Disclosure Policy and Investment in Oil and Gas Exploration

Thomas R. Covert [1] Richard L. Sweeney [2]

September 2019

[1]Chicago Booth
[2]Boston College

Information spillovers make competitive exploratory drilling inefficient. Could secrecy solve this problem?

- Resources are uncertain, spatially correlated, and can only be learned by drilling. When competitors are neighbors, there will be a free riding problem:
  - I want Rich to drill first, to see what happens in his well
  - … but he wants me to go first!
- Hendricks & Kovenock (RAND, 1989) analyzed this problem, and found that competing firms can't invest as efficiently as a planner would.
- Common policy solution to free riding: let firms keep **secrets**
- Our goal: in theory terms, does secrecy help? Does it look like it did in a natural experiment?

Hendricks and Kovenock (1989) in a nutshell

- Two firms (τ, ρ) own adjacent parcels
- Each receives a private signal (s) about the underlying resource quality (X)
- Chose to drill in period 1 or period 2 (or let lease expire)
- If τ waits, and ρ drills in period 1, τ observes X, and can make an efficient drilling decision in period 2

Equilibrium play has a straight-forward symmetric Bayes Nash equilibrium

In equilibrium, there are cutoffs $s_1 > s_2$:

- In period 1, τ drills if $s > s_1$
- If τ doesn't drill in period 1, but ρ does, τ observes X and makes efficient investment decision in period 2.
- If ρ doesn't drill, τ drills in period 2 if $s > s_2$

This is *inefficient* relative to what a planner would do with control and knowledge of both signals.

We adapt HK model to allow for incomplete social learning

- Under well confidentiality laws ρ can keep X a secret if it drills in period 1
- Since drilling itself is likely too noticeable to hide, τ still learns something about ρ's *signal*
- We solve for symmetric Bayes Nash equilibria in this revised game

What happens if Rich, ρ, and/or Thom, τ, are allowed to keep their observation of X a secret?

- With secrecy, equilibrium play still has a cut-off structure
  - again, drill early if $s >= t_1$, but $t_1 < s_1$
  - if one player drills early, and the other doesn't, laggard makes a **risky** second period decision, if $s >= t_2$, with $t_2 < s_2$
  - if no one drills early, drilling **never** happens
- Intuition: gains to waiting are lower if you learn less, but if you saw your competitor wait, that is worse news than before
- Theorem: there is more and earlier drilling when firms can keep their drilling results secret
- *Almost* a theorem: secrecy is less efficient than no secrecy. Some free-riding might be better than none.

How might secrecy affect the market for drilling rights?

- Competition creates efficiency losses, even without secrecy. Might secrecy affect the likelihood of separate vs. concentrated ownership of drilling rights?

- Our intuition: because secrecy *decreases* the benefits of being a drilling right owner in a competitive drilling game, it might reduce the incidence of separate ownership in the first place.

- If a firm wins both leases P% of the time, generating total value V^E, and otherwise generating V^C, then the expected value is:

$$PV^E + (1 - P)V^C$$

  Value of secrecy depends on its effects on P and V^C

Natural Experiment on Secrecy in Appalachian Shale Basins

- Most states allow *short* secrecy periods: 3 months - 1 year. Pennsylvania used to allow firms to keep production secret for **5 years**.

- In 2010, the Pennsylvania revised their secrecy rule, bringing it in line with similar rules in West Virginia and Ohio, states which share both borders and shale formations with Pennsylvania.

