NO FRACKING WAY: AN EMPIRICAL INVESTIGATION OF LOCAL SHALE DEVELOPMENT BANS IN NEW YORK

BY

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Across the United States, local governments and states have adopted measures to restrict shale development that uses high-volume hydraulic fracturing and horizontal drilling (collectively, fracking) within their borders, hindering a national energy policy that relies on continued access to natural gas trapped within shale formations. This Article takes an empirical look at what might motivate these local anti-fracking measures by analyzing the behavior of New York towns from 2010 through the end of 2013. Before New York's highest court recognized a town's authority to ban fracking and before the state officially banned fracking, more than a hundred shale-rich New York towns adopted bans or moratoria on fracking. The results show that towns most likely to adopt bans were those with residents that were more vulnerable to potential water contamination and those with little history of prior oil-and-gas development. Moratoria adoption, in contrast, was largely associated with residents' environmental preferences. The results suggest that, at least when deciding to ban fracking, towns weigh the local costs and benefits of the practice, relying on their knowledge of local conditions and vulnerabilities. The results, then, lay the groundwork for state and federal efforts to reduce local opposition by facilitating responsible shale development, with provisions for taking into account local knowledge and incentives for optimal activity levels, acceptable risk-taking, and comprehensive remediation.

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I. INTRODUCTION

On August 3, 2011, the town of Dryden, a small farming town located in upstate New York atop the gas-rich Marcellus Shale, banned oil-and-gas activities commonly associated with high-volume hydraulic fracturing and horizontal drilling (collectively, fracking) within its borders.[1] For several years, oil-and-gas representatives (so-called landmen) had approached residents about leasing their mineral rights to the industry.[2] Even after New York adopted a moratorium on fracking in 2008, town residents continued to worry about the oil-and-gas industry's plans for their town and formed a group called the Dryden Resource Awareness Coalition.[3] In 2010, the Coalition began collecting petition signatures from their fellow residents to ask the town board to restrict gas drilling, ultimately collecting "enough signatures to win an election" and forcing the board to pay attention.[4] After holding several public hearings and reviewing scientific studies, Dryden's (bipartisan) town board unanimously voted to amend its local zoning ordinance to clarify that all oil-and-gas development activities were "prohibited uses" of land within the town.[5] And within six weeks, the Anschutz Exploration Corporation, which had obtained several leases in

[1] TOWN OF DRYDEN, ADOPTION OF AMENDMENTS TO ZONING ORDINANCE (2011), https://perma.cc/E32Q-LFWB; *see also* Chris Jordan-Bloch & Kathleen Sutcliffe, *Dryden: the Town that Changed the Fracking Game*, EARTHJUSTICE (June 20, 2014), https://perma.cc/VUH3-XZ25 (describing the technique of fracking). I refer to the application of both technologies, horizontal drilling and hydraulic fracturing, as fracking. These technologies have also been referred to as "fracing." *See, e.g.*, Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 6 (Tex. 2008) (describing "hydraulic fracturing stimulation, or 'fracing,' as the process is known in the industry"). Horizontal drilling and hydraulic fracturing technologies are used together to extract oil or gas from unconventional, shale, or tight formations—but hydraulic fracturing, by itself, is also used with vertical wells drilled in conventional formations. *See, e.g.*, Ctr. for Biological Diversity v. Bureau of Land Mgmt., 937 F. Supp. 2d 1140, 1145 (N.D. Cal. 2013).

[2] *See* Jordan-Bloch & Sutcliffe, *supra* note 1.

[3] *The Story of Dryden: The Town that Fought Fracking (and is Winning)*, EARTHJUSTICE, https://perma.cc/X33C-G93F (last visited Nov. 25, 2018).

[4] *Id.*; Jordan-Bloch & Sutcliffe, *supra* note 1.

[5] TOWN OF DRYDEN, ADOPTION OF AMENDMENTS TO ZONING ORDINANCE, *supra* note 1.

Dryden, sued the town in the New York Supreme Court, initiating a multi-year litigation over whether the town acted within its rights to ban fracking.[6]

Dryden was not alone in its decision to ban fracking. By 2014 in New York, more than fifty towns had passed fracking bans, and more than 120 towns had passed moratoria on fracking activities.[7] Across the United States, the numbers were even higher. According to the environmental group Food and Water Watch, the total included more than 400 communities across more than twenty states as well as four states and the District of Columbia.[8]

Deep shale formations in the United States have long been known to hold large quantities of gas and oil, but their low permeability made energy extraction challenging and previously unprofitable.[9] Advancements in fracking made shale development not only possible but also profitable,[10] generating a boom in the oil-and-gas industry and transforming the U.S. energy landscape.[11] Shale gas now plays an important role, at least in the short run, in achieving national objectives such as attaining energy security and reducing carbon dioxide emissions. In 2015, for example, the United States produced almost all of the natural gas it consumed,[12] and its electric power sector emitted the lowest level of carbon dioxide emissions since 1993 largely due to the displacement of coal by natural gas.[13] To the extent that U.S. energy policy continues to rely on access to natural gas trapped within shale formations, the prevalence of local bans, especially in shale-rich areas like those in New York, should raise at least some concerns.

In fact, in 2012, the International Energy Agency (IEA) warned companies that, in order to avoid widespread bans and other limits on production, they should support regulations that deal convincingly with the environmental risks of fracking.[14] In particular, IEA asserted that its proposed "Golden Rules," which would raise production costs by about 7%, would mitigate public concerns in the United States and elsewhere by

6 *See* Anschutz Expl. Corp. v. Town of Dryden, 940 N.Y.S.2d 458, 461 (N.Y. Sup. Ct. 2012), *aff'd sub nom. In re* Norse Energy Corp. USA v. Town of Dryden, 964 N.Y.S.2d 714, 718 (N.Y. App. Div. 2013), *aff'd sub nom. In re* Wallach v. Town of Dryden, 16 N.E.3d 1188, 1191 (N.Y. 2014).

7 *See infra* Table 1.

8 *See Local Resolutions against Fracking*, FOOD & WATER WATCH, https://perma.cc/XXF3-XSS9 (last visited Nov. 25, 2018).

