

# ACES high or low? The impact of a severance tax change on Alaskan oil activity

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# Severance taxes on oil production in Alaska

- On April 14th, 2013, the Alaska State 28<sup>th</sup> Legislature passed Senate Bill 21
  - A significant reduction in Alaska's severance tax rate
  - hoping to stimulate exploration, field development, oil production, and job creation
- Fundamental tradeoff: potential loss of tax revenue for purported gains in exploration and production activity
  - Key question: are severance taxes effective in this regard?
  - Little empirical evidence

# Severance taxes on oil production in Alaska

- Alaska's severance tax reform was a response to declining oil production from North Slope fields

*“Declining oil production is not because [Alaska is] running out of oil, but because [Alaska is] running behind in the competition. Alaska's North Slope has billions of proven barrels of oil, but [Alaska does] not have a tax system designed to attract new investment for more production.”*

Alaska Governor Sean Parnell, January 15, 2013.



# Severance taxes on oil production in Alaska

- Senate Bill 21 was implemented in response to Alaska's previous highly progressive tax structure (ACES)
  - Alaska's Clear and Equitable Share
  - Introduced in 2007 under Gov. Sarah Palin
  - Combined with increased oil prices, ACES more than tripled the tax liability for much of the oil already under production in Alaska



# Severance taxes on oil production in Alaska

- Supporters of Senate Bill 21:
  - ACES diminished incentives for investment in development and exploration
  - ACES led to reduced employment opportunities and oil production
- Opponents of Senate Bill 21:
  - pointed to statistics showing increases in oil and gas employment and investment
  - claimed that there was no evidence of ACES' negative impact on Alaska's investment climate





# Severance taxes on oil production in Alaska

- Evidence presented by both sides was substantial in volume, but its evidentiary basis was incomplete.
  - Many important factors unrelated to ACES had the potential to affect the path of oil activity in Alaska.
- Failure to ask the key identifying question:

*How would have Alaskan oil activity evolved since 2007 in the absence of ACES?*
- Without establishing the counterfactual, it is difficult to accept whether or not ACES led to any actual gains or losses.

# Purpose of Our Research

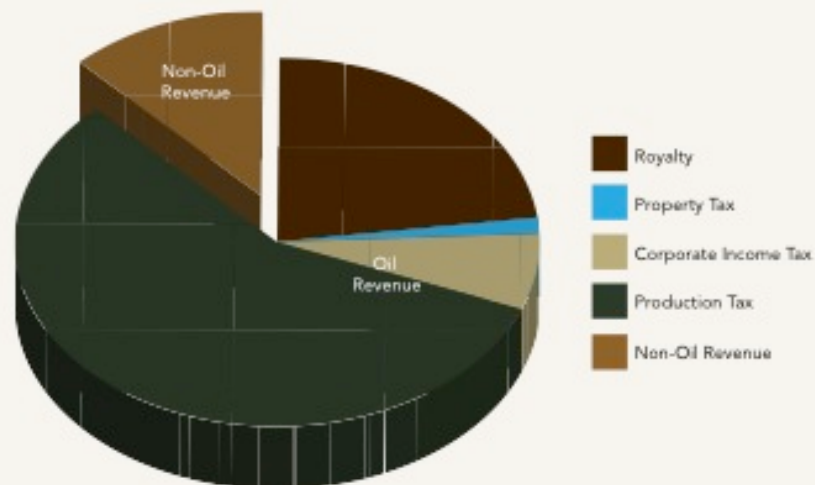
*How would have Alaskan oil activity evolved since 2007 in the absence of ACES?*

- Attempt to answer this question through a more rigorous approach
- Estimate the impact of ACES on Alaskan resource development and employment
- Use a comparative case study employing the synthetic control method (Abadie et al., 2010)
- Construct a synthetic Alaska from a donor pool of U.S. energy states
- Comparison between synthetic Alaska outcomes with real Alaska outcomes provides an estimate of the impact of ACES

# Background: Alaska's Oil Economy

- Over 16.6 billion barrels of oil produced in Alaska since statehood
- 30 billion additional barrels undiscovered
- Revenue from oil production represented approximately 93% of all revenue in FY 2012
- Two-thirds of economic growth since statehood attributed to oil.

Figure 5-1 Alaska General Fund Revenue Sources, FY 2011





# SEVERANCE TAXES AS A SHARE OF TOTAL TAXES

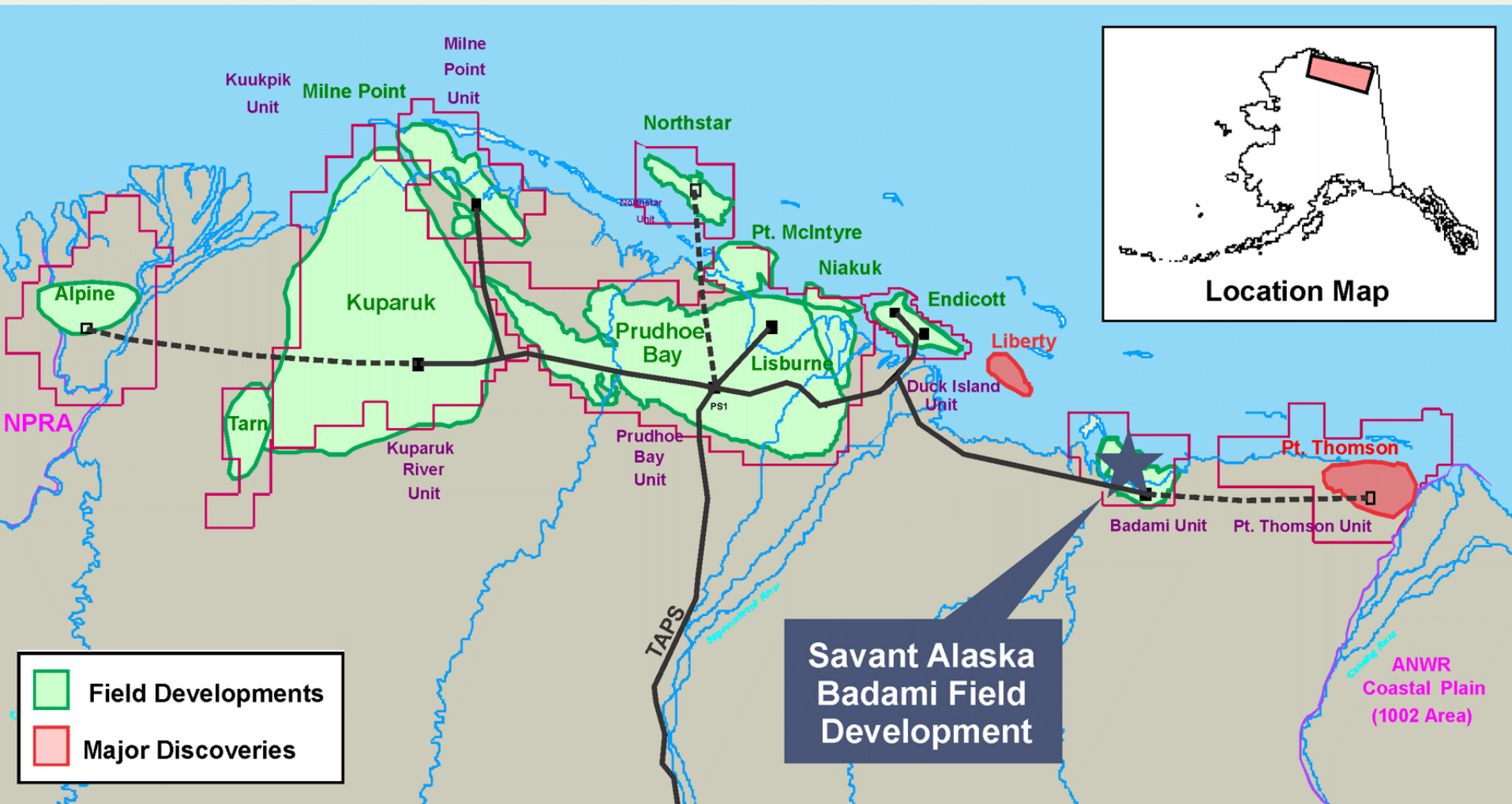
## State Tax Collections (Thousands) FY2008

	Severance Taxes	Total Taxes	Share
Alaska	\$6,939,040	\$8,424,714	82.4%
Wyoming	883,786	2,168,016	40.8%
North Dakota	791,692	2,312,056	34.2%
New Mexico	1,089,836	5,674,530	19.2%
Montana	347,221	2,457,929	14.1%
Oklahoma	1,184,765	8,484,227	14.0%
Louisiana	1,035,695	11,003,870	9.4%
Texas	4,131,185	44,675,953	9.2%
West Virginia	347,592	4,879,151	7.1%
Kansas	168,696	7,159,748	2.4%
Mississippi	135,248	6,618,349	2.0%
Utah	106,060	5,944,879	1.8%
Colorado	151,474	9,624,636	1.6%
Energy States	17,312,290	119,428,058	14.5%
Non-Energy States	947,347	661,897,236	0.1%
United States	18,259,637	781,325,294	2.3%

