DISSERTATION

# RISK, PLACE AND OIL AND GAS POLICY PREFERENCES AMONG COLORADOANS

Submitted by

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# ABSTRACT

## RISK, PLACE AND OIL AND GAS POLICY PREFERENCES AMONG COLORADOANS

Unconventional oil and gas extraction, primarily via hydraulic fracturing ("fracking"), has changed the energy landscape in the United States. The policy regime currently governing fracking is a complex patchwork in which state regulators have the primary authority. Social scientists have thoroughly documented general beliefs and risk perceptions related to fracking there is a lack of policy-related research. This dissertation examined public policy preferences for fracking regulation using a survey data from a statewide sample of Coloradoans. Theoretically, it was hypothesized that policy support hinged upon factors like risk perceptions, benefit perceptions, place attachment, community economic identity and political ideology. Overall, risk perceptions and political ideology emerged as relatively consistent and powerful predictors of support for unconventional oil and gas regulatory policy. On the other hand, several possible predictors had little to no role. Benefit perceptions had little effect on any policy dependent variable. Further, community economic identity and place attachment played very little role. I discuss policy implications and directions for future research.

# ACKNOWLEDGEMENTS

The research presented here would not have been possible without the support and assistance of several individuals. Before I begin, I would like to acknowledge these individuals.

First, I would like to thank Dr. Tara Shelley for her seemingly never-ending support. This dissertation literally could not have happened without her, as she was essential in helping implement every stage of this project from its initial inception, to data collection, to the analysis of the results. In some ways I have been a demanding graduate student—always applying for grants, submitting manuscripts, etc.—and I am truly indebted to the enormous amount of time that Dr. Shelley has invested in my success. Moving forward, any success that I have in my social science career will be largely a result of Dr. Shelley's mentorship and guidance.

Dr. Stephanie Malin has brought a unique expertise into the social dimensions of energy development to this dissertation. She has been pivotal in clarifying key theoretical issues and keeping this research grounded in the literature. I am very fortunate to have an engaged, emerging expert on this topic on my dissertation committee.

The methodological expertise of Dr. Mike Lacy has also been essential to this project. Dr. Lacy has given me dozens, if not hundreds, of hours of his time to hammer out some of the nuances of designing an effective sampling strategy, exploiting a somewhat small sample size and working through numerous other issues. In addition, Dr. Lacy's input in other areas and his general intuition about research challenges beyond methods has been very useful.

I have long had an interest in "adapting" valuation methods and related techniques from economics to sociology. A prior collaborator, Dr. Catherine Keske, suggested that I reach out to Dr. John Loomis for his methodological expertise, referring to him as a "legend". There are few

legends in the social sciences and I am grateful to have one as my outside member. While I had read a great deal of the technical literature on valuation techniques meeting with Dr. Loomis in person helped clarify a number of complexities that I have struggled with. His help was invaluable.

My master's thesis advisor, Dr. Jeffrey Timberlake, has also been an instrumental figure in my development as a social scientist. Looking back, I was very lucky to have such a nurturing and understanding mentor early on in graduate school. Dr. Timberlake has continued to provide valuable advice even though I have left the University of Cincinnati.

Working with undergraduate research assistants to collect the data used in this dissertation was the highlight of my graduate career. This project would not have been possible without them. I send my warmest gratitude to Chloe Thome, Andrew Walz, Daniel Callahan, Ruby Castro, Marie Harding, Nolan Case, Neil Griffith, Danny Valdez, Heather Crosby, Rich Fordham, Lauren Perotti, Jose Gomez, David Strait, JD Haley, Ryan Becker, Jessie Miranda, Lauren Hartsough, Taylor Loberg, Alyssa Jansekok, Alexandra Poynter, Allison Brown and Jazmine Gonzalez.

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I greatly appreciate the financial support provided by the Rural Sociological Society (RSS) for this project, as it would not have been possible without it. RSS funds important, applied research and should be an example in this regard for other societies within sociology. The Institute for Learning at Teaching (TILT) also provided me with financial support to fund

translation and hire Spanish language interviewers. Without this essential support, the data would not be representative of the large Spanish-speaking population in Colorado.

TABLE OF CONTENTS

# CH. 1 INTRODUCTION

The purpose of this dissertation was to understand what policies the public supports to regulate hydraulic fracturing and to develop a theoretical understanding of the forces that drive people to support oil and gas policies. I used survey data to accomplish this task. The present chapter reviewed the topic of unconventional oil and gas development, introduced the theories that informed the analysis, detailed the research questions, and described the data.

## STATEMENT OF THE PROBLEM

The United States has recently experienced a boom in domestic oil and gas production as the combination of hydraulic fracturing and directional drilling has allowed for access to previously unreachable oil and gas deposits. Using data from the Energy Information Agency (EIA), I constructed Figures 1.1 and 1.2 to show trends in oil and gas production. Figure 1.1 shows domestic gas production since 1995, indicating a dramatic increase in which total natural gas production has nearly doubled in the past decade or so. Figure 1.2 shows that oil production has nearly doubled since 2010. Unconventional drilling technologies, like fracking, are a significant cause of this increase in domestic oil and gas production (Krupnick et. al. 2014; Yergin 2011).

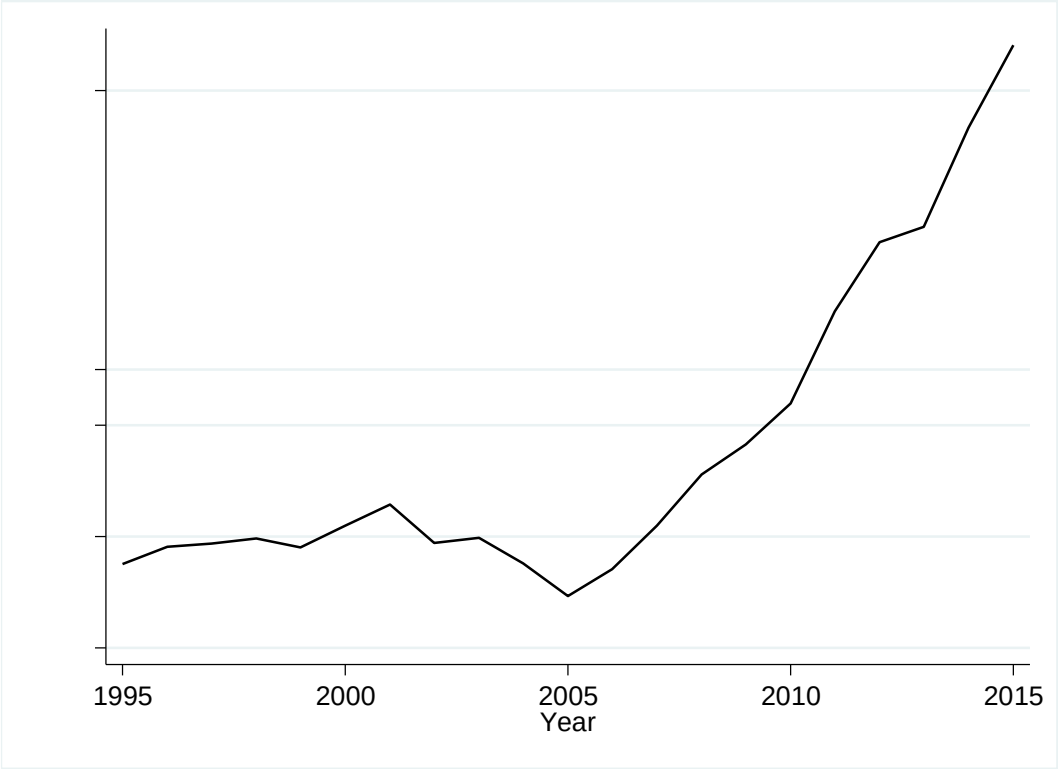


**Figure 1.1 Natural Gas Production**

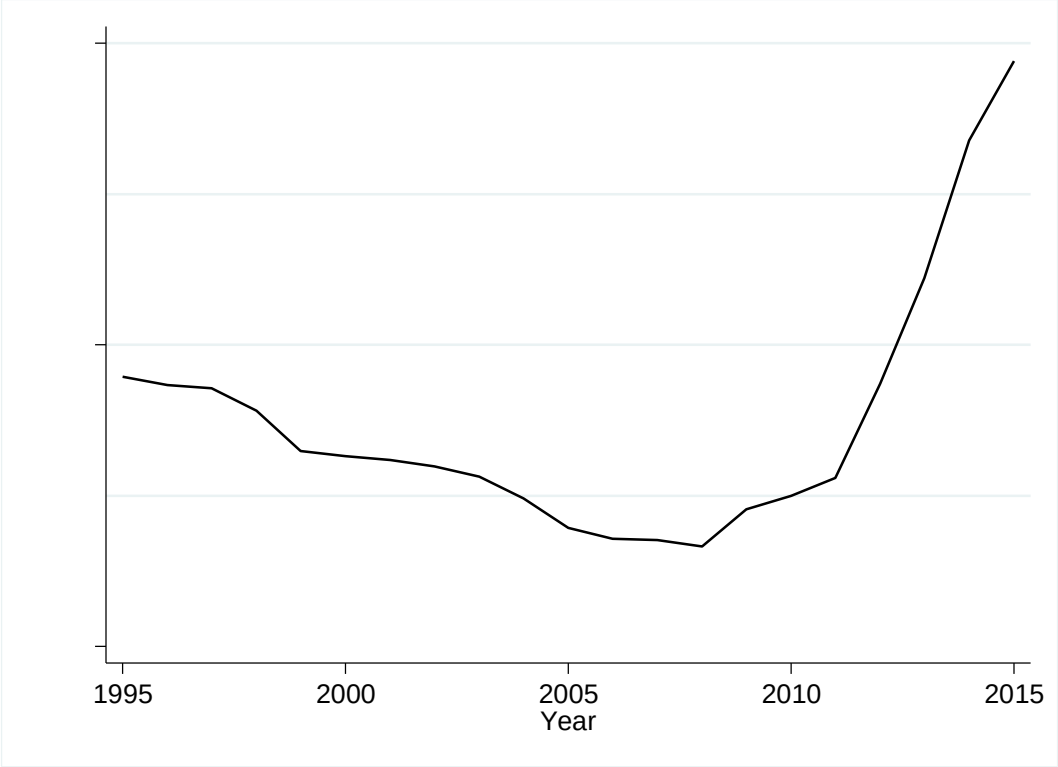


**Figure 1.2 Oil Production**

The explosion in fracking holds both promise and risk. With respect to promise, oil and gas development could provide much-needed jobs and tax revenue—particularly for underdeveloped rural areas (Lee 2015 Newell and Raimi 2015; Paredes, Komarek and Loveridge 2015; Weber 2013). However, early estimates of the job growth provided by fracking—particularly estimates from industry groups—were drastically over-stated and the actual amount of jobs is likely rather modest (Kinnoman 2011; Weber 2013). In addition, few jobs actually go to local rural populations because highly specialized skills are needed to operate the machinery used in oil and gas extraction (particularly fracking) and thus, many direct jobs go to outsiders (Hardy and Kelsey 2015). While recent research examining a short time period has found a positive effect on job growth and economic development, a well-established "research curse" line of scholarship indicates that long-run specialization in extractive industries leads to economic underdevelopment (Haggerty et. al. 2014; James and Aadland 2011). Thus, the fracking boom has had some short-run positive impact on economic development but it is unclear if this is sustainable long-term.

With respect to risks, there is preliminary evidence of human health impacts from fracking. Hill (2013) found adverse birth outcomes near drilling sites in Colorado and Pennsylvania. People who live near fracking tend report more skin and respiratory problems (Rabinowitz et. al. 2015), hospital utilization is higher near oil and gas drilling (Jamielta et. al. 2015), and traffic accidents are more common (Rahm, Fields and Farmer 2014). Chemicals used in fracking could cause several ailments related to respiratory problems and endocrine disruption (Colborn et. al. 2011; Kassotosis et. al. 2013). Still, this health impact research is in its infancy and more sophisticated research designs (e.g., case control, quasi-experiments) and richer data are necessary to make causal inferences.

In addition to human health effects, residents of communities experiencing resource booms often report negative impacts on quality of life, and fracking is no different. For example, these quality of life impacts may include increased crime, traffic or noise (Komarek 2014; Theodori 2009) and problems related to community cohesion (Boudet et. al. 2014).

There are also potential risks for the environment. For example, natural gas may have significant benefits in terms of climate change as it produces far less $CO^2$ than coal when used to generate electricity (Hultman et. al. 2011). Indeed, natural gas is often described as a "transition fuel" that can provide affordable energy as the U.S. electricity sector moves away from coal towards renewables (Yergin 2011). However, there is emerging evidence that fugitive methane emissions may attenuate any potential climatic benefits of abundant natural gas development (Bouman et. al. 2014; Howarth 2014; O'Sullivan and Paltsev 2012).

Sociologists and related scholars have exhaustively documented risk and benefit perceptions related to fracking (e.g. Crowe, Ceresola and Silva 2015; Jacquet 2012; Schaft, Borlu and Glenna 2013) and qualitative research has examined in depth how individuals and communities have responded to oil and gas development (Crowe and Silva 2014; Ladd 2013; Malin 2013). The risks and benefits outlined above are of interest as they may relate to public support of energy development generally and regulatory policies more specifically. However, we know relatively little about what types of policies the public might support to regulate fracking. This dissertation represents the first comprehensive assessment of public policy attitudes towards fracking. Thus, it addresses both a significant gap in scholarly knowledge and may help inform better policy formation.

Theoretically, this dissertation applies diverse theories from the risk perception, place and community economic identity. As discussed in the proceeding chapters, risk perception appears

to be a particularly robust predictor of a range of policy preferences. While social scientists have articulated sophisticated theoretical frameworks to explain the emergence of risk perceptions (Douglas and Wildavsky 1983; Beck 1992), the policy consequences of risk perception are generally under-theorized. One implication of the empirical results of this dissertation is that behavioral and policy responses to risk perception need further theorization—that is, we need theories that better articulate how and why risk perceptions lead people to endorse ameliorative policies or take action. Further, place-based factors like community economic identity (Bell and York 2010) and place attachment (Devine-Wright 2005, 2009; Devine-Wright and Howes 2010) have received much theoretical elaboration, but have rarely been connected to policy outcomes. Generally, the operationalizations of these variables produced modest effects in the models reported in the empirical chapters. However, place certainly matters for unconventional oil and gas policy, but this relationship needs further elaboration. Ideally, the empirical results presented here could inform greater theorizing at the intersection of risk and policy and place and policy.

## STUDY BACKGROUND

Social scientists have long been interested in the social dimensions of energy development. Here, I will briefly discuss major theoretical and empirical traditions in the literature and consider how this literature can be applied to fracking.

The classic "boomtown" literature documented negative social impacts from rapid energy development (Cortese and Jones 1977; Gilmore 1976; Kohrs 1974). The early works in this literature have been critiqued for their ad-hoc nature and methodological limitations (Wilkinson et. al. 1982; Wilkinson et. al. 1984). Still, these works provided an important grounding for later research that showed that communities recover from boom and bust cycles in the long-run (Brown, Dorius and Krannich 2005; Freudenburg 1981; Smith et. al. 2001).

However, it is unclear if the boomtown framework can be readily applied in the case of hydraulic fracturing. Jacquet and Kay (2014) point out several possible reasons why insights from the boomtown literature cannot necessarily be generalized to the case of fracking. For one, scholars portrayed boomtowns as extremely rural and isolated. Yet unconventional drilling techniques have changed the spatial dimension of extraction as they allow for drilling to occur much more diffusely and on a larger scale than previously possible. Hence, unconventional oil and gas extraction is not confined to rural, isolated areas but often occurs proximate to suburban areas. Jacquet and Kay (2014) also explain that fracking is unlikely to produce large scale cycles of boom and bust. Rather, the diffuse nature of fracking suggests that micro booms and busts will occur contemporaneously across different drilling locations. Hence, the underlying assumptions of the boomtown model limits its applicability to the case of fracking.

The environmental justice and environmental inequality literature have long documented how vulnerable population—typically non-white or lower socio-economic status groups—are more likely to be exposed to environmental harms (e.g. Bullard 1999; Downey 2003; Downey et. al. 2008; Ard 2015). Critical scholars writing in this area argue that our economic system relies on externalizing environmental costs to disenfranchised populations (Hornborg 1998). Yet it is unclear if there is also a similar calculus of goods and bads from fracking. Castelli (2015) argued that the rural poor shoulder an unjust burden of the environmental and health impacts of fracking but are not likely to receive royalty payments or industry jobs. Currently, little is known about the social distribution of the costs and benefits of fracking but there are reasons to question if fracking has the same environmental justice consequences as other types of energy development. The spatial diffusion of unconventional oil and gas drilling suggests that it's proximate harms are

not likely to be confined among a single population group. That is, unconventional technologies allow for drilling to occur in many places and not just among marginalized communities.

Rural sociologists and related scholars have long considered the problem of natural resource dependence. Natural resource dependence is a key contributor to seemingly intractable rural poverty (Humphrey et. al. 1993; for related papers see Peluso et. al. 1994; Nord and Luloff 1993 and Freudenberg and Grambling 1994). Further, the resource curse or "paradox of plenty" literature from economics suggests that, at least in the long run, economies based around extractive industries experience slower growth and generally worsened socio-economic outcomes than others (Deller and Schrieber 2012; Partridge, Betz and Laboa 2013). There are a few proposed mechanisms by which specialization in extractive industries lead to stagnation. Internationally, extractive economies are associated with autocracies (Robinson, Torvik and Verdier 2006; Tsui 2011; Ulfelder 2007; Wright, Frantz and Geddess 2013) and in the U.S. natural resource dependence is associated with a lack of political competition at the local level (Goldberg, Wibbels, and Mvukiyehe 2008). Hence, extractive economies may lead to low quality institutions and a lack of democracy. Extractive economies typically have lower levels of human capital as there is less need for companies to invest in education and training (Kurtz and Brooks 2011; Papyrakis and Gerlaugh 2004).

Weber (2014) finds no evidence for a resource curse from the current boom in unconventional oil and gas extraction. A resource curse may be unlikely to emerge around fracking for a few reasons. As explained above, one of the primary mechanisms that drives the resource curse is a lack of human capital—extractive economies tend to have low investment in education and skill building. However, modern oil and gas extraction involves a great deal of advanced technology that requires a high degree of training to operate. Natural resource

dependence also emerges because local labor markets become "overadapted" to an industry, reducing economic diversity (Freudenberg and Gramling 1992; Freudenberg and Gramling 1993). However, fracking creates only modest job growth and few locals have the necessary skills to operate the equipment (Weber 2013). Thus, the limited employment and high technical skills required for unconventional oil and gas extraction many attenuate the possibility of natural resource dependence and the resource curse.

There are several rich theoretical perspectives on risk and risk perception, with a great deal of research identifying the factors that engender or attenuate risk perceptions. The psychometric paradigm—pioneered by Slovic (1987)—highlights how features of a source of risk, such as its familiarity, can heighten or reduce risk perception. The Cultural Theory of Risk (Douglas and Wildavsky 1983) is usually operationalized by examining how cultural worldviews drive risk perceptions (e.g. Dake 1991). More sociologically, the Beck's risk society theory focusses on how modern societies increasingly generate risks that threaten their very existence (Beck 1992). Thus, responding to and managing risks is a central task of modern social institutions.

Generally, the risk and risk perception literature has less to say about *how* risk perceptions might influence the choices people make—such as the policies they chose to support. However, other research suggests an implicit rational choice perspective on the relationship between risk perceptions and policy support—that is, people will support policies to address problems perceived as risky or dangerous (Leiserowitz 2006; O'Connor, Bord and Fisher 1999; Stoutenborough, Vedlitz and Liu 2015). Thus, the chapters below rely on this rational choice perspective as is relates to individual calculation of risks and benefits.

Regarding political identity, I leaned heavily upon social psychological research about group social identities (Hogg 2007; Taifel and Turner 1986; Turner et. al. 1994). This research typically begins with the assumption that innate drives lead people to affiliate with groups and these group affiliations tend to shape individual attitudes (Hornsey 2008). This theoretical understanding of social identities has been applied to political ideology were evidence indicates that strongly ideological individuals work to reconcile their own viewpoints with those of their groups, leading to a relative uniformity of opinion within an ideological community (Cohen 2003; Malka and Lelkes 2010; Unsworth and Fielding 2014). Further, strongly ideological individuals are highly receptive to "elite cues" in which elite members of their groups (e.g. media figures, politicians) can shift the opinion of the entire group (Converse 2000; Jost, Frederico and Napier 2009; Layman and Carsey 2002; McClosky and Zaller 1984, Jost, Frederico and Napier 2009; Sniderman, Brody and Tetlock 1993). Both experimental (Cohen 2003) and observational (McCright and Dunlap 2011) studies lend support to this perspective. An additional implication of this research is that people come to rely on their political ideology to inform more than just their policy attitudes. For instance, belief in the mere existence of some environmental problems—like climate change—largely hinges upon political ideology (McCright and Dunlap 2011).

"Place" also seems very important in fracking policy controversies. For example, in Colorado, Pennsylvania and Texas, some communities have mobilized to resist the oil and gas industry, while others have effectively embraced development. The social scientific literature on "place" is vast, spanning multiple disciplines with various strands of research relying upon their own set of technical terms and methods. However, two concepts related to place seemed especially useful for understanding support (or lack thereof) for regulating energy development.

The first, “place attachment”, focuses on the connection people have to both the physical and social elements of a place (Brehm, Eisenhauer and Krannich 2006; Cross 2016; Flora 1998; Forrest and Kearns 2001; Stedman 2003). I hypothesized that people who are highly attached to the natural or social elements of their place might be more apt to seek to regulation of the oil and gas industry.

I derived the second concept associated with place from the work of Devine-Wright and colleagues (Devine-Wright 2005, 2009; Devine-Wright and Howes 2010) who found when a sudden change endangers important aspects of a place people engage in “place protective action”. For instance, residents of a Scottish town resisted a wind energy project despite their pro-environmental attitudes because developers planned the project for a historically significant landscape with coastal views. It is feasible that individuals might engage in place-protective action in two ways. First, the perceived threat of fracking to important elements of place might cause resistance. Secondly, for some individuals support for the oil and gas industry may be a type of place protective action. Indeed, some regions have a deep history of extraction and perceived or actual reliance on oil and gas development to provide jobs and tax revenue. In these communities, more stringent regulation might be seen as a threat to an important element of place—the oil and gas industry. Thus, opposition to regulation may also be a type of place protective action.

Another potential aspect of “place” is “community economic identity” (Bell and York 2010). Bell and York (2010) were interested in why so many West Virginians rallied in support of the coal industry, even though industry provides little direct employment in the state. They suggested that aggressive industry public relations, often featuring regional celebrities in tandem with the historical economic and cultural significance of coal in Appalachia, have forged a

collective identity around the industry. With this research in mind, I borrow the notion of "colliding treadmills" from a case study conducted by Gasteyer and Carrera (2013). The authors studied a region of rural Central Illinois with a long history of large-scale agriculture—particularly soybeans and corn. The area also had a history of coal mining. Residents perceived a new mining technique—long-wall mining—as a threat to the region's industrial agriculture. Gasteyer and Carrera suggested that mining and agriculture were irreconcilable growth imperatives or "colliding treadmills". In this case, residents of Central Illinois rallied against the coal industry to protect agriculture. Similar dynamics may be at play in states that have a history of both industrial agriculture and various types of extractive activity. Some resistance to fracking, or efforts to regulate the oil and gas industry, may be the result of perceptions that oil and gas represents a threat to agriculture or other industries.

It's also important to understand the current regulatory landscape for unconventional oil and gas extraction and how it relates to broader societal processes of neoliberalism and devolved governance. Definitions of neoliberalism vary in their particulars but it is usually described as a process in which centralized regulatory authority is diminished with power being transferred to individuals, markets and corporations in the name of efficiency and profitability (Castree 2010; Castree 2011). Neoliberalism is contested and uneven, even chaotic. Neoliberalism often occurs in tandem with devolution whereby smaller units of government play an increasingly larger role in governance (Jonas and Bridge 2003; McCarthy 2004; Prudham 2003).

Neoliberalism and devolution are evident in the regulatory regime for unconventional oil and gas. Key aspects of oil and gas operations are exempted from pieces of federal environmental and health regulations (e.g. the famous "Halliburton Loophole"), leading to patchwork regulations across the nation in which state and local governments have largely taken

responsibility for oversite of the oil and gas industry (Davis 2012; Werner and Shapiro 2013; Zairians et. al. 2016). These governments may not have adequate capacity to regulate oil and gas development, leading to a de facto regime of de-regulation.

## RESEARCH SETTING

I situate my research in Colorado, as it has been a key state in this latest energy boom with roughly 51,000 active oil and gas wells (COGCC 2016). Moreover, this unprecedented increase in oil and gas production has presented a challenge to state policy makers. As noted above, unconventional oil and gas development is exempted from key aspects of federal environmental and health regulations. As a further complication, state regulatory bodies may suffer from problems of regulatory capture[1] and lack the capacity to enforce existing regulations effectively (Opsal and Shelley 2014).

Another compelling reason to study this issue in Colorado is the conflict between the state government and cities. Several cities have passed their own regulations (or outright bans and moratoria) on oil and gas development and the state and oil and gas industry have formally opposed these efforts with legal action (Enockson 2014; Minor 2014). Though it may seem that communities within Colorado are mostly resistant to the spread of fracking there are areas that have embraced the industry. For example, in 2013, a state succession movement arose in northern Colorado counties with high volumes of oil and gas extraction; the impetus for this movement was, at least in part, new oil and gas regulations implemented by the state government (Whaley 2013). Hence, the local politics of oil and gas development within Colorado are highly contentious.

[1] Regulatory capture refers to a situation in which government regulatory agencies are under the sway of special interests, leading to a regulatory regime that favors those interests as opposed to the public good.

## RESEARCH QUESTIONS AND METHODS

This dissertation investigated the following research questions:

1) How does the perception of risk and benefits impact public endorsement of restrictive fracking policies?
2) Does community economic identity explain why some people may have embraced the oil and gas industry while others seek to regulate the industry further? Further, is there evidence of "colliding treadmills" in that the public believes that other industries may be threatened by oil and gas development?
3) Does political ideology act as a type of social identity, influencing not only policy preferences but also other variables that predict policy preferences—such as risk perception or trust? If so, is the effect of political ideology mediated by intervening variables like risk perception and trust?
4) How does "commensurating" a policy by associating it with economic sacrifice (such as increased taxes) influence policy support? Will support of further regulation decline as the associated costs rise?
5) How does "place" and place attachment matter for oil and gas policy preferences?

To investigate these research questions, I conducted a stratified random digit-dial survey of Colorado residents in the fall of 2014. After thorough pre-testing of the instrument, I designed a unique sampling frame in which counties with a high degree of drilling were oversampled. This oversampling was done because of the highly unequal spatial distribution of population within Colorado; most of the state population lives within the Denver metropolitan area, which has relatively little drilling. The oversampling strategy involved ranking Colorado counties by active well counts and then dividing this ranking into ten strata. Then, I randomly sampled households

within strata. Survey Sampling International Inc. provided a sample that included both cell phones and landlines. The research team conducted interviews in both English and Spanish.

## OUTLINE OF DISSERTATION

I organized this dissertation in standalone essay format as opposed to a book-style "treatise" format. There are four empirical chapters to this dissertation (chapters 2-5), a short conclusion (chapter 6), and two appendices. The second chapter examines policy support using theories related to place and risk. Here, I measured policy support using a scale constructed of different possible fracking regulatory policies. Predictors include risk perceptions, benefit perceptions and place-related variables. The third chapter uses contingent valuation methodology—seldom employed by sociologists—to understand what drives willingness to pay for fracking oversight in the form of more frequent inspections. In doing so, I considered the theoretical literature on "commensuration" and the sociology of environmental valuation. This chapter also included variables for risk perceptions, benefit perceptions, trust in the oil and gas industry, and relevant controls. The fourth chapter considered the problem of governance scale—that is, what level of government (e.g. federal, state, local) should regulate oil and gas development. For predictor variables, I include risk perceptions, benefit perceptions and standard controls. The fifth chapter clarifies the role of political ideology in fracking policy preferences. Relying on a theoretical understanding of political ideology borrowed from social psychology (e.g. Cohen 2003) I tested for the exogeneity of political ideology. More specifically, I investigated whether political ideology influences variables that predict policy preferences—such as risk perceptions or trust in the oil and gas industry—while also having a direct effect on policy support. A methodological appendix detailing the sample frame, instrument development,

pre-testing and related issues supports this dissertation. A second appendix contains the survey instrument.

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# CH. 2 FRACKING POLICY SUPPORT: THE ROLE OF PLACE, RISK AND TRUST

## SUMMARY

In this chapter, I considered how place, risk/ benefit perceptions and trust influence support for fracking policy among Coloradoans. Results suggested that place-related variables, such as place attachments or community economic identity, had relatively little role while risks perceptions and trust are important predictors of policy support Further, political ideology was a powerful predictor of fracking policy support.

