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Economic Identity, Price and Policy: Willingness to Pay for Fracking Regulation in Colorado

Cover Page Footnote

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ECONOMIC IDENTITY, PRICE AND POLICY: WILLINGNESS TO PAY FOR FRACKING REGULATION IN COLORADO*

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ABSTRACT

This paper considers public support for increased regulation of unconventional oil and gas development in Colorado. We examine the role of community economic identity and investigate the possibility of “colliding treadmills” in local political economies as drivers of policy preferences. We find that many place-based variables do little to predict regulatory support, but the cost associated with regulation (increased taxes) and political identity are especially important. Further, this paper is one of a handful of sociological analyses to employ the contingent valuation method for environmental valuation, in doing so it provides a first step toward establishing an empirically rigorous sociology of environmental valuation.

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

The UOGE boom has also met with controversy as it has been tied to negative impacts on public health (Colborn et. al. 2011; Hill 2014; Kassotis et. al. 2013; Perry 2012; Rabinowitz et. al. 2015) and the environment (Ferrar et. al. 2013; Holzman 2011; Howarth, Santoro, and Ingraffea 2011). Yet, UOGE is a source of jobs, economic growth and tax revenue (Energy from Shale 2015; Lee 2015; Newell and Raimi 2015). In the United States, 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 have mostly embraced the industry (Simonelli 2014; Zirotiannis et. al. 2016). This fragmentary policy landscape is a result of the convergence of selective exemptions from federal environmental and health

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regulations for oil and gas development (Warner and Shapiro 2013) and ongoing contestation about federal and state preemption in oil and gas governance (Minor 2013; Wiseman 2016).

Despite the political controversy and policy challenges presented by the boom, little research has examined public policy preferences in this area. Social scientists have documented perceived threats and opportunities (Brasier et. al. 2013; Jacquet 2012; Schafft, Borlu and Glenna 2013; Silva and Crowe 2015) and surveyed general support (Boudet et. al. 2014; Kriesky et. al. 2013; Crowe, Ceresola, and Silva 2015). However, we know surprisingly little about what types of policies the public would like to see in place to regulate UOGE. 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 paper addresses this gap in the literature using survey data from Colorado, one of the nation's top oil and gas producing states. Colorado is a macrocosm of the nation because public response to the spread of UOGE has varied significantly from place to place within the state. To account for public policy preferences, we accessed the literature on community economic identity, risk and benefit perceptions, and other known predictors of policy attitudes, described in the next section. Further, we access the literature on commensuration and adapt techniques from environmental economics to understand willingness to pay to regulate UOGE.

BACKGROUND

Community Economic Identity

A vast and diffuse literature spread across multiple social sciences speaks to the nature of places and the meanings and bonds that people form with places (Cross 2015; Massey 2010; Stedman 2002).¹ Despite the impressive volume of this literature, Ardoin (2006) points out that economic and political institutions have rarely been given careful consideration. Fortunately, a vein of scholarship emanating from rural sociology provides some insight into the significance of

¹The "place" or "sense of place" literature is far too broad to review here. This literature can be roughly organized into more qualitative or theoretical works focused on the experiential nature of place (Gustafson 2001; Nardi 2014; Thwaites 2001; Tuan 1975, 1977) and a quantitative, psychometrics literature (Jorgensen and Stedman 2006; Stedman 2002; Vaske and Kobrin 2011). People hold deep bonds with both the natural and social dimensions of places (Hidalgo and Hernandez 2001; Knez 2005; Lukacs and Ardoin 2014; Scannell and Gifford 2010; Trentelman 2009) and are dependent upon places to fulfil emotional and physical needs (Anton and Lawrence 2016; Gibbons and Ruddell 1995; Stedman 2003; Williams et. al. 1992). For reviews and theoretical considerations readers may consult Chavis and Pretty (1999), Cross (2015), Gustafson (2001), Hidalgo and Hernandez (2001), and Masterson et al. (2017).