Source: U.S. Census Bureau

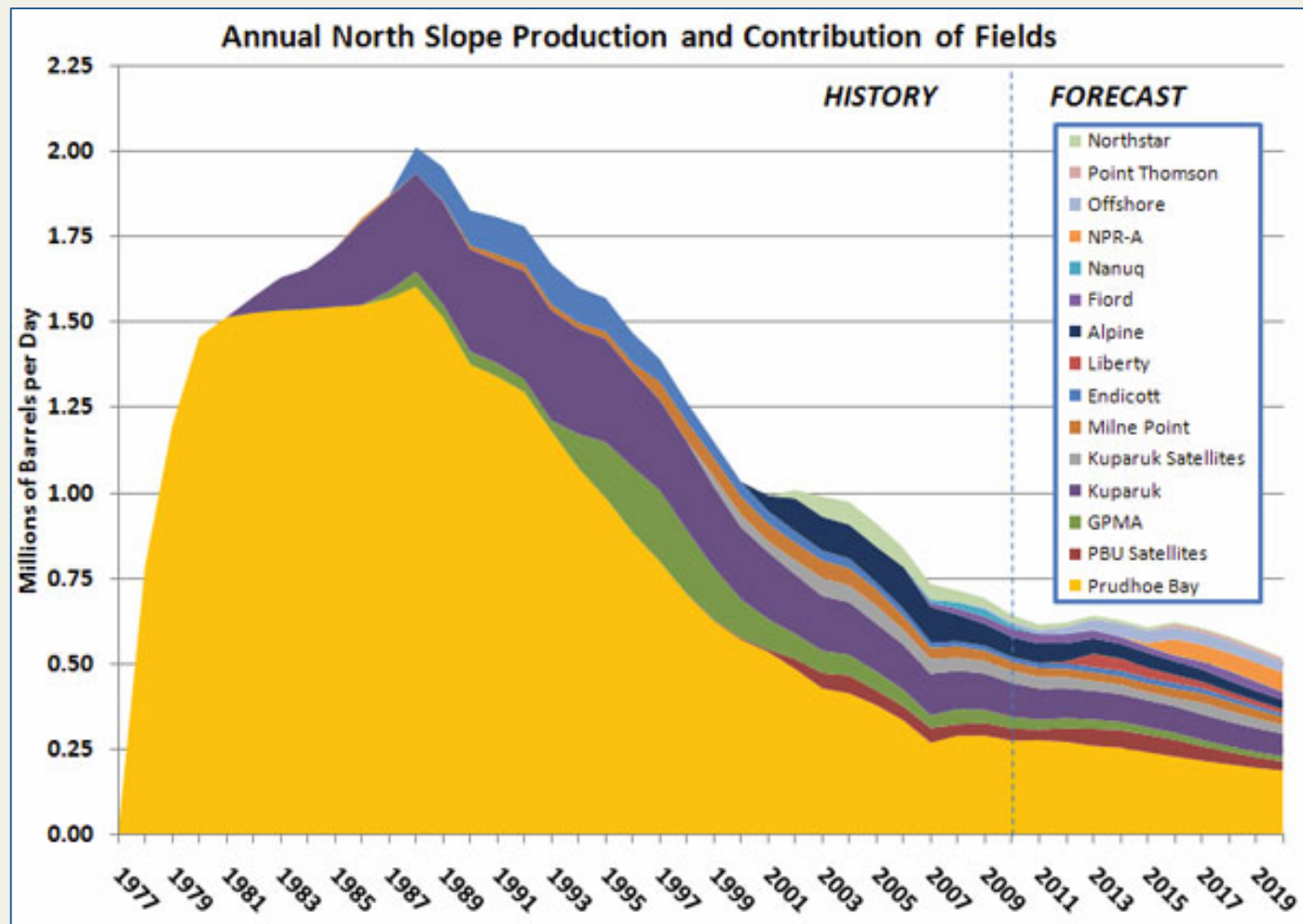
# Background: North Slope Oil Fields

- North Slope has seen considerable development since the construction of TAPS in 1977.



# Background: Declining North Slope Production

- North Slope production has been declining since “peak oil” in 1987.

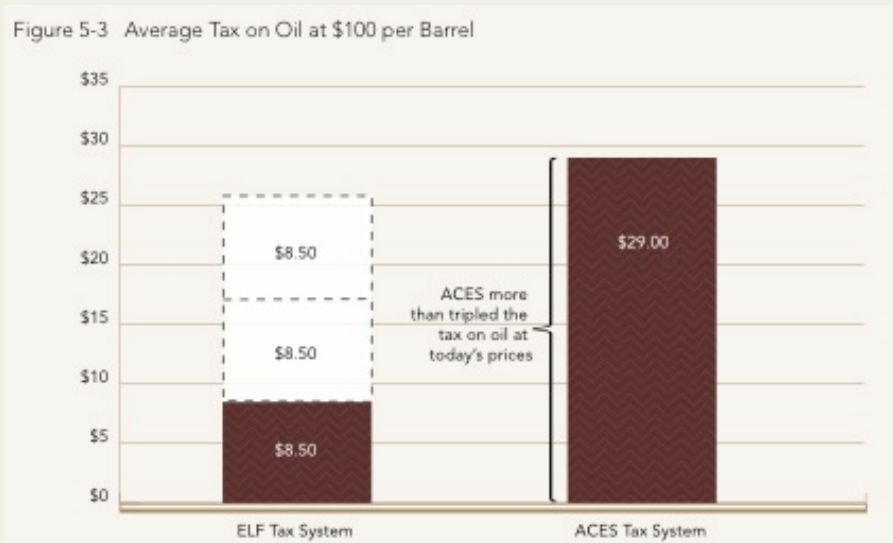


# Background: A Short Tax History

- ELF I (1977-1989)—progressive tax on gross revenues
  - Progressivity applied against productivity of the average well in a field
  - Maximum tax rate of 12.25% (15% for fields > 5 years old)
- ELF II (1989-2006)—changed calculation of ELF I to account for oil field size.
  - By 2005, productivity in Kuparuk had fallen so much that effective tax rate was <1%.
  - Higher oil prices initiated new tax structure
- PPT (2006-2007)—progressive tax on net revenues.
  - Base rate of 22.5% with an increase of 0.25% for every \$1 increase in net revenue per barrel > \$40.
  - Credits for exploration, capital expenditures, new area development
  - Short-lived due to allegations of bribery and corruption

# Background: A Short Tax History

- ACES (2007-present)—same as PPT except:
  - Base rate of 25% with an increase of 0.4% for every \$1 increase in net revenue per barrel > \$30.
  - Increase of 0.1% per dollar above \$92.50 per barrel of net revenue.
  - Maximum tax rate of 75%
- Immediate effect at oil price = \$100/barrel:
  - Triple the tax liability for much of the oil already under production in Alaska



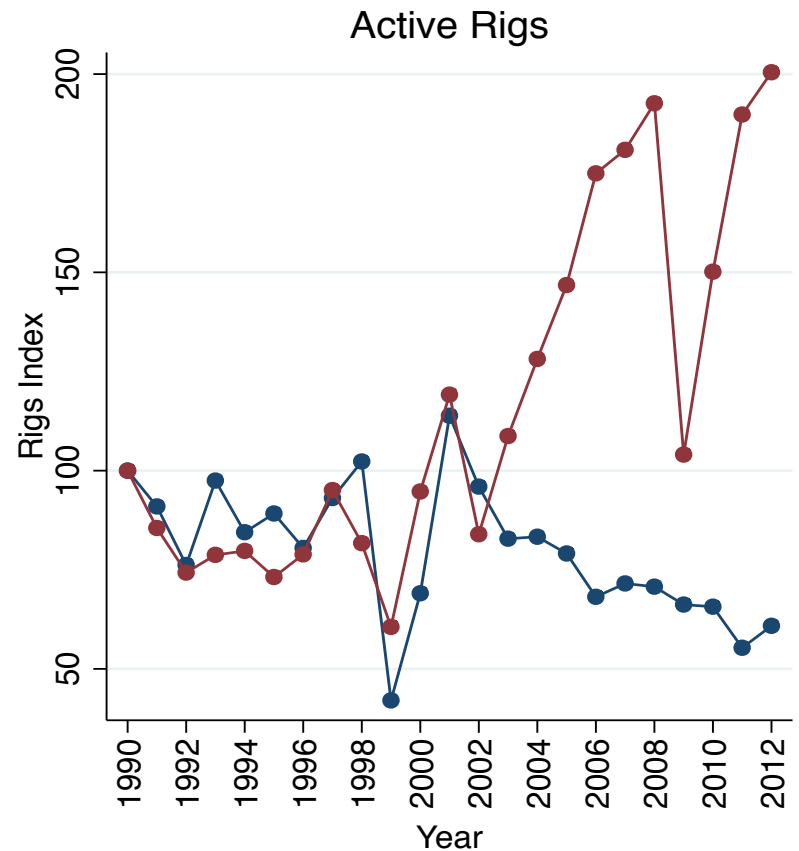
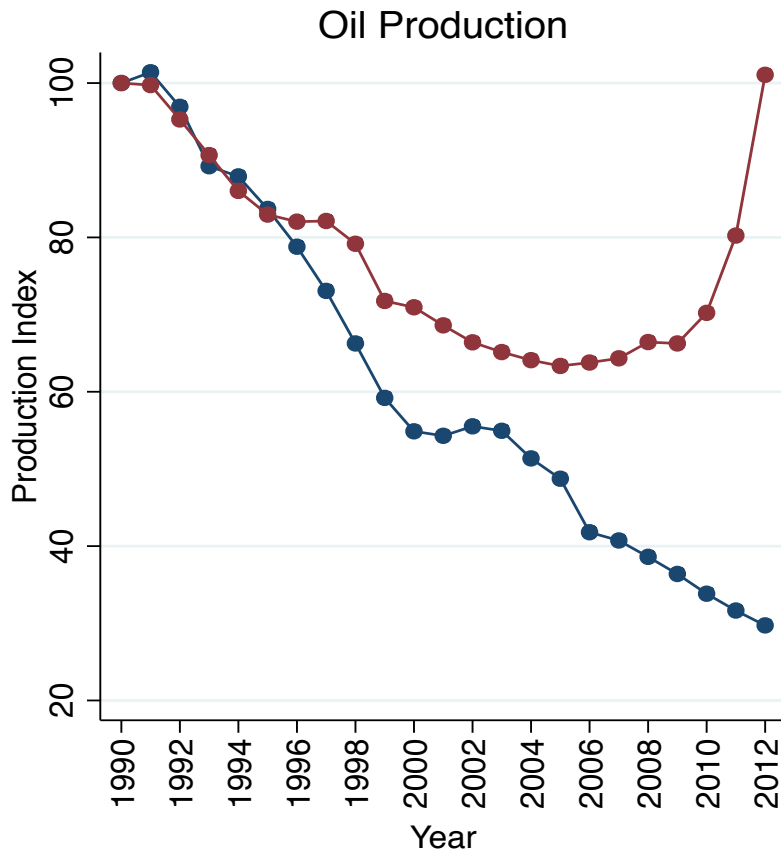
# Theory: Effect of Severance Tax Rate