## INTRODUCTION

Unconventional oil and gas extraction, primarily through a process called hydraulic fracturing or "fracking", has created a boom in U.S. oil and gas production with natural gas production increasing by about 30% from 2005 to 2015 (Krupnick et. al. 2014; Silverstein 2014: USDA ERS 2016)[2]. Many have seen the dramatic increase in domestic oil and gas production as an economic boon. Unconventional oil and gas extraction has provided jobs and economic development in distressed rural areas (Driessen 2013; Energy from Shale 2015; Lee 2015), in addition to tax revenue for cash-strapped governments (Newell and Raimi 2015). Unconventional oil and gas development could have a large multiplier effect, leading to secondary job growth, and, more indirectly, job growth spurred by lower energy prices (Krupnick et. al. 2014). Moreover, natural gas burns cleaner than other fossil fuels, possibly contributing to lower greenhouse gas emissions and providing a "transition fuel" to cleaner

[2] The term "fracking" technically refers to a very specific portion of a larger process of oil and gas development involving the injection of water and chemicals at high velocity to shatter rock formations. However, the public often uses the term "fracking" to refer to the larger process of unconventional onshore oil and gas development. This chapter uses the term "fracking" in the latter sense.

energy sources (Hultman et. al. 2011; Moniz 2011; Tour, Kittrell and Colvin 2010). However, fugitive methane emissions may attenuate many of the environmental benefits of natural gas (Bouman, Ramirez and Herwitch 2014; Howarth 2014; O'Sullivan and Paltsev 2012)

Yet oil and gas extraction via fracking has been associated with negative effects on public health and quality of life (Colborn et. al. 2011; Hill 2014; Kassotis et. al. 2013; Perry 2012; Rabinowitz et. al. 2015), wildlife and livestock health (Bamberger and Oswald 2012, 2015; Kiviat 2013; Latta et. al. 2014), strains on local infrastructure (Graham et. al. 2015;Rahm, Fields and Farmer 2015), water contamination (Ferrar et. al. 2013; Holzman 2011; Rozell and Reaven 2012), air pollution (Howarth, Santoro, and Ingraffea 2011), employment much lower than industry estimates (Kinnamon 2011; Mauro et. al. 2013; Weber 2012), jobs that primarily go to outsiders (Hardy and Kelsey 2015), negative effects on housing values (Bennett 2013; Muehlenbachs, Spiller and Timmons 2014), and crime (Komarek 2014; Theodori 2009). Critics also point out that the volume of extractable natural gas is largely unknown as estimates have varied widely and production occasionally falls far short of initial expectations (Smil 2015). Moreover, the "transition fuel" label may unintentionally impede efforts to create more energy efficiency, conservation, and renewable energy (Stephenson, Doukas and Shaw 2012).

Several studies have analyzed public attitudes towards unconventional oil and gas, mostly focusing on risk and benefit perceptions (Brasier et. al. 2013; Jacquet 2012; Schaft, Borlu and Glenna 2013; Silva and Crowe 2015) or general support for fracking (Boudet et. al. 2014; Clarke et. al. 2015; Crowe, Ceresola and Silva 2015; Davis and Fisk 2014). Case-study research has documented how individuals and communities impacted by fracking have responded to the boom (Ladd 2014; Malin 2014; Perry 2012; Sprague 2015). Yet there is surprisingly little research on

fracking regulation— we have little information about what policies the public supports and the predictors of said policy support.

This chapter aimed to address this gap in our knowledge. In the next section, I outlined a theoretical background in which I present "place," risk, and benefit perceptions as key drivers of policy support related to hydraulic fracturing. I test this theoretical background using a statewide survey of Colorado residents collected in the fall of 2014.

## THEORETICAL BACKGROUND

The public response to the fracking boom seems to be highly contingent upon "place". Political leaders in Pennsylvania have largely embraced unconventional oil and gas development while neighboring New York has banned fracking statewide (Negro 2012; Simonelli 2014). Within Colorado, the public response has varied significantly on an even smaller scale. For instance, Weld County, Colorado is home to roughly 21,000 active oil and gas wells. In 2013, a state succession movement arose in part because of new state oil and gas regulations (Whaley 2013).[3] On the other hand, the nearby towns of Fort Collins, Longmont, and Boulder have passed temporary or permanent bans on fracking (Davis 2014; Rinfret, Cook, and Pautz 2014), prompting the state government to sue these cities (Gullmann 2015).

Social scientists have produced an enormous volume of research on "place" and, not surprisingly, no singular theoretical or operational definition of "place" dominates the literature. The "place" literature can be roughly divided into theoretical, phenomologically oriented works which focus on the experiential nature of place primarily using qualitative methods (Gustafson

[3] The state succession movement was largely symbolic and was concerned with more cultural politics issues like gay marriage and gun rights. However, the resistance of local leaders to state regulations underscores the apparently place-contingent nature of oil and gas politics within Colorado.

2011; Nardi 2014; Thwaites 2001; Tuan 1977) and a more quantitatively-oriented psychometric approach (e.g. Bott 2000; Jorgenson and Stedman 2001; Williams and Vaske 2003; Vorkinn and Riese 2001). Among this latter literature, a concept perhaps best called "sense of place" has emerged; sense of place is broadly recognized as a multi-dimensional construct (Ardoin, Schuh and Gould 2012; Kudryavtev, Stedman and Krasny 2012; Kyle, Graefe and Manning 2005; Williams and Vaske 2003). People form bonds with the community and natural aspects of a place (Brehm, Eisenhauer and Krannich 2006; Flora 1998; Forrest and Kearns 2001; Stedman 2003), are functionally or emotionally dependent upon places (Brown and Raymond 2007; Manzo 2003; White, Verden and Van Ripper 2008). Further, people work to protect places that are culturally, emotionally or socially significant (Brehm and Eisenhauer 2013; Devine-Wright 2009; Scannell and Gifford 2013). [4]

Critics charge that the sense of place literature lacks a perspective on the political economy of place. Ardoin (2006) argued that the political-economic dimension of place has received relatively little study, yet "Questions of power and identity, particularly as manifested in place-based political movements and economic structures, explore some of the most transformative ideas linked to the relationships between people and place" (p. 118). Cheng, Kruger and Daniels (2003) observed that "dominant groups in natural resource politics have developed a fairly narrow set of place meanings…this relatively narrow set of place meanings serves to legitimize the existing power of dominant groups" (p. 101). Hence, while the sense of place literature consistently demonstrates that places are emotionally, cognitively, and socially

[4] Given the vastness of the place literature in the social sciences, it cannot possibly be exhaustively reviewed here. For reviews and theoretical discussion we recommend Scannell and Gifford (2010), Hidalgo and Hernandez (2001), Cross (2015), Lewicka (2011), Twigger-Ross and Uzzell (1996); and Gustafson (2001)The splintered, multi-disciplinary nature of the sense of place literature have likely hindered it's theoretical and methodological development (Trentelman 2009; Hernandez, Hidalgo and Ruiz 2014.)

significant for people, it typically lacks a critical perspective on how political and economic forces might forge understandings of place.

*Community Economic Identity.* The concept of community economic identity (Bell and York 2010) provides a window into understanding the political economy of sense of place. Studying West Virginia, Bell and York (2010) began their analysis with a puzzle: Why do so many West Virginians uncritically support the coal industry and oppose environmental and safety regulations when the industry provides relatively marginal economic benefits to the state? Bell and York explained that "public acquiescence to the wishes of industry is in part achieved by industries' calculated efforts to reconstruct a bond with the communities they degrade, attempting to replace the employment connection between industry and community with a constructed ideology of dependency and economic identity" (p. 116). The authors emphasized the role of astro-turf organizations like "Friends of Coal" and the use of regional celebrities in pro-industry advertisements to construct a "community economic identity" in which coal extraction is believed to be of central economic, social, and cultural importance. Thus, the meanings people attach to the places and communities in which they live can be a result of power relations and deliberate efforts by powerful actors to construct place meanings. [5]

Bell and York (2010) argued that community economic identity is constructed via top-down efforts of powerful actors; their model implies a type of "false consciousness" as it relies on highly structural Marxist theorizing and presents actors as relatively powerless in the face of hegemonic industries. Malin (2015) conducted a relevant study of the siting of a uranium facility in rural Colorado. Residents of the effected communities strongly supported the uranium facility

[5] Sometimes scholars study community economic identity without invoking the term. In his study of fracking in Louisiana Ladd (2014) notes that: "Louisiana residents have long shown a high degree of comfort with the oil and gas industry, implicitly trust it to create jobs and wealth, ensure worker safety, and protect the environment"(p.304-305).

as uranium was a central part of their collective identity. Malin's research suggested that more than just industry public relations drive community economic identity. Rather, community economic identity has deep historical antecedents rooted in a community's sense of self-determination and justice.[6]

Perceptions of the significance of particular industries may be especially important in local land use and environmental conflicts as some industries may come into conflict or "collide". Gasteyer and Carrera (2013) provided a relevant case study from rural Illinois. Despite the region's history of coal mining, there was wide spread resistance to a new coal mining technique (long wall mining) which was believed to have unusually high environmental impacts. However, environmentalist values or abstract environmental concern did not motivate resistance to coal. Rather, many residents believed that environmentally destructive coal mining would interfere with the region's robust industrial agricultural economy centered on soybeans and corn. In this case, the agricultural aspects of community economic identity trumped the extractive aspects of community economic identity. This study suggested that, in addition to considering community economic identity related to the oil and gas industry, scholars should consider community economic identity related to other industries, as well.

**Place Protective Behavior**

Sense of place may partially explain other public responses towards local energy projects (Devine-Wright 2005; Devine-Wright and Howes 2010; Jacquet and Stedman 2013). Devine-Wright (2005; 2009) critiqued the notion of NIMBYism ("Not in my back yard"). Chiefly focused on wind energy projects, Devine-Wright argued individuals' "place protective"

[6] In addition, economic factors, such as persistent poverty, may increase support for potentially hazardous industries (Luloff, Albrecht and Bourke 1998) though the evidence is mixed since it has also been the case that poor people often resist potentially harmful industries (Bohon and Humphrey 2000; Bullard 2000).

orientation could explain local resistance. New industries—such as wind energy projects or fracking—may suddenly alter natural or social environments. Thus, energy development might disrupt the place as a source of bonding, meaning, and identity. Communities may actively resist changes in places that hold cultural or social significance.

As noted above, the policy response to the fracking boom has varied significantly from place to place within Colorado, with some municipalities threatening to secede from the state over new oil and gas regulations. Residents of communities that are relatively supportive of oil and gas development likely have a community economic identity rooted in the oil and gas industry. That is, the oil and gas industry may be an especially significant component of their place along historical, cultural and economic lines. As such, efforts to resist regulation of the industry are a type of place protective behavior as regulation is often seen as a threat to industry (Cabrejas 2012; Freudenberg, O'Leary and Wilson 1999; Peeples et. al. 2014). That is, the state succession movement mentioned above is possibly a type of "place protective" mobilization because people believed that increased regulations threatened a significant aspect of place.

**Risk and Benefit Perceptions**

In the public mind, fracking is associated with environmental harms, negative effects on public health, infrastructure impacts, and quality of life impacts (Jacquet 2012; Jacquet and Stedman 2013; Perry 2012; Schaft, Borlu and Glenna 2013; Theodori 2009; Willow 2015).[7]On the other hand, the public also perceives an array of benefits such as job creation, tax revenue, energy independence, and reduced carbon dioxide emissions (Anderson and Theodori 2009; Ladd 2013; Schaft et. al. 2014). No studies have examined how fracking risk and benefit perceptions impact support for specific regulatory policies though perceived economic benefits

[7] Typically, in many of these and related studies risk perceptions are the dependent variable; in this chapter, I argue that risk likely has a role as an independent variable in predicting policy support.

may lead people to support fracking in a more general sense (Kriesky et. al. 2014; Malin 2014). Risk perceptions about climate change are associated with support for climate change policy (Leiserowitz 2006; O'Connor, Bord and Fisher 1999; Park and Vedlitz 2013)—suggesting that fracking risk perceptions are also likely to increase support for restrictive regulation.

There is conflicting evidence about the role of actual proximity to environmental or technological hazards in predicting risk perceptions. Some studies have shown that proximity to oil and gas operations is associated with increased risk perception (Boudet et. al. 2016; Schaft, Borlu and Glenna 2013) while other research suggests that living near dangerous or potentially toxic industrial activity can become "normalized" via several complex social processes (e.g. Malin 2013; Zavestovski et. al. 2004; Zavestovski et. al. 2002). Thus, in addition to actual, objective proximity to oil and gas activity, it is important to consider unwelcome proximity.

**Other Predictors of Policy Support**

Several other variables affect environmental policy attitudes. Konisky, Milyo and Richardson (2008) observe a small effect of trust in government on support for environmental policy. Harring (2013) finds a positive association between willingness to make economic sacrifices for the environment and political trust; also, the author reports that political corruption reduces willingness to sacrifice. Corruption and lack of trust also cause people to believe that environmental policy is less effective (Harring 2014).

Trust in major institutions, such as the oil and gas industry or state regulatory agencies, may be especially important in Colorado. The Colorado Oil and Gas Conservation Commission (COGCC) is the primary regulatory body responsible for oversight of the oil and gas industry. Critics have argued that the COGCC employs too many former oil and gas industry employees, (CBS News 2013b; Marshall 2013). Using interviews and documentary analysis, Opsal and

Shelley (2014) concluded that the COGCC suffers from regulatory capture. Thus, some Coloradoans may support stricter regulation on oil and gas extraction, but they believe that regulators are too close to the industry, rendering enforcement and punishment inconsistent at best and unlikely at worst. Prior research suggests that people do not necessarily trust local governments more than state or national governments (Petrzelka, Marquart-Pyatt and Malin 2013). However, the municipal fracking bans and moratoria imply that, at least on oil and gas related issues, Coloradoans may trust their local government more than the state government. In addition, trust in the oil and gas industry may reduce risk perceptions, which in turn might reduce support for regulatory policy since people who trust the oil and gas industry may not feel that it needs regulation from the state.

Several additional variables that account for environmental policy support—such as political ideology, gender, age, education, and income (Flynn, Slovic and Mertz 1994; Pampel and Hunter 2012; Stern, Dietz and Kalof 1993; Xiao and McCright 2013). Of these, political ideology is one of the more powerful explanatory variables. Self-assessed conservatives and Republicans report lower levels of environmental concern (Dietz, Stern and Guagnano 1998; Hamilton, Colocousis and Duncan 2010) and are less likely to support environmental policy or take environmental action (Gromet, Kunreuther and Larrick 2013; Kotchen, Boyle and Leiserowitz 2013). Some environmental issues, such as climate change, have become especially polarized over the last few decades (McCright and Dunlap 2011a; 2011b), though it is unclear if views about fracking policy are similarly polarized.

The reasons why political identification is so strongly associated with both abstract environmental views and environmental policy preferences are less clear. Regarding climate change, evidence suggests that industry front groups, think tanks, and conservative media figures

have been key figures in a "climate denial" movement, which has galvanized conservatives' opposition to climate policy efforts and even to the science of climate change (Elsasser and Dunlap 2013; Jacques, Dunlap and Freeman 2008; McCright and Dunlap 2003, 2010).

Political ideology has not been a central variable of interest for scholars studying unconventional oil and gas. National opinion polls indicate some partisan polarization on general perceptions of fracking (Boudet et. al. 2014). However, politicians of varying political stripes support unconventional natural gas extraction. Thus, it is unclear how relevant partisan identification or political ideology is for local resistance or acquiescence to oil and gas activity.

**Hypotheses**

Following the theories outlined above, I expect that support for fracking policy hinges upon place-related variables such as community economic identity as well as risk and benefit perceptions. Hence, this chapter tests the following hypotheses:

Hypothesis 1: Place attachment is associated with support for restrictive fracking regulation.

Hypothesis 2: Community economic identity around the oil and gas industry *reduces* support for fracking regulation.

Hypothesis 3: Community economic identity around other industries *increases* support for the regulation of fracking.

Hypothesis 4: Risk perceptions are *positively* associated with endorsement of regulation.

Hypothesis 5: Benefit perceptions are *negatively* associated with support for regulatory policy.

Hypothesis 6: Actual proximity to oil and gas operations will have no effect on support for regulations (H6a), while unwanted proximity will increase support (H6b).

## DATA, MEASURES AND METHODS

### Data

To test these hypotheses, I used unique survey data collected in the fall of 2014. The data comes from a random digit dial survey of Colorado residents and the sample includes both landlines and cell phones. The spatial distribution of unconventional oil and gas distribution is highly unequal within Colorado—of the roughly 55,000 active oil and gas wells, some 21,000 are in Weld County, and another 10,000 are concentrated in sparsely populated Garfield County. A random sample of Colorado residents would produce data that included respondents concentrated in the metropolitan Denver area where there is relatively little drilling. To ensure that the study represented the opinions of people who live near oil and gas drilling, intensive drilling counties were oversampled. I divided Colorado's counties into strata based upon the number of active wells and randomly sampling within those strata.

I significantly revised the instrument after the research team conducted extensive pre-testing. Administration of the survey occurred in both English and Spanish. The final response rate was 9% using the most conservative response rate formula (AAPOR RR1)—similar research has produced roughly the same response rate (Boudet et. al. 2014; Clarke et. al. 2016; Pew 2014). Using AAPOR RR6, which assumes that cases of no contact are ineligible, the response rate was 14%. I ask that the reader bear in mind that response rates and data quality are two distinct issues—is it possible that a survey might have a high response rate yet. al. so contain a great deal of bias due to poor design (Groves 2006; Keeter et. al. 2008; Rosen et. al. 2014; Wagner 2012). The completion rate was 95%.

The public tends to use the term "fracking" to describe the entire drilling process, from exploration to the disposal of wastes. However, fracking is more technically a short-term

technique used to stimulate wells. Evensen et. al. (2014) found that the term "fracking" elicited more negative responses than the term "shale gas development". However, Stoutenborough, Robinson and Vedlitz (2016) find no difference in response between the terms "hydraulic fracturing" and "fracking". To avoid biasing responses, the instrument used the phrase "oil and gas activity".

*Dependent Variable: Policy Scale.* The dependent variable was a scale constructed from a series of questions that ask about specific regulatory policies for unconventional oil and gas extraction. These included requiring oil and gas companies to disclose the chemicals used in drilling, stricter setbacks from homes and schools, prohibition of drilling on public land, real time monitoring of air and water pollution, regulations on noise pollution, and special taxes to pay for problems caused by oil and gas drilling or to fund alternative energy. Respondents could "Strongly Support" to "Strongly Oppose" these items. Table 2.1 reports the distribution of each question. In general, Coloradoans were supportive of regulations on the oil and gas industry. About 87% of respondents indicated "strongly support" or "support" for disclosure rules, while that same figure for residential and school setbacks is about 77%. There was somewhat less support for restricting drilling on public lands (48%). There was support or strong support for air pollution monitoring (80%), water pollution monitoring (86%), noise limits (60%), taxes for problems caused by oil and gas (75%) and even taxes on oil and gas drilling to fund renewables (67%).

**Table 2.1 Distribution of the Individual *Policy Scale* Items**

| | Strongly Support % | Support % | Oppose % | Strongly Oppose % |
|---|---|---|---|---|
| Disclosure | 44.3 | 43.04 | 8.35 | 4.3 |
| Residential Setback | 33.85 | 41.1 | 19.01 | 5.99 |
| School Setback | 35.2 | 41.8 | 17.09 | 5.87 |
| Restricting Drilling on Public Land | 15.68 | 32.7 | 36.22 | 15.41 |
| Air Pollution Monitoring | 31.61 | 48.19 | 16.84 | 3.37 |
| Water Pollution Monitoring | 40.15 | 46.21 | 10.86 | 2.78 |
| Noise Limits | 17.96 | 46.41 | 29.01 | 6.63 |
| Tax for problems caused by oil and gas | 28.31 | 47.09 | 18.25 | 6.35 |
| Tax to fund renewable energy | 25.59 | 41.1 | 21.37 | 11.87 |

After calculating a polychoric correlation matrix[8] for these items, I performed an exploratory factor analysis using the iterated principal factors technique for factor extraction. This analysis produced a single factor solution (eigenvalue=5.4, all variables loaded above .4, 89% of variation accounted for). I then calculated an additive scale using these items that produced a Cronbach's alpha of .89. The combined results of the factor analysis and Cronbach's alpha strongly suggest that a single latent factor underlies these questions.

*Predictor: Community Economic Identity.* A novel set of questions in which respondents rated the importance of various industries to their area assessed community economic identity.[9] These industries included the following: tourism, oil and gas activity, agriculture, colleges and universities, hospitals and medicine, wind and solar, high technology (e.g. computers, software, or the internet), brewing/distilling, and manufacturing. A strong majority (65%) ranked tourism

[8] By default, most software packages use a Pearson correlation matrix for factor analysis. Polychoric correlations are specifically designed to estimate the relationship between ordinal variables (Olssson 1978) and are recommended for use in factor analysis with ordinal data (Halgoda-Tello 2010).

[9] Blaacker, Woods and Oliver (2012) provide the only other quantitative operationalization of community economic identity using a sample of West Virginia college students. I adapted their indicators and found that they pretested poorly. The new indicators developed for this study performed well in cognitive pre-testing.

as “important” or “very important.” The distribution of oil and gas activity is split roughly in half between “very important” and “important” and “somewhat important” and “not at all important.” 76% of respondents rated Agriculture as “very important” or “important”. Colleges and universities and hospitals and medicine follow roughly the same distribution; about 70% of respondents answered “very important” or “important.” Like oil and gas activity, wind and solar was split roughly evenly between “very important” or “important” and “somewhat important” and “not important.” A majority (71%) named high technology as “very important” or “important.” This same figure for brewing and distilling is only 46%. Manufacturing was rated as “very important” or “important” by 55% of respondents.

Exploratory factor analysis using a polychoric correlation matrix and iterated principal factor extraction was performed on these items. The initial solution was highly ambiguous, with very low eigenvalues (e.g. at or below 1.0), and the items cross-loaded on multiple factors. The correlation matrix shown in Table 2.2 provides a more nuanced understanding of the relationship between these items.

**Table 2.2. Polychoric Correlations for the Community Economic Identity Items**

| | Tourism | Oil and Gas Activity | Agriculture | Colleges and Universities | Hospitals and Medicine | Wind and Solar | High Technology | Brewing and Distilling |
|---|---|---|---|---|---|---|---|---|
| Tourism | 1.000 | | | | | | | |
| Oil and Gas Activity | 0.232 | 1.000 | | | | | | |
| Agriculture | 0.183 | 0.498 | 1.000 | | | | | |
| Colleges and Universities | 0.191 | 0.126 | 0.148 | 1.000 | | | | |
| Hospitals and Medicine | 0.108 | 0.100 | 0.224 | 0.719 | 1.000 | | | |
| Wind and Solar | 0.200 | -0.002 | 0.156 | 0.400 | 0.382 | 1.000 | | |
| High Technology | 0.175 | 0.144 | 0.032 | 0.413 | 0.390 | 0.260 | 1.000 | |
| Brewing and Distilling | 0.217 | 0.156 | -0.011 | 0.420 | 0.354 | 0.267 | 0.389 | 1.000 |
| Manufacturing | 0.096 | 0.228 | 0.223 | 0.359 | 0.345 | 0.391 | 0.404 | 0.299 |

Generally, correlations between items were very low. However, a few correlations are rather strong. There was a strongly correlation between "Hospitals and Medicine" and "Colleges and Universities," (.719) and both have a moderate correlation with "Wind and Solar" and "High Technology". A separate exploratory factor analysis was run on these items alone, which provided evidence of a single factor solution (eigenvalue= 1.9, factor loadings above .55, 88% of variance accounted for). More theoretically, these items all relate to white-collar industries that involve a high-degree of human capital. An additive scale was created with Cronbach's alpha= .69 where high values are associated with increased importance.

Further analysis of the correlation matrix reveals that "agriculture" and "oil and gas activity" moderately correlated. When combined, these items only produced an alpha coefficient of .56, below an acceptable level. Given the theoretical importance of the "oil and gas activity" variable, it is used as a stand-alone predictor in the regression models. As with other variables, it was reverse coded so that higher values indicate more importance.[10]

*Predictor: Place Attachment*. Several possible place attachment scales pretested poorly.[11] The instrument did not first define a place and proceed to ask respondents about their level of attachment to it—the usual strategy in place attachment research.[12] Instead, respondents considered "your local area and the place that you live." A strong majority of respondents reported high levels of community and natural attachment. I dichotomized these variables were a

[10] In unreported models we included Agriculture as a predictor but it had null effects.
[11] For instance, the scale offered by Scannell and Gifford (2010b) was pre-tested. Respondents described several questions as "silly" and occasionally laughed. Respondents also complained that the scales were highly repetitive and occasionally grew agitated. Motivated by these concerns, I opted for a simpler way of measuring place attachment.
[12] For instance, Jorgenson and Stedman (2001) asked respondents about their attachment to their lakeshore properties while Ramkisoon, Smith and Weiler (2013) studied sense of place related to a national park. While pre-defining a place for respondents in a survey instrument was appropriate for these studies, it was deemed inappropriate for this research given that it uses a statewide sample.

"1" was given to respondents with community or natural attachment and a "0" was given to those with low or no attachment.

*Predictor: Risk and Benefits.* Respondents assessed the risks they perceived from unconventional oil and gas development including the following: community quality of life, road traffic, air or water quality, land use, noise pollution, human health, wildlife/livestock health, and real estate values. These items used a likert-type scale ranging from strongly disagree to strongly agree. Except for "community quality of life," the distributions of these items are markedly similar. For instance, 55% percent of respondents perceive negative impacts on air or water quality, and roughly the same number perceive impacts on wildlife or human health. Exploratory factor analysis using a polychoric correlation was performed on these items, revealing a single factor solution (eigenvalue=6.6, 92% of variance explained, lowest loading on the factor was .77). From here I created an additive scale where higher values are associated with more risk perception (Cronbach's alpha=.94).

To capture unwanted proximity, respondents were asked if they feel they live too close to oil and gas activity (0=no, 1=yes). For actual proximity COGCC data was used to calculate the distance to the nearest well for each respondent in miles. Because I did not have actual addresses for the respondents, I assigned each respondent to the population centroid of their zip code. Respondents varied significantly on this variable from .07 miles to around 28 miles.[13]

Benefits items included community quality of life, job creation, tax revenue, community infrastructure, energy independence from foreign oil, the development of clean energy, and

[13] A shape file downloaded from the COGCC was scrapped for active oil and gas well latitude and longitude using the shp2dta command, and the command user written geonear was then used to calculated distance to the nearest well. The primary disadvantage of this method is that I do not have access to actual addresses for the anonymous survey respondents. However, this method is more precise than other options, such as using county-level well counts or oil and gas production figures.

reducing household energy bills assessed using a likert type scale (i.e. strongly disagree to strongly agree). I conducted exploratory factor analysis using a polychoric correlation matrix using iterated principal factors for factor extraction. This produced an unambiguous single factor solution with an eigenvalue of 4.6 and factor loadings more than .6 for all variables; indeed, several factor loadings exceeded .9. Because the exploratory factor analysis strongly suggested that a single latent variable underlies these items, an additive scale with Cronbach's alpha of .89 was constructed; in this scale, higher values mean greater perception of benefit.

*Control Variables.* I controlled for trust in the two major oil and gas regulatory agencies within Colorado — the Colorado Oil and Gas Conservation Commission (COGCC) and Colorado Department of Public Health and Environment (CDPHE) — and the oil and gas industry. These items used four response categories: no trust, very little trust, some trust, and a great deal of trust. A minority of respondents reported a "great deal of trust" in the oil and gas industry (25%), while the mode is "some trust" (43%). Most respondents have "some trust" in the COGCC (63%) and CDPHE (57%).

Political ideology was captured using a variable which ranges from 1=very Liberal to 5=very Conservative. No single group reaches a majority, though over 30% of respondents identify as moderate—in national elections Colorado is typically a "swing state" with many moderates and unaffiliated voters. A few respondents gave ambiguous responses (e.g. "pissed off" or "I hate 'em all") which could not be coded into a valid category. Race was a dummy variable (1=white and 0=all others) as is sex (0=male and 1=female). I coded age in years. Education was recoded slightly as the "less than high school" category was combined with "some high school" due to data sparseness; the recoded variable ranged from 1 (less than high school) to 6 (PhD or other graduate degree). A six-category variable for income was also

included (1= $0-$25,000, 6= $150,000 or more). Table 2.3 provides descriptive statistics for all predictors.

**Table 2.3 Descriptive Statistics for all Variables**

| | Mean | Standard Deviation | Minimum | Maximum | Polychoric Correlation w/ Policy Scale |
|---|---|---|---|---|---|
| **Political Ideology** | 3.11 | 1.21 | 1 | 5 | -.492 |
| **Education** | 4.45 | 1.37 | 1 | 6 | .171 |
| **Age** | 51.65 | 16.25 | 18 | 89 | -.008 |
| **White** | 0.82 | 0.38 | 0 | 1 | .103 |
| **Female** | 1.48 | 0.50 | 1 | 2 | .131 |
| **Income** | 3.61 | 1.63 | 1 | 6 | -.074 |
| **Trust- Oil and Gas Industry** | 2.22 | 0.98 | 1 | 4 | -.646 |
| **Trust- COGCC** | 2.19 | 0.77 | 1 | 4 | -.171 |
| **Trust- CDPHE** | 2.14 | 0.82 | 1 | 4 | .156 |
| **CEI- Oil and Gas** | 2.31 | 1.14 | 1 | 4 | -.329 |
| **Community Attachment** | 0.91 | 0.29 | 0 | 1 | -,001 |
| **Natural Attachment** | 0.94 | 0.24 | 0 | 1 | -.076 |
| **White Collar** | 1.64 | 0.68 | 0 | 3 | .059 |
| **Risk Scale** | 1.42 | 0.67 | 0 | 3 | .597 |
| **Benefit Scale** | 2.07 | 0.63 | 1 | 4 | -.534 |
| **Distance to nearest well** | 3.45 | 4.12 | 0.07 | 28.17 | .081 |
| **Unwanted proximity** | 0.11 | 0.31 | 0 | 1 | .582 |

## Statistical Models

I used ordinary least squares regression, which adjusts for the stratified sampling design and includes probability weights, to model the influence of the predictor variables on the policy support scale. Multicollinearity was not a problem in any of the model (i.e. the highest VIF was 2.45) and a plot of the residuals against the fitted values suggested a lack of heteroscedasticity.

