

Chapter 4:

What does the punctuated equilibrium theory predict for hydraulic fracturing?¹

INTRODUCTION

Punctuated equilibrium theory (PET) suggests that policy change is preceded by new policy images and issue definitions (Baumgartner and Jones [1993] 2009). The origin of new policy frames includes real world events (e.g., natural disasters) and efforts by stakeholders to infuse new ideas and policy definitions into longstanding policy debates. The effect of changing or shifting issue definitions, facilitated by the media's coverage of these new frames, is to mobilize and change public and elite perceptions and policy positions, penultimate to the adoption of new policy. Research has demonstrated the accuracy and breadth of PET in accounting for policy change (see Jones and Baumgartner 2012) in the U.S. and in comparative settings. Combine with opening paragraph.

What is not fully appreciated and empirically understood are the relationships between key exogenous variables in PET and how they explain policy change. Implicit in PET is that a consensus among key stakeholders regarding the policy image must emerge around a single (set) of policy positions before policy change can occur.² Yet, we wonder if different policy images can prevail for similar if not identical policy positions among different stakeholders? Can stakeholders 'agree to disagree' about why they prefer the same or similar policies? Does consensus on policy image and issue positions

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² Baumgartner and Jones note that this change in policy image is not always evidenced in public opinion (Baumgartner forthcoming; note 3, p. 7).

have to precede policy change? The practical implication of this question directs attention to the concept of compromise in the policy making process; an anemic condition in contemporary U.S. politics.

In this paper we offer a nuanced explanation for how diversity of policy images among stakeholders might enhance policy change. Like Baumgartner and Jones ([1993] 2009) the focus of our empirical investigation is a case study, specifically of hydraulic fracturing. Unlike other case studies of PET, hydraulic fracturing is not a yet a settled policy and continues to be debated at the national, state and local levels. Consequently our empirical investigation is limited to identifying the preliminary conditions that are penultimate to predicting policy change on hydraulic fracturing using the punctuated equilibrium model.

Our paper is organized as follows. In the next section we briefly reprise the punctuated equilibrium theory identifying in more detail elements/variables of the model and their relationships as discussed in extant literature. We specifically set out our expectations about how policy change might be predicted for the issue of hydraulic fracturing. Section three details the research design, methods and measures for studying policy change on hydraulic fracturing. Section four introduces the case of hydraulic fracturing and identifies the relevant stakeholders, policy images, policy positions/tones and policy adoptions for the period 2008-2012. We report our findings about that might predict policy change on the issue of hydraulic fracturing in section six and conclude with a discussion about future research.

A BRIEF REPRISÉ OF THE PUNCTUATED EQUILIBRIUM THEORY

Baumgartner and Jones ([1993] 2009; 2012) and others who have applied punctuated equilibrium theory to the study of public policy have identified several key factors that together structure the dynamics of policy change and explain why the status quo is the predominate condition for most public policies. The expectation is that the adoption of policy change (i.e., non-status quo policy adoption) occurs when several conditions are in alignment. These conditions concern the number of prevailing policy images and the number of engaged stakeholders.

Policy image refers to “how a policy is understood and discussed (Baumgartner and Jones 2009, 26).” More precisely policy image defines the the empirical conditions of the problem the policy will address (i.e., its causes and solutions)along with an evaluative component. The evaluative component refers to the *tone* of the policy, that is, whether the policy has a positive or negative effect signaling support or opposition, respectively, for the policy from those advancing the policy position. For example, nuclear power after the Second World War was positively framed in terms of a low cost, safe energy source associated with economic progress. After notable events associated the commercial application of nuclear power including *Three Mile Island* in 1979 and damage to Japanese nuclear reactors after the Tsunami of 2011, nuclear power became “associated with danger and environmental degradation (Baumgartner and Jones 2009, 27).” Generally opponents and supporters of the same policy position espouse different if not competing images.

Policies will differ in the degree to which a single image is well accepted by all. In some cases, there is virtually no disagreement about the social or political implications of a given policy, while in other cases there may be considerable conflict over the proper way to describe or understand it (Baumgartner and Jones 2009, 26).

Conflict over policy images is indicative of a policy arena with competing views and policy positions. Punctuation occurs most often when one policy image dominates all others by acquiring the attention and adherence of a significant majority of stakeholders and policy makers, sufficient to adopt new non-status quo legislation. Policy images acquire their dominance through the advocacy of stakeholders who rely on the mass media to assist in setting a policy agenda through the intensity of news coverage (Waste 1990; Weart 1988). Baumgartner and Jones document a strong positive relationship between policy change and spiked increases over time in media coverage of new policy images.

What would the dynamics and properties of policy look like if policy images had a relatively flat distribution, one without any dominate and modal policy image between polar policy positions? We suspect that this distribution of policy images and tones might provide greater opportunities for policy compromise even in the face of many and divergent policy images. Moreover, we would not expect to observe parallel and counterproductive policies as observed for policies like tobacco (Baumgartner and Jones [1993] 2009).

Could multiple policy images related to policy choices even across multiple venues be sufficient to motivate the adoption of a new, non-status quo policy? The intuitive answer to this question is no and depicted in Figure 4.1. Here, bipolar policy images occupy opposite ends of the policy continuum. Moreover, the policy choices associated with these divergent policy images corresponds with the same bipolar distribution of policy images. This condition closely resembles U.S. policy on tobacco for most of the mid-20th century. Other notable examples of this type of policy condition include U.S. slavery

policy throughout the 18th and 19th century, culminating in the U.S. Civil War and current U.S. abortion policy. All these policies produced non-compromising policy stalemates.

Figure 4.1
Bipolar Distribution of Policy Images - Policy Predicted Not to Change

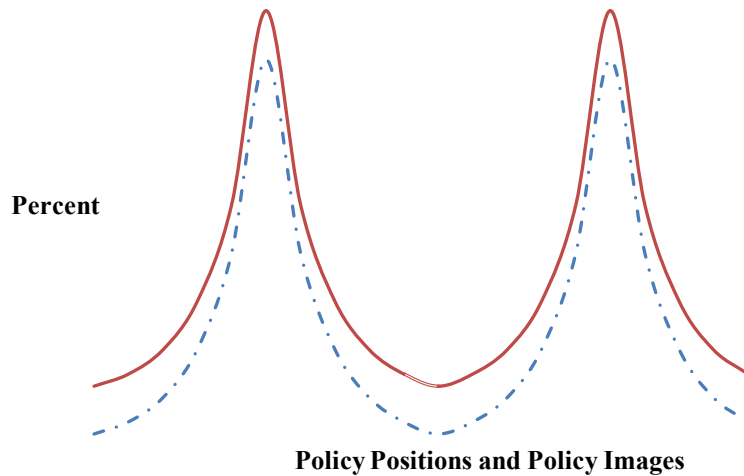
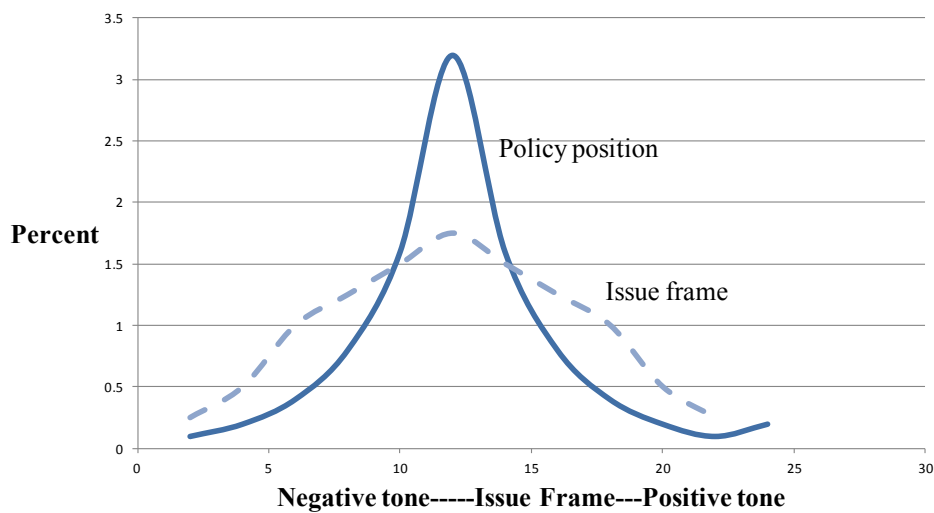


Figure 4.2 depicts a different distribution of policy images and tones. Policy tones/positions are single peaked between two extremes, yet the distribution of policy

Figure 4.2
Single-Peaked Distribution of Policy Images – Policy Predicted to Change



images is much flatter and supports a wide range of policy positions. We suspect this condition might promote policy compromises across a range of policy choices, in part

because of supporting policy images for many modestly different policy choices. One reason policy preferences are singled peaked may be that many different policy images can support a narrow range of policy choices.

RESEARCH DESIGN, MEASURES AND DATA SOURCES

Consistent with previous research on punctuated equilibrium models of policy we have relied on newspaper accounts of hydraulic fracturing to study this policy debate over hydraulic fracturing. While one could survey interest groups directly to capture their issue positions and policy goals, we assume that the journalists have been thorough and accurate in their coverage of the stakeholders and the debate over policy options. Even if any particular journalist or news outlet were biased toward any interest group or policy option, our dataset includes a sufficient number of newspapers, stories and journalists to reduce this error. Moreover we use newspaper articles because it is expected from the punctuated equilibrium theory that news coverage is the chief medium through which elites and policy makers seek to inform and shape public opinion penultimate to policy adoption.