9 U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, REVIEW OF EMERGING RESOURCES: U.S. SHALE GAS AND SHALE OIL PLAYS 4 (2011), https://perma.cc/KYL4-E28G (describing how fracking exposes more shale rock to the wellbore (horizontal drilling) and creates and props open tiny fractures that allow trapped gas and oil to flow into the wellbore (hydraulic fracturing)).

10 NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: AN UPDATE 19 (2013).

11 Russell Gold & Tom McGinty, *Energy Boom Puts Wells in America's Backyards*, WALL STREET J. (Oct. 25, 2013), https://perma.cc/82PH-QP7K.

12 *See* U.S. ENERGY INFO. ADMIN., NATURAL GAS EXPLAINED (2017), https://perma.cc/BF2B-J4DY.

13 *See* U.S. ENERGY INFO. ADMIN., CARBON DIOXIDE EMISSIONS FROM ELECTRICITY GENERATION IN 2015 WERE LOWEST SINCE 1993 (2016), https://perma.cc/ZB79-67JS.

14 INT'L ENERGY AGENCY, GOLDEN RULES FOR A GOLDEN AGE OF GAS: WORLD ENERGY OUTLOOK SPECIAL REPORT ON UNCONVENTIONAL GAS 10, https://perma.cc/Z3Z2-LLUU.

focusing on sound water management.[15] In other words, the agency assumed that banning behavior was motivated by the perceived net environmental costs of shale development to jurisdictions.[16]

The IEA's assumption is not unreasonable. Although shale development provides national and local benefits, it comes with potential costs—and these costs are mostly felt at the local level. The extensive drilling associated with shale development generates negative externalities that can range in severity from increased traffic and noise to potential drinking water contamination and other environmental damage.[17] In fact, industry experts and regulators identify risks to water from spills of fracking fluid or wastewater as the most concerning fracking risks.[18] Scholars such as David Spence have persuasively argued that the mismatch between the largely dispersed benefits and the largely localized costs might be driving local banning behavior.[19] If so, then bans might be adopted in those areas where the net local costs of fracking are largest. If so, then efforts to reduce the environmental costs of fracking—such as adopting the IEA's Golden Rules—should reduce net costs faced by local jurisdictions and reduce the likelihood of adopting fracking bans.

But this is not the only explanation for widespread banning behavior. Some have speculated that powerful and organized environmental interests are responsible for the bans.[20] National environmental groups like the Sierra Club and the National Resources Defense Council have supported local opposition movements.[21] The Community Environmental Legal Defense Fund, in particular, has been involved with movements in Ohio, Pennsylvania, New York, Maryland, and New Mexico.[22] Others view local fracking bans as just another instance of "Not In My Backyard" (NIMBY) behavior, or community resistance to unwanted development projects.[23] Such NIMBY-based resistance reveals itself in diverse contexts, opposing projects ranging from low-income housing projects to wind farms, and

15 *Id.* at 10, 17, 108.

16 *Id.* at 60.

17 Part II, *infra*, provides a more detailed overview of some of these risks.

18 *See* ALAN KRUPNICK ET AL., PATHWAYS TO DIALOGUE: WHAT THE EXPERTS SAY ABOUT THE ENVIRONMENTAL RISKS OF SHALE GAS DEVELOPMENT 36–37 (2013), https://perma.cc/AZ5K-P8V5.

19 *See* David B. Spence, *The Political Economy of Local Vetoes*, 93 TEX. L. REV. 351, 355–58, 376–79 (2014) [hereinafter Spence, *Local Vetoes*]; *see also* David B. Spence, *Backyard Politics, National Policies: Understanding the Opportunity Costs of National Fracking Bans*, 30 YALE J. REG. 30, 31 (2013) [hereinafter Spence, *Backyard Politics*].

20 *See, e.g.*, Rebecca W. Watson & Jennifer Cadena, *Anti-Fracking Initiatives: Power to the People or More of the Same?*, 28 NAT. RESOURCES & ENV'T J. 44, 47 (2014); Alex Ritchie, *On Local Fracking Bans: Policy and Preemption in New Mexico*, 54 NAT. RES. J. 255, 284–85 (2014).

21 *See* Spence, *Local Vetoes, supra* note 19, at 356–58.

22 *See* Watson & Cadena, *supra* note 20, at 47. Alex Ritchie also concludes that environmental special group influence played a role in a fracking ban enacted by Mora County, New Mexico. *See* Ritchie, *supra* note 20, at 287–90.

23 *See, e.g.*, Emeka Duruigbo, *Fracking and the NIMBY Syndrome*, 26 N.Y.U. ENVTL. L.J. 227 (2018); Jason Schumacher & Jennifer Morrissey, *The Legal Landscape of "Fracking": The Oil and Gas Industry's Game-Changing Technique is its Biggest Hurdle*, 17 TEX. REV. L. & POL. 239, 252 (2013).

fracking may be no different.[24] While these alternative explanations may have roots in environmental concerns, they are neither tied to nor predicted by community-specific and fact-based environmental vulnerabilities.[25] Reducing underlying risks might do nothing to alter underlying environmental preferences, ties to environmental groups, or resistance to development. If the bans are not linked to actual risks and vulnerabilities, then operators' willingness to reduce these risks (whether voluntarily or by complying with regulations) will not stem banning behavior. If public support is desired, then alternative strategies might be more effective.

IEA did not provide evidence to support its assumption that governments and their citizens are motivated by the underlying risks of fracking.[26] In fact, no scholars have empirically analyzed whether such a link exists.[27] One existing empirical study found support for the idea that net costs of fracking matter to local jurisdictions, but it focused on whether jurisdictions receive some offsetting revenue from fracking and not whether jurisdictions were particularly vulnerable to risks.[28] The study also did not explain why, subject to the same revenue-sharing rules such as within New York, some local jurisdictions adopt bans while others do not.[29]

This Article fills this gap by empirically examining whether the adoption of local restrictions on fracking is predicted by the relative exposure of local governments to the costs and benefits of fracking, including exposure to relevant risks. If there is evidence that jurisdictions base their decisions to adopt such restrictions on their exposure to fracking risks, in particular, then there is at least the potential for targeted regulations to reduce such opposition.