I adopted a stepwise approach to model building. The first model included only control variables; the second added the place attachment items; the third added community economic identity; and the fourth model included the risk and benefit perceptions. I trimmed variables that do not reach statistical significance and do not contribute to the model (in terms of $R^2$

improvement) from subsequent models for the sake of parsimony. Table 2.4 shows regression coefficients, standard errors, p-values and model fit statistics.

*Model 1*. Model 1 only included the socio-demographics, political ideology, and trust control variables. Political ideology was a strong predictor of policy attitudes; self-identified conservatives were less supportive of regulating unconventional oil and gas development. People with more education, older residents, and women were more likely to endorse regulations than men. Income, on the other hand, has relatively little influence; only two categories are significantly different from the reference category. Trust has a more complex impact. Trust in the COGCC had almost no effect, while a lack of trust in the oil industry and the CDPHE both reduce policy support.

*Model 2.* Model 2 added the binary place variables for community attachment and natural attachment. Both coefficients are substantively small and neither reach statistical significance. Compared to the prior model, political ideology had relatively little influence; only "very conservative" is statistically different from "very liberal." Trust in the oil and gas industry, the CDPHE and many of the socio-demographics—such as education, sex, and age— retained relatively similar effects as in Model 1. These models excluded trust in the COGCC and income. An unreported model included income; none of the categories reaches statistical significance, and including these items in model 2 only improves the $R^2$ by .01.[14]

*Model 3.* Model 3 added the community economic identity items. Community economic identity around the oil and gas industry had some impact on policy support as the "very

[14] The lack of an effect of trust in regulators is worthy of further discussion. One possibility is that some respondents, particularly politically conservative respondents, have a general distrust of state regulators, while other respondents may distrust because they perceive regulators as corrupt or inept (Opsal and Shelley 2014). To some degree, these twin forces may cancel out the effect of trust in regulators on policy support.

important" category was significantly different from the "not at all important" category; and "somewhat important" approaches significance at a conventional alpha level (i.e. p=.05). The white collar/ industrial scale, on the other hand, had almost no impact. As in Model 2, there was relatively little effect of political ideology or race, while women, older, and education were positively associated with support for restrictive regulation. Neither of the place attachment variables were included in Model 3, in part because of their lack of effect in model 2, and because the $R^2$ is slightly higher in this model if they are not included.

*Model 4.* Model 4 added the risk and benefit perception variables (risk scale, benefit scale, unwanted proximity, and distance to the nearest well). Risk perceptions increased support for unconventional oil and gas regulation while benefit perceptions had a much smaller and not statistically significant effect. Proximity to oil and gas operations, either real or unwanted, had negligible influence. As in Model 3, political ideology had an effect only at its extremes since very conservative persons are significantly different from very liberal persons. Except for sex, other socio-demographic variables had roughly the same effect. The role of trust in the oil and gas industry and the CDPHE in predicting policy support was robust against the inclusion of the risk and benefit variables. I excluded the white collar/industrial scale because it had relatively little effect in the prior model—in an unreported model, I included this variable, and the $R^2$ is virtually identical to the reported model.

**Table 2.4 Weighted OLS Models for Policy Support**

| | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b | se | p | b | se | p | b | se | p | b | se | p |
| **Political Ideology** *(ref very liberal)* | | | | | | | | | | | | |
| *Somewhat liberal* | -0.194 | 0.128 | 0.140 | -0.040 | 0.105 | 0.704 | 0.013 | 0.117 | 0.914 | 0.057 | 0.103 | 0.586 |
| *Moderate* | -0.272 | 0.123 | 0.035 | -0.153 | 0.117 | 0.200 | -0.146 | 0.131 | 0.275 | -0.097 | 0.125 | 0.443 |
| *Somewhat Cons.* | -0.280 | 0.145 | 0.063 | -0.213 | 0.127 | 0.103 | -0.161 | 0.144 | 0.272 | -0.104 | 0.124 | 0.406 |
| *Very Cons.* | -0.596 | 0.125 | 0.000 | -0.451 | 0.119 | 0.001 | -0.402 | 0.113 | 0.001 | -0.290 | 0.090 | 0.003 |
| **Education** *(ref less than HS)* | | | | | | | | | | | | |
| *High School* | 0.282 | 0.151 | 0.073 | 0.251 | 0.147 | 0.098 | 0.270 | 0.162 | 0.105 | 0.227 | 0.163 | 0.174 |
| *Trade or Vocational* | 0.239 | 0.182 | 0.198 | 0.161 | 0.177 | 0.372 | 0.181 | 0.192 | 0.355 | 0.180 | 0.194 | 0.362 |
| *Some College* | 0.512 | 0.149 | 0.002 | 0.453 | 0.131 | 0.002 | 0.444 | 0.140 | 0.003 | 0.435 | 0.152 | 0.007 |
| *College* | 0.314 | 0.140 | 0.033 | 0.301 | 0.128 | 0.025 | 0.292 | 0.140 | 0.045 | 0.285 | 0.151 | 0.067 |
| *Post Grad* | 0.298 | 0.157 | 0.069 | 0.285 | 0.140 | 0.050 | 0.317 | 0.167 | 0.067 | 0.315 | 0.169 | 0.071 |
| **Age** | 0.006 | 0.002 | 0.003 | 0.005 | 0.002 | 0.003 | 0.004 | 0.001 | 0.019 | 0.004 | 0.001 | 0.008 |
| **White** | 0.026 | 0.084 | 0.754 | 0.028 | 0.090 | 0.760 | 0.068 | 0.080 | 0.401 | 0.019 | 0.079 | 0.806 |
| **Female** | 0.084 | 0.034 | 0.018 | 0.065 | 0.032 | 0.052 | 0.076 | 0.036 | 0.045 | 0.051 | 0.034 | 0.138 |
| **Income** *(ref $0-$25,000)* | | | | | | | | | | | | |
| *$26,000-$50,000* | 0.189 | 0.075 | 0.018 | | | | | | | | | |
| *$51,000-$74,000* | 0.114 | 0.092 | 0.226 | | | | | | | | | |
| *$75,000-$100,000* | 0.094 | 0.100 | 0.352 | | | | | | | | | |
| *$101,000-$149,000* | 0.225 | 0.114 | 0.057 | | | | | | | | | |
| *$150,000 or more* | 0.039 | 0.090 | 0.666 | | | | | | | | | |
| **Trust- Oil and Gas Industry** *(ref great deal of trust)* | | | | | | | | | | | | |
| *Some Trust* | 0.074 | 0.127 | 0.563 | 0.196 | 0.052 | 0.001 | 0.206 | 0.066 | 0.004 | 0.115 | 0.071 | 0.114 |
| *Very Little Trust* | 0.249 | 0.113 | 0.036 | 0.594 | 0.090 | 0.000 | 0.634 | 0.102 | 0.000 | 0.400 | 0.114 | 0.001 |
| *No Trust* | 0.383 | 0.141 | 0.011 | 0.895 | 0.096 | 0.000 | 0.838 | 0.074 | 0.000 | 0.496 | 0.115 | 0.000 |
| **Trust- COGCC** *(ref great deal of trust)* | | | | | | | | | | | | |
| *Some Trust* | -0.163 | 0.097 | 0.104 | | | | | | | | | |
| *Very Little Trust* | -0.065 | 0.116 | 0.577 | | | | | | | | | |
| *No Trust* | -0.108 | 0.149 | 0.474 | | | | | | | | | |
| **Trust- CDPHE** *(ref great deal of trust)* | | | | | | | | | | | | |
| *Some Trust* | -0.238 | 0.108 | 0.036 | -0.108 | 0.035 | 0.004 | -0.083 | 0.045 | 0.075 | -0.082 | 0.046 | 0.088 |
| *Very Little Trust* | -0.649 | 0.099 | 0.000 | -0.268 | 0.067 | 0.000 | -0.310 | 0.071 | 0.000 | -0.259 | 0.082 | 0.003 |
| *No Trust* | -0.863 | 0.101 | 0.000 | -0.311 | 0.116 | 0.012 | -0.297 | 0.104 | 0.007 | -0.267 | 0.102 | 0.013 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Community Attachment** | | 0.073 | 0.069 | 0.300 | | | | | | |
| **Natural Attachment** | | 0.080 | 0.080 | 0.325 | | | | | | |
| **White Collar** | | | | | 0.063 | 0.052 | 0.230 | | | |
| **CEI- Oil and Gas** *(ref not important)* | | | | | | | | | | |
| *Somewhat Important* | | | | | -0.089 | 0.047 | 0.068 | -0.093 | 0.041 | 0.029 |
| *Important* | | | | | -0.098 | 0.070 | 0.167 | -0.053 | 0.061 | 0.391 |
| *Very Important* | | | | | -0.248 | 0.095 | 0.014 | -0.164 | 0.074 | 0.035 |
| **Risk Scale** | | | | | | | | 0.208 | 0.030 | 0.000 |
| **Benefit Scale** | | | | | | | | 0.093 | 0.057 | 0.113 |
| **Unwanted Proximity** | | | | | | | | -0.037 | 0.065 | 0.579 |
| **Distance to Well** | | | | | | | | -0.001 | 0.005 | 0.904 |
| Constant | 1.832 | | 1.797 | | | 1.803 | | | 1.823 | |
| $R^2$ | 0.495 | | 0.471 | | | 0.479 | | | 0.520 | |

## DISCUSSION

The purpose of this chapter was to understand how community economic identity, risk (in the form of risk perceptions, actual proximity to oil and gas activity, and unwanted proximity), benefit perceptions, place attachment, and control variables impact support for fracking regulations. I organized this discussion around the six hypotheses listed above at the end of the theoretical background section

While other research has found that place attachment motivates support for various policies or place-protective measures (e.g. Devine-Wright and Howes 2009; Cross et. al. 2011), I found that place attachment does not influence fracking policy support—there is no support for hypothesis 1. Recall that the measures of place attachment were extremely general, and, perhaps, place-specific indicators would have not have produced null results. For example, Devine-Wright and Howes' (2009) case study of a wind energy citing controversy involved a landscape that was highly significant to the community under study; my indicators, by contrast, asked about community and natural attachment in a generic sense. Of course, the highly specific questions used in some community-based studies of place attachment (e.g. Bonaiuto et. al. 2002; Cross et. al. 2011; Kyle et. al. 2004) are probably not appropriate for a statewide survey.

In hypotheses 2 and 3, I suggested that community economic identity might explain fracking policy attitudes. Perceived importance of the oil and gas industry had a small, downward effect on policy support, lending some support to hypothesis 2. There was no evidence for the "colliding treadmills" perspective (hypothesis 3) because community economic identity related to industries other than oil and gas did not explain whether people want to regulate fracking. Bell and York (2010) use qualitative methods to understand community economic identity, and other research that studies collective identities around industries is also

mostly qualitative (Ladd 2014; Malin 2014, 2015). Though the quantitative operationalization of community economic identity presented in this analysis had relatively little effect, it is likely that community economic identity still matters for oil and gas policy. There is clearly a need for more research to develop a richer understanding of community economic identity and build a better scale.

Moving forward, risk perception was a notable predictor of policy support (hypothesis 4), while benefit perceptions had a null effect (hypothesis 5); and both actual proximity (hypothesis 6a) and unwanted proximity (hypothesis 6b) and were unimportant. Hence, the analysis presented here suggests that subjective risk perceptions are an especially important predictor of policy attitudes. There is relatively little research that tests how risk perceptions drive policy outcomes and this is an especially fruitful area for future research. Earlier I argued that benefit perceptions might lead to decreased policy support if regulation is seen as a threat to the oil and gas industry. It is possible that respondents did not view the regulations included in the policy scale variable as a direct threat to industry, leading to a null effect of benefit perceptions.

Some of the control variables warrant further discussion. Political ideology only had an effect at its extremes. Political ideology functions as a type of social identity in which highly partisan individuals rely on cues from elite members of their in-group to formulate their opinions (Damafol 2005; Levendusky 2010; Zaller 1990). Perhaps there is less ideological polarization in fracking politics than broader environmental issues like climate change; in other words, Coloradoans might not lean on political ideology heavily to inform their views about unconventional oil and gas extraction. Trust also proves to be an important factor. In each model, individuals who trust that the industry can operate safely were less supportive of regulation of

the oil and gas industry, while trust in one of the major state regulatory agencies increased support for regulation.

There are several limitations to this study; early, I described limitations related to question wording. Further, this study did not include all the possibly relevant predictors of environmental policy attitudes. For instance, I did not assess abstract environmental values (e.g. Dunlap et. al. 2000). However, environmental values are probably associated with other independent variables, such as conservatism, risk perceptions and trust in the oil and gas industry, so their omission is not a fatal flaw of this research. Indeed, it is possible that the inclusion of environmental values, while theoretically important, would do little to enhance the explanatory power of any of the models presented in this project. There are also several possible endogenous relationships not explored here. For instance, I found modest direct effect of political ideology, but is it is possible that ideology predicts risk perceptions, which in turn predicts policy preferences. Further, the limited resources available for this project limited the sample size.

Overall, results indicate that the politics of the fracking boom are not contingent upon "place;" with "place" being conceptualized as a bundle including community economic identity, place attachment, and actual and unwanted proximity to oil and gas activity. These variables had little to no influence on policy support, while trust and risk perceptions are especially important. Many of the place variables used here probably do not explain the differential response to fracking from place to place. Rather, risk perceptions and trust in the oil and gas industry probably have a differential spatial distribution from community to community, resulting in differential policy outcomes across places.

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# CH. 3 WILLINGNESS TO PAY FOR FRACKING REGULATION AMONG COLORADOANS

## SUMMARY

This chapter considered support for increasing the frequency of inspections of oil and gas operations using the contingent valuation method and logistic regression. I developed insights from Bell and York's concept of "community economic identity" and Gasteyer and Carrera's notion of "colliding treadmills" that suggested people may perceive the oil and gas industry as a threat to other locally significant industries or, alternatively, rally in support of the industry if it is deemed locally significant. However, I found no support for either of these perspectives. Rather, increased taxes to fund more frequent inspections are the most consistent predictor while risk perceptions and political ideology are also important predictors of willingness to pay for fracking regulations.

## INTRODUCTION

The depletion of easy to access oil and gas reserves has ushered in a new era of "tight oil" or "tough gas" in which horizontal drilling technologies and hydraulic fracturing (i.e. "fracking") are being used to access previously unreachable oil and gas deposits (Hughes 2013). Since the mid-2000s, these unconventional onshore drilling technologies have spread rapidly throughout the U.S. and created an unprecedented boom in domestic oil and gas production (Krupnick et. al. 2014; Yergin 2011)—from 2005 to 2015 domestic production increased some 30% (USDA-ERS 2016).

The fracking boom has also met with much controversy as it has been tied to negative impacts on public health (Colborn et. al. 2011; Hill 2014; Perry 2012; Kassotis et. al. 2013; Rabinowitz et. al. 2015) and the environment (Ferrar et. al. 2013; Holzman 2011; Howarth, Santoro, and Ingraffea 2011; Rozell and Reaven 2012). Yet, oil and gas development is also a source of jobs, economic growth and tax revenue (Driessen 2013; Energy from Shale 2015; Lee 2015; Newell and Raimi 2015). There has been an extremely divergent political response to fracking from place to place; the states of New York and Maryland have banned fracking, while other states (e.g. Pennsylvania and Colorado) have largely embraced oil and gas development (Simonelli 2012; Ziorgannis et. al. 2016). This fragmentary policy landscape is largely a result of selective exemptions from federal environmental and health regulations for oil and gas development; many states have struggled to implement an adequate regulatory response to the sudden boom in oil and gas production (Werner and Shapiro 2013).

Despite the political controversy and policy challenges presented by the fracking boom, little research has examined what types of policies the public supports. Social scientists have documented perceived threats and opportunities from fracking (Brasier et. al. 2013; Jacquet 2012; Schaft, Borlu and Glenna 2013; Silva and Crowe 2015) and surveyed general support for the process (Boudet et. al. 2014; Kriesky et. al. 2012; Silva, Crowe and Ceresola 2015). However, we know surprisingly little about what types of policies the public would like to see in place to regulate fracking. Moreover, we do not know what the public is willing to pay in exchange for oil and gas regulations in the wake of the current boom.

This chapter addressed this gap in the literature using survey data from Colorado, one of the key states in the unconventional oil and gas boom. To some degree, Colorado is a macrocosm of the nation because public response to the spread of fracking has varied significantly from

place to place within the state. To account for public policy preferences, I accessed the literature on place, risk and benefit perceptions, and other known predictors of policy attitudes. The dependent variable was a dichotomous choice contingent valuation question that assessed support for additional inspections of oil and gas operations. The next section described the theoretical understandings used to inform the subsequent empirical analysis.

## BACKGROUND

*What is "place"?* A vast, interdisciplinary literature has unpacked the nature of place. Places are more than simply a collection of natural characteristics and human infrastructure. Rather, several complex socio-cultural processes give meaning to places (Cross 2015; Massey 2010). This "sense of place" literature can be roughly organized into more qualitative or theoretical works which focus on the experiential nature of place (Gustafon 2011; Nardi 2014; Thwaites 2011; Tuan 1975, 1977) and a quantitative literature rooted in psychometrics (Jorgenson and Stedman 2006; Stedman 2002; Vaske and Kobrin 2011). People develop deep bonds with both the natural and social dimensions of a place (Knez 2005; Trentelman 2009; Scannell and Gifford 2010; Lukacs and Ardoin 2014; Hidalgo and Hernandez 2001). Further, people are dependent upon places to fulfill emotional, economic and even physical needs (Anton and Lawrence 2016; Gibbons and Ruddell 1995; Stedman 2003; Williams et. al. 1992). People whom are attached to a place will often engage in "place protective action" to protect meaningful places from unwanted changes from perceived threats (Anderson and Schirmer 2015; Devine-Wright 2005, 2009; Devine-Wright and Howes 2010; Kearns and Collins 2010).

Places, of course, also contain political and economic institutions. The sense of place literature has largely ignored these institutions (Ardoin 2006). However, other literature speaks to the political economy of "sense of place", even if the authors do not situate their work in that

literature. Bell and York (2010) argued that people develop a "community economic identity" around industries that are perceived as important to their place. Studying West Virginia, Bell and York (2010) observed that coal industry public relations have forged a collective identity around the coal industry; the authors called this "community economic identity." Even though coal provides very few jobs and is no longer the economic cornerstone of the state, West Virginians remain largely supportive of the industry.

To some degree, people who rally in support of environmentally or socially harmful industries may be engaging in a unique type of "place protective" behavior. That is, if an industry is widely perceived as economically, culturally or historically significant to a place, people who defend said industry may be doing so because they seek to protect valued aspects of their place. Some communities in Colorado have opposed more stringent regulation of the oil and gas industry in part because the industry is perceived as economically important and historically significant to their area and further regulation is seen as overly onerous—going so far as to threaten to secede from the state (Stablemore 2013). Hence, community economic identity around the oil and gas industry likely impacts willingness to pay to regulate the industry, and this chapter tested the following hypothesis:

> *Hypothesis 1: Community economic identity related to the oil and gas industry reduces willingness to pay for oil and gas regulation.*

However, places often contain multiple industries, and, to varying degrees, people may develop a collective identity around more than one industry. Gasteyer and Carrera (2013) provided a useful case study to understand the multi-dimensional nature of community economic identity. Examining central Illinois, the authors argued that both coal mining and large-scale agriculture were seen as significant industries; the authors did not invoke the term "community

economic identity" but argued that residents of central Illinois had a type of collective identity around both industries. At the local level, the growth imperatives of big agriculture and coal mining acted as "colliding" treadmills of production; the spread of long-wall coal mining was widely viewed as a threat to industrial agriculture and ultimately, residents resisted the expansion of mining. Thus, community economic identity is likely multi-dimensional, and support for oil and gas regulations may be higher if industries other than oil and gas are seen as significant or important—especially if oil and gas are perceived as a threat to those other valued industries. Following this multi-dimensional understanding of community economic identity, I tested the following hypothesis:

> *Hypothesis 2: Community economic identity related to other industries increases willingness to pay for oil and gas regulation.*

*Risk and benefit perceptions.* The public perceives an array of risks from unconventional oil and gas extraction such as impacts on public health, the environment, and local roads (Brasier et. al. 2013; Crowe, Ceresola and Silva 2015; Jacquet 2012; Schaft, Borlu and Glenna 2013). However, people also perceive many benefits including jobs, tax revenue, and energy independence from foreign oil (Brasier et. al. 2011; Jacquet and Stedman 2013; Ladd 2014; Malin 2013). Researchers have not examined how fracking risk perceptions influence policy preferences. However, risk perceptions predict policy support in other areas—such as climate change (Leiserowitz 2006; O'Connor, Bord and Fisher1999). To the best of my knowledge, no studies have examined how the perception of benefits influences policy attitudes using quantitative data. However, qualitative analyses suggest that communities may welcome the expansion of unconventional oil and gas extraction because of possible economic development (Ladd 2014; Malin 2013; Malin and Demaster 2016; Silva and Crowe 2015). Thus, people may

perceive regulation as a threat to a beneficial industry. On the other hand, perceived risks are likely to increase support for regulations. This chapter tests two hypotheses regarding risk and benefits:

*Hypothesis 3: Colorado residents who perceive more risk related to unconventional oil and gas development are more willing to pay for regulation..*

*Hypothesis 4: Perceptions of benefits from unconventional oil and gas will reduce willingness to pay for additional regulation.*

While it may seem rational that proximity to a source of risk or hazard will heighten risk perceptions or support for policies to address said risk there is limited support for this position in the literature. A range of social factors—such as the framing of risk by media and local political leaders—determine the public response to a source of risk (Kasperson et. al. 1988; Masuda and Garvin 2006; Renn et. al. 1992; Zavestoski et. al. 2002; 2004). Malin (2013) showed that Pennsylvania farmers who sign leases with the oil and gas industry see the expansion of drilling as an inevitable, market-driven process, thereby blunting any community resistance. Thus, living in a toxic environment can become "normalized" (Auyero and Swinstun 2008). Hence, proximity to a source of risk will not necessarily lead to a response—such as policy support or social movement mobilization. Rather, unwelcome proximity or unfamiliarity is more likely to lead people towards efforts to ameliorate a source of risk (Bickerstaff 2004; Song and Schwartz 2009). Informed by this literature, this chapter tests the following hypotheses:

*Hypothesis 5: Actual proximity to oil and gas drilling will have no effect on willingness to pay for regulation.*

*Hypothesis 6: Unwanted proximity will increase willingness to pay for additional regulation.*

**Environmental Valuation**

While sociologists have developed an impressive understanding of the individual and contextual factors that contribute to support for environmental policy, they are less apt to consider how features of a policy affect public support. Environmental and ecological economists, on the other hand, employ an array of techniques that uncover how characteristics of a policy influence whether people support it. A central question for environmental economics is environmental valuation, often in terms of what the public is willing to pay for a non-market good, such as environmental protection or environmental policy.

Some scholars critique the valuation of environmental protection as the "neoliberalization of nature;" the criticism is that by placing a dollar value on environmental protection, we are implicitly saying that environmental quality should be for sale as a type of consumer good. However, there are reasons to question whether environmental valuation leads to a cheapening of the environment. Fourcade (2011) studied the public response to large oil tanker spills in France and the U.S. She concluded that because the U.S. government employed valuation techniques, the punitive response to the oil industry for catastrophic accidents was much harsher than in France. Fourcade suggested that, from a Durkheimian perspective, environmental valuation "sacrilizes" the environmental as something worth being "set apart" (Fourcade 2011 p. 1770).

Environmental valuation can be understood as a larger part of a social process of commensuration; this is the process by which unlike items are increasingly compared with a common metric (Espelund and Stevens 1998; Espelund and Sauder 2008; Peeters and

Verschraegen 2014). This common metric is often, but not always, money (Dalsgaard 2013; Stephan 2012). To some degree, commensuration theory echoes the arguments of Simmel in the *Philosophy of Money*; Simmel argued that money increasingly underpins a relativistic understanding of the world (Simmel and Frisby 2004). Sociologists have already theoretically wrestled with questions of valuation and commensuration. Developing an empirical, sociological understanding of willingness to pay for environmental policy is a logical next step. To achieve this aim, I used the contingent valuation method (CVM), described further below. Regarding willingness to pay, I investigated the following hypothesis:

> *Hypothesis 7: As the personal economic sacrifice increases, support for additional regulations will decline.*

## DATA, MEASURES AND METHODS

### Data

A random digit dial survey of Colorado residents gathered in the latter half of 2014 provides the data used in this analysis. The sample included both landline and cell phones to guard against coverage bias. To represent residents of rural, high drilling areas I ranked Colorado's counties by the number of active wells and I then created strata based upon that ordering. Next, I randomly sampled households within those strata. Roughly 400 respondents completed the survey for a 5% margin of error. Using the most conservative response rate (AAPOR RR1), the response rate was 9%—this response rate is like that of other studies on energy and environmental issues (e.g. Clarke et. al. 2015; Pew 2014a, 2014b). A more inclusive response rate—AAPOR RR6—was 14%. While a greater response rate would have been ideal in that it would have resulted in a larger sample the current consensus among survey methodologists is that bias results from poor sampling designs or problems in data collection, not

low response rates per se (Groves 2006; Keeter et. al. 2008; Rosen et. al. 2014; Wagner 2012). 95% of respondents who began the survey completed it.

The term "fracking" may elicit more visceral, negative responses than terms that are more neutral like "shale gas development" (Evensen et. al. 2014). However, Stoutenborough, Robinson and Vedlitz (2016) found no differences between "fracking" and "hydraulic fracturing". As a further complication, the term "fracking" technically refers to a rather short-term stage in the drilling process in which high volumes of water and chemicals shatter rock and trapped oil and gas. However, the public tends to use "fracking" to refer to the entire process of onshore, unconventional oil and gas development from exploration to the disposal of waste after drilling has ended. To avoid biasing the results, the survey instrument used the phrase "oil and gas activity" which was defined at the beginning of the survey as follows:

> "'Oil and gas activity' could refer to exploration, drilling using hydraulic fracturing or 'fracking,' the transfer of oil and gas, and the storage of byproducts and waste."

Ideally, the definition provided at the onset of the survey will militate against the biases created by a stronger and less precise term like "fracking" while also being more specific than "development". Throughout this chapter, I have used the term "fracking" as a useful short hand that reflects public understanding of the term.

**What is CVM?**

Bowen (1943) and Ciriacy-Wantrup (1947) provided the groundwork for CVM. Both were concerned with how to price non-market goods such as landscapes and soil quality. Separately, each advocated for the use of surveys to elicit preferences for public goods—especially those related to the environment and natural resources. Modern CVM is a survey-

based methodology whose purpose is to quantify the value that the public is willing to pay for an "unpriced," non-market good like a natural amenity, ecosystem service, environmental policy, or biological diversity. The aim of a CVM study is to approximate the "price-taking" behavior of consumers in a market for more typical goods. The "contingent" in "contingent valuation" refers to the style of survey question used. Typically, a respondent is given a certain situation, a non-market good, and a value for that non-market good. This type of instrument facilitates the calculation of willingness to pay (hereafter "WTP") in explicit dollar terms. Aggregating WTP estimates, if the sample is representative, can give an estimate of public willingness to pay for a non-market good. Most often, CVM involves inserting a randomly varying dollar amount into a survey question as a type of survey experiment. [15,16]

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[15] CVM has become enormously popular for a number of applications in ecological, environmental and natural resource economics. A google scholar search for "stated preference" produced 31,400 results. A similar search for "contingent valuation" produced 45,000 results. Applications include climate policy (Berrens et. al. 2004), transportation (Lambert et. al. 2001), fisheries (Wattage et. al. 2005), mountain biking areas (Fix and Loomis 1998), and forests (Lindhjem 2007). The EPA, USDA, and other government agencies have funded many studies.

[16] Although CVM is very popular within economics, it is not without its critics. Noted economist Jerry Hausman dismisses CVM almost entirely (e.g. Hausman 2012).While some economists dismiss CVM completely, others have offered more substantive critiques that have improved the methodology. After the controversy surrounding CVM and the Exxon Valdez oil spill, The National Academy of Oceanic and Atmospheric Sciences assembled an expert panel to assess the use of CVM in valuation (Arrow et. al. 1993). Ultimately, this panel of experts concluded that CVM has a role in understanding environmental valuation.

