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TO: ZACHARY Q. JACKSON, INDIANA STATE BUDGET DIRECTOR
FROM: JACOB ALDER, TAX ANALYST
DATE: FEBRUARY 16, 2022
RE: DYNAMIC ADEQUACY OF INDIANA TAX ON TOBACCO

In 2003, Indiana increased the tax rate per pack of 20 cigarettes from \$0.16/pack to \$0.56/pack, and again in 2008 to \$1.00/pack.[1] This memorandum provides a review of the changing revenue pattern of the tax from 1985 to 2014. This variability, called "dynamic adequacy" holds meaning in comparison both to the tobacco tax, as well as in the context of Indiana's total revenue stream.

When the Indiana State Budget Authority ("SBA") makes revenue policy decisions ranging from program fairness to economic impacts, I recommend consideration of dynamic adequacy. The variable nature of a tax base in relation to economic activity, such as a tax on cigarettes, represents a critical source of information and may help lessen the effect of revenue shocks.

The subsequent sections of the memo review the assumptions and methodology used to calculate each measure of the dynamic adequacy of the tax on cigarettes. Buoyancy, elasticity, and stability comprise this measure and provide a more comprehensive overview of the tax in the observed period. For each of the calculations, I used a price deflator (2009 = 100) to convert nominal values to real dollar amounts.

BUOYANCY

Buoyancy measures the relationship between tax revenue and economic activity, but does not distinguish between changes in tax policy. Revenue depends on tax multiplied by a base, which is a function comprised of tax policy, economic activity, and other variables. Since the tax policy changed significantly twice during the observation period, the statistic may have limited interpretation. I provide the buoyancy model below:

$$\log(\mathrm{R_{tax}}) = \alpha + \beta \log(\mathrm{Y}) + \epsilon$$

The variable R_{tax} is a real-adjusted measure of the revenue generated from the cigarette tax; the variable Y is a real-adjusted measure of revenue generated from the personal income tax. Both are reported in thousands of dollars; ϵ captures unobserved effects, which I assume are, on average, uncorrelated with Y. Structuring the model as a log-log enables the interpretation of percent change over time.

I report the full table of robust coefficients in Table 1. The coefficient β I estimated at 1.87, meaning, the buoyancy is 187% over the observed period. As previously noted, the buoyancy measure does not account for changes in tax policy. Figure 1 also provides a graphical outline of both the logged and the real tax revenues over time.

[1] Actual tax rates differ due to rounding.

Elasticity

The computation of elasticity builds on the specification for buoyancy, but includes an additional measure for the change in the tax rate. Given that the tax rate changed twice over the observed period, the regression includes two dummy variables, equal to one if the rate is $0.56, zero otherwise, and equal to one if the rate is equal to $1.00, and zero otherwise.

$$\log(B_{tax}) = \alpha + \beta \log(Y) + \gamma\text{TaxRate} + \epsilon$$

The other important change in the elasticity model is the variable B_{tax}, which captures the physical number of cigarette packs sold (in millions). As in the previous model, log-log specification allows for a percent change interpretation. My estimate for tax elasticity, measured by β, is 0.051, or 5% elastic over the observation period.

Stability

Finally, I report the measure of tax stability on the base (packs sold) by calculating the standard deviation over the period. This I calculate as 0.0739, interpreted as 7.4% change in total tax base over the observation period.

Conclusion

Each of the measures reported in this memorandum can help the SBA provide a more informed review of the changes in cigarette tax income with respect to economic activity over time. Though each has its interpretative shortcoming, together, the metrics illustrate the dynamic adequacy of the tax.