- Recent theory based on Pindyck's (1979) model of optimal depletion with exploration and production decisions
- General lessons from increased severance tax:
  - Reduction in future drilling and production
  - Reductions are modest (i.e. firms are highly inelastic)
  - Proportionately more tax revenue, redirecting rents from industry to public sector
  - General equilibrium effects (e.g. GDP, employment) depend on elasticity of oil production and drilling
- But.....
  - Standard theory does not account for opportunity cost of investment capital
  - Increased severance tax may redirect investment to more favorable jurisdictions



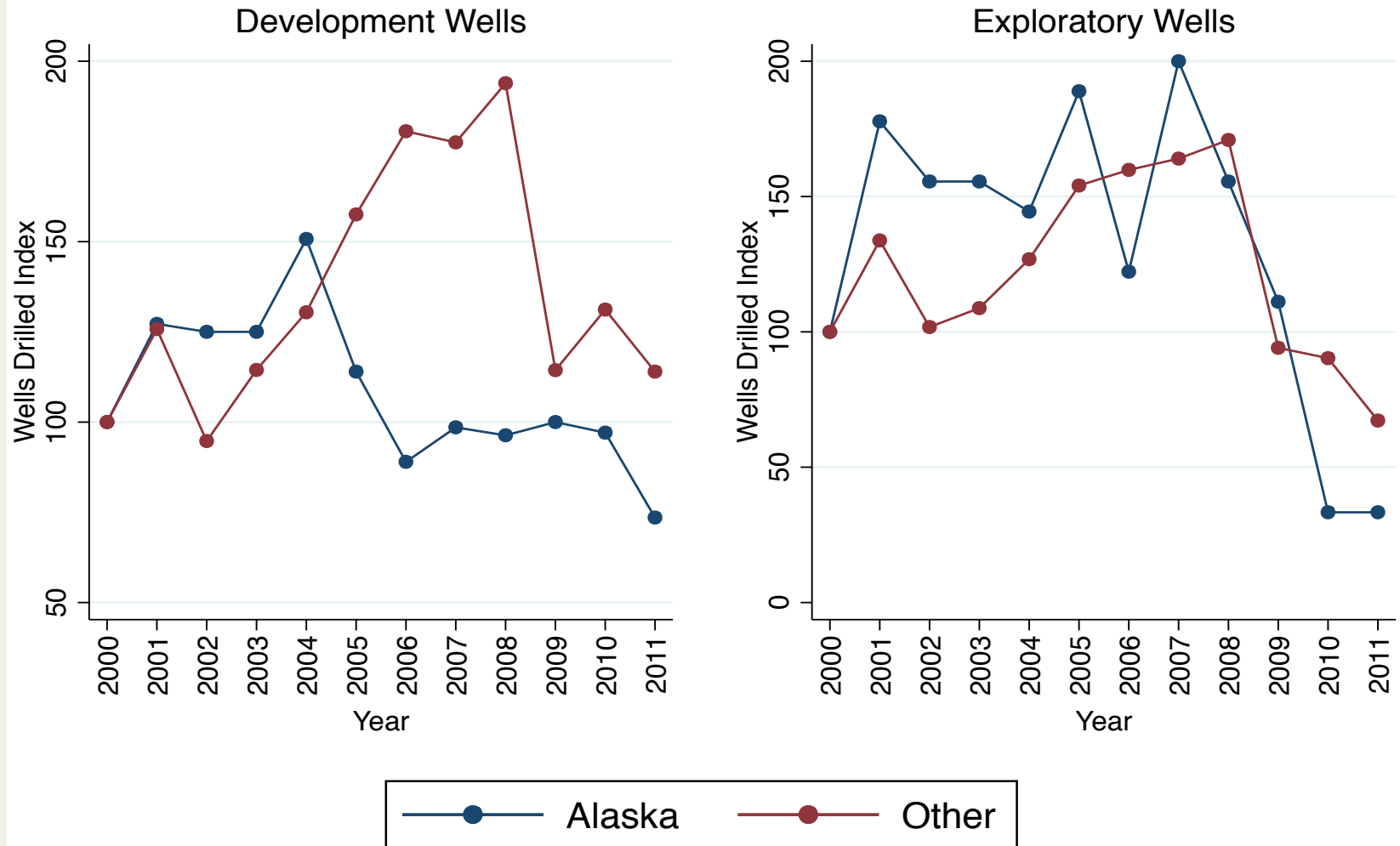
# Alaska Oil Production: Pre- and Post-ACES

## Oil Activity: Alaska vs Other Energy States



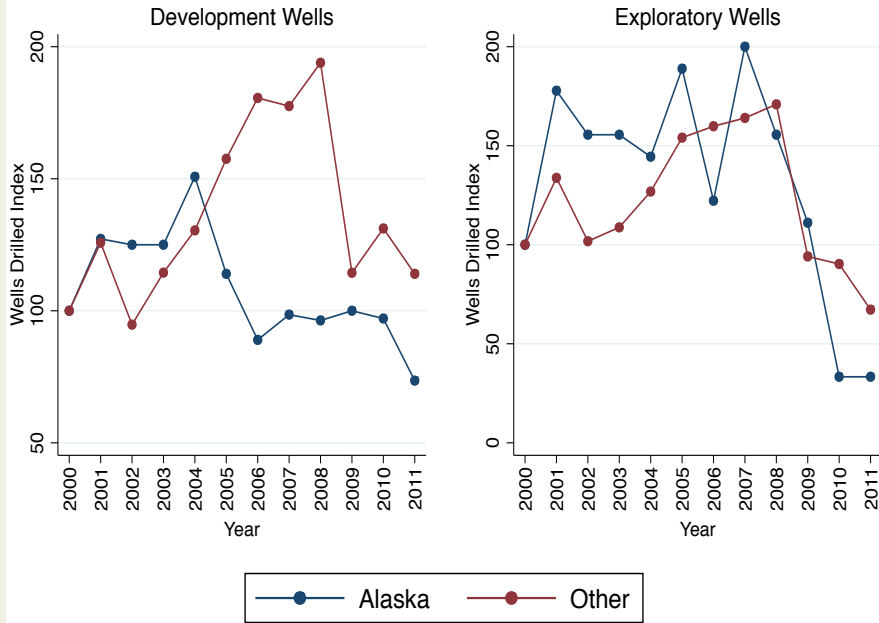
# Alaska Well Drilling: Pre- and Post-ACES

## Wells Drilled: Alaska vs Other Energy States

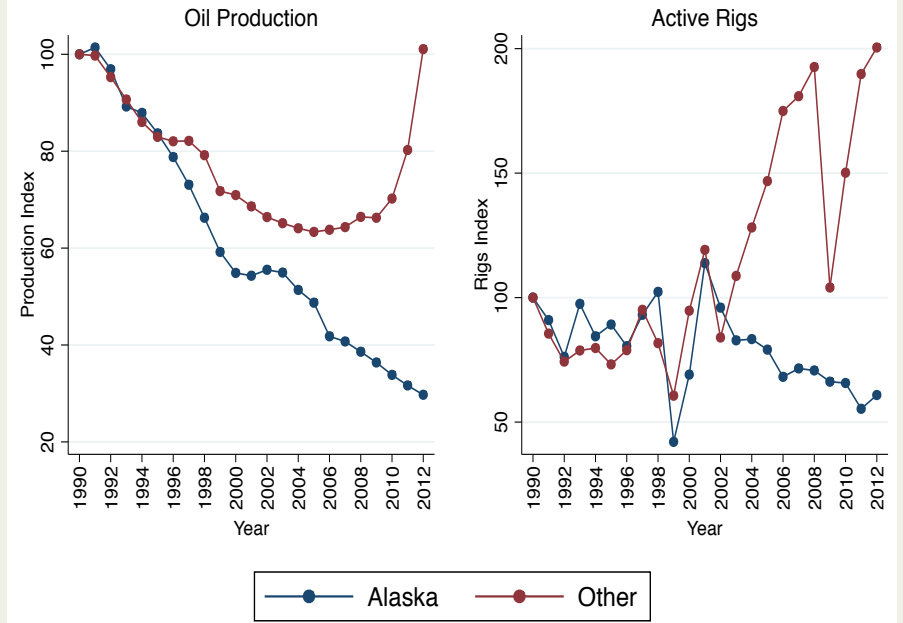


# Alaska: Pre- and Post-ACES

## Wells Drilled: Alaska vs Other Energy States



## Oil Activity: Alaska vs Other Energy States



Are these differences attributable to ACES?

