Energy Policy 62 (2013) 62–69

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Social costs from proximity to hydraulic fracturing in New York State

Jennifer H. Popkin [a,*], Joshua M. Duke [a], Allison M. Borchers [b,1], Thomas Ilvento [a]

[a] Department of Applied Economics and Statistics, University of Delaware, 531 S. College Avenue, Newark, DE, United States19716
[b] Economic Research Service, USDA, 1400 Independence Ave., SW, Mail Stop 1800, Washington, DC 20250-1800, United States

HIGHLIGHTS

- New York households were surveyed to determine impacts of hydraulic fracturing.
- Households on average lose welfare if hydraulic fracturing gas provides their electricity.
- The average welfare loss is estimated to be 16–46% of respondents' electricity bill.
- The welfare impacts were heterogeneous, with some predicted to have welfare gain.
- Proximity to hydraulic fracturing wells decreases welfare, on average.

ARTICLE INFO

Article history:
Received 25 May 2012
Accepted 18 July 2013
Available online 15 August 2013

Keywords:
Fracking
Choice experiment
Welfare

ABSTRACT

The study reports data from an economic choice experiment to determine the likely welfare impacts of hydraulic fracturing, in this case using natural gas extracted by hydraulic fracturing for household electricity. Data were collected from an Internet survey of 515 residents of New York State. The welfare analysis indicated that on average households incur a welfare loss from in-state hydraulic fracturing as the source of their electricity. The evidence suggests that households in shale counties bear more costs from HF electricity than households out of shale counties. The average welfare loss is substantive, estimated at 40–46% of average household electric bills in shale counties and 16–20% of bills in counties without shale. The evidence also suggests that relative proximity to HF well sites also increases cost borne by households.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Hydraulic fracturing (HF) is promoted as domestic, clean energy but also is condemned as environmentally destructive. Little scientific evidence exists to evaluate competing claims, especially about the social acceptance of HF. An economic framing of the scientific question is: Will social wealth be greater with or without rules restricting HF? Data for such a benefit–cost analysis are sparse to nonexistent, and this study seeks to contribute evidence by reporting the results of an original data collection about the public values of HF in New York State (NYS), USA.

Recent technological advancements in HF with horizontal drilling spurred an increasingly rapid development of domestic and global shale plays. News media attention often focuses on the Marcellus Shale in the Northeast United States—an area with large gas reserves but also a large population with conflicting views on HF. Policymakers and the press link HF to a number of negative environmental impacts, many of which occur outside markets: for instance, extraordinary water requirements and potential groundwater contamination from HF chemicals (NYS DEC, 2011). At the same time, natural gas as a resource can have numerous positive social impacts, some of which occur outside markets: Gas burns cleaner and emits a smaller fraction of carbon and particulates than coal and oil; it provides a domestic source of energy (U.S. EPA, 2007); and it may benefit local economies and employment (NYS DEC, 2011). Distributional issues may drive this debate about the potential positive and negative impacts of natural gas, where many may bear cost and a few may benefit. The direct benefits of HF most likely accrue to owners and employees connected to energy exploration, but also those who sell extraction rights. These direct benefits are use values and offer an incomplete estimation of HFs impact on social welfare. Most of HFs positive and negative impacts are market failures associated with public goods and bads, and thus direct and indirect data on existing market transactions cannot – by themselves – be used to measure net social impacts. In sum, the perceived distribution of costs and benefits of HF are driving social conflict, but there exist little systematic data about welfare impacts from HF. Economists cannot look to existing markets for comprehensive answers.

* Corresponding author. Tel.: +1 302 831 2512/631 220 6918.
E-mail address: JPopkin@udel.edu (J.H. Popkin).

[1] "The views expressed here are those of the authors and may not be attributed to the Economic Research Service or the US Department of Agriculture."

0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.07.080

Economists use choice experiments (CE) to estimate welfare when environmental quality changes have large nonuse value components. Recently, green energy studies have used CE, often using household electricity as the payment vehicle. U.S. green energy studies largely find that households are willing to pay (WTP) a premium for electricity from green energy sources such as wind, solar, and biomass (Borchers et al., 2007; Roe et al., 2001; Susaeta et al., 2011). International studies find similar results (Gerpott and Ilaha, 2010; Oliver et al., 2011; Scarpa and Willis, 2010). We were unable to locate existing CEs or other nonmarket valuation studies on HF, though CE data on natural gas as an energy source show WTP premiums for domestic supplies because of energy security and reliability (Damigos et al., 2009). A non-CE, natural gas valuation study shows that property values decrease with proximity to oil and gas facilities (Boxall et al., 2005). Studies on HF that do not use nonmarket valuation techniques show that HF in local communities will have both positive and negative implications for jobs, revenue, cost of living, and the natural environment (Alter et al., 2010; Christopherson and Rightor, 2011; Williamson and Kolb, 2011). A recent input–output analysis of the Marcellus Shale in Pennsylvania estimated 24,000 new jobs and $3 billion dollars in economic activity in 2009 (Kelsey et al., 2011). Another analysis, conducted ex-post on the natural gas industry growth in Colorado, Texas and Wyoming, estimates 2.35 local jobs are created for every $1 million in gas production (Weber, 2012).

Our study is exploratory in that we have no a priori information about whether the mean WTP for HF electricity relative to the status quo is positive or negative; simply, the aforementioned positive and negative effects could possibly lead to positive or negative premiums for HF electricity. We thus use a flexible CE format, which allows us to test for any net positive/negative social impacts. The electricity setting also allows us to narrow this study to a manageable size. The CE payment vehicle is modeled as household electricity that may or may not be supplied by in-state natural gas from HF, and the sample is restricted to populations in and out of HF counties in New York State. An overarching hypothesis states the difference between mean willingness to pay for NYS HF electricity and conventional electricity is zero. This hypothesis is tested within a multivariate framework, which also takes into account a set of heterogeneity variables – age, gender, educational attainment, and whether or not the subject lived in the shale region of New York State – and proximity to shale fields measured as distance to drill sites. Proximity effects are examined because households near HF are more likely to enjoy the direct use impacts but also endure disamenities.

2. Methods

This section offers a brief summary of the CE procedures. For details see Popkin (2012). An original survey instrument, "Willingness to Pay for Hydraulic Fracturing in New York State," was designed to elicit residents' WTP for electricity from HF in the Marcellus Shale. The Marcellus Shale extends from western New York State through Pennsylvania, Ohio, and West Virginia, and is approximately 95,000 square miles (Arthur et al., 2009). It is estimated to have 168–516 trillion cubic feet of natural gas trapped, the approximate energy equivalent of 28–88 billion barrels of oil (NYS DEC, 2011). Enumeration occurred in May 2011—during this time NYS had a temporary moratorium policy on new wells; all new exploration and drilling stopped until lawmakers had created a final rule.

A major design challenge was to connect HF to welfare in a salient way that applies to a large share of households. Although no practical sampling method existed to identify those households that actually were located near current or potential wells, the green-energy literature provided guidance on appropriate sampling methods and framing of environmental quality changes. Following other green and conventional energy studies (Borchers et al., 2007; Damigos et al., 2009; Susaeta et al., 2011; Roe et al., 2001; Zografakis et al., 2010), the CE scenario altered household electricity bills. CE scenarios are designed to mimic decisions about real-life tradeoffs. Econometric analysis of CE responses measures underlying utility for the environmental amenity/disamenity trade-offs over several attributes, and further analysis allows for welfare calculations. Arrow et al. (1993) recognized the validity of stated preference analyses, of which CE is a modern variant. Apart from naturally occurring experiments, which are rare and offer the researcher little control, stated preference techniques are the only systematic and economic approaches to measuring changes in nonuse values—i.e., social values for pure public goods (see Hanley et al., 1998). CEs are popular in the environmental economic literature, and best practices were followed in this CE, including the use of budget constraint reminders. The economic basis of CE is the random utility model, which assumes that utility can be modeled in separate observable and random components (Adamowicz et al., 1998; Boxall et al., 1996; Hanley et al., 1998). Although the random component is unobservable to the investigator, the model assumes that there is no systematic tendency in the random component that biases the estimated results.

2.1. Experimental design

Respondents choose among two hypothetical options for NYS HF electricity and a status quo option, which represented current electricity consumption for the household and does not involve new HF electricity. The design dichotomously varies the distance from drill sites to the household (near/far), the source of their household electricity, and a change to their monthly electric bill. A sample CE question is presented in Fig. 1.

The context of the choice question was the aforementioned moratorium, which existed at the time of enumeration. The choice involved voting among options, where two options involved NYS HF and one involved the status quo of the moratorium. The choice implicitly assumed that all respondents would be affected by electricity supply. Although this assumption is standard practice in this type of study, this context does indeed imply that households do not have the freedom to shop around for electricity suppliers. The change to the electric bill was presented as a percent change to the respondents' self-reported current average monthly electric bill for HF electricity: −25%, −10%, −5%, +5%, +10%, +25%, or +50%. The status quo choice was the only time respondents viewed the level of "no change" in their bill, and the status quo was always the existing fuel mix described as electricity from "largely fossil fuels". It is possible that some of the status-quo fuels contain out-of-state HF gas, but the status quo sought to describe a baseline in which no additional in-state HF gas was supplied because of the moratorium. The negative and positive percentage changes provide the flexible format for testing the hypothesis that electricity from NYS HF provides either a net amenity or disamenity. In addition, by adjusting the current bill up or down by a percentage less than 100, the experimental design enables researchers to maintain a WTP format – a best practice in CE – rather than introducing the possibility of a willingness to accept compensation valuation question. In other words, the respondents were always asked WTP because their electric bill in the scenario was always positive.

Utility also is hypothesized to depend on the source of electricity and the distance of a HF drill site to the respondent's home. The source of electricity was presented as either "Natural Gas from Hydraulic Fracturing" in the non-status quo options or "Largely Fossil Fuels", the existing fuel mix, in the status quo. For the HF options, the drill site distance was presented as a "near" or a "far" option, where the specific distances (in miles) were

متن کامل مقاله ← دریافت فوری

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات