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Fracking and environmental protection: An analysis of U.S. state policies



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ABSTRACT

This paper examines the correlates of state policies designed to mitigate prospective environmental impacts associated with U.S. oil and gas drilling (fracking operations). I found that policy decisions are especially influenced by political factors such as the partisan orientations of the statewide electorate and the ideological makeup of state voters as well as economic resource variables such as the generation of revenue from severance taxes. Less important in accounting for variation in state fracking policies are socioeconomic characteristics such as median educational attainment and per capita income and general indicators of a state's prior receptivity to the enactment of environmental programs.

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1. Introduction

An increasingly important policy goal in state government over the past several years has been the development of unconventional natural gas and oil resources made possible by technological advances in hydraulic fracturing and horizontal drilling (i.e., fracking). The public policy benefits are clear. Greater industry use of fracking offers an abundant source of domestic energy that reduces U.S. reliance upon imported oil from politically unstable or unfriendly countries (IHS, 2009). Second, natural gas is a cleaner burning fossil fuel, thus contributing to the argument that a quicker decline in greenhouse gas emissions may occur when it used to displace coal in the generation of electrical power (Engelder, 2011). Third, fracking operations result in economic development gains such as the creation of infrastructure, well-paying jobs, revenues and taxes for affected local governments (Sovacool, 2014).

However, others are concerned about how oil and gas production might adversely affect environmental quality. This includes potentially negative impacts on air quality from fugitive methane leaks (Vengosh et al., 2014), water contamination linked to leaking or improperly capped wells (Moore et al., 2014), the depletion of groundwater resources for use in fracking operations (Sovacool, 2014), and adverse health effects for people living in close proximity to drilling sites (Bamberger and Oswald, 2012; Adgate et al., 2014). This has led to increased political tension between those who perceive fracking as an economic or energy

issue versus others who see this issue through the lens of environmental protection (Jacquet, 2014; see also Mazur, 2016). State and local policymakers are largely responsible for devising policies through legislation and rulemaking activities that balance resource development goals with environmental quality.

States vary in terms of efforts to regulate fracking in ways that allow production to coexist with public health and environmental quality. My research goal in this paper is to identify the characteristics of oil and gas producing states that have enacted policies designed to mitigate prospective environmental impacts associated with fracking operations. I begin by considering whether these policy decisions are significantly influenced by *political factors* such as the partisan orientations of the statewide electorate and the ideological makeup of in state voters, *socioeconomic characteristics* such as median educational attainment and per capita income, *economic resource variables* such as oil and gas production and severance tax revenues, or *environmental policy support* indicators such as the enactment of state-level green policies or regulations and the voting record of the state's congressional delegation on bills dealing with environmental issues.

After briefly outlining the regulatory context of fracking policies, I examine the small but growing literature dealing with factors that influence state-level decisions and offer a number of research expectations. A preliminary effort to test these expectations is then presented in the findings section using information obtained from documentary and secondary sources, agency and nongovernmental websites and scholarly articles. In short, this research offers some preliminary empirical work on fracking policies that reveals why some states are more likely than others to

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address environmental impacts in the design of regulatory programs. I conclude by considering the extent to which these findings are consistent with the results of other state level studies dealing with energy or environmental policymaking.

2. The regulatory context of oil and gas drilling operations

The regulation of oil and gas drilling in the U.S. has been described as “fractured, fragmented federalism” (Warner and Shapiro, 2013). Federal officials retain or share legal authority to shape some fracking policy decisions. For example; the U.S. Environmental Protection Agency (EPA) administers the Clean Air Act, including a rule adopted in 2012 that addresses air quality problems linked to oil and gas operations. However, it is important to emphasize that the states are the major policy players. A state-centric focus has been maintained by oil and gas producer states since the enactment of the Interstate Oil Compact (later renamed the Interstate Oil and Gas Compact) in 1935. The policy also created a compact commission (IOGCC) consisting of at least one representative from every member state to coordinate oil and gas production and conservation programs and to recommend a set of guidelines for the development of state regulatory programs (Zimmerman, 2002).

State policymakers saw the IOGCC and its Commission as a beneficial means of avoiding federal agency regulation of energy industries while creating some semblance of market stability for member state firms. Since then, the regulation of U.S. oil and gas drilling operations has been carried out by state-level commissions, agencies or departments with occasional guidance from IOGCC. This includes regulatory decisions made before and after the surge in shale gas production occurring since the mid-2000s (Richardson et al., 2013) as well as the enactment of new state policies designed to deal with industry changes and impacts linked to fracking operations (Rabe, 2014).

Efforts to retain state-level autonomy within a rapidly changing policy arena have largely succeeded thanks to defensive political actions taken by the IOGCC, trade groups such as the American Petroleum Institute (API) and the American Gas Association (AGA), state elected officials, Republican members of Congress, and state regulators (Warner and Shapiro, 2013). In 2005, Bush Administration officials and their allies within Congress prevented EPA from regulating water-related aspects of oil and gas fracking operations through a provision of the Energy Policy Act often referred to as the “Halliburton Loophole.” Since then, Congressional Democrats have tried (unsuccessfully) to enact the “Frac Act,” a bill that seeks to reinstate EPA’s regulatory authority under the Safe Drinking Water Act (Warner and Shapiro, 2013).

3. Environmental research and state fracking policies

Much of the literature cited here follows the path of environmental public policy research that focuses on the states as the primary units of analysis and looks to the importance of political and economic characteristics of these jurisdictions as important explanatory variables (Koniski and Woods, 2012a). The connection between economic factors and state environmental decisions is considered to be particularly important because of the belief that state policymakers may be reluctant to regulate firms that generate pollution (Koniski, 2007; Rabe and Mundo, 2007).

Since states compete for manufacturing firms and the jobs they create, industry officials will direct attention to regulatory compliance costs as one of the important factors along with tax structures and access to markets that structure facility siting choices. This presumably leads to a potentially destructive “race to the bottom” form of competition where environmental protection standards are weakened or de-emphasized by state officials in an

effort to lure jobs (Koniski and Woods, 2012b). So a key question is whether regulated firms can exercise disproportionate influence on state program decisions despite federal requirements that uniform environmental protection standards be met. In examining state policy actions, it is difficult to address constituency response to environmental mitigation efforts since public opinion is evenly divided among supporters and opponents of fracking (Boudet et al., 2014). Others suggest that states producing more oil and gas resources are quite susceptible to industry influence over regulatory decisions (Cook, 2014); however, other staunchly pro-environmental states like Vermont and New York have chosen to ban the use of fracking technologies for resource extraction purposes.

The evidence is mixed on this question when focusing on environmental policy writ large. Studies by Williams and Matheny (1984) and Woods (2006) found a link between economic dependency on regulated industries and a willingness to relax enforcement behavior. Another analysis of state regulators also concluded that enforcement attitudes were somewhat influenced by industry complaints about regulatory compliance costs but respondents were more inclined to suggest that other factors were more important in shaping actual decisions (Koniski, 2007). However, for some regulated firms, the additional costs associated with meeting pollution control requirements were offset by the corresponding reduction in regulatory uncertainty affecting longer term investment decisions (Feiock and Stream, 2001; Koniski and Woods, 2012a).

It is important to note that economic context may assume greater importance within a state’s regulatory calculus given the fixed location of oil and gas resources. However, there is precious little empirical work that directly links economic factors with state fracking policies. Case analyses of states like Texas (Rahm, 2011), Pennsylvania (Rabe and Borick, 2013) and Colorado (Heikkila et al., 2014) suggest that the “golden goose” effect is real, thus suggesting a prominent role for economically important oil and gas trade associations in pushing for industry friendly outcomes as well as the provision of generous campaign funding for pro-drilling candidates for state elective positions. Economic dependency on energy revenues derived from severance taxes is also important since higher production states can more easily deal with recessionary pressures (Rabe and Hampton, 2015).

