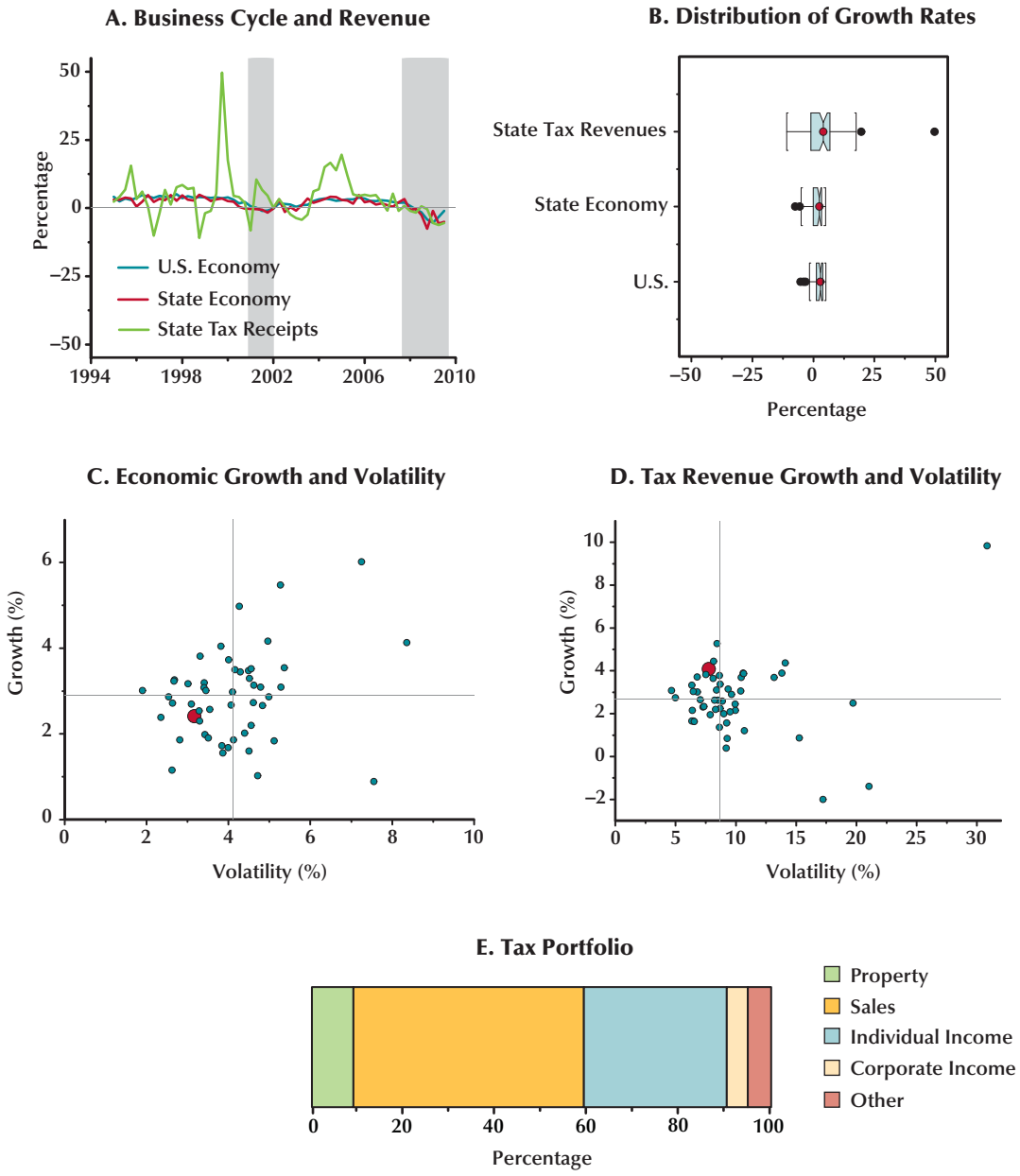
Texas Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 12

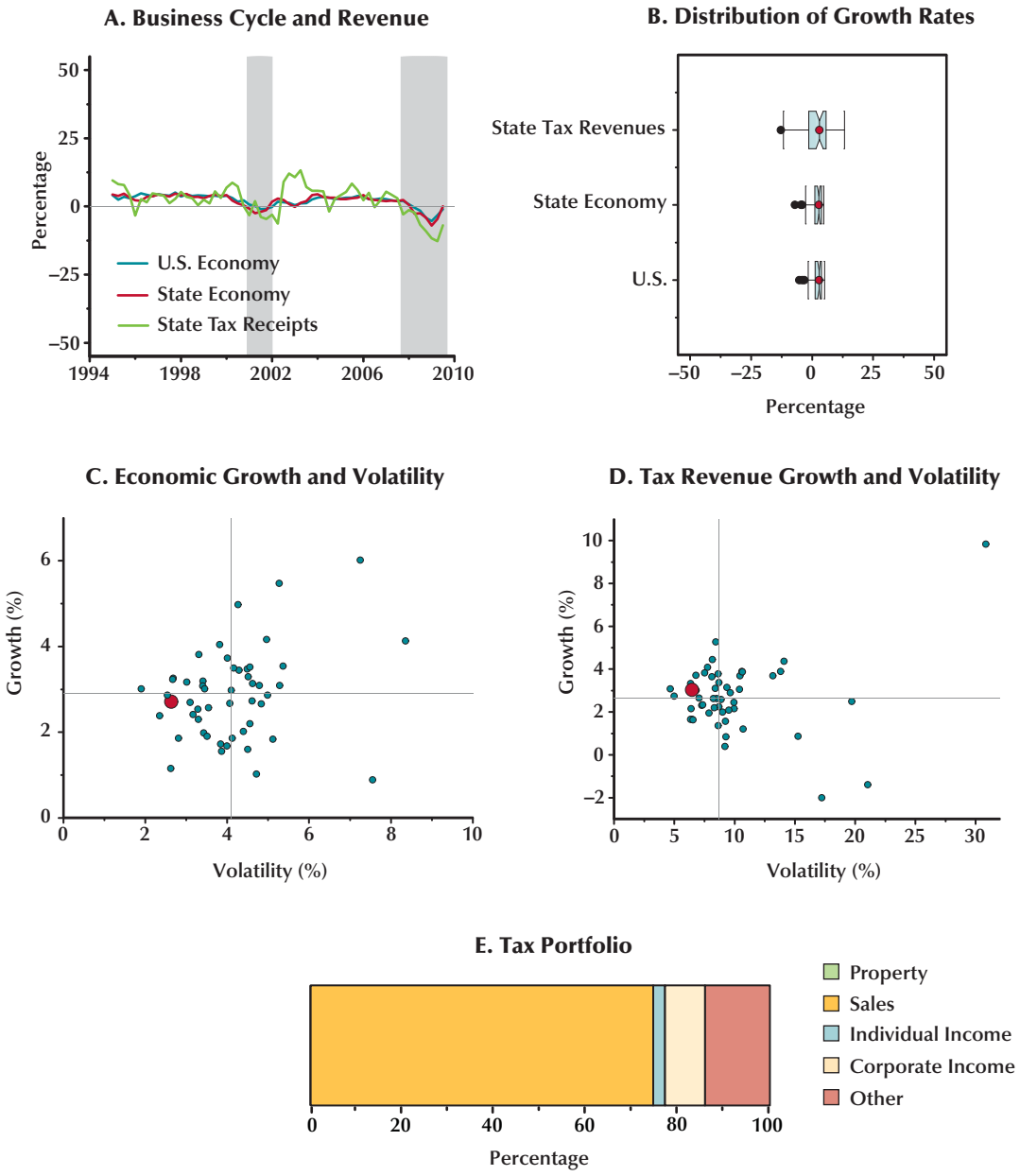
Arkansas Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 13