Respondents may actually pay less if presented with the choice in the "real world" instead of in a survey—this is called "hypothetical bias". Hypothetical bias may also exist when a respondent does not know much about the environmental amenity, ecosystem service, or policy in question, or in poorly-designed surveys. In particular, studies that do not encourage the respondent to consider their own budget constraints may cause hypothetical bias. There are two common approaches to address hypothetical bias called ex-post and ex-ante (Aadland and Caplan 2006; Murphy, Stevens and Weatherhead 2005). The first, called the ex-post approach, involves asking a series of questions after the WTP question to provide a sort of robustness check for the CVM instrument. Commonly, a respondent is asked to rate their degree of certainty with their WTP response. Another ex-post technique is to ask a question similar to, but not identical to, the CVM instrument to see if responses change. For example, after a WTP question a study might ask a similar valuation question. Another technique has been to request actual payment after a WTP instrument.

Ex-ante approaches involve carefully designed survey instruments and other parts of the survey to force respondents to contextualize their answer to the CVM question within their personal or household budget constraints. The ex-ante approach to mitigating hypothetical bias can involves several different strategies such as reminding a

## Dependent Variable

The dependent variable assesses willingness to pay for increased inspections of oil and gas operations. In Colorado, the understaffed Colorado Oil and Gas Conservation Commission (COGCC) is responsible for inspections (Earthworks 2015; Ogburn 2013). While the estimates vary, most drilling locations go several years without a visit from an inspector (Earthworks 2015; Ogburn 2013). One proposed policy response to the fracking boom is increasing the frequency of inspections. Thus, the following question provides the dependent variable:

> "On average, the Colorado Oil and Gas Conservation Commission inspects each oil and gas operation about once every three years. Now, I'd like you to think about a possible increase in your state income taxes to hire additional inspectors so that all oil and gas sites in Colorado could be inspected at least once per year. Thinking about your household's finances, would you pay **$X** more in state income taxes PER YEAR to fund more frequent inspections of oil and gas operations?"

The bid amount given by **$X** was randomly varied across respondents; responses were evenly split between "yes" and "no" but varied significantly across bid amounts.[17] As shown in Table 3.1, at relatively low bid amounts, most respondents said, "yes," but as cost increased, respondents were more likely to say, "no". The bid amount was adjusted up or down throughout

respondent of their budget constraints and possible substitutes when applicable. Loomis, Gonzalez-Caban, and Gregory (1994) adopt both of these approaches but find no difference in WTP for groups exposed to reminders and those not exposed. Another approach to attenuating hypothetical bias, commonly called the "cheap talk" approach, stems from the work of Cummings and Taylor (1998; 1999). This approach involves an explicit description before the WTP instrument of the hypothetical bias problem. In other words, the study includes a block of text that tells respondents that people often overestimate their WTP. Further, hypothetical bias is lower when respondents believe that their answers will inform actual policy implementation (Vossler, Doyon and Rondau 2012). Most of these methodological issues remain unsettled. An example of cheap talk would be providing a detailed explanation of the hypothetical bias problem to the respondent and explaining that prior research has indicated that people tend to overestimate their willingness to pay. However, the actual effect of cheap talk scripts is not clear (Aadland and Capland 2006). In addition, I pre-tested a cheap talk script was removed after respondents reacted very negatively to it. CVM users continue to defend CVM and economists like Hausman, who dismissed CVM over two decades ago, continue their opposition.

[17] I chose these values so that a large number of respondents would answer "yes" and a large number would answer "no".

survey administration. I used the bid amount variable as a predictor of support in a binary logistic regression model. I called this variable *Inspections Tax.*[18],[19]

[18] The present study assessed response certainty for respondents who answered "yes" to the inspections question using a scale from 1 (not at all certain) to 10 (completely certain). Average response certainty was 8.9. The inspections item also correlates moderately too strongly with several other policy items included in the survey instrument (polychoric correlations range from .4 to .8).

[19] Other studies which have used CVM to examine unconventional oil and gas policy include Bernstein et. al. (2013), Siikamaki and Krupnick (2014) and Throupe, Stevens and Mao (2013).

**Table 3.1 Willingness to pay for increased state income taxes for *Inspections Tax***

| Bid Amount ($) | Yes | No | Row Total | % Yes |
|---|---|---|---|---|
| 2 | 5 | 5 | 10 | 50 |
| 3 | 0 | 1 | 1 | 0 |
| 5 | 6 | 3 | 9 | 67 |
| 8 | 3 | 5 | 8 | 38 |
| 10 | 3 | 7 | 10 | 30 |
| 12 | 8 | 1 | 9 | 89 |
| 15 | 4 | 5 | 9 | 44 |
| 18 | 6 | 3 | 9 | 67 |
| 20 | 17 | 11 | 28 | 61 |
| 25 | 7 | 13 | 20 | 35 |
| 28 | 10 | 8 | 18 | 56 |
| 30 | 14 | 4 | 18 | 78 |
| 35 | 4 | 5 | 9 | 44 |
| 37 | 5 | 3 | 8 | 63 |
| 40 | 10 | 8 | 18 | 56 |
| 42 | 1 | 3 | 4 | 25 |
| 45 | 4 | 5 | 9 | 44 |
| 50 | 7 | 11 | 18 | 39 |
| 55 | 5 | 5 | 10 | 50 |
| 58 | 4 | 2 | 6 | 67 |
| 60 | 10 | 6 | 16 | 63 |
| 65 | 5 | 3 | 8 | 63 |
| 70 | 12 | 6 | 18 | 67 |
| 75 | 2 | 8 | 10 | 20 |
| 80 | 11 | 15 | 26 | 42 |
| 90 | 3 | 5 | 8 | 38 |
| 100 | 6 | 0 | 6 | 100 |
| 110 | 1 | 8 | 9 | 11 |
| 125 | 13 | 19 | 32 | 41 |
| 150 | 5 | 4 | 9 | 56 |
| 175 | 3 | 7 | 10 | 30 |
| 250 | 1 | 7 | 8 | 13 |
| | 195 | 196 | 391 | |

**Predictor Variables**

*Community Economic Identity.* This chapter operationalized community economic identity (CEI) via questions that assess the perceived importance of a range of industries to a respondent's local area. These industries include oil and gas activity, agriculture, tourism, manufacturing, brewing and distilling, alternative energy (like wind and solar), high technology (computers, software and internet-based firms), colleges and universities, and hospitals. These indicators allow for a multi-dimensional understanding of community economic identity.

I utilized factor analysis to understand the underlying dimensions of these items. First, because all the relevant survey questions are ordinal, I calculated a polychoric correlation matrix. Then I used iterated principal factor extraction to factor the matrix and performed a varimax rotation. Tourism and manufacturing did not load strongly and had relatively low correlations with the other items. I treat these as standalone variables for the analysis. An additional factor analysis indicated that oil and gas activity loaded on a single factor, and colleges and universities, hospitals and medicine, wind and solar, high-technology, and brewing and distilling loaded on a second item; these were combined into an additive scale with Cronbach's alpha=0.63; I call this scale *CEI-Other.* Agriculture, on the other hand, had ambiguous cross-loadings across factors and I excluded it from further scale development and included it as a standalone predictor in the regression models estimated below. I treated the perceived importance of the oil and gas industry as a stand-alone item in the analysis reported below. These variables tested Hypotheses 1 and 2.

*Risk and Benefits.* Unconventional oil and gas extraction is associated with a range of risks and benefits in the public mind (e.g. Brasier et. al. 2011; Jacquet 2012). The survey instrument included questions related to risks such as threats to human health, non-human health,

air and water quality, community quality of life, road traffic, land use, noise pollution, and real estate values. Risk perceptions are highest for environmental problems and wildlife/livestock health. Both exploratory factor analysis and Cronbach's alpha confirmed that a single latent variable underlay these items. An additive scale with Cronbach's Alpha = .94 was constructed to examine Hypothesis 3.

I captured benefit perceptions using a series of items that included community quality of life, job creation, tax revenue, energy independence from foreign oil, investments in infrastructure, reducing household energy expenses, and promoting cleaner energy. As with risk, respondents perceived many benefits. Like risk, the Cronbach's alpha for these items was quite high (0.89), and exploratory factor analysis indicated a single factor solution. An additive benefit scale variable is included as a predictor to test Hypothesis 4.

Individuals can also become accustomed to living in proximity to potentially harmful industrial an extractive activity—familiar risks are less likely to produce a public response (Bickerstaff 2004; Song and Schwartz 2009). For this reason, I included a variable for *unwanted proximity*. Respondents were asked: "Do you feel oil and gas activity is too close to where you live?" (0=no, 1=yes). This question will facilitate the testing of hypothesis 5. To examine hypothesis 6, I calculated each respondent's distance to the nearest active oil and gas well in miles using a GIS shape file from the Colorado Oil and Gas Conservation Commission (COGCC 2014); because I did not have exact street addresses for the anonymous respondents I assigned them to the latitude and longitude of their zip code population centroid. Respondents varied quite extensively on this variable from .07 to 28 miles.

*Control Variables.* Trust in government institutions has been shown to increase support for environmental policy (Harring 2013; Konisky, Milyo and Richardson 2008; Zannakis,

Wallin, and Johansson 2015), while persons who trust in industries tend to have lower risk perception and potentially lower support for regulatory policy (Siegrist, Cvetkovich and Roth 2000; Whitfield et. al. 2009). Respondents assessed their degree of trust in the oil and gas industry to operate safely (1=no trust, 4= a great deal of trust). The survey also assessed trust in Colorado Oil and Gas Conservation Commission (COGCC), the primary regulatory body of oil and gas development in Colorado. Environmental groups argue that the COGCC favors the oil and gas industry (Cook 2014, 2015), and laypeople who have filed complaints against the industry with the agency report that the agency is ineffective and favors the side of industry in disputes (Shelley and Opsal 2014). Trust in the COGCC was assessed with a survey item where 1=no trust and 4= a great deal of trust. Respondents who own their own home may believe that oil and gas development will threaten its value—thus, I used a variable for homeownership (0=respondent did not own their home, 1= respondent did own their home).

Controls for sex (0=male, 1=female); age in years, education (0= less than high school, 6=graduate degree); income (0=less than $50,000, 1=$50,000 to $99,999, 2= $100,000 or more); race (0=non-white, 1=white); and political affiliation (0=not conservative, 1=conservative) are also included. Table 3.2 provides descriptive statistics and question wording for all predictor variables.

**Table 3.2 Descriptive Statistics for Predictor Variables**

| Variable Name | Description | Mean | SD |
|---|---|---|---|
| Risks | Scale (Cronbach's Alpha=.94) from the following items: community quality of life, road traffic, air or water quality, land use, noise pollution, human health, wildlife/ livestock health, and housing values | 1.42 | 0.67 |
| Benefits | Scale (Cronbach's Alpha=.89) constructed from following items: community quality of life, job creation, tax revenue, infrastructure investment, energy independence from foreign oil, the development of clean energy, and lower energy costs | 1.93 | 0.63 |
| Unwanted Proximity | Do you feel oil and gas activity is too close to where you live? (0=no, 1=yes) | 0.109 | 0.312 |
| Distance to Nearest Well | Author's calculation from COGCC data | 3.449 | 4.124 |
| Trust-Oil and Gas Industry | How much do you trust the oil and gas industry to operate safely? (1=no trust, 4= a great deal of trust) | 2.777 | 0.979 |
| Trust-COGCC | How much do you trust the COGCC to provide neutral oversight of oil and gas activity? (0=very little to no trust, 1= A great deal to some trust) | 0.763 | 0.426 |
| CEI-Other | Scale (Cronbach's Alpha=.63) constructed from the following CEI items: colleges and universities, hospitals and medicine, wind and solar, high-technology, and brewing and distilling | 1.64 | 0.68 |
| CEI- Oil and Gas | How important is oil and gas activity to your local area? (0=not at all important, 4=very important | 0.503 | 0.501 |
| Sex | 1=male, 2=female | 1.478 | 0.5 |
| Conservative | How would you describe your political beliefs? (0=not conservative, 1=conservative | 0.359 | 0.480 |

| | | | |
|---|---|---|---|
| Education | What is the highest level of education you have received? (0= less than high school, 6=graduate degree) | 4.453 | 1.368 |
| Income | What is your total household income before taxes? (0=less than $25,000, 6= greater than $150,000) | 1.062 | 0.799 |
| Age | Age in years (author's calculation) | 51.652 | 16.25 |
| White | What is your race or ethnicity? (0=non-white, 1=white) | 0.825 | 0.381 |
| Home Ownership | Respondent owns their home (0=does not own, 1=owns) | 0.791 | 0.407 |

## Modeling Strategy

Because the dependent variable is binary, I employed binary logistic regression. The experimental bid amount was included as a predictor and I adopted a stepwise model building strategy to understand the relative contribution of each group of variables. In binary logistic regression models, data sparseness can cause bias in the parameter estimates, and in more severe cases can lead to separation problems and even non-convergence (Albert and Anderson 1984; Peduzzi et. al. 1996). To avoid including unnecessary predictors in the models, I conducted an exploratory correlational analysis using polychoric correlations. I used polychoric correlations because most of the variables are categorical. Variables that correlated weakly with the outcome are not included in the binary logistic regression models. Table 3.3 displays these correlations.

*Bivariate Correlations*

**Table 3.3 Polychoric Correlations of Predictor Variables with *Inspections Tax***

| | |
|---|---|
| Bid Amount ($) | -0.17** |
| CEI-Other | 0.13 |
| CEI-Oil and Gas | -0.35** |
| CEI-Tourism | -0.03 |
| CEI-Agriculture | 0.28** |
| Risk | 0.58** |
| Benefits | -0.51** |
| Distance to Nearest Well | 0.01 |
| Unwanted Proximity | 0.58** |
| Trust-COGCC | -0.25 |
| Trust-Oil and Gas | -0.63** |
| Education | -0.01 |
| Income | -0.2 |
| White | -0.07 |
| Female | 0.12 |
| Age | -0.13 |
| Conservative | -0.51** |
| Home Ownership | -.11 |

*=p<.05, **=p<.01

The bivariate correlations indicated that several possible predictors correlate very weakly with *Inspections Tax* and I excluded them from the regression models. These variables are community economic identity related to white collar/industrial industries (rho=.13), tourism

(rho= -0.03) as do education (rho=-0.01), being white (rho=-0.07), female sex (rho=0.12) age (rho=-0.13), home ownership (rho=-.11) and distance to the nearest well (rho=0.01). Given their lack of correlation, these variables were not included in the regression models. Unsurprisingly, the bid amount is negatively correlated with support but the relationship is rather weak (rho=-0.17). On the other hand, several predictors correlate relatively strongly with *Inspections Tax*. Risk perceptions are associated with increased support (rho=0.58) while benefit perceptions have a similar correlation in a negative direction (rho=-0.51).

Before proceeding with the regression models, it is important to determine if some respondents might object to the payment vehicle in question—increased taxes. A follow-up question queried respondent's support for charging the oil and gas industry a fee to fund increased inspections. Seventy-three percent supported this policy and about 23% of the "no" responses to the dependent variable supported charging the industry a fee. Thus, a minority of respondents appears supportive of increasing oversight yet do not wish to bear the cost. Table 3.4 provides the average bid amount by support for charging industry a fee. The average bid amount is roughly the same in each category, suggesting that protest votes are not sensitive to the size of the tax increase.

**Table 3.4 Average Bid Amount by Support for Charging fee to Oil and Gas Industry.**

| | |
|---|---|
| Strongly Support | 58.66 |
| Support | 61.52 |
| Oppose | 59.60 |
| Strongly Oppose | 57.21 |

*Regression Models.* In this section, I present a series of binary logistic regression models. The first model included the controls for trust, income, and political ideology. In the next model, I dropped variables that were not statistically and practically significant and added community

economic identity related to the oil and gas industry. The third model tested for the "colliding treadmills" hypothesis by adding community economic identity around agriculture to the previous model. Finally, the fourth model included the risk and benefit perception scales and unwanted proximity, while dropping unnecessary variables from previous models. I then estimated predicted probabilities from this final model to understand the regression results more fully.

Table 3.5 reports modelling results. All models adjusted for the complex sampling design and included appropriate probability weights. Motivated by concerns about bias due to the relatively small sample size and number of predictors, I bootstrapped the standard errors using 5,000 replications.[20] Variance inflation factors did not exceed 2.1, indicating that the models were not plagued by multicollinearity.

[20] Bootstrapping involves drawing samples with replacement from the sample data. The reported standard error is the average the standard error from the 5,000 replications.

**Table 3.5 Binary Logistic Regression Models for *Inspections Tax***

| | Model 1<br>b(se) | Model 2<br>b(se) | Model 3<br>b(se) | Model 4<br>b(se) |
|---|---|---|---|---|
| **Bid Amount ($)** | -0.006*<br>(0.003) | -0.006*<br>(0.003) | -0.005<br>(0.004) | -0.007**<br>(0.003) |
| **Income (ref. less than $50,000)** | | | | |
| $50,000-$100,000 | -0.993**<br>(0.421) | -0.952**<br>(0.450) | -1.031**<br>(0.470) | -0.827*<br>(0.430) |
| More than $100,000 | -0.509<br>(0.406) | -0.505<br>(0.439) | -0.458<br>(0.457) | -0.371<br>(0.413) |
| **Conservative** | -0.910***<br>(0.342) | -0.884**<br>(0.354) | -0.957***<br>(0.368) | -0.820**<br>(0.348) |
| **Trust-Oil and Gas industry (ref. No trust)** | | | | |
| Very little trust | -0.657<br>(0.675) | -0.512<br>(0.699) | -0.629<br>(0.752) | 0.105<br>(0.785) |
| Some trust | -1.957***<br>(0.609) | -1.805***<br>(0.634) | -1.895***<br>(0.704) | -0.791<br>(0.783) |
| Great deal of trust | -2.819***<br>(0.693) | -2.594***<br>(0.718) | -2.736***<br>(0.807) | -1.303<br>(0.884) |
| **CEI-Oil and Gas (ref. Not at all important)** | | | | |
| Somewhat important | | -0.351<br>(0.480) | 0.017<br>(0.596) | |
| Important | | -0.354<br>(0.413) | -0.214<br>(0.474) | |
| Very important | | -0.643<br>(0.460) | -0.611<br>(0.551) | |
| **CEI-Agriculture (ref. Not at all important)** | | | | |
| Somewhat important | | | -1.419*<br>(0.804) | |
| Important | | | -0.587<br>(0.565) | |
| Very important | | | -0.423<br>(0.617) | |
| **Risks** | | | | 0.848**<br>(0.408) |
| **Benefits** | | | | -0.100<br>(0.410) |
| **Unwanted Proximity** | | | | 0.844<br>(1.183) |
| *N* | 404 | 404 | 404 | 404 |

* $p<0.1$; ** $p<0.05$; *** $p<0.01$, standard errors bootstrapped with 5,000 replications

*Results.* Model 1 included only the bid amount variable, income, trust, and political ideology. As the cost ascribed to more frequent inspections rises, support decreases (b=-0.006)—though this effect is not significant at conventional alpha levels (p=0.065). Higher income persons and political conservatives were less likely to endorse increasing inspections. As trust in the oil and gas industry increases, support for *Inspections Tax* declines.

Model 2 added the CEI-oil and gas variable and retained all the predictors from the prior model. People who believe the oil and gas industry is significant to their area are less likely to endorse increased inspections but this effect did not approach statistical significance. The effects of the bid amount, income, political affiliation and trust in the industry were remarkably like Model 1. For instance, the effect of "great deal of trust" compared to "no trust" is nearly identical between Model 1 and Model 2 (b=-2.819 vs. b=-2.594). The relative stability of these coefficients suggests that the exclusion of community economic identity regarding the oil and gas industry does not induce omitted variable bias.

Though it was not significant in the prior model CEI-Oil and Gas is included in Model 3 and I added CEI-Agriculture. Neither of these variables appeared to have important effects in this model. The coefficient for the bid amount is roughly the same though its p-value was inflated. Income remains relevant; as income increases, people are less willing to pay additional taxes, though this effect is strongest for the $50,000-$100,000 group.

Because models 2 and 3 indicated that community economic identity did not predict support for inspections, I dropped these variables in Model 4 and added the risk and benefit perception variables. Despite the inclusion of risk and benefit variables, political conservatism still had a powerful, downward effect (b= -0.820, $p<.05$). Prior models demonstrated that trust in the oil and gas industry decreases endorsement of more frequent inspections. The inclusion of

the risk and benefit variables obliterated this effect; in this model, it appears that trust has almost no role.[21] Risk perceptions, on the other hand, were positively associated with support, while benefit perceptions had a much smaller coefficient that did not reach statistical significance (b=-0.100, p=0.601). Unwanted proximity also appeared to have negligible effect.

Logit coefficients are notoriously difficult to interpret, so I calculated predicted probabilities derived from model 4 reported in Figure 3.1. The first panel of Figure 3.1 displays average predicted probabilities of support for inspections when the risk perception scale is set to its lowest value (1), its midpoint (2.5), and its highest value (5) plotted against Bid Amount ($). I held all other variables at their observed values. Though conservative political ideology was a control variable, its robust effect across model specifications needs further attention. To better grasp the effect of conservative political affiliation on support for *Inspection*, I display probabilities of support plotted against Bid Amount ($) for conservatives and non-conservatives in panel 2 of figure 3.1. For these calculations, I again held other variables at their observed values.

[21] The attenuation of trust in the oil and gas industry deserves further discussion. One possibility for this null effect is that individuals who trust the industry to operate safely may not feel the need for further inspections but are not necessarily opposed to additional inspections. That is, trusting individuals may assume that because the industry is operating safely additional inspections, while not needed, will not harm the industry.

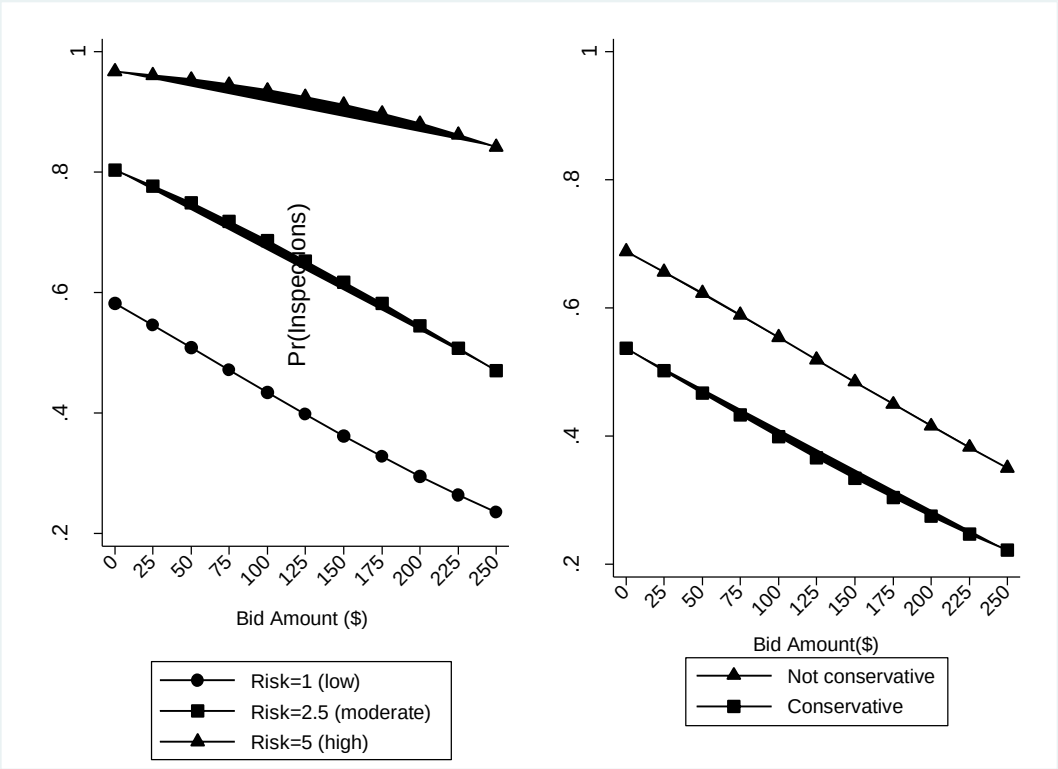


**Figure 3.1. Predicted Probabilities for Inspections**

The first panel of Figure 3.1 shows that risk perception increases support for *Inspections Tax* independent of the effect of the cost of the policy, but support declines across all risk perception groups as cost increases. Indeed, if risk perceptions are high and costs are negligible, the predicted probability of support verges upon 1, while if risk perceptions are low and Bid Amount ($) is also low, the probability of support is less than 0.6. The second panel shows a consistent downward effect of being politically conservative on support regardless of costs. Indeed, when the bid amount was especially high, conservatives were extremely unlikely to endorse inspections that are more frequent.

## DISCUSSION

In this chapter, I sought to develop an understanding of the factors that drive public support for oversight of unconventional oil and gas development, while using an experimental technique called contingent valuation to understand how the cost ascribed to a policy effects support. The theoretical background included a focus on the political economy of place, manifested in the concept of community economic identity, and other possible predictors such as risk and benefit perceptions and actual and unwanted proximity to oil and gas drilling.

The results above suggest that, counter to Hypotheses 1 and 2, community economic identity did little to explain support for oil and gas regulation. The correlation between *Inspections Tax* and community economic identity related to industries other than oil and gas was so low that I did not include the relevant variable in any of the models. Thus, I find no support for Hypothesis 1: "colliding treadmills" did not appear to be a factor in fracking policy within Colorado. In other words, there was no evidence that support for regulating the oil and gas industry arises because the respondents believed it threatened other industries.

The bivariate correlation between community economic identity associated with oil and gas and *Inspections Tax* was somewhat stronger, but this variable had little impact when controlling for the other variables in Models 2 and 3. Thus, the results lend no support to Hypothesis 2. To some degree, the null findings for community economic identity may be a function of the operationalization of this concept developed for this project. Bell and York (2010) rely on qualitative data to formulate the initial conceptualization of community economic identity. The only other quantitative, survey-based study of this topic, Blaacker, Woods and Oliver (2012), used a different set of survey questions, a convenience sample of college students, and did not examine policy preferences. I suspect that community economic identity, in terms of

the perceived historical and contemporary significance of the oil and gas industry to an area, likely has some impact on oil and gas policy preferences, but the present operationalization of community economic identity may need improvement. Also, it is possible that community economic identity centered on oil and gas extraction might reduce support for highly stringent regulation—such as levying heavy fines or restricting drilling in some areas—while it has little effect on a relatively noninvasive policy like increasing the frequency of inspection to once per year.

I also hypothesized that risk perceptions have a positive influence on support (Hypothesis 3), and that benefit perceptions reduce support (Hypothesis 4). There is unambiguous support for Hypothesis 3: respondents with heightened risk perceptions were highly supportive of increasing the frequency at which oil and gas operations are inspected. Benefit perceptions, on the other hand, do not play much of a role in determining whether someone supports *Inspections Tax*. Thus, there was no support for Hypothesis 4. It appears that even individuals who ascribe a great deal of benefits to oil and gas development are still willing to regulate the industry, net of other predictors.

Moving forward, I found that actual proximity to oil and gas drilling, operationalized as miles to the nearest well, had almost no correlation with *Inspections Tax*. Indeed, I did not include this variable in the regression model because the correlation was so low. Unwanted proximity did have some bivariate correlation, as shown in Table 3.2, yet it had almost no effect in the regression models presented in Table 3.3. Thus, support for increasing the rate of inspections did not hinge upon the closeness of oil and gas operations, or if said operations were unwelcome. These findings run counter to Hypotheses 5 and 6 were I hypothesized that both actual and unwanted proximity to oil and gas operations would increase support.

I also hypothesized that as the bid amount rose, support for *Inspections Tax would* decline (Hypothesis 7). In all model specifications, the cost ascribed to the policy was negatively associated with support; hence, there is strong support for Hypothesis 7. These unique results suggest that as a policy becomes commensurate—that is, as its costs rises—support for said policy will decline. I suggest that future research attend to questions of valuation, as it appears that cost had relatively strong and consistent predictive power in the models; its effect was virtually unaltered by the inclusion of various sets of other predictors.

The controls also reveal important findings. Household income deserves further discussion. The bivariate correlation between income and *Inspections Tax* indicated that higher income persons are less willing to pay taxes to improve oversite of oil and gas facilities, and the downward effect of income was robust across the logistic regression models. In other words, those who had the most *ability* to pay were the least *willing* to pay. One possible explanation for this surprising finding is that higher-income individuals may be relatively insulated from the potential deleterious impacts of fracking and thus have lower willingness to pay. Another possibility is that the income group which was most resistant to inspections, those making $50,000-$100,000 per year in household income, may believe that they are the most likely to benefit economically from oil and gas development via direct employment or oil and gas leases. As discussed above, political ideology also has a powerful impact on whether a respondent endorses inspections that are more frequent. Other socio-demographics have almost no association.

These results indicated that sociologists should more aggressively grapple with questions of environmental valuation. Fourcade (2011) argued that environmental valuation might bolster environmental protection. Respondents who support environmental protection or environmental

policy—even when it entails a cost to them—may be more committed in their support. People undoubtedly face trade-offs between their household finances and environmental protection. By accessing CVM from environmental economics, this manuscript is a first step towards establishing an empirical sociology of environmental valuation—and, more broadly, a sociology of tradeoffs faced in environmental policy formation. Moving forward, I suggest that sociologists devote more attention to environmental valuation and quantifying willingness to sacrifice for environmental policy and environmental protection. This chapter also contributes to the scholarship on the social aspects of the unconventional oil and gas boom and is one of the first quantitative applications of community economic identity. There is a need for more research to understand the role of the political economy of place in informing public policy preferences for oil and gas development.

