

Estimating the Effects of Changes in Permit-to-Purchase Handgun Laws on Suicide Rates

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Prior Research on Firearms and Suicide Risks

- 21,175 firearm suicides in 2013 – 51.5% of all suicides
- 80%-90% of firearm suicide attempts are fatal. 0.7% for cutting attempts, 2.5% of poisonings, 20% of jumping, 78% hanging (CDC, 2013)
- Suicide ideation can be fleeting and most survivors of suicide attempts do not complete suicides later.
- Firearm availability increases risk of suicide 3-fold after controlling for other factors (Anglemyer et al., 2014)

Gun Laws and Suicide Risks

- Prohibiting conditions for firearm possession are risk factors for suicide – convictions for crimes of violence, domestic violence, substance abuse, young age, threat to self or others due to mental illness.
- Some regulations – wait periods, obtaining permits from law enforcement – delay or deter gun acquisition.
- Prior research indicate permit-to-purchase handgun laws negatively associated with suicide rates, but estimates based on cross-sectional variation because no laws changed (Adres & Hempstead, 2011; Fleegler et al., 2013).

Estimating the effects of changes in PTP handgun laws in Connecticut and Missouri

- Connecticut adopted permit-to-purchase handgun law Oct. 1995 – mandated background PTP for all handgun transfers contingent on passing background check and safety training course.
- Missouri had PTP handgun law since the 1920s that required PTP for all handgun sales, permits obtained from sheriff and good for 30 days. Repealed the law Aug. 28, 2007.

Estimating the effects of changes in PTP handgun laws in Connecticut and Missouri

Design: Comparative interrupted time-series (difference in difference).

Difference-in-difference estimates from regression models with 50 states vulnerable to bias because states vary on unmeasured determinants of Y_{it}

Analytic Method: Synthetic Control approach. Abadie and Gardeazabal (2003), Abadie, Diamond, and Hainmueller (2010, 2013 [2010 paper cited 665 times]) Weights comparison units to make their pre-period trend (approximately) match that of the intervention.

Counterfactual Assumption: Trends in intervention and synthetic control would have continued in similar ways post-law if they tracked each other pre-law change except for the intervention's effect.

Some basics on synthetic control estimation

- Weights derived to minimize the distance between observed covariates and outcomes for the intervention unit in the pre-period and the weighted average of the non-intervention units.
- Choose weights for control such that mean squared prediction error (MSPE) of Y_t is minimized for the pre-intervention periods.

Inference based on permutation tests

- More appropriate than large-sample inferential techniques when the number of units in the comparison group is small.
- Used a placebo test to examine whether or not the estimated effect of the actual intervention is large relative to the distribution of the effects estimated for the pool of “at risk” of exposure to the intervention but were not. (Abadie et al., 2010)
- Pool of comparisons were 39 states other than Connecticut that did not adopt a new PTP law in 1995, and 9 other states that could have repealed their PTP law (excluding CT) in 2007 but didn't.

Data

- Suicides identified from vital statistics data from the CDC's WISQARS for 1981-2007 and a data request to the NAPHSIS for 2008-2012 to calculate annual rates for firearm and nonfirearm suicides by state.
- Used 3-year moving averages of Y_t to smooth data.
- Covariates: unemployment, poverty, demographics (% male, black, Hispanic, married, completed high school, military veteran, live in MSA), consumption of ethanol spirits, firearm availability, religious adherence, strong mental health parity laws.

Predictor balance averaged over pre-law-change period
between Connecticut and synthetic control for firearm suicides

	Connecticut	Control (RI=0.74, ND=0.26)
% White	90	94
% ages 18-34	27	29
Gun availability proxy	0.44	0.38
% veteran status	17	17
Unemployment rate	5.14	5.94
Firearm suicide rate in 1981	3.68	3.81
Firearm suicide rate in 1987	4.21	4.21
Firearm suicide rate in 1994	4.41	4.41