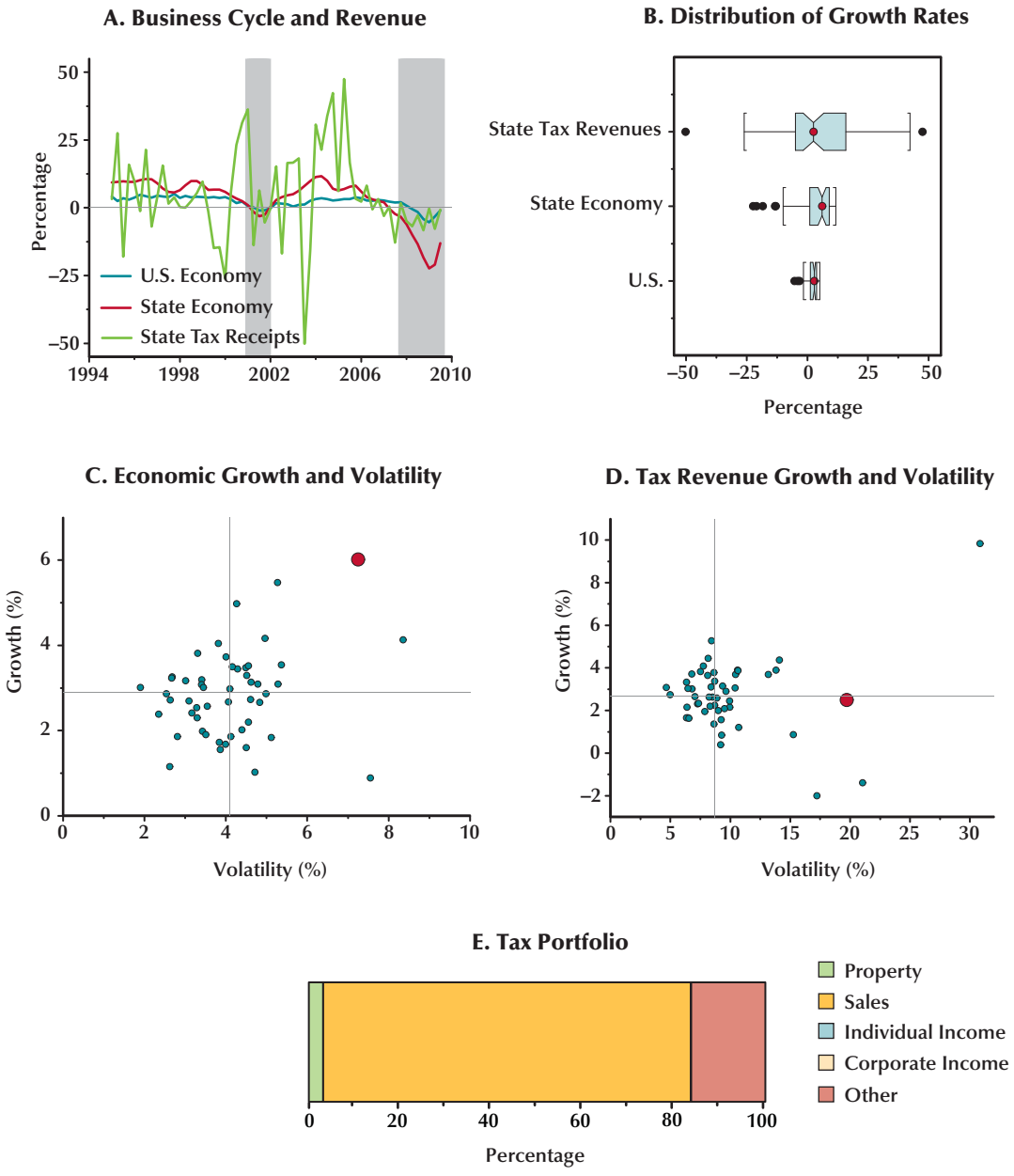
Tennessee Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 14

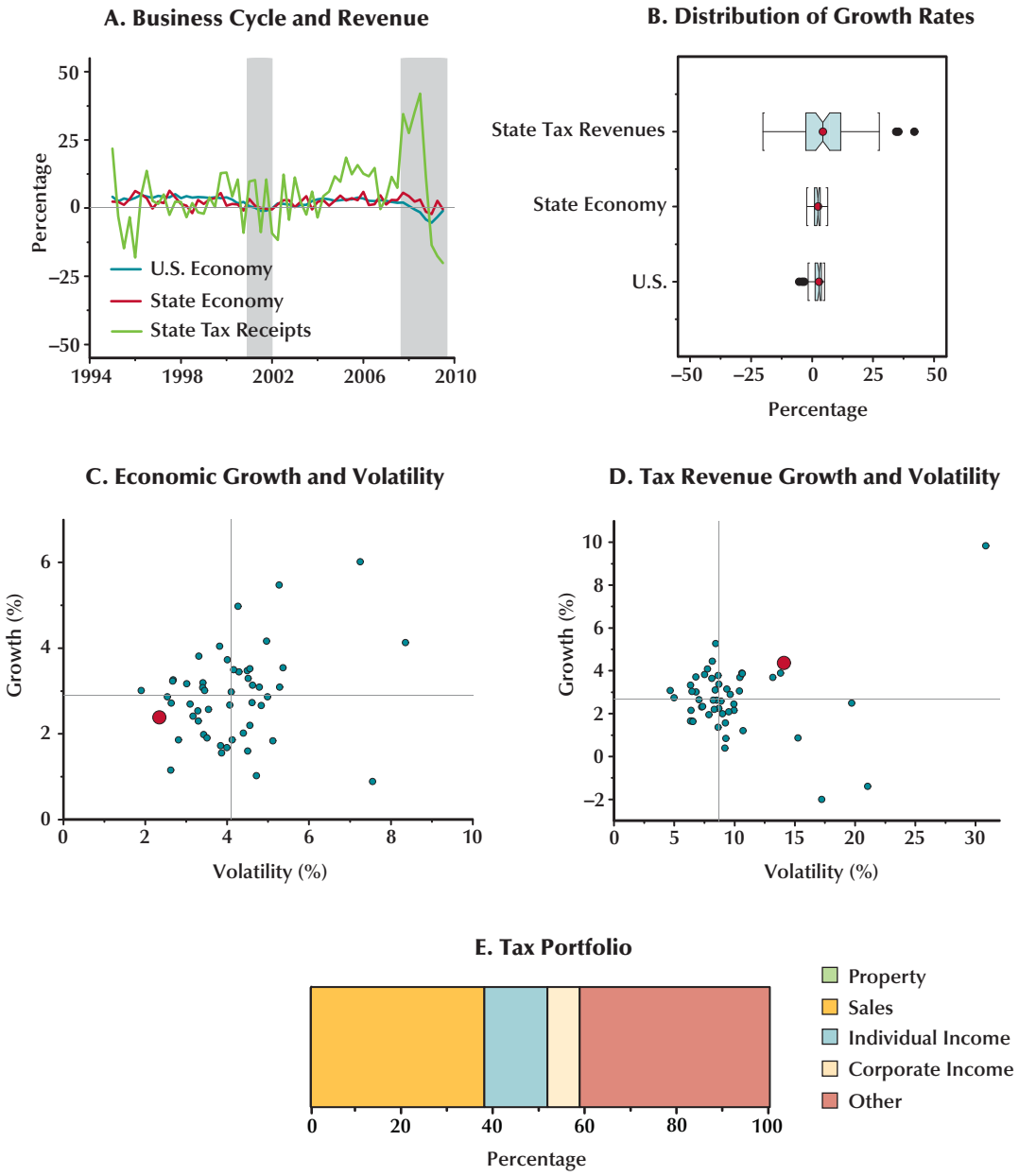
Nevada Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 15

