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Analysis

Security Bonding in Unconventional Gas Development: Evidence from an Economic Experiment☆

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ABSTRACT

Recent developments in drilling technology promise significant benefits from extraction of unconventional gas. At the same time, the deployment of this technology creates serious concerns about the negative effects it may have on agriculture and on the environment. This paper applies a behavioural approach to explore possibilities for improved negotiation outcomes between unconventional gas developers and host landowners using economic experiments in the laboratory. The paper specifically focuses on the role that security bond could have in resolving some of the conflicts surrounding unconventional gas development. The empirical findings from the economic experiments show that a security bond deposited by a developer prior to the commencement of the gas extraction can result with improved negotiation outcomes between developers and host landowners. Our findings suggest that the security bond is effective because it mitigates the effects of loss averse behaviour by landowners that do not hold sub-surface extraction rights.

1. Introduction

Unconventional gas is seen as a source of plentiful and cleaner energy (Mason et al., 2015). Its development promises economic growth in regional areas including significant local employment benefits (Maniloff and Mastromonaco, 2017). Recent study in the US, where most of unconventional gas development has taken place so far, found a significantly positive overall economic welfare effect from that development (Hausman and Kellog, 2015).

However, unconventional gas development can also have potentially devastating impact on agriculture and on the surrounding environment. The threat stems from the technologies involved in extracting unconventional gas: hydraulic fracturing and horizontal drilling (Osborn et al., 2011). These are deemed to be safe by developers (Schafer, 2012), but their environmental record is contested (Lloyd-Smith and Senjen, 2011). Negative environmental effects that have been associated with unconventional gas development include significant surface water (Olmstead et al., 2013) and groundwater quality impacts (Osborn et al., 2011). There are also serious human health concerns that have been linked to unconventional gas extraction (Hill, 2014). It has been shown that the perceptions about these negative health effects translate into the real estate market, leading to reduced values of residential property that relies on groundwater for its supply (Muehlenbachs et al., 2015). Development of negative social behaviours, such as increased crime rates, has been documented in some local areas that have experienced a boom in unconventional gas development (James and Smith, 2017).

The literature has documented both significant benefits, but also significant problems, related to unconventional gas. How to reconcile unconventional gas development with the need to sustain long-term agricultural productivity and maintaining ecosystems in good health remains an unresolved conundrum.

Internationally, there has been a boom of drilling for unconventional gas (The Economist, 2013). The response from environmental groups has been critical (Mall, 2012). In the EU, some countries (e.g. France) have banned hydraulic fracturing, while others are looking at ways to adequately regulate the unconventional gas industry (European Commission, 2016). In Australia, farming groups and environmentalists are aligned in their opposition against its development (Colvin et al., 2015). This is similar to the situation in Poland (The Guardian, 2015).

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One of the key aspects of the problem lies in the disagreement between developers of unconventional gas and the landowners on whose land the gas extraction activities are meant to take place, which is the focus of this paper. The interactions between the developers and host landowners are largely dependent on the legal framework of property rights on sub-surface mineral assets. In countries where sub-surface assets are owned by the owner of the top soil (i.e. the landowner), such as the US, there is a tendency for greater cooperation between developers and landowners. This varies considerably across individual US states, with some states regulating unconventional gas (and oil) extraction more than others (Richardson et al., 2013). Nevertheless, the development of unconventional gas in the US overall has been very rapid. Conversely, in countries like Australia or the members of the EU, where sub-surface mineral rights are owned by the State, there has been unsurpassable conflict between developers and landowners, and unconventional gas development has been brought to a stalemate.

In countries where landowners do not hold sub-surface mineral rights they do not get a fair share of the unconventional gas rent, and are implicitly asked to bear significant uncertainty about how their land rent might be affected by the unconventional gas development. Therefore, it is not surprising that landowners oppose it. In this light, we investigate a specific policy instrument – a security bond – that could mitigate the uncertainty surrounding the unconventional gas development that landowners face.

Security bonds, or sometimes referred to as assurance bonds, are very similar to environmental bonds that have been known in theory and practice for over twenty-five years (Costanza and Perrings, 1990; Shogren et al., 1993). They have been widely used in mining to prevent avoidance of rehabilitation activities in abandoned mines (Boyd, 2001). Security bonds have been implemented in the oil and natural gas extraction industries in the US for decades. They have been also implemented in the US in the context of unconventional gas development (Davis, 2015). Recent literature has examined whether the existing bonding requirements in some parts of the US (e.g. Pennsylvania) are sufficient to incentivize proper environmental care by unconventional gas developers (Kim and Oliver, 2017).

There could be various types of security bonds, but in its simplest form it refers to a situation where a developer deposits a given amount in a holding account. This amount is held until the operation is finished and the regulator is satisfied that there have been no negative effects on the productivity of agricultural land, or other environmental consequences and regulatory breaches, in which event the amount is returned to the developer. If the regulator finds that environmental consequences or regulatory breaches have occurred, the amount is forfeit, and it is used by the regulator to rectify, − in whole or in part –, those negative consequences.

While economics experiments have been used extensively in environmental and ecological economics research over the last twenty years (Shogren and Hurley, 1999; Sturm and Weimann, 2006) there was only one study we were able to identify that specifically examined environmental bonds using experimental methods (Cornwell and Costanza, 1994). The study found that environmental bonds are effective in mitigating uncertainty related to environmental damages. A somewhat similar concept of 'deposit-refund' schemes has been investigated using economic experiments, but in the context of international climate treaties (Cherry and McEvoy, 2013).

The current paper is the first to use economic experiments to evaluate security bonds as a policy instrument for regulating unconventional gas exploitation. The experiments were conducted to specifically test the role that security bond can play as a mechanism to mitigate uncertainty.

The paper proceeds as follows: the following section provides an overview of the institutional and regulatory arrangements that govern unconventional gas development in countries where landowners do not hold sub-surface extraction rights. This is the context upon which we base the experimental design. Experimental methods and procedures are described in Section 3, which is followed by a section that presents the results obtained from the experiments. The ultimate section draws conclusions from this study.

2. Background

In order to understand the nature of the strategic interactions between unconventional gas miners and landowners, it is necessary to discern the institutional and legislative underpinnings that currently govern exploitation of sub-surface mineral assets in many jurisdictions around the world (e.g. UK, Poland, China, Australia), where the ownership of those assets is separate to the ownership of surface agricultural land. This study is focused on the situation in those jurisdictions. The property right frameworks in those countries are very different to the property rights in the US. In the US, the sub-surface mineral rights are typically owned by the owner of the surface land rights. Under such property rights regime the joint owner of surface and sub-surface rights can, at least in theory, appropriate the rents from both surface assets (i.e. agricultural land rent), and the rent from sub-surface assets (i.e. resource rent on natural gas). Consequently, the joint owner is inclined to accept unconventional gas development on, and underneath their land, driven by the prospect of receiving substantial resource rent income from it. The fact that the US has led the way in unconventional gas development is to a large extent a result of this property rights structure.

In contrast, in most other jurisdictions around the world, the public, or the Crown, owns the sub-surface mineral rights, which are explicitly separate from the surface land rights. Under this property rights framework, the government (representing the public) has incentives to encourage unconventional gas development due to the prospect of receiving resource rent income, but the local landowners have no such incentive whatsoever, as they are not entitled to any share of the rent on the natural gas. The fact that we observe staunch opposition by landowners to unconventional gas development in so many non-US jurisdictions around the word is to a large extent a result of this property rights framework. The empirical analyses undertaken through the economic experimental procedures presented further below were designed with this property right framework in mind.

Where the landowner does not hold sub-surface rights, there are generally very limited avenues by which they can attempt to negotiate compensation for any possible future losses with the unconventional gas miner (Swayne, 2012). This is because governments issue gas exploitation rights to miners, and consequently miners have legal instruments to enforce those rights (Swayne, 2012). In this sense, sub-surface rights dominate surface rights, meaning that landowners cannot invoke property rights as a defence against possible damages.

This suggests that regulatory procedures that govern the relationship between unconventional gas developer and the host landowner seem to favour the developers. In addition, there is a significant uncertainty that the landowner faces in terms of possible negative effects that unconventional gas mining might have on the productivity of their land, now or in the future. These possible negative effects are well described elsewhere, and we refer to those sources for details (e.g. Lloyd-Smith and Senjen, 2011; Phelan and Jacobs, 2016; Mason et al., 2015). The evidence presented in the literature shows that there are serious concerns about current and future agricultural land productivity in areas with unconventional gas development, mostly due to threats from soil degradation, water quality deterioration, groundwater depletion, and surface landscape disturbance.

As a result, the observed situation in the field has been that most landowners strongly oppose unconventional gas development on and underneath their land. They do not enter into negotiations with unconventional gas miners, which has resulted in a virtual stop of unconventional gas developments over the last several years in many countries (The Guardian, 2015; Colvin et al., 2015).

The ensuing empirical work presented in this paper simulates the