Panel Applications

09 Nov 2026 | Chapter 10

ECO 351 – Introduction to Econometrics

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Can the same state provide a better comparison?

The beer-tax application follows **48 US states, 1982–1988**: 336 state-year observations.

Y_{it}	Annual traffic deaths per 10,000 residents
X_{it}	Real beer tax: 1988 dollars per case

Last class, we removed persistent state differences. A state now raises its tax and starts a new road-safety campaign.

Which part of this change would state fixed effects remove? Which part would remain?

Locate the possible confounder in the model

For state i in year t, use the population model

$$Y_{it} = \alpha_i + \lambda_t + \beta X_{it} + u_{it}.$$

- α_i: a persistent state baseline, such as fixed geography.
- λ_t: an additive year change shared by every state.
- u_{it}: remaining state-specific changes, including an omitted new campaign.

A causal tax interpretation needs the remaining error to have mean zero given the state's tax history and fixed effects.

We will compare fitted slopes on the **same 336 observations**.

The same sample, three comparisons

```
. estimates table pooled statefe twoway, b(%9.3f) se(%9.3f) stats(N)
-----------------------------------------------------
    Variable |  pooled      statefe     twoway
-------------+---------------------------------------
     beertax |     0.365      -0.656      -0.640
             |     0.120       0.292       0.357
-------------+---------------------------------------
           N |       336         336         336
-----------------------------------------------------
                                       Legend: b/se
```

- `pooled`: mixes differences between states and changes within states.
- `statefe`: compares changes within the same state.
- `twoway`: also removes additive year changes shared by all states.

Selected raw rows; second row = state-clustered standard error.

Explain the sign change to a policymaker

A report says:

> *The coefficient changes from $+0.365$ to -0.656. Clustering must have reversed the effect. The negative estimate proves the tax works.*

1. Correct the statement about clustering.
2. Explain what changes when state effects are added.
3. Give one omitted state characteristic that could affect the pooled comparison, and one changing factor that could still affect the fixed-effects comparison.

What changed, and what did not?

Choice	What it changes
Add state effects	Removes persistent additive state baselines from the comparison.
Add year effects	Removes additive movements shared by all states in a year.
Cluster by state	Allows errors within a state to be related over time when estimating uncertainty.

The negative within-state slope is evidence to interpret. Its causal meaning still depends on what changed alongside the tax.

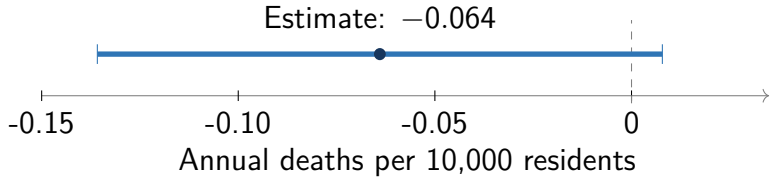
What would a ten-cent tax increase imply?

Use the state-and-year-effects model. A ten-cent increase means $\Delta X = 0.10$ in 1988 dollars per case.

```
. lincom 0.10*beertax
 ( 1)  .1*beertax = 0
------------------------------------------------------------------------------
    fatality | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         (1) |   -.063998   .0357078    -1.79   0.080    -.1358329    .0078369
------------------------------------------------------------------------------
```

State the fitted rate change. Does the interval establish a reduction at the 5% level? Does it establish no effect?

A negative estimate with an uncertain sign



For a **hypothetical state with 1 million residents**, the fitted rate difference corresponds to

$$(-0.064)\frac{1{,}000{,}000}{10{,}000} = -6.4 \quad \text{expected deaths per year.}$$

This scale conversion is not a guaranteed number of deaths prevented.

Discussion: what else changed with the tax?

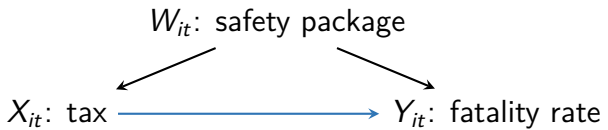
Suppose a state raises its beer tax and starts extra road-safety enforcement in the same year. Enforcement could also reduce deaths.

1. Would the state effect absorb this new campaign?
2. Would year effects absorb it if other states did not adopt it?
3. What additional evidence would help separate the tax comparison from the enforcement comparison?

Be specific about the variable, its timing, and why it could move with the tax.

The remaining back-door path

Let W_{it} be a new state safety package that raises the tax and expands enforcement.



$X_{it} \leftarrow W_{it} \rightarrow Y_{it}$ can remain open after state and year effects.

Seek the timing and content of the safety package. A smaller standard error would not close this path.

Close the panel application

A defensible policy statement reports:

- The comparison: changes within states, accounting for common year shifts.
- The magnitude and units: about -0.064 annual deaths per 10,000 for a ten-cent increase.
- The uncertainty and remaining state-specific confounding concern.

Today, 9 November: term project due under the existing instructions.

Wednesday, 11 November: Midterm 2; no lecture.

Monday, 16 November: binary outcomes and predicted probabilities.