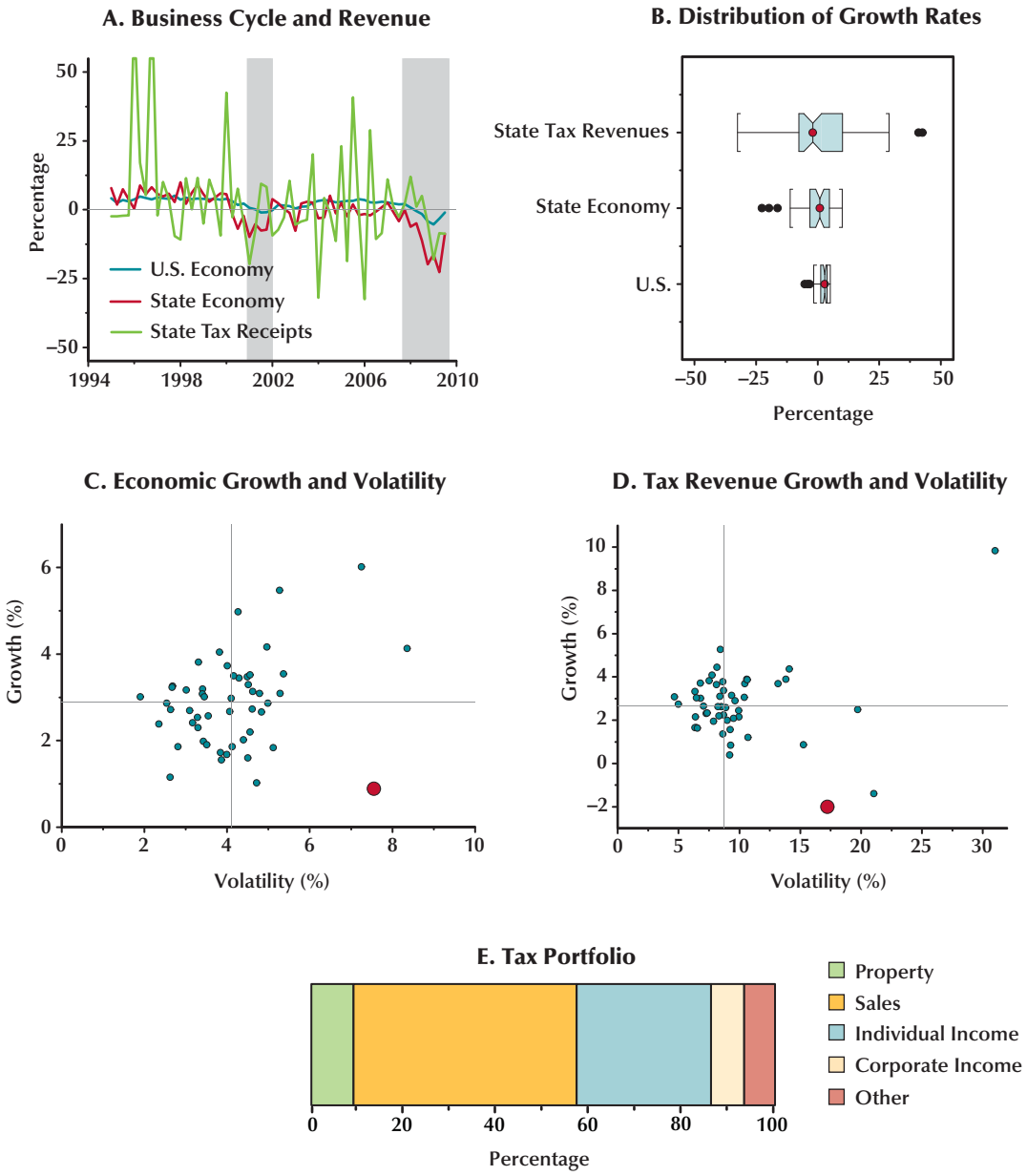
North Dakota Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 16

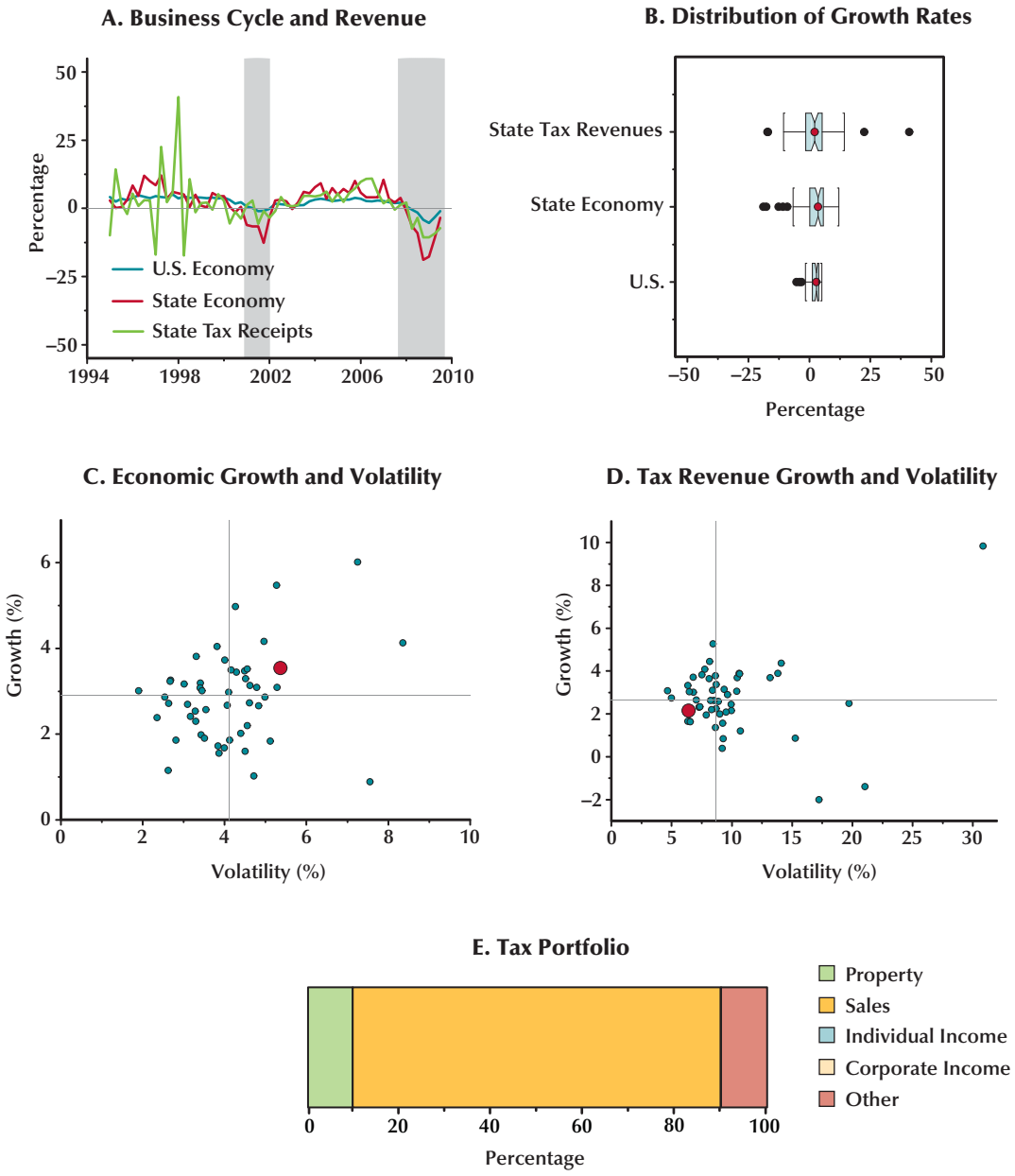
Michigan Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 17