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economic phenomena for places. Bell and York (2010) pioneered research on “community economic identity” (CEI), wherein one industry or another is perceived as having a special local significance. Studying West Virginia, the authors observed that coal industry public relations have forged a collective identity around the industry. Though coal provides very few jobs and is no longer the economic cornerstone of the state, coal is still a major component of West Virginians’ cultural identity and dominates the state’s political landscape. Efforts to ameliorate coal’s negative health and environmental impacts widely viewed as an attack on not only the industry, but the culture and livelihoods of communities that have historically been host to coal mining (Lewin 2017; Olson-Hazboun 2018).

Sometimes, people who rally in support of environmentally or socially harmful industries may be engaging in “place protective” behavior (Anderson and Schirmer 2015; Devine-Wright 2005, 2009; Devine-Wright and Howes 2010; Kearns and Collins 2010). Devine-Wright (2005, 2009) argues that communities will resist unwanted changes in significant places. Thus, if an industry is widely perceived as economically, culturally or historically significant, 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 UOGE in part because the industry is perceived as important to their area and further regulation is perceived as overly onerous—going as far as to threaten to secede from the state (Whaley 2013). Hence, community economic identity around the oil and gas industry likely affects willingness to support regulation. Thus, we test 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 contain multiple industries and communities may develop an identity around more than one industry. Gasteyer and Carrera (2013) provide a useful case study to understand the multidimensional nature of community economic identity. Examining central Illinois, the authors argue that both coal mining and industrial agriculture were viewed as locally significant. 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 multidimensional, and support for UOGE regulations may be higher if other industries are locally significant.

Following this multidimensional understanding of community economic identity, we 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

Residents of areas with UOGE, or the potential for UOGE, perceive a complex array of risks and benefits. Studies conducted in locations as diverse as Pennsylvania, Texas and Illinois find that the public expresses worry about negative public health impacts, deleterious effects on environmental quality, damage to local infrastructure, and increased crime (Brasier et. al. 2013; Crowe et al. 2015; Jacquet 2012; Schafft et al. 2013; Theodori 2013). However, the public also perceives many benefits including jobs, tax revenue, and energy independence (Anderson and Theodori 2009; Brasier et. al. 2011; Jacquet and Stedman 2013; Ladd 2014; Malin 2013; Theodori 2009). Indeed, local policy leaders may perceive great economic potential from UOGE, even when local benefits have not materialized (Ceresola and Crowe 2015; Silva and Crowe 2015).

Currently, researchers have not examined how UOGE risk perceptions influence policy preferences, yet risk perceptions predict policy support in other areas—such as climate change (Leiserowitz 2006; O'Connor, Bord, and Fisher 1999). Qualitative analyses suggest that communities may welcome UOGE 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 while perceived risks are likely to increase support for regulations. We test 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 to regulate.

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

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; Zvestoski et. al. 2002; 2004). Malin (2013) showed that Pennsylvania farmers who sign leases with the oil and

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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 Swistun 2008) and 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 cause efforts to ameliorate a source of risk (Bickerstaff 2004; Song and Schwarz 2009). Informed by this literature, this paper tests the following hypotheses:

Hypothesis 5: Actual proximity to oil and gas drilling will not affect 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 techniques that uncover how characteristics of a policy influence whether people support it. A central task for environmental economics is environmental valuation, often in what the public is willing to pay for a nonmarket 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 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. 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 where unlike items are increasingly compared with a common metric (Espelund and Stevens 1998; Espelund and Sauder 2008; Peeters,

Verschraegen, and Debels 2014). This common metric is often, but not always, money (Dalsgaard 2013; Lovell et. al. 2013; Stephan 2012). Often, commensuration theory echoes Simmel's argument 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 advance this aim, we use the contingent valuation method (CVM), described further below. Regarding willingness to pay, we investigate the following hypothesis:

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

DATA, MEASURES AND METHODS

Data

Our data is provided by a random digit dial survey of Colorado residents gathered in the latter half of 2014 by a team of undergraduate research assistants. Colorado's population has a highly skewed spatial distribution, wherein metropolitan Denver houses about 25% of the entire state population and a series of smaller cities nestled along the Front Range of the Rockies contain another significant portion. Although unconventional oil and gas development is moving increasingly closer to highly populous suburban areas on the Front Range, overall, because these areas are host to little active oil and gas drilling, a probability sample of the state population would largely exclude people with proximity to development. To counteract this problem, we devised a method of oversampling rural, high-drilling intensive regions. In doing so, we ordered all counties within Colorado by the amount of active oil and gas wells within the county and divided counties into 10 strata. From there, we randomly sampled phone numbers within each county strata.