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# CH. 4 WHO SHOULD BE IN CHARGE? GOVERNANCE SCALE PREFERENCES FOR OIL AND GAS DEVELOPMENT

## SUMMARY

Environmental governance has been increasing devolved from centralized, relatively powerful governments to lower levels of government with limited resources. Further, governance has been increasing shifted to industry, particularly in the case of oil and gas development, were there are significant exemptions from federal oversight. The purpose of this chapter was to understand what level of government (i.e. local, state or federal) Coloradoans believed should regulate the oil and gas industry ("governance scale preferences"). A series of exemptions from various aspects of federal environmental and health regulations has left oversight primarily in the hands of states. The state government of Colorado, in tandem with the oil and gas industry, has taken legal action against cities that have passed their own oil and gas development regulations. Descriptive results indicated that few Coloradoans support federal exemptions while many respondents endorse local regulation. Further, few variables have consistent results in the binary logistic regression models.

## INTRODUCTION

Directional drilling combined with hydraulic fracturing ("fracking") has caused an unprecedented boom in domestic oil and gas production since the mid-2000s. This boom has met with much controversy because of risks to public health (Colborn, et. al. 2011; Hill 2014; Kassotis et. al. 2013; Jamieleta et. al. 2015; Perry 2012; Rabinowitz et. al. 2015) and the environment (Ferrar et. al. 2013; Holzman 2011; Howarth, Santoro and Ingraffea 2015; Paulik et. al. 2015; Rozell and Reaven 2012). However, the fracking boom also holds much promise as

it can contribute to job growth (Driessen 2013; Energy from Shale 2015; Lee 2015), lower energy prices (Krupnick 2014), and provide tax revenue (Newell and Raimi 2015).[22]

The current regulatory regime for unconventional oil and gas extraction is reflective of a broader trend in environmental governance towards neoliberalization, devolution and re-regulation to protect corporate profitability (Castree 2008; Harvey 2005; Jonas and Bridge 2003; McCarthy 2004; Prudham 2003). Unconventional oil and gas development is exempt from many federal environmental and health regulations—perhaps the most significant of these is the "Halliburton Loophole" embedded in the 2005 Energy Policy Act (Anderson 2012; Nolon and Gavin 2013; Kraft, Stephen and Abel 2011; Rabe and Borick 2013; Werner and Shapiro 2013). This federal policy vacuum devolved regulatory power to states and municipalities that struggle to grapple with how to regulate the rapid expansion of unconventional oil and gas extraction. Current regulations vary substantially from state to state (Cook 2014; Davis 2012; Davis and Fisk 2012; Fisk 2013; Rabe 2014; Rinfret, Cook and Pautz 2014; Zirogiannis et. al. 2016). For instance, Wyoming has encouraged unconventional oil and gas development while simultaneously levying high severance taxes while Colorado has a regulatory regime that is generally more stringent but with lower taxes (Headwaters 2014).

Because of the void in federal regulation, there has been a great deal of contestation around what level of government (e.g. federal, state or local) should regulate oil and gas development—particularly within the state of Colorado. The official position of the Colorado state government and the oil and gas industry is that the state should control all, or most,

[22] Kinnamon (2011) reviewed estimates of the economic impact of fracking and found that the industry has over-stated job growth. Oil and gas development contributes to local job creation and economic growth in the short to medium run (Munasib and Rickman 2014; Paredes, Kamorek and Loveridge 2015; Weber 2012) though areas which specialize in oil and gas over a long period are less economically developed (Haggerty et. al. 2015).

regulations pertaining to development. That is, state regulators and the industry prefer a regulatory regime that devolves power from the federal government but does not allow for local oversight. Indeed, the state government has pursued legal action against municipalities, such as Longmont and Fort Collins, who have passed bans on fracking within city limits or otherwise sought to regulate development (Minor 2014). The extent of local efforts to ban or oversee the industry indicates that Coloradoans may prefer a flexible governance regime that allows for local control.

Theoretical inquiry has identified neoliberalization and devolution as two dominant trends in governance since the 1980s (Harvey 2005; Castree 2010, 2011) and case study research describes the unfolding of these processes (e.g. Fry, Brannsrtom and Murphy 2015; McCarthy 1995; Prudhom 2004). However, we know relatively little about how publics that are effected by neoliberalization and devolution feel about that matter. That is, little research has examined public preferences regarding what level of government should oversee regulating the oil and gas industry; in other words, we do not understand public preferences for *governance scale* on this topic. Further, we do not know whether the public supports current exemptions for oil and gas development from federal environmental and health regulations. The purpose of this chapter was to fill this void by using Colorado-wide survey data and outcome variables related to governance scale preferences, while accounting for known predictors of policy attitudes. Due to the ongoing friction between state and local governments on oil and gas regulations Colorado is an ideal location to conduct this research. The next section further describes the regulatory climate for oil and gas, and then moves on to a discussion of factors that might account for governance scale preferences.

## BACKGROUND

*Neoliberal Environments* The late 1970s and early 1980s marked the rise of the "neoliberal" turn in governance with the rise of Ronald Reagan in the United States and Margaret Thatcher in the U.K. Castree notes that scholars have used conflicting definitions of the term "neoliberalism" (Castree 2010; 2011). Broadly, it refers to changing governance regimes in which policy-makers pursue "re-regulation" to promote corporate profitability in the name of free markets. This process often occurs in tandem with devolution or the "hallowing out" of the state—that is, central regulatory authorities are increasingly defunded or their regulatory capacity is otherwise muted (Peck 2001; Jessop 2004). Neoliberalization is a chaotic, uneven process were previously stable regulatory regimes are replaced with a disordered, fragmented and conflicted system of governance involving multiple stakeholders whose interests are often at odds (Birch and Mykhnenko 2009; Pellizoni 2011)

This process is evident in the current regulatory environment for unconventional oil and gas. Federal regulations would apply to fracking if not for a series of exemptions. These include partial exemptions buried in the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (), as well as in loopholes for toxic release inventory reporting requirements (Kraft, Stephen and Abel 2011). Perhaps the most significant is the so-called "Halliburton Loophole" in the 2005 Energy Policy Act, which absolves reporting requirements for chemicals (except for diesel fuel) used in the hydraulic fracturing process from the Safe Drinking Water Act (Werner and Shapiro 2013). The hands-off approach of the federal government has resulted in a fragmented regulatory landscape in which states are primarily in charge of developing and implementing oversight of the oil and gas industry. These state regulations vary quite substantially and states may lack the

capacity to regulate effectively (Cook 2014; Davis 2012; Davis and Fisk 2012; Fisk 2013; Rabe 2014; Rinfret, Cook and Pautz 2014; Zirogiannis, et. al. 2016).

Within Colorado, the primary state regulatory body for the oil and gas industry is the Colorado Oil and Gas Conservation Commission (COGCC); the agency has a "dual mandate" to promote oil and gas drilling, while also safeguarding public health and the environment (Stokols 2013). COGCC typically creates regulations in a rule-making process that involves receiving *ad hoc* input from stakeholder groups. Cook (2014; 2015) interviewed industry representatives, environmental groups, and COGCC officials who participated in rule making. Cook's research characterized the COGCC's rule-making process as relatively open to a variety of perspectives, but, ultimately, the industry holds more influence than other stakeholders (Cook 2014: 2015). Opsal and Shelley (2014) conducted an exhaustive analysis of the COGCC's complaint database and interviewed several Colorado residents who had filed formal complaints with the agency against the industry. The authors found that the state often "dilutes" complaints against the oil and gas industry by minimizing the extent of citizen grievances.

Perhaps because of lax state regulations or lack of enforcement, several Colorado municipalities have attempted to regulate oil and gas development. In fall 2014, four cities had citizen-led petitions to create city ordinances to ban (temporarily or permanently) hydraulic fracturing and related activities. In Broomfield, for example, the proposed ordinance banned hydraulic fracturing and the storage of waste materials for five years (Broomfield 2015). In Boulder, the ordinance extended the preexisting fracking ban until 2018 to allow for more time for the city to assess the impacts of local oil and gas development (City of Boulder 2015). Earlier, Boulder County had commissioned a study that found that tax revenue generated by oil and gas development would not offset infrastructure impacts, such as damage to roads (Boulder

County 2015). Lafayette residents proposed a permanent ban on all oil and gas activity within city limits (City of Lafayette 2015). Finally, earlier, in 2012, the city of Longmont voted to ban hydraulic fracturing and the storage of waste products within city limits; the Longmont regulations served as a template for other municipal oil and gas regulations (Enockson 2014). The state government and the oil and gas industry have sought legal action against these cities (Minor 2014).

In contrast to citizen-led ballot initiatives, Commerce City enacted a drilling ordinance that works on a case-by-case basis, while prohibiting drilling near two wildlife refuges (Robles 2012). Thus, companies with an interest in drilling in the city must negotiate agreements with the city government. Unlike the bans and moratoria passed in Longmont, Broomfield, Lafayette, Boulder, and Fort Collins, neither the state regulators nor the oil and gas industry have challenged Commerce City's ordinance.

The ballot initiatives all passed. Fifty-five percent of Fort Collins voters and 58% of Lafayette voters voted to ban fracking, while the Broomfield initiative passed with only 20 votes (City of Broomfield 2015). Support was more resounding in Boulder with 76% voting to extend the city's moratorium on oil and gas development (City of Boulder 2015). The oil and gas industry spent an estimated $900,000 to fight these bans (Noon 2013).

Hence, the oil and gas industry and local municipalities have waged pitched legal battles about *strengthening* regulations at the local level. Yet residents of some areas of Colorado have resisted existing state regulation as overly onerous and damaging to the industry and their local economies. In 2013, a group of local politicians from Weld County, CO threatened to secede from the state in part because of increased setback rules from the COGCC, among other issues

(Whaley 2013).[23] This movement was largely symbolic, yet it does highlight the extremely divergent response to state regulation of the oil and gas industry within Colorado: some municipalities want local control to *increase* regulation, while others want local control to *reduce* the stringency of current state regulations. Hence, some communities have actively resisted neoliberal governance of unconventional oil and gas, while others have embraced neoliberal governance. Still, despite the volume of research on neoliberalism and devolution we know little about the perspectives of people living under these regimes. The next section considered the broader literature on environmental policy attitudes.

**Predictors of Policy Attitudes**

*Risks and Benefits.* As noted in the introduction, the public perceives a complex array of environmental, health, and quality of life risks from fracking, yet associates fracking with several benefits such as job creation, tax revenue, and reducing domestic reliance on foreign oil (Brasier et. al. 2013; Ceresola and Crowe 2015; Crowe, Silva, Ceresola, Buday and Leonard 2015; Jacquet 2012; Jacquet and Stedman 2013; Schaft, Borlu and Glenna 2013; Silva and Crowe 2015). In the prior research, risk or benefit perceptions are *dependent* variables, but it stands to reason that risk and benefit perceptions also have a role in predicting policy attitudes. To the best of my knowledge, no studies have connected risk and benefit perceptions to governance scale preferences for fracking. However, risk perceptions do increase support for policies related to other environmental problems—such as climate change—in that individuals who think that climate change is dangerous are more likely to support policies to reduce greenhouse gas emissions or adapt to a changing climate system (Leiserowitz 2006; Lubell 2006; Lubell, Zahran

[23] Oil and gas regulations were only one of many concerns spurring the secession movement. The state also moved towards legalizing gay marriage and started regulating assault rifles—these changes also helped mobilize local leaders against the state government in northern Colorado (Whaley 2013).

and Vedlitz 2006; O'Connor, Bord and Fisher 1999; Semenza et. al. 2008; Stoutenborough, Sturgess and Vedlitz 2013; Stoutenborough, Vedlitz and Liu 2015). Thus, it is likely that persons who believe that fracking is risky are supportive of regulations for the process. On the other hand, benefit perceptions have received less attention in the prior literature but it is possible that people who believe that fracking is beneficial will be more resistant to policies that might threaten the extent of drilling.

*Community Economic Identity.* Much research documents public resistance against socially or ecologically harmful industries or has grappled with why mobilization does not occur (McAdam and Boudet 2012; Wright and Boudet 2012; Zavestovski et. al. 2002; Zavestovski.et. al. 2004). Less research has considered mobilization in favor of potentially toxic industrial or extractive industries; Bell and York (2010) provided a notable exception. Examining the coal industry in Appalachia, the authors argued that West Virginians have developed a collective sense of identity around the industry; West Virginians see coal as economically significant and important in a socio-cultural sense. Bell and York use the term "community economic identity" to refer to this perceived collective significance of the coal industry. The authors suggested that community economic identity related to coal accounts, at least in part, for why West Virginians often rally in support of the industry. Other research, while not invoking the phrase "community economic identity," demonstrated that people will mobilize in support of industries that they deem historically, economically, or culturally significant (Cabrejas 2013; Ladd 2013, 2014; Malin 2014, 2015). To the best of my knowledge, no studies have asked how community economic identity influences policy attitudes. However, it is plausible that communities that have adopted a collective identity around the oil and gas industry may be more resistant to regulating the industry, or prefer local control to reduce existing regulations.

*Political Ideology and Socio-demographics.* Political ideology is an important predictor of attitudes towards environmental and technological issues (Kahan et. al. 2007; Kellstedt, Zahran and Vedlitz 2008; Stoutenborough, Sturgess and Vedlitz 2013; Yeo et. al. 2014; Zia and Todd 2010). In recent years, public opinion regarding some environmental issues, particularly climate change, has become highly partisan (McCright and Dunlap 2008; 2011). Regarding energy, conservatives are less supportive of renewable energy and more supportive of fossil fuel extraction (Dietz, Dan and Schwom 2013; Kotchen, Boyle and Leiserowitz 2013) and less likely to engage in energy efficiency behaviors (Gromet, Kunreuther and Larrick 2013; Newell and Silkamaki 2013). Moreover, environmental and technological attitudes hinge upon socio-demographic factors such as age, race, education, income, and sex (e. g. Finucane et. al. 2000; Shelley,Chiricos and Gertz 2011; McCright 2010; Slimak and Dietz 2006; Xiao and McCright 2012). While I suspected that socio-demographics and political ideology are likely important predictors of governance scale preferences, the literature has not examined this relationship.

## DATA, MEASURES AND METHODS

To understand public preferences for who should regulate the oil and gas industry, I relied on a random digit dial survey conducted in fall 2014 (n=404). The sample included both cell phones and landlines, and purposefully over-sampled rural, high-drilling regions of the state; as such, the data is not entirely generalizable to the state population but does represent the views of residents who live near fracking operations.[24] The research team conducted exhaustive cognitive pre-testing, and interviewers delivered the survey in both English and Spanish. Using the most conservative calculation possible, the response rate was 9%; for a 5% margin of error;

[24] Colorado's population distribution is spatially skewed; the majority of the state's population lives in the Denver metropolitan area which has very little drilling. Unless the sample size was unusually large, a truly representative sample would omit residents of high-drilling, rural areas.

this response rate is roughly like nationally representative polls related to policy issues (e.g. Pew 2015a; 2015b; Clarke et. al. 2015). A more expansive response rate—AAPOR RR6—assumes that cases of non-response are ineligible. Using this formula, the response rate was 14%. Response rates and data quality are distinct issues (Groves 2006; Keeter et. al. 2008; Rosen et. al. 2014; Wagner 2012)—that is, a low response rate does not mean that sample data is biased nor does a high response rate mitigate against biases which results from a poor sample design. The completion rate was 95%.

Evensen et. al. (2014) reported that question wording can bias respondents—they found that the word "fracking" elicited much more negative response than the phrase "shale gas development". Alternatively, Stoutenborough, Robinson and Vedlitz (2016) observed no difference between the terms "fracking" and "hydraulic fracturing". The survey instrument for this project used the phrase "oil and gas activity" and interviewers explained that this term referred to exploration, drilling, and the disposal of waste. Ideally, this wording guarded against the biases observed by Evensen et. al. (2014).

**Dependent Variables**

A series of questions assessed Coloradoans' governance scale preferences. Respondents rated the following statements from strongly agree to strongly disagree:

- "Towns should be able to relax regulations on oil and gas activity."
- "Towns should be able to pass stricter regulations on oil and gas activity."
- "The state government should have control over all regulations involving oil and gas activity."
- "The oil and gas industry should be exempt from federal environmental regulations."

The first two of these questions assessed whether respondents believed that municipalities should be able to govern the industry, by either reducing or intensifying regulations.[25] The next question captured whether respondents feel that the state government should control all oil and gas regulations. Finally, respondents were asked about federal exemptions from environmental and health regulations.

Table 4.1 displays the distribution of these variables in percentages. A small majority (53%) strongly agreed or agreed that towns should be able to relax existing regulations on the oil and gas industry, while a larger majority (70%) agreed or strongly agreed that towns should be able to pass stricter regulations. On the other hand, there was limited support for centering regulatory power in the state; only 47% of respondents "strongly agree" or "agree." The results were even starker regarding federal exemptions. Here, only 12% strongly agreed or agreed that oil and gas development should be exempt from federal environment and health laws.

**Table 4.1 Distribution of Governance Scale Items**

| | Strongly Agree % | Agree % | Disagree % | Strongly Disagree % |
|---|---|---|---|---|
| Towns-relax regulations | 10.77 | 43.08 | 30.77 | 15.38 |
| Towns-stricter regulations | 16.67 | 52.53 | 22.98 | 7.83 |
| State control | 10.29 | 36.68 | 43.27 | 9.76 |
| Federal exemptions | 1.26 | 10.61 | 46.46 | 41.67 |

[25] I chose "town" over "municipality" after cognitive pre-testing indicated that "municipality" might be confusing for respondents as many respondents asked for clarification on the term "municipality".

**Predictor Variables**

*Risk and Benefit Perceptions.* As noted earlier, the public perceives an array of risks and benefits related to fracking. Interviewers asked respondents about the following benefits: community quality of life, job creation, tax revenue, infrastructure investment, energy independence from foreign oil, the development of clean energy, and lower energy costs using likert-type response categories. These items were combined into a scale with Cronbach's alpha = .89. Risk perceptions included community quality of life, road traffic, air or water quality, land use, noise pollution, human health, wildlife/ livestock health, and housing values—these also used likert-type response categories. Benefits perceptions were combined into a scale with a Cronbach's alpha =. 94.[26] For both of the scales higher values indicate more of that construct (i.e. more risk or benefit perception).

*Proximity.* For proximity to oil and gas development, I used two different measures. First, I included a measure for *unwanted proximity*; respondents were asked if oil and gas activity was closer to their home than they would like (0=no, 1=yes). Secondly, I calculated distance to the nearest well in miles for each respondent. [27]

*Community Economic Identity.* People who believe that the oil and gas industry is economically, socially, or culturally significant to their area may be less willing to regulate the

[26] As a robustness check, I also performed exploratory factory analysis using a polychoric correlation matrix for the risk and benefit items. Using different extraction techniques, the exploratory factor analysis consistently pointed towards a single factor solution.

[27] Distance to the nearest well was calculated by assigning each respondent to their zip code centroid. COGCC shape files were scraped for well locations using the Stata command shp2dta (Crow 2013) and distance was then calculated using the geonear command (Picard 2012). While this strategy only approximates a respondents local experience with oil and gas development it perhaps the best option as I do not have exact street addresses for the anonymous survey respondents. Another option is to use county-level well counts. However, this is much more imprecise as counties vary substantially in geographic area and some respondents might live in an area of a county with relatively little drilling.

industry. To capture community economic identity regarding the oil and gas industry, respondents rated the importance of the oil and gas industry to their local area on a scale from 1= not at all important to 4= important. [28]

*Trust.* The survey assessed trust in the oil and gas industry with a question worded as follows: "How much do you trust the oil and gas industry to operate safely?" Respondents could answer on a scale from 1= a great deal of trust to 4= no trust. Trust in the COGCC was captured with a survey item which asked about trust in the agency to provide neutral oversight (1= a great deal of trust, 4= no trust).

*Control Variables*. Controls for political ideology (1= liberal, 2=moderate, 3=conservative), income (1= 0-$25,000, 6= $150,000 or more), college (0= less than college, 1= college graduate or more), age in years, and sex (1= male, 2= female) were also included. Table 4.2 displays descriptive statistics and other information about the predictors.

[28] Blaacker, Woods, and Oliver (2013) provide the only other quantitative operationalization of community economic identity. Relying on a self-administered survey of West Virginia college students, they asked their respondents to guess the amount of jobs and tax revenue that the coal industry provides the state; results indicated that college students drastically over-estimated the economic significance of coal. Adaptations of their questions performed poorly in pre-testing; in particular, the Colorado respondents became agitated and confused at the questions. Perhaps the difference in samples and mode explain why these questions did not do well. Further, coal may have a unique socio-historical significance and long-term presence in West Virginia while extractive activity on its current scale is relatively recent in Colorado.

## Table 4.2 Descriptive Statistics for Predictor Variables

| Variable Name | Description | mean | sd |
|---|---|---|---|
| Risks | Scale (Cronbach's Alpha= .94) constructed from the following risk perception items: community quality of life, road traffic, air or water quality, land use, noise pollution, human health, wildlife/ livestock health, and housing values | 1.42 | 0.67 |
| Benefits | Scale (Cronbach's Alpha= .89) constructed from the following benefit perception items: community quality of life, job creation, tax revenue, infrastructure investment, energy independence from foreign oil, the development of clean energy, and lower energy costs | 1.93 | 0.63 |
| Unwanted Proximity | Do you feel oil and gas activity is too close to where you live? (0= no, 1= yes) | 0.109 | 0.312 |
| Distance to nearest well | Author's calculation from COGCC data | 3.449 | 4.124 |
| Trust-Oil and Gas Industry | How much do you trust the oil and gas industry to operate safely? (1= No trust, 4= A Great Deal of Trust) | 2.777 | 0.979 |
| Trust-COGCC | How much do you trust the COGCC to provide neutral oversight of oil and gas activity? (0= very little to no trust, 1= A great deal to some trust) | 0.763 | 0.426 |
| Importance- Oil and Gas | How important is oil and gas activity to your local area? (0= not at all important, 1= important or very important) | 0.503 | 0.501 |
| Sex | 0= male, 1= female | 1.478 | 0.500 |
| Political Ideology | How would you describe your political beliefs? (1= liberal, 3= conservative) | 3.107 | 1.206 |
| College | What is the highest level of education you have received? (0= less than college, 1= college graduate) | 4.453 | 1.368 |
| Income | What is your total household income before taxes? (0= less than $25,000, 6= greater than $150,000) | 3.609 | 1.634 |
| Age | Age in years (author's calculation) | 51.652 | 16.250 |
| White | What is your race or ethnicity? (0= non-white, 1= white) | 0.825 | 0.381 |

**Analysis**

The analysis occurs in three steps. First, motivated by data sparseness and separation concerns the dependent variables were recoded so that 0= do not support and 1=support. Secondly**,** I estimated polychoric correlations[29] to understand the relationship between the outcome and predictor variables; predictors that correlate weakly with the outcomes were not included in the statistical models. Lastly, a series of binary logistic regression models examined predictors of governance scale preferences.

*Correlational Results.* As shown in table 4.2, risks and benefit perceptions correlate moderately with each outcome variable other than State Control. Both distance and unwanted proximity had a relatively weak association across the outcomes. The bivariate relationship between community economic identity related to the oil and gas industry varied significantly across dependent variables. It had a mild positive correlation with Towns-Relax and a mild negative correlation with Towns-Stricter and Fed-Exemption. However, it had almost no correlation with State-Control. Trust in the oil and gas industry followed a similar pattern but with stronger correlations; it was associated with increased support for local relaxation of oil and gas regulations and federal exemptions, and decreased support for local increases in regulation and state control. Trust in the COGCC was associated with increased support for state control and local relaxation of regulations, and decreased support for more stringent local regulations and federal exemptions. Turning to the socio-demographics, sex had almost no correlation with any of the dependent variables. Income barely correlated with any of the outcomes, except for State-Control. Compared to other variables, the pattern for education was rather strange; it

[29] Polychoric correlations are recommend when correlated ordinal variables or a mix of ordinal and continuous variables (Ulsonn 1979).

correlated negatively with Towns-Relax, Towns-Strict, and State-Control, while it appeared to increase support for federal exemptions. Age also had an inconsistent and relatively minor association across dependent variables. Being white correlated weakly or not at all with all of the outcomes except Towns-Strict. Overall, the correlations suggested that risk and benefit perceptions, coupled with trust in the oil and gas industry, education and political ideology were associated with governance scale preferences.

**Table 4.3. Polychoric Correlations between Predictors and Dependent Variables**

| | Towns-Relax | Towns-Strict | State Control | Federal Exemption |
|---|---|---|---|---|
| Risks | -0.43*** | 0.5*** | -0.09 | -0.28** |
| Benefits | 0.42*** | -0.41*** | 0.14* | 0.29** |
| Distance | 0.12 | 0.16* | -0.16* | -0.04 |
| Unwanted Proximity | -0.36*** | 0.47*** | -0.07 | -0.15 |
| Importance-Oil and Gas | 0.14*** | -0.12*** | 0.01 | -0.15 |
| Trust-Oil and Gas Industry | 0.52*** | -0.51*** | 0.28* | -0.49* |
| Trust- COGCC | 0.32 | -0.23 | 0.25** | -0.37 |
| Sex | -0.12 | 0.02 | -0.11 | -0.06 |
| Income | -0.03 | -0.11 | -0.19 | 0.12 |
| Political Ideology | 0.33*** | -0.29*** | 0.04 | -0.43** |
| College | -0.24*** | -0.17*** | -0.13** | 0.27*** |
| Age | -0.02 | -0.22 | 0.1 | -0.15* |
| White | 0.25* | -0.43* | -0.01 | 0.12 |

* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

*Binary Logistic Regression Models.* The purpose of the correlational analysis displayed above was to locate variables to trim from the regression models to avoid over-fitting. Sex, income, distance, and unwanted proximity emerged as mostly uncorrelated with the outcomes, and I excluded them from the models. Before estimating the models, I recoded several variables. Education was collapsed into two categories (0= less than college, 1= some college or more), as was trust in the COGCC (0= no to little trust, 1= some to a great deal of trust). Trust in the oil and gas industry (0= no to little trust, 1= some to a great deal of trust), and the perceived importance of oil and gas (0= not at all or very important, 1= somewhat or very important) were

similarly recoded. Variance inflation factors did not exceed 2.4 in any of the models, indicating that multicollinearity is not an issue. Because of the relatively small sample size, I bootstrapped the standard errors with 5,000 replications.[30]

Table 4.4 displays the results of the binary logistic regression models. Individuals who perceived greater risk were surprisingly supportive of allowing towns to relax oil and gas regulations, while trust in the oil and gas industry decreased support for local relaxation. Trust in the COGCC, on the other hand, increased support for local relaxation. No other variables reach statistical significance in this model. Turning to the second model, risk perceptions increase support for allowing towns to pass stricter regulations—that is, respondents with greater risk perception prefer local control whether it is to increase or relax regulations. Trust in the oil and gas industry reduces support. Other variables do not reach statistical significance—though the coefficient for white may have some practical significance.[31] For the state control model, none of the predictors was statistically significant, and their coefficients are, for the most part, much smaller than in other models. For federal exemptions, education was the only statistically significant predictor, but the effects of risk, trust in industry, and political ideology may have some practical significance.

[30] In this application bootstrapping involved sampling from the master data with replacement 5,000 times and averaging standard errors across those replications.
[31] In unreported models, I included unwanted proximity, but it did not reach statistical significance.

**Table 4.4 Binary Logistic Regression for Governance Scale Preferences**

| | Towns-Relax | Towns-Strict | State Control | Federal Exemptions |
|---|---|---|---|---|
| | b(se) | b(se) | b(se) | b(se) |
| **Risk** | 0.588* | 0.909** | 0.161 | -0.425 |
| | (0.349) | (0.422) | (0.339) | (0.532) |
| **Benefits** | -0.031 | 0.006 | 0.099 | 0.065 |
| | (0.392) | (0.420) | (0.370) | (0.703) |
| **Oil and Gas Importance** | 0.115 | 0.231 | -0.134 | -0.361 |
| | (0.321) | (0.326) | (0.291) | (0.468) |
| **Trust-Industry** | -1.257*** | -1.334** | 0.460 | 0.674 |
| | (0.456) | (0.583) | (0.436) | (0.923) |
| **Trust-COGCC** | 0.730* | 0.339 | 0.602 | 0.111 |
| | (0.424) | (0.442) | (0.393) | (0.920) |
| **College** | 0.298 | -0.368 | -0.606 | -1.918*** |
| | (0.413) | (0.413) | (0.381) | (0.452) |
| **White** | 0.887** | -0.822 | 0.159 | -0.167 |
| | (0.450) | (0.505) | (0.372) | (0.517) |
| **Political Ideology *(ref. liberal)*** | | | | |
| Moderate | -0.208 | 0.280 | 0.286 | 0.527 |
| | (0.391) | (0.463) | (0.389) | (0.725) |
| Conservative | -0.407 | -0.091 | -0.108 | 0.516 |
| | (0.403) | (0.447) | (0.401) | (0.652) |
| *N* | 404 | 404 | 404 | 404 |

* $p<0.1$; ** $p<0.05$; *** $p<0.01$. Standard errors bootstrapped with 5,000 replications.