While the economic context of a state can provide data pertaining to jurisdictional dependency and the likely importance of industry trade groups, the socioeconomic attributes of a state’s electorate such as educational attainment or family income can presumably reveal information about prospective links between constituencies and public policy. Public opinion analysts have historically found greater support for environmental protection policies among people who are more affluent and more highly educated (Jones and Dunlap, 1992) but a more nuanced examination of energy-related attitudes suggests that neither income nor educational attainment is strongly related to attitudes toward offshore oil drilling (Smith, 2002).

More recently, articles by Boudet et al. (2014) and Davis and Fisk (2014) examined the links between demographic factors and perceptions of fracking. Again, neither income nor educational attainment was significantly related to support for or opposition to the use of fracking to extract oil and gas resources. This suggests that state level rankings for income or education are unlikely to influence the enactment of fracking policies; however, it is plausible to assume that shifting contexts such as a combination of NIMBYism with a concern for property values could affect policy decisions indirectly; e.g., the rise of local opposition to drilling in close proximity to neighborhoods (Fisk, 2015).

What about the impact of political factors? Some of the more commonly scrutinized variables include various measures of

partisanship as well as ideology. Studies consistently show that factors such as Democratic control of state political institutions and the percentage of residents that self identify as more liberal are related to support for stronger pollution control measures (Jones and Dunlap, 1992; Liu et al., 2014). Among aggregate measures, I would expect to find that states with Democratic governors are more likely to favor fracking policies with environmental conditions attached; however, any such relationship can disappear or be diluted when control is divided between the legislature and the governor's office.

On the other hand, indicators of ideology or partisan identity drawn from polling or attitudinal research are less complicated when applied to the adoption or rejection of fracking policies. Recent studies have found that respondents classified as Democrats or liberals are less likely to favor use of fracking by oil and gas companies and are more inclined to place emphasis on environmental protection in relation to jobs or economic development (Boudet et al., 2014; Vedlitz, 2012). Accordingly, I expect to find that states with a larger percentage of Democrats and liberals are more likely to enact environmentally sound fracking policies.

State policy responses may be attributed to not only to general political leanings or the economic climate but to a history of concern for substantive policies such as environmental protection as well. Some earlier research focused on the state receptivity to environmental policy concerns as a dependent variable; e.g., one measure commonly used measure was Hall and Kerr's Green Index that was based on the number of environmental programs enacted within states (cited in Koniski and Woods, 2012b). A more recent green index of state environmental programs was developed by Wingfield and Marcus (2007). Other analysts have used League of Conservation Voter (LCV) scores to assess aggregate levels of support for environmental policy concerns within a state's congressional delegation (Koniski, 2007; Ringquist, 1993).

It seems plausible to expect that state receptivity to environmental concerns is related to the adoption of policies requiring that fracking be done in environmentally responsible ways. There is limited support for this expectation from a study that found a statistically significant relationship between LCV scores and the enactment of state disclosure policies for chemicals used in fracking operations (Fisk, 2013).

4. Research expectations

Based on the survey of empirical research on environmental and fracking policies, I expect to find that some factors are more likely than others to be associated with the enactment of policies designed to mitigate potential environmental harms associated with fracking operations:

1. States that produce more oil and gas are more likely to adopt environmental mitigation policies linked to fracking operations.
2. States that rely more on severance taxes as a revenue source for public programs are more likely to adopt environmental mitigation policies linked to fracking operations.
3. States with a larger percentage of self-identified conservatives are less likely to adopt environmental mitigation policies linked to fracking operations.
4. States with a larger percentage of self-identified Democrats are more likely to adopt environmental mitigation policies linked to fracking operations.
5. States that have shown prior support for environmental programs are more likely to adopt environmental mitigation policies linked to fracking operations.

