

Appendix A

Tax changes occur for many reasons. Some legislated tax changes are passed for philosophical reasons or to reduce an inherited budget deficit. Others are passed because the economy is weak and predicted to fall further, or because government spending is rising. Because the factors that give rise to tax changes are often correlated with other developments in the economy, disentangling the effects of the tax changes from the effects of these underlying factors is inherently difficult.

In order to deal with these empirical challenges, this article employs the “synthetic control method” as in Abadie and Gardeazabal (2003).ⁱ A combination of other US states is used to construct a “synthetic” control, which resembles relevant economic characteristics of Connecticut before the tax regime change in 1991.

I. The impact of tax progressivity on Connecticut’s economy

The methodology is taken directly from Abadie and Gardeazabal (2003). The goal of this section is to assess the impact that the tax regime change had on various economic outcomes for the state of Connecticut. Table 1 summarizes the data. Prior to the introduction of the progressive income tax, Connecticut had higher than average labor force participation rates, higher than average employment and lower than average poverty, therefore a simple comparison of the changes in these variables for Connecticut and other U.S. states may not only reflect the impact of the tax regime change, but also other pre-income tax differences which affected subsequent economic outcomes.

Table 1	<i>Connecticut</i>		<i>Other (49) states average</i>	
	1980-1992	1996-2007	1980-1992	1996-2007
<i>Yearly averages before and after the tax regime changes</i>				
Sex				
Male	47.0%	47.1%	47.7%	48.0%
Age groups				
Under 22	11.8%	10.9%	13.0%	12.0%
22-31	21.5%	13.6%	23.1%	17.4%
32-41	21.0%	23.9%	20.6%	21.5%
42-51	14.7%	22.6%	14.4%	21.1%
52-61	13.6%	14.2%	12.7%	13.8%
62 and older	17.4%	14.8%	16.1%	14.3%
Race/ethnicity				
Non-Hispanic whites	87.6%	74.9%	79.8%	72.8%

Non-Hispanic blacks	6.2%	9.4%	8.9%	10.7%
Education				
College educated	22.6%	30.4%	16.5%	22.7%
Labor force participation rate	70.1%	71.2%	66.1%	69.8%
Entrepreneurship rate	2.4%	7.5%	2.8%	7.8%
Poverty rate	5.5%	8.1%	11.7%	10.5%
Average unemployment duration (in weeks)	14	17	15	15
Employment per capita	66.7%	67.8%	61.3%	66.3%

The empirical strategy is to compare the evolution of Connecticut during the progressive income tax era with that of a weighted combination of other U.S. states chosen to resemble the characteristics of Connecticut before the tax regime change. This weighted average of other US states, referred to as a “synthetic” Connecticut economy without a progressive income tax is compared to the actual Connecticut economy with a progressive income tax.

Let J be the number of available control regions (the 49 US states other than Washington, D.C., and Connecticut), and $\mathbf{W} = (w_1, w_2, w_3, \dots, w_J)'$ a $(J \times 1)$ vector of nonnegative weights which sum up to one. The scalar w_j represents the weight of state j in the synthetic Connecticut economy. Each different value of \mathbf{W} produces a different synthetic Connecticut economy, and therefore the choice of a valid subset of control regions is embedded in the choice of the weights \mathbf{W} . The weights are chosen so that the synthetic Connecticut economy most closely resembles the actual one before the tax regime change. Let \mathbf{X}_1 be a $(K \times 1)$ vector of pre-tax regime change values of K predictors of our variables of interest (*the economic outcomes that we investigate*). Let \mathbf{X}_0 be a $(K \times J)$ matrix with contains the values of the same variables for the J possible control regions. Let \mathbf{V} be a diagonal matrix with nonnegative components. The values of the diagonal elements of \mathbf{V} reflect the relative importance of the different predictors. The vector weights \mathbf{W}^* is chosen to minimize $(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})' \mathbf{V}(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})$ subject to $w_j \geq 0$ ($j = 1, 2, \dots, J$) and $w_1 + \dots + w_J = 1$. The vector \mathbf{W}^* defines the combination of non-tax regime change control regions which best matched characteristics of Connecticut’s economy when the tax regime change was introduced.

The optimal weights, \mathbf{W}^* are positive for New Jersey, Rhode Island and Vermont with values 0.396, 0.508 and 0.097 respectively and take value zero for the other potential controls. The selection of these states is not unexpected because a visual inspection of the data reveals that these regions are comparable in terms of their

demographic makeup before the Connecticut tax regime change. Table 2a shows how well the weighted combination of control regions reproduce the values of independent variables for the Connecticut economy before the tax regime change. As expected, the synthetic economy looks comparable to the actual one.