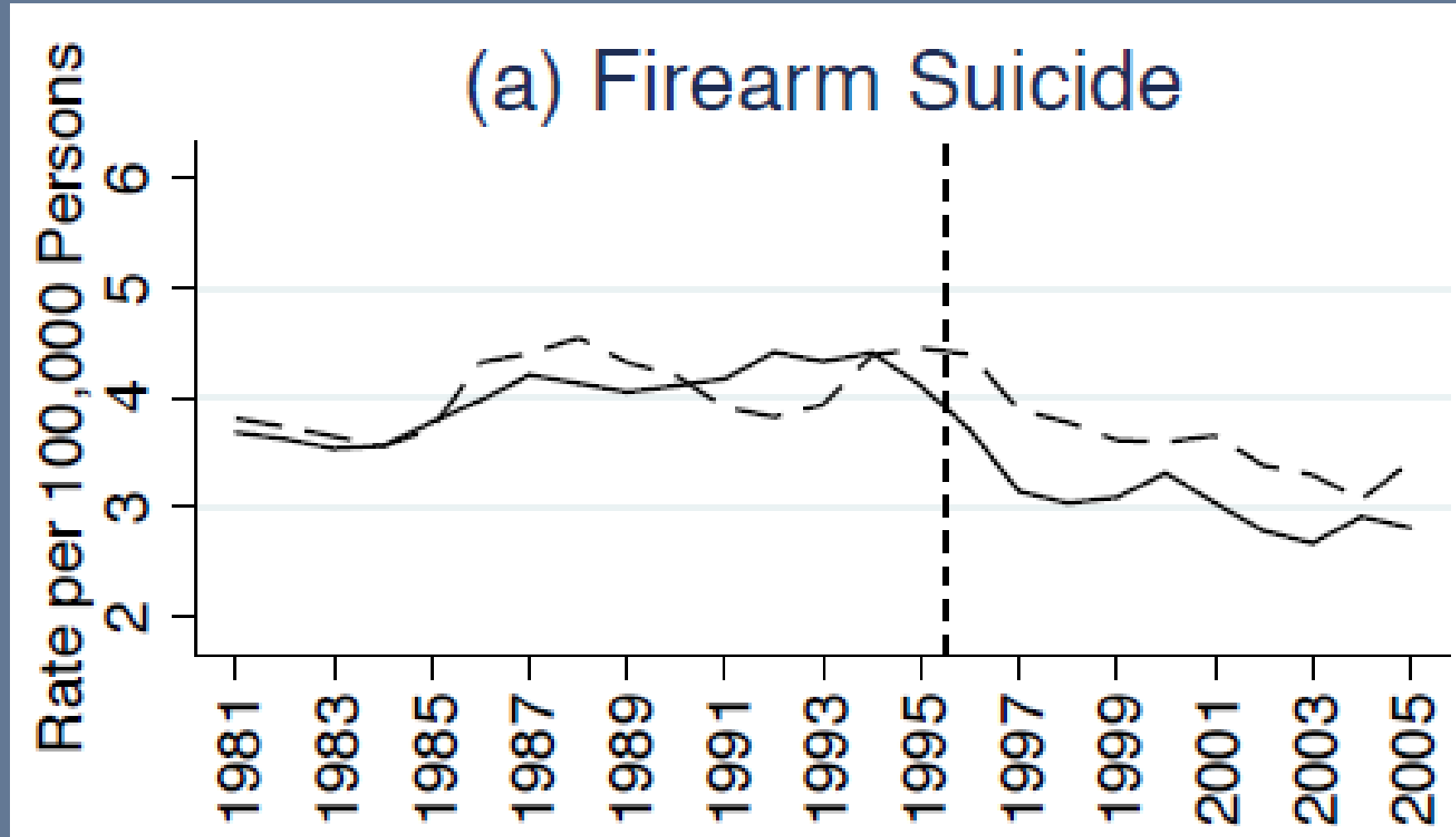
Predictor balance averaged over pre-law-change period between Missouri and synthetic control for firearm suicides

	Missouri	Control (NC=0.79, NE=0.21)
% White	88	80
% ages 18-34	25	27
Gun availability proxy	0.62	0.66
% veteran status	16	15
Unemployment rate	5.70	4.94
Firearm suicide rate in 1981	7.48	8.70
Firearm suicide rate in 1993	8.43	8.33
Firearm suicide rate in 2006	7.55	6.78