5. Findings

My examination of state fracking policies is based on information sources from 20 oil and gas producing states that were subsequently analyzed by researchers at the Resources for the Future (RFF) in a 2013 report (Richardson et al., 2013). The use of statistical techniques in this paper to analyze a relatively small number of cases is justified by the concentration of oil and gas resources in these states – well over 90% (U.S. Energy Information Administration, 2013). Policies or regulations designed to protect people and communities from the unwanted impacts from fracking operations include a number of specific environmental concerns that are considered here as dependent variables – industry disclosure requirements for fracking fluids, setback requirements from drilling sites to populated structures, setback requirements from drilling sites to waterways, tracking requirements for company disposal of wastewater associated with fracking operations, and restrictions placed upon industry venting of natural gas. Since the substance of each program varied across adopting states, the most plausible way to analyze interstate differences was to classify each policy as moderate to strong, weak, or nonexistent.

The source for these factors was a report by Richardson et al. (2013) that analyzed state policy and regulatory responses to oil and gas production. Let me add that several important policies such as sealing or cementing gas wells have not been included within the data analyses since nearly all states require them or because they represent highly technical and less visible risks that rarely if ever evoke policy concerns from environmental groups or elected officials. On the other hand, the policies examined in this paper better represent fracking-related controversies since they address issues that are *politically salient* (Ringquist et al., 2003).

One of the more commonly adopted policies requires that oil and gas companies disclose the chemical ingredients associated with the use of fracking fluids to extract oil and gas resources from shale. The goal is to offer protection for individuals accidentally exposed to chemical fracking fluids by balancing a physician's "need to know" with the protection of the company's trade secrets (Centner, 2013). Other regulatory requirements likely to generate citizen interest include *minimum setbacks* for drilling sites from residential neighborhoods, populated areas such as schools, government buildings, hospitals or businesses, and water sources like rivers or lakes.

Some states also require *wastewater tracking systems* for the disposal of produced waters containing fracking fluids and naturally occurring salts that migrate to the surface from fracking operations. While this requirement is not directly linked to the process of fracking, it warrants inclusion here since wastewater disposal is not only associated with the public understanding of oil and gas drilling operations (Evensen et al., 2014) but is also found to be related to the increased incidence of seismic activity including earthquakes (Ellsworth, 2013). The main objective of this policy is to limit risks of subsequent contamination of aquifers or waterways since municipal treatment facilities are ill equipped to filter wastewater containing brine or fracking fluids.

In addition, there are *venting* requirements that address air quality and resource conservation concerns linked to the release of gas from the wellbore into the atmosphere. This happens because of leaks occurring during the drilling process (e.g., compressors) or from production in more remote areas lacking pipeline infrastructure (such as North Dakota). States may ban venting practices outright, apply restrictions or ignore the issue altogether. My final dependent variable is an *environmental protection index* that evaluates states on the basis of how many of the above policies or regulations have been enacted.

In an effort to account for between-state differences in fracking laws and regulations, I use several indicators commonly deployed by students of environmental policy as independent variables. State level policy studies often include aggregate *socioeconomic variables* obtained from decennial analyses conducted by the U.S. Census Bureau. I decided to utilize *annual family income* and *educational attainment* from the 2010 survey as representative measures. The inclusion of *economic context* in analyzing state fracking policies gets at the importance of oil and gas resources as a provider of jobs and economic stimulus as well as a key revenue source via severance taxes or impact fees for state and local government. Two variables are included – one is state *oil and gas production* using data obtained from the U.S. Energy Information Administration. The other is the amount of *severance tax revenue* generated by oil and gas firms operating within these states (Rabe and Hampton, 2015).

Third, I consider *political factors* dealing with partisanship and ideology. To assess these factors in relation to state fracking policies, I obtained data on both partisanship and ideology from the PEW Research Center (2013). One of the indicators is the *governor's political party*, a measure that may be useful in measuring the interrelation between party and an occasionally strong policymaking role for the governor although its value can be diluted by the incidence of divided partisan control between the chief executive and the state legislature. Another indicator gauges individual level support for party identification at the state level that is referred to as *democratic advantage* or the percentage of voters within a state that is classified as “democratic” or “lean democratic.” Closely related to partisan ID is *ideology*. States are ranked on the basis of voters that identify themselves as “conservative.”

