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**PERCEPTION OF THE NATURAL GAS INDUSTRY AND  
ENGAGEMENT IN INDIVIDUAL CIVIC ACTIONS\***

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ABSTRACT

Data collected in a general population survey from a random sample of individuals in Tarrant County, Texas, were used to empirically examine issues associated with public perception of the natural gas industry. Further, the associations of public perception of the energy industry with individual actions that (a) may or may not have been taken and/or (b) may or may not be taken in response to the exploration and production of natural gas were investigated. Echoing findings from research in two neighboring Barnett Shale counties (Theodori 2009), members of the public in Tarrant County appear to dislike certain potentially problematic social and/or environmental issues perceived to accompany natural gas development. Conversely, these same Tarrant County residents view less negatively the economic and/or service-related benefits that often result from such development. Moreover, the results of this study suggest that the social/environmental perceptual variable is a key factor in explaining past behaviors and predicting future behaviors taken in response to the exploration and production of natural gas. Possible implications of these findings are proposed.

An extensive rural sociological literature exists on the social, economic, and social-psychological consequences—both positive and negative—associated with energy development (Jacquet 2009). The data for many of these studies were collected in the “boomtowns” of the intermountain West or in communities in the coastal region of Louisiana. Over the past five years, a new body of empirical research on energy development has begun to accrue in the rural sociological literature. These studies have focused on the experiences and perceptions of various stakeholders—including, but not limited to, community leaders, landowner coalition leaders, and members of the public—with respect to shale gas development (e.g., Anderson and Theodori 2009; Brasier et al. 2011; Jacquet and Stedman 2011; Schafft, Borlu, and Glenna 2013; Theodori 2009, 2012; Wynveen 2011).

Shale gas development is a controversial form of energy development (Marsa 2011; Walsh 2011). At the center of the shale gas debate is the well stimulation/completion process known as hydraulic fracturing (Finkel and Law

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2011; Rahm 2011). Shale gas development relies heavily on multistage hydraulic fracturing stimulation to maximize commercial viability. Wells are hydraulically fractured by flushing large quantities of “frac fluid”—a mixture of freshwater, proppants, and small amounts of friction reducers and other chemicals—into them at extremely high pressure levels to create small cracks, or “fractures,” in the shale formations. Doing this allows natural gas to flow more freely through the reservoir and, in turn, increases recovery. Frac jobs commonly use 1 to 3 million gallons of water per gas well; in some cases, water use may exceed 5 million gallons per frac (Anderson and Theodori 2009). Numerous concerns have been raised over the amount of freshwater used by gas producers in the hydraulic fracturing process (Capozza 2009; Theodori 2009). Furthermore, fears continue to escalate over the potential contamination of surface waters and freshwater aquifers from the chemicals used in the hydraulic fracturing process (Olmstead et al. 2013; Osborn et al. 2011).

Despite this growing rural sociological literature consisting of contemporary attitudinal studies on shale gas development, surprisingly little research has been conducted on the individual actions that (a) may or may not have been taken and/or (b) may or may not be taken in response to the production of shale gas. The purpose of this research note is to extend the current scientific literature on the social issues associated with unconventional natural gas development (c.f., Theodori 2011). Here, using data gathered in a general population survey from a random sample of individuals living in one county in the Barnett Shale region of Texas, I examine the effects of public perception of the natural gas industry on six behavior-related dependent variables (i.e., three variables reflecting past behaviors and three variables indicative of behavioral intent).

## DATA AND MEASUREMENT

The data used for this paper were drawn from a 2009 study focusing on quality of life and energy production in Tarrant County, Texas. Tarrant County, a metropolitan county in the core production zone of the gas shale basin known as the Barnett Shale, covers 897.48 square miles (land area = 863.42 square miles) (Texas Almanac 2009). The population of Tarrant County in 2000 was 1,449,290; the 2009 estimated county population was 1,784,078 (U.S. Census Bureau 2011). Tarrant County’s largest city and county seat is Fort Worth.

As of September 2001, there were 19 regular producing gas wells in Tarrant County (RRC 2001). Four years later, in September 2005, the number of regular producing gas wells in Tarrant County had increased to 573 (RRC 2005). Between

September of 2005 and February 2009, regular producing gas wells in Tarrant County increased by roughly 200 percent ( $n = 1,708$ ) (RRC 2009). Gas and oil well production data in Tarrant County from January 2001 through December 2009 are reported in Table 1. Included in the table are figures for gas well natural gas (i.e., wells without completions for the production of oil), condensate (i.e., natural gas liquid recovered from gas wells from lease separators or field facilities), casinghead gas (i.e., natural gas produced along with crude oil from oil wells), and oil. As shown in Table 1, production of natural gas from gas wells in Tarrant County between 2001 and 2009 increased by approximately 16,676 percent (from 3,271,732 mcf to 548,858,355 mcf) (RRC 2013).