# Identifying the Impact of ACES

- Question—How did ACES affect Alaskan economy?
  - Want to compare post-2007 Alaska *with* ACES to post-2007 Alaska *without* ACES
- Problem—We don't observe Alaska without ACES!
  - Using pre-2007 Alaska probably not a good approximation of post-2007 Alaska without ACES (too many confounding factors)
- Possible Solution: comparative case study
  - Use sufficiently similar U.S. states post-2007 that did not receive the treatment to estimate Alaska without ACES
- Problem—how does one choose comparison states?
  - Especially true if there is a set of multiple states from which to choose
  - Diff-in-diff approach treats all treatment and control states as the same in the absence of the treatment

# The Synthetic Control Method (SCM)

- A data-driven procedure that creates a “synthetic” Alaska
  - Creates a comparison unit from a convex combination of potential comparison units from a “donor pool”
- Weights are calculated to best match the synthetic Alaska to Alaska based on pre-intervention characteristics
- SCM handles confounding unobserved characteristics that vary over time
  - Diff-in-diff restricts confounding unobserved characteristics to be constant



# The Synthetic Control Method (SCM)

- Example from Abadie, Diamond, and Hainmueller (2010)
  - Estimate the impact of Proposition 99 on cigarette sales in California

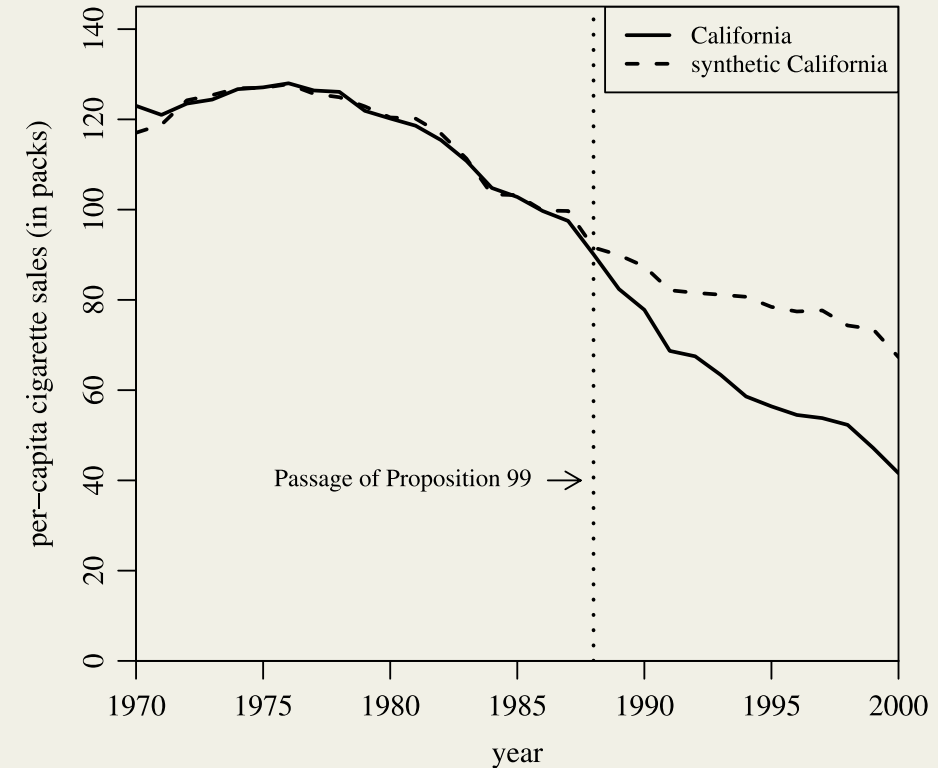
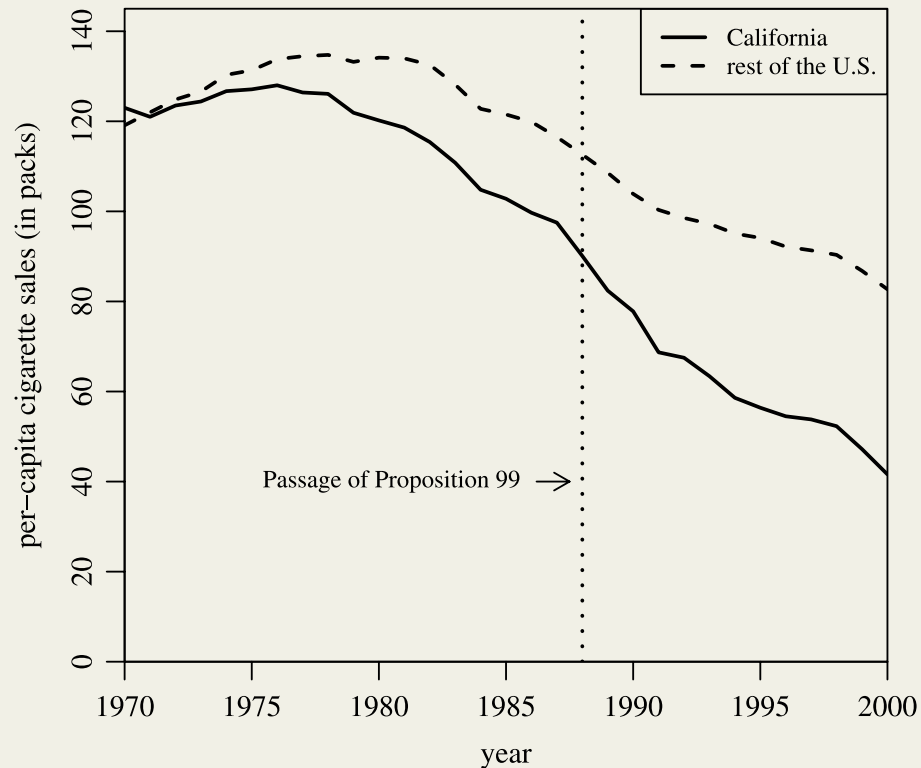


Figure 1. Trends in per-capita cigarette sales: California vs. the rest of the United States.

Figure 2. Trends in per-capita cigarette sales: California vs. synthetic California.



# Donor Pool for Alaska

- Important: Outcomes from donor pool states must be driven by the same structural process as Alaska and not be subject to structural shocks within the sample period

## U.S. Energy States

- California
- Colorado
- Kansas
- Louisiana
- Mississippi
- Montana
- New Mexico
- North Dakota
- Oklahoma
- Texas
- Utah
- Wyoming

# SCM: Inference

- Placebo Tests: How often would we obtain results of this magnitude if we had chosen a state at random rather than Alaska?
- Apply SCM on states in donor pool that did not receive treatment (i.e. ACES)

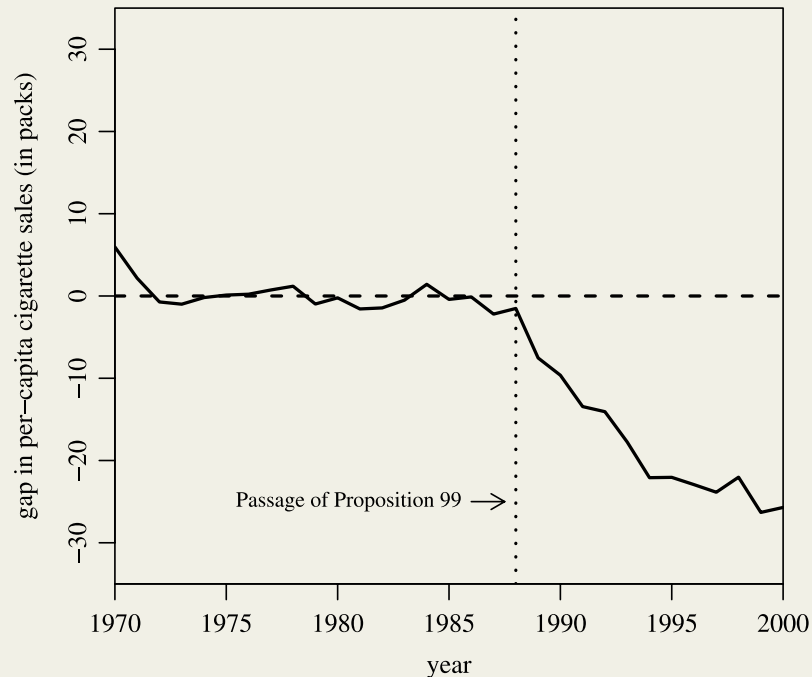


Figure 3. Per-capita cigarette sales gap between California and synthetic California.