I now direct attention to states that have developed fracking laws or regulations. Table 1 summarizes oil and gas production figures (U.S. Energy Information Administration, 2013). A glance at the data reveals a couple of points worth mentioning. First, oil and gas resources are not evenly distributed. “Have” states include longstanding members of the oil patch such as Texas, Oklahoma, and Louisiana as well as major energy states like Pennsylvania, Colorado, New Mexico, and Wyoming. Thus, major shale plays can be found in most regions of the U.S. other than states located in the Pacific northwest, upper New England or the Southeast. Second, a number of states show up as major producers or natural gas or oil

but not both. This suggests that levels of economic dependency and energy sufficiency vary considerably across producer states, factors that can easily contribute to differences in fracking policies.

How can we account for these differences? Correlations between state-level characteristics (Pearson's *r*) and state fracking policies are presented in Table 2. As expected, socio-economic factors are not strongly associated with policy development. Family income is weakly related to states' adoption of venting policies and the environmental protection index. Likewise, states with a higher concentration of college educated residents are slightly more likely to enact venting rules but are somewhat less likely to favor policies establishing setback requirements for buildings or wastewater tracking systems. The absence of statistically significant findings is consistent with the attitudinal research studies conducted by Boudet et al. (2014) and Davis and Fisk (2014).

The data indicate that economic context factors matter more in accounting for policy variation across states. Higher oil and gas production states are significantly more likely to enact regulations dealing with wastewater tracking systems as well as the larger set of programs subsumed within the environmental protection index. Greater production is also moderately correlated with the enactment of venting rules and chemical disclosure programs although the coefficients do not quite reach statistical significance. States benefitting from higher revenues from severance taxes or impact fees are moderately inclined to favor these programs as well.

The evidence linking political factors to the adoption of state fracking rules is mixed. Not surprisingly, the governor's political party affiliation is largely unrelated to policy development of any sort. Perhaps it may gain some explanatory relevance if researchers expand an admittedly crude measure to include more contextual information about degrees of partisan control across institutions. On the other hand, states with a greater preponderance of voters that identify as democrats or democratic leaning are significantly more likely to enact setback requirements for oil and gas drilling near buildings (a priority for environmental activists) as well as rules aimed at restricting venting practices. To a lesser degree, democratic advantage is also related to the adoption of policies tracking the disposal of wastewater associated with fracking operations.

Ideology is also an important correlate for fracking policies. Somewhat unexpectedly, the state's proportion of conservative voters are seemingly no less likely than more liberal states to adopt the more specific policies or rules other than laws tracking wastewater disposal. However, a more conservative stance among producer states is negatively but significantly related to the larger environmental protection index. Thus, findings for both democratic advantage and ideology dovetail fairly well with research by Vedlitz (2012) and Boudet et al. (2014).

Finally, I examine the role played by a state's historical receptivity to environmental programs. While the aggregate LCV scores of a state's congressional delegation have occasionally worked well as an environmental indicator in other studies, it is unrelated to any of the fracking policy measures. It is conceivable that for this type of policy, federal voting scorecards are not especially useful for interpreting state regulatory decisions. However, the more direct record of state environmental policy-making does not work particularly well either although it is significantly related to state enactment of venting rules. One limitation for using cumulative indices based on the number of environmental laws enacted is that authors may differ in the selection of policies or rules that others may regard as meaningless or irrelevant.

Turning now to the bigger question of which factors shape state environmental protection policies, three factors stand out—the

Table 1
State Oil and Gas Production in 2013.

	Oil Production (000 barrels)	Gas Production (mmcf)
Arkansas	565	1,146,168
California	17,236	246,822
Colorado	5509	1,709,376
Indiana	196	8814
Kansas	3749	296,299
Kentucky	254	106,122
Louisiana	6117	2,955,437
Michigan	682	129,333
Mississippi	1986	63,843
Montana	2102	66,954
New Mexico	8667	1,215,773
North Dakota	28,620	179,004
Ohio	649	84,482
Oklahoma	9462	2,023,461
Pennsylvania	491	2,256,696
Tennessee	22	5825
Utah	3099	490,393
Virginia	1	146,405
West Virginia	354	529,860
Wyoming	5270	2,022,275

Source: U.S. Energy Information Administration.