We expect news coverage of hydraulic fracturing, including the issue frames and policies advanced by different stakeholders, to vary significantly over time. Specifically, we expect to see a monotonically increasing incidence of news stories on this issue, both nationally and in regions where significant deposits of natural gas exist and where hydraulic fracturing is being used to extract gas deposits. Moreover we expect that the distribution of issues frames and policy positions advocated by different participants will signal the likelihood of policy adoption per Baumgartner and Jones ([1993] 2009).

Though it may be premature to predict policy adoptions from these data, we can identify whether the distribution of issues frames reported in the news is indicative of a consensual or competitive environment.

Our empirical analysis is based on a dataset that includes all news articles in selected newspapers that mentioned hydraulic fracturing for the period January 2008 and July 2013. The newspapers include four major national newspapers (i.e., *New York Times*, *USA Today*, *Washington Post*, and *Wall Street Journal*) and 16 regional papers in states with significant shale gas deposits and hydraulic fracturing operations.³ Using LexisNexis, we identified news articles that included the terms “hydraulic fracturing” and variations of this phrase.⁴ We identified a total of 3,821 news articles in our sample of 20 national and regional newspapers for the study period January 2008 thru June 2013 (see Table 4.1).⁵

To measure the issue frames, policy positions, venues and stakeholders reported in each news story we employed *ReadMe*, an automated machine content analysis program (Hopkins and King 2010; Hopkins n.d.).⁶ *ReadMe* takes a set of text documents, in our case, news stories, to compute the proportion of documents in each category defined by the user. The categorization scheme is defined by a small subset of documents hand coded by the user. Utilizing such “training sets,” *ReadMe* estimates

³ Regional newspapers include Denver Post (CO), Salt Lake Tribune (UT), Wyoming Tribune-Eagle in the West (WY), Charleston Gazette (WV), Dayton Daily News (OH), Detroit News (MI), Pittsburgh Post-Gazette (PA), Richmond Times Dispatch (VA), Plain Dealer (OH), and Roanoke Times (VA) in the Northeast, and Arkansas Democrat-Gazette (AR), Daily Oklahoman (OK), Dallas Morning News (TX), Houston Chronicle (TX), Odessa American (TX), and San Antonio Express-News (TX) in the South. See also Appendix Table 1

⁴ Variations on hydraulic fracturing searched for included: “hydraulic fracturing,” “hydraulic fracing,” “hydro fracturing,” “hydro hydraulic fracturing,” “hydro fracing,” “hydraulic fracturing,” and “fracing.”

⁵ Because of the paucity of articles mentioning hydraulic fracturing prior to 2008, we truncated our observation period to between January 2008 and June 2012.

⁶ <http://gking.harvard.edu/readme> Daniel Hopkins and Gary King, A Method of Automated Nonparametric Content Analysis for Social Science, *American Journal of Political Science*, 54, 1 (January 2010): 229–247.

Table 4.1
Newspapers by Region (# of Articles)

Newspaper	# Articles	Region
Arkansas Democrat-Gazette	139	South
Daily Oklahoman	256	
Dallas Morning News	177	
Houston Chronicle	498	
Odessa American	22	
San Antonio Express-News	156	
Charleston Gazette	346	Northeast
Detroit News	31	
Pittsburgh Post-Gazette	521	
Richmond Times Dispatch	19	
Roanoke Times	25	
The Plain Dealer (Cleveland)	162	
Dayton Daily News	90	
Denver Post	281	West
Salt Lake Tribune	28	
Wyoming Tribune-Eagle	72	
New York Times	371	National
USA Today	41	
Wall Street Journal	428	
Washington Post	158	
Total	3821	

within normal sampling error the proportion of the documents that are dedicated to each of the defined categories.

It is important to note that we do not assume that each news article addresses a single policy image, stakeholder, or policy position. When reporting on public policies journalists often refer to multiple frames, stakeholders, tones and policy options in the same article. Paragraphs of articles frequently present the same hurdle. This problem can be solved by analyzing/coding new story sentences.⁷ Unlike hand coded analyses of news stories employed in previous research, the automated coding method allows us to identify multiple categories of our measures (i.e., issue frames and venues) in the same

⁷ A sentence also could include multiple mentions of frames, etc., especially in long, compound sentences, but which rarely appeared to do so.

news story. Consequently, the *ReadMe* software codes each sentence of a story producing a dataset made up of over 100,000 sentences from the 3,821 articles over 66 months (January 2008-June 2013). We aggregate the sentences into sets by month and newspaper (by month and region for some tests), which *ReadMe* examines to estimate the portion of sentences that fall into each category of policy images and tone. The final dataset obtained from the *ReadMe* reports the proportions (or estimated probabilities) that a certain policy image and tone appear in the newspapers surveyed in each month.

To determine the categories for our training documents, we initially consulted two sources, one assumed to be positive towards hydraulic fracturing, published by American Petroleum Institute, a trade organization representing the oil and gas industry and the other a position paper on hydraulic fracturing issued by Greenpeace and other environmental organizations critical of procedure. From these two documents we identified 16 different policy images. We later refined those 16 images into nine based on both cluster analysis of the grouping tendencies of those images and on more in-depth reading of the newspaper coverage of hydraulic fracturing. Figure 4.3 depicts the final nine policy images, which are described in detail in the next section.

Our next step was to hand-code a set of sentences for each category of issue frame. We used sentences from the New York Times for the hand-coded training set since it is representative of news coverage in a national paper and local newspaper adjoining a shale gas producing region.⁸ We picked sentences published at the initial,

⁸ The validity of the automated coding into the designated categories is based on the assumption that “the documents in the hand-coded set contain sufficient good examples of the language used for each document category in the population” (Hopkins and King 2010, 237). We are confident that the terminology used in discussions about hydraulic fracturing have not changed or evolved in the time period of our observations. We have observed that the language used to refer to the different frames, stakeholders, venues and to reflect tone has been near constant since 2004 until now.

middle, and the most current period of the study and coded each sentence for policy image (840 sentences) and tone (678 sentences). To make our categorization mutually exclusive, we also coded 342 sentences representing “no relevant image or tone.”⁹ Based on Hopkins and King (2010, 242), this quantity of training set documents should be sufficient to remove any coding bias.¹⁰

THE POLICY IMAGE OF HYDRAULIC FRACTURING:

At its essence, hydraulic fracturing is a drilling technique. When hydraulic fracturing, drilling companies pump a mix of water, sand and chemicals at high pressure into rock pores deep underground to break open the rock so that more oil and natural gas can be recovered. Though the procedure has a long history in the energy field its wider usage dates from 1998 when the procedure was refined and made possible the economical extraction of shale gas. Hydraulic fracturing provides a useful context for studying punctuated equilibrium theory because it is susceptible to policy monopolies and disruptions. In his classic article “Up and Down with Ecology,” Anthony Downs (1972) argues that public attention to political issues typically follows a cyclical pattern if the issue possesses three characteristics: (1) It’s a minority issue: the majority of persons in society are not suffering from the problem nearly as much as some minority; (2) it’s benefits are diffuse dispersed: the issue provides significant benefits to a majority or a powerful minority of the population; and (3) not a valence issue: the problem has no intrinsically exciting qualities. (1972:41). While the *status quo* policy equilibrium on

⁹ We do not report on these “no relevant image or tone” categories, but 95% of the observations of no relevant image ranged between 3.6% to 36.7% of the sentences in a given newspaper in a given month. The corresponding range for no relevant tone is between 0% to 42.1%.