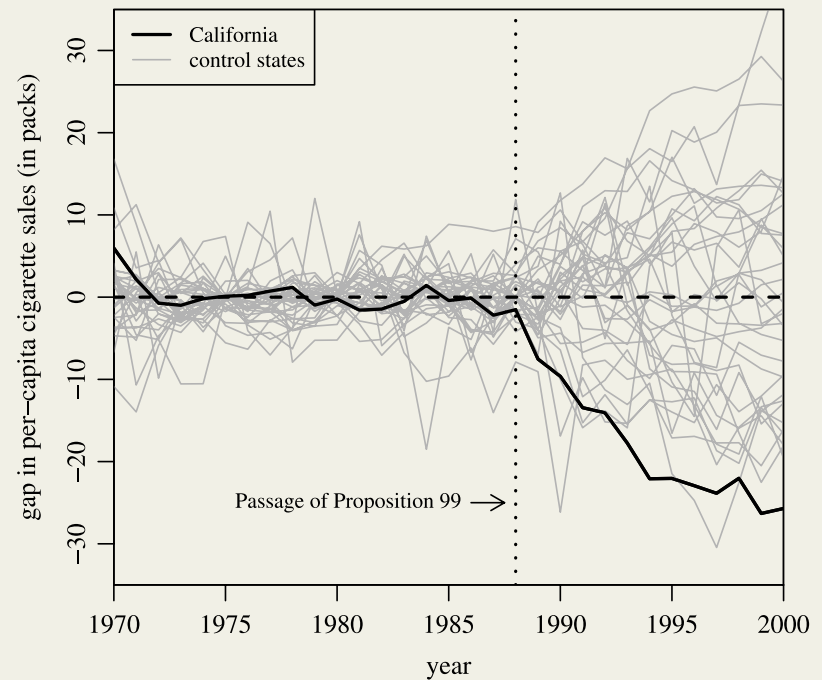
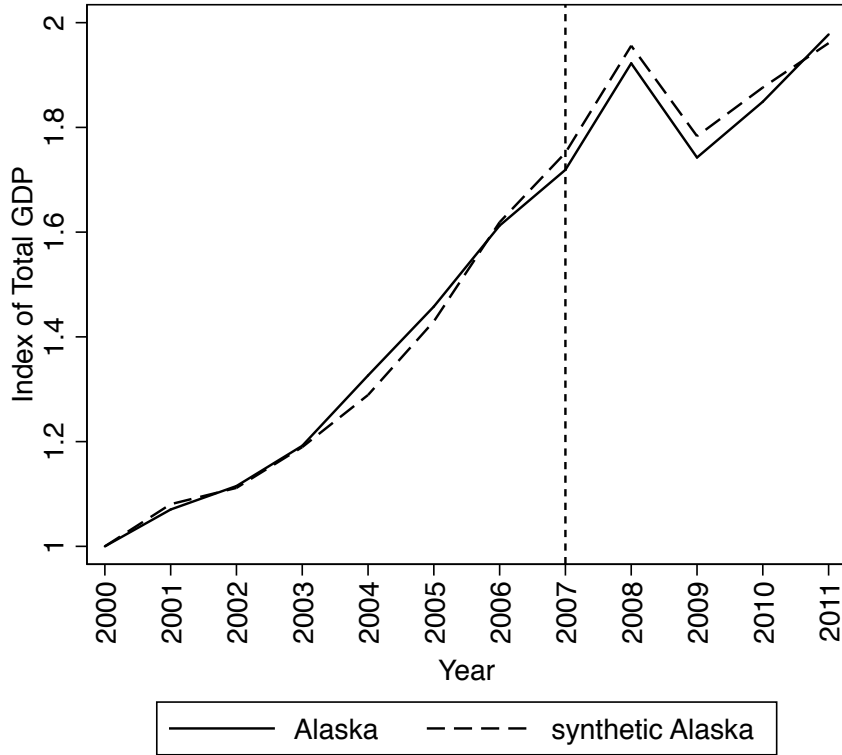


Figure 5. Per-capita cigarette sales gaps in California and placebo gaps in 34 control states (discards states with pre-Proposition 99 MSPE twenty times higher than California's).

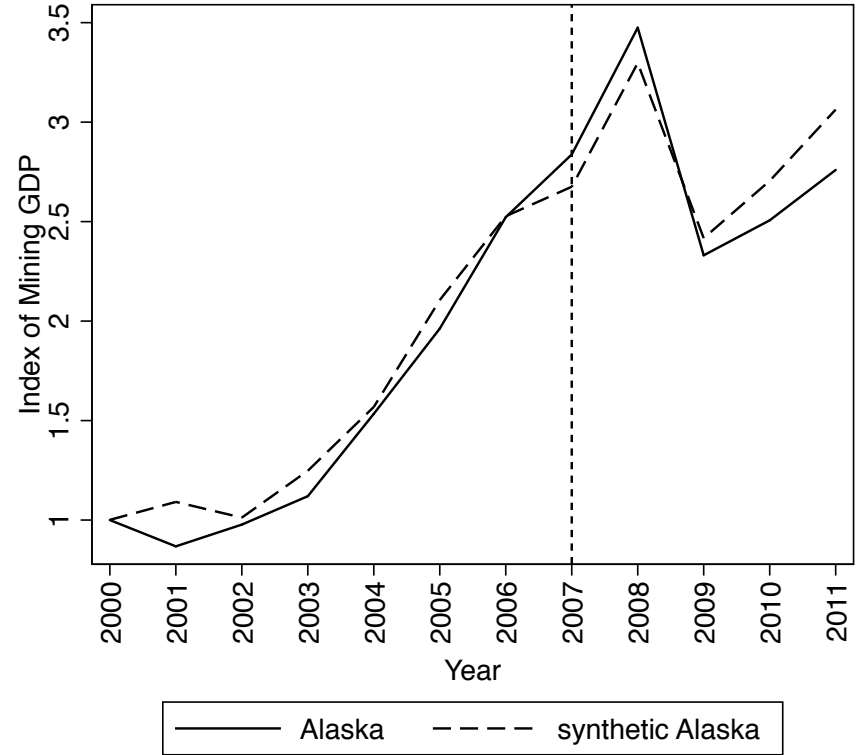
# Impact of ACES on Alaska GDP: Synthetic

## Synthetic Control for Index of Total GDP



Source: Bureau of Economic Analysis

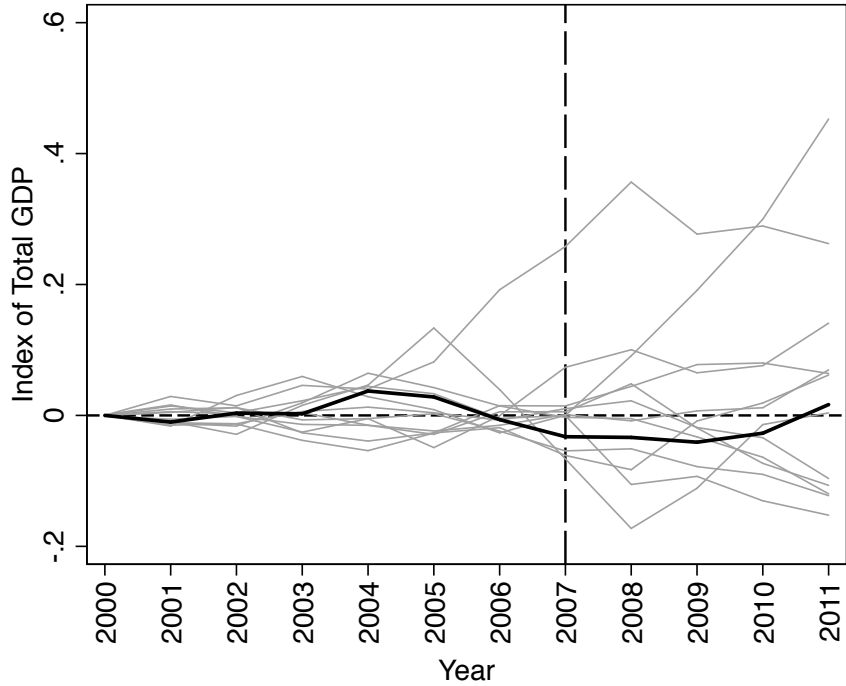
## Synthetic Control for Index of Mining GDP