TABLE 1. PRODUCTION DATA FROM OIL AND GAS WELLS IN TARRANT COUNTY: 2001 THROUGH 2009.

YEAR	GAS WELL GAS (MCF)	CONDENSATE (BBL)	CASINGHEAD (MCF)	OIL (BBL)
2001.....	3,271,732	58	0	0
2002.....	17,884,104	465	0	0
2003.....	40,529,629	2,115	0	0
2004.....	75,283,248	3,124	0	0
2005.....	123,633,307	5,278	0	0
2006.....	183,779,481	14,967	0	0
2007.....	280,635,253	43,274	0	0
2008.....	464,196,936	57,513	0	0
2009.....	548,858,355	45,158	0	0
Total. ....	1,738,072,045	171,952	0	0

Following a modified tailored design method (Dillman 2000), a survey questionnaire was delivered via the United States Postal Service to 450 randomly selected households in the county. To obtain a representative sample of individuals within residences, a response was requested from the adult in the household who most recently celebrated his/her birthday. The survey instrument, organized as a self-completion booklet, contained 42 questions and required approximately 60

minutes to complete. After the initial survey mail out, a post card reminder, and two follow-up survey mailings, a 34 percent response rate was achieved.<sup>1</sup>

*Independent Variable – Perception of the Natural Gas Industry*

Following Theodori (2012), perception of the natural gas industry was assessed using a list of ten statements. Respondents were asked to indicate whether they “strongly agree,” “agree,” “disagree,” or “strongly disagree” with each of the following items: (a) The natural gas industry is important to the local economy; (b) Natural gas industry operators in Texas are too politically powerful; (c) Not enough information concerning the development of natural gas is being made available to the public; (d) Even when carefully controlled, natural gas development is likely to upset the quality of life in a local area; (e) Too little attention is being paid to the social costs of natural gas development; (f) The natural gas companies have no compassion for our natural environment; (g) Natural gas operators MUST adopt and use more environmentally-friendly drilling practices; (h) Natural gas companies will do only what’s required by law; (i) Natural gas operators are drilling and producing too close to homes and businesses; and (j) In the long run, I’m sure that people in this area will be better off if our natural gas resources are developed.

Response categories were coded so that higher values reflected more negative views of the oil and gas industry. Items “b” through “i,” which reflected less positive views of the oil and gas industry were coded as 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Items “a” and “j,” which reflected more positive views of the oil and gas industry were reverse coded (1 = strongly agree; 4 = strongly disagree).

Maximum likelihood factor analysis using oblique rotation was conducted on these perceptual items to determine what, if any, underlying structures existed among them (Costello and Osborne 2005). The analysis produced a two-factor solution. After rotation, two of the ten items loaded on factor 1 (see Table 2). These items addressed the perceived economic aspects of natural gas development. Eight of the ten items loaded on factor 2. These measures addressed the perceived social/environmental aspects of the oil and gas industry in Texas. Factor 1 accounted for 28.43 percent of the total variance; factor 2 accounted for 22.12 percent of the total variance. Composite scores were calculated by averaging the

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<sup>1</sup>Eighteen of the 450 questionnaires were returned as undeliverable. None of the undeliverable household addresses were replaced with new ones. Hence, the final sample size was reduced to 432.

values for individual items loading on each factor. These scores were used in subsequent analyses.

TABLE. 2. FACTOR LOADINGS FOR PERCEPTION OF THE NATURAL GAS INDUSTRY ITEMS.

	LOADING
<b>Factor 1: Economic aspects of the natural gas industry</b>	
The natural gas industry is important to the local economy. . . . .	0.52
In the long run, I'm sure that people in this area will be better off if our natural gas resources are developed. . . . .	0.99
<b>Factor 2: Social and environmental aspects of the natural gas industry</b>	
Natural gas industry operators in Texas are too politically powerful. . . . .	0.61
Not enough information concerning the development of natural gas is being made available to the general public. . . . .	0.63
Even when carefully controlled, natural gas development is likely to upset the quality of life in a local area. . . . .	0.63
Too little attention is being paid to the social costs of natural gas development. . . . .	0.67
The natural gas companies have no compassion for our natural environment. . . . .	0.67
Natural gas operators MUST adopt and use more environmentally-friendly drilling practices. . . . .	0.51
Natural gas companies will do only what's required by law. . . . .	0.64
Natural gas operators are drilling and producing too close to homes and businesses. . . . .	0.80

The two economic items and the eight social/environmental perceptual items were ranked in decreasing order according to mean score (see Table 3). As noted, each of the mean scores for the items comprising the social/environmental factor, as well as the overall mean score for that factor, was higher than the mean score for the two economic items and the overall mean economic score. This indicated that,

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overall, members of the public in Tarrant County, Texas, viewed the items comprising the social/environmental factor less positively than the items comprising the economic factor.