Table 2a: Predictors for the size of the labor force	Connecticut	"Synthetic" CT
Number of metro areas per capita	1.38E-06	8.17E-07
Married population	0.6	0.6
Manufacturing share of GDP	0.146	0.136
College population	0.2	0.2
Male population	0.5	0.5
White non-Hispanic population	0.9	0.9
Black non-Hispanic population	0.1	0.1
Under 22 population	0.1	0.1
22-31 population	0.2	0.2
32-41 population	0.2	0.2
42-51 population	0.1	0.1
52-61 population	0.1	0.1
62 and over population	0.2	0.2

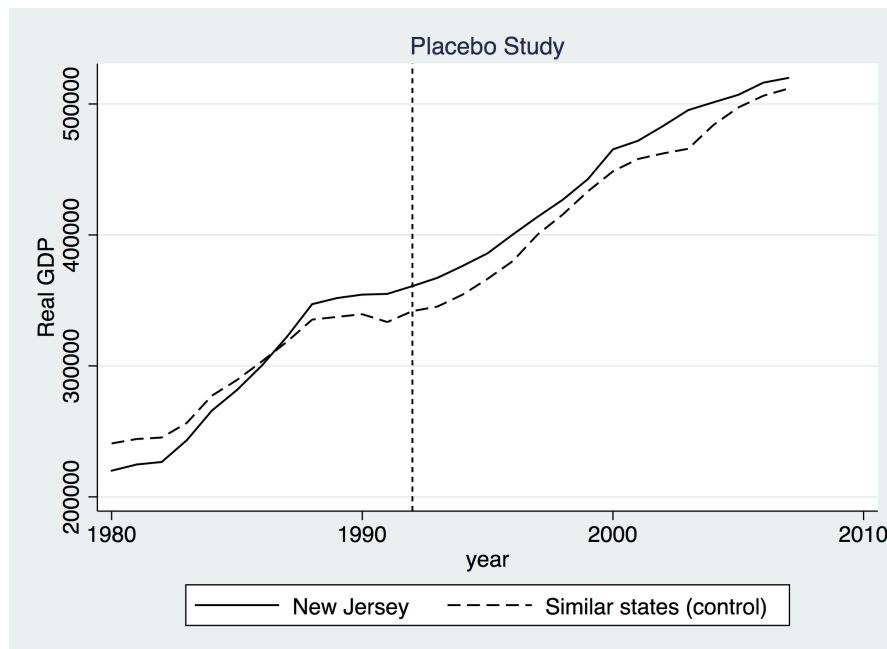
Table 2b	Weights
New Jersey	39.6%
Rhode Island	50.8%
Vermont	9.7%

Let \mathbf{Y}_1 be a $(T \times 1)$ vector whose elements are the value of our variable of interest (dependent variables) for the Connecticut economy during T periods. Let \mathbf{Y}_0 be a $(T \times J)$ matrix which contains the values of the same variables for the control regions. Our goal is to approximate the endogenous variables (*employment, labor force participation and poverty*) that the Connecticut economy would have experienced in the absence of the tax regime change. This counterfactual path of the economy is calculated as the same variable of the synthetic Connecticut economy, $\mathbf{Y}_1^* = \mathbf{Y}_0 \mathbf{W}^*$. Any divergence in the paths of the actual and synthetic economies reflects the impact of the event on the actual Connecticut economy.

Placebo test: Did the tax regime change really cause the observed gap between Connecticut and other similar states?

To address this question, a placebo study is performed applying the method to a state that is identified as very similar to Connecticut, but that did not experience a tax regime change: New Jersey, for example.

New Jersey did not experience a tax regime change and real economic output continued to grow at the same rate, that is faster than the control regions.



II. Who's most likely to be below the poverty line?

Using a logistic model on the pooled sample of observation years, we estimate regressions for the probability that an individual is below the official poverty line in year t :

$$Prob(y_{i,t}) = f(\beta X_{i,t})$$

Where $y_{i,t} = 1$ if individual i is below the official poverty line in year t and $y_{i,t} = 0$ if the individual is not considered poor. The $X_{i,t}$ are explanatory variables that are specific to the individual. β is the corresponding coefficient vector on these variables. All regressions include year and state fixed effects. Regressions are estimated for men and women separately.