Source: Bureau of Economic Analysis

# Impact of ACES on Alaska GDP: Placebos

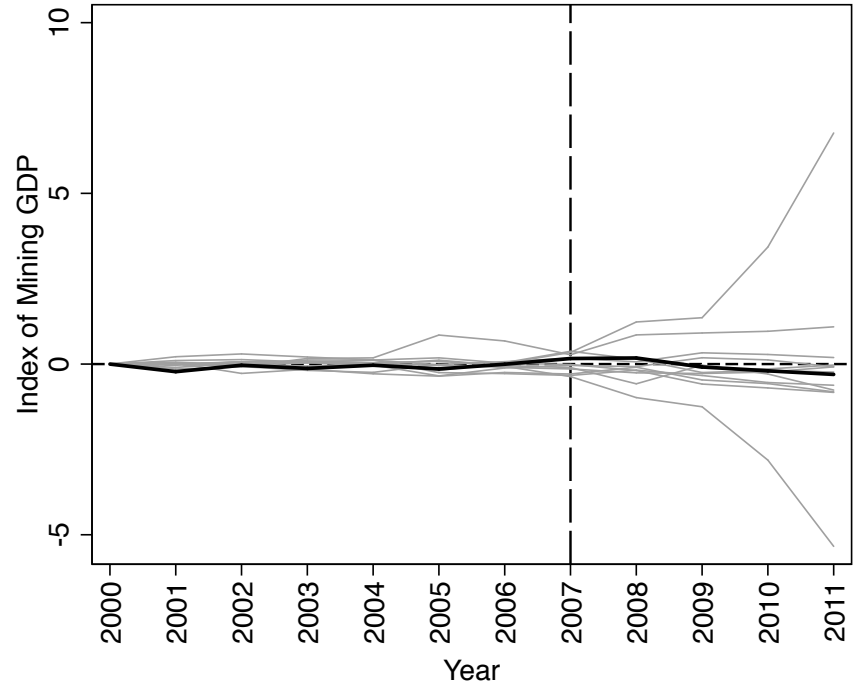
## Placebo Comparison: Total GDP



— Alaska — Energy States

Source: Bureau of Economic Analysis

## Placebo Comparison: Mining GDP

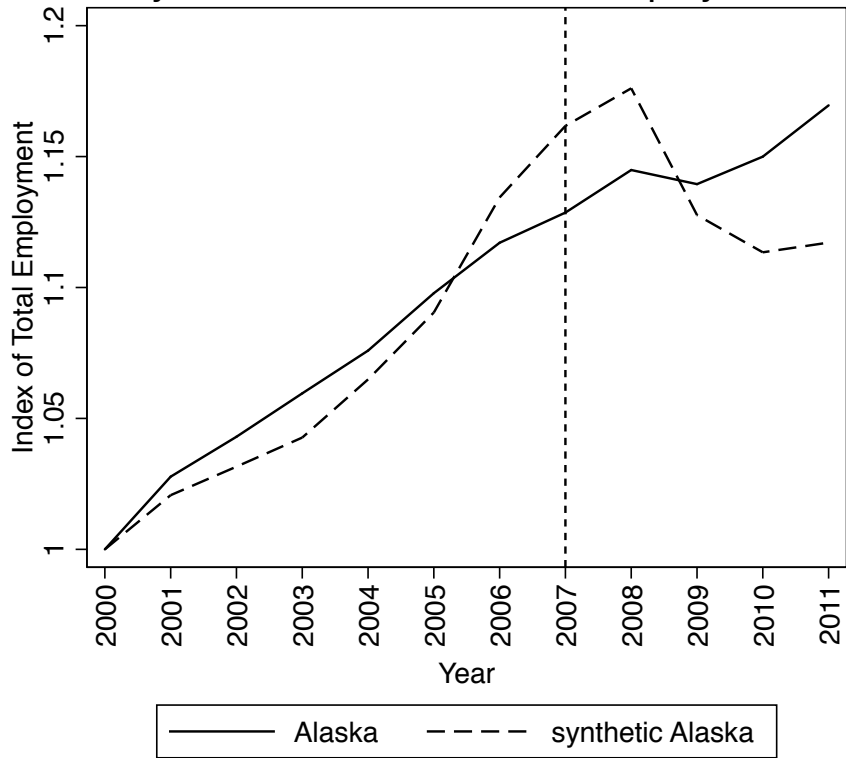


— Alaska — Energy States

Source: Bureau of Economic Analysis

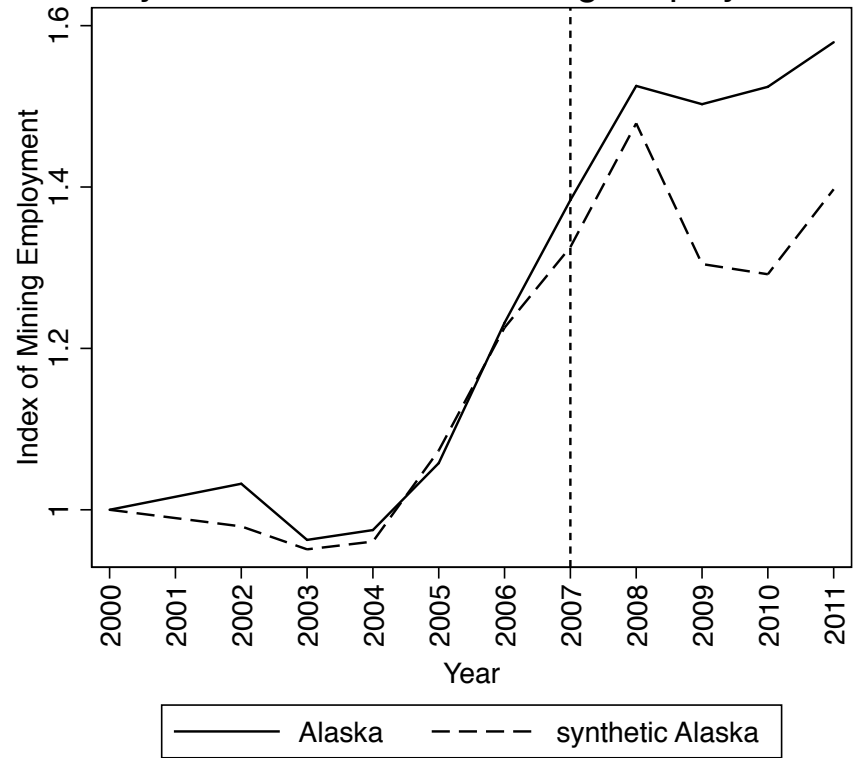
# Impact of ACES on Alaska Employment: Synthetic

## Synthetic Control for Total Employment



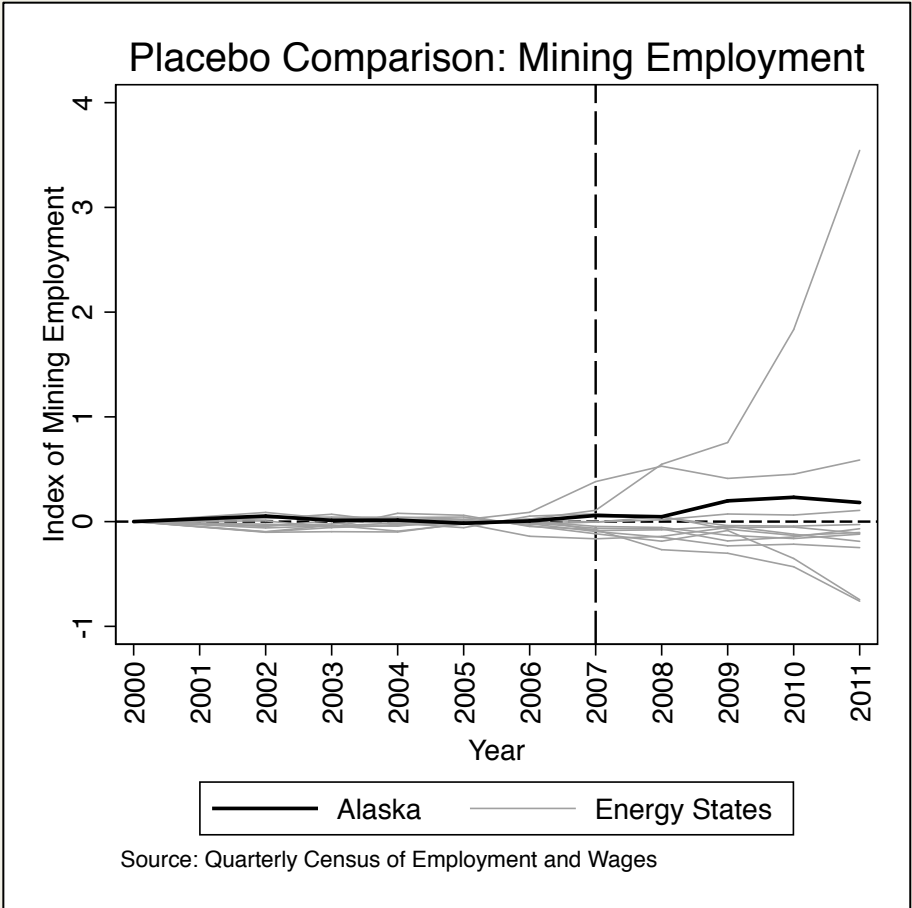
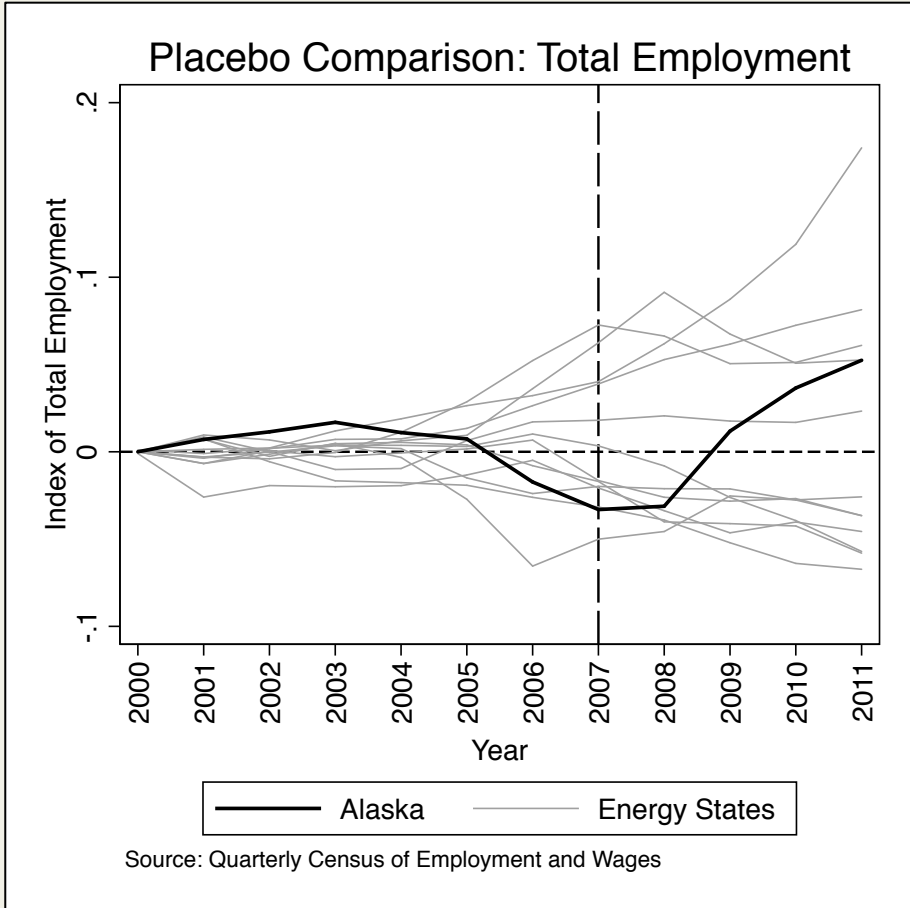
Source: Quarterly Census of Employment and Wages