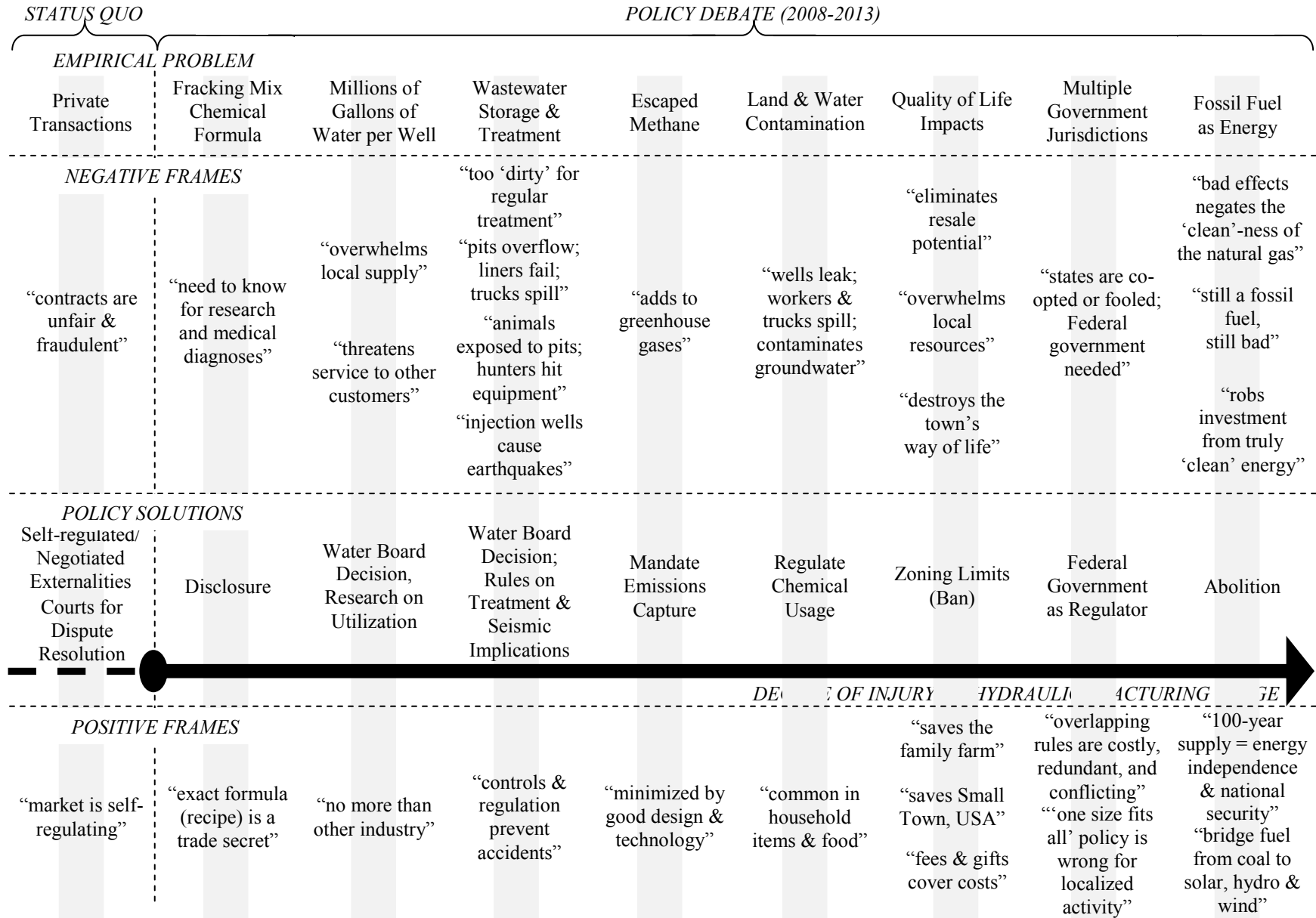
¹⁰ Hopkins & King (2010), find that 500 sentences are sufficient to remove coding bias from the subsequent automated coding.

hydraulic fracturing generally consists of private contracts (leases) between drilling companies and landowners under existing state laws on drilling and environmental protection, policymaking on hydraulic fracturing is very much not settled due the externalities associated therewith, and continues to be debated at the national, state and local levels. Central to the Baumgartner and Jones theory is their concept of a policy image, which is the narrative that connects the empirical facts about a real-world problem (i.e. issue) to a possible government solution, couched in “core political values which can be communicated directly and simply through image and rhetoric” (2009, 7). This section will describe the various policy images surrounding hydraulic fracturing, detailing the empirical facts about it, the political values or and the government solution or policy option advocated. Figure 4.3 visually depicts this discussion.

Profit, Fairness and Regulation of Market Transactions (Status Quo)

The decision regarding hydraulic fracturing is primarily a private one, which is to say the government needs not be involved; this describes the prevailing status quo policy equilibrium on hydraulic fracturing. It is the drilling company that decides to employ the technology. Because the resource to be extracted using hydraulic fracturing is far underground it, it has no owner per se; so the drilling company is not hindered a priori by this fact. However, the drilling equipment is installed and operated at the Earth’s surface, and someone, typically a private individual, owns that territory and the rights to the minerals below it. The transaction between the drilling company and the landowner by which the former buys or leases the land, the permission to drill, and the resources extracted from the latter is characterized by market dynamics, into which each party willingly entering and attempting to maximize their benefit. This private transaction is

Figure 4.3 – Policy Images of Hydraulic Fracturing



typically very rewarding to both parties, especially the landowners, which helps explain the explosion in hydraulic fracturing activity since the early 2000s. There are many news stories that could be headlined “Hydraulic fracturing saves the family farm” in that they describe how hydraulic fracturing allows rural landowners who are struggling to make a living from agricultural or other uses of their land to be able to enjoy a comfortable living off of the proceeds from their hydraulic fracturing leases.

Like all market activity, there is some room for government regulation of the transaction between drilling companies and landowners, especially in light of the information asymmetry between the two parties. Particularly, there have been complaints from landowners that they were bound to unfair practices through the use of deliberately obtuse language in leasing contracts or that drilling companies took unfair advantage over landowners’ lack of information about hydraulic fracturing in general. These landowners appeal to values of fairness and negative images of “big business” taking advantage of the “little guy”, and have used the courts and their Attorneys General for permission break leases and enter renegotiation. The situation changes only slightly when the government is itself the landowner, like in the case of state and national parks. In those situations the government is inherently involved, but the dynamics of the transaction remain generally unchanged.

Disclosure, Research on Contamination, and Trade Secrets

Many groups are contesting to know the exact content and quantity of chemicals that are added to the water in a fracturing operation. Water comprises the bulk of the fluid mixture in a fracturing operation; the remaining < 1% of the mixture may include chemicals that are toxic to humans and animals in direct contact. Scientists and activists argue that information about these

chemicals is needed in order to more conclusively test for any soil, water or air contamination. Doctors and activists argue that the information is needed in order to better treat patients they suspect have been sickened through exposure to these chemicals. Drilling companies have been reluctant to release the information, however, especially the actual proportions of each chemical. They argue that such information is a trade secret, and that the public disclosure of that information would be the equivalent of handing its winning recipe over to the competition.

The government solution to this lack of information is to mandate that drilling companies disclose that information. Yet there are important variants on this mandate. The first regards whether companies can disclose only the chemicals used or whether they must disclose the actual proportions of those chemicals. Another variant deals with the timing of the disclosure, whether it should occur before operations begin or after drilling is completed. A third variant relates to who would have access to the disclosed information. Pennsylvania, for example, exempts drilling companies from revealing trade secrets, except when requested by a doctor who is treating a patient that may have been exposed to chemicals; the doctor must not divulge what they learn. A final variant deals with where that registry of information must reside. The oil and gas industry voluntarily began to disclose the identity of chemicals the use on the industry website, FracFocus.org. The Department of the Interior has been considering the establishment of its own registry for drilling allowed on Federally-owned land.

Water Regulation, Wastewater, and Contamination

Water is the principal ingredient in the mixture that is pumped underground and cycles back to the surface during hydraulic fracturing operations. Each well will use millions of gallons of water, which comprises over 99% of the fluids used, with a portion of that fluid remaining in

the well permanently, being irretrievable. The remaining < 1% of the fluid mixture includes chemicals of types known to cause harm to humans and animals. These chemicals are damaging by themselves and remain damaging once mixed with the water. Also, when the water cycles back up during drilling operations, it can carry with it naturally-occurring radioactive material, which makes the water even more potentially damaging. The wastewater—water that has completely cycled through the entire hydraulic fracturing process—cannot be returned safely to the water supply without undergoing a level of treatment or clean-up that is more sophisticated than the level generally provided at water treatment facilities. Other disposal options include storing the wastewater in open air pits constructed onsite, allowing the water to evaporate, leaving behind the chemicals. Another option is to store permanently the wastewater deep underground in injection wells. Emerging technology also is enabling the recycling of wastewater so that it could be re-used in other wells.

The fact that hydraulic fracturing requires such a vast quantity of water motivates a controversy over the supply of this water. It is easiest for a drilling company if the water can be obtained from the water authority local to the well site. However, some worry that hydraulic fracturing's demand for water may overwhelm the local authority, threatening its service to other customers, especially if the area is subject to drought (San Antonio Express News 7/3/11). Some also worry that the water that hydraulic fracturing takes from the local supply will not return to the local supply, since some water is irretrievable from the well and the rest may need to be taken out of the area for treatment if the local water authority is incapable of doing so (Houston Chronicle 2/1/12). It is harder for a drilling company if the water needs to be transported from a location distant from the well site, at least in terms of the added costs. Even this practice is not

without its detractors, however, who object to the amount of wear and tear that the additional truck traffic puts on the roads (Arkansas Democrat-Gazette 7/24/11).

A primary concern of environmental advocates is the numerous ways that humans and wildlife could be exposed to the chemicals that are part of hydraulic fracturing operations. During operations, workers might simply spill some of the chemicals onto the ground. Heavy rains and flooding could cause the wastewater storage pits to overflow onto the ground. If not physically barred from doing so, animals could come into contact with the wastewater pits. Also, the liners in the pit separating the water from the ground below could fail.

The use of underground injection wells to permanently store the hydraulic fracturing wastewater is also problematic. These disposal wells have been linked to seismic activity in Arkansas (Arkansas Democrat-Gazette 7/27/11 & 3/15/12), Ohio (New York Times 3/10/12) and northwestern England (New York Times 10/22/11). Interestingly, most research to date successfully ties earthquakes to disposal wells, while concluding no link between earthquakes and the wells that produce or extract oil and natural gas (Houston Chronicle 1/23/12).