Figure 4.1 provides average marginal effects with 95% confidence intervals.[32] For the Towns-Relax model, college education, while not statistically significant, appeared to increase support. Other variables had marginal effects at or near zero, corroborating the null effects reported in Table 4.4. Regarding Towns-Strict, two variables that were not statistically significant —being white and having a college education—may have some practical significance. For state control, the marginal effects confirm the lack of effect reported for any of the predictors in Table 4.3. Turning to federal exemptions, the marginal effects suggested that political ideology might have more of an effect than implied by the coefficients in Table 4.3;

[32] Bergtold, Yeager, and Featherstone (2011) suggested that average marginal effects may be less biased in situations of data sparseness; data sparseness is a concern given the relatively small sample size and distribution of the predictors.

though again, these variables did not reach statistical significance. Overall, the marginal effects underscore the largely null findings from the logistic regression models.

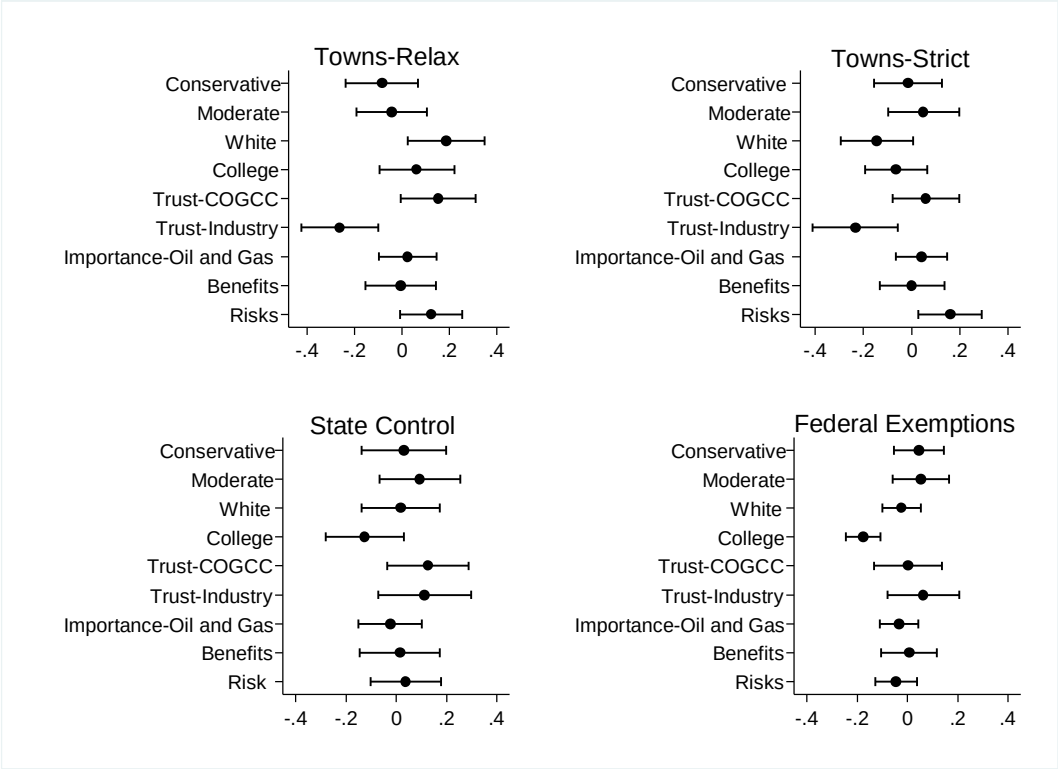


**Figure 4.1. Average Marginal Effects**

## DISCUSSION AND CONCLUSION

The results outlined above reveal several important considerations regarding the views of people living under a neoliberalized, devolved governance regime. Most strikingly, the descriptive analysis conducted before the estimation of the statistical models indicated broad public support for multilevel governance of oil and gas development. Relatively few respondents supported concentrating power in the state government, and hardly anyone supported exempting the industry from federal regulations. Hence, a key finding was that the public appeared to support a regulatory regime that blends different governance scales, while still allowing for local

autonomy. Thus, Coloradoans' preferred governance regime is devolved on the one hand, but still has some power centralized in the federal government.

The bivariate correlations and to some degree the regression models indicated that trust in the oil and gas industry is a key variable for issues of local control. Ladd (2014) argued that his Louisiana informants trusted the industry to operate safely and provide economic growth and jobs. A similar type of social contract may exist in the minds of some Coloradoans; those who trust the industry are willing to relinquish local control and support a policy regime that shifts power to industry. Further, trust in industry might explain public acquiesce to neoliberal governance.

Many variables that are well-known predictors of environmental attitudes had negligible effect on governance scale preferences. For instance, political ideology is one of the strongest and most consistent predictors of both general environmental attitudes and policy preferences related to environmental issues (e.g. Leiserowitz 2006; McCright and Dunlap 2011a; 2011b). Yet in my models for governance scale preferences, this variable had relatively little influence. Political ideology is a type of social identity that people rely upon as a heuristic to form opinions about controversial issues (Cohen 2003; Jost, Frederico and Napier 2009). That is, political ideology is not simply a set of political preferences but rather a source of identity that people access to make sense of complex problems. It is possible that because fracking is a immediate concern for many Colorado residents than other environmental problems (e.g. climate change), political ideology may be somewhat less salient. Further, to the best of my knowledge, this was the first quantitative study of governance scale preferences for fracking regulations; assuming that results from other studies on other topics (e.g. climate change) should generalized to fracking governance scale may not be warranted.

Socio-demographics, such as race and income, may have had little effect because of the nature of fracking within Colorado. While the environmental inequality literature suggests that toxic facilities are less proximate to higher income groups and/or whites (Ard 2015; Downey 1998; Downey and Crowder 2010) fracking is not as spatially contained as other types of environmentally harmful practices. That is, fracking occurs in relatively affluent, suburban areas and is not limited to isolated, impoverished rural communities (Jacquet and Kay 2015). Hence, socio-demographics, particularly income, may be less important predictors than for other types of environmental dependent variables.

There is a need for more research to understand whom the public believes should oversee regulating the oil and gas industry and environmental governance more broadly. We have a good theoretical and empirical understanding of environmental attitudes more generally, but questions of governance scale have received less attention. This chapter is an initial foray into this area. Few variables reach statistical significance in the models, and many have substantively small coefficients. Indeed, my descriptive results suggested that the public favors a multi-level system of governance, and subsequent research could work to unpack which level of government should perform specific regulatory functions.

It is clear from this chapter and many others that the fracking boom is associated with a range of threats and opportunities in the public mind (Ladd 2014; Israel et. al. 2015; Jacquet 2012), and these threats and opportunities are, to varying degrees, confirmed by empirical analyses (e.g. Paulik et. al. 2015; Rabinowitz et. al. 2015). Because risk and benefits are complex and multi-layered, perhaps a similar multi-layered approach to regulating fracking is appropriate. This analysis suggests that policy makers in states with a significant concentration of regulatory

power in the state government, such as Colorado, could lessen their grip on regulatory power to better align with public opinion and democratic values.

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# CH. 5 THE EXOGENEITY OF POLITICAL IDEOLOGY IN THE FRACKING POLICY CONTROVERSTY


## SUMMARY

The U.S. is currently experiencing an unprecedented boom in oil and gas production due in large part to hydraulic fracturing ("fracking") and horizontal drilling; and yet, we know little about public preferences for fracking regulation. Political ideology is a strong predictor of policy support in other arenas. The purpose of this chapter was to clarify the role of political ideology in fracking policy. I hypothesized that political ideology has a direct impact on policy support and an indirect impact via risk/ benefit perceptions and trust in the oil and gas industry. Using the KHB mediation technique, I showed that about half of the impact of political ideology is indirect via these mediating variables.


## INTRODUCTION

Unconventional drilling technologies like hydraulic fracturing ("fracking") and horizontal drilling have spurred a boom in oil and gas production in the United States—from 2005 to 2015 domestic natural gas production increased some 30% (USDA ERS 2016). The fracking boom has met with much controversy as it has been associated with an array of negative impacts on public health (Colborn et. al. 2011; Hill 2014; Jamieleta et. al. 2015; Kassotis et. al. 2013, 2015; Perry 2012; Rabinowitz et. al. 2015), environmental quality (Ferrar et. al. 2013; Holzman 2011; Howarth, Santoro and Ingraffea 2015; Paulik et.al. 2015; Rozell and Reaven 2012) and quality of life (Perry 2012; Opsal and Shelley 2014). In contrast, advocates argue that unconventional drilling provides jobs and tax revenue, particularly in economically marginalized rural areas (Driessen 2013; Energy from Shale 2015; Lee 2015; Munasib and Rickman 2014; Newell and Raimi 2015; Paredes, Kamorek and Loveridge 2015; Weber 2012).

The political response to fracking has been highly divergent with federal policy taking a lenient approach to regulating environmental and public health impacts. For example, fracking is exempted from key federal regulations—perhaps the most significant of these is the "Halliburton Loophole" embedded in the 2005 Energy Policy Act (Anderson 2012; Kraft, Stephen and Abel 2011; Nolon and Gavin 2013; Rabe and Borick 2013; Werner and Shapiro 2013). These loopholes have left the states to fill the regulatory gap, resulting in a patchwork of state regulations (Cook 2014; Davis 2012; Davis and Fisk 2012; Fisk 2013; Rabe 2014; Rinfret, Cook and Pautz 2014; Zirogiannis et. al. 2016). Some states (e.g. Pennsylvania and Colorado) have a regulatory regime that is largely supportive of expanding drilling (Cook 2014; Opsal and Shelley 2015) while other states (e.g. New York) have passed bans on hydraulic fracturing (Simonelli 2014; Warner and Shapiro 2013). Local regulation is especially contested, with state governments and the oil and gas industry often taking legal action against cities that pass their own regulations (Davis 2014; Gulmann 2015; Maqbool 2015; Minor 2014).

Risk and benefit perceptions associated with fracking have been well documented (Clarke et. al. 2013; Jacquet 2012; Ladd 2014; Schaft, Borlu and Glenna 2013; Theodori 2009) as has general support for oil and gas development using fracking (Boudet et. al. 2014; Crowe, Ceresola and Silva 2015). However, we know little about what types of policies the public would like to see (if any) in place to regulate fracking. This is a significant gap in our knowledge because, as noted above, the regulatory regime is highly fragmented and decentralized across multiple levels of governance and under constant negotiation. Moreover, because the public perceives a complex array of risks and benefits it is likely that their policy preferences are similarly complex. Unpacking these policy preferences is an important task.

Given that there is little research on public policy attitudes towards fracking, I draw from related literature on public opinion on environmental and technological issues. In this literature, political ideology has emerged as a key driver of attitudes on a range of issues (Buttell and Flinn 1978; Leiserowitz 2006; Yeo et. al. 2014). For instance, climate change views have become highly polarized in recent years (McCright and Dunlap 2008; McCright and Dunlap 2011a, 2011b). Despite the centrality of political ideology to environmental views, it has received relatively little direct attention in the literature on fracking.

In the section below, I review the literature on risk, political ideology and public support for environmental policy. The literature indicates that political ideology is a uniquely important variable because it is a predictor of variables that explain policy preferences (e.g. risk perceptions) while it also has a direct effect on policy support. Hence, the purpose of this chapter was to understand the unique, dual role of political ideology in that it influences risk perceptions and other predictors of policy support while it also has a direct effect on policy support. I used KHB mediation technique to test this theory (Kohler, Karlson and Holm 2011). In the next section, I review distinct literatures regarding policy attitudes, risk perceptions, trust and political ideology.

## BACKGROUND

### Risk, Benefits and Policy Outcomes

The public perceives an array of risks and benefits from fracking. These include concerns about crime and more general social disorganization (Israel 2015; Theodori 2009), threats to the environment (Brasier et. al. 2011; Jacquet and Stedman 2013; Theodori 2009), public health (Jalbert, Kinchy and Perry 2014; Kriesky et. al. 2013; Poole and Hudgins 2014) and nuisances like noise and dust (Jacquet 2012; Stedman et. al. 2013; Willow 2015). Yet fracking is also viewed as a source of job growth and economic development—particularly for economically marginalized rural areas (Anderson and Theodori 2009; Ceresola and Crowe 2015; Schaft, Borlu and Glenna 2013; Silva and Crowe 2015). Others argue that natural gas and oil extracted via hydraulic fracturing burns cleaner than coal, reducing the environmental impacts of energy production (Ladd 2013) and some tout fracking's ability to engender "energy independence" or "energy security" (Yergin 2011; Wright 2012).

A truly vast literature documents the predictors of risk perceptions (see Adam, Beck and Van Loon (2000), Boholm (1998) and Boholm and Cevellec (2011), Jaeger et. al. (2013), Wildavsky and Dake (1990), and Wilkinson (2000) for reviews). Benefit perceptions have generally received less attention but a few studies detail the perceived benefits of emerging technologies (e.g. Kahan et. al. 2009; Siegrist 2000; Siegrist, Cvetkovich and Roth 2000). Further, less is known about how risk and benefit perceptions might influence policy attitudes. Risk society theory (Beck 1992; 2009) suggests that a fundamental challenge facing modern societies is responding to socially generated risks like global environmental problems (i.e. climate change). Yet people must first acknowledge the danger presented by these risks to act.

Thus, risk society theory implies that societies will respond environmental or technological issues deemed risky. Policy is one way to respond to risk.

A small body of literature has empirically investigated the relationship between risk and benefit perceptions and policy support. Perceptions of climate change-related risk increase support for policy (Leiserowitz 2006; Lubell 2006; Lubell, Zahran and Vedlitz 2006; Lubell 2006; Lubell, Zahran and Vedlitz 2006; O'Connor, Bord and Fisher 1999; Semenza et. al. 2008; Stoutenborough, Sturgess and Vedlitz 2013; Stoutenborough, Vedlitz and Liu 2015). On the other hand, benefit perceptions related to nuclear power are associated with more favorable attitudes towards its use in electricity production (Whitfield et. al. 2009; Visschers, Keller and Siegrist 2011; Visschers and Siegrist 2012). Thus, it is very likely that risk and benefit perceptions matter for fracking policy outcomes, but this relationship needs study.

**Trust**

Trust is necessary for effective policy implementation (Rothstein 2001, 2005) and, more broadly, it is a prerequisite for cooperation in a complex, highly integrated world (Giddens 2013; Szomptka 1999; Uslander 2002). Trust in government increases support for environmental policy (Konisky, Milyo and Richardson 2008; Zannakis, Wallin, and Johansson 2015), propensity to make personal sacrifices for environmental quality (Harring 2013) and engagement in pro-environmental behavior (Vainio and Paloniemi 2013). In contrast, if trust is lacking people are less likely to believe in the effectiveness of environmental policy (Harring 2014).

More specific to Colorado, Cook (2014; 2015) interrogated the rule-making process of the primary oil and gas regulatory body within Colorado—the Colorado Oil and Gas Conservation Commission (COGCC)—and found that the agency's ostensibly neutral rule-making process privileges the oil and gas industry. Opsal and Shelley (2014) demonstrated that

citizens who have filed complaints against the industry view the COGCC as untrustworthy—their informants believed that the agency consistently favored the oil and gas industry. Further, Opsal and Shelley (2014) documented how the COGCC routinely mis-represents citizen complaints, often "diluting" their content in favor of the oil and gas industry.

As noted above, trust in government is important for understanding public preferences for environmental policy but trust in industry is also important. For instance, Ladd (2014) described how Louisianans' trust in the oil and gas industry legitimates a laissez faire regulatory regime. Whitfield et. al. (2009) showed that both trust in the nuclear power industry and trust in nuclear regulators is positively associated with support for nuclear power; similarly, Ansolabehere and Konisky (2009) found that trust in government increases support for nuclear power. Thus, trust in both regulators and industry is likely consequential for fracking policy attitudes.

**Political Ideology as a Social Identity**

In this section, I accessed research on political ideology as a social identity. Social identities, broadly construed, provide a map to help people make sense of their complex environments (Hogg 2007) and opinions and beliefs are rooted in said social identities (Taifel and Turner 1986; Turner et. al. 1994). Affiliation with a social group tends to generate uniformity of attitudes as people reconcile their attitudes with their group affiliation (Ashforth and Mael 1989; Hornsey 2008; Taijfel and Turner 1986). Thus, political ideology is an important aspect of social identity that people use to inform their views about a range of issues (Cohen 2003; Malka and Lelkes 2010; Unsworth and Fielding 2014).

Political identities are established in childhood and they are unlikely to change during adulthood. Voluminous literature documents how parents transmit their partisan and ideological affiliations to their children (e.g. Hyman 1959; Sapiro 2004; Sears 1975; Sears and Levy 2003).

The effect of parental socialization may wane slightly with age but overall, political affiliations are usually formed in adolescence via parental and peer group socialization and are unlikely to shift over the life-course (Jennings and Niemi 1968; Jennings, Stoker and Bower 2009; Kitt and Gleicher 1950; Stillman, Guthrie and Becher 1960; Tedin 1974).

"Elite cues" from politicians, media figures and other powerful members of an ideological community sway individual opinions. Group elites create a set of socially constructed attitudes, orientations and opinions bundled together with ideological identities particular to a place or time (Converse 2000; Jost et. al. 2003; Layman & Carsey 2002; McClosky & Zaller 1984, Sniderman, Brody and Tetlock 1993). Cues from elite members of an in-group provide a heuristic for formulating opinions around complex public policy issues (Arceneaux 2008; Lewkowicz 2006; Kam 2005). Environmental problems are especially difficult for the public to grasp, often leading to a muddled understanding that conflates disparate environmental issues (Bostrom et. al. 1994; Gowda et. al. 1997; Huxster, Uribe-Zarain and Kempton 2015; Kempton 1991; Sterman and Sweeney 2007; Read et. al. 1994). Given the complexity of fracking, elite cues may be especially salient.

Experimental evidence suggests that elite cues can shape beliefs among partisan individuals. Cohen (2003) showed that cues drive individuals to support policies that are highly inconsistent with their stated ideological beliefs. Using a series of experiments, Cohen demonstrated that conservatives who are ideologically opposed to the welfare state will be driven to support the expansion of social benefits if they are given an informational prompt that states that Republican politicians favor the measure. Democrats had similar results; self-described Democrats who professed to support social welfare policies opposed said policies if told that

Democratic politicians were in opposition. The control groups did not receive either treatment—that is, no "elite cues" where given to either the republican or democrat control groups.

Observational evidence also corroborates the effect of elite cues on public opinion. In the early 1990s, there was only a slight partisan difference in attitudes about climate change. However, elite conservative organizations and religious leaders increasingly began to challenge the notion that the climate was changing because of human combustion of fossil fuels (Farrell 2015a, 2015b; Hempel, Macilroy and Smith 2014; McCright and Dunlap 2003, 2010; Oreskes and Conway 2010). By the late 2010s, this had resulted in a significant gap between conservative and non-conservative beliefs in mere existence of climate change (McCright and Dunlap 2008, 2011a, 2011b).

Political conservatives tend to have lower risk perceptions across a range of technological and environmental risks such as climate change (Kellstedt, Zahran and Vedlitz 2008; Leiserowitz 2005; McCright and Dunlap 2011) and nuclear power (Peters and Slovic 1996; Yea et. al. 2014). Political conservatives also have less trust in science (Gauchat 2012; McCright et. al. 2013; Hamilton, Harter and Saito 2015) and government (Cooke and Gronke 2005). Indeed, discourse among conservative elites often frames regulation in "apocalyptic" terms that suggests regulation threatens to destroy entire industries or unravel the U.S. economy (Peeples. et. al. 2014). Moreover, conservatives may have greater trust in the oil and gas industry and lower result perceptions because of the large amounts of funding conservative organizations receive from the fossil fuel industry (Jacques, Dunlap and Freeman 2008; McCright and Dunlap 2003; Brulle 2014). More specific to present chapter, conservatives are more supportive of hydraulic fracturing (Boudet et. al. 2014; Clarke et. al. 2015).

*Proposed Mediation Model.* The literature reviewed above suggests that political ideology is a uniquely important predictor of policy preferences. Overall, the prior studies imply that political ideology is exogenous to other predictors of policy attitudes yet, also, is a predictor of policy support. That is, political ideology predicts risk perception and trust—these variables are, in turn, key predictors of policy support. Though I am not aware of research that documents a connection between political ideologies and the perceptions of benefits the existing research implies that conservatives likely perceive more benefits from extractive industries. Hence, this chapter tests a mediation model in which political ideology is mediated by variables like risk perception, benefit perception and trust in industry. Figure 5.1 displays this hypothesized relationship graphically and the next section describes the data and statistical techniques:

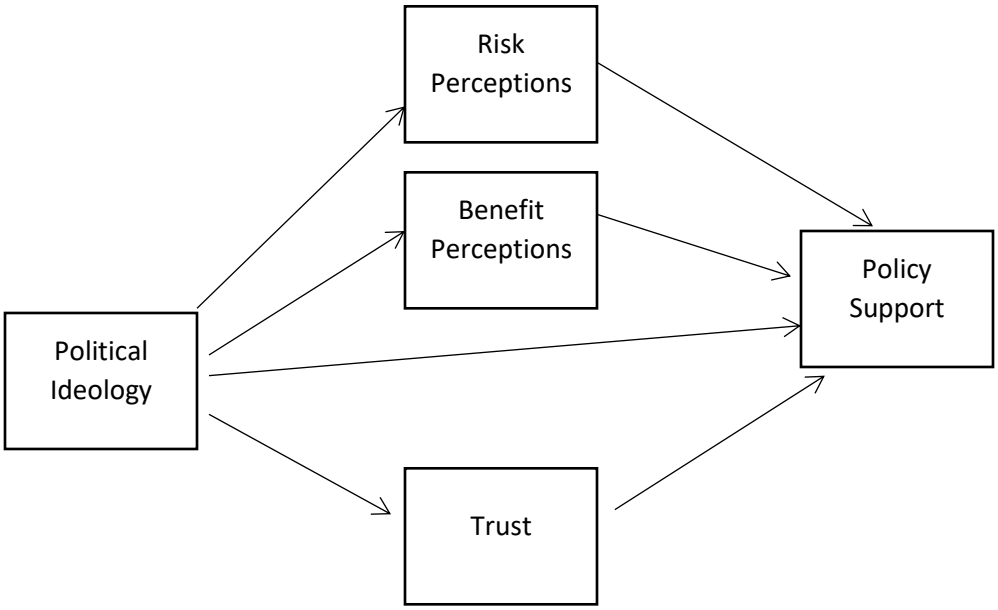


**Figure 5.1 Proposed Mediation Model**

## DATA, MEASURES AND METHODS

I obtained data via a random digit-dial survey of Colorado residents in the fall of 2014. As explained above, exemptions from federal environmental and health regulations have left states to fill a policy vacuum (Davis 2014; Warner and Shapiro 2013); thus, public attitudes at the state level are especially relevant. Colorado is home to roughly 5.3 million people, about 2.7 million of which live in the metropolitan Denver area (U.S. Census 2015), and another large portion of the population lives in cities like Boulder and Fort Collins along the front range of the Rocky Mountains. A truly random, representative sample would largely exclude residents of rural, high drilling areas and include mostly residents of Denver and surrounding suburbs—areas which have very little active oil and gas drilling. To militate against this problem, residents of drilling-intensive counties were oversampled. To target these drilling-intensive areas I ordered all counties in Colorado by active well counts and divided the ordered counties into ten strata. From there, I randomly sampled households within county strata. Both cell phones and landlines were included to avoid coverage bias and the research team administered the survey in English and Spanish.

Given the contentious nature of fracking politics, it is not surprising that question wording may bias responses. Evensen et. al. (2014) observed sharp difference between the term "fracking" and the phrase "shale gas development"—the respondents viewed the former much more negatively. However, Stoutenborough, Robinson and Vedlitz (2016) report no difference in response between "fracking" and "hydraulic fracturing". Motived by potential biases the survey instrument used the term "oil and gas activity" and the introduction explained that "oil and gas activity" referred to exploration, drilling (possibly via fracking) and waste disposal.

The completion rate was 95%. Using the most conservative definition (AAPOR Response Rate 1), the response rate was 9% and the margin of error was 5% while a more liberal definition (AAPOR Response rate 6) produced a 14% response rate. This response rate parallels other telephone polls on energy and environmental issues (e.g. Pew 2014; Clarke et. al. 2015; Boudet et. al. 2016). Survey methodologists have noted that there is not a tradeoff between response rates and data quality—that is, bias results from poor sampling design, errors in data collection, coding problems and the like and not necessarily low response rates (Groves 2006; Keeter et. al. 2006; Groves and Peytcheva 2008).

**Analytic Strategy**

The data analysis occurred in three steps. First, I described the dependent variable, the exogenous political ideology variable, the mediators, and the control variables and provide basic descriptive statistics. In the next section, I used ordinary least squares regression (OLS) to understand the relationships between all the predictors and the policy dependent variable. Thirdly, I employed the KHB technique for mediation (Kohler, Karlson and Holm 2011). Compared to other mediation techniques KHB performs remarkably well in models using a mix of categorical and continuous variables (Karlson and Holm 2011). KHB estimates a total and indirect effect and a percentage confounding— if conservative ideology is exogenous to risk/ benefit perceptions and trust in the oil and gas industry this confounding percentage should be substantively large.[33]

[33] Before estimating the models, I conducted exploratory analysis using polychoric correlations between possible predictors of policy attitudes and the dependent variables. I found that several theoretically plausible variables, such as proximity to oil and gas drilling, trust in regulators, and place attachment had almost no correlation with either outcome variable and are thus excluded from this analysis. Correlation results are available from the author upon request.

*Dependent Variable: Policy Scale.* The dependent variable is a scale constructed from a range of policy options for unconventional oil and natural gas extraction. These policies included: disclosure of chemicals used in drilling, setbacks from residences and schools, prohibiting drilling on public lands, real-time monitoring of air and water pollution, noise limitations, and taxes on oil and gas drilling to fund efforts to reduce its impacts or taxes to develop renewable energy. Each question used response categories that ranged from strongly support to strongly oppose. As shown in Table 5.1, most Coloradoans support an array of regulatory policies—many of these policies are more stringent than current policies.At least 60% of respondents indicated "support" or "strongly support" for disclosure rules, setbacks, air and water pollution monitoring and even special taxes on the oil and gas industry. There is somewhat less support for restricting drilling on public lands with only 48% indicating support or strong support.

**Table 5.1 Distribution of The Individual *Policy Scale* Items**

| | Strongly Support % | Support % | Oppose % | Strongly Oppose % |
|---|---|---|---|---|
| Disclosure | 44.3 | 43.04 | 8.35 | 4.3 |
| Residential Setback | 33.85 | 41.1 | 19.01 | 5.99 |
| School Setback | 35.2 | 41.8 | 17.09 | 5.87 |
| Restricting Drilling on Public Land | 15.68 | 32.7 | 36.22 | 15.41 |
| Air Pollution Monitoring | 31.61 | 48.19 | 16.84 | 3.37 |
| Water Pollution Monitoring | 40.15 | 46.21 | 10.86 | 2.78 |
| Noise Limits | 17.96 | 46.41 | 29.01 | 6.63 |
| Tax for problems caused by oil and gas | 28.31 | 47.09 | 18.25 | 6.35 |
| Tax to fund renewable energy | 25.59 | 41.1 | 21.37 | 11.87 |

The dimensionality of these items was examined via an exploratory factor analysis using iterated principal factor extraction, this produced a single factor solution (eigenvalue=5.4, all variables loaded above .4). An additive scale was constructed (Cronbach's alpha= .89) with a

mean of 1.9 and standard deviation of .62. This scale, which I call *policy*, serves as the dependent variable.

*Exogenous Variable: Political Ideology.* Political ideology is measured using a question in which respondents were asked "How would you describe your political beliefs?"; after recoding this variable is 0=not conservative and 1=conservative. About 37% of respondents identified as conservative; this roughly aligns with voter registration in the state as about 1/3 of active voters are registered Republicans (Hutchins 2016).

*Endogenous Variables and Controls.* The survey included several questions related to risks posed by oil and gas development using a likert type strongly agree to strong disagree scale. The following risks were included: real estate values, livestock or wildlife health, human health, noise pollution, air or water pollution, land use, traffic and community quality of life. I combined these risk perception items into an additive scale with Cronbach's alpha= .89 and exploratory factor analysis provided a single factor solution (eigenvalue=6.1). Higher values on the scale indicate more risk perception. The risk perception scale has a mean of 1.42 and a standard deviation of .62.

*Benefit Perception.* Respondents rated their perception of the following benefits: reducing household energy bills, the development of clean energy, energy independence from foreign oil, investment in infrastructure, tax revenue, jobs, and community quality of life using a likert type scale from strongly agree to strongly disagree. Exploratory factor analysis using iterated principal factor extraction provided strong evidence of an unambiguous single factor solution with an eigenvalue of 4.6 and factor loadings more than .6 for all variables; indeed, several factor loadings exceeded .9. From there, I constructed an addictive scale with these items

(Cronbach's alpha=.94, mean=1.07, standard deviation=.63). Higher scores on this scale corresponded to more benefit perception.