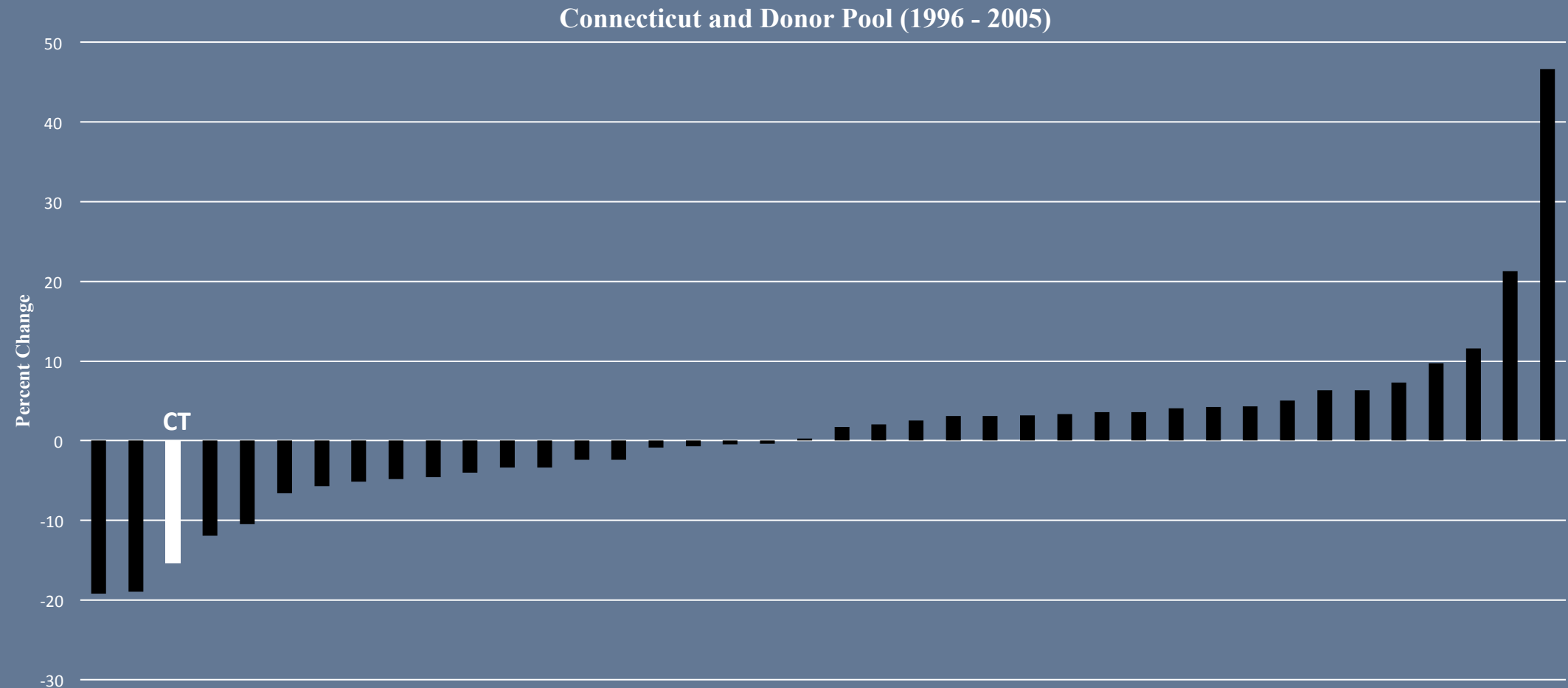
Root mean square prediction error for pre-law-change period for intervention, control, and mean for donor pool states.

	Connecticut		Missouri	
	Synthetic Control	Mean all donor states	Synthetic Control	Mean all donor states
Firearm suicides	0.27	5.03	0.52	3.58
Non-firearm suicides	0.13	0.50	0.14	0.47

