

A NEW MEASURE FOR THE VARIATION OF STATE TAX PRICES

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Richard Vedder's contributions to academic scholarship over the decades span many subdisciplines in economics. Many of his earlier works focused on various issues in state and local government finance. In a 1990 article, in this journal, he examined the relationship between interstate tax-price variation and state economic growth (Vedder 1990) to determine whether such variability might impact state prosperity and economic growth.

In part, Vedder's empirical analysis used the coefficient of variation across state tax prices in a given year to reveal whether "convergence" or "divergence" better described the behavior of state tax prices over time. He acknowledged that the results of this examination would be difficult to interpret because of confounding influences on the variability of state tax prices that are beyond the control of a state tax policy. This begs the question: Could a better measure of variability be constructed to control for such influences? This article attempts to do just that.

The first section of this article explains Vedder's methodology for measuring interstate tax-price variability and the challenging issues that he identified as confounding his attempt to determine whether such variability was rising or falling over time. The second section proposes a new measure for such variability and explores its

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usefulness in controlling for these confounding issues. The penultimate section uses empirical data to generate annual values of this measure across two decades of available tax data. The conclusion summarizes these results and considers how such information may drive forward the work that Vedder initially pursued.

Vedder's Methodology

To better understand the impact of state tax policy on prosperity and economic growth, Vedder describes two competing models that explain how states attract and sustain a viable tax base for supplying goods and services. Both models attempt to describe interstate tax policy as a competition between states, but the models produce dissimilar tax-price implications. According to one model, state governments compete primarily on tax price; this model predicts converging tax prices across state jurisdictions. In the other model, state governments compete on the quantity (or quality) of publicly funded goods and services; here the prediction is for divergent tax prices across states.

The first model Vedder considers is actually a blend of two separate models of public economics. The Brennan and Buchanan (1980) perspective assumes state governments behave like firms, selling goods and services to a customer base of taxpayers that is somewhat captive, due to nontrivial relocation costs. This is combined with Niskanen's (1971) perspective, in which bureaucratic rent-seeking activity causes the inefficient production of these goods and services. Any one state government's market power to set a tax price for supplying a given quantity of goods and services is limited by the ability of the taxpayers to migrate to another state that is perceived as offering a more favorable tax price. Further, if the inefficiency in supplying goods and services due to bureaucratic rent-seeking activity increases proportionately with the quantity of government goods and services produced, state taxpayer perceptions of tax prices relative to the value of state goods and services received worsens proportionately as well. This intensifies state taxpayers' search for a state jurisdiction with the best tax price for state-provided goods and services. The implication of this blended model is that state tax prices for goods and services tend to *converge* across states that compete on tax price to attract a sustainable base of taxpayers.

The second model that Vedder considers is that of Tiebout (1956), in which state taxpayers are assumed to have diverse preferences for

the size and scope of state-provided goods and services. These taxpayers are assumed to be fairly mobile across state jurisdictions, with the ability to shop across a diverse collection of state-supplied baskets of goods and services, in an effort to find one that best fits their unique preferences. This means that state governments compete by offering differing quantities (or qualities) of goods and services to attract a sustainable customer base of taxpayers within their constituency. The implication of this model is that state tax prices for goods and services tend to *diverge* across the states.

To explore whether U.S. economic history supports one model over the other, Vedder collects data from various years on state own-source tax revenues. These are expressed in two ways: first, per capita; second, per dollar of personal income in the state in question. Vedder then calculates the coefficient of variation in each of these two measures across the 48 contiguous states for selected years. The objective of this longitudinal analysis was to detect whether such state tax-price variation tended to converge or diverge over time. Unfortunately, the data did not speak as clearly as Vedder hoped.

The trend in variation of per capita revenue data from 1902 to 1942 appears to support the Brennan and Buchanan model of tax-price convergence, but the trend in variation of revenue per dollar of personal income from the same period appears to support the Tiebout model of tax-price divergence. Vedder notes that this dichotomy may arise from a substantial decline in per capita income variation across the states during this time period, which could create the *appearance* of state tax-price convergence. Thus, analysis of this time period reveals the first limitation of measuring variation in this manner: the coefficient of variation of state tax prices does not control for interstate income differentials. As a result, these measures may not accurately reflect the underlying trends in cross-state convergence or divergence in tax prices.