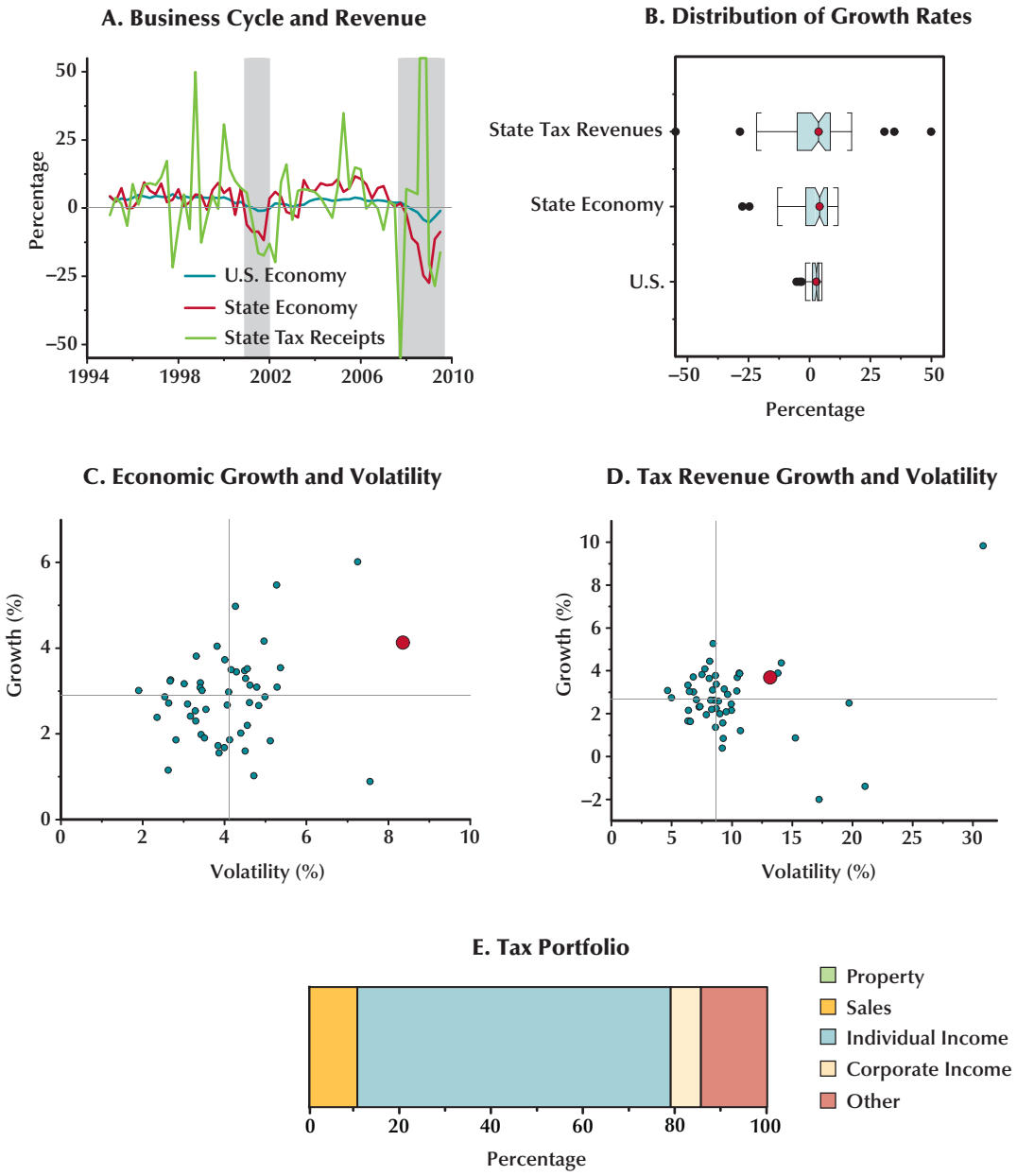
Washington Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 18