The policy options to deal with these water, contamination, and seismic externalities of hydraulic fracturing stop short of amounting to the abolition or outright ban on hydraulic fracturing. Instead, they represent compromises regarding the supply of water and the disposal of wastewater. Local government level water authorities typically are the decision makers on whether the locality can accommodate the water demands and/or wastewater treatment of local hydraulic fracturing operations, though some state regulators have participated in research on water use demands of hydraulic fracturing relative to competing users (Houston Chronicle 11/14/11). Any government actor, or even the drilling company and landowner in their negotiations, could order the use of storage tanks rather than open air pits to temporarily store the

hydraulic fracturing wastewater, though this represents a greater expense to the drilling company. States, like Pennsylvania, have banned the use of injection wells, which led companies drilling in that state to place its injection wells in the neighboring state of Ohio, where some seismic activity has occurred. Contamination concerns motivate many localities to attempt to affect where wells are located. They pass restrictions, typically zoning laws, intended to keep drilling sites away from sensitive areas or high-density populations like bodies of water and schools, so that if contamination does occur, the harm to humans or wildlife would be limited.

Air Quality and Emissions Capture

Wells where hydraulic fracturing is used have the potential to leak natural gas, whether drilling for natural gas or for oil. Studies have estimated the rate of leaks to be 2%-6% of the volume of the resource extracted, be it oil or natural gas. Most of the emissions is methane, “a potent, heat-trapping gas, 20 times more powerful in its affect on the atmosphere than carbon dioxide” (New York Times, 4/9/12). For dealing with this externality, it is easiest for the drilling companies to ignore potential leaks, or to siphon and burn off (a.k.a. flare) the natural gas that would otherwise escape. Technology allows for both the minimization of leaks through better well design and the capture of gases that nevertheless escape during production. While capturing emissions does carry a cost, the sale of the captured emissions can constitute another source of revenue for the drilling company.

Landowners, residents and government officials at all levels have expressed concern about or passed regulations related to hydraulic fracturing operations’ contribution to air quality. The Environmental Protection Agency issued rules in April 2012 requiring drilling companies to install capture equipment, referred to as “green completion” equipment, on all wells by January

1, 2015. Other policy options include mandating construction standards that would minimize the potential for leaks.

Regulatory Treatment Meets Federalism

Drilling companies are facing a political landscape where governments at the federal, state and local levels are each, independently considering regulating hydraulic fracturing in some way. The federal nature of the U.S. system of government allows multiple governmental bodies at multiple levels to exercise jurisdiction simultaneously over the particular parcel of land where the well is located. The disparate nature of the externalities of hydraulic fracturing adds to the potential regulatory complexity. Each of these externalities pertain to distinct areas of policy—from fraud to land use to water regulation to air quality to disclosure—which are often governed by separate, single-purposed governmental bodies. Lastly, governments are in the hydraulic fracturing business not only to resolve disputes over the externalities of hydraulic fracturing, but also as landowners. Much hydraulic fracturing activity occurs on state and federal public lands, which give those entities—a notable one being the U.S. Department of the Interior—jurisdictional authority to impose whatever regulations they deem appropriate.

The companies argue that the imposition of so many layers of permitting and regulation would cripple their industry. The drilling companies would prefer to maintain the status quo, which is to have hydraulic fracturing continue to be regulated primarily by state government, typically by an executive agency with jurisdiction over natural resource development. Even as concerns have arisen about the many externalities, drilling companies have continued to assert that the state (agency) regulators are sufficient guardians of the public interest; that they have the most expertise relevant to the particulars of the companies and geology in their geographic area. Anti-hydraulic fracturing activists, some holding public office, have argued that the Federal

government needs to establish national standards for hydraulic fracturing. The years 2011 and 2012 have witnessed many efforts by the Environmental Protection Agency to inject itself into the regulation of hydraulic fracturing. These activists hold that states are outmaneuvered or co-opted by drilling companies, and that federal legislation would force the drilling companies to internalize the costs of hydraulic fracturing's externalities. Drilling companies counter that a one-size-fits-all pattern is ill-fitted to an activity whose contours change with the terrain; that federal standards would appeal to the lowest common denominator in given areas, resulting in unnecessary costs for each given drilling operation (San Antonio Express News 1/26/12). Some anti-hydraulic fracturing activists have targeted downward on the federal ladder by appealing directly to local governments, attempting to use the various powers of government bodies at that level—especially zoning laws—to regulate or eliminate hydraulic fracturing “in their backyards”.

Economic Growth, Carbon-Based Energy, Land Use and Abolition

Hydraulic fracturing as a private, market transaction is the “state of nature” which government intervention would seek to modify through policy. Hydraulic fracturing shifts from being a purely private issue to becoming a political issue once one begins dealing with the large number of externalities hydraulic fracturing produces. While these other externalities appear to argue against the use of the practice, another externality—the economic benefit to the towns where hydraulic fracturing occurs—provides incentive for actors not directly involved to yet favor the use of hydraulic fracturing. Just as some landowners do better financially after signing leases, advocates hail hydraulic fracturing as saving small town U.S.A. in that the towns where these landowners reside are benefitted by the new tax revenue and spending of these landowners. For example, *The New York Times* reported that Dimmit County, Texas, due to the increase in

hydraulic fracturing activity, saw its unemployment rate fall in half and sales tax receipts increase by 70 percent from 2010 to 2011, such that the county could hire more police officers and buy sanitation and road repair equipment. It also claimed that thanks to increased drilling activity, “the recession bypassed North Dakota entirely” (New York Times 5/28/11).

Activists complain about the growth hydraulic fracturing brings to town based on the notion that hydraulic fracturing destroys the town’s way of life. They consider hydraulic fracturing to be incompatible with growth from other industries that needs to use the land in other ways, particularly farming, hunting, and tourism. All property owners may be hurt to the extent that their property values drop due to fracturing operations decreasing the aesthetic appeal of the area, typically by clearing away trees and operating with lights and noise throughout the night. Farming is harmed when those in the organic food industry ban the inclusion of produce from or near lands where drilling is taking place. Also, farmers may be harmed or when previous sources of financing refuse to extend loans to landowners who lease their land for drilling, which the Rural Housing Service and the Rural Business and Cooperative programs of the U.S. Department of Agriculture chose to do in March 2012. Fracturing operations often are tucked among terrains where hunters search for wildlife, which brings the risk of gunshots from hunters accidentally hitting workers and equipment.

Another controversy regarding the growth brought by hydraulic fracturing is the strain such growth puts on the infrastructure of the town. Drilling companies use an immense quantity of truckloads to transport hydraulic fracturing materials to and from the well site. Local roads may be ill equipped to handle such traffic (San Antonio Express News 3/29/12). The housing stock of some towns has also been unable to absorb the temporary housing needs of company workers. Some therefore argue that hydraulic fracturing does more harm than good in that the

economic benefits to the areas around hydraulic fracturing well sites may be outweighed by the immediate and long-term economic costs to be borne.

Another not-very-controversial externality of hydraulic fracturing is the energy and environmental utility of the natural gas extracted. The amount of natural gas that can be extracted by hydraulic fracturing from U.S. reserves is so large that the industry often calls it a “100-year supply” of energy. According to research by Dr. Scott Tinker, a geology professor at the University of Texas at Austin, among the carbon-based materials used for energy, natural gas poses the least threat to the environment while providing the second-most energy bang per investment buck. In terms of energy source, only coal provides a greater yield of energy per investment, but does much more harm environmentally. Drillers and some environmental activists, therefore, argue that the natural gas extracted by hydraulic fracturing can be the “bridge fuel” between environmentally damaging fuel sources like coal and environmentally benign sources like hydro, solar and wind. Nevertheless, some environmentalists oppose natural gas because it is a carbon-based energy source and, thus, still harmful to the environment, at least more so than non-carbon-based sources. Plus, they argue that hydraulic fracturing keeps us from clean energy, contending that it would be better to direct the resources now invested in natural gas extraction towards those even cleaner sources of energy to increase their energy yields.

The policy options most associated with the controversies over the economic and energy benefits due to hydraulic fracturing are policies that seek to abolish hydraulic fracturing, or at least abolish it in certain places. “Good” hydraulic fracturing, which might mitigate the potentially harmful effects of hydraulic fracturing, is not sufficient for those wanting to shift investment from hydraulic fracturing into non-carbon energy, to shift land use from hydraulic fracturing to farming, hunting or tourism, or even to stop the lease/sale transactions between

drilling companies and landowners. Their outcomes can be achieved only by the abolition of hydraulic fracturing activities, which they hope to accomplish through the use of government authority. These include outright bans on hydraulic fracturing, as well as temporary moratoriums, debated primarily at the state level. Local governments use bans and moratoriums also, where state laws allow, but most typically use zoning and other land use policy options to achieve the same effect.