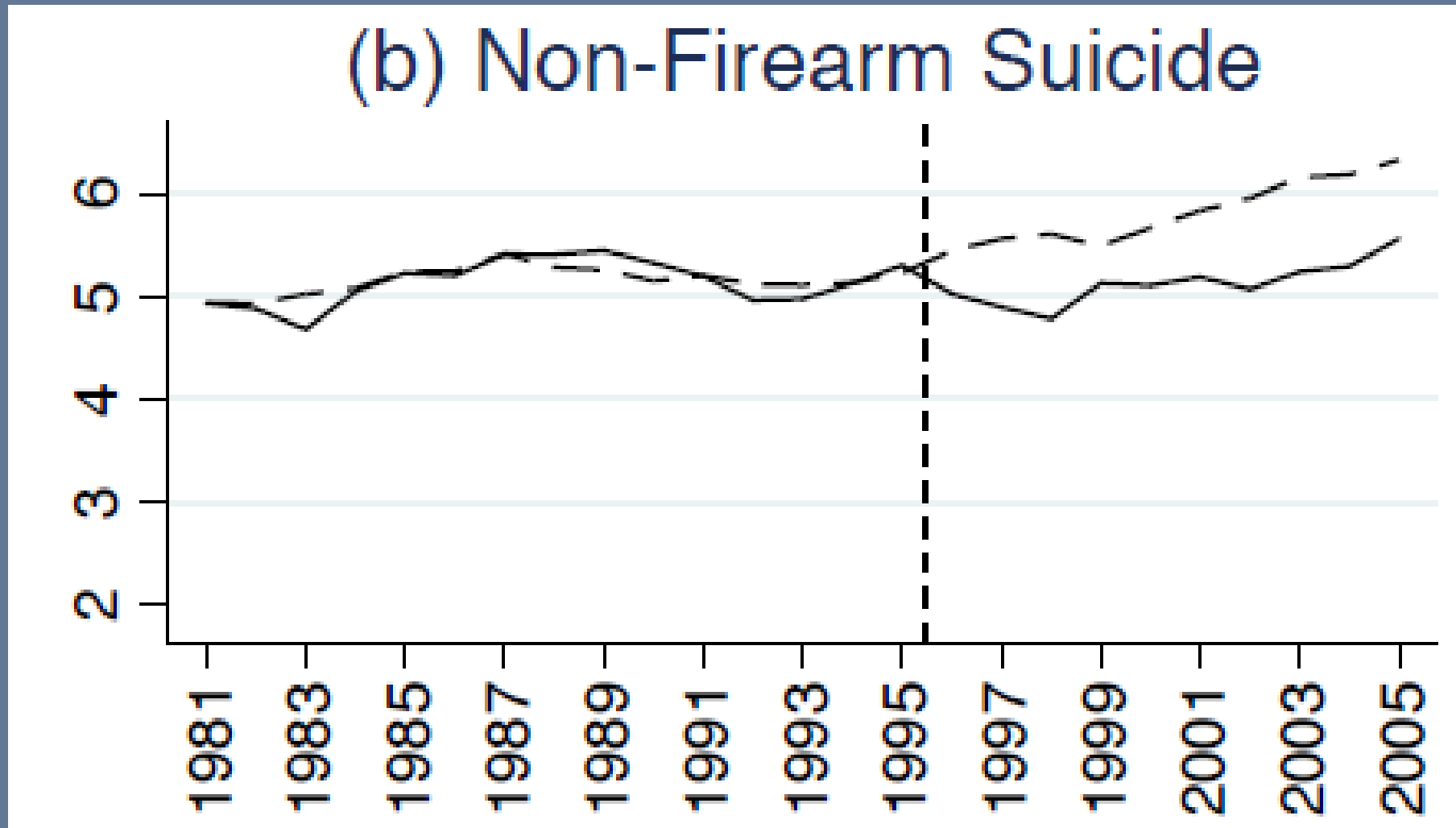
Firearm suicide rates for Connecticut (solid) and synthetic control (dashed) 1981-2005. PTP law Oct. 1995



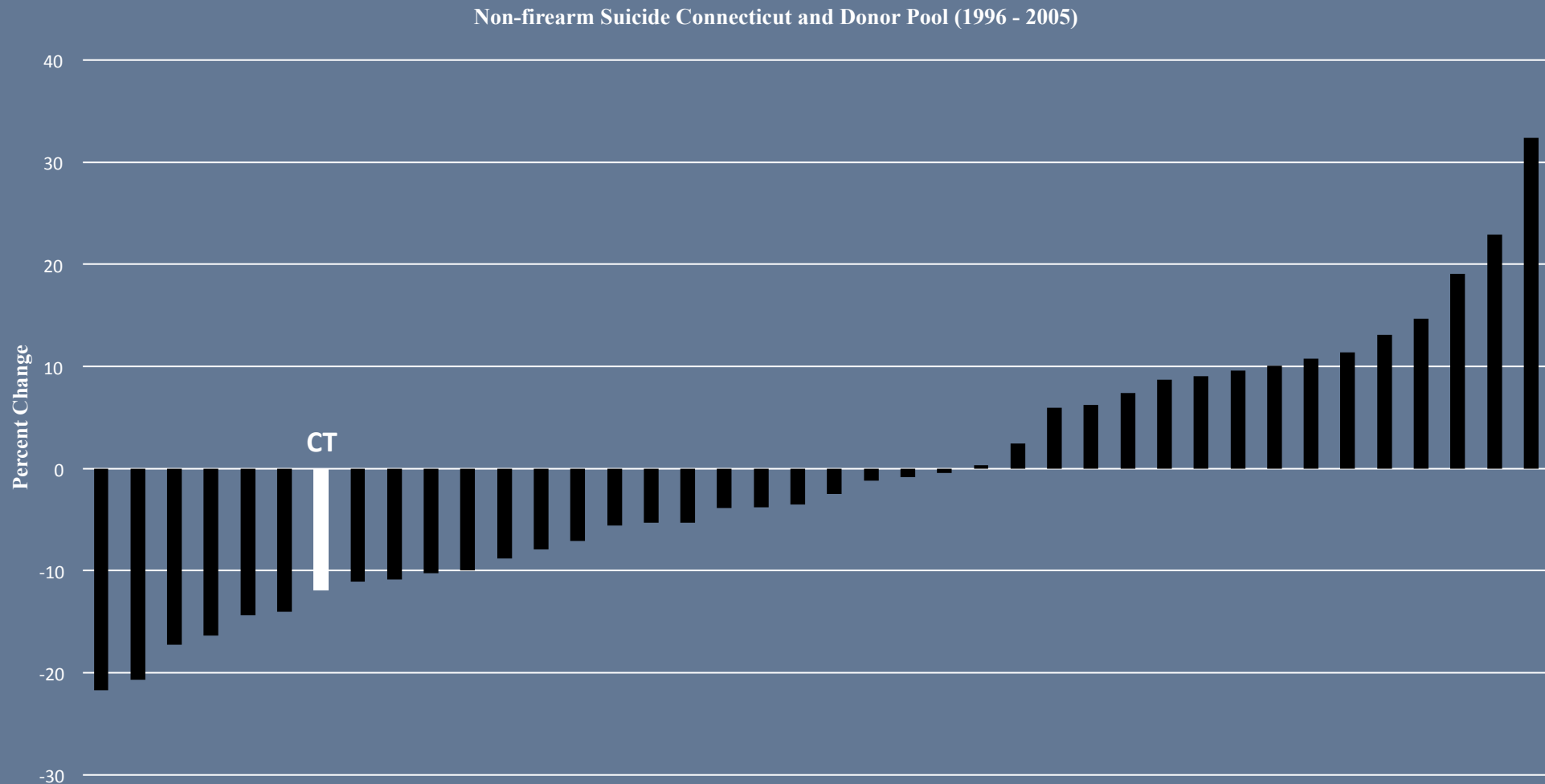
Percent difference in cumulative firearm suicide rates between 40 states at risk of PTP law in 1995 and their synthetic controls, 1996-2005.