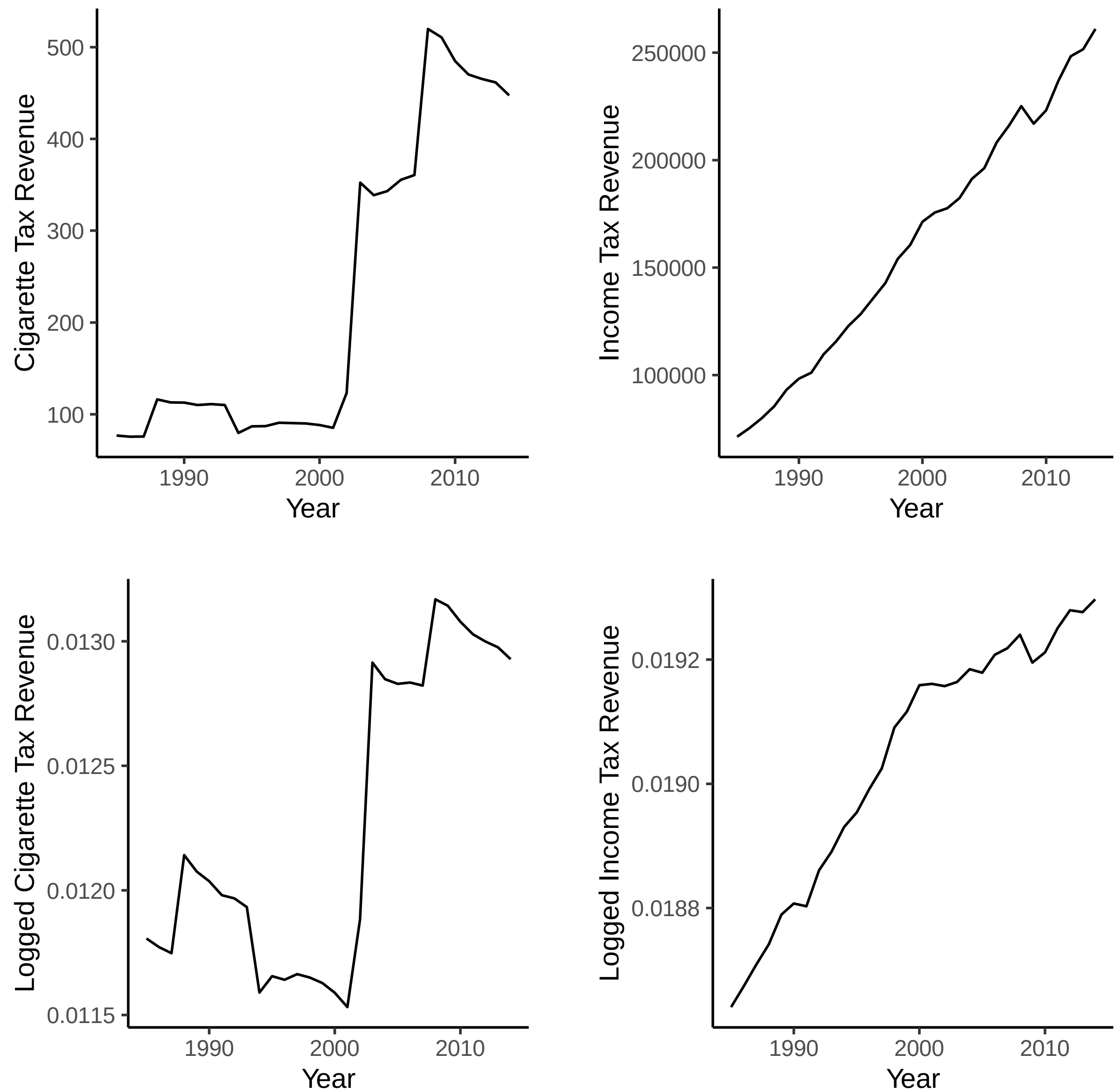
APPENDIX

TABLE 1. INDIANA CIGARETTE TAX ELASTICITY AND BUOYANCY REGRESSION MODELS

Coefficient	**Buoyancy Model**	**Elasticity Model**
(Intercept)	-23.246	5.648
	(-8.209)	(-1.315)
log(Revenue from Income)	1.865	0.051
	(-0.431)	(-0.069)
Tax Rate = $0.555/pack		-0.213
		(-0.032)
Tax Rate = $0.995/pack		-0.505
		(-0.032)
Statistics		
Num.Obs.	30	30
Adjusted R2	0.379	0.942
F-statistic	18.71	158.7
Standard Errors	Heteroskedastic-Robust	Heteroskedastic-Robust

Note: Coefficients are calculated using Heteroskedastic-Robust standard errors. The standard errors are reported in parenthesis below the coefficient estimates. The F-statistic in both models is greater than ten, which indicates that the variables are sufficiently different from each other. The buoyancy model has a substantially greater coefficient on log(Revenue from Income) compared to the elasticity model, as well as higher standard errors. The buoyancy model is likely less statistically accurate on account of the lower R2 and higher comparative standard errors, which measure the relative distribution of the coefficient estimates.

FIGURE 1. TAX REVENUE; 1985 - 2014



Note: Each plot has a unique vertical axis; the horizontal axis, Year, is common between all four plots. The top two plots show actual revenues, adjusted to real dollars; the bottom two plots show logged revenues, also adjusted in real dollars.