TABLE. 3. MEAN SCORES FOR PERCEPTION OF THE NATURAL GAS INDUSTRY ITEMS.

	MEAN SCORE
<b>Factor 1: Economic aspects of the natural gas industry</b>	
In the long run, I'm sure that people in this area will be better off if our natural gas resources are developed. . . . .	1.98
The natural gas industry is important to the local economy. . . . .	1.72
<i>Overall mean – Factor 1</i>	<i>1.84</i>
<b>Factor 2: Social and environmental aspects of the natural gas industry</b>	
Natural gas operators MUST adopt and use more environmentally-friendly drilling practices. . . . .	3.16
Natural gas companies will do only what's required by law. . . . .	2.94
Not enough information concerning the development of natural gas is being made available to the general public. . . . .	2.81
Natural gas industry operators in Texas are too politically powerful. . . . .	2.75
Natural gas operators are drilling and producing too close to homes and businesses. . . . .	2.74
Too little attention is being paid to the social costs of natural gas development. . . . .	2.64
The natural gas companies have no compassion for our natural environment. . . . .	2.44
Even when carefully controlled, natural gas development is likely to upset the quality of life in a local area. . . . .	2.43
<i>Overall mean – Factor 2</i>	<i>2.75</i>

*Dependent Variables – Individual Civic Actions*

The dependent variables of interest in this research note included respondents' past individual civic actions and their intention to perform individual civic actions in response to the exploration and production of natural gas. As defined by Wakefield et al. (2006:44):

... *individual civic action* refers to individual activities that attempt to change societal processes (e.g., by complaining to government or industry about environmental problems or by donating to an environmental group). These activities could lead to environmental change. They also can promote individual empowerment, both psychological and skills related. They do not, however, lead to new linkages within the community.<sup>2</sup>

In this study, respondents were asked to indicate (1) whether or not they engaged in certain individual civic actions as a response to the exploration and production of natural gas and (2) their likelihood of engaging in such actions in the future. First, respondents were asked whether they had ever: (a) contacted a local elected official or governmental agency to complain about a natural gas drilling and/or production issue; (b) voted FOR a political candidate because of his/her favorable position on the drilling and/or production of natural gas; and (c) voted AGAINST a political candidate because of his/her favorable position on the drilling and/or production of natural gas. Each individual civic action was dummy-coded (1 = yes; 0 = no). Next, respondents were asked to indicate their likelihood of engaging in these same three actions in the future. The likelihood of engagement for each item was dummy-coded (1 = likely; 0 = not likely).

ANALYSES<sup>3</sup>

The association of public perception of the energy industry with individual civic actions that (1) may or may not have been taken in response to the exploration and

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<sup>2</sup>Individual civic action is one of four types/categories of environmental action identified by Wakefield et al. (2006). The other three types/categories of active responses to environmental concern include: reactive lifestyle change, personal change, and cooperative civic action. See Wakefield et al. (2006) for detailed information on each type/category.

<sup>3</sup>Cases with missing data on any of the variables used in the analyses were excluded. Hence, a listwise deletion reduced the sample to 118 cases.



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production of natural gas and (2) may or may not be taken in response to the exploration and production of natural gas was assessed using multivariate logistic regression techniques. Net odds ratios for the effects of public perception on individual civic actions that may or may not *have been taken* in response to the exploration and production of natural gas are reported in Table 4.<sup>4</sup> Net odds ratios

TABLE 4. NET ODDS RATIOS FOR THE EFFECTS OF PUBLIC PERCEPTION ON INDIVIDUAL CIVIC ACTIONS THAT MAY OR MAY NOT HAVE BEEN TAKEN IN RESPONSE TO THE EXPLORATION AND PRODUCTION OF NATURAL GAS.

	Multivariate Odds Ratios <sup>a</sup>
<p>Contacted a local elected official or governmental agency to complain about a natural gas drilling and/or production issue.</p> <p>Economic factor.....</p> <p>Social/Environmental factor.....</p>	<p>0.71</p> <p>34.43**</p>
<p>Voted FOR a political candidate because of his/her favorable position on the drilling and/or production of natural gas.</p> <p>Economic factor.....</p> <p>Social/Environmental factor.....</p>	<p>0.35</p> <p>0.69</p>
<p>Voted AGAINST a political candidate because of his/her favorable position on the drilling and/or production of natural gas.</p> <p>Economic factor.....</p> <p>Social/Environmental factor.....</p>	<p>1.75</p> <p>6.13*</p>

NOTES:<sup>a</sup>Odds ratios computed controlling for mineral rights ownership, personal/familial ties to the natural gas industry, and length of residence in the county; \* $p \leq 0.05$ ; \*\* $p \leq 0.01$

<sup>4</sup>Following Theodori (2012), three variables – mineral rights ownership, personal/familial ties to the natural gas industry, and length of residence in the county – were included in this research as control factors. Mineral rights ownership (0 = does not own; 1 = owns) and personal/familial ties to the natural gas industry (0 = respondent and/or family members not employed either part-time or full-time in an occupation related to the natural gas industry; 1 = respondent and/or family members employed either part-time or full-time in an occupation related to the natural gas industry) were both dummy-coded. Length of residence in the county was measured in years.

for the effects of public perception on individual civic actions that may or may not be taken in response to the exploration and production of natural gas are reported in Table 5.