Examining the trend in interstate tax-price variation from 1942 to 1962 appears to support the Brennan and Buchanan model of tax-price convergence, regardless of which measure is used. However, Vedder notes that federal income tax rates escalated over this period. He warns that taxpayers' ability to deduct their state tax burden from their federal tax liability might effectively lower their perceived tax price of state-provided goods and services, even if state tax prices remain stable. Furthermore, the remaining period of 1962 to 1988 is largely characterized by a general return to stability in interstate

variation of tax prices. Vedder notes that high marginal federal income tax rates declined significantly over this time period, lowering the benefits of deductibility. He warns that state tax burden deductibility might effectively increase taxpayers' perceived tax price, even if no real change in state tax prices had occurred.

Taken together, analysis of the time period 1942–88 reveals the second limitation of using the data in this manner: the measure of the interstate coefficient of variation does not control for changes in the federal tax burden that arise from state tax deductibility or from changing federal income tax rates. Again, this means that the resulting measures may not accurately reflect the underlying trends in cross-state convergence or divergence in tax prices.

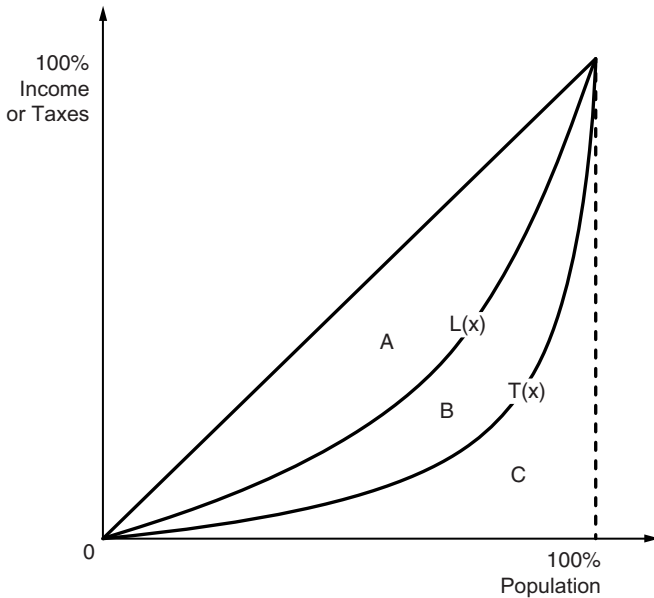
In order to properly discern which of the two models—Brennan-Buchanan or Tiebout—more accurately reflects interstate competition, one must develop a measure of interstate tax-price variation that accounts for both interstate variation in per capita income and for changes in state taxpayer's perceived federal income tax burden. The next section proposes a way to do exactly that.

A New Measure of Interstate Variation in Tax Prices

Consider how the Gini coefficient measures the degree of income inequality across population groups. Using the graph in Figure 1, below, a 45 degree line out of the origin depicts a near-perfect cumulative income distribution across a given number of population segments (x). The Lorenz curve, $L(x)$, depicts the actual cumulative income distribution across the population. The Gini index is the ratio of area A to the total area under the 45 degree line ($A + B + C$). When income becomes more evenly distributed, the Lorenz curve becomes flatter, area A becomes smaller and the Gini index value approaches zero. When income becomes more unevenly distributed, the Lorenz curve becomes more skewed, area A becomes larger and the Gini index value approaches unity. In this way, the Gini index value reflects the degree of income inequality of the population on a scale of zero to one.

A measure for interstate variation in tax prices for goods and services can be created using a similar approach. First, consider how each state's share of national personal income (expressed in per capita terms) can be accumulated from the poorest state to the richest state. This creates a type of Lorenz curve, $L(x)$, which represents how

FIGURE 1
CUMULATIVE INCOME AND TAX BURDEN CURVES



national personal income is actually distributed across the ($x = 50$) states. If states exhibited more variation in per capita income, the curve would become more skewed; area A would increase relative to area $A+B+C$, and the Gini index would increase. If states exhibited less variation in per capita income, the curve would become less skewed; area A would decrease relative to area $A+B+C$, and the value of the Gini index would fall.

Next, consider the net tax price of publicly provided goods and services within a state. State and local own-source tax revenue data can be collected for each state and expressed in per capita terms. Also, the *net* federal taxes collected for each state can be calculated as the difference in total federal income tax payments made by the taxpayers of each state, less the total federal grants in aid received by each state, also expressed in per capita terms. The net tax price for each state can then be calculated as the sum of these three different per capita measures. Next, each state's own share of national tax expenditures (expressed in per capita terms) can be accumulated along the horizontal axis from the poorest state to the richest state, as

already ordered when constructing the Lorenz curve. This creates a net tax-price curve, $T(x)$, that represents how net tax prices are distributed across the 50 states.

Finally, information from the Lorenz curve and the net tax-price curve can be combined to produce an interstate tax-price variation index that is similar to a tax progressivity index introduced by Stroup (2005) and further developed by Stroup and Hubbard (2013). Referring to Figure 1, above, area B can be expressed as a ratio of area B+C to create a tax-price variation index that is akin to the Gini index. If interstate variation in net tax prices were to increase, all else being equal, the net tax-price curve would become more skewed; the size of area B would increase relative to area B+C, and the value of the tax-price variability index would rise. The higher index value reflects the greater tax-price divergence across the states. This method of measuring interstate variation would control for the very issues that confounded Vedder's initial analysis, as explained below:

- *Variation in per Capita Incomes across the States:* If interstate variation in per capita income were to increase, all else being equal, the Lorenz curve would become more skewed. Area B would decrease relative to area B+C, and the tax-price variability index would fall. This decrease in the index value would reflect how interstate tax prices had converged *relative* to the new personal income variation that exists across the states.
- *The Deductibility of State Tax Burdens on Federal Income Taxes:* If the scope of state tax burden deductibility from federal income taxes were to expand, all else being equal, this would lessen the perceived impact of federal income tax burdens more intensively among taxpayers in those states with higher per capita incomes, because taxpayers with higher median incomes face higher marginal tax rates in a progressive federal income tax system. This causes the net tax-price curve to become less skewed, as the higher-income state taxpayers enjoy a bigger federal tax break than the lower income state taxpayers. This means area B decreases as a ratio of area B+C, thereby reducing the value of the interstate tax variation index. This decrease in the index value reflects a convergence of interstate tax prices that stems from the perception that state tax prices are lower due to a declining federal tax burden.
- *Changes in the Federal Income Tax Rates:* If federal income tax rates declined, all else being equal, the deductibility of state

taxes combined with a progressive federal tax rate structure implies that the perceived impact of any given state tax burden would be felt more heavily by those states with wealthier median-income taxpayers. This is because the discount on federal tax burdens arising from state tax deductibility has, in this scenario, diminished more severely for those states with relatively higher income taxpayers. As a result, the tax-price curve would become more skewed, since those state taxpayers with higher median incomes would lose more of their federal tax break than the lower income state taxpayers. As a result, area B would increase as a ratio of area B+C, thereby raising the value of the interstate tax-variation index. This increase in the index value reflects a divergence of interstate tax prices, as falling federal tax rates give the impression of higher effective state tax prices.

Once the personal income and net tax-price data for all 50 states are arranged from lowest to highest per capita state income, the net tax-price curve will be everywhere below the Lorenz curve, as represented in Figure 1. However, accumulating each state's data point from the smallest per capita income state to the largest may not create a curve that always increases as states are added. Some states may have a negative state tax price if total federal grants received exceed both federal and state taxes collected, which would create a negative slope between two state data points on the curve. Regardless, the curve must still eventually rise to reach 100 percent of all revenues collected. This means the value of the index will rise as the interstate variation in net tax price rises and will fall when interstate variation in net tax price falls. Further, the ratio still approaches the value of zero when interstate variation is minimized and approaches the value of one when it is maximized.

Estimating the Interstate Tax-Price Variability Index

Ultimately, this net tax-price index can be estimated for each year of available data to provide an annual, cross-sectional analysis that shows whether net tax prices have converged or diverged across states over time. The pertinent areas of the graph in Figure 1 can be calculated using the observations from the 50 states to estimate a Lorenz curve, $L(x)$, and a net tax price curve, $T(x)$. These curves can be estimated using a simple linear spline function for each year of

data. While using tax data from the same years as Vedder's original analysis would provide the optimal comparison, not all data for those specific years are available.

State per capita personal income can be downloaded from the Bureau of Labor Statistics (www.bls.gov). Data for per capita, own-source state and local tax burdens for each state can be downloaded from the Tax Foundation (www.taxfoundation.org), but only for the years 1985 through 2005, which proves to be the limiting factor in determining the time period used for this analysis. The federal income taxes collected from each state, as well as the grants in aid given back to each state, can also be downloaded from the Tax Foundation for this time period. These federal data are then converted to per capita terms using state population data downloaded from the U.S. Census Bureau (www.census.gov). Figure 2 shows two sets of Lorenz and net tax-price curves that have been estimated for the years 1985 and 2005, to illustrate the change in interstate variation in tax prices over that time.

As described above, these graphs can be used to calculate both a Gini index and an interstate tax variation index. The results of such calculations are outlined below:

- *The Gini Index*: Table 1 reveals the value of the Gini coefficient when using state per capita personal incomes to estimate a Lorenz curve for the 50 states. The data series creates a mean of 0.060 and a standard error of 0.001. This implies that the value of the Gini index is not significantly different from the series mean of 0.060 for either 1985 or 2005, using the traditional 5 percent error level. Those years where the Gini index exceeded these 95 percent confidence bounds are denoted with an asterisk. While the index values were above this confidence interval for the early years of 1986 to 1990, they were below the interval for the middle years of 1994 to 1997. The index values exceeded these bounds for only two of the last eight years of the data, implying that the Gini index generally returned to the series mean during the last third of this period. Taken together, this evidence implies that interstate income inequality has neither consistently increased nor decreased across the two decades from 1985 to 2005.
- *The Interstate Tax Variation Index*: Table 2 reveals the value of the interstate tax-price variation index for the same years. The data series create a mean of 0.207 and a standard error of 0.018.

FIGURE 2
 CUMULATIVE STATE PER CAPITA INCOME AND
 NET TAX-PRICE CURVES

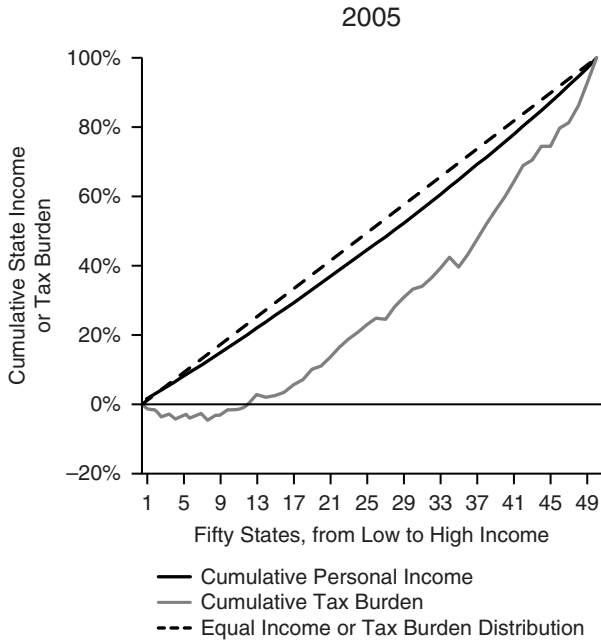
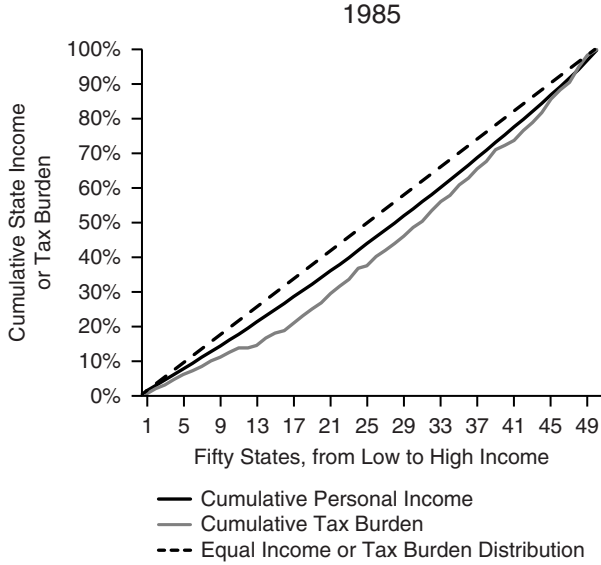


TABLE 1
ANNUAL GINI INDEX VALUES

Year	1985	1986	1987	1988	1989	1990	1991
Gini Index	0.061	0.063*	0.066*	0.070*	0.069*	0.064*	0.061
Year	1992	1993	1994	1995	1996	1997	1998
Gini Index	0.059	0.057	0.054*	0.055*	0.053*	0.057*	0.058
Year	1999	2000	2001	2002	2003	2004	2005
Gini Index	0.061	0.063*	0.060	0.058	0.057*	0.058	0.058

*Gini index exceeded the 95 percent confidence interval.

Those years where the tax variation index exceeded the 95 percent confidence interval about the series mean are denoted with an asterisk. While the tax-variation index values were below this confidence interval for each of the early years of 1985 to 1991, they rose above the mean for each of the latter years of 2001 to 2005. This implies that interstate tax-price variability consistently and significantly increased over these two decades, having fallen in value only twice in a span of over 20 years. In other words, state tax prices clearly diverged in the two decades from 1985 to 2005.