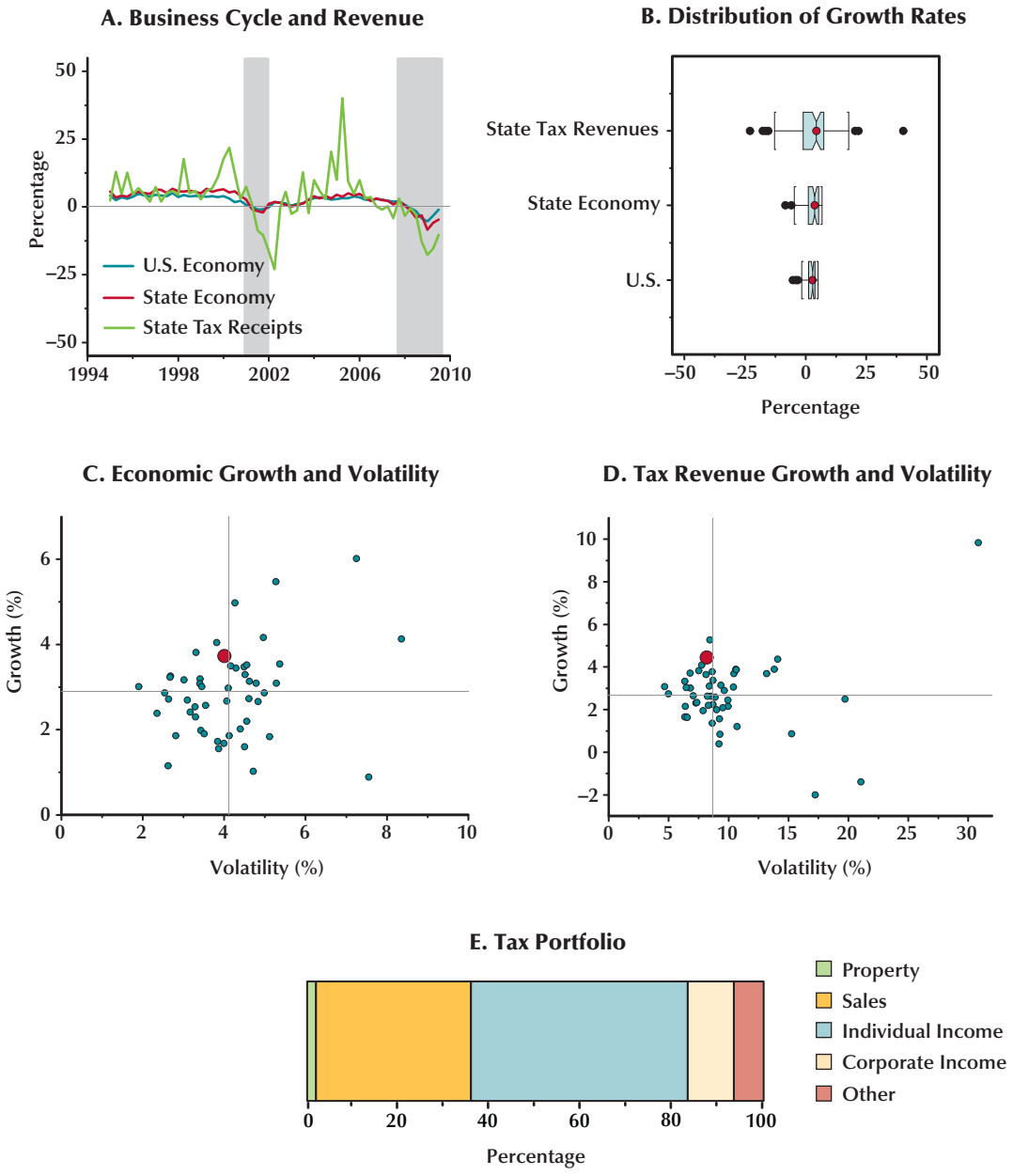
Oregon Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 19

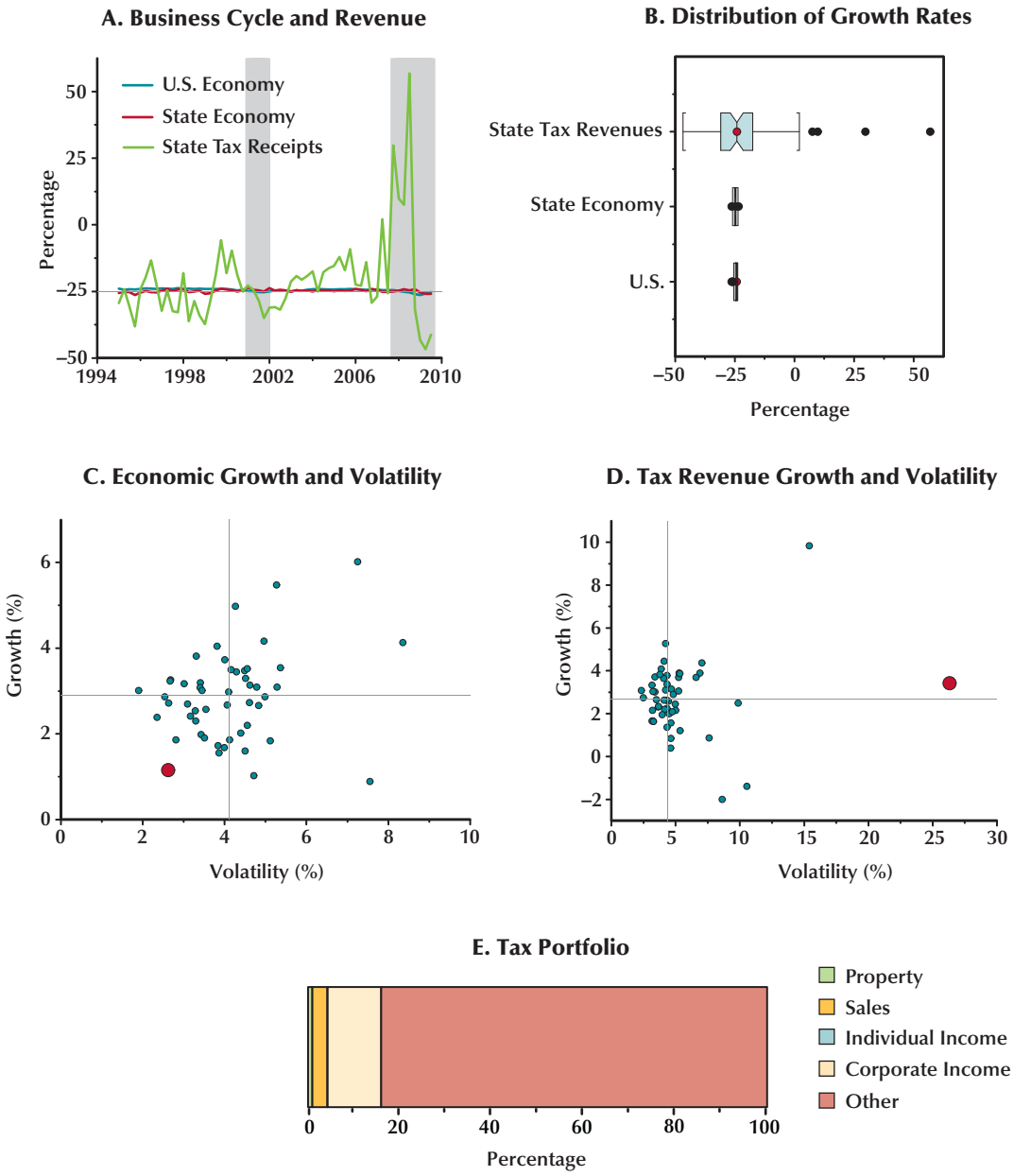
California Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 20