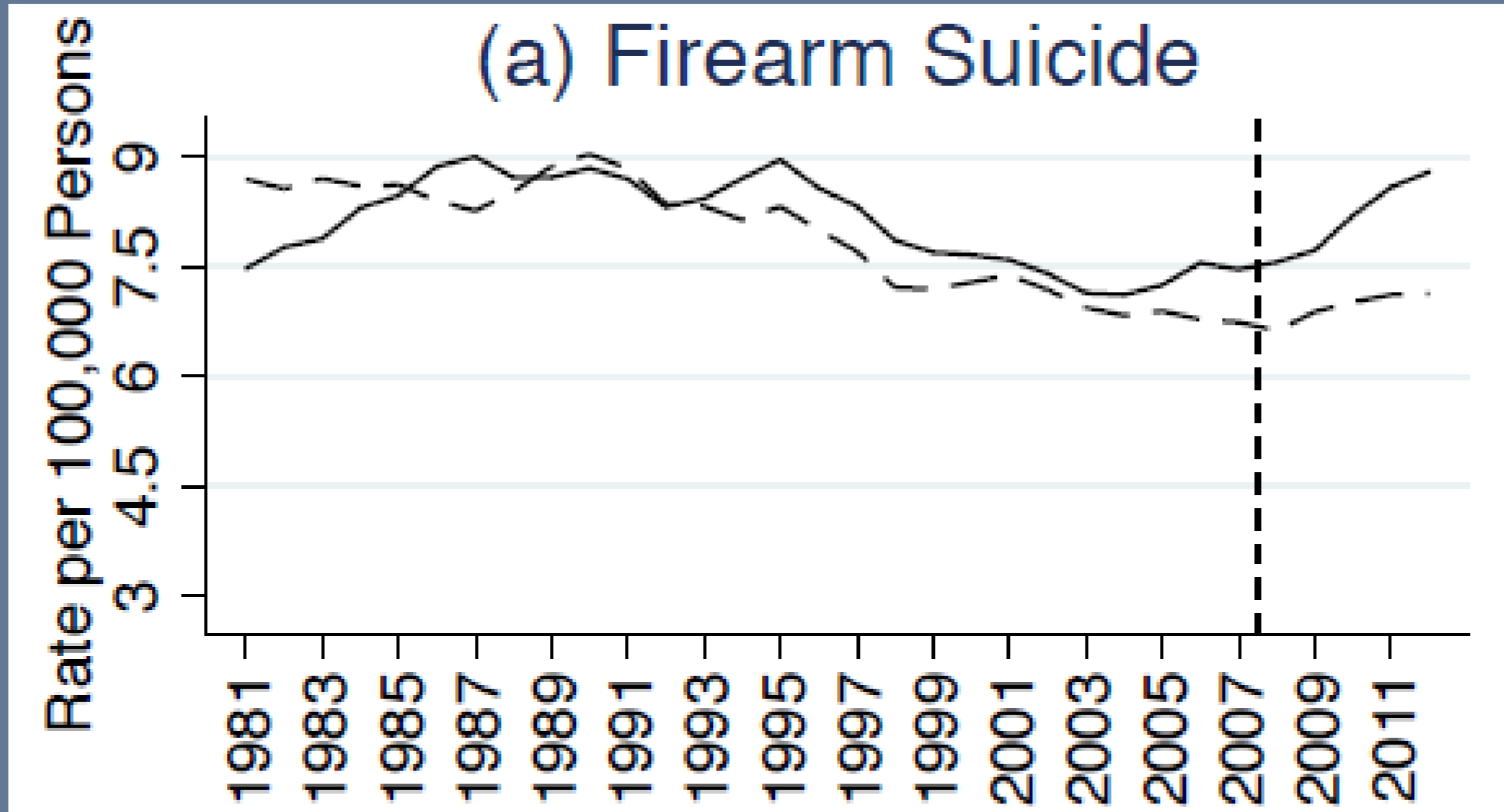
Nonfirearm suicide rates for Connecticut (solid) and synthetic control (dashed) 1981-2005. PTP law Oct. 1995