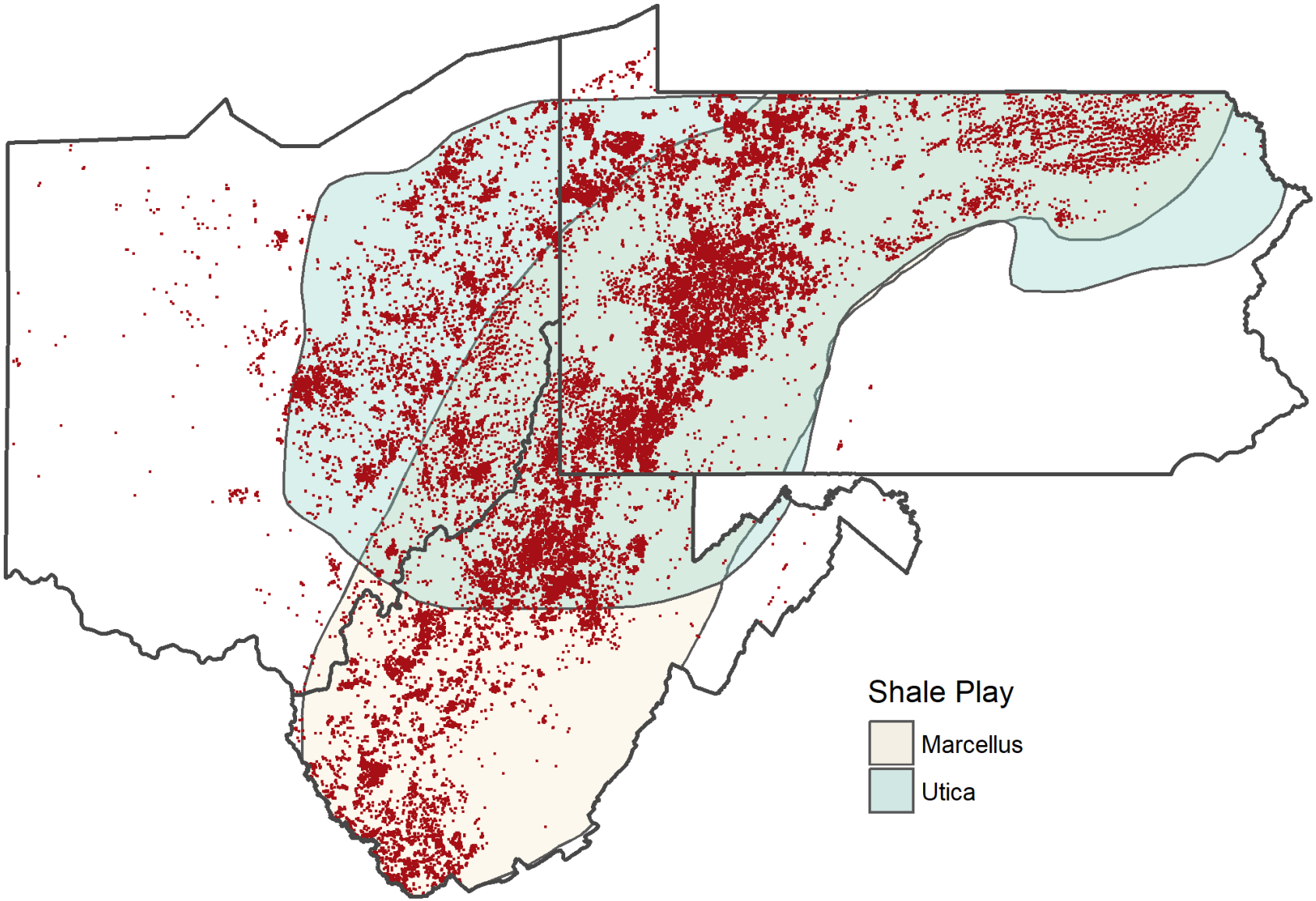
- Empirical question: what is the causal effect of secrecy on the value (gas revenues minus drilling costs) of shale gas exploration and production?

    - Use data on *leasing* and *drilling* to capture effects of secrecy on both the allocation of drilling rights, and, conditional on those, the efficiency of drilling.