## Synthetic Control for Mining Employment



Source: Quarterly Census of Employment and Wages

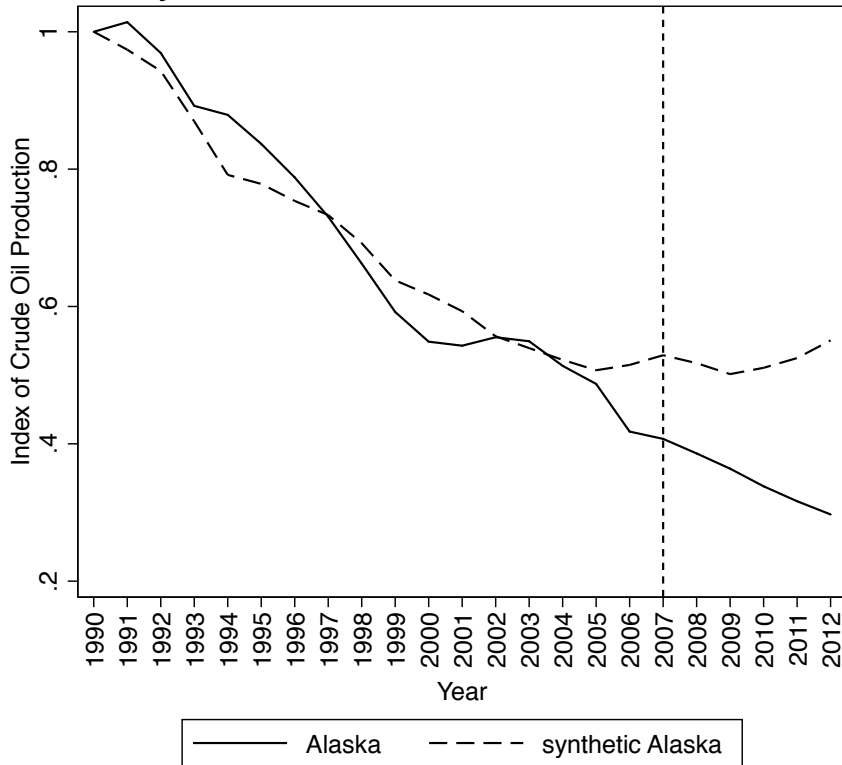
# Impact of ACES on Alaska Employment: Placebos





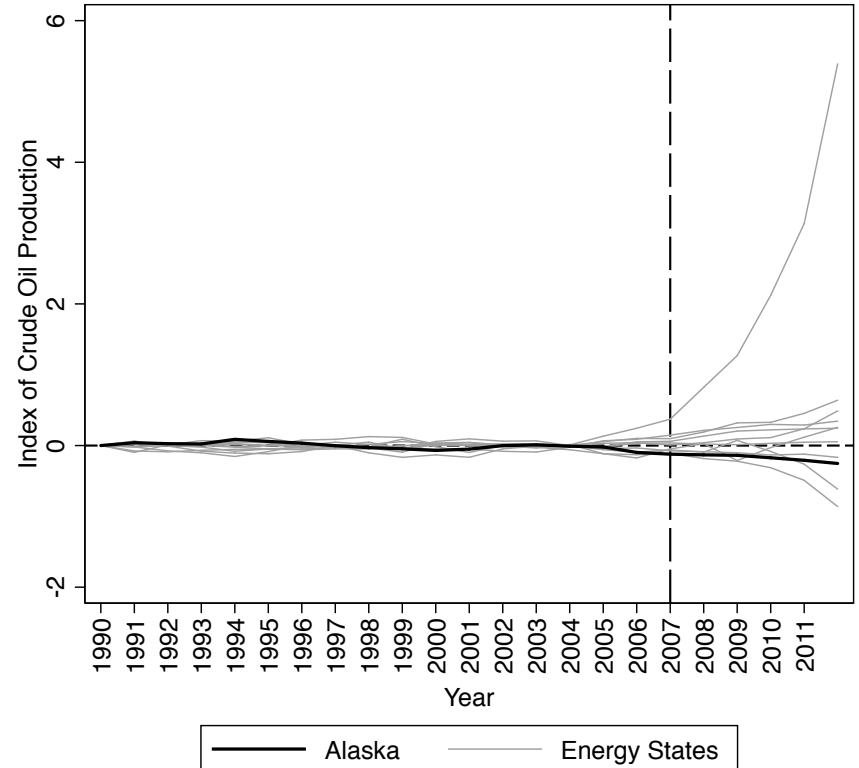
# Impact of ACES on Alaska Oil Production: Synthetic & Placebos

### Synthetic Control for Crude Oil Production



Source: US Energy Information Administration

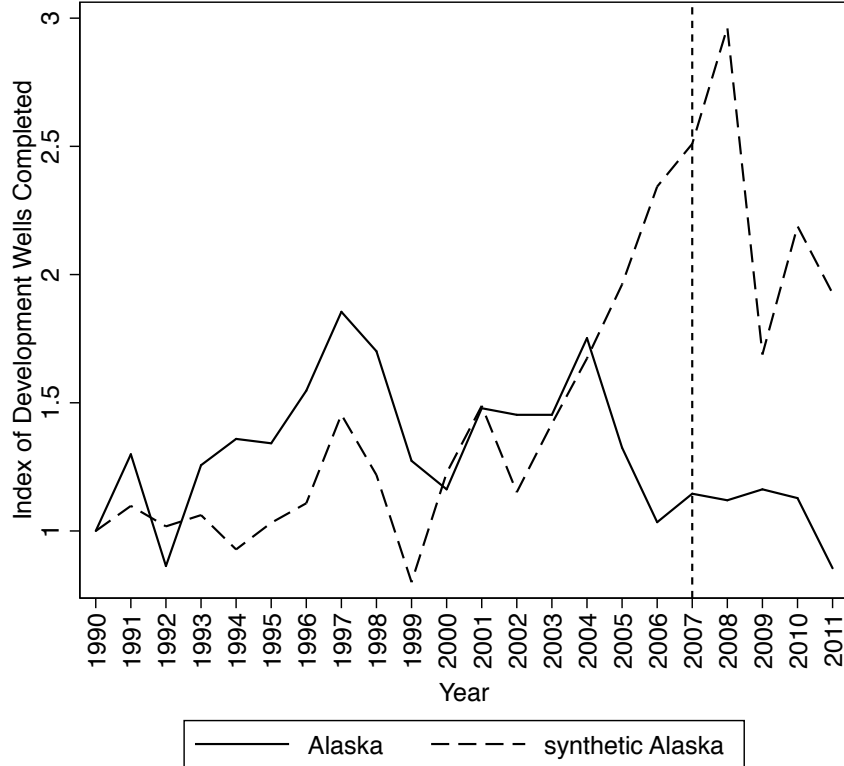
### Placebo Comparison: Crude Oil Production