Roughly 400 respondents completed the survey for a 5% margin of error. Using the most conservative response rate (AAPOR RR1, which assumes that all instances of nonresponse are valid phone numbers), the response rate was 9%. This figure is similar to other studies on energy and environmental issues (e.g., Clarke et. al. 2015). 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. 2006; Rosen et. al. 2014; Wagner

2012). Ninety-five percent of respondents who began the survey completed it. To avoid problems of coverage bias, our sample included both cell phones and landlines and the survey was administered in both English and Spanish.

The term “fracking” may elicit more negative responses than more neutral terms 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 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 often 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, we used the phrase “oil and gas activity” which was defined at the beginning of the interview 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 interview will militate against the biases created by a stronger and less precise term like “fracking” while also being more specific than “development.” Throughout this paper, we have used the term “fracking” as a useful short hand that reflects public understanding of the term. The next section describes our dependent variable and the contingent valuation method (CVM).

What is CVM?

Bowen (1943) and Ciriacy-Wantrup (1947) provided the groundwork for CVM by advocating for 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,” nonmarket good like a natural amenity, ecosystem service, or environmental policy by approximating 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 nonmarket good, and a value for that nonmarket good. This type of instrument facilitates the calculation of willingness to pay (hereafter “WTP”) in

explicit dollar terms. Most often, CVM involves inserting a randomly varying dollar amount into a survey question.²

Dependent Variable

In Colorado, the Colorado Oil and Gas Conservation Commission (COGCC) is responsible for some, but all not all, inspections of oil and gas operations. While the estimates vary, most 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?”

²CVM is enormously popular in economics. A Google Scholar search for “contingent valuation” produced 45,000 results. Applications include climate policy (Berrens et. al. 2004), transportation (Lambert, Poisson, and Champlovier 2001), fisheries (Wattage et. al. 2005), mountain biking areas (Fix and Loomis 1998), and forests (Lindhjem 2007). Still, CVM 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 (Arrow et. al. 1993). Ultimately, this panel of experts concluded that CVM has a role in understanding environmental valuation.

Respondents may pay less in the “real world” —this is called “hypothetical bias.” This problem can be addressed with ex post or ex ante methods (Aadland and Caplan 2006; Murphy, Stevens and Weatherhead 2005). 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.

The ex-ante approach involves several different strategies. These include reminding a respondent of their budget constraints and possible substitutes. Loomis, Gonzalez-Caban, and Gregory (1994) adopt both approaches but find no difference in WTP for groups exposed to reminders and those not exposed. Another approach to attenuating hypothetical bias, the “cheap talk” method, stems from the work of Cummings and Taylor (1998; 1999). This uses an explicit description of the hypothetical bias problem. In other words, the survey includes text that tells respondents not to overestimate their WTP. Most of these methodological issues remain unsettled. The actual effect of cheap talk scripts is not clear (Aadland and Caplan 2006). In addition, we pretested a cheap talk script was removed after respondents reacted very negatively to it.

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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.³ As shown in Table 1, at low bid amounts, most respondents said, “yes,” but as cost increased, “no” became more likely. The bid amount was adjusted up or down throughout survey administration. We used the bid amount variable as a predictor of support in our regression models.⁴

Predictor Variables

Community Economic Identity. We 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, agriculture, tourism, manufacturing, brewing and distilling, alternative energy (e.g., wind and solar), high technology (e.g., software and internet-based firms), colleges and universities, and hospitals.