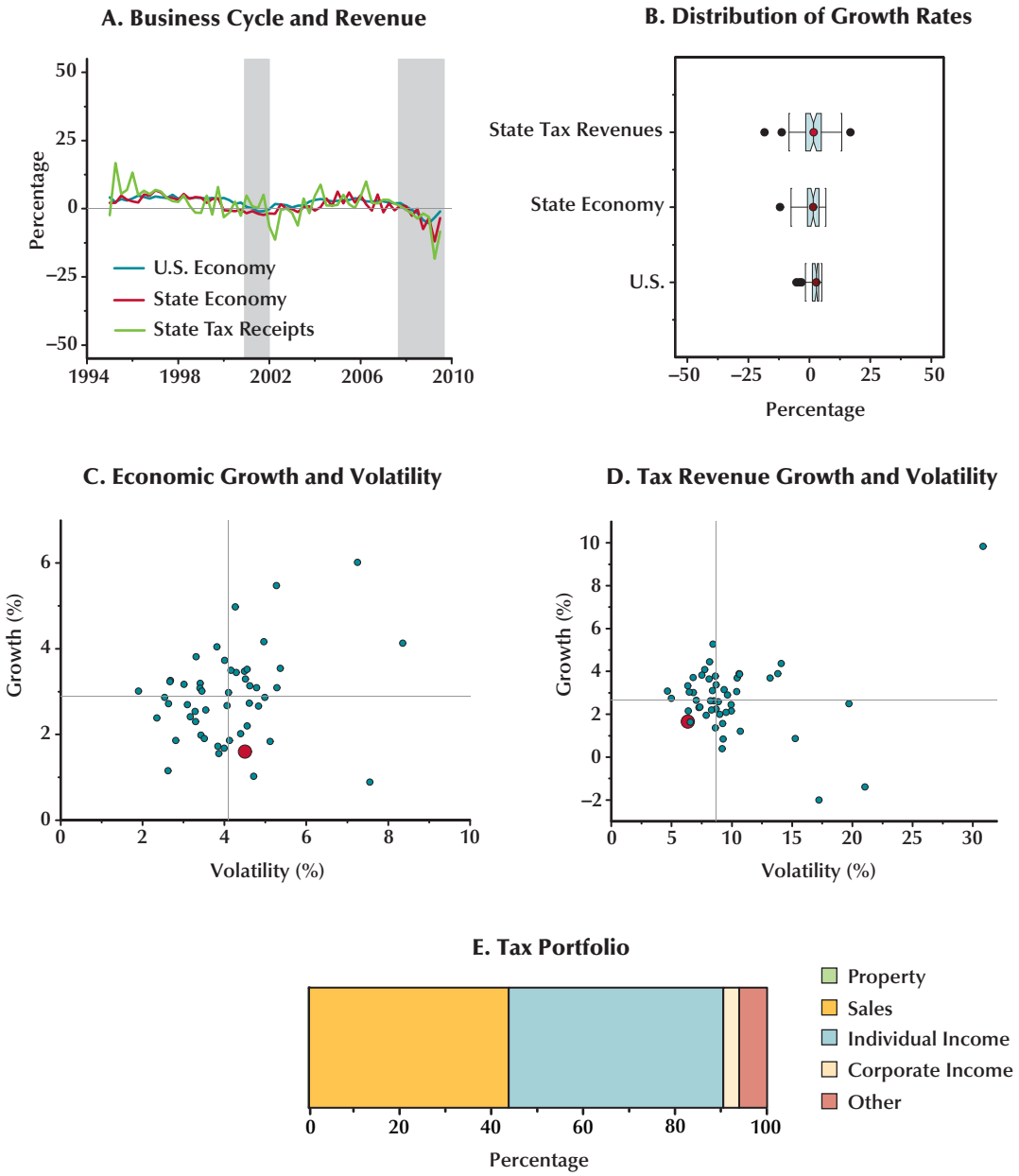
Alaska Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 21

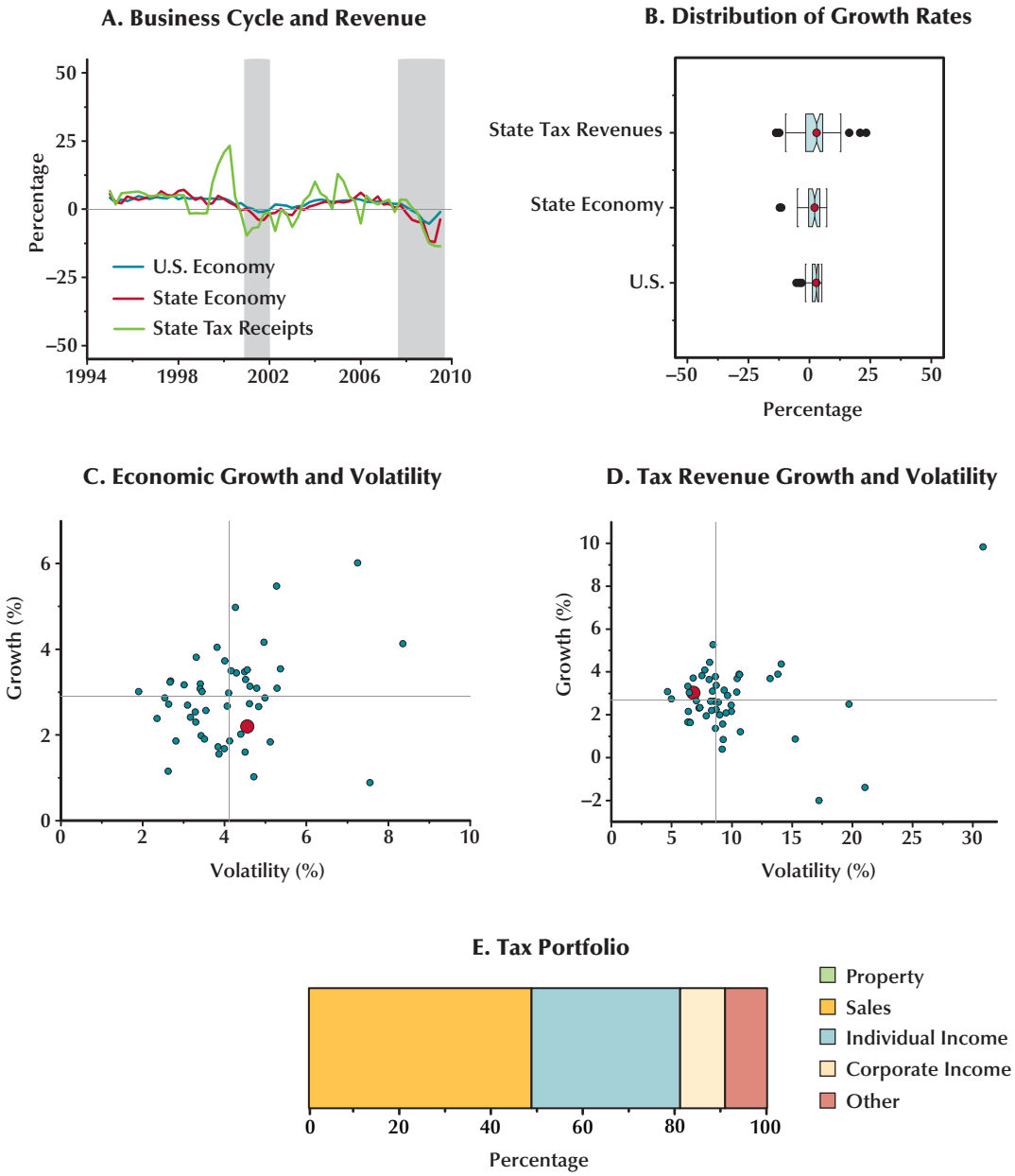
Missouri Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 22