Hydraulic fracturing: A Multi-Dimensional, Non-Zero Sum Issue

The use of hydraulic fracturing does not have to come at the expense of human and environmental health, nor does protecting health make extraction unprofitable. This means that the policy outcomes don't need to devastate any particular interest. In fact, there are many stakeholders advocating similar policies but for different reasons. For example, if you're on a local water board, you care mainly about water supply issues, but if you're a user's rights advocate you care about clean drinking water, and the state seismologist cares about the earthquake activity. Similarly, looking at three policy alternatives: the drilling company (1) stores its wastewater to be recycled through its wells; (2) buying water locally and cleaning it before sending it into the local system; and (3) trucks in water and trucking out wastewater to be treated elsewhere. The water board can support all but (2) using the local water system, since some water is inevitably lost in the process, thereby depleting the local supply. The user's rights group favors all but (3) the trucking of water since trucking accidents can spill chemicals into local drinking water supplies. The seismologist favors all but (1) the storing of water and materials, since research shows that storage tanks, not drilling, are associated with increased seismic activity. So, a frame can lead a group to support more than one policy alternative.

The non-zero nature of hydraulic fracturing, coupled with the dispersed impact of its externalities, means that to make *a decision* on hydraulic fracturing is really to make *many decisions* on many different policy dimensions. Hydraulic fracturing is multi-dimensional in nature. On its face, punctuated equilibrium theory appears to predict that no change or direction in policy would be made under such conditions, primarily because the multiple dimensions would hinder, if not preclude, the emergence of a consensus or of some sort of “grand compromise” among policymakers along any particular policy dimension. But is that truly the case? How likely is consensus to emerge for multi-dimensional issues? How much consensus is necessary and sufficient for policy change to occur? The analysis below of the debate surrounding hydraulic fracturing offers answers to those questions.

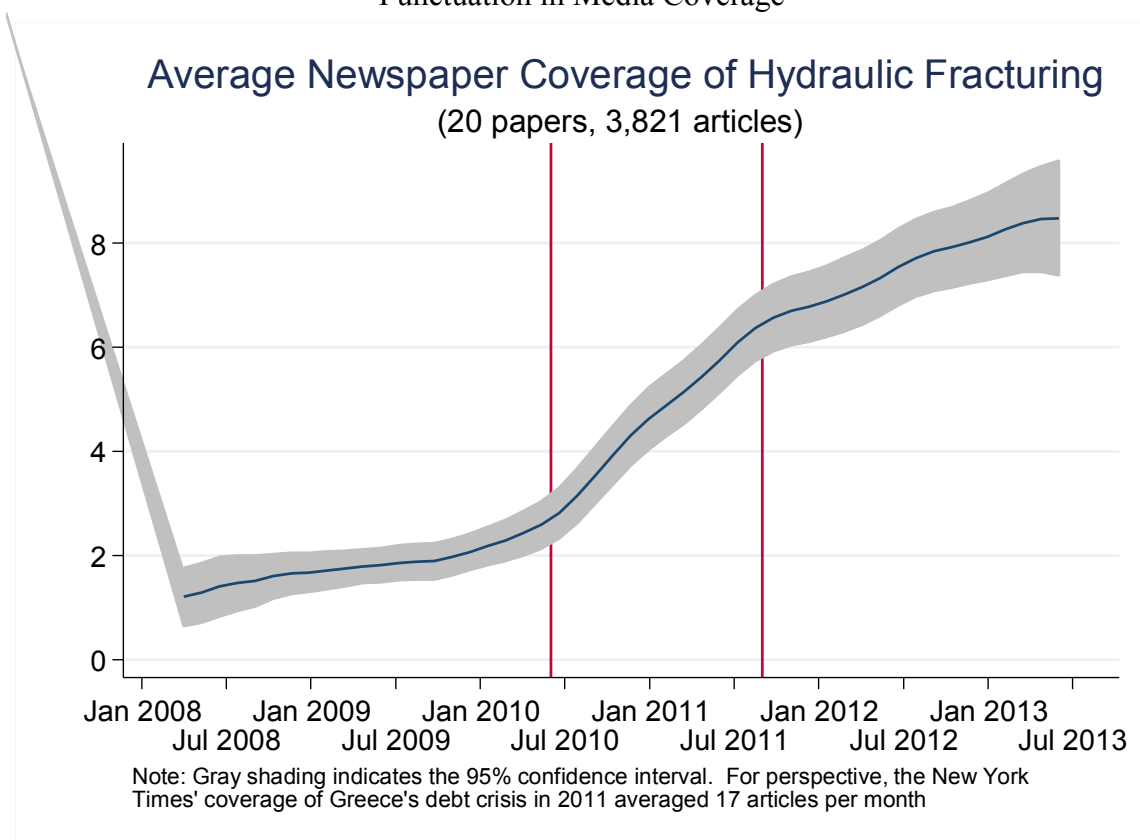
ANALYSIS – TOWARDS A POLICY PREDICTION FOR HYDRAULIC FRACTURING?

Consistent with much research on punctuations and policy adoptions, we perform a number of tests. First, we look for the presence of punctuation in terms of media coverage. Second, we look for a prevailing or dominate frame and tone that accompanies punctuation in news coverage on hydraulic fracturing. Punctuated equilibrium theory predicts that over the course of the disruption of a policy monopoly, an interest group will successfully advocate a particular policy image that competes with the status quo, sufficient to generate a new policy. Due to the multiple policy options related to hydraulic fracturing and the nascent nature of the policy debate, we cannot test the efficacy of these first two conditions on policy change at this time. We do inspect for the possibility that a policy compromise could be predicted from flat distribution of issue frames around a few policy options.

Punctuation in Media Coverage

The dataset reveals a fairly distinct punctuation in news coverage related to hydraulic fracturing. Figure 4.4 shows the average number of articles and sentences per month per newspaper that mention hydraulic fracturing for the period 2008-2013. The incidence of news coverage confirms a significant change in the incidence of coverage consistent with the expectation that policy change might be observed. The change in coverage is both monotonic and well fitted to the statistical expectation of policy change as predicted by the punctuated equilibrium model.²⁴ One can identify three distinct periods in the average number of monthly

Figure 4.4
Punctuation in Media Coverage



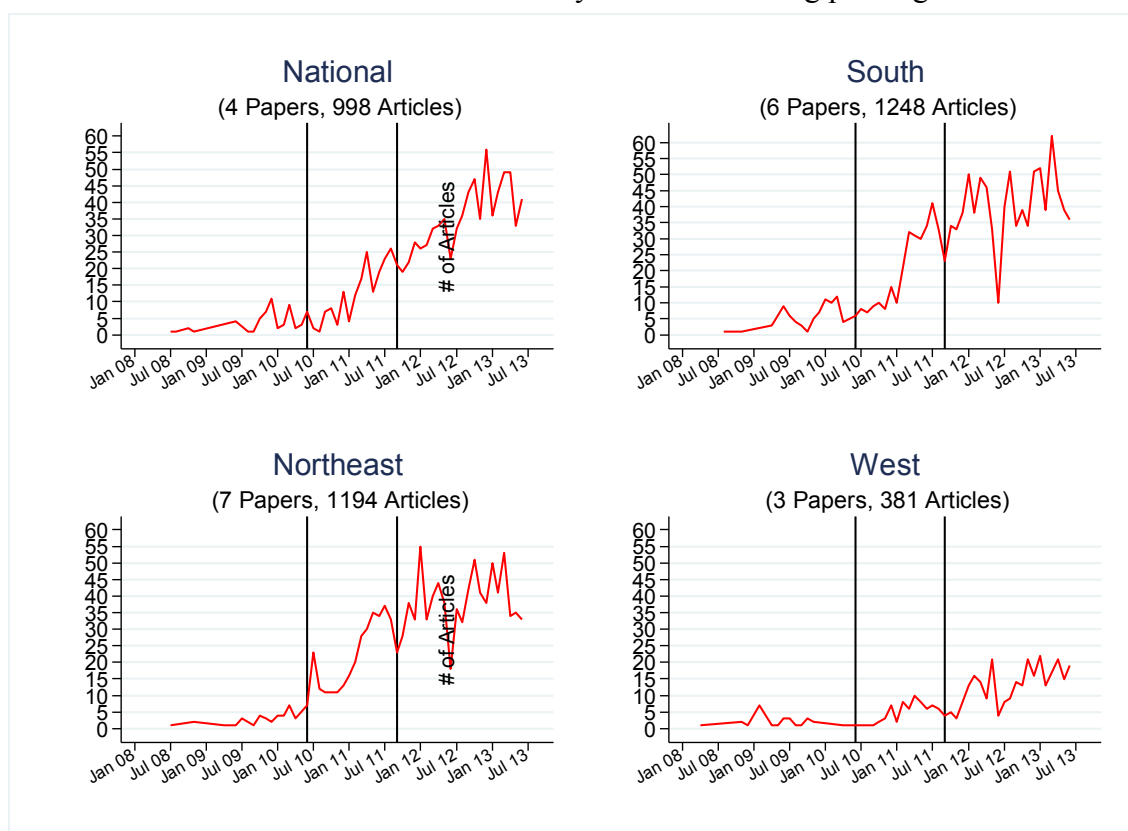
news stories on hydraulic fracturing. The first period begins in January 2008 and ends in June 2010. It is characterized by sporadic, but relatively light coverage. The second period begins in

²⁴ A kernel-weighted local polynomial smoothing graph of the actual figures in the dataset is statistically significant, $P < .05$. The Kernel-weighted local polynomial smoothing function involves a nonparametric regressor, which allows the data to speak for itself better than a linear or quadratic regression function.

