

In-Class Activity: Fixed Effects Showdown (Answer Key)

Setup. Cheng and Hoekstra (2013) study whether **castle doctrine** laws increase homicide. You have a balanced panel of **50 U.S. states from 2000–2010** ($T = 11, N = 50, 550$ obs.). The dependent variable is the **log homicide rate**. The key regressor is $post_{it}$, an indicator equal to 1 once state i 's castle doctrine law is in effect. States adopt at different times, so this is a staggered-adoption setting. You estimate:

- (1) Pooled OLS: $\log(\text{homicide rate}_{it}) = \beta_0 + \beta_1 post_{it} + u_{it}$
- (2) Entity FE: $\log(\text{homicide rate}_{it}) = \beta_1 post_{it} + \alpha_i + u_{it}$
- (3) Entity + Time FE: $\log(\text{homicide rate}_{it}) = \beta_1 post_{it} + \alpha_i + \gamma_t + u_{it}$
- (4) First Difference: $\Delta \log(\text{homicide rate}_{it}) = \beta_1 \Delta post_{it} + \Delta u_{it}$

where α_i is a state fixed effect and γ_t is a year fixed effect.

	(1) Pooled OLS	(2) Entity FE	(3) Entity+Time FE	(4) First Diff.
$post_{it}$	0.193** (0.072)	-0.034 (0.024)	0.060** (0.029)	0.046* (0.023)
State FE	No	Yes	Yes	—
Year FE	No	No	Yes	—
Differenced	No	No	No	Yes
SE type	Clustered	Clustered	Clustered	Clustered
N	550	550	550	500
R^2	0.033	0.914	0.934	0.005

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All regressions are weighted by state population, and all SEs are clustered by state. The TWFE specification is a simplified teaching version of Cheng and Hoekstra (2013). If treatment is coded as the fraction of the year that a castle doctrine law is in effect (rather than a binary post indicator), the weighted TWFE column corresponds closely to Table 5, Panel A, column 1.

1. For each specification, briefly state what omitted variables it *does* control for, and what it does *not* control for in this application.

- (1) Pooled OLS: Controls only for included regressors and ignores persistent state differences.
- (2) Entity FE: Controls for time-invariant state traits such as gun culture, urbanization, or baseline crime. Does *not* control for national shocks that move homicide in all states over time.
- (3) Entity + Time FE: Controls for time-invariant state traits and common year shocks. Does *not* control for time-varying, state-specific confounders.
- (4) First Difference: Removes time-invariant state traits by differencing adjacent years. Does *not* automatically absorb common national shocks unless year dummies are added to the differenced model.

2. Give one specific example of a *time shock* in this context (something that would affect homicide in all states in a given year). How does adding year fixed effects in specification (3) address it?

Answer: Examples include the 2008 financial crisis, a national policing shift, or a nationwide change in drug markets. Year fixed effects give each year its own intercept, partialling out changes shared by all states.

3. The coefficient on $post_{it}$ drops from 0.193 in pooled OLS to -0.034 with state fixed effects, then rises to 0.060 once year fixed effects are added. Explain what this pattern suggests about omitted variable bias in pooled OLS and about the role of year fixed effects.

Answer: Pooled OLS compares high-homicide and low-homicide states in levels, so it is contaminated by persistent state differences correlated with adoption. State fixed effects remove those level differences and the estimate turns slightly negative. Adding year fixed effects then absorbs national shocks, so the within-state treatment effect rises to about 0.06 log points.

4. Column (3) is the standard two-way fixed effects regression. Interpret the coefficient 0.060 in percentage terms. Is this interpretation exact or approximate?

Answer: The exact percent effect is $\exp(0.060) - 1 \approx 0.062$, so this is about a 6.2 percent increase in the homicide rate. Saying “about 6.0 percent” is the usual log-point approximation.

5. Even with two-way fixed effects (specification 3), what threats to a causal interpretation remain? Identify at least **two** specific concerns.

Answer: Possible threats include: (1) time-varying, state-specific confounders such as policing, incarceration, or other criminal justice reforms; (2) policy endogeneity, where states adopt in response to changing violence; (3) spillovers across states; and (4) dynamic treatment effects.