Source: US Energy Information Administration

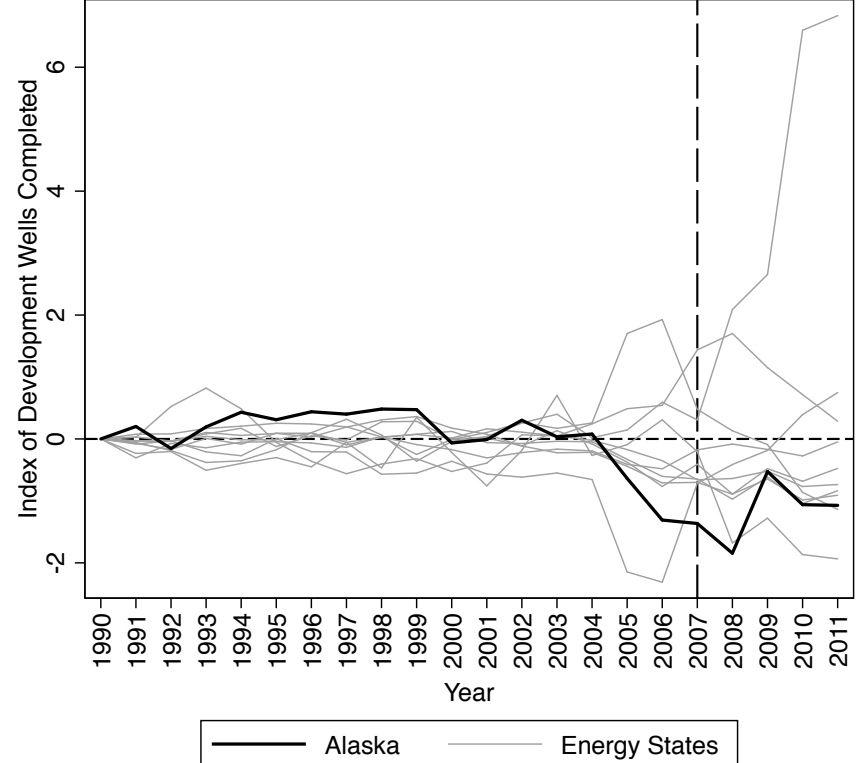
# Impact of ACES on Alaska Development Well Drilling: Synthetic & Placebos

### Synthetic Control: Development Wells



Source: American Petroleum Institute

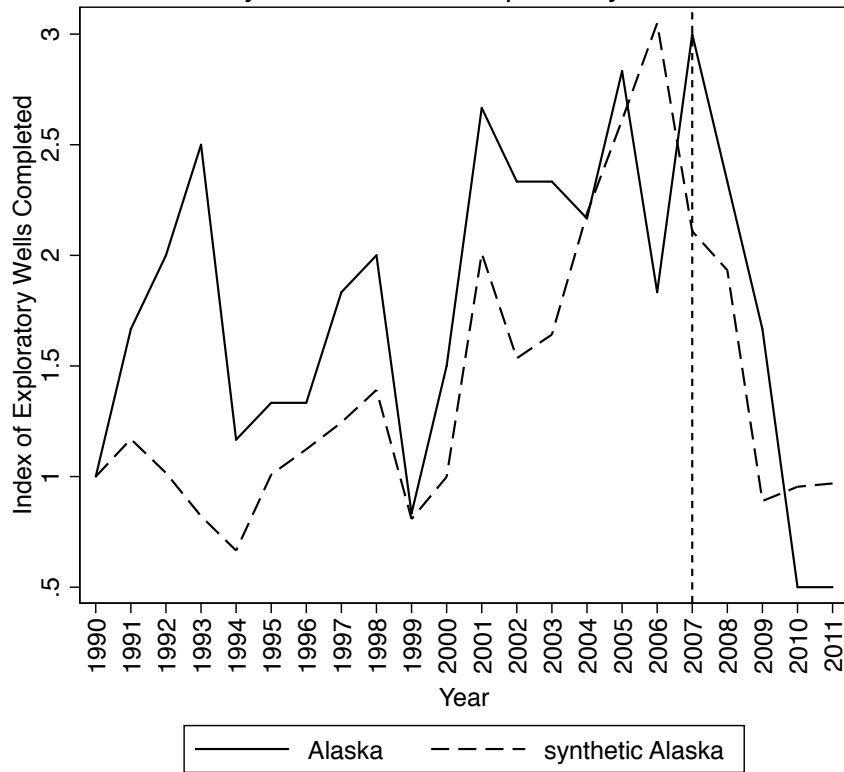
### Placebo Comparison: Development Wells



Source: American Petroleum Institute

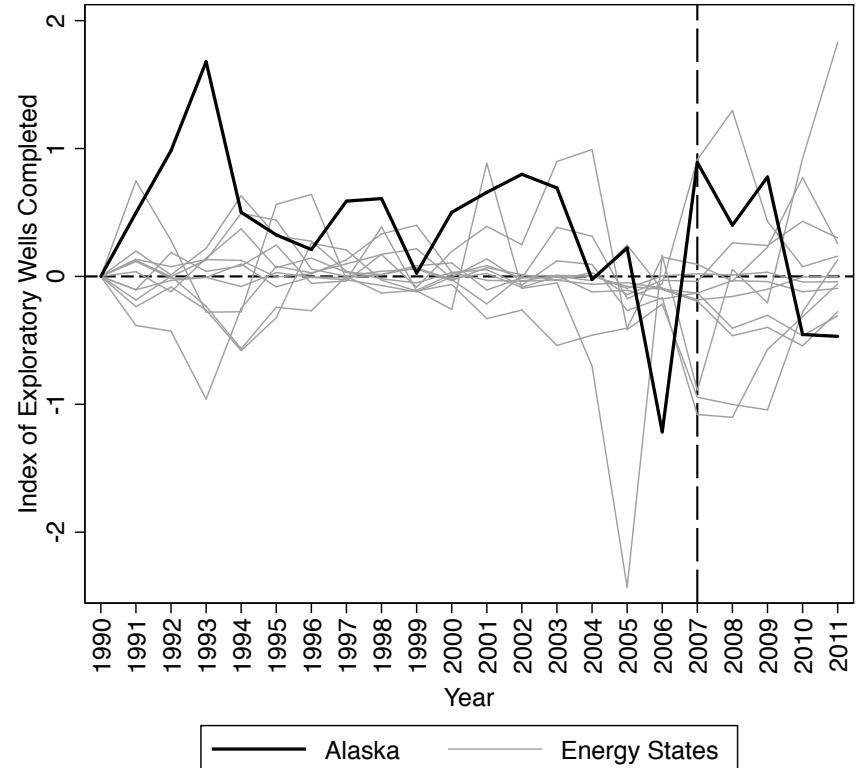
# Impact of ACES on Alaska Exploratory Well Drilling: Synthetic & Placebos

### Synthetic Control: Exploratory Wells



Source: American Petroleum Institute

### Placebo Comparison: Exploratory Wells



Source: American Petroleum Institute

# Conclusion

*How would have Alaskan oil activity evolved since 2007 in the absence of ACES?*

- Results: No discernable difference between Alaska and its synthetic control post-ACES.
  - Supported by results from diff-in-diff approach
  - Suggests that ACES had a minimal effect on the overall Alaskan economy between 2007 and 2011
  - Arguments used to support SB 21 are not supported by our results

# Conclusion: Limitations

- Shale boom shock in all other U.S. energy states
  - Violates the assumption that donor pool states follow the same structural process with no structural shocks during sample period
- What our synthetic Alaska is really estimating:
  - What Alaska would have looked like in the absence of ACES *and* in the presence of a shale boom
- Reason to believe our results:
  - Shale boom should *reinforce* the impact of ACES, and yet we still do not see a significant effect
  - This is the correct counterfactual if we believe ACES prevented the shale boom from migrating to Alaska (lots of shale opportunity in AK)

# Conclusion: Limitations

- Only a 5 year window to evaluate the impact of ACES
  - If oil producing firms are only responsive to fiscal policy in the long-run, then we fail to capture the long-run impact of ACES
- Relevant counterfactual may be: *what would the State of Alaska look like in the presence of ACES 10 or 20 years from now?*
  - A more structural approach needed
- Alaska is a unique state:
  - Difficult to create a synthetic state that resembles Alaska
  - Relatively poor pre-intervention fit from some outcomes
  - If Alaska is unlike any other state, how can we estimate a counterfactual Alaska under a set of different policies?

# Weighting Matrix

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State	Total GDP	Total Employment	Crude Oil Production	Development Wells Completed	Exploratory Wells Completed
Colorado	0.398	0.000	0.000	0.000	0.000
Kansas	0.000	0.000	0.056	0.000	0.000
Louisiana	0.000	0.000	0.236	.000	0.000
Mississippi	0.000	0.000	0.000	0.000	0.000
Montana	0.000	0.000	0.000	0.000	0.475
New Mexico	0.000	0.732	0.000	0.000	0.271
North Dakota	0.000	0.000	0.000	0.000	0.000
Oklahoma	0.000	0.000	0.000	0.000	0.000
Texas	0.000	0.000	0.000	0.948	0.000
Utah	0.000	0.000	0.000	0.052	0.254
West Virginia	0.000	0.000	0.000	0.000	0.000
Wyoming	0.602	0.268	0.708	0.000	0.000

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