July 2010 and ends in September 2011. This period is characterized by monotonically increasing coverage. The third period begins in October 2011 concluding with the end of our time series, June 2013. During this period the rate at which news coverage on hydraulic fracturing slows from the previous period but continues to increase. Overall, newspaper coverage of hydraulic fracturing has experienced an unambiguous, significant and steep increase over between 2008 and 2013. During this period the average monthly number of articles on hydraulic fracturing rose from two to more than eight.

We observe in Figure 4.5 the same unambiguous increase in regional news coverage beginning in 2010 increasing monotonically until the end of our study period when we shift our

Figure 4.5
Total Number of Articles on Hydraulic Fracturing per Region



attention to regional news coverage of hydraulic fracturing. Though the amplitude of coverage varies across region, the trend does not vary greatly across region. There is an exception in the

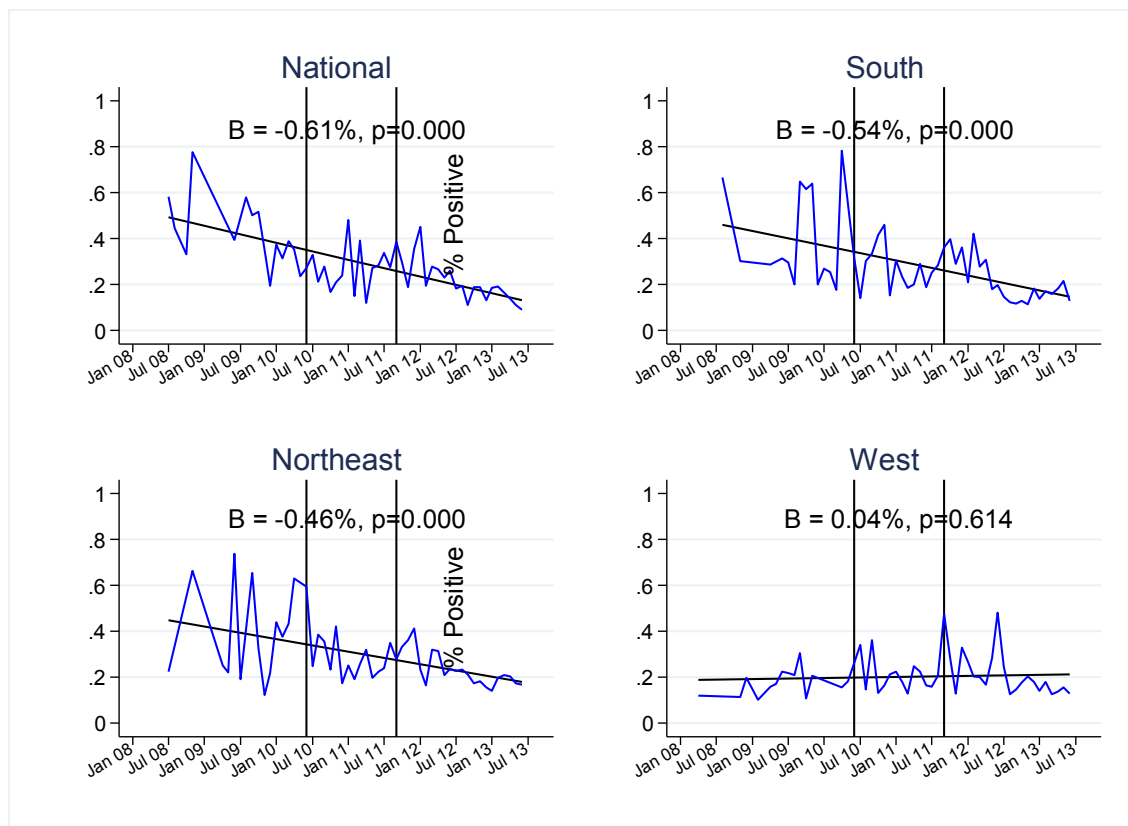
case of news coverage in Western states. News coverage in the West is decidedly muted over the time-series and does not show a significant change until the beginning of the third period, September 2011. We suspect several causes, especially two principal ones. Mining and mineral extraction are major industries in the states we selected, especially Wyoming where it's the leading industry. Also, Dick Cheney exerted great influence diffusing opposition to hydraulic fracturing in the region from his first election in 1979 as Wyoming's lone U.S. House Representative to his time as Vice-President (Meyerson 1993; Winburn 2006).

Punctuation in news coverage of a policy is a necessary, but not sufficient condition in the punctuated equilibrium model to predict policy change. Sufficiency for policy change also entails a dominance of policy tone and issue frame.

Change in Tone of Coverage

Figure 4.6 depicts the change in the tone of newspaper coverage of hydraulic fracturing for national and regional news coverage over the period 2008-2013. We observe a significant change in the tone of news coverage about hydraulic fracturing over the study period in every region except the Western region. In our national newspapers, as well as those in the South and Northeast, coverage of hydraulic fracturing is fairly neutral at first, with the percentage of positive coverage hovering around 50%. Yet over the period the tone decidedly drops, fastest in the national newspapers, averaging a 0.61% drop in tone each month, followed by the southern papers (0.54% drop each month) and the Northeast (0.46% drop each month). The coverage of hydraulic fracturing in the Western newspapers does not drop, remaining rather constant over the period. However, the coverage stays rather negative, being only 20% positive on average.

Figure 4.6
Changes in Coverage and Tone by Region



Catastrophic events or “whistle-blowing” exposés often are associated with significant spikes in both the volume of news coverage and a skew in the tone news coverage. For example, the Three Mile nuclear accident in Washington State was associated with a significant increase in news coverage that was decidedly negative and skewed towards opposition to the construction of new nuclear power plants (Buamgartner and Jones 2009:196). We have not detected any significant events that might be associated with either spikes or trend effects in the volume or tone of new coverage on fracturing.²⁵ Since many of the early articles appeared to be aimed at

²⁵ Two events combined could have amounted to a “whistleblowing” event. On September 9, 2010, the EPA requested certified information of the nine leading hydraulic fracturing service providers. This represented the first large-scale intervention of the Federal government into fracturing. This was not whistleblowing in the traditional sense because it did not reveal any unknown information since the results of the inquiry were not scheduled for release until December 2012. What did reveal new information about the environmental and health issues involved in hydraulic fracturing was the coincidental premiere in New York City of the documentary, *Gasland*. Josh Fox’s documentary on natural gas exploration depicted the flammable tap water and lawsuits by residents of Dimock Township, PA against Cabot Oil and Gas. While the movie was far from a box-office smash, it might have been enough to awaken the interest of media elites to an emerging story. These two events, the EPA inquiry and

educating readers of the controversies involved in hydraulic fracturing, our thoughts turned immediately toward the amount of hydraulic fracturing taking place. Could it be that the rise in coverage is simply related to increased drilling activity? Based on advice from expert researchers on oil and natural gas drilling, we use data on the number of drilling rigs actively employed in a given state in a given month. Counts of active drilling rigs are expected to capture new drilling activity and the portion of the drilling process that is most visible and potentially disruptive to the surrounding community.²⁶ Figure 4.7 shows the number of active drilling rigs per state per month, divided into regions.²⁷ Drilling activity was scaled back drastically from the third quarter of 2008 through the second quarter of 2009, which industry experts attributed to the global recession and contemporary oversupply of natural gas—the unemployment rate is plotted to graphically depict the recession.²⁸ Outside of that major downturn, drilling activity increased steadily, appearing to lead the punctuation in article coverage by about six months. Table 4.2 shows the results of the statistical tests on the contemporary and lagged effect of drilling activity on newspaper coverage of hydraulic fracturing. For a few states—notably, at least one state in each region--, we find statistical support for the supposition

Figure 4.7
Number of Active Drilling Rigs per State

the Gasland premiere, may have combined to generate a media-driven punctuation in coverage on hydraulic fracturing.

²⁶ After drilling, the well is completed then set into production. In those stages the footprint and traffic to and from the well site scales down significantly.

²⁷ Texas is plotted in the graph with nation-wide totals simply due to the scale of drilling activity in Texas.

²⁸ January 28, 2009 Press Release of Baker Hughes Incorporated.