To understand the dimensionality of these items, we factored a polychoric correlation matrix using iterated principal factor extraction and a varimax rotation. Tourism and manufacturing did not load strongly on any factors, with factor loadings below 0.4. We treat these as standalone variables for the analysis. Further factor analyses indicated that oil and gas activity loaded on a single factor (factor loading = 0.53). Colleges and universities, hospitals and medicine, wind and solar, high-technology, and brewing and distilling loaded on a single factor (eigenvalue = 2.54, variance explained = 78%); these were combined into an additive scale called *CEI-Other* (Cronbach’s $\alpha = 0.63$). Agriculture had ambiguous cross-loadings across factors and was excluded from further scale development and is used as a stand-alone predictor. We also treated the perceived importance of the oil and gas industry as a stand-alone item. These variables tested Hypotheses 1 and 2.

Risk and Benefits. We used questions related to risks such as threats to human health, animal health, air and water quality, community quality of life, road traffic, land use, noise pollution, and real estate values. Both exploratory factor analysis and Cronbach’s α ($\alpha = 0.94$) suggested the items could be combined. We constructed additive risk perception scale to examine Hypothesis 3.

³We chose these values so that many respondents would answer “yes” and many would also answer “no.”

⁴Other studies that have used CVM for oil and gas policy include Bernstein, Kinnaman, and Wu (2013), Siikamaki and Krupnick (2014) and Throupe, Simons, and Mao (2013).

TABLE 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
Total	195	196	391	

We 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. Like risk, the Cronbach's α for these items was quite high (0.89), and exploratory factor analysis indicated a single factor solution. The benefit scale variable is used to test hypothesis 4.

To test hypothesis 5, we 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). For hypothesis 6, we calculated each respondent's distance to the nearest active oil and gas well in miles using spatial data from the COGCC (2014); because we did not have exact addresses for the respondents we assigned them to the latitude and longitude of their zip code population centroid.

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 trust in industries often reduces risk perception and support for regulatory policy (Siegrist, Cvetkovich and Roth 2000; Whitfield et. al. 2009). Recent research also distinguishes between more general trust in government and trust in specific agencies (Robinson, Stoutenborough, and Vedlitz 2017). Respondents assessed their degree of trust in the oil and gas industry to operate safely (1 = no trust, 4 = a great deal of trust). Environmental groups charge that the COGCC privileges the industry (Cook 2014, 2015), and laypeople report that the agency is ineffective and favors of industry in disputes (Opsal and Shelley 2014). Trust in the COGCC was assessed with a survey item where 1 = no trust and 4 = a great deal of trust. Homeowners may believe that oil and gas development will threaten its value—thus, we used a variable for homeownership (0 = not a homeowner, 1 = homeowner).

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 2 provides descriptive statistics and question wording for all predictors.

Modeling Strategy

We employed binary logistic regression because our dependent variable is binary. 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 and inducing bias in the models, we conducted an

TABLE 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 Distance to Nearest Well	Do you feel oil and gas activity is too close to where you live? (0 = no, 1 = yes)	0.11	0.31
Trust-Oil and Gas Industry	Author's calculation from COGCC data How much do you trust the oil and gas industry to operate safely? (1 = no trust, 4 = a great deal of trust)	3.45	4.12
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)	2.8	1.0
CEI-Other	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)	0.76	0.43
CEI-Oil and Gas	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
Sex	How important is oil and gas activity to your local area? (0 = not at all important, 4 = very important)	0.50	0.50
Conservative	1 = male, 2 = female	1.5	0.5
Education	How would you describe your political beliefs? (0 = not conservative, 1 = conservative)	0.36	0.48
Income	What is the highest level of education you have received? (0 = less than high school, 6 = graduate degree)	4.5	1.4
Age	What is your total household income before taxes? (0 = less than \$25,000, 6 = greater than \$150,000)	1.1	0.80
White	Age in years (author's calculation)	51.7	16.3
Home Ownership	What is your race or ethnicity? (0 = non-white, 1 = white)	0.83	0.38
	Respondent owns their home (0 = does not own, 1 = owns)	0.79	0.41

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initial correlational analysis using polychoric correlations. Variables that correlated weakly with the outcome are not included in the binary logistic regression models. Table 3 displays these correlations.

TABLE 3. POLYCHORIC CORRELATIONS OF PREDICTOR VARIABLES WITH INSPECTIONS TAX.