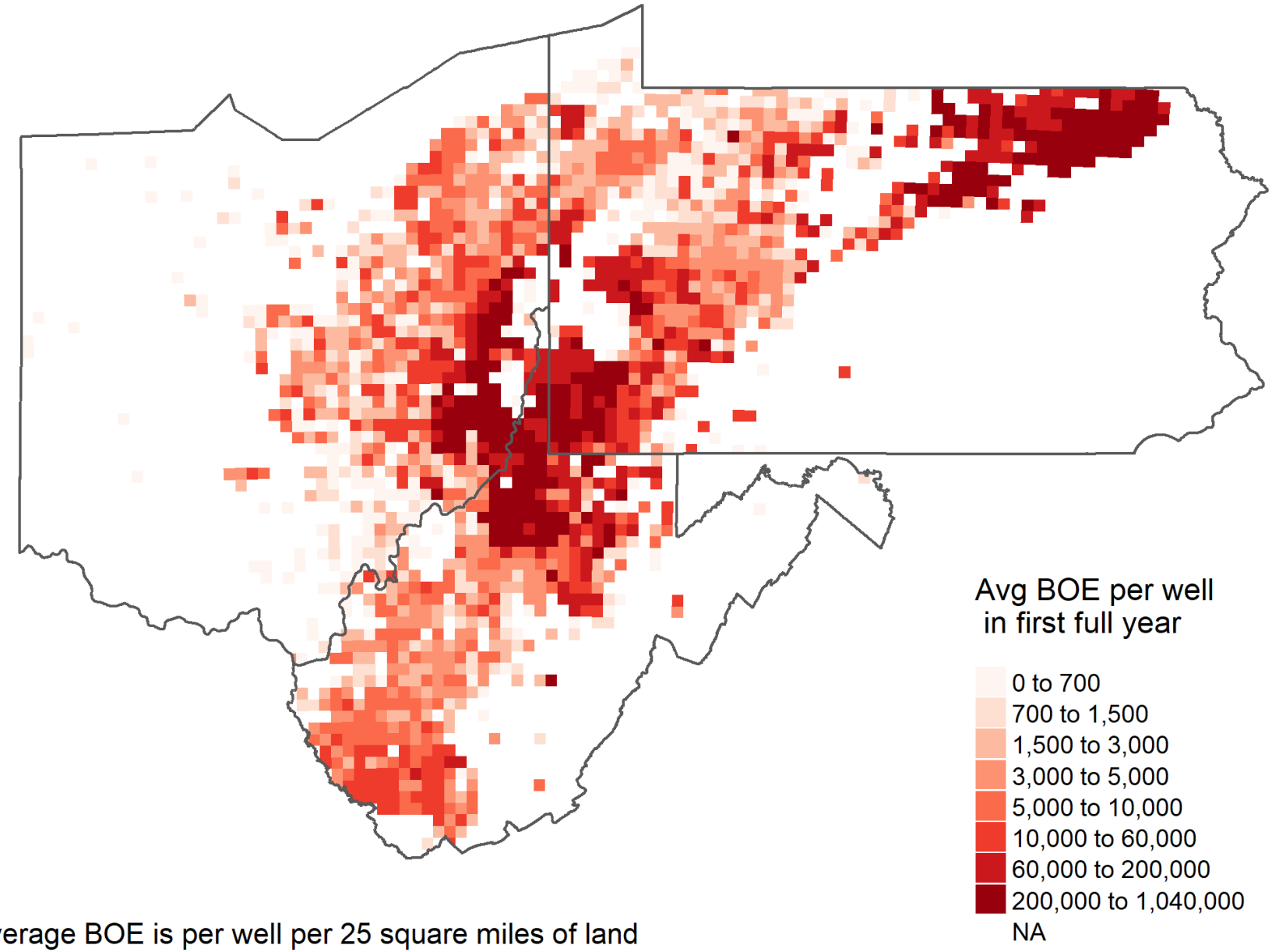
Data and empirical strategy

- PA confidentiality 5 years until 2010, then effectively 1.
- OH (6 months) and WV (1 year) unchanged.
- $\sim$ **500,000** leases from DrillingInfo and Jim Bourbeau (largest land services company in Appalachia)
  - Shape, date, location, lessee/lessor, assignments...
- Difference in differences estimates: compare leasing, drilling and output within a shale basin, across states, before and after law change.
- Triple diffs: *conditional* on allocation of leases, compare drilling and output in split vs. common ownership cases