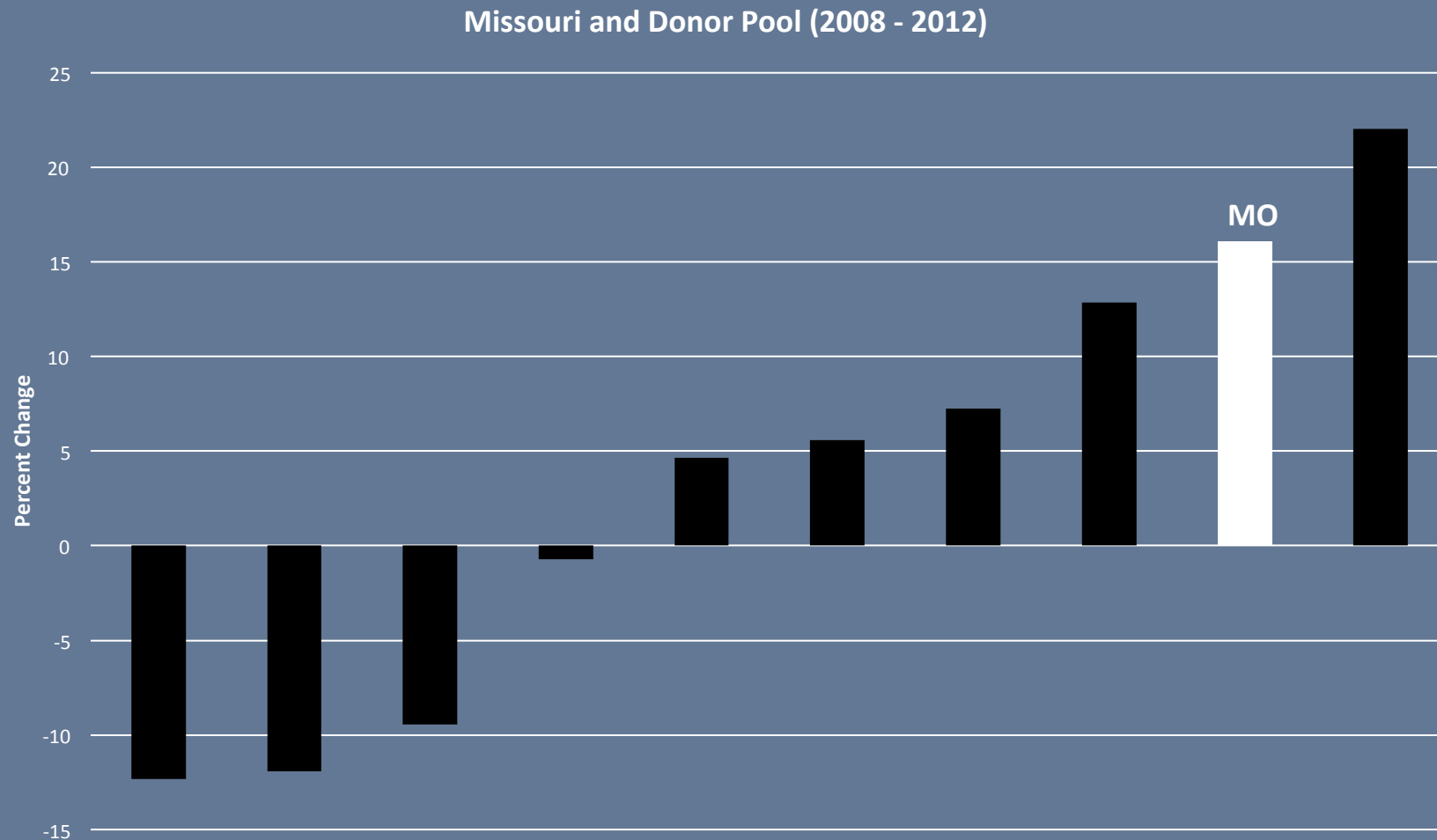
Percent difference in cumulative nonfirearm suicide rates between 40 states at risk of PTP law in 1995 and their synthetic controls, 1996-2005.