Table 2
Correlates of State Fracking Policies Designed to Preserve Environmental Quality.

	frack fluid disclosure	setbacks bldgs.	setbacks water	wastewater tracking	venting rules	enviro pro-tection index
Socioeconomic factors						
family income	0.14	0.13	0.00	0.12	0.25	0.27
college education	0.00	0.26	0.12	0.24	0.25	0.07
Economic context						
oil & gas production	0.28	0.04	0.17	0.39	0.28	0.45
severance						
tax	0.37	0.04	0.06	0.30	0.30	0.34
Political factors						
% conservative	0.22	0.10	0.19	0.33	0.04	0.36
democratic						
advantage	0.00	0.44	0.18	0.30	0.47	0.13
governor's pol party	0.00	0.14	0.14	0.25	0.22	0.06
Environmental policy support						
enviro policies enacted	0.00	0.23	0.06	0.20	0.43	0.20
LCV score	0.07	0.16	0.17	0.07	0.04	0.19

percentage of self-identified conservatives, severance taxation rates imposed on oil and gas firms, and the actual amount of oil and gas production. All are moderately associated with the state adoption of environmental mitigation policies. When these factors are regressed on the environmental protection index, the explanatory importance of the ideology variable remains high; i. e., less conservative states are more inclined to enact pro-environmental policies (see Table 3).

But the economic factors that remain are intercorrelated; hence, it is not surprising that only one would retain some ability to account for state policy differences. The data indicate that the more important economic source policy-wise is severance tax rate, an indicator that is more directly linked to programs that address environmental impacts. Thus jurisdictions with higher severance taxation rates and fewer conservatives produce a higher degree of environmental protection ($R = 0.56$), explaining 19% of the variation across oil and gas producing states.

6. Conclusions

This research goal in this paper is to provide a preliminary assessment of state policies designed to mitigate potential environmental harms associated with fracking operations. Less than half of U.S. states are significantly involved in the use of fracking technology to extract oil and gas resource from underground shale deposits and most production output can be attributed to the ten leading states. That said, states vary in terms of how fracking-related environmental risks are addressed. It is important to note that variation in state policymaking is *somewhat* dampened at the outset by the efforts of the IOGCC to recommend

Table 3
Effects of Economic and Political Factors on State Adoption of Environmental Mitigation Policies Linked to Fracking Operations.

Factors	B ^a	Standard Error
% Conservative	0.50	2.18
Severance tax rate	0.55	2.34
Oil and gas production	0.09	2.23

Multiple $R = 0.56$, $R^2 = 0.31$, Adjusted $R^2 = 0.19$, Standard error = 5.83.

^a Regression coefficients.

guidelines for the development of state regulatory programs. But differences remain and can be attributed largely to the economic context of fracking states and to state-level political factors.

State-level political party and ideological indicators tell us why some states are more receptive to environmental protective measures linked to fracking. States with a higher percentage of voters identifying as conservative are less likely to enact protective regulations while the opposite is true for states with a greater share of democratic voters. These findings suggest that using surveys and attitudinal studies to assess the partisan and ideological orientation of a state may have some carryover effects when examining how and why fracking policy decisions are made by elected officials and regulators.

The economic importance of a state's revenue stream also contributes to a better understanding of why states favor efforts to mitigate fracking-related environmental risks. States that receive revenue from severance taxes and impact fees are moderately receptive to policies dealing with chemical disclosure, wastewater tracking and venting restrictions as well as the general index of environmental protection.

What can we say about the compatibility of state fracking policy research findings with the literature on environmental policy-making? The findings presented here suggest that the importance of both economic and political variables in accounting for the enactment of regulations to deal with fracking-related risks does resemble research dealing with state environmental protection policies (Koniski and Woods, 2012a) as well as related areas such as renewable energy (Vachon and Menz, 2006; Lyon and Yin, 2010). However, one important point of departure for an evaluation of both fracking and renewable energy policies in relation to general environmental laws is the general absence of federal oversight or influence in state policy decision-making dealing with energy issues.

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