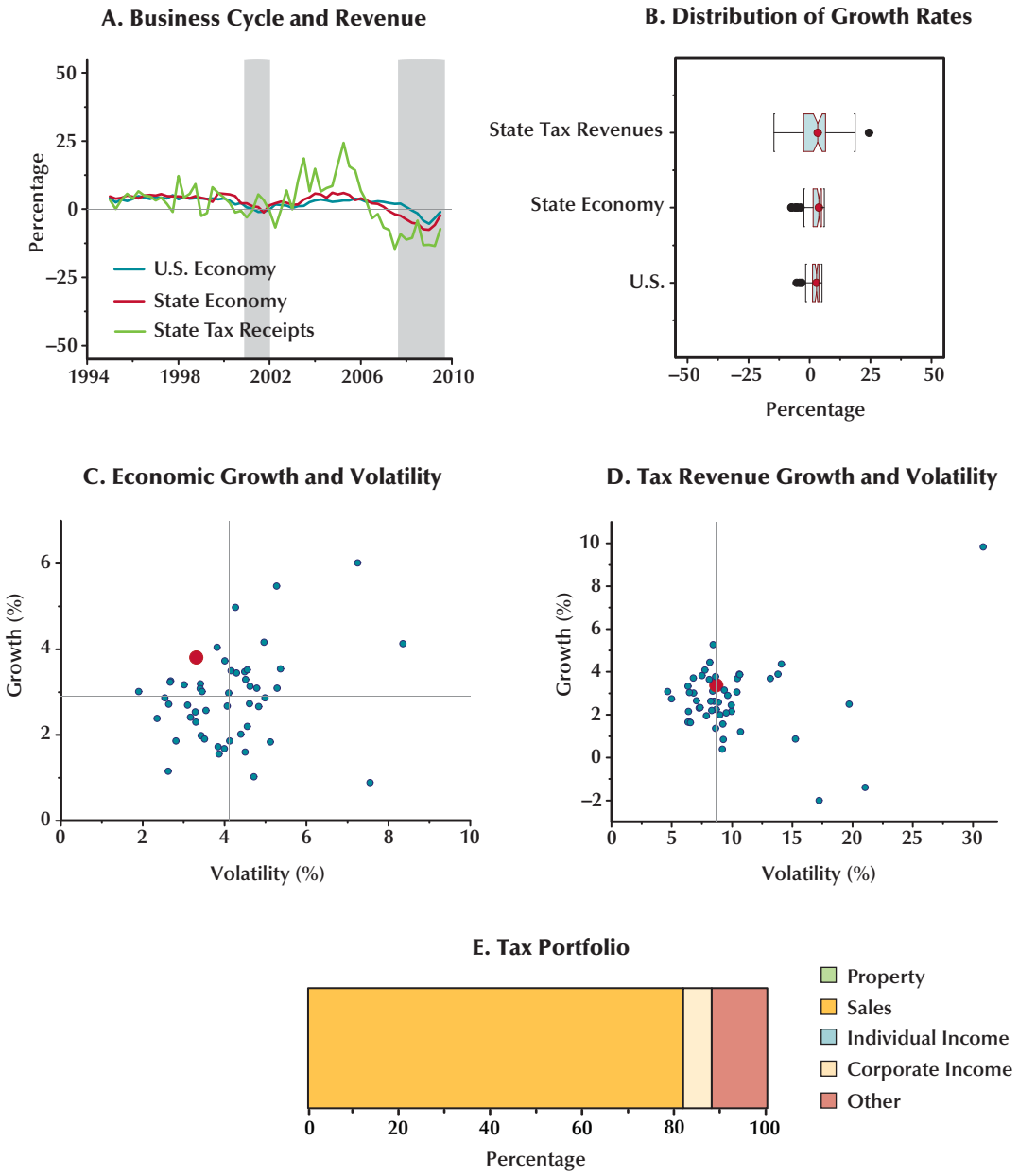
Illinois Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

Figure 23

Florida Growth Rate and Volatility (1995-2009)



SOURCE: Federal Reserve Bank of Philadelphia State Coincident Indexes and Census Bureau Quarterly State and Local Government Tax Revenue.

varying effects of these choices. Washington's dependence on the sales tax places its tax revenues in the low-growth/low-volatility quadrant (Figure 17, Panel D). Oregon's dependence on the income tax keeps its tax revenues far from the efficiency frontier by maintaining or increasing the undesirable combination of lower expected growth for the given level of volatility.

Interestingly, California (Figure 19) exhibits no extremes in growth and volatility for either its economy or tax revenues. It might be, therefore, that the well-documented fiscal travails of California are more strongly related to its budgeting and legislative process than to inherent tax structure deficiencies or economic instability.

Alaska (Figure 20) is an example of the extreme potential effects on growth and volatility that can be exerted by a tax portfolio. Because of the wide fluctuations in the rates of change shown in Panel A, it is difficult to evaluate Alaska's economy relative to the U.S. economy. The panel does show, however, the dominance of revenue volatility relative to the economy. Alaska's choice to depend on "other" and corporate income taxes rather than sales or individual income taxes causes its tax revenues to have particularly high expected growth and volatility.

The additional examples in Figures 21 through 23 further demonstrate the potential positive and negative effects of tax policy. Although Missouri's economy sits in the low-growth/high-volatility quadrant (Figure 21, Panel C), its tax portfolio successfully places its tax revenues in the more-desirable low-growth/low-volatility quadrant (Panel D). Illinois's economy sits in the inferior low-growth/high-volatility quadrant (Figure 22, Panel C), and it tax revenues in the high-growth/low-volatility quadrant (Panel D). Finally, although Florida's economy sits on the efficiency frontier (Figure 23, Panel C), its tax code keeps its tax revenues off the efficiency frontier by decreasing their growth and increasing their volatility relative to those measures for other states (Panel D).

BUDGETING IMPLICATIONS

As mentioned, revenue adequacy is a key criterion used to evaluate tax systems. Because elected officials rarely have the political ability to simply stop funding services such as education or public safety, they need reliable revenue sources. For this reason, good public policy suggests that states work to mitigate revenue uncertainty. While recognizing the importance of equity and efficiency in tax policy formulation, even the best-intended tax design cannot offset the instability resulting from tax schemes that magnify rather than attenuate business cycle effects.

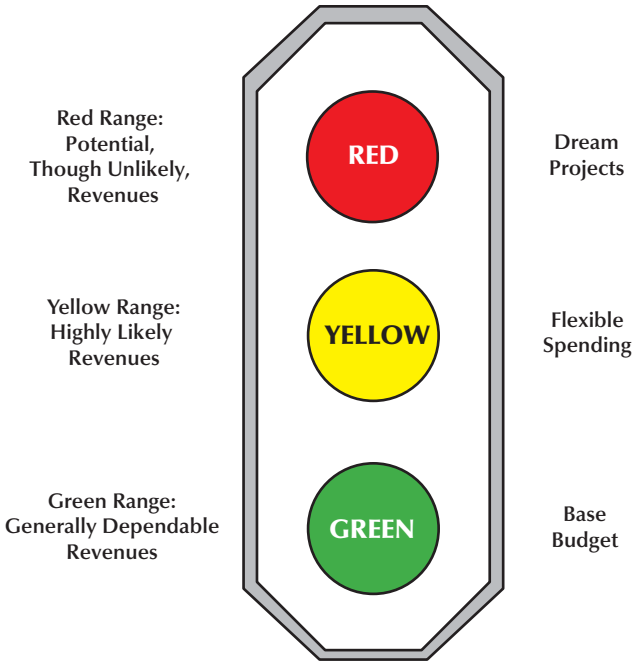
Super (2005) notes that economists' growing sophistication in understanding business cycles should translate into better prediction of fiscal cycles. Given the severity of the current downturn, however, his observations may be slightly premature and overly optimistic. Nonetheless, understanding the fiscal consequences of downturns may help develop policies that allow rational responses to fiscal trauma. Two examples of methods that incorporate growth and volatility into budgeting decisions are revenue semaphores and value at risk (VAR). Neither method has anything to do with reforming tax systems to make them more stable. They simply show that information about growth and volatility can improve state policy processes and budget outcomes.