*Trust.* Trust in the oil and gas industry was captured with an ordinal indicator constructed from a survey question that asked: "How much do you trust the oil and gas industry to operate safely?" (1=a great deal of trust, 4= no trust). Forty-one percent of respondents said "Some Trust".

*Controls.* I also included controls for sex (0=male, 1=female), education (1=high school or less, 6=graduate degree or more), age in years, and income (1=$0-$25,000, 6=$150,000 or more).

Earlier I suggested that political ideology is likely exogenous to a range of variables that predict policy support—such as risk perception, benefit perceptions and trust. To understand how conservatives differ from other respondents, Table 5.2 provides descriptive statistics for conservative respondents and those who did not identify as conservative. The table demonstrates that conservatives have somewhat lower risk perceptions and somewhat higher benefit perceptions and trust in the oil and gas industry.

**Table 5.2 Descriptive Statistics by Political Ideology**

| | Not Conservative | | Conservative | | Polychoric Correlation w/ Policy Scale |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Risk Scale | 1.6 | 0.64 | 1.1 | 0.58 | 0.597 |
| Benefit Scale | 1.77 | 0.62 | 2.22 | 0.56 | -0.534 |
| White | 0.79 | 0.41 | 0.88 | 0.33 | 0.103 |
| Education | 4.52 | 1.38 | 4.34 | 1.34 | 0.171 |
| Income | 3.56 | 1.68 | 3.71 | 1.55 | -0.074 |
| Age | 49.28 | 15.86 | 55.94 | 15.95 | -0.008 |
| Trust-Oil and Gas | 2.47 | 0.95 | 3.32 | 0.76 | -0.646 |

**Results**

*OLS regression.* Table 5.3 shows OLS regression results for the policy scale dependent variable. Because of the modest sample size, I report bootstrapped standard errors estimated via 5,000 replications for both the OLS regression and mediation model.[34] I assessed multicollinearity via variance inflation factors (vif): the averaged VIFs were 2.2 in the OLS model, indicating that multicollinearity is not a problem.

As shown in Table 5.3, the effect of political conservativism is statistically significant and powerful ($b=-0.225$, $p<.05$). Risk and benefit perceptions are strong predictors while trust in the oil and gas industry has relatively little influence in both models. Socio-demographic controls such as sex, age, race, education and income did relatively little to explain policy support. For instance, high-income individuals were less supportive of restrictive fracking policy but the effect of very high income (i.e. above $150,000) referenced to low income ($25,000 or less) was miniscule ($b= -.088$).

[34] Bootstrapping involves resampling with replacement from the data and developing an average standard error from repeated draws.

**Table 5.3 OLS Regression for *Policy Scale***

| | b | bootstrap se | p-value |
|---|---|---|---|
| **Conservative** | -0.225 | 0.058 | 0.000 |
| **Risk Scale** | 0.264 | 0.067 | 0.000 |
| **Benefits** | -0.159 | 0.070 | 0.023 |
| **White** | 0.052 | 0.076 | 0.495 |
| **Education** *(ref. less than High School)* | | | |
| High School | 0.281 | 0.274 | 0.305 |
| Trade School | 0.318 | 0.289 | 0.271 |
| Some College | 0.574 | 0.268 | 0.032 |
| BA/BS | 0.436 | 0.270 | 0.107 |
| Graduate Degree | 0.475 | 0.267 | 0.076 |
| **Income** *(ref. less than $25,000)* | | | |
| $26,000-$50,000 | 0.036 | 0.119 | 0.758 |
| $51,000-$74,000 | 0.012 | 0.102 | 0.903 |
| $75,000-$100,000 | -0.087 | 0.104 | 0.403 |
| $100,000-$149,000 | 0.071 | 0.107 | 0.504 |
| $150,000 or more | -0.110 | 0.115 | 0.339 |
| **Age** | 0.003 | 0.002 | 0.043 |
| **Trust-Oil and Gas** (*ref. no trust)* | | | |
| Very little trust | -0.014 | 0.085 | 0.870 |
| Some trust | -0.211 | 0.094 | 0.024 |
| Complete trust | -0.319 | 0.120 | 0.008 |
| **Intercept** | | 1.513 | |
| *Adjusted* $R^2$ | | 0.476 | |
| *N* | | 334 | |

*Standard errors bootstrapped with 5,000 replications*

*KHB mediation.* Table 5.4 provides the results of the KHB mediation results. In these models, political ideology is exogenous to risk perceptions, benefit perceptions, and trust in the oil and gas industry. The mediation model also included controls for age, white, sex, education and income. KHB estimates a total, direct and indirect effect. The total effect is the sum of the

indirect and direct effect while the indirect effect represents the portion of the effect of political ideology mediated by the intervening variables of risk perceptions, benefit perceptions, and trust in the oil and gas industry. The direct effect represents the impact that political ideology has on *policy* independent of the mediators.

The total effect of conservative was b= -51. Here, about 61% of the effect of being conservative is mediated by the intervening variables; after using risk perceptions, benefit perceptions and trust in the oil and gas industry as mediators the direct effect of conservative becomes b= -20. Risk perception has a particularly strong intervening effect—about 29% of the mediated effect of conservative is via risk perceptions. Benefit perceptions mediate about 13% of the effect of political ideology while trust in the oil and gas industry mediates about 18% of the effect.

**Table 5.4 KHB mediation analysis for *Policy Scale***

| Conservative | Coef | Bootstrap SE | Confounding (%) |
|---|---|---|---|
| Total Effect | -0.51 | 0.08 | NA |
| Direct Effect | -0.20 | 0.07 | NA |
| Mediated Effect | -0.31 | 0.05 | 60.56 |
| Through | | | |
| Risk Scale | -0.15 | 0.05 | 28.57 |
| Benefit Scale | -0.07 | 0.03 | 13.05 |
| Trust-Oil and Gas | -0.10 | 0.04 | 18.94 |

Control variables: Income, Education, Sex, Age and White, R2=.47, n=334. Standard errors bootstrapped with 5,000 replications.

## DISCUSSION

The purpose of this chapter was to expand sociological inquiry into public support for restrictive fracking policy—an area which has received relatively little attention. As such, this chapter is an extension of previous work on perceptions of hydraulic fracturing (e.g. Boudet et. al. 2014; Ladd 2014; Jacquet 2012) while also contributing to literature on the role of political ideology in forming attitudes towards environmental and technological issues (e.g. McCright and

Dunlap 2011a; 2011b; Whitfield et. al. 2009). This research also adds to scholarship on the social response to energy development more broadly (e.g. Devine-Wright 2005; 2009; McAdam and Boudet 2012; Malin 2015).

The OLS models presented above indicated, unsurprisingly, that support for fracking regulation is partisan in that conservatives were less likely to support restrictive fracking policy. Risk perceptions increased support while those who trust in the oil and gas industry were less apt to endorse restrictive regulation. Benefit perceptions had a less pronounced role.

I argued that the literature strongly suggests that political affiliation is exogenous to trust, risk, and benefit perceptions because people form their political affiliation at a young age and it acts as a combined social identity and cognitive heuristic. The mediation results largely confirm that political ideology is exogenous to other predictors of policy support. In the case of fracking, political ideology has a two-fold influence on policy outcomes. First, conservatives have lower risk perceptions, higher benefit perceptions and greater trust in the oil and gas industry—the combination of these variables reduces policy support. Secondly, there is a direct effect of affiliation on policy attitudes; still, slightly more than half of the effect of political affiliation occurs via risk perceptions, benefit perceptions, and trust in the oil and gas industry while less than half is direct. Hence, results indicate that people rely on their politics to inform more than just their policy attitudes; rather, it also influences risk/ benefit perceptions and trust. Conservative resistance to oil and gas regulation is due, in large part, to lower risk perceptions, greater benefit perceptions, and more trust in the oil and gas industry—not policy preferences per se.

In Colorado, fracking often occurs near homes or schools and is, for many Coloradoans, is an intimate, local issue. Moving forward, I suggest that scholars interested in local

controversies around energy development attend to the question of political ideology. Local resistance, acquiesce or acceptance of potentially harmful industrial or extractive activity might be impacted by political ideology more substantially than previously thought. Moving forward, the literature on political ideology and environmental public opinion (e.g. McCright and Dunlap 2011a; 2011b) should be more thoroughly integrated with the literature on mobilization (or lack thereof) regarding energy (e.g. Bell and York 2010; Malin 2015; McAdam and Boudet 2014).

Several socio-demographic control variables that are known predictors of environmental attitudes did not reach statistical significance and had substantively small effects. Gender, for instance, is often associated with environmental attitudes (Mobley and Kilbourne 2013; Mohai 1992; Xiao and McCright 2012). There are several reasons why these socio-demographics may have relatively little influence in these models. Regarding gender, it is unclear if findings about broader environmental concerns can generalize to the more specific, intimate question of fracking policy support. Opposition to extractive industries in Appalachia is highly gendered (e.g. Bell 2014; Bell and Braun 2010; Smith 2014) yet there is some evidence that resistance to fracking in Colorado skews less female than in Appalachia (Kizewksi 2015).

While I identified a large body of literature which suggests that political affiliations are exogenous to variables like risk perception, I cannot fully rule out reverse causation. For instance, it is possible that some people will first develop risk perceptions and subsequently seek out an ideological affiliation that is reflective of those risk perceptions. The literature cited above (e.g. Jennings, Stoker and Bower 2009; Stillman, Guthrie, & Becher, 1960) suggests that this circumstance is unlikely because people are socialized into a political affiliation at a young age, but it certainly is not impossible. As such, the mediation models may contain some small degree of unaccounted for reverse causation. Future research could use longitudinal analysis or case-

control studies to uncover if individuals are likely to change political affiliation based upon their risk perceptions. Still, individuals who change their political affiliations (i.e. from liberal to conservative or vice versa) are likely very rare in the population and establishing causality in this way could be daunting.

The findings of this chapter largely corroborate a social-psychological understanding of political ideology. Political ideology is a uniquely important variable in environmental controversies because it holds influence on policy outcomes and predictors of policy support like risk perceptions, benefit perceptions and trust. This analysis suggests that, even with highly intimate local issues like fracking, political ideology acts as a combined heuristic and social identity that people use to construct their viewpoints.

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# CH 6. CONCLUSION

Unconventional oil and gas extraction via hydraulic fracturing has changed the energy landscape within the U.S. The purpose of this dissertation was to provide a comprehensive account of fracking policy preferences using a statewide sample of Colorado residents. I considered a range of plausible theoretical explanations related to place, risk and community economic identity, trust and political ideology, for why people support or do not support restrictive oil and gas policy while also "borrowing" some valuation techniques from environmental economics. This dissertation is the first thorough assessment of fracking policy attitudes, the first quantitative operationalization of "community economic identity" and one of the few sociological applications of non-market valuation techniques. As such, this research should make empirical, theoretical and methodological contributions.

In this concluding chapter, I will first offer conclusions from each chapter considering the data analysis and the theories that informed the models. Then, I will provide conclusions that are more general, explain the contribution of this research and suggest directions for future research.

Chapter 2 set out to understand how variables related to place and risk impact policy support. Theoretically, I suspected that policy support would be a function of risk perceptions, benefit perceptions and place variables. However, I found that place-related variables—such as place attachment, distance to the nearest active well, and unwanted proximity to oil and gas activity—have almost no effect on support for more restrictive policy. Subjective risk perceptions were a relatively powerful predictor while benefit perceptions did not reach statistical significance and community economic identity played little role. Interestingly, trust in regulators and the oil and gas industry, while initially conceptualized as control variables,

emerged as important factors over the course of analysis. Political ideology, unsurprisingly, was also a significant factor in policy support. Many of the socio-demographic controls had relatively little impact.

In Chapter 3, I considered if willingness to pay for more frequent inspections of oil and gas facilities—assessed via contingent valuation—was informed by variables derived from risk perception (e.g. O'Connor, Bord and Fisher1999) and place-based theories (e.g. Stedman 2003). As in Chapter 2, the place related variables and community economic identity had little to no association with support for increasing inspections while heightened risk perceptions did increase support. Further, political affiliation was a powerful predictor. As the cost associated with increasing inspections rose, public support declined. Though this result is not entirely surprising, sociologists have rarely considered how the features of a policy—such as its cost—influences whether people support it. In particular, semi-structured interviews might be especially useful here given the apparent complexity of public views.

Chapter 4 examined what I called "governance scale preferences"—that is, beliefs about what level of government should oversee regulating the oil and gas industry. Prior research that had examined neoliberalization and devolution in environmental governance informed this chapter. While much as been written on these topics, we know relatively little about how publics living under a neoliberalized governance regime feel about it. This chapter indicated that there was almost no support for fully exempting fracking from federal regulations. The public does also not endorse the state governments' position that it should have sole regulatory authority (Minor 2014). Rather, the results suggested that Coloradoans would like to see a complex, multi-layered approach to oil and gas governance that allows significant local control to either reduce or increase existing regulations. In other words, Coloradoans seemed to support devolution in the

form of local control but not neoliberalization in the form of little to no regulation. The logistic regression models showed that there were relatively few consistent predictors of governance scale preferences—there is a need for more research to understand what level of government people believe should regulate oil and gas development.

Chapter 5 sought to clarify the role of political ideology in oil and gas policy. I relied on theoretical and empirical analyses from social identity theory that suggest political ideology is about far more than just policy preferences. Rather, political ideology is a sort of group identity that people use to inform a range of viewpoints, many of which have little to do with actual policy (e.g. Cohen 2003; McCright and Dunlap 2011). Using mediation techniques, I found that risk perceptions, benefit perceptions and trust in the oil and gas industry are endogenous to political ideology. That is, politically conservative individuals have lower risk perceptions, higher benefit perceptions, and more trust in the oil and gas industry. These variables act to reduce policy support and political ideology has a direct effect on policy support. This chapter largely corroborates a social psychological understanding of political ideology as a type of social identity—an identity that informs more than just policy preferences.

While it is helpful to examine the finding of each chapter independently, it is equally important to consider some of the overarching conclusions derived from this work. The next several paragraphs describe some over-arching conclusions considering the research questions listed in the introduction.

One of the purposes of this dissertation was to quantify the theoretical concept of "community economic identity" as developed by Shannon Bell and alluded to by many others. Interviewers asked respondents to assess the importance of various industries to their local area. In general, I found that community economic identity had little effect on any of the policy

dependent variables using multiple regression models, though some bivariate relationships may have been statistically or substantively important. I suspect that community economic identity (CEI) is likely relevant for oil and gas policy formation, but we need a better scale to measure this construct.

For example, the scale developed in this dissertation did not consider the *historical* roots of community economic identity. Perhaps a future CEI scale could assess how respondents understand the history of their place and how it relates to extractive industries. In addition, my CEI scale assessed *how* important people perceive various industries to be but did not assess *views about that importance*. For instance, it is possible that someone might believe that oil and gas development is important to their place but prefer that it was less important. This could be especially true of individuals who live in extractive communities but would like to see their local economy diversity or limit economic development altogether.

Another possible explanation for the null findings of community economic identity is that Colorado's population consists of many in-migrants. Bell and York (2010) describe how the historical significance of coal is leveraged by the industry in West Virginia—a state with little population growth. Colorado's more transient population may be less apt to develop a strong identification with an industry because of the lack of deep historical and cross-generational connects to any industry within the state. Comparing two areas—one with little in-migration and one with a great deal of in-migration—might be one way to test this notion.

I began this project with the assumption that risk and benefit perceptions were likely strong predictors of policy attitudes. In doing so, I relied on an implicit rational choice explanation of this relationship; if fracking is perceived as risky people are more willing to regulate it, whereas if it is perceived as beneficial people are less willing to support regulation. The results from the

empirical chapters largely corroborate this understanding. Risk perceptions were a powerful predictor of a range of policy preferences. Perceived benefits, on the other hand, had a less consistent effect but were still an important predictor of policy preferences. Overall, benefit perceptions have received little attention in the literature, suggesting future research on risk should include greater consideration of benefit perceptions.

The formation of community economic identity also involves the social construction of benefits to a place and time. That is, the concept of community economic identity suggests that sometimes groups of people come to believe that an industry is economically or culturally important to them. Community economic identity and benefit perceptions may be overlapping constructs. Alternatively, perhaps, the type of "identity construction" discussed in Shannon Bell's work is one way that benefit perceptions are socially constructed. While benefit, perceptions do not perfectly track community economic identity around the oil and gas industry, they may both be facets of the same underlying theoretical construct. Future research, ideally with mixed methods, might be able to disentangle the complex relationships between benefit perceptions and the cultural significance of an industry. One possibility is to study attitudes towards an employer before or after an expansion.

Political events around oil and gas within Colorado led me to believe that "place" also accounted for fracking policy attitudes as the public response to fracking seemed to be so different in different places. This led me to the "sense of place" literature and concepts like place attachment (e.g. Scannell and Gifford 2010). However, I found that place attachment had little effect in multiple regression models nor did other place related variables like proximity to drilling. This is not to say that "places" have no relevance for oil and gas policy formation. Clearly, there has been a very differential policy response to the fracking boom across spaces.

While I did not investigate this issue, I suspect that one possible explanation is that the spatial distribution of strong predictors—like risk perception and political ideology—is highly unequal. In other words, the reason why some places seem so resistant to fracking while others seem so receptive may related to the fact that people in those different places have divergent levels of risk perception, political ideology, benefit perceptions and the like. The spatial pattern in the public response to fracking may not have as much to do with how people relate to a place (i.e. place attachment) but rather how viewpoints (e.g. political ideologies, trust or risk perception) tend to cluster spatially. This project cannot answer this question but future researchers should look for spatially clustering of attitudes to explain oil and gas policy outcomes.

I also examined how proximity to oil and gas activity relates to various policy attitudes. I found a null relationship across every dependent variable—actual proximity seemed to have no association with support for regulation. As noted throughout the chapters, the measurement for proximity was a rough proxy calculated by assigning respondents to their zip code centroids. I suspect that risks related to fracking involve a great deal of "social construction" in which the actions of regulators, media figures, local movements, and other social factors heighten or dull risk perceptions. However, it is important to remember that the measurement of proximity used in this dissertation is inexact.

Except for governance scale preferences, I found that political ideology is a rather powerful predictor of policy preferences. Further, the medication chapter (Ch. 5) indicated that political ideology informs far more than just individuals' policy preferences—rather, people rely on their political ideology to answer questions like "is fracking a health risk?". This chapter suggests that political ideology may be a uniquely significant predictor of regulator policy attitudes because of it is exogenous to other predictors.

This dissertation is also one of the first sociological applications of contingent valuation. My interest in this technique was motivated by a concern that sociologists need to consider how the characteristics of a policy—not just the attributes of an individual or their social environment—lead to policy support. Chapter 3 showed that the cost associated with a policy is a robust predictor of support across model specifications. Future research, especially qualitative interviews, could be very useful in figuring out how people interpret the commensuration of a policy.

There are some broad policy implications from this research. Perhaps the most significant is that Coloradoans support a relatively stringent regulatory regime, though there are differences based upon variables like risk perception and political ideology. The challenge for policy-makers is to develop a regulatory regime that: (1) safeguards public health and the environment and (2) allows for energy development all while simultaneously developing a multi-level system of governance.

While I provided some specific limitations in each chapter, there are some general limitations to this entire project. First, resource limitations hampered the sample size and the number of Spanish language interviews. A larger sample would have been ideal. A second limitation is this data is observational and cross-sectional and thus, any results reported here are associational and not causal. A third limitation is generalizability. This study examined Colorado residents at a point in time. They may not generalize to other regions of the country and other times. Indeed, the policy regime for fracking is ever shifting so it is likely that public opinion on fracking policy issues will change accordingly. Further research should attend to shifting public opinion on oil and gas regulation.

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# APPENDIX A: METHODOLOGICAL APPENDIX

## Sample

Before data collection, I established 400 as the goal sample size. I selected this figure because it represents roughly a 5% margin of error and because, given the limited resources available for this project, achieving a larger sample size was unlikely.

I considered and rejected several possible sampling strategies. For instance, one strategy common in rural sociology is to select a handful of counties and compare responses across counties to ascertain the effect of contextual-level variables, such as the extent of drilling (e.g. Kriesky et. al. 2014; Theodori 2012). This strategy is not optimal primarily because it does not provide much variance on the extent of drilling, a key contextual level-variables. As such, contextual variables cannot be used as predictors in a regression modeling framework and ascertaining their causal inference from this sampling design is dubious at best.

This project uses an alternative strategy which seeks to maximize variance on a key contextual variable—the extent of local drilling. I describe this approach in depth below. Initially, I considered using a statewide sample proportional to the state population. Because place and the extent of local drilling is important, a statewide sample proportional to population is inappropriate. Ultimately, this sampling strategy would poorly represent populations exposed to oil and gas activity because Colorado's population is concentrated in the Denver metro area and along the front range of the Rockies— areas with relatively little drilling. To produce a sample representative of populations exposed to oil and gas activity, I accessed county-level well counts from the Colorado Oil and Gas Conservation Commission (COGCC 2014). County well counts are highly skewed: nearly 50% of all active wells in the state are in Weld County (20,794)

while sizable portions are also in Garfield (10,547) and Yuma County (3,885) counties. Indeed, 74% of all wells are within only 4 of Colorado's 64 counties. As a further complication, county-level well counts could vary because counties are of different geographic sizes—to deal with this issue, I calculated wells per square mile. Figure A.1 shows the distribution of this variable:

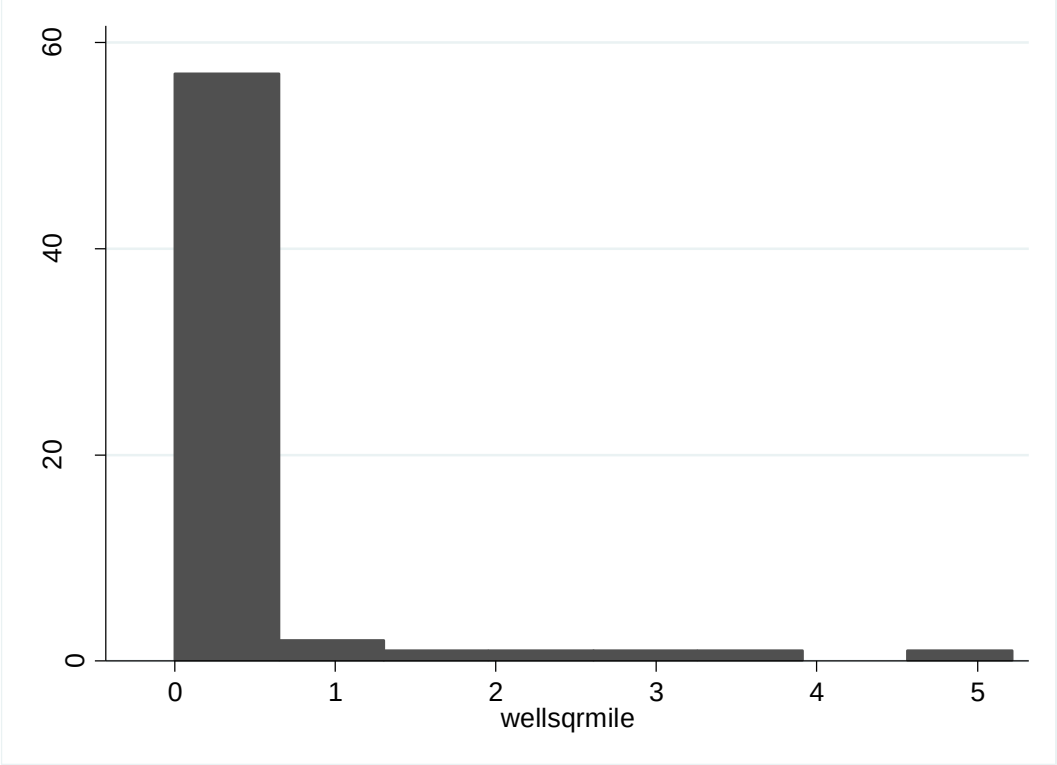


**Figure A.1. Wells per square mile**

Because of this highly skewed distribution, I performed a fourth-root transformation to produce a relatively uniform distribution. The fourth-rooted version is showed in Figure A.2:

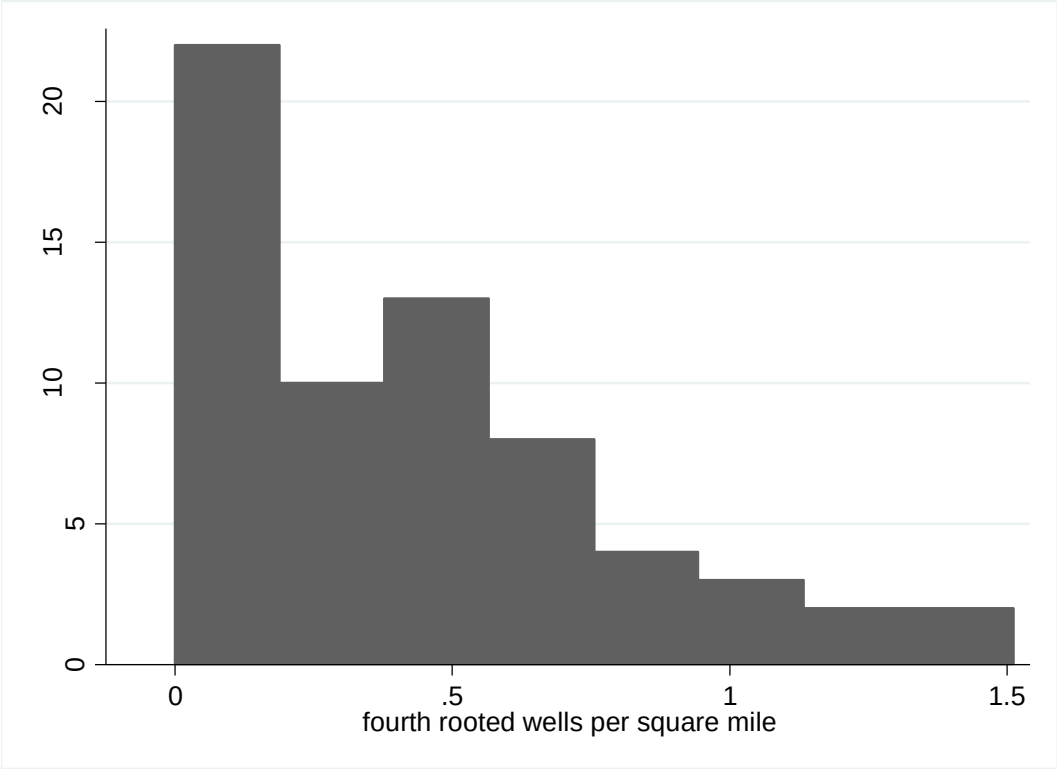


**Figure A.2 Fourth Root wells per square mile**

Then, I created10 strata of fourth-rooted county well counts per square mile by dividing this variable into 10 intervals. Each stratum was than assigned 1/10 (i.e. 40 observations) of the targeted sample size of 400. Within each stratum, I assigned projected sample size in proportion to county population. Because of this sampling strategy, the data retains some degree of generalizability to the entire state while better representing the views of those who live near oil and gas activity. In addition, this approach maximizes the amount of variation on the degree of individual exposure to oil and gas activity and, as such, is superior to other sampling strategies used in the extant literature that compare two or more communities (e.g. Kriesky et. al. 2014). However, the sample is likely least generalizable to counties which have both a small population and little to no oil and gas activity as this sampling strategy may not represent those counties.

Survey Sampling International (SSI) provided the sample.[35] I gave SSI a list of counties and asked to produce a sample of both cell phone and landline numbers to achieve the targeted sample for that county and avoid problems of coverage bias. SSI representatives explained that targeting specific counties could be inexact because not all phone exchanges are contained within one county (Personal Communication 2014). In addition, some people might live in a county but use a cell phone listed in another county. SSI representatives also explained that county-level estimates of cell-phone only households do not currently exist. Ideally, I could have calibrated the sample with such information but this is not possible. The sample included 4,762 wireless numbers and 2,334 landlines.

**Data Collection**

Following Institutional Review Board approval, the research team collected data during the fall semester of 2014 by sociology undergraduate students enrolled in a senior capstone course specifically designed to incorporate a service learning research experience with financial support and endorsement of The Institute for Teaching and Learning (TILT) at CSU and the Rural Sociological Society (RSS). All service-learning students had completed, or were currently enrolled, in research methods and statistics courses. For the first third of the semester, students were required to read and respond to articles and book chapters about survey research including survey design, implementation and human subjects and informed consent. Following this academic preparation, Dr. Shelley and I trained students in appropriate interview techniques. This included the operation of the call center, the logic of the survey instrument, the informed consent statement, and a standardized prompt sheet. We did not incentive students, via grades or compensation, to complete interviews to produce the highest quality data. Dr. Tara Shelley or I

[35] SSI is a data solutions firm that provides sampling and survey design to some 3,600 clients worldwide.

managed the call center approximately five days per week with the exceptions of Friday and Tuesday evenings.

*Survey Introduction.* Following the ethical guidelines of the AAPOR (2015) and the National Council on Public Polls (NCPP 2015), the introduction included the interviewers' name, the sponsoring parties, referenced CSU as the affiliated institution, an explained that the survey was voluntary, and stated risk and benefits to participation.