For this study, I examine towns in New York that chose to prohibit fracking either permanently (via a ban) or for a specified term (via a moratorium) (collectively, "anti-fracking measures") from 2010 through the

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24 *See* Duruigbo, *supra* note 23, at 241–46 (describing the sources of different kinds of NIMBY-based resistance).

25 Consider, for example, persistent NIMBY opposition to the citing of cellular towers due to discredited concerns about health effects. *See* Jesse J. Richardson, Jr., *Local Regulation of Hydraulic Fracturing*, 117 W. VA. L. REV. 593, 605 (2014) (comparing opposition to fracking to opposition to citing cellular towers, and stating that "[l]ike objections to cellular towers, some objections to hydraulic fracturing fail to find solid grounding in fact").

26 INT'L ENERGY AGENCY, *supra* note 14, at i.

27 Only one other study empirically examines the relationship between banning behavior and net costs of fracking, but it did not focus on risks. *See* Robert D. Cheren, *Fracking Bans, Taxation, and Environmental Policy*, 64 CASE W. RES. L. REV. 1483, 1484–85 (2014). Another study examines the effect of New York's statewide moratorium on property values and finds that shale-rich towns had a net *positive* valuation of fracking—but it ignores local banning behavior. *See* Andrew Boslett et al., *Valuation of Expectations: A Hedonic Study of Shale Gas Development and New York's Moratorium*, 77 J. ENVTL. ECON. & MGMT. 14, 15 (2016).

28 *See* Cheren, *supra* note 27, at 1484–85 (finding that jurisdictions, such as New York towns, that did not draw additional revenue from fracking were more likely to impose fracking bans).

29 In particular, the analysis does not explain why, within New York and subject to the same tax and revenue policies, some towns chose to ban fracking and some towns did not. In fact, the results appear to be driven by the prevalence of bans by towns in New York, which had no revenue-sharing rules in place at the time. *See id.*

end of 2013.[30] The relevant period includes local banning behavior that occurred before the 2014 decision of the New York Court of Appeals recognizing a town's authority to ban fracking[31] and before New York's 2015 decision to officially ban fracking.[32] Thus, towns in the study period adopted an anti-fracking measure when fracking was a realistic threat to the town and, by doing so, risked costly litigation regarding their authority to adopt such a measure.

Part II briefly outlines the costs and benefits of fracking, and Part III presents one possible mechanism for how such costs and benefits might translate into banning behavior. Part IV describes the context behind the behavior of New York towns during the study period. Specifically, during the study period towns faced significant interest from the oil-and-gas industry, uncertainty about the final form of state regulation, and uncertainty about the legality of their options. Part V describes the various sources of town-level and county-level data that are used in this study and introduces the empirical specification.

Part VI presents the results. Overall, I find evidence that concerns about water risks to people and livestock played a role in the decision to adopt a ban. Towns with a higher reliance on private water wells and those with higher livestock water use were associated with a higher probability of adopting a ban. Demographic characteristics, environmental preferences, and political interests also predicted whether a town adopted a ban. Moratoria adoption, on the other hand, was different. The largest driver of moratoria adoption was the county recycling rate, possibly indicating that moratoria were symbolic gestures driven by environmental preferences. Finally, oil-and-gas industry presence and previous experience with drilling tended to decrease the probability that a town adopted any anti-fracking measure, consistent with either a cost-benefit or an interest-group story.

II. LOCAL COSTS AND BENEFITS OF FRACKING

The shale revolution has exposed many local jurisdictions to extensive drilling.[33] The widespread development has highlighted outstanding uncertainty about its environmental, health, and safety impacts—most prominently, its water-contamination risks—and about the ability of current institutions to deal with these impacts.[34] This Part outlines some of these costs and benefits that might inform such perceptions.[35]

30 Although New York banned fracking, this analysis is still relevant as New York might decide to allow fracking in the future and as the analysis might provide lessons for other areas dealing with local bans. *See infra* Table 1.

31 *See* Matter of Wallach v. Town of Dryden, 16 N.E.3d 1188, 1191 (2014).

32 *See* Glenn Coin, *New York State Officially Bans Fracking*, SYRACUSE.COM (June 29, 2015), https://perma.cc/YA3Z-V4DQ.

33 Russell Gold & Tom McGinty, *The Rig Next Door: Energy Boom Puts Wells in America's Backyards*, WALL STREET J., E. ED. (Oct. 26, 2013).

34 U.S. GOV'T ACCOUNTABILITY OFFICE, REPORT TO CONGRESSIONAL REQUESTERS, GAO-12-732, UNCONVENTIONAL OIL AND GAS DEVELOPMENT: KEY ENVIRONMENTAL AND PUBLIC HEALTH REQUIREMENTS 2 (2012). For fracking risk-management proposals, see Caroline Cecot,

A. Costs

As an initial matter, local communities are likely to care about the undesirable day-to-day realities of introducing shale development to their area, especially if their communities have been relatively free from other industrial development.[36] A typical Marcellus well pad spans about five acres and includes multiple horizontal wells, industrial drilling equipment such as compressors and generators, and on-site water, fluid, and wastewater storage facilities.[37] Active production is noisy and disruptive; each day, multiple trucks transport thousands of gallons of water, sand, and chemicals to the fracking site, putting a heavy toll on local roads and other infrastructure and transforming a quiet rural community into an industrial hub.[38] The extensive production may have effects on recreation, tourism, and property values.