PREDICTOR VARIABLE	CORRELATION (ρ)
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	-0.20
White	-0.07
Female	0.12
Age	-0.13
Conservative	-0.51**
Home Ownership	-0.11

NOTES: * $p \leq 0.05$, ** $p \leq 0.01$

RESULTS

Bivariate Correlations

The bivariate correlations indicated that several possible predictors correlate weakly with our dependent variable. These variables are *CEI-Other* ($\rho = 0.13$), tourism ($\rho = -0.03$) education ($\rho = -0.01$), white race ($\rho = -0.07$), female sex ($\rho = 0.12$) age ($\rho = -0.13$), home ownership ($\rho = -0.11$), and distance to the nearest well ($\rho = 0.01$). Given their lack of correlation, these variables were not included in the regression models. The bid amount is negatively correlated with support but the relationship is weak ($\rho = -0.17$). Trust in the COGCC modestly correlated with the

dependent variable, but this correlation did not approach statistical significance.⁵ On the other hand, several predictors correlate relatively strongly with support for increased inspections. Risk perceptions are positively associated with support ($\rho = 0.58$) while benefit perceptions have a similar correlation in a negative direction ($\rho = -0.51$).

Before proceeding with the regression models, determining if some respondents might object to the payment vehicle in question—increased taxes—is important. A follow-up question queried support for charging the oil and gas industry a fee to fund inspections. Seventy-three percent endorsed this policy and about 23% of the “no” responses to the dependent variable supported charging the industry a fee. Thus, a minority of respondents back increased oversight yet do not wish to bear the cost. Table 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 these protest responses are not sensitive to the size of the tax increase.

TABLE 4. AVERAGE BID AMOUNT BY SUPPORT FOR CHARGING FEE TO OIL AND GAS INDUSTRY.

LEVEL OF SUPPORT	AVERAGE BID
Strongly Support	58.66
Support	61.52
Oppose	59.60
Strongly Oppose	57.21

Regression Models

Here we present a series of binary logistic regression models. 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, we bootstrapped the standard errors using 5,000

⁵This modest association between trust in the COGCC and support for increased inspections deserves some discussion. We suspect, but cannot formally assess, that there are a few distinct causes of this surprising finding. As we note above, the COGCC is viewed by some Coloradans as compromised by industry influence, suggesting that some respondents may not trust the COGCC because of concerns of regulatory capture. On the other hand, some respondents might harbor a broader, more abstract distrust in government regulators, and hence not trust the COGCC.

replications.⁶ Variance inflation factors did not exceed 2.1, indicating no problematic multicollinearity. Table 5 reports modeling 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 ($b = -0.01$)—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 is not statistically significant. 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 ($b = -2.82$ vs. $b = -2.59$). 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 retained in Model 3 and we added CEI-Agriculture. Neither of these variables have important effects. The coefficient for the bid amount is roughly the same though its p -value was inflated. Income remains relevant; 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, we 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 ($b = -0.82$, $p \leq .05$). 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.⁷ Risk perceptions, on the other hand, were positively associated with support, while benefit perceptions had a much

⁶Bootstrapping involves drawing samples with replacement from the sample data. The reported standard error is the average the standard error from the 5,000 replications.

⁷The 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.

TABLE 5. BINARY LOGISTIC REGRESSION MODELS FOR INSPECTIONS TAX.