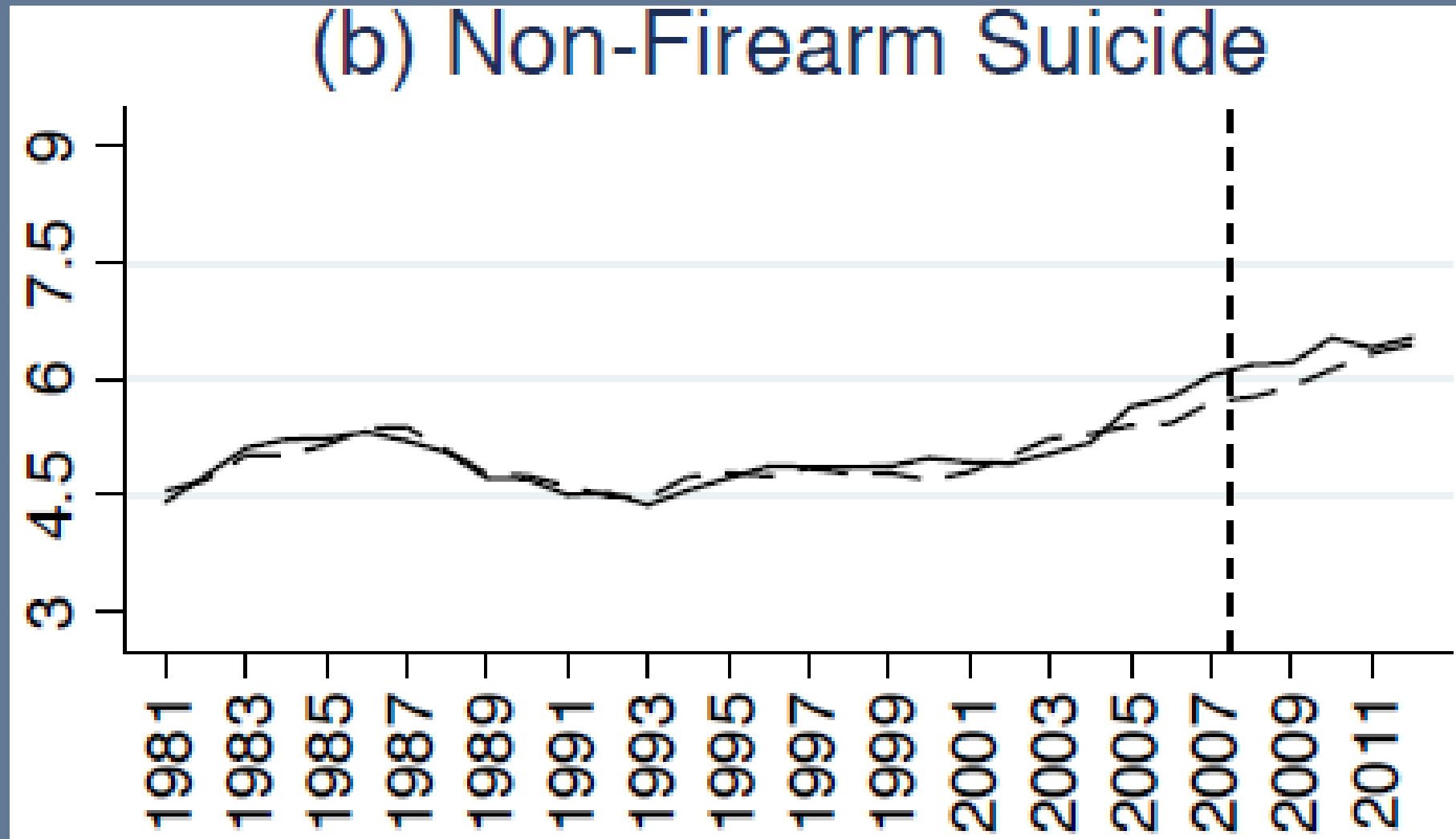
Firearm suicide rates for Missouri (solid) and synthetic control (dashed) 1981-2012. PTP law repealed 8/28/07