TABLE 5. NET ODDS RATIOS FOR THE EFFECTS OF PUBLIC PERCEPTION ON INDIVIDUAL CIVIC ACTIONS THAT MAY OR MAY NOT BE TAKEN IN RESPONSE TO THE EXPLORATION AND PRODUCTION OF NATURAL GAS.

	Multivariate Odds Ratios <sup>a</sup>
Contacted a local elected official or governmental agency to complain about a natural gas drilling and/or production issue.	
Economic factor.....	0.94
Social/Environmental factor.....	6.55 <sup>***</sup>
Voted FOR a political candidate because of his/her favorable position on the drilling and/or production of natural gas.	
Economic factor.....	0.65
Social/Environmental factor.....	0.82
Voted AGAINST a political candidate because of his/her favorable position on the drilling and/or production of natural gas.	
Economic factor.....	2.31
Social/Environmental factor.....	3.37 <sup>*</sup>

NOTES:<sup>a</sup>Odds ratios computed controlling for mineral rights ownership, personal/familial ties to the natural gas industry, and length of residence in the county; <sup>\*</sup> $p \leq 0.05$ ; <sup>\*\*\*</sup> $p \leq 0.001$

As shown in Table 4, individuals with more negative views on the social/environmental factor were more likely than their counterparts to have contacted a local elected official or governmental agency to complain about a natural gas drilling and/or production issue. Moreover, such individuals were more likely to have voted against a political candidate because of his/her favorable position on the drilling and/or production of natural gas.

As shown in Table 5, individuals with increasingly negative views on the social/environmental factor indicated that they would be more likely than their counterparts to contact a local elected official or governmental agency to complain

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about a natural gas drilling and/or production issue in the future. Such respondents also indicated that they would be more likely to vote against a political candidate because of his/her favorable position on the drilling and/or production of natural gas.

### CONCLUDING COMMENTS

In short, the purpose of this empirical research note was to add to the burgeoning scientific literature on the social issues associated with shale gas development. Two primary conclusions can be drawn from this effort. First, it appears that in Tarrant County, Texas, members of the public dislike certain potentially problematic social and/or environmental issues perceived to accompany natural gas development. Conversely, citizens view less negatively the economic and/or service-related benefits that often result from such development. These results echo the findings from previous attitudinal studies in the Barnett Shale (Theodori 2009; Wynveen 2011) and Marcellus Shale (Brasier et al. 2011; Kriesky et al. 2013). Second, it appears that the social/environmental perceptual variable is a key factor in explaining past individual civic actions taken in response to the development of shale gas and predicting future behaviors that may, in fact, be taken in response to proposed developments. Based upon the results of this study, representatives of the energy industry, community leaders, governmental and regulatory agency personnel, non-governmental and environmental organization representatives, and other stakeholders must recognize and understand that the public's perception of shale gas development – what the public thinks about such development, particularly with respect to the social and environmental consequences – is associated with *both very real and very meaningful* actions.

Despite the statistical significance, important limitations of these data must be acknowledged when considering the generalizability of the results. First, it is important to understand that these general population survey data were drawn from a single metropolitan county in one shale gas basin. Moreover, comparisons of selected sociodemographic characteristics between the sample and Census data indicated that the survey respondents were older and more educated than the general population within the county. The sample data set also included slightly higher percentages of whites and males than were reflected in the Census data.

Considering the findings presented here, future theoretical and empirical research is warranted to provide a more comprehensive understanding of the associations between perceptions of the natural gas industry and behaviors taken (and/or behavioral intentions) in response to current and/or proposed natural gas

development. Such studies might include additional perceptual measures and other individual civic action items. Furthermore, future research might incorporate measures of *cooperative civic action*, a type of action that “has a fundamentally communal character” (Wakefield et al. 2006:44). Cooperative civic action, as defined by Wakefield et al. (2006:44), “promotes individual empowerment and facilitates community empowerment by creating links between community members.” Examples of this form of action include attendance at public meetings and participation in protests (Wakefield et al. 2006). Knowledge about such actions would be of vital interest to both community leaders and energy industry personnel.

#### AUTHOR BIOGRAPHY

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