Is Hawaii's Tax System Stable?

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Is Hawaii's tax system stable? There is a relatively small literature on state tax system's long and short run stability, or variability. Short run stability refers to a response to recessions. Research indicates that there is considerable variation among state's tax revenues during downturns. Suppose a state's tax revenue has a long term, stable elasticity of one with respect to a state's personal income. During a recession, characterized by a drop in real personal income in the short term, does revenue fall by more than one, less than one, or exactly one percent? If a state's tax system has a short-term elasticity of tax revenues with respect to personal income greater than its long run elasticity then it can be considered unstable, or volatile. In other words, if personal income rises by one percent in normal conditions, then tax revenues rise by one percent. A recession is characterized by a drop in personal income if it tax revenues drop by same percentage they did before then that would be expected. Some states, like Hawaii, have a different reaction in that they drop by more then they did previously.

One unexplored outcome of this issue is the impact instability can have on state's economy. For example, during a recession in which nominal, or real, personal income might decline by five percent a state's revenues decline by ten percent, forcing cuts by that amount. Obviously, given even modest multipliers, then there will be a further decline in the economy and a prolonging of the recession for those states. What makes this worse is that these declines might be unforeseen even if a state's forecasters had precise knowledge of how great the decline in personal income was.

The methodology that has been used is to first, derive an unbiased long run elasticity estimate using Dynamic Ordinary Least Squares (DOLS) as proposed by Stock and Watson (1988). For short-term results, the variables in the DOLS model are first differenced and this produces elasticity's in percent changes, referred to below as the regular change model. In addition Vector Error Correction Model (VEC) have also been used. The VEC produces an estimate of the long run equilibrium similar to DOLS and an error correction term, or adjustment parameter, similar to the "change model." The adjustment parameter is the short-term response to disequilibrium. This has been done using annual data for tax revenues or tax bases and various measures of personal income or GDP, for example real per capita personal income, real personal income or nominal personal income.

Holcombe and Solow (1997) use annual data from 1973 through 1993 for each state. They measure variability of tax revenue using per capita tax revenue, and real per capita personal income or real per capita GDP to estimate the effects of local and national business cycles on revenue for all fifty states. They find the long -term elasticity of tax revenue for Hawaii with respect to personal income to be 1.22, first differenced, the elasticity is 1.783, and the error

correction term is 1.405. They also find that this volatility in part comes from the GET tax base rather than the income tax base.

Bruce, Fox and Tuttle (2006), use income and sales tax bases for all fifty states using annual data from 1967 through 2000. They compare a modified VEC that allows for asymmetric adjustments to changes in personal income. They compare these to DOLS results. They find Hawaii's tax bases have an asymmetric response to changes in personal income. For the GET base the DOLS elasticity is 1.1 (Holcombe and Solow's estimate was 1.11) and the income tax base is 1.32. In response to a recession the estimated elasticity's are 1.3 and 2.0 for the GET base and income tax base respectively. When the system is "above equilibrium" as during a recovery the elasticity's are 0.629 and 0.786, for the GET and income tax base respectively. (Although the income tax base is not statistically significant). They also explore potential causes of short run variability and could come to no conclusion.

Generally both of these studies find that Hawaii's tax system to be volatile, or unstable, in response to short run changes in personal income. They do not have the same results in measuring volatility between tax bases. Holcombe and Solow find the GET tax base more volatile, while Bruce, Fox and Tuttle find the income tax base more volatile. This could have something to do with how they measure bases. Holcombe and Solow use the reported tax base for GET and the Federal Adjusted Gross Income for the income tax base. Bruce et. Al. Use the same AGI but derive state sales tax bases by dividing sales tax revenue by the main rate. This could lead to differences because intermediate goods are sometimes taxed at a different rate.

Below, in Table 1, I have duplicated Holcombe and Solow's methodology for Hawaii using a variety of measure of personal income and tax revenues and tax bases. I use annual data between 1978 and 2008. I report a standard OLS estimate in order to check the effect of the DOLS. For DOLS I use three lags and leads, and a Newey-West correction for standard errors. I then first difference the variables to derive a regular change model. I report the parameters for a VEC model; long run equilibrium (beta) and short run adjustment (alpha). Holcomb and Solow use real per capita income and tax revenue using the GDP deflator for the inflation adjustment. I use the Honolulu CPI to adjust tax revenue. (Sources for the data are found in Table A.1) For comparison purposes, Tables 2 and 3 contain the results of other studies. My results, Holcombe and Solow's and Tuttle et al, agree almost exactly in terms of the DOLS estimate for the Real GET base. For Total Per Capita Tax Revenue my short run results are close to Holcomb and Solow's. I find the real GET base to be more stable than the real income base, and my results tend mirror Holcomb and Solow's results for the income tax base. Furthermore my results in terms of the income tax base tend to agree with Tuttle et al, in that my short run adjustment parameter is close to theirs, 1.92 to 2.0.

More importantly, these results tend to confirm that the short run response to a fall in personal income is greater than the long run equilibrium. Real total tax revenues have a short-term elasticity of around 2.0 in both the regular change

model and the error correction model. Although there is a difference in the results for nominal total revenue these too are above the long run values and between 1.6 and approximately 1.4. Basically these results suggest that in response to a recession tax revenues will fall at a greater rate than personal income. Given the balanced budget requirement for state government this has a dynamic impact on the downturn. This forces greater cuts in the state budget than would be required if tax revenues fell at the same rate as personal income. Multiplier effects lead to a further deepening, and prolonging of the recession, beyond what would be expected.

Tax bases are the first place to look in terms of underlying factors for this volatility. The results tend to agree with Bruce et al; the income tax base is more unstable than the GET tax base. These results are not uniform in that the short-term adjustment terms do not agree with regular change model. Generally, first differenced models results are more susceptible to the initial start of the data series than error correction models. The time periods for the data on the tax bases is different from the tax revenue data, it is annual from 1980 to 2005. So this outcome could be the result of differences in the models combined with different starting points. The VEC results were all tested for stability and specification. These included tests for serial correlation, normality of errors and a check of the modulus. Johansen tests for cointegration between the variables were done. (Except for one, see below).

Table 1: Hawaii Total Tax Revenue, Tax Bases, and Various Measures of Personal Income

	Long Run		Short Run			
		DOLS/NW	Regular	Error Correction		Independent
	OLS	Correction	Change	Model		Variable
Dependent Variable	Beta	Beta	Beta	Beta	Alpha	
Real Per Capita Hawaii Total Tax Revenue	1.30* (0.13)	1.64* (0.21)	1.85* (0.55)	1.30* (0.10)	1.24* (0.32)	Real Per Capita Hawaii Income
Real Total Tax Revenue	1.14* (0.068)	1.23* (0.08)	1.96* (0.53)	1.14* (0.03)	2.02* (0.57)	Real Personal Income
Nominal Total Tax Revenue	1.05* (0.024)	1.09* (0.03)	1.60* (0.354)	1.04 (0.017)	1.35* (0.24)	Nominal Personal Income
Nominal Total Tax Revenue	2.94* (0.11)	2.91* (0.15)	1.79* (0.64)	2.73* (0.09)	0.75* (0.24)	Real Personal Income
Nominal GET Base	0.98* (0.02)	1.05* (0.03)	1.07* (0.25)	1.01* (0.012)	2.45* (0.59)	Nominal Personal Income
Real GET Base	0.94*	1.10*	1.01*	0.97*	1.28*	Real Personal

	(0.05)	(0.13)	(0.32)	(0.05)	(0.35)	Income
Nominal State Adjusted Gross Income	0.98* (0.02)	0.99 (0.05)	0.81* (0.24)	1.08* (0.02)	1.80* (0.78)	Nominal Personal Income
Real Adjusted Gross Income	0.95* (0.07)	1.18* (0.06)	1.04* (0.26)	1.14* (0.08)	1.92* (0.56)	Real Personal Income

- 1 percent level of significance, **5 percent, ***10 percent

Table 2: Holcombe and Solow: Short and Long Run Estimates of Hawaii Tax Revenues and Bases

	Long Run		Short Run		
Holcombe and Solow	OLS	DOLS	Regular Change	Error Correction	Independent Variable
Real Per Capita Hawaii Total Tax Revenue	1.65* (0.21)	1.92* (0.266)	0.64** (0.39)	0.662* (0.277)	Real Per Capita GDP
Real Per Capita Hawaii Total Tax Revenue	1.166* (0.06)	1.224* (0.117)	1.783* (0.480)	1.405* (0.605)	Real Per Capita Income
Real GET Base	1.116* (0.037)	1.09 (0.95)	2.037* (0.673)	1.97* (0.525)	Real State Personal Income
Real Income Tax Base	0.977* (0.05)	0.871* (0.103)	0.953 (0.551)	1.637** (0.613)	Real State Personal Income

Table 3: Bruce, Fox and Tuttle; Short and Long Run Estimates of Hawaii Tax Bases

	DOLS	Above Equilibrium	Below Equilibrium	Error Correction	
Real GET Base	1.11**	1.3**	0.629	0.476**	Real State Personal Income
Real Income Tax Base	1.32**	2.0**	0.786	0.677**	Real State Personal Income

- 1 percent level of significance, **5 percent, ***10 percent

I included in the results, above, total revenue and real personal income. And the results had high long-term adjustment results, high short-term adjustment in the change model and low adjustment in the error correction term. If the VEC is calculated with total tax revenue, nominal personal income

and inflation entered separately then what results are two cointegrating equations. one with total revenue and inflation and one with personal income and inflation. These enter into the VEC separately and additively so that the change in total revenue has two short-term adjustment parameters and two long-term equilibrium relationships. I report these below. (Actually this is a model that might have some potential for forecasting Hawaii Tax Revenues).

		Alpha	Beta	
Cointegrated Equation 1	Total revenue	0.99	1.69	Honolulu cpi
Cointegrated Equation 2	Personal income	1.45	1.65	Honolulu cpi