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Valuation of expectations: A hedonic study of shale gas development and New York's moratorium[☆]

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ABSTRACT

This paper examines the local impacts of shale gas development (SGD). We use a hedonic framework and exploit a discrete change in expectations about SGD caused by the New York State moratorium on hydraulic fracturing. Our research design combines difference-in-differences and border discontinuity, as well as underlying shale geology, on properties in Pennsylvania and New York. Results suggest that New York properties that were most likely to experience both the financial benefits and environmental consequences of SGD dropped in value 23% as a result of the moratorium, which under certain assumptions indicates a large and positive net valuation of SGD.

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1. Introduction

Shale gas development (SGD) has dramatically changed the US energy landscape in the last decade. The [Energy Information Administration \(2013\)](#) predicts that the US will shift from being a net importer to a net exporter of natural gas by 2020 and domestic production will increase 44% by 2040. Much of the attention on SGD has been on the Marcellus Shale, which extends over 95,000 square miles across New York, Ohio, Pennsylvania, and West Virginia ([Kargbo et al., 2010](#)). Marcellus drilling began in 2005 and has been the source of considerable extraction. From 2005 to 2014, 7797 unconventional wells have been drilled in Pennsylvania alone.

While the macroeconomic benefits to the US economy are clear, there is uncertainty surrounding the local benefits and costs to households and communities impacted by SGD. Property owners with mineral rights can receive substantial gas

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lease and production royalties (Pennsylvania Department of Environmental Protection, 2012); however, little is known about the magnitude of payments due to the private nature of the contracts. Potential costs of SGD could include various health and environmental impacts such as water pollution, air pollution, and traffic congestion. The impacts from the health and environmental externalities are also highly uncertain.

Given the current scale of SGD and expected growth in the future, it is critical to understand the local valuation of SGD. This paper seeks to answer this question using a hedonic framework, as housing prices should reflect the future stream of benefits and costs tied to the property. Empirically, this is hindered in two ways. First, the location of wells may be endogenous. Second, expectations about SGD form in advance of actual drilling, and if expectations are capitalized into housing prices, then a simple before–after comparison may lead to incorrect inference about the valuation. We mitigate these confounding factors by specifically focusing on expectations and using an exogenous shift in expectations to reveal valuation.

Just as hydraulic fracturing was beginning its exponential increase in Pennsylvania, New York State implemented a de facto moratorium on hydraulic fracturing on July 23, 2008, citing uncertainty about health and environmental impacts (State of New York's Executive Chamber, 2008).¹ The state extended the moratorium multiple times between 2010 and 2014 (e.g., Wiessner, 2011) and, on December 17, 2014, the New York Department of Environmental Conservation implemented a permanent ban (Kaplan, 2014). These decisions were highly contentious, as evidenced by several dozen towns in New York passing resolutions in support of SGD in the spring and summer of 2012 and 15 towns are currently considering secession (Mathias, 2015).² To date, there has been no hydraulic fracturing in New York.

This paper exploits changes in expectations that resulted from New York's moratorium on drilling and measures this event's impact on housing prices. Importantly, the moratorium did not mark a change in the amount of hydraulic fracturing in New York – expectations about future SGD are the only thing that changed.

We estimate the effect of the statewide moratorium using a difference-in-differences methodology. We use Pennsylvania as a counterfactual because expectations about future SGD were likely similar to those in pre-moratorium New York, but in contrast with New York, those expectations were realized. Our aim is to identify the change in prices for properties in New York that are most likely to be impacted by SGD (both positively and negatively), relative to price changes for similar properties in Pennsylvania. We use private well water use as a proxy for properties likely to experience SGD.³ These are essentially rural properties outside of municipal water supply boundaries, meaning they have the space requirements for drilling. Further, contaminated well water is one of the most common and serious environmental costs.

The design of our preferred sample is motivated by a border discontinuity and underlying shale geology. We begin with property transactions data for two Pennsylvania and three New York counties along the border. In the vein of recent border discontinuity designs (e.g., Grout et al., 2011; Turner et al., 2014) and specifically those that use state borders (Holmes, 1998; Rohlin et al., 2014), we restrict observations to be within five miles of the border in order to minimize unobserved differences in price determinants and best model the counterfactual for New York residents. Even after these restrictions, there are still substantial shale geology differences across the border. Thus, we further restrict observations to be in a specific band of shale thickness, a geological characteristic that strongly affects the amount of gas or oil in a reservoir (Advanced Resources International, 2013). These restrictions are meant to improve the similarity of expectations about future SGD. Post-moratorium spillovers across the border are a threat to identification. However, we contend that these effects are minimal due to pre-moratorium expectations about spillovers, the rapid pace of drilling stemming from high initial prices, the area comprising a single labor market, and southerly flow of surface water.

Using the 5-mile border and shale geology restrictions, our results suggest that the statewide moratorium decreased New York property values 23.1% for those properties most likely to experience SGD. Relaxing the sample restrictions leads to smaller estimates in the range of 10–21%, which suggests that effects are heterogeneous across our New York counties and that accounting for shale geology is critical for understanding expectations. We estimate a series of robustness checks that test additional shale geology restrictions, test for spillover effects across the state border, and use municipal water properties as an additional control, and results are consistent with point estimates in the range of an 18–26% drop in housing values.

We interpret these results as a positive net valuation of SGD by buyers and sellers in New York and Pennsylvania. However, this interpretation relies on two assumptions: the expected probability of SGD in pre-moratorium New York is 1 and the expected probability of post-moratorium SGD is 0 and New York and Pennsylvania property owners and buyers accurately valued the negative and positive aspects of SGD prior to the moratorium.⁴ We estimate several models that

¹ There is considerable heterogeneity in state regulation on shale gas development as a result of different political, hydrological, and geological dynamics (Kulander, 2013; Richardson et al., 2013). Some states have used a more lenient approach to regulation. For example, Pennsylvania had no specific regulations concerning hydraulic fracturing until early 2010 (Kulander, 2013). Since then, Governor Tom Corbett's signed Act 13, prohibiting any local regulation or restrictions on shale gas well production (Begos, 2012). Like New York, New Jersey and Maryland have enacted regulations to restrict or ban hydraulic fracturing.

² These resolutions could not supersede state law, but were meant to send a signal to state politicians in Albany and were in contrast to the more common local bans and moratoria implemented elsewhere in the state.

³ While we cannot predict exactly where SGD would occur in New York, 99.8% of drilling in our Pennsylvania sample occurred in private well water areas.

⁴ It is possible that as production and leases are exhausted that home prices would fall over shale areas as the mineral rights become less valuable. As discussed in the Section 2.1, the duration of benefits could exceed 30 years and leases are not likely to be exhausted during our study period.

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