Plenty of Drilling/Leasing in Appalachia

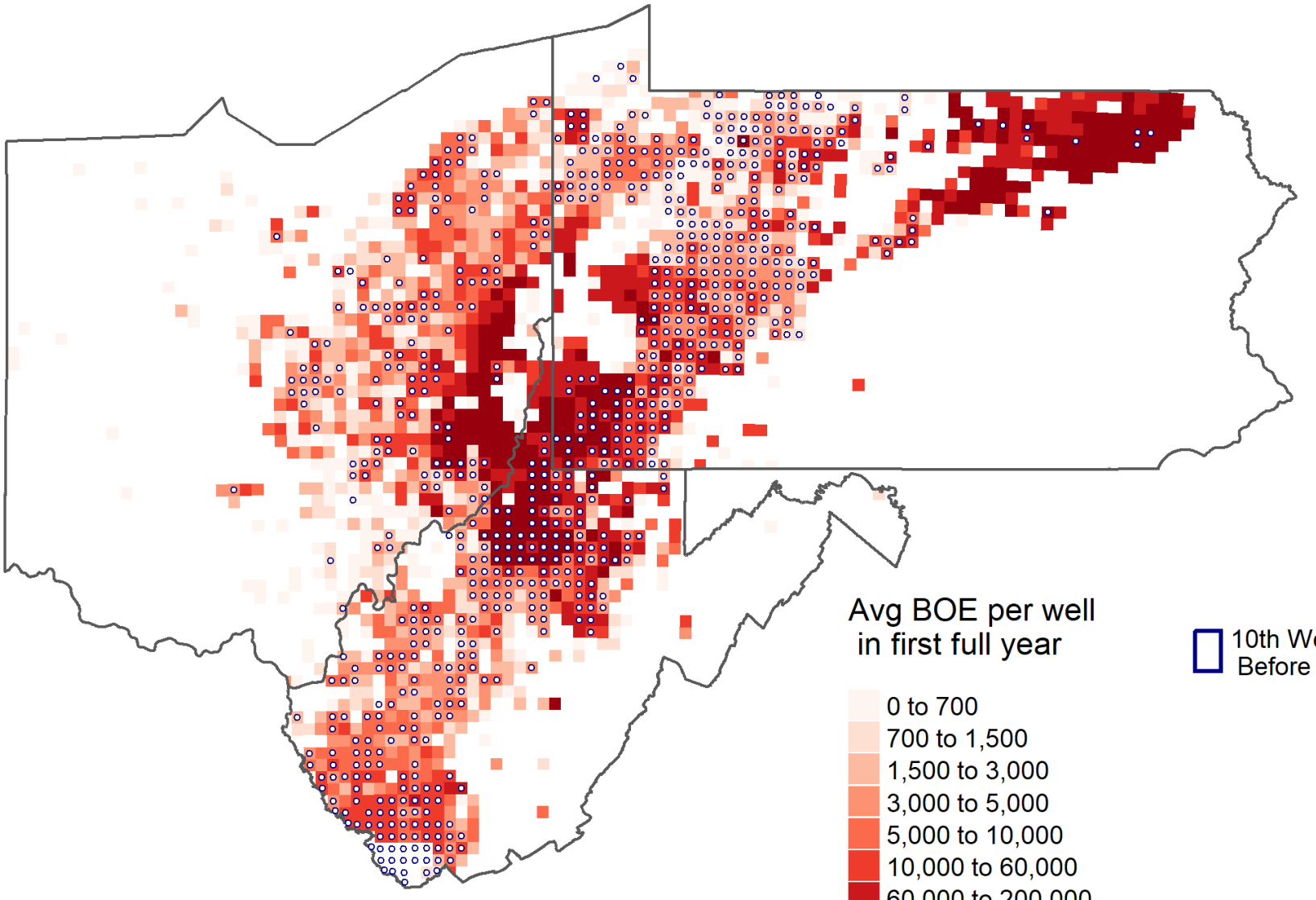


Plenty of Resource Heterogeneity



*Average BOE is per well per 25 square miles of land

Plenty of Resource *Uncertainty*



*Average BOE is per well per 25 square miles of land

Summary

- Strategic incentives reduce social welfare in environments with informational spillovers and costly investment, like oil and gas exploration.
- We extend a model of perfect social learning to one where information revelation is incomplete, find that secrecy (probably) reduces welfare further, conditional on split ownership.
- Have a plan to take the model to data in Pennsylvania.
- Research has implications as shale boom continues to play out globally.