In addition, the unprecedented scale of shale development exposes more areas to ordinary perils associated with drilling activities, including air pollution, drilling and road accidents, fluid spills, and well blowouts, the cumulative effects of which could be significant.[39] Fracking also presents its own set of possible risks, such as groundwater and surface water contamination from fracking fluid or wastewater,[40] water-supply shortages due to fracking's sizeable water requirements,[41] and earthquakes induced through the injection of fracking wastewaters into disposal wells.[42] Current

Regulatory Fracture Plugging: Managing Risks to Water from Shale Development, 6 TEX. A&M L. REV. 29, 40–55 (2018); David A. Dana & Hannah J. Wiseman, *A Market Approach to Regulating the Energy Revolution: Assurance Bonds, Insurance, and the Certain and Uncertain Risks of Hydraulic Fracturing*, 99 IOWA L. REV. 1523, 1528–29 (2014); Thomas W. Merrill & David M. Schizer, *The Shale Oil and Gas Revolution, Hydraulic Fracturing, and Water Contamination: A Regulatory Strategy*, 98 MINN. L. REV. 145, 197, 245 (2013).

35 For an illuminating account of people's experiences with shale development, see DANIEL RAIMI, THE FRACKING DEBATE: THE RISKS, BENEFITS, AND UNCERTAINTIES OF THE SHALE REVOLUTION 204–05 (2018).

36 *See* Michael Burger, *The (Re)federalization of Fracking Regulation*, 2013 MICH. ST. L. REV. 1483, 1501–03 (2013).

37 NAT'L ENERGY TECH. LAB., *supra* note 10.

38 Spence, *Backyard Politics*, *supra* note 19, at 33; *see also* David B. Spence, *Responsible Shale Gas Production: Moral Outrage vs. Cool Analysis*, 25 FORDHAM ENVTL. L. REV. 141, 150–55 (2013) [hereinafter Spence, *Responsible Shale Gas Production*]; Andrew Meyer, *"Get the Frack out of Town:" Preemption Challenges to Local Fracking Bans in New York*, COLUM. J. ENVTL. L. FIELD REP. (Apr. 22, 2016), https://perma.cc/UVR8-DQCN.

39 Spence, *Responsible Shale Gas Production, supra* note 38, at 141–42.

40 One study of Pennsylvania, where shale gas development is prevalent, estimated that an additional well pad drilled within 1 km of a groundwater intake area for a community water system increased shale gas-related contaminants by, on average, 1.5 to 2.7%. Elaine Hill & Lala Ma, *Shale Gas Development and Drinking Water Quality*, 107 AM. ECON. REV. 522, 522 (2017).

41 *See* Yusuke Kuwayama et al., *Water Quality and Quantity Impacts of Hydraulic Fracturing*, 2 CURRENT SUSTAINABLE/RENEWABLE ENERGY REP. 17, 19 (2015).

42 The risk of earthquakes from the disposal of fracking waste waters has been well-documented. *See Induced Earthquakes*, U.S. GEOLOGICAL SURV., https://perma.cc/9XWU-7EZX (last visited Nov. 25, 2018). *See generally* Monika U. Ehrman, *Earthquakes in the Oilpatch: The Regulatory and Legal Issues Arising out of Oil and Gas Operation Induced Seismicity*, 33 GA. ST. U. L. REV. 609 (2017) (reviewing the geologic mechanisms, scientific studies, and applicable

research has not convincingly isolated a causal connection between specific fracking-related pathways and some of these adverse events. And, in any event, the total expected damages would depend on the number of wells drilled, on the location of the wells, and on the practices employed by operators—as well as on regulatory enforcement within each state. As a result, there is significant uncertainty surrounding the expected overall costs of shale development.

The most publicized risk is drinking-water contamination by fracking fluid or wastewater, most likely to occur through surface spills from drilling activities.[43] For example, fracking wastewater is often stored in on-site pits, at least temporarily, and then transported for treatment or injection into a disposal well.[44] Spills could occur when wastewater is improperly enclosed in a storage container or when it is transported.[45] In fact, industry experts and regulators identified risks to water from spills as the most pressing fracking risks,[46] and such spills might already be causing contamination.[47] If spills or leaks are not cleaned up, then contaminants can migrate into surfacewater and groundwater sources. Under federal law, operators must report qualifying spills of hazardous substances,[48] but states are responsible for ensuring that proper regulations are in place to prevent such spills, and these state regulations vary widely.[49]

B. Benefits

The most salient benefits of shale development, on the other hand, are generalized.[50] Natural gas provides low-cost energy for individuals, households, and firms.[51] Advocates of shale development claim that development promotes energy security (if homegrown shale gas replaces imported conventional oil) and reduces global greenhouse gas emissions (if shale gas replaces coal).[52] Shale gas is abundant domestically, and our national energy policy relies on continued increases in natural gas

federal environmental legislation and state regulatory frameworks related to oil-and-gas-induced seismicity).

43 Gayathri Vaidyanathan, *Fracking Can Contaminate Drinking Water*, SCI. AM. (Apr. 4, 2016), https://perma.cc/LY65-XZ7A.

44 Abrahm Lustgarten, *Are Fracking Wastewater Wells Poisoning the Ground Beneath Our Feet?*, SCI. AM. (June 21, 2012), https://perma.cc/997R-7DMN.

45 *See* KRUPNICK ET AL., *supra* note 18, at 37.

46 *Id.* at 46.

47 Hill & Ma, *supra* note 40, at 522.

48 Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. § 9603(a) (2012).

49 NATHAN RICHARDSON ET AL., THE STATE OF STATE SHALE GAS REGULATION 21 (2013), https://perma.cc/M7W3-3EPM.

50 *See* Spence, *Local Vetoes*, *supra* note 19, at 377 (arguing that the involvement of local governments can be partly explained by the unequal distribution of costs and benefits).

51 MASS. INST. OF TECH., THE FUTURE OF NATURAL GAS 2 (2011).

52 *See, e.g.*, U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2015 WITH PROJECTIONS TO 2040 17–18 (2015), https://perma.cc/D33A-2HMQ.

production.[53] And even some environmental groups support responsible shale development in the hope that natural gas (the cleanest-burning fossil fuel) replaces coal, putting the United States on a "cost-effective bridge to . . . a low-carbon future."[54] In fact, this process is already underway, as a United States Department of Energy report recently confirmed: "[t]he biggest contributor to coal and nuclear plant retirements has been the advantaged economics of natural gas-fired generation."[55]

But not all benefits of shale development are so generalized. Shale development can also bring benefits to the local communities that may offset some of the local costs.[56] According to advocates, shale development boosts local and state economies by increasing employment, income, property values, and tax revenues.[57] Jobs in the oil-and-gas industry are attractive, providing job training and high wages.[58] Shale gas production also attracts workers and new development to the area, increasing the demand for rental housing and commercial real estate.[59] In addition, some homeowners benefit from bonus and royalty payments from oil-and-gas companies in exchange for mineral-rights leases.[60] Finally, to the extent that spending and property values increase, local and state governments often see increases in tax revenue.[61] These benefits could lead to economic growth in parts of the country that suffered from the last recession. One newspaper's analysis of government data suggested that wealth in the United States is, in fact, shifting to rural shale gas towns.[62] Some researchers,

53 *Id.* at 20–21.