Revenue Semaphores

Revenue semaphores (Cornia, Nelson, and Wilko, 2004) aid the budgeting process by providing a graphical approach for communicating expected growth and volatility of each potential revenue source so that expenditures may be prioritized. Rather than provide a single-valued point forecast of tax revenues, revenue semaphores categorize the distribution of potential tax receipts into three different categories. As shown in Figure 24, the first, green for "go," identifies those revenues available for basic expenditures. Although a small probability always exists for a major economic upheaval, these revenues can usually be considered safe parts of base budgets. The second category, yellow for "caution," includes highly likely revenues, which are allocated to projects and expenditures likely to be fully funded. With this categorization, in the case of revenue shortfalls, state executive and legislative branches can more easily see where they need to cut back to balance the budget. The third category, red for "stop,"

Figure 24

Revenue Semaphores



identifies potential—although unlikely—revenues that could allow capital expenditures or tax cuts in the case of a very large revenue surplus. Even though "red revenues" are highly unlikely, anticipating these potential windfall resources could foster more transparent decisionmaking at the end of the budget year.

Implementation of revenue semaphores requires that analysts and officials consider the growth and volatility of their state economies. They must also consider the potential impact on growth and volatility that comes from their chosen tax portfolio. These factors, as they interact to determine available revenues in the budgeting process, determine the boundaries for the green, yellow, and red categories of revenue semaphores.

Value at Risk and Optimal Rainy Day Funds

Nelson and Cornia (2004) use the financial concept of VAR to show how states should consider the entire probability distribution of budget surpluses/deficits when determining the optimal size of their rainy day funds. Probability distributions similar to the one shown in Figure 25 are critical for the application of VAR methodology to rainy day funds.

If one considers state rainy day funds as a type of insurance, it is reasonable to recognize that it is infeasible to totally insure against all adverse and improbable outcomes. The size of a rainy day fund needed to cover the worst-possible budget deficit would be neither politically possible nor financially feasible. Therefore, when determining the optimal size of a rainy day fund, decisionmakers must decide how large of a budget deficit can be insured. Using VAR, decisionmakers simply determine the probability, p, of the deficit size they cannot insure. The dollar amount that leaves a probability of p in the left tail of the probability distribution, like the one shown in Figure 25, corresponds to the VAR. This value then determines the size of the rainy day fund.

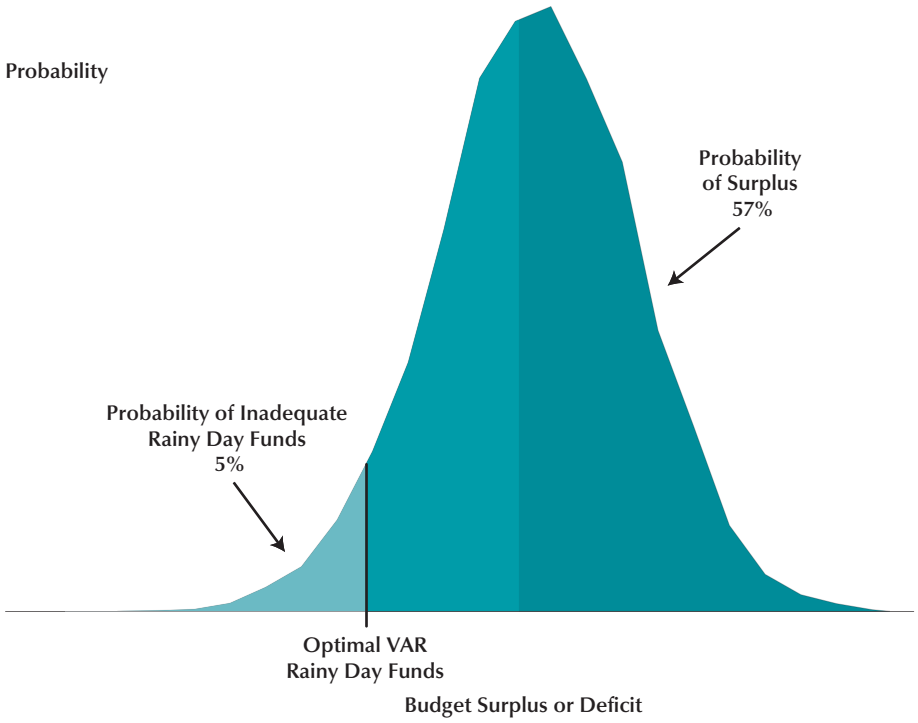
The expected growth and volatility of tax revenues strongly impacts the probability distribution of deficits/surpluses, such as the one in Figure 25. For this reason, states should carefully consider the unique characteristics of their economy and tax portfolio when calculating the optimal size of their rainy day funds. The application of a simple rule of thumb without customization to a state's economic and tax environment will result in a suboptimal solution.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This analysis establishes the joint importance of economic conditions and tax portfolios in determining the growth and volatility of state tax revenues. It also reveals that a variety of growth and volatility combinations exist among states. As states consider tax reform and revenue-enhancing measures in the current fiscal crisis, they should carefully anticipate and consider the possible impacts of their proposed changes on the growth and volatility of their unique tax revenue portfolios.

Figure 25

Optimal Rainy Day Funds Determined as Value at Risk



The current recession has wrought budgeting havoc among states. The Philadelphia Fed's coincident indexes clearly establish the historic gravity of the most recent economic downturn. Although some states have been more severely affected than others, all states have suffered challenges due to the economic slowdown. Because state economies do not react uniformly to the national business cycle, state officials must take care that they tailor policy proposals to the unique characteristics of their economy.

In the short run, states cannot alter the volatility of their economies, but they can change their tax portfolios to minimize the effects of the business cycle on their fiscal health. For this reason they need to consider the natural tendencies of their economies when formulating tax policy. This means that states with volatile economies might want to choose tax portfolios that minimize the impact of national macroeconomic trends and avoid volatile funding sources that can result in even more volatile revenues. States with stable economies might consider adopting more aggressive tax portfolios.

This analysis recognizes the importance of sales and individual income taxes as the principal revenue sources in state budgeting. The sales tax offers stability but at the cost of a lower growth rate. The individual income tax offers growth but at the cost of increased volatility. Although the property tax currently is used mostly for financing local governments, its attractive growth and volatility combination might mean that states should consider adopting it as an additional source of funding to complement the growth and volatility characteristics of the sales and individual income taxes.

More research is needed to understand how a state's economy and tax portfolios interact to determine the growth and volatility of its tax revenues.

Better understanding of the probabilistic characteristics of tax revenues will improve the budgeting process in ways beyond the revenue semaphores and optimal rainy day funds discussed in this paper. Formal econometric modeling can exploit the panel nature of the economic and revenue data to formalize the ad hoc findings presented in this paper. The resulting knowledge could significantly improve tax reform and budget-balancing public policy decisions.

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