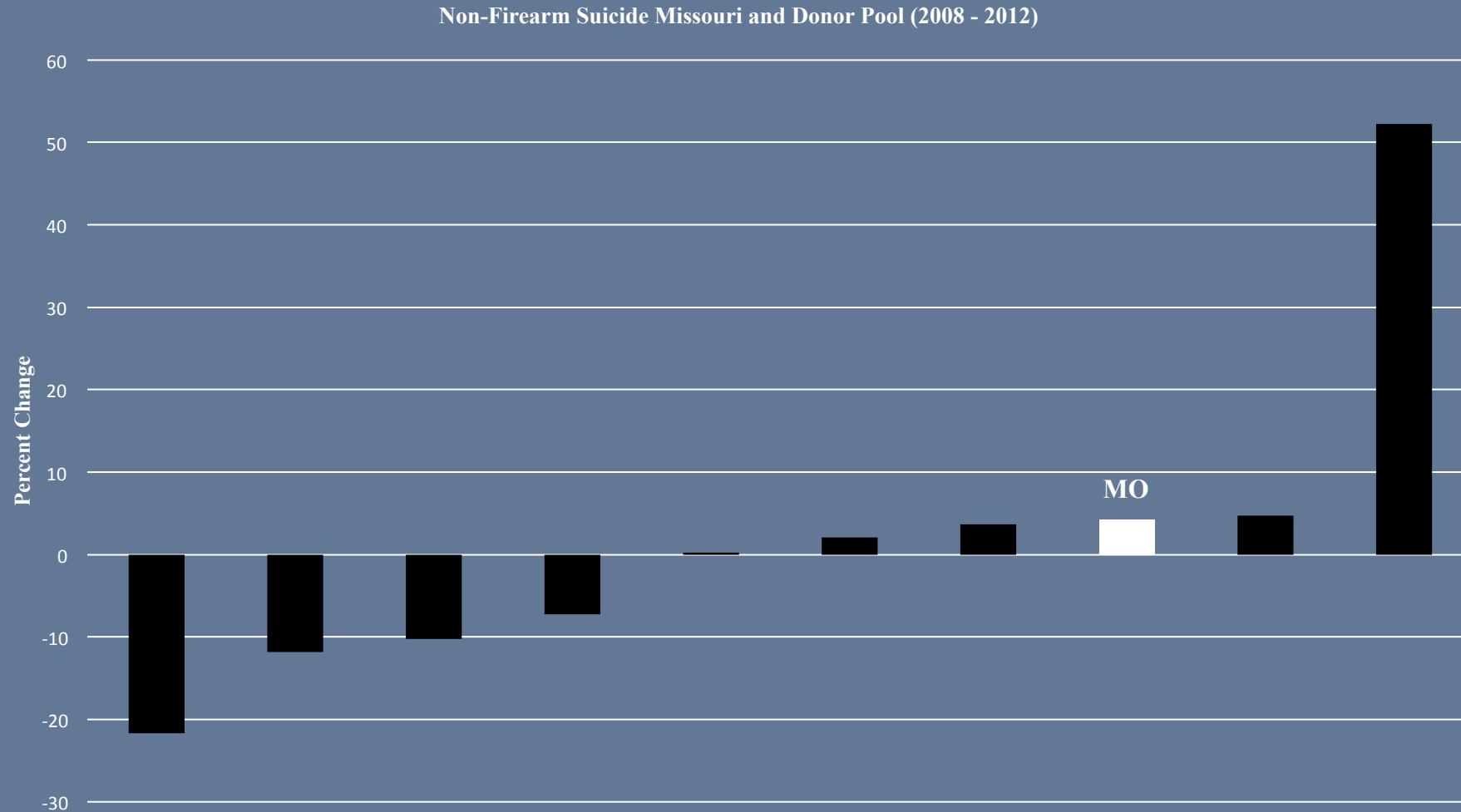
Percent difference in cumulative firearm suicide rates between 10 states at risk of PTP law repeal in 2007 (CT excluded) and their synthetic controls, 1996-2005.



Nonfirearm suicide rates for Missouri (solid) and synthetic control (dashed) 1981-2012. PTP law repealed 8/28/07



Percent difference in cumulative nonfirearm suicide rates between 10 states at risk of PTP law repeal in 2007 (CT excluded) and their synthetic controls, 1996-2005.



Other relevant findings

- Fit for CT's non-firearm suicide rates pre-PTP-law good, but most weight from states in other regions with more guns and unemployment (UT, PA, SD, AS, NM, RI, MS). Changes in social forces in synthetic control during post-law period may confound estimate of law's effects.
- NB regression estimates for CT's PTP law on non-firearm suicides was in opposite direction (+) and statistically significant.
- PTP law effects on rates for age 20-29 evident, but discriminating effects for firearm vs. non-firearm suicide rates less so.

Conclusions

- Evidence from synthetic control estimation generally consistent with PTP laws having protective effect against suicides.
- Estimated effects on Connecticut's non-firearm suicides may signal PTP law effects confounded by other social forces protective against suicides generally in the state OR underscore a limitation of the methodology.
- Gun law studies should examine multiple approaches to carefully assess ability of models to predict pre-law-change trends.