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A regression discontinuity approach to measuring the effectiveness of oil and natural gas regulation to address the common-pool externality

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ABSTRACT

Oil and natural gas reservoirs typically span multiple productive leases so that no owner has rights to the entire stock of resource, resulting in production externalities. Previous literature has examined the effectiveness of government regulation in Texas and Oklahoma in abating these externalities, finding Oklahoma to be more successful in unifying common pools and securing property rights. Using regression discontinuity design, we quantify the impact of regulatory difference between the two states. We find that Oklahoma produces an average of 3361 more barrels of oil over the life of a well, relative to Texas. Given the maturity of the fields in question, the result underscores the continuing importance of addressing common pool externalities even after the primary phase of recovery has largely been completed.

1. Introduction

The oil and natural gas industry often suffers from an externality during extraction. Because hydrocarbons are mobile, production at one well can cause drainage patterns to change, negatively affecting production at nearby neighboring wells, even causing hydrocarbons to flow across property lines.

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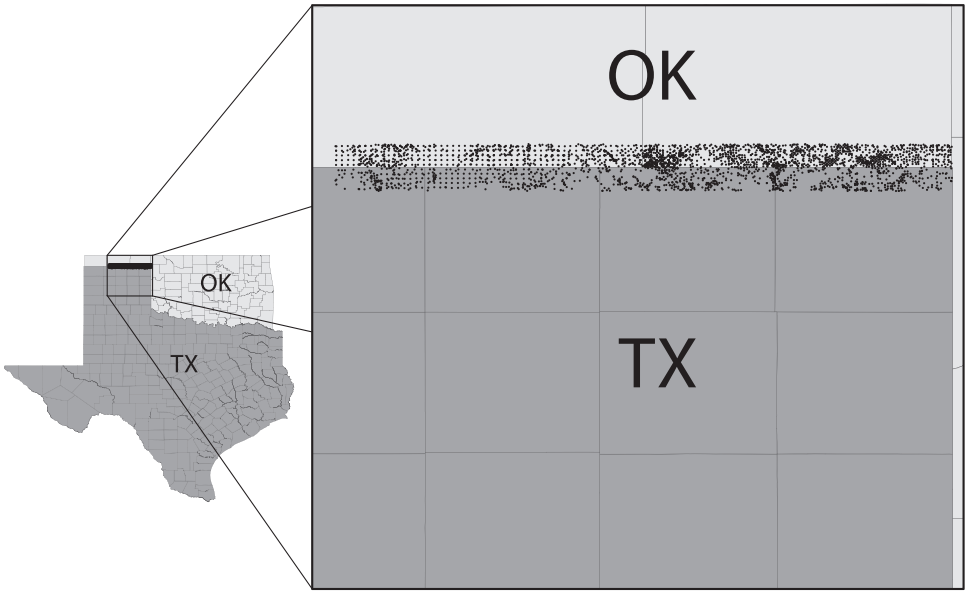

Fig. 1. Well locations.

Under these circumstances competition over the resource can incite a race to extract, leading to economic and physical waste. Addressing this production externality has been the focus of previous research and is an important policy consideration. Policy options include prorationing (production quotas), well-spacing guidelines, severance taxes, and field unitization (contracting a single operator to produce the entire field). Yet there are no causal empirical measurements of the effects different combinations of policies have in altering production profiles to moderate the race to extract.

In this paper we exploit a natural experiment to causally identify the effect policy has on production by comparing wells in the Anadarko Basin along the Texas-Oklahoma border. We find that the more property-rights oriented Oklahoma policy, which emphasizes unitization, leads to a significant increase in cumulative oil recovery per well relative to Texas, which has stricter well-spacing guidelines and severance taxes that favor earlier oil extraction. A caveat to our estimates is that they are specific to the area under study.

Regression discontinuity design provides the framework for estimating the causal effect of the relative policy difference between Oklahoma and Texas. Because well productivity is determined largely by geological factors, which are clustered together in space, wells that are close to one another will be similarly productive. By historical accident, wells that have been drilled into the same reservoir have been randomly exposed to different policies. The randomization is a result of the Missouri Compromise of 1820, when the US Congress prohibited slavery in the Louisiana Territory north of a line 36°30′. This line became a state border, and separated the as yet unrecognized Anadarko Basin between Oklahoma, to the north, and the Texas, to the south (see Fig. 1). By comparing the production profiles of wells on either side of this border, we are able to identify the treatment effect of the relative policy difference between states.

We find Oklahoma producers are more successful in terms of cumulative oil recovery than their Texas counterparts. The difference in recovery may stem from more efficient secondary recovery in Oklahoma (Lang Weaver, 2011) (pp. 33–34), but we are unable to test this claim with the present dataset. This finding extends earlier research focusing on common-pool externalities in Texas and Oklahoma, and strategies to abate them (Libecap and Wiggins, 1984, 1985; Wiggins and Libecap, 1985); our study also provides empirical corroboration to an earlier geophysical-economic simulation study (Lueck and Schenewerk, 1996).