Ultimately, these empirical results indicate that cross-state variation in tax prices increased from 1985 to 2005, while cross-state variation in prosperity remained relatively unchanged. This implies that rising income inequality across the states would not confound the

TABLE 2
ANNUAL TAX VARIATION INDEX VALUES

Year	1985	1986	1987	1988	1989	1990	1991
Tax Index	0.091*	0.117*	0.126*	0.144*	0.144*	0.153*	0.165*
Year	1992	1993	1994	1995	1996	1997	1998
Tax Index	0.198	0.190	0.173	0.177	0.182	0.182	0.188
Year	1999	2000	2001	2002	2003	2004	2005
Tax Index	0.206	0.218	0.267*	0.330*	0.358*	0.379*	0.361*

*Gini index exceeded the 95 percent confidence interval.

direct implications arising from a rising inequality in state tax burdens across the two decades in question. While the blended Brennan and Buchanan/Niskanen model predicts a convergence in state tax prices, the observed divergence in tax prices across these two decades clearly lends support to the Tiebout model of interstate competition for a viable tax base, which suggests that governments vie with one another for taxpayers by offering differing quantities (and/or qualities) of publicly funded goods and services.

The data also reveal that some states enjoy a net negative tax price for their publicly provided goods and services, which is exhibited whenever the tax-price curve has a negative slope between states. Most (but not all) of these states have the lowest median incomes. This is to be expected when income is redistributed among states within a system of fiscal federalism. Such redistribution tends to create the negative slope portions of the tax-price curve across those states with the lowest per capita incomes, as exhibited in the 2005 graph in Figure 2.

For example, 10 states enjoyed negative tax prices in 2005, including Alaska, North Dakota, New Mexico, Mississippi, Louisiana, West Virginia, and Alabama. The last five of these were all in the lowest quartile of states when ranked by per capita state income. North Dakota narrowly misses being included in this poorest quartile, having the 14th lowest per capita income in 2005.

While it may appear that all of the residents in a negative tax-price state enjoy being paid to consume publicly provided goods and services, it is only on average that this is true. Not all taxpayers within that state will, in fact, have a negative net tax bill. Even if the state in question did not have a progressive state tax system to collect own-source revenues, the federal income tax system is still quite progressive. This implies that upper income taxpayers in a negative net tax-price state still pay a positive net tax price for consuming state-provided goods and services.

Conclusion

The purpose of this analysis was to develop and test a new measure of interstate variation in tax prices for state-provided goods and services. This effort arose in response to Vedder's initial attempt at measuring such variation by using the coefficient of variation in either per capita spending on state-provided goods and services, or in

spending as a ratio of personal income. He recognized that this simple measure failed to control for changes caused by variation of per capita incomes across states, by variation in marginal federal income tax rates, and by variation in the deductibility of state tax burdens over time. As such, it was difficult for him to identify the influence that interstate tax-price variability might have on state prosperity and economic growth.

This article has proposed a new measure of interstate tax-price variability that is based on the methodology of the Gini index used for measuring income inequality across a population. This new measure conceptually accounts for the influence that any changes in the interstate income distribution might have on the interstate variability of tax prices. It also conceptually accounts for the influence of taxpayer perceptions of state tax prices, which might result from changes in federal income tax deductibility of state tax burdens, or from changes in marginal federal income tax rates.

Using annual data from 1985 to 2005, our estimate of the value of this new measure implies that interstate variation in median personal income varied earlier in this period, but then returned to its mean value. In contrast, the interstate variation in net tax prices increased nearly every year over the time period in question. This growing divergence in net tax prices across states appears to support the state tax-price divergence predicted by the Tiebout model of interstate competition for a viable tax base, rather than the convergence in state tax prices predicted by the blended Brennan and Buchanan/Niskanen model.

A better measure of interstate tax-price variability would surely inform the body of empirical research that Vedder was pursuing. He wrote that “the empirical evidence continues to suggest that the growth-inducing effects of governmental expenditures, on balance, are less than the growth-impeding effects of taxes used to finance those expenditures” (Vedder 1990: 106). Having a more accurate estimate of interstate tax-price variability would have allowed for a better comparison between states with high versus low tax prices, while controlling for the level of tax-price variability across the states. While that effort is beyond the intended scope of the present analysis, perhaps the measure of interstate tax-price variability that we have developed here will support further empirical research in this area.

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