Table 3 **Likelihood of being below the official poverty line**

	Women	Men
Education		
College degree	-0.20 *** (-123.07)	-0.06 *** (-90.78)
Race		
White non-Hispanic	-0.132 *** (-129.41)	-0.056 *** (-115.21)
Marital status		
Married	-0.162 *** (-127.09)	-0.051 *** (-109.64)
Metro area residency	-0.054 *** (-44.41)	-0.026 *** (-49.47)
Age		
16-21	-	-
22-31	-0.103 *** (-26.09)	-0.061 *** (-26.72)
32-41	-0.161 *** (-41.47)	-0.069 *** (-30.09)
42-51	-0.211 *** (-55.05)	-0.075 *** (-32.76)
52-61	-0.202 *** (-51.96)	-0.067 *** (-28.93)
62 and up	-0.198 *** (-52.01)	-0.065 *** (-28.14)
Pseudo R2	0.1448	0.0950
Number of observations	590,392	1,001,802

Logit coefficients have been transformed to partial derivatives evaluated at the mean.

All regressions include year and state fixed effects

*** p<0.001; **p<0.01; *p<0.05; +p<0.10

III. Figures (Connecticut vs. Synthetic Economy)

Figure 1: The income tax lowered employment

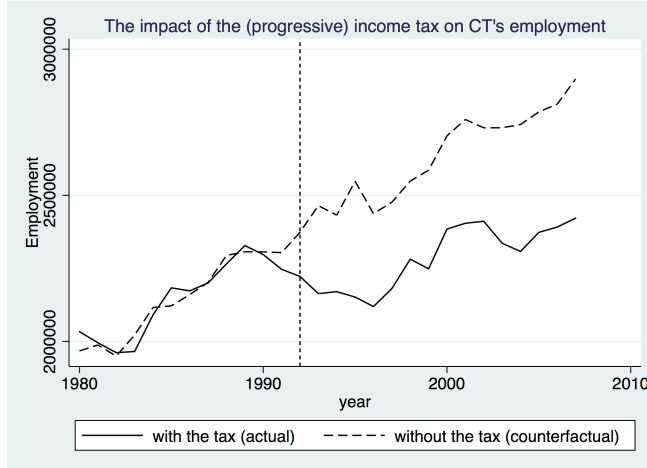


Figure 2: The income tax lowered the size of Connecticut's labor force

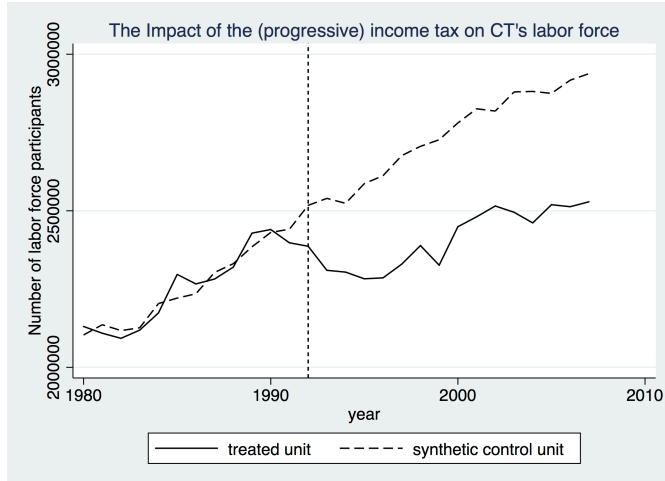
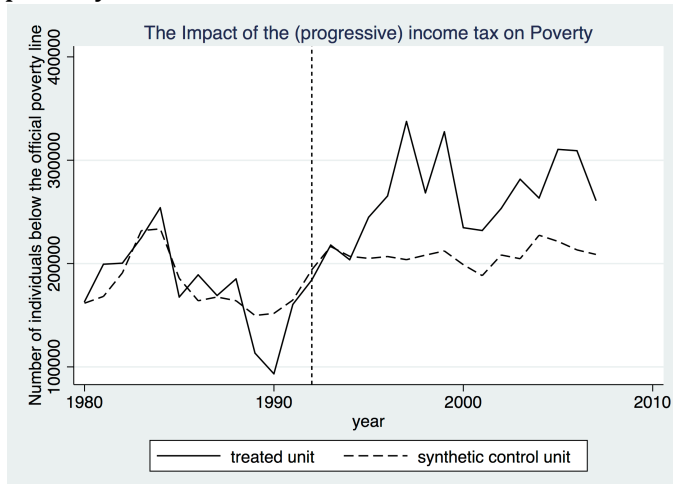


Figure 3: The income tax increased the number of individuals under the official poverty line



ⁱ Alberto Abadie and Javier Gardeazabal, “The economic costs of conflict: A case study of the Basque Country,” *American Economic Review*, 2003, 93(1): 113-132.