*Margin of Error and Methods to Improve Response Rate.* Colorado has an adult population of about 4,030,301. To achieve a 3% margin of error would require 1,050 interviews. Given the limited resources associated with dissertation research project, I believed that it was highly unlikely that I would be able to achieve this margin of error. Based on the projected time spent in the call center, I expected to collect about 400 surveys for a margin of error of 4.9%. Similar studies have produced roughly the same sample size (e.g. Crowe et. al. 2015).

To increase response rates, I used proven methods like tracking calls, scheduling callbacks, calling at different times of day and on weekends, and using a tight, short introduction with the interviewers' name and the name of the affiliated institution; Dillman, Gallegos and Frey 1976; Holbrook, Krosnick and Pfent 2007). In addition, because the survey involves a highly salient and timely topic, potential respondents were probably more likely to participate in the research and provide higher quality answers (Adua and Sharp 2010; Dillman et. al. 2014; Vossler and Watson 2012; Carson et. al. 2013). We called each number up to eight times before receiving its final disposition.

*Spanish Survey.* Per the American Community Study (ACS 2013) roughly 6.5% of the total state population in Colorado speaks English with less than "very good" proficiency and about 21% of the state identifies as Hispanic or Latino. During data collection, we gave

respondents the choice of taking the survey in Spanish or English. For those opting Spanish, a fluent Spanish speaker administered the survey.

A team of undergraduate students from Colorado State University translated the survey instrument. Each is a native Spanish speaker who has spent many their lives in Colorado—the translators are members of the target population. Translation occurred in three waves. One student performed the initial translation; then, we passed the translated instrument on to another student to validate. Next, this translation to the third student to be double-checked. At the end of this process, the translators and I met as a group to work out any remaining issues. For instance, the translator explained that there was no Spanish analogue to "noise pollution" so we used the phrase "El aumento de ruido causado". The translators also administered the survey in Spanish.

**Survey Development and Content**

This section outlines the operationalization of key concepts described earlier as well as questions from the survey instrument. I replicated most the questions from previous research. Capstone students pre-tested the instrument on 60 adults residing in Colorado, and revised as needed based on results of the pre-test.

The phrase "oil and gas activity" is used throughout the survey as the word "fracking" may generate more negative responses than more ambiguous and softer phrases like "shale gas development" (Evenson et. al. 2014). However, other research has found no difference in response between "fracking" and "hydraulic fracturing" (Stoutenborough, Robinson and Vedlitz 2016). In addition, an industry spokesperson spoke to the capstone course and pointed out that the actual process of fracking only lasts a few days. Thus, "fracking" appears to have become an inaccurate catchall term for oil and gas development. Because of this, few of the survey questions refer directly to fracking. However, survey did not use the phrase "shale gas

development" because it I judged it too ambiguous and because a substantial portion of the drilling within Colorado is for oil, not just shale gas. Given these considerations, I deemed the phrase "oil and gas activity" an acceptable compromise. At the beginning of the survey, interviewers supplied respondents with a definition of "oil and gas activity" it was re-read as needed during survey administration:

*"Oil and gas activity could refer to exploration, drilling using hydraulic fracturing or "fracking", the transfer or oil and gas, and the storage of byproducts and waste."*

Ideally, this holistic definition of "oil and gas activity" did not produce the emotional reaction of simply using the phrase "fracking" while also being more specific than "shale gas development."

*Response Rate and Completions.* 404 interviews were completed, slightly exceeding the targeted number of completions (400). There are several different ways to calculate response rates. I used AAPOR Definition #1 in which the number of completed interviews is divided by the number of completed interviews, partial interviews, non-interviews (which includes refusals and non-contacts) and cases of unknown eligibility. The "minimum" response rate is another name for this definition. Using this definition, the response rate was 8.6%. For cell phones, the response rate was 7.6% and for landlines it was 8.9% using AAPOR definition 1. This response rate is lower than other phone-based surveys of oil and gas policy attitudes (e.g. Rabe and Borick 2011) and much lower than mail surveys on this topic (e.g. Jacquet 2012) but is consistent with recent studies of energy policy attitudes conducted by Pew Research (Pew 2014a; 2014b) and several studies published in leading journals (Boudet et. al. 2014; Clarke et. al. 2015). However, few researches explain how response rates were calculated; that is, it is possible that some prior studies with seemingly high response rates were simply using a different method of calculation.

Using AAPOR definition 2—which excludes units with no contact—the response rates was 9.4%. Using AAPOR definition 6, which assumes that cases are unknown eligibility are not eligible, the response rate jumps to 14%. In addition, in technical reports and journal articles researchers rarely provide the number of attempts for a given case. It is possible, for example, that if the research team called each number 15 times instead of 8 times the response rate would have been higher.

Still, this low response rate is reflective of a long-term trend of increased non-participation in phone surveys (Desilver and Keeter 2015; Keeter et. al. 2008). While it has been demonstrated that low response rates do not necessarily bias data (Groves 2006; Keeter et. al. 2008; Rosen et. al. 2014; Wagner 2012) more participation would have been ideal. However, biased data results from poor sampling designs, rampant non-response bias, coverage bias and the like—not low response rates per se.

**Sample Size by County**

This section compares the sample size per county by the ideal sample size provided to SSI and the actual sample. As Table A.1 below reveals, the collected data does not completely reflect the targeted sample size per county—the counties listed in bold font on the top four in terms of wells per square mile. There are several reasons why we did not reach the targeted sample size. As noted above, representatives from SSI explained that targeting respondents by county is inexact and including cell phones in the sample further exacerbates this geographic inexactness.[36] To some degree, the difference between target n and actual n per county could be because of these problems. Some respondents may also have recall problems. For example,

[36] The central problem with targeting by county is that phone exchanges are not always contained within county borders and, with regards to cell phones, individuals may have a cell phone number from a different county (or state).

Denver County is over-represented while nearby Douglas County is under-represented. Because both counties are in the Denver metro area, some residents of Douglas County may believe that they live in Denver County.

## Table A.1 Comparisons of Target n and Achieved n

| | target n | achieved n | Diff |
|---|---|---|---|
| Adams County | 39 | 25 | 14 |
| Alamosa County | 2 | 4 | -2 |
| Arapahoe County | 14 | 34 | -20 |
| Archuleta County | 1 | 0 | 1 |
| Baca County | 1 | 0 | 1 |
| Bent County | 1 | 1 | 0 |
| Boulder County | 7 | 11 | -4 |
| **Broomfield County** | 20 | 6 | 14 |
| Chaffee County | 2 | 3 | -1 |
| Cheyenne County | 1 | 0 | 1 |
| Clear Creek County | 1 | 1 | 0 |
| Conejos County | 1 | 1 | 0 |
| Costilla County | 1 | 0 | 1 |
| Crowley County | 1 | 1 | 0 |
| Custer County | 1 | 0 | 1 |
| Delta County | 6 | 7 | -1 |
| Denver County | 15 | 21 | -6 |
| Dolores County | 0 | 1 | -1 |
| Douglas County | 35 | 18 | 17 |
| Eagle County | 6 | 1 | 5 |
| Elbert County | 21 | 3 | 18 |
| El Paso County | 5 | 32 | -27 |
| Fremont County | 10 | 7 | 3 |
| **Garfield County** | 20 | 13 | 7 |
| Gilpin County | 1 | 0 | 1 |
| Grand County | 2 | 2 | 0 |
| Gunnison County | 3 | 3 | 0 |
| Hinsdale County | 1 | 1 | 0 |
| Huerfano County | 1 | 2 | -1 |
| Jackson County | 1 | 3 | -2 |
| Jefferson County | 17 | 36 | -19 |
| Kiowa County | 1 | 1 | 0 |
| Kit Carson County | 1 | 0 | 1 |
| Lake County | 34 | 3 | 31 |
| **La Plata County** | 1 | 15 | -14 |
| Larimer County | 31 | 40 | -9 |
| Las Animas County | 1 | 4 | -3 |
| Lincoln County | 1 | 0 | 1 |
| Logan County | 2 | 2 | 0 |
| Mesa County | 3 | 14 | -11 |
| Mineral County | 0 | 0 | 0 |
| Moffat County | 1 | 2 | -1 |
| Montezuma County | 3 | 2 | 1 |
| Montrose County | 1 | 5 | -4 |
| Morgan County | 1 | 3 | -2 |
| Otero County | 2 | 0 | 2 |
| Ouray County | 1 | 0 | 1 |
| Park County | 1 | 0 | 1 |
| Phillips County | 1 | 1 | 0 |
| Pitkin County | 4 | 1 | 3 |
| Prowers County | 3 | 1 | 2 |
| Pueblo County | 18 | 24 | -6 |
| Rio Blanco County | 15 | 0 | 15 |
| Rio Grande County | 1 | 0 | 1 |
| Routt County | 5 | 2 | 3 |
| Saguache County | 1 | 1 | 0 |
| San Juan County | 1 | 0 | 1 |
| San Miguel County | 1 | 1 | 0 |
| Sedgwick County | 1 | 0 | 1 |

| | | | |
|---|---|---|---|
| Summit County | 3 | 2 | 1 |
| Teller County | 3 | 0 | 3 |
| Washington County | 0 | 1 | -1 |
| **Weld County** | 40 | 41 | -1 |
| Yuma County | 6 | 1 | 5 |
| Sum | 400 | 404 | |

Response rates might possibly vary by county for other, locally specific reasons. Larimer County, the home of Colorado State University, is somewhat over-represented in the sample data. It is possible, though unverifiable, that residents of this county may be more apt to respond to a survey given by Colorado State University students due to the economic and socio-cultural significance of the university in the area. The degree of oil and gas activity within a county might also influence a respondents' propensity to respond to a survey about oil and gas activity, but there is little evidence for this position. Among the counties with the most intensive drilling La Plata county is over-represented while Garfield, Yuma and Broomfield are underrepresented. Another possibility is that respondents who live in counties with rapidly increasing drilling might have been more apt to take the survey while respondents in areas with a long history of drilling might be less apt because of the normalization of development. Also, the spatial distribution of drilling within some counties may be such that drilling is far removed from population areas within the county, rendering oil and gas development less salient. However, I cannot test for these explanations with the existing data. At a minimum, the lack of a consistent pattern suggests that intensity of local oil and gas activity is not a strong determinant of a respondent's propensity to complete the survey.

**Comparing the Sample to Colorado Demographics**

Table A.2 compares the sample data (both weighted and unweighted) to the state of Colorado on several demographic variables. The U.S. Census—that provided the statewide

data—uses different categories than the sample data. Probability weights that adjust for each respondent's probability of selection within county were calculated and applied when estimating the descriptive in the second column of this table. The third column provides the Census data.

Between 3-4% of the sample, whether unweighted or weighted, had a high school education. Individuals with some college represented about 25-26% of the sample and about 31% had a college degree. Regarding race, about 10% of the respondents identified as Hispanic/ Latino, 80% identified as weight, and there were relatively few respondents of any other race. Turning now to income, the modal category was $51,000-$74,000 while a sizable number exceeded $150,000 in annual household income.

The sample missed the mark in several instances. For instance, the sample over-represented education individuals. In the statewide population, about 22% are High School Graduates and 31% have a Bachelor's degree. Regarding race, 21% of the Colorado population identifies as Latino. Income skewed higher in the sample data. Household incomes over $150,000 per year represent about 11% of the state population.

I suspect that higher educated, more affluent and white respondents had a higher propensity to respond—a well-documented problem in survey research (Remler and Van Ryzin 2010). The divergence between the sample data and the census data is also likely a result of the sample design. Recall I designed sample so that it would be representative of counties with extensive oil and gas drilling. These counties, such as Garfield, have relatively small populations and a fully representative, random sample of the Colorado population might not include respondents from these areas because the population of the state in concentrated in the Denver metropolitan area. As such, the novel sampling design explains some of the non-representativeness of the sample.

Race is somewhat better represented, though these categories are less comparable because the census conceptualizes “Hispanic/ Latino” as an “ethnicity” using an additional question after asking about race. Hence, the Census allows people of any race to identify as “Hispanic”.

**Table A.2 Comparing the Sample to Statewide Demographics**

| | Unweighted Sample | Weighted Sample | Colorado Demographics | |
|---|---|---|---|---|
| | % | % | | % |
| Education | | | Education (25 years of age and older) | |
| Less than HS | 0.5 | 0.74 | Less than High School | 10 |
| Some HS | 2.23 | 1.49 | High School Graduate | 22 |
| HS | 11.88 | 10.92 | Some College or Associates | 31 |
| Trade/ Vocational School | 3.96 | 2.91 | Bachelor's Degree | 24 |
| Some College | 25.25 | 26.38 | Graduate or Professional Degree | 14 |
| College | 31.19 | 31.29 | | |
| Post Grad | 25 | 26.27 | | |
| Race | | | Race | |
| Hispanic/ Latino | 9.64 | 10.82 | Hispanic/ Latino | 21 |
| White | 82.49 | 80.12 | White | 88 |
| Black of African-American | 2.03 | 2.84 | White alone | 69 |
| Native American | 0.51 | 0.51 | Black of African-American | 4 |
| Asian or Pacific Islander | 1.52 | 2.4 | Native American | 1 |
| Multi-Racial | 1.02 | 1.14 | Asian or Pacific Islander | 3 |
| Other | 2.79 | 2.17 | Multi-Racial | 3 |
| Income | | | Income | |
| Less than $25,000 | 11.61 | 11.21 | Less than $10,000 | 6 |
| $26,000-$50,000 | 17.28 | 17.24 | $10,000 to $14,999 | 4 |
| $51,000-$74,000 | 21.81 | 19.83 | $15,000 to $24,999 | 10 |
| $75,000-$100,000 | 14.16 | 11.88 | $25,000 to $34,999 | 10 |
| $100,000-$149,000 | 18.13 | 21.43 | $35,000 to $49,999 | 13 |
| $150,000 or more | 17 | 18.4 | $50,000 to $74,999 | 18 |
| | | | $75,000 to $99,999 | 13 |
| | | | $100,000 to $149,999 | 14 |
| | | | $150,000 to $199,999 | 6 |
| | | | $200,000 or more | 5 |
| Age | | | Age | |
| mean | 50.9 | 50.1 | 18 to 24 | 10 |
| | | | 25 to 29 | 15 |
| | | | 30 to 34 | 14 |
| | | | 35 to 44 | 14 |
| | | | 45 to 54 | 14 |
| | | | 55 to 64 | 13 |
| | | | 65 to 74 | 7 |
| | | | 75 years or older | 5 |
| | | | median age | 36 |

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APPENDIX B: SURVEY INSTRUMENT

# Oil and Gas Policy Preferences among Coloradoans

*"Hello my name is _____ and I am a student in the Sociology Department at Colorado State University. Colorado State University is conducting a brief public opinion survey on oil and gas activity and public policy.*

*"Do you have approximately 12 minutes to complete the survey?"*

[If no, ask if there is a better time to call and record their preference on the call disposition sheet.]

If yes—"*Thank you. Your participation is voluntary and you may stop answering questions at any time. There is no direct benefit for your participation; however, by participating in the survey you will provide Colorado State University with information that may help improve research in the field of public opinion.* ***There are NO KNOWN RISKS in participating and your responses will be treated CONFIDENTIALLY.*** *As part of this confidentiality guarantee, we do not have access to your name or associate your telephone number to your survey responses. Are you ready to take the survey?"*

(*Don't read*) Date _____

(*Don't read*) Record Student Name _____

(*Don't read*) Record Start Time _____

***(Do Not Read)*** **SCREENING QUESTIONS**

**Are you 18 years of age or older?** (*If the respondent is under 18, ask if someone 18 or older is available to complete the survey. If no person age 18 or older is available, state that survey respondents must be 18 or older. Thank them for their time, abort the survey, & record INE on the call sheet.*)

- (*Don't read*)Yes
- (*Don't read*) No

***(Do Not Read)* Oil and Gas Policy**

These first questions concern policies regarding oil and gas activity in Colorado. Oil and gas activity could refer to exploration, drilling using hydraulic fracturing or "fracking", the transfer of oil and gas, and the storage of byproducts and waste. We are interested in public opinion on these issues. There are no right or wrong answers to these questions.

Q1. Thinking about the current amount of state regulation of the oil and gas industry, would you say the current amount of regulation is: too much, too little or about right?

- ❍ (*Don't read*) Too much
- ❍ (*Don't read*) Too little
- ❍ (*Don't read*) About right
- ❍ (*Don't read*) Don't know
- ❍ (*Don't read*) Refused
- ❍ (*Don't read*) Neutral

Q2. I am going to read you a list of policies that have been suggested for regulating the oil and gas industry. Please consider each of these policies individually. Do you strongly support, support, oppose or strongly oppose….(*Read response list again after item **a)** and as needed*):

| | Strongly Support | Support | Oppose | Strongly Oppose | DK *(Don't Read)* | REF *(Don't Read)* | Neutral *(Don't Read)* |
|---|---|---|---|---|---|---|---|
| ***a)*** Requiring oil and gas companies to fully disclose the chemicals used in drilling to the public before it begins? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** Prohibiting oil and gas activity within 1000 feet of residential properties? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** Prohibiting oil and gas activity within 1000 feet of schools? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** Prohibiting oil and gas activity on public lands? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***e)*** Requiring the state to conduct real-time monitoring of potential *air pollution* at the drilling location? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***f)*** Requiring the state to conduct real-time monitoring of potential *water pollution* at the drilling location? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***g)*** Setting stronger limits on noise that can come from oil and gas operations? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***h)*** Taxing oil and gas companies on the amount of oil or gas they extract and using those revenues to deal with potential problems caused by oil and gas activity? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***i)*** Taxing oil and gas companies on the amount of oil or gas they extract and using those revenues for the development of renewable energy? | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

Q3. Another policy that has been suggested is a 3-year *temporary*, statewide ban on fracking so that more research can be conducted on its potential environmental or health impacts. Do you strongly support, support, oppose or strongly oppose a temporary, statewide ban on fracking?

- ❍ Strongly Support *(Go to Q4)*
- ❍ Support *(Go to Q4)*
- ❍ Oppose *(Go to Q5)*
- ❍ Strongly Oppose *(Go to Q5)*
- ❍ (*Don't read*) Don't Know *(Go to Q5)*
- ❍ (*Don't read*) Refused *(Go to Q5)*
- ❍ (*Don't read*) Neutral *(Go to Q5)*

## (CALLER NOTE: *only ask Q4 if the respondent answered strongly support or support to Q3):*

Q4. *(Only ask if respondent said SS or S for Q3)*: Some argue that a statewide ban on fracking would reduce the supply of oil and gas, which could lead to higher monthly utility or energy bills. Thinking about your household finances, would you still support a fracking ban if your household utility and energy bills increased by **$X** per month?

- ❍ (*Don't read*)Yes (G*o to Q4a)*
- ❍ (*Don't read*) No *(Go to Q5)*
- ❍ (*Don't read*) Don't Know *(Go to Q5)*
- ❍ (*Don't read*) Refused *(Go to Q5)*

Q4a. Now, please think about your response to that last question: How certain are you? Use a scale of 1-10, where 1 means you are not at all certain and 10 means you are completely certain.

(*Don't read*) 1 2 3 4 5 6 7 8 9 10 DK REF Neutral

Q5. On average, the Colorado Oil and Gas Conservation Commission inspects each oil and gas operation about once every three years. Now, I'd like you to think about a possible increase in your state income taxes to hire additional inspectors so that all oil and gas sites in Colorado could be inspected at least once per year. Thinking about your household's finances, would you pay **$X** more in state income taxes PER YEAR to fund more frequent inspections of oil and gas operations?

- (*Don't read*)Yes (G*o to Q5a)*
- (*Don't read*) No *(Go to Q5b)*
- (*Don't read*) Don't Know *(Go to Q5b)*
- (*Don't read*) Refused *(Go to Q5b)*

Q5a. Now, please think about your response to that last question: How certain are you? Use a scale of 1-10, where 1 means you are not at all certain and 10 means you are completely certain.

(*Don't read*) 1 2 3 4 5 6 7 8 9 10 DK REF Neutral

Q5b. Please indicate if you would strongly support, support, oppose or strongly oppose charging oil and gas companies an annual fee so that inspections can occur at least once per year?

- (*Don't read*) Strongly Support
- (*Don't read*) Support
- (*Don't read*) Oppose
- (*Don't read*) Strongly Oppose
- (*Don't read*) Don't Know
- (*Don't read*) Refused
- (*Don't read*) Neutral

Q6. People have different perspectives about federal, state or local oversight of the oil and gas industry. Please tell me if you strongly agree, agree, disagree or strongly disagree with each of these different perspectives. (*Read response list again after item **a)** and as needed):*

| | Strongly Agree | Agree | Disagree | Strongly Disagree | *(Don't Read)* DK | *(Don't Read)* REF | *(Don't Read)* Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** Towns should be able to relax regulations on oil and gas activity. | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** Towns should be able to pass stricter regulations on oil and gas activity. | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** The state government should have control over all regulations involving oil and gas activity. | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** The oil and gas industry should be exempt from federal environmental regulations. | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

**(*Do Not Read*) Benefits, Risks and Impacts**

Q7. Please tell me if you strongly agree, agree, disagree, or strongly disagree that oil and gas activity has had a POSITIVE impact on….. (*Read response list again after item **a)** and as needed):*

| | Strongly Agree | Agree | Disagree | Strongly Disagree | (*Don't read*) DK | (*Don't read*) REF | (*Don't read*) Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** Community quality of life | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***b)*** a positive impact on job creation | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** a positive impact on generating tax revenue | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** Investment in community infrastructure | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***e)*** Energy independence from foreign oil | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***f)*** The development of clean energy | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***g)*** Reducing household energy bills | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

Q8. Please tell me if you strongly agree, agree, disagree, or strongly disagree that oil and gas activity has had a NEGATIVE impact on: (*Read response list again after item **a)** and as needed)*

| | Strongly Agree | Agree | Disagree | Strongly Disagree | (*Don't read*) DK | (*Don't read*) REF | (*Don't read*) Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** Community quality of life | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** a negative impact on road traffic | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** a negative impact on air or water quality | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** Land use | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***e)*** Noise pollution | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***f)*** Human health | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***g)*** Wildlife or livestock health | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***h)*** Real estate values | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

***(Do Not Read)* Risk Proximity**

Q9. Do you have oil and gas activity located on your land?

- (*Don't read*) Yes *(Go to Q10)*
- (*Don't read*) No *(Go to Q9a)*
- (*Don't read*) Don't Know *(Go to Q9a)*
- (*Don't read*) Refused *(Go to Q9a)*

Q9a. Do you have oil and gas activity in your local area?

- (*Don't read*) Yes (*Go to Q10)*
- (*Don't read*) No *(Go to Q10)*
- (*Don't read*) Don't Know *(Go to Q10)*
- (*Don't read*) Refused *(Go to Q10)*

Q10. Please answer yes or no: Do you feel oil and gas activity is too close to where you live? (*only read categories if absolutely necessary)*.

- (*Don't read*) Yes, (*read if needed:* oil and gas activity is too close to where I live)
- (*Don't read*) No, (*read if needed:* oil and gas activity is not too close to where I live)
- (*Don't read*) Don't know
- (*Don't read*) Refused

Q11. Have you, or a family member, experienced any negative health effects resulting from oil and gas activity?

- (*Don't read*) Yes
- (*Don't read*) No
- (*Don't read*) Don't Know
- (*Don't read*) Refused

**(*Do Not Read*) Community Economic Identity**

Q12. Now, I'd like to ask you some questions about your local economy and the place where you live. I am going to read you a list of different industries that may be in your area. Please tell me if these industries are very important, important, somewhat important, or not at all important to your area...*(Read response list again after item **a)** and as needed):*

| | Very Important | Important | Somewhat Important | Not Important | (*Don't read*) DK | (*Don't read*) REF | (*Don't read*) Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** Tourism | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** Oil and gas activity | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** Agriculture | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** Colleges and universities | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***e)*** Hospitals | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***f)*** Alternative energy sources like wind and solar | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***g)*** High technology like computers, software or the internet | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***h)*** Brewing and distilling | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***i)*** Manufacturing | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

***(Do Not Read)* Place Attachment**

Now, I'd like for you to think again about the area where you live.

Q13. How long have you lived in this area? *(Record Verbatim, probe for a specific time in years, days or months if needed*)_____

Q14. Thinking again about the area where you live, please tell me whether you strongly agree, agree, disagree or strongly disagree with the following statements. (*Read response list again after item **a)** and as needed):*

| | Strongly Agree | Agree | Disagree | Strongly Disagree | (*Don't read)* DK | (*Don't read)* REF | (*Don't read)* Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** You feel connected to your community | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** You are attached to the natural areas in your area | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

## *READ:* We are almost finished.

***(Do Not Read)*: Trust**

Q15. How much do you trust the oil and gas industry to operate safely? Do you have a... *(Read list)*

- ❍ Great deal of trust
- ❍ Some trust
- ❍ Very little trust
- ❍ No trust
- ❍ (*Don't Read)* Don't know
- ❍ (*Don't Read)* Refused
- ❍ (*Don't Read)* Neutral
- ❍

Q16. I am going to read you a list of organizations that may have oversight of the oil and gas industry. Please tell me if you have a great deal of trust, some trust, very little trust or no trust in the following organizations to provide neutral oversight of the oil and gas industry? (*Read response list again after item **a)** and as needed)*

| | Great Deal of Trust | Some Trust | Very Little Trust | No Trust | (*Don't read)* DK | (*Don't read)* REF | (*Don't Read)* Neutral |
|---|---|---|---|---|---|---|---|
| ***a)*** The Colorado Oil and Gas Conservation Commission | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***b)*** The Colorado Department of Public Health and Environment | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***c)*** Local government officials | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***d)*** Members of the State legislature | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| ***e)*** The governor's office | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

***(Do Not Read)*** **Demographics and Controls**

## READ: The following demographic questions are for statistical purposes only. These questions will only take a moment.

Q17. What county do you live in*? (Record Verbatim)*_____

Q18. What is your zip code? _____ *(Caller note: Make sure it is five digits)*

Q19. What is the highest level of education you have received? Please stop me when I reach the *highest level* of education that you have received.

- ❍ Some high school
- ❍ High school graduate or GED
- ❍ Vocational or trade school
- ❍ Some college or associates degree
- ❍ College graduate
- ❍ Post graduate work or degree
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q20. What year were you born? *(Record Verbatim)*_____

Q21. For demographic purposes, I am required to ask all respondents to report their sex. (*CALLER NOTE: Pause so they can respond. If they are expressing confusion you may offer the categories*)

- ❍ (*Don't read*) Male
- ❍ (*Don't read*) Female
- ❍ (*Don't read*) somewhere else on the gender spectrum (*Record Verbatim)*:_____
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q22. What race or ethnicity do you consider yourself? (*Don't read categories)*

- (*Don't read*) Latino or Hispanic
- (*Don't read*) White
- (*Don't read*) Black or African-American
- (*Don't read*) Native American
- (*Don't read*) Asian or Pacific Islander
- Multi-racial (*write down what they say*:_____)
- Other (write down what they say:_____)
- (*Don't read*) Don't Know
- (*Don't read*) Refused

Q23. How would you describe your political beliefs? *(Read List)*

- Very conservative
- Somewhat conservative
- Moderate
- Somewhat liberal
- Very liberal
- (*Don't read*) Other (*write down what they say*_____)
- (*Don't read*) Don't Know
- (*Don't read*) Refused

Q24. Do you rent or own your home?

- ❍ (*Don't read*) Own
- ❍ (*Don't read*) Rent
- ❍ (*Don't read*) Other
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q25. Do you get your drinking water from a well?

- ❍ (*Don't read*) Yes
- ❍ (*Don't read*) No
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q26. Do you own the mineral rights under the land where you live?

- ❍ (*Don't read*) Yes
- ❍ (*Don't read*) No
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q27. Which of the following best describes your current work situation?

- ❍ Self-employed
- ❍ Employed full-time
- ❍ Employed part-time
- ❍ Not employed, but looking for work (*Go to Q29)*
- ❍ Not employed, not looking for work (*Go to Q29)*
- ❍ Retired (*Go to Q29)*
- ❍ (*Don't read*) Other (*write down what they say*_____)
- ❍ (*Don't read*) Don't Know
- ❍ (*Don't read*) Refused

Q28. What is your occupation? _____

Q29. Looking ahead, do you expect that at this time *next* year you will be financially better off than now or worse off than now?

- ❍ (*Don't read*) Better
- ❍ (*Don't read*) Worse
- ❍ (*Don't read*) The same
- ❍ (*Don't read*) Don't know
- ❍ (*Don't read*) Refused

Q30. What is your total household income before taxes? Please stop me when I reach your income category. *(Read List)*

- ❍ 0-$25,000
- ❍ $26,000-$50,000

- ❍ $51,000-$74,000
- ❍ $75,000-$100,000
- ❍ $100,000-$149,000
- ❍ More than $150,000
- ❍ (*Don't read*) Don't know
- ❍ (*Don't read*) Refused

## READ: Do you have any questions for me regarding this research project?

[*CALLER NOTE: If yes, read respondent the related prompts about how to obtain results, researcher contact information, confidentiality, rights as participant in research, etc., then read statement below.*]

**READ: By completing this survey you have helped us understand public attitudes about oil and gas policy. On behalf of Colorado State University, we appreciate your help and thank you for your time. Have a good** _____(select: day/night/ weekend**).**

**Record End Time: _____**

**Type of Phone:**

- ❍ **Landline/ Residential**
- ❍ **Cell Phone**