54 MASS. INST. OF TECH., *supra* note 51, at 2. While burning natural gas undeniably emits less greenhouse gases than does burning coal, scientists disagree on whether the entire carbon footprint of natural gas is lower than that of coal. *See, e.g.*, UNION OF CONCERNED SCIENTISTS, ENVIRONMENTAL IMPACTS OF NATURAL GAS, https://perma.cc/9728-JY8G.

55 U.S. DEP'T OF ENERGY, STAFF REPORT TO THE SECRETARY ON ELECTRICITY MARKETS AND RELIABILITY 13 (2017).

56 This quality distinguishes shale development from other energy-related development often considered alongside shale development on other dimensions. *Contra* Uma Outka, *Intrastate Preemption in the Shifting Energy Sector*, 86 U. COLO. L. REV. 927, 929 (2015) (comparing the local opposition to fracking to the local opposition to wind development).

57 Jeremy G. Weber, *The Effects of a Natural Gas Boom on Employment and Income in Colorado, Texas, and Wyoming*, 34 ENERGY ECON. 1580, 1581 (2012) (discussing how employment and income increase with a natural gas boom). *But see id.* at 1587 (showing that property values decrease as natural gas extraction increases).

58 *See* Pamela King, *Oil, Gas and Mining Sector Leading U.S. Wage Growth*, E&E NEWS (Oct. 12, 2012), https://perma.cc/7SWS-NFK8.

59 *See, e.g.*, Brian Louis, *Fracking in Ohio Sparks Real Estate Rebound: Mortgages*, BLOOMBERG (June 10, 2012), https://perma.cc/2E4F-ADCN.

60 *See* Kevin Begos, *Billions in Gas Drilling Royalties Change Individual Lives, but Broader Gains are Modest*, GLOBAL NEWS (Jan. 27, 2013), https://perma.cc/9B3V-PWTX.

61 Ellen M. Gilmer, *Drilling Boosts Taxes Collected by Pennsylvania Counties—Study*, E&E NEWS (May 10, 2012), https://perma.cc/CPZ5-2JME. Some states and local areas directly tax fracking activities or increase permitting fees in order to gain revenue for better regulatory enforcement or for structural improvements. *See* Daniel Raimi & Richard G. Newell, *US State and Local Oil and Gas Revenues* 3, (Resources for the Future Discussion Paper 16-50 2016), https://perma.cc/F9EJ-D7Z5.

62 Dennis Cauchon, *Wealth Rises in USA's Heartland*, USA TODAY (Nov. 26, 2012), https://perma.cc/MAG6-3GD8. In any event, it is unclear how long these booms are likely to last.

however, have challenged many of these conclusions, finding that the supporting analyses are often characterized by unrealistic assumptions that could overstate the gains to state and local economies.[63] But, in any event, for many residents the question of whether shale development and its associated fracking is net beneficial is a close one.[64]

III. TOWN BOARDS AND RESIDENT PREFERENCES

This Article empirically examines whether local costs and benefits of fracking are associated with the adoption of anti-fracking measures. In particular, I test the influence of several factors that relate to the costs and benefits of fracking to see whether they play a role in local decision making. There are several ways that costs and benefits might inform a town's decision to adopt an anti-fracking measure. For example, the town's decision might be based on its perception of resident preferences, which, in turn, might be based on the perceived costs and benefits of fracking. This basic framework is loosely based on the median voter theory of government action,[65] in which the preferences of voters affect the incentives of policymakers to support various laws and regulations. While this study neither can identify nor need identify the exact mechanism underlying any revealed association between the net costs of fracking and the adoption of anti-fracking measures, this Part presents a brief overview of one possible mechanism.

Political scientists have long theorized that politicians have incentives to respond to the median voter in their jurisdictions. Essentially, when there are two political candidates vying for a position, the median voter theory posits that a majority-rule voting system will select the candidate most preferred by the median voter, and political candidates will maximize their support when they gravitate toward the median voter's position (subject to a number of simplifying assumptions).[66] At its core, the model predicts which

Unlike production at conventional oil and gas wells, unconventional well production declines steeply during the first few years of production; operators must constantly drill new wells to maintain production. *See* Timothy J. Considine et al., *Economic and Environmental Impacts of Fracking: A Case Study of the Marcellus Shale*, 9 INT'L REV. RES. & ENVTL. ECON. 209, 215 (2016).

63 *See* Thomas C. Kinnaman, *The Economic Impact of Shale Gas Extraction: A Review of Existing Studies*, 70 ECOLOGICAL ECON. 1243, 1244, 1249 (2011). In addition, these consequences of shale development might not correspond to true net benefits and may involve double counting of relevant effects. One of the few peer-reviewed, empirical studies that compared employment and income differences in boom counties to differences in nonboom counties found that employment and income gains were far more modest than previous studies and estimates suggested. *See* Weber, *supra* note 57, at 1586–87.

64 Clifford Kraus, *Split Decision by Voters on Local Fracking Bans*, N.Y. TIMES (Nov. 5, 2014), https://perma.cc/RB9P-UXQ5.

65 *See generally* Duncan Black, *On the Rationale of Group Decision-Making*, 56 J. POL. ECON. 23 (1948) (suggesting that multi-member decision-making bodies will select a policy preferred by the median of voters despite holding different views themselves); Anthony Downs, *An Economic Theory of Political Action in a Democracy*, 65 J. POL. ECON. 135 (1957) (theorizing that voter preferences influence the actions of elected officials).