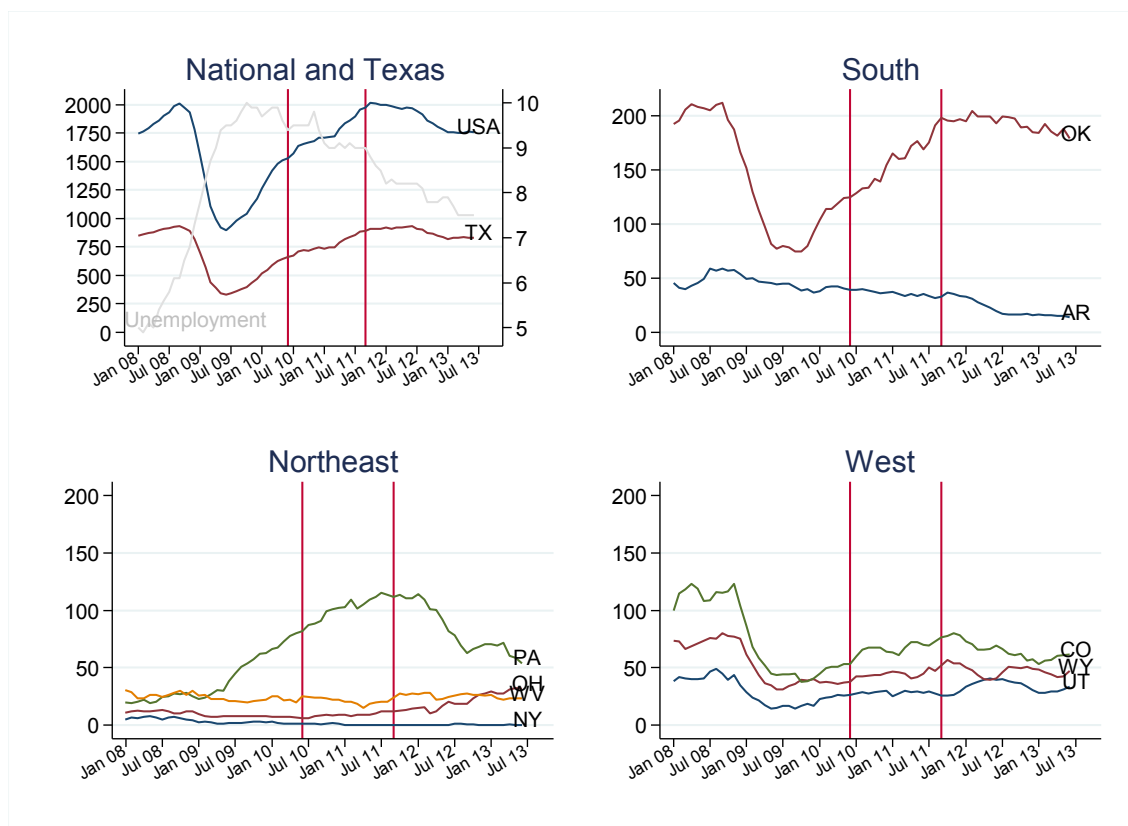


Table 4.2
Time-Series Regression of Active Drilling Rigs on Number of Articles, by State

	TX	OK	AR	PA	OH	WV	NY	CO	UT	WY
Rigs this month	0.024	0.0281	0.0106	-0.1675	0.2201	0.0671	0.4012	-0.0168	0.0943	-0.0845
	<i>0.038</i>	<i>0.034</i>	<i>0.897</i>	<i>0.002</i>	<i>0.542</i>	<i>0.770</i>	<i>0.636</i>	<i>0.790</i>	<i>0.007</i>	<i>0.239</i>
Rigs 6-mth prior	0.0348	0.005	-0.0885	0.2767	-0.0259	-0.1314	-2.3784	-0.0661	-0.0039	0.084
	<i>0.002</i>	<i>0.708</i>	<i>0.289</i>	<i>0.000</i>	<i>0.961</i>	<i>0.549</i>	<i>0.004</i>	<i>0.218</i>	<i>0.866</i>	<i>0.088</i>
Constant	-25.303	0.1454	6.5524	3.0293	4.2975	9.522	10.1956	12.7779	-1.1601	2.1772
	<i>0.000</i>	<i>0.926</i>	<i>0.000</i>	<i>0.263</i>	<i>0.129</i>	<i>0.218</i>	<i>0.000</i>	<i>0.010</i>	<i>0.233</i>	<i>0.560</i>
Adjusted R2	0.5554	0.1902	0.0852	0.4909	0.0105	-0.0377	0.302	0.0002	0.3459	0.0639

Note: Bold indicates coefficients that are statistically significant at the 0.10 level or less. Italics indicates p-values of coefficient estimates.

that drilling activity has an immediate and sometimes lagged effect on newspaper coverage.

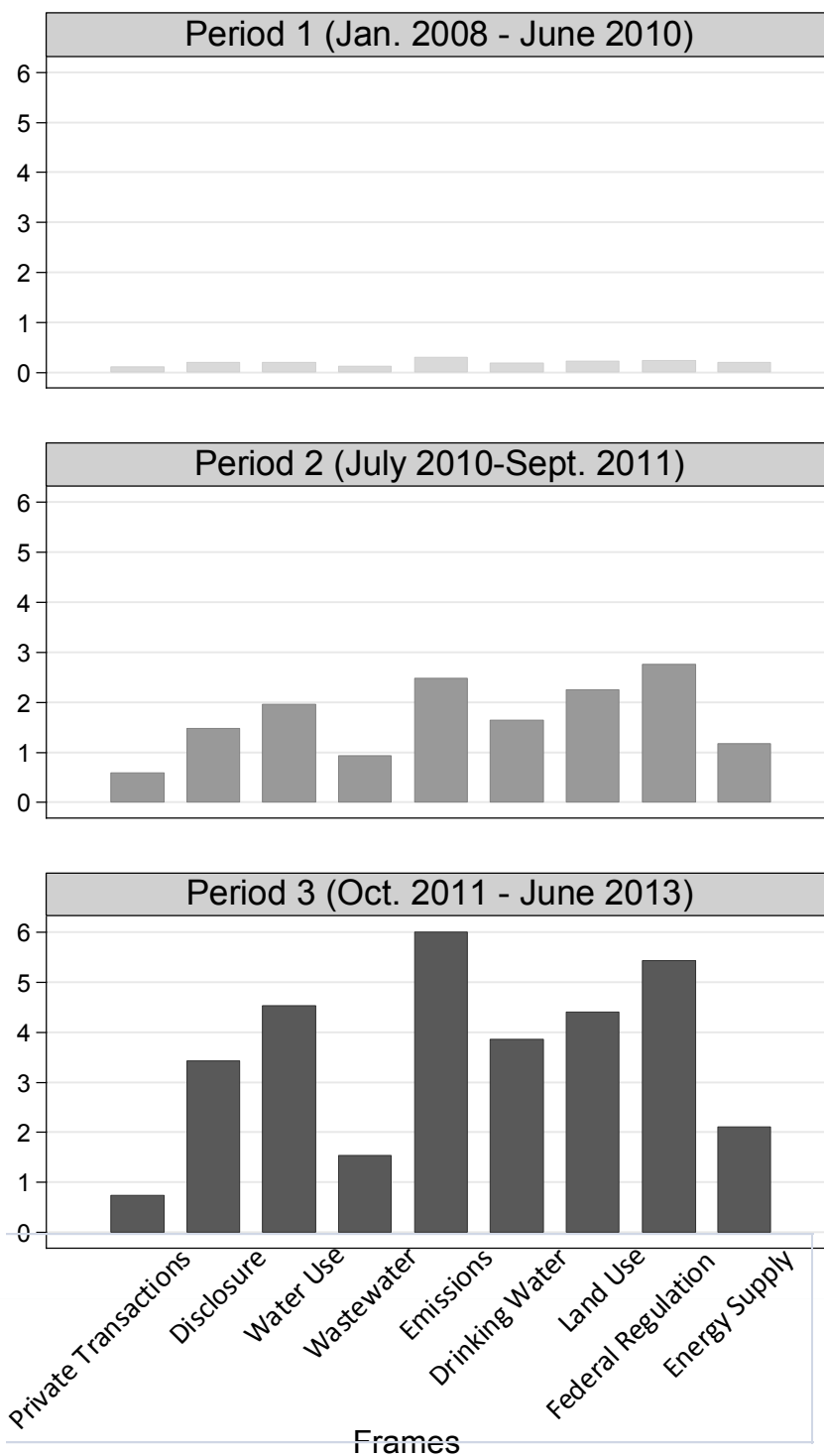
This correlation is stronger to the extent that newspapers in one state cover the activity in neighboring states directly or simply by purchasing and reprinting the articles of their newspaper partners.

The apparent empirically-driven rise in coverage paired with the gradual decline in tone suggests that journalists, and through them both the public and policymakers, are growing in their awareness and concern over hydraulic fracturing and especially its negative externalities. The distinct pattern in the West suggests that journalists there possessed this awareness and concern even at the initial months of our time period, an awareness that everyone elsewhere eventually came to share. Lacking a type of crisis or whistleblower motivation, it is questionable whether the punctuation in coverage of hydraulic fracturing is of a type sufficient to portend or even trigger a major change in policy.

Changes in Distribution of Issue Frames

Central to PET is the emergence of single and controlling issue frame penultimate to policy punctuation. Figure 4.8 reports the proportion of news stories per month by issue frame, for the three periods identified in our time series (January 2008-June 2010; July 2010-September 2011; October 2011-June 2013). These results indicate a qualified no to the question does one issue frame come to dominate news coverage on hydraulic fracturing. No particular policy image gained dominance over the others in newspaper coverage of hydraulic fracturing. In fact, the distribution of issue frames increases in amplitude over time reflecting the increase in news coverage of this issue. To determine this, we calculated the breadth of the coverage of the nine policy images using the normalized Shannon H measure, as recommended by Boydston, Bevan and Thomas (2013), which ranges from zero to one with lower values indicating a narrow focus on one particular image and higher values indicating a broader, more even focus across

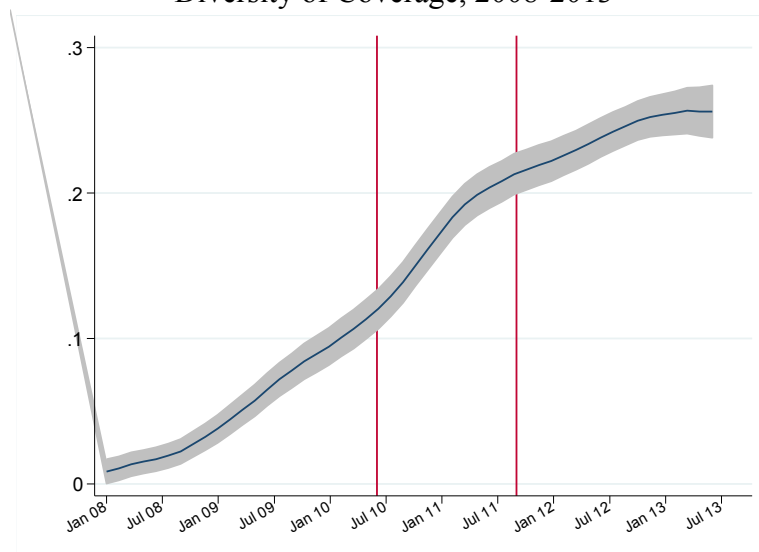
Figure 4.8
Prominence of Frame in Media Coverage



Note: X-axis (Frames) is arrayed on the continuum of Deregulation (Left) – Abolition (Right). Y-axis reports the percentage of articles reflecting that frame.

many images. The performance of that measure over time, depicted in Figure 4.9, confirms that the breadth of coverage across the images of hydraulic fracturing continually increase over the period, changing only in the pace of that increase, which roughly corresponding to the periods of differing rates of punctuation. This condition is incompatible with an impending change in policy on hydraulic fracturing, according to punctuated equilibrium theory.

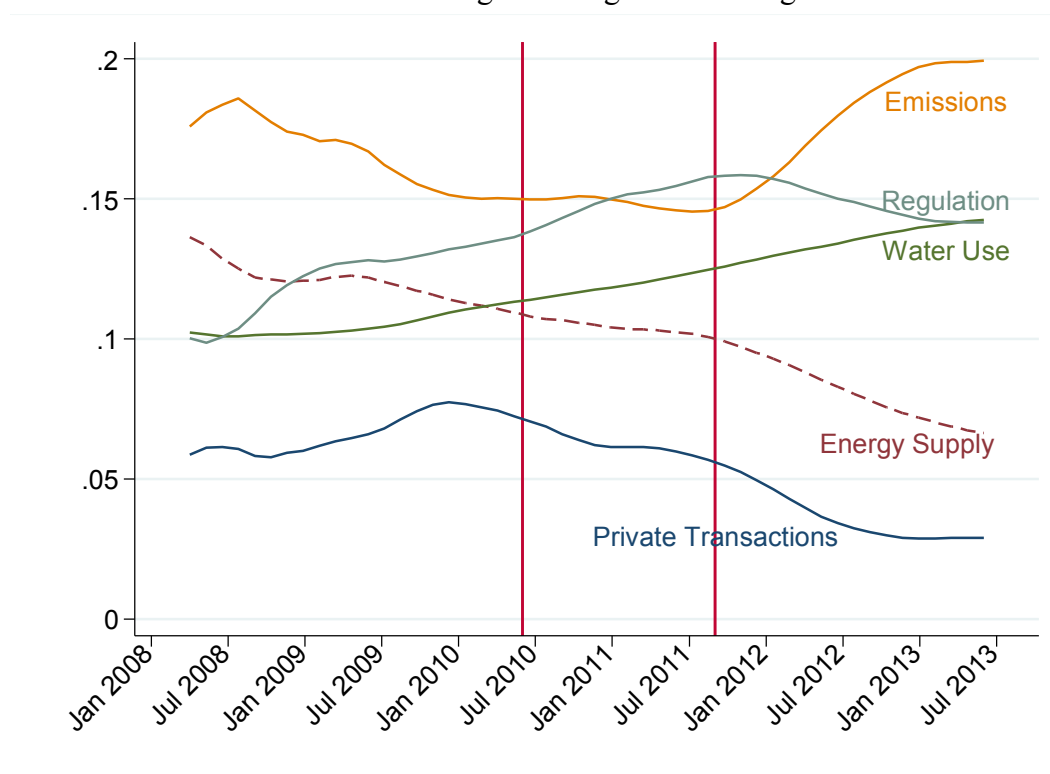
Figure 4.9
Diversity of Coverage, 2008-2013



An ever increasing breadth of issue frames covered does not necessarily indicate that each issue frame received the same amount of coverage throughout the period. It could be the case that certain frames were featured earlier in the period to be later displaced by other frames. Such a substitution of issue frame coverage could still happen while the coverage grows more diverse. Close examination finds exactly that. Figure 4.10 shows the predicted average of coverage for five frames for which we observed the greatest amount of change in coverage over the period: Private Transactions, Energy Supply, Water Use, Emissions, Regulation. Early on, journalists focused more on how much energy could be supplied by the oil and natural gas that hydraulic fracturing allows access to, and on the profits and problems associated with the private market leases between landowners and drilling companies. Perhaps reflecting changing activity,

or because of limited space on newspaper pages, journalists shifted their attention to the methane gas leaks from hydraulically fractured wells, increases in regulatory activity at Federal and local levels, and concerns over the volume of water used in hydraulic fracturing. This shift in attention raises expectations that policies related to emissions, water use, especially from policymakers outside of state regulatory agencies.

Figure 4.10
Frames with Largest Changes in Coverage



DISCUSSION AND CONCLUSION: “BIG TENT” POLICY COALITION?

Noting the anecdotal rise in attention given to hydraulic fracturing, our thoughts turned to the punctuated equilibrium theory to see what it would predict about policy adoption conditional on this attention. We thus endeavored to verify empirically a punctuation in newspaper coverage, which we did, centering around the fall of 2010. We also examined the tone of that coverage, noting a very slight, but significant decrease in the positivity of coverage in the

Northeast and South regions. This would place hydraulic fracturing in the state of policymaking where critics are attempting to disrupt the status quo policy monopoly. For these critics to succeed, we would expect a consensus to form (and be reflected in newspaper coverage) around a particular policy option and frame. To determine whether this occurred, we had to deal with the myriad range of policy options that are all invoked in the singular decision to employ hydraulic fracturing as a drilling technique, along with the myriad of frames tied to those options. We arrayed these options and frames along a spectrum from the abolition to the deregulation of fracturing. Once arrayed, we did see an increase to the coverage of those frames and options, however we did not see any one option and frame occupying a greater proportion of that coverage. It is as if either the debate on fracturing is still at too early a stage, or as if the vast array of critics have not themselves coalesced around a single, disruptive strategy, or as if the drilling companies and others advocating the status quo have successfully diffused the various criticisms. In either case, this application of the punctuated equilibrium theory to hydraulic fracturing would predict that no policy change would take place, at least not in the short term.

An Associated Press article on March 20, 2013 describes a new Pittsburgh-based Center for Sustainable Shale Development, created by environmentalists and the energy industry. It is a voluntary certification program by which a drilling company can have its hydraulic fracturing processes given a seal-of-approval by a board of industry, environmental, and science representatives, if found to be in compliance with a set of relatively high standards on emissions capture, groundwater monitoring, well-design, wastewater disposal, less toxic chemicals and seismic monitoring. This “big tent” type of policy outcome—if a non-governmental, voluntary program can be claimed as a policy outcome—is not predicted by a strict interpretation of punctuated equilibrium theory. No single policy option regarding hydraulic fracturing has yet

crowded out other options to lead the path towards disrupting the status quo of private transactions with negotiated externalities under general state regulation. Perhaps, it is useful to relax the theory's prediction to allow for a single dominant cohort of multiple policy options and frames to lead a push for a new policy bargain.

Further research, perhaps tied more closely to data directly from the interest groups and other stakeholders involved, is needed to determine exactly how seemingly divergent interest groups could coalesced into such a cohort. Olson (1965)—if we characterized coalition building and policymaking as collective action problems—would predict that the large potential profits to be made by drilling companies from hydraulic fracturing, even after incurring the costs of internalizing its externalities, provide sufficient motivation to make whatever concessions needed to appease the concerns of other interests. Perhaps it is the non-zero-sum nature of fracturing that allows most interest groups to come to peace with its continued use. Hydraulic fracturing represents windfall wealth to landowners and towns while providing environmentalists with a cleaner alternative to coal and petroleum. Each element of this broad-based group of stakeholders, thus, possesses separate, positive motivations to favor in some way the use of hydraulic fracturing, perhaps sufficient to motivate them to form the consensus to be reflected in future policy.

Our study appears to uncover another intervening factor, that of political venue. One cluster of frames deals with the arguments typically made about the proper regulation of hydraulic fracturing, especially in the municipalities and states where the wells are located. We have also identified from our dataset, the multitude of policy decisions on fracturing, and noted that only the Federal government has been “slow” to make its decision. We suspect that the stakeholders are constantly searching and finding particular political venues that are more

receptive to their frame and policy option, and that can overrule the previous decisions of other venues. We believe that there is a jurisdictional dimension to the Schattschneider-esque (1960) expansion of the conflict as hinted at in Baumgartner and Jones (2009, 36; see also Holburn and Vanden Bergh 2004; Holyoke, Brown, and Henig 2012; Pralle 2010), and we hope to examine this dimension in future research.

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