	MODEL 1	MODEL 2	MODEL 3	MODEL 4
	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
	(SE)	(SE)	(SE)	(SE)
Bid Amount (\$)	-0.01*	-0.01*	-0.01	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Income (ref. less than \$50,000)				
\$50,000-\$100,000	-0.99**	-0.95**	-1.03**	-0.83*
	(0.42)	(0.45)	(0.47)	(0.43)
More than \$100,000	-0.51	-0.51	-0.46	-0.37
	(0.41)	(0.44)	(0.46)	(0.41)
Conservative	-0.91***	-0.88**	-0.96***	-0.82**
	(0.34)	(0.35)	(0.37)	(0.35)
Trust-Oil and Gas industry (ref. No trust)				
Very little trust	-0.66	-0.51	-0.63	0.11
	(0.68)	(0.70)	(0.75)	(0.79)
Some trust	-1.96***	-1.81***	-1.90***	-0.79
	(0.61)	(0.63)	(0.70)	(0.78)
Great deal of trust	-2.82***	-2.59***	-2.74***	-1.30
	(0.69)	(0.72)	(0.81)	(0.88)
CEI-Oil and Gas (ref. Not at all important)				
Somewhat important		-0.35	0.02	
		(0.48)	(0.60)	
Important		-0.35	-0.21	
		(0.41)	(0.47)	
Very important		-0.64	-0.61	
		(0.46)	(0.55)	
CEI-Agriculture (ref. Not at all important)				
Somewhat important			-1.42*	
			(0.80)	
Important			-0.59	
			(0.57)	
Very important			-0.42	
			(0.62)	
Risks				0.85**
				(0.41)
Benefits				-0.10
				(0.41)
Unwanted Proximity				0.84
				(1.18)
N	404	404	404	404
Mcfadden R ²	0.20	0.21	0.22	0.24

NOTES: * $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$, standard errors bootstrapped with 5,000 replications

smaller coefficient that did not reach statistical significance ($b = -0.10$, $p = 0.601$). Unwanted proximity also appeared to have negligible effect.

Logit coefficients are notoriously difficult to interpret, so we calculated predicted probabilities derived from Model 4 in Figure 1. The first panel of figure 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 the bid Amount (\$). We held all other variables at their observed values. Though political identity 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, we display probabilities of support plotted against Bid Amount (\$) for conservatives and non-conservatives in panel 2 of Figure 1. For these calculations, we again held other variables at their observed values.

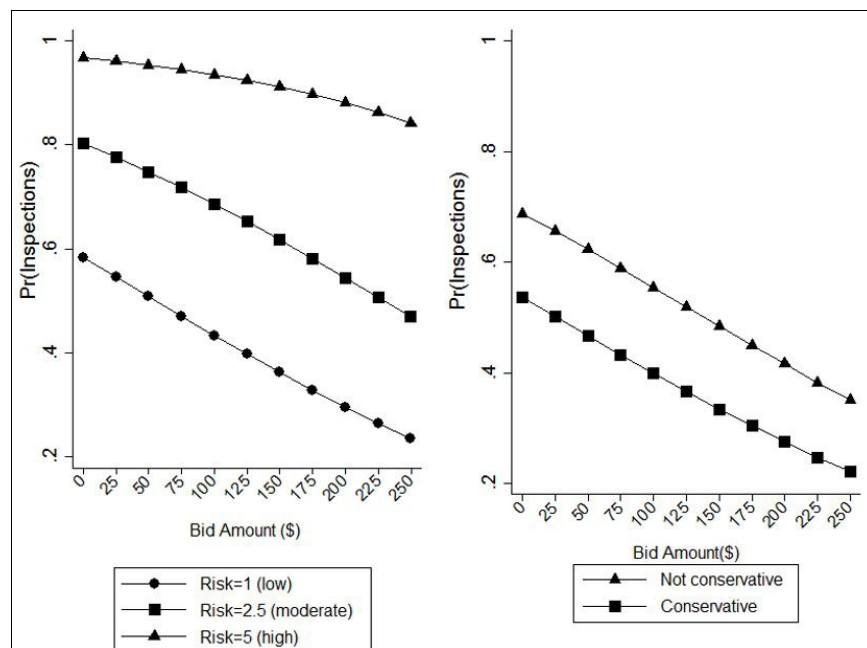


FIGURE 1. PREDICTED PROBABILITIES OF SUPPORT FOR INSPECTIONS TAX

DISCUSSION

In this paper, we explored the factors that drive public support for oversight of unconventional oil and gas development using an experimental technique called contingent valuation to understand how cost affects support. Theoretically, we relied on the concept of community economic identity and argued that some people who resist regulating the oil and gas industry may be engaging in place protective

active. We considered other predictors like risk and benefit perceptions and actual and unwanted proximity to oil and gas drilling. Overall, we find that about half our participants are willing to pay some amount to increase the frequency of inspections at oil and gas operations, while a strong majority (73%) endorse charging industry to pay for more inspections. Methodologically, we advanced the literature by adopting the contingent valuation method from environmental economics to advance sociological inquiry.

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 the dependent variable and community economic identity related to industries other than oil and gas was so low that we did not include the relevant variable in the regression models. Thus, we find no support for Hypothesis 1; “colliding treadmills” were not a factor in fracking policy within Colorado. In other words, no evidence supports for regulating the oil and gas industry arises because the respondents believed it threatened other industries. We note, however, that these results might be sensitive to wording of our questions, as this is a first attempt to develop a quantitative operationalization of community economic identity.

The bivariate correlation between community economic identity associated with oil and gas and the dependent variable was somewhat stronger, but this variable had little impact net of other predictors in Models 2 and 3. Thus, the results lend no support to Hypothesis 2. The null findings for community economic identity may depend on our operationalization of this concept. Bell and York (2010) rely on qualitative data to for their initial conceptualization of community economic identity. The only survey-based study of this topic, Blaacker, Woods and Oliver (2012), used a different set of questions, a sample of college students, and did not examine policy preferences. We suspect that community economic identity, in terms of the significance of the oil and gas industry to an area, likely has some impact policy preferences, but the present operationalization 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 does not affect a relatively noninvasive policy like increasing the frequency of inspections. Thus, perhaps community economic identity centered on extractive industries might drive people to resist policies deemed a threat to the continued viability of the industry (e.g., bans on drilling) but policies that are more modest are less apt to spur resistance. Although current literature suggests that residents of extractive communities seek

to protect the economic viability of these industries (e.g., Lewin 2017; Olson-Hazboun 2018), it is currently unclear if said communities oppose all regulatory efforts. This question—the types of regulations that people who view extractive industries favorably will support—is fertile ground for future research.

We hypothesized that risk perceptions have a positive influence (Hypothesis 3), and that benefit perceptions reduce support (Hypothesis 4). There is unambiguous support for Hypothesis 3: heightened risk perceptions were strongly associated with support for increasing the frequency of inspections. Benefit perceptions, on the other hand, do not play much of a role in determining whether someone supports inspections. 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 still endorse modest, existing regulation like inspections—as we note above, our respondents may have not viewed regulation as a threat to continued oil and gas development and the benefits it may provide to local economies. This finding is important, as a large volume of literature documents risk and benefit perceptions from oil and gas drilling (e.g., Mayer 2016; Theodori et al. 2009; Wynveen 2011), the consequences of these perceptions for governance not well known.

Moving forward, actual proximity to oil and gas drilling, operationalized as miles to the nearest well, had almost no correlation with inspections. Indeed, we did not include this variable in the regression model because the correlation was low. Unwanted proximity (i.e., “Do you feel oil and gas activity is too close to where you live?”) did have some bivariate correlation, as shown in Table 2, yet it had little effect in the regression models. 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 where we hypothesized that both actual and unwanted proximity to oil and gas operations would increase support. However, we also note that our measure of proximity of inexact, which may have potentially attenuated this effect.

We also hypothesized that as the bid amount rose, support for inspections 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 a cost is ascribed—endorsement of said policy will decline. Support for more frequent inspections was much higher when the survey respondents were told that the industry would provide the funding, suggesting that support for regulatory policy is contingent (at least partially) on who bears the cost. We 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 indicated that higher income persons are less willing to pay taxes to improve oversight 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 see less reason to regulate. As discussed above, political identity also has a powerful impact on whether or not a respondent endorses increased inspections. Political polarization on large, complex environmental issues like climate change is well-documented, perhaps even seemingly local policy preferences are more rooted in political identities than is currently recognized. Other sociodemographics have almost no effect.

These results indicated that sociologists should more aggressively grapple with environmental valuation. 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 tradeoffs between their household finances and environmental protection. By adapting CVM from economics, this paper is a first step toward establishing an empirical sociology of environmental valuation—and, more broadly, a sociology of tradeoffs faced in environmental policy formation. Moving forward, we suggest that sociologists devote more attention to environmental valuation and quantifying willingness to sacrifice for environmental protection. This paper also contributes to the scholarship on the social aspects of UOGE 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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