66 *See generally* Black, *supra* note 65; Downs, *supra* note 65.

voter preferences are important to candidates or incumbents seeking to maintain their office. The model says nothing about how voters form their preferences but does assume that voters behave rationally and consistently based on their ordered preferences. Thus, economists and political scientists have invoked the median voter model as a way to use the individual utility maximizing model applied to the median income family to analyze government behavior.[67]

In New York, each town is governed by a town board that may adopt local laws pursuant to the home rule powers granted by Article 9 of the state Constitution[68] and the Municipal Home Rule Law.[69] The town board is typically made up of five elected (and typically paid) officials—the supervisor (two-year term) and four councilpersons (four-year terms).[70] Most towns employ at-large majority voting to elect the single supervisor every two years, but use at-large single-nontransferable voting to elect two councilpersons every two years (a plurality voting system).[71] Theoretically speaking, the outcome from a plurality voting system need not coincide with the median voter outcome,[72] meaning that the councilpersons need not necessarily converge on the median voter's preferences to get elected in some circumstances.

For the purposes of this mechanism, however, it suffices that measures adopted by the town board, as a whole, can reasonably be tied to relevant resident preferences. Putting aside political theory, the elected officials that made up the board have an obligation to represent resident preferences.[73] According to the New York town manual, whenever a town councilperson votes on a proposal before a town board, "he or she is representing, through that vote, the views of all of the residents of the town."[74] And even self-

67 *See, e.g.*, Downs, *supra* note 65, at 150. The median voter model, however, rests on a special set of assumptions about group preferences that may not be satisfied in practice. MAXWELL L. STEARNS & TODD J. ZYWICKI, PUBLIC CHOICE CONCEPTS AND APPLICATIONS IN LAW 329–30 (2009). In most elections, for example, there are more than two candidates, policy preferences rarely align along a single-dimensional scale, and the voting population is divided into electoral districts. *See, e.g.*, Downs, *supra* note 65, at 142. In those cases, it is still possible for self-interested political candidates to converge on the median voter's position, but other outcomes are also possible, often depending on the voting scheme.

68 N.Y. CONST. art. IX, § 2(c)(i).

69 N.Y. MUN. HOME RULE LAW § 36 (McKinney 2018).

70 OFFICE OF THE N.Y. STATE COMPTROLLER, INFORMATION FOR TOWN OFFICIALS 10 (2018), https://perma.cc/JW4Q-UKQH; N.Y. TOWN LAW § 24 (McKinney 2018). To access salaries for local elected officials in New York, see *What Are You Paying Your Local Elected Lawmakers and Executives?*, NYDATABASES.COM, https://perma.cc/54C3-P2EG (last visited Dec. 11, 2018).

71 DIV. OF LOCAL GOV'T SERVS., N.Y. DEP'T OF STATE, LOCAL GOVERNMENT HANDBOOK 63 (2009), https://perma.cc/D24H-8QF9. Fifteen towns, however, employ a ward election system instead of an at-large election system. *See The Ward System of Town Government*, N.Y. DEP'T OF STATE, https://perma.cc/8VBP-79DN (last visited Nov. 25, 2018). In robustness checks, I included a control for ward towns during the study period; the qualitative results remain the same.

72 *See* STEARNS & ZYWICKI, *supra* note 67.

73 Ass'n of Towns of the State of N.Y., *Town Law Manual for Town Supervisors and Town Boards*, TOWN VERONA (Jan. 2004), https://perma.cc/5TMQ-8P6C.

74 *Id.*

interested officials should care about resident preferences on shale development. Simply put, voter retaliation is more likely on a local scale where the anti-fracking action may be one of few town board actions. Resident homeowners pay particular attention to decisions that affect the use of their land, and those local decisions are especially likely to be majoritarian.[75] Local politicians are also likely to know resident preferences in this context, usually having held town resident meetings in advance of any anti-fracking action. Politicians are also aware of the various demographic factors that could lead some residents to be more or less likely to express their preferences or engage in collective action.[76] In short, local officials fulfill their duties and often maximize their support when they estimate and follow resident preferences when making a decision on a proposal.

For these reasons, median resident perceptions of the local costs and benefits of fracking might influence a town's adoption of an anti-fracking measure.[77] But local costs and benefits might not predict the adoption of all anti-fracking measures equally. When adopting a ban, typically through a local zoning amendment,[78] town residents are very likely to pay attention to costs and benefits. Zoning has long been considered a way for local governments to manage various industry externalities and protect property values, considerations that are based on perceived costs and benefits. Moratoria, however, are unlikely to have much effect given the state's longstanding moratorium on fracking activities and the short adopted duration of most town moratoria. The local costs and benefits of fracking, then, might not be as important to residents when adopting a moratorium in New York. For this reason, the relationship between the costs and benefits of fracking and the adoption of moratoria might not be as strong.

But a cost-benefit story is not the only way to interpret any relationship between costs and benefits of fracking and ban adoption. Interest group theory, where rational legislators confer regulatory benefits on interest-seeking industry groups,[79] might offer an alternative mechanism under some

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75 *See, e.g.*, Christopher Serkin, *Big Differences for Small Governments: Local Governments and the Takings Clause*, 81 N.Y.U. L. REV. 1624, 1646 (2006).

76 My assumptions about how politicians estimate resident preferences are similar to those in James Hamilton's analysis of how firms estimate the intensity of resident preferences in their decisions to locate in different neighborhoods. *See* James T. Hamilton, *Testing for Environmental Racism: Prejudice, Profits, Political Power?*, 14 J. POL'Y ANALYSIS & MGMT. 107, 118 (1995).

77 This is one possible mechanism that links local costs and benefits to the decision to ban fracking, but other mechanisms are possible. Local officials might follow their own preferences, which might or might not correspond to the median voter's preferences, and their preferences might or might not correspond to local costs and benefits. Or, they might be influenced by powerful special interests, which might or might not match up with observed costs and benefits. The empirical component, *see infra* Part VI, examines whether a cost-benefit account, via any mechanism, *can* explain observed banning behavior.

78 *See* William J. Brady & James P. Crannell, *Hydraulic Fracturing Regulation in the United States: The Laissez-Faire Approach of the Federal Government and Varying State Regulations*, 14 VT. J. ENVTL. L. 39, 58 (2012).

79 *See, e.g.*, George J. Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 1, 3, 5–6 (1971); Sam Peltzman, *Toward a More General Theory of Regulation*, 19 J.L. &

circumstances. In particular, the established presence of an industry could not only be related to resident perceptions of relative costs and benefits of fracking but also translate directly to political influence. In the fracking context, prior oil-and-gas drilling in an area, for example, could reduce resident uncertainty about drilling (cost-benefit story), reduce the marginal costs of additional drilling (cost-benefit story), and indicate the influential presence of the oil-and-gas industry (interest-group story). The presence of the agriculture industry could similarly translate into higher potential costs of fracking given crop exposure to possible contamination (cost-benefit story) or provide a competing influential group (interest-group story). Environmental groups are another kind of relevant interest group in this context. Scholars have speculated that environmental groups formed a powerful special interest that organized residents to effectively lobby their town boards to pass anti-fracking measures.[80] As in Dryden, small local groups comprised primarily of fracking opponents often initiated movements about adopting an anti-fracking measure.[81] Such efforts might be especially powerful in areas where residents have strong environmental preferences. In general, studies have found that both median voter models and interest group models are useful in explaining some local and state behaviors.[82]

IV. NEW YORK TOWNS

During the study period, town residents faced growing pressures from industry representatives to allow fracking on their land before knowing the level of regulation that the state would ultimately approve.[83] Some residents voiced their concerns about fracking to their local town boards.[84] These

ECON. 211, 211–12, 217 (1976); Gary S. Becker, *A Theory of Competition Among Pressure Groups for Political Influence*, 98 Q.J. ECON. 371, 372–74, 388 (1983).

80 *See* Spence, *Local Vetoes*, *supra* note 19, at 356–58 (describing how national environmental groups have supported local movements); Watson & Cadena, *supra* note 20, at 47 (describing the influence of the Community Environmental Legal Defense Fund in organizing anti-fracking campaigns). Rebecca Watson and Jennifer Cadena argue that these environmental-group-led "[i]nitiatives are on a fast-track that favors the proponents." *Id.* at 48 ("The proponents have already conducted focus groups and polling on the initiative by the time the signature-gatherers hit the streets," while "[t]he targeted industry group is typically focused on their business and not on politics.").

81 Jason Schumacher & Jennifer Morrissey, *The Legal Landscape of "Fracking": The Oil and Gas Industry's Game-Changing Technique Is Its Biggest Hurdle*, 17 TEX. L. REV. & POL. 239, 257 (2013).

82 *See, e.g.*, Roger D. Congleton & Randall W. Bennett, *On the Political Economy of State Highway Expenditures: Some Evidence of the Relative Performance of Alternative Public Choice Models*, 84 PUB. CHOICE 1, 24 (1995); Sultan Ahmed & Kenneth V. Greene, *Is the Median Voter a Clear-Cut Winner?: Comparing the Median Voter Theory and Competing Theories in Explaining Local Government Spending*, 105 PUB. CHOICE 207, 230 (2000); Michael L. Walden & Gunce Eryuruk, *Determinants of Local Highway Spending in North Carolina*, 43 GROWTH & CHANGE 462, 481 (2012).

83 *See* Thomas Kaplan, *Citing Health Risks, Cuomo Bans Fracking in New York State*, N.Y. Times (Dec. 17, 2014), https://perma.cc/3CLE-964X.

84 *See* Schumacher & Morrissey, *supra* note 81, at 284.

town boards, in turn, decided whether to adopt an anti-fracking measure in the face of uncertainty about their legal authority to do so.[85] It was under these circumstances that many town boards adopted anti-fracking measures during the study period.

Some towns voted to prohibit fracking either permanently or for a specified term, usually between six months and two years.[86] This study compares shale towns that chose to adopt anti-fracking measures to shale towns that chose not to adopt such measures. Table 1 provides a list of the towns that adopted an anti-fracking measure between 2010 and 2014 that are included in this analysis.[87] In this Part, I provide details on the context in which residents and towns made decisions about fracking and on the statewide views of fracking based on polling data.

A. Political, Regulatory, and Legal Landscape

In New York, the Department of Environmental Conservation (NYSDEC) regulates oil-and-gas permitting and drilling activities.[88] Since July 2008 and through the period of this study, New York had a moratorium on high-volume fracking in order to allow the NYSDEC to study the environmental effects of the drilling techniques associated with fracking and to develop appropriate regulations.[89] In furtherance of this goal, the NYSDEC released a draft Supplemental Generic Environmental Impact Statement (draft SGEIS) in September 2009, a revised draft SGEIS in September 2011, and proposed regulations in October 2011.[90] The proposed state program to regulate oil-and-gas development analyzed in the draft SGEIS would preempt local government regulation but would also provide for site-specific environmental review, notification to relevant local governments before approval of permits in their jurisdiction, and consultation with local governments if a permit would be inconsistent with local laws, regulations,

85 *Id.*

86 *See infra* Table 3.

87 In addition, there were six towns that adopted an anti-fracking measure during the sample period that were excluded from this analysis because the towns do not lie on a shale formation. *See, e.g.*, *infra* Table 1.

88 *See Oil, Gas and Solution Salt Mining in New York State*, N.Y. ST. DEP'T OF ENVTL. CONSERVATION, https://perma.cc/A9TD-YN7N (last visited Nov. 25, 2018). The Delaware River Basin Commission (DRBC) has power to oversee drilling in its area of jurisdiction, which includes parts of New York in the watershed area of the Delaware River. *See* Jamison Cocklin, *Lawsuit Challenging DRBC Authority to Regulate NatGas Drilling Rejected*, NAT. GAS INTELLIGENCE (Mar. 27, 2017), https://perma.cc/7FBC-5VY9; *Delaware River Basin Map*, DEL. RIVER BASIN COMMISSION, https://perma.cc/5LHC-9S6L (last visited Nov. 25, 2018).

89 Miriam R. Aczel & Karen E. Makuch, *Environmental Impact Assessments and Hydraulic Fracturing: Lessons from Two U.S. States*, CASE STUD. ENV'T. (Jan. 2, 2018), https://perma.cc/S229-QDZJ.

90 *High Volume Hydraulic Fracturing in NYS*, N.Y. ST. DEP'T OF ENVTL. CONSERVATION, https://perma.cc/3DEE-SR5R (last visited Nov. 25, 2018); *see also* N.Y. ST. DEP'T OF ENVTL. CONSERVATION DIV. OF MINERAL RES., FINAL SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM, FINDINGS STATEMENT 5-7 (2015) (summarizing the procedural history) [hereinafter NYSDEC, FINAL SGEIS, FINDINGS].

or policies.[91] Despite its inclusive approach to regulating shale development, including a role for local input, the proposed program attracted significant criticism.[92] In particular, residents worried that the state was underfunded and understaffed, the proposed regulations were too general, and the operators would not disclose fracking chemicals.[93] Some upstate residents questioned why the proposed program provided for special restrictions on drilling near watersheds delivering drinking water to New York City residents but failed to impose similar restrictions near other aquifers and private water sources.[94]

During the study period, the NYSDEC was waiting on a review from the New York State Department of Health (NYSDOH) of the potential impacts of shale drilling on public health before it expected to finalize the SGEIS.[95] Once the SGEIS was finalized, NYSDEC could move forward with developing criteria and conditions for permit approvals pursuant to the proposed regulatory program.[96] The resulting final regulations would have applied statewide, except in areas that the NYSDEC determined would be off-limits to fracking.[97] But, of course, NYSDEC never implemented the proposed program outlined in the draft SGEIS. Joe Martens, NYSDEC Commissioner, announced in December 2014 that he would issue a legally binding findings statement that would ban fracking in New York.[98] His decision came just after the NYSDOH's report determining that, in light of the significant uncertainties about adverse health outcomes associated with fracking and concerns about the adequacy of mitigation measures to protect

91 *See* N.Y. ST. DEP'T OF ENVTL. CONSERVATION DIV. OF MINERAL RES., DRAFT SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM 7-63, 8-3 (2009) [hereinafter NYSDEC, DRAFT SGEIS].

92 Kate Sinding, *With EPA Launching First-of-its-Kind Study, No Excuse for NY to Rush Forward with Drilling in the Marcellus*, NRDC EXPERT BLOG (Apr. 6, 2010), https://perma.cc/FE55-CFLR.

93 *See* W. McDonald Plosser, *Into the Fracking Fray: A Balanced Approach to Regulating Hydraulic Fracturing in Tennessee*, 44 U. MEM. L. REV. 667, 683–84 (2014) (discussing these concerns).

94 Letter from Barbara Lifton, Member of Assembly, 125th District, to N.Y. State Dep't of Envtl. Conservation (Jan. 11, 2013), https://perma.cc/QT7V-T984; Letter from Lynn Thurston, Ph.D., Chairperson, Finger Lakes Regional Watershed All., Inc., to N.Y. State Dep't of Envtl. Conservation (Nov. 21, 2011), https://perma.cc/972X-C75C.

95 *See* Coin, *New York State Officially Bans Fracking*, *supra* note 32.

96 *See, e.g.*, NYSDEC, DRAFT SGEIS, *supra* note 91, at 8-1 to 8-9 (outlining the proposed program). Ultimately, however, the final SGEIS recommended no action on fracking. *See* NYSDEC, FINAL SGEIS, FINDINGS, *supra* note 90, at 4-5.

97 For an overview of how the regulatory program would have applied, and the specific restrictions in areas such as the New York City watershed area, see generally *High Volume Hydraulic Fracturing in NYS*, *supra* note 90.

98 Glenn Coin, *NY Environmental Commissioner: I Will Ban Fracking in New York*, SYRACUSE.COM (Dec. 17, 2014), https://perma.cc/QZQ9-Y9H2; *see also* NYSDEC, FINAL SGEIS, FINDINGS, *supra* note 90, at 5 (selecting the "No-Action" alternative).

public health, fracking should not proceed in the state.[99] On June 29, 2015, New York officially banned fracking within the state.[100]

In addition, the towns that decided to adopt an anti-fracking measure during the study period risked costly litigation because the legal issue of whether New York towns had authority to ban or delay fracking within their borders was not yet resolved. In fact, two towns, Dryden and Middlefield, were sued as a result of their actions banning fracking through zoning laws during the study period.[101] The town of Dryden, as discussed in the introduction, was sued by the Anschutz Exploration Corporation, a privately held drilling company, while the town of Middlefield was sued by a landowner who had signed two oil-and-gas leases in 2007 with Elexco Land Services, Inc.[102] According to the plaintiffs, the bans, disguised as local zoning restrictions, were actually a form of local regulation of oil-and-gas development, and such local regulation was preempted by New York state's oil-and-gas law.[103]

The towns won their lawsuits at the lower court level, with courts upholding the actions under the home-rule authority of the towns to engage in zoning.[104] These rulings encouraged an increase in the number of towns that adopted bans or moratoria.[105] On appeal, Norse Energy, a Norway-based drilling company (whose U.S. unit filed for bankruptcy protection in December 2012) replaced Anschutz Exploration in the Dryden case.[106] The New York Appellate Court upheld the lower court decisions in 2013.[107] But it was not until June 2014 that the New York Court of Appeals, combining both actions, conclusively held that the state's oil-and-gas law did not preempt local zoning ordinances that banned oil-and-gas extraction.[108] In addition to these preemption challenges, the towns also faced potential legal challenges arguing that the local bans amounted to "regulatory takings" of owners'

99 *See* Coin, *NY Environmental Commissioner: I Will Ban Fracking in New York*, *supra* note 98.

100 *See* Coin, *New York State Officially Bans Fracking*, *supra* note 32.

101 In addition, there was an unsuccessful challenge against a town's moratorium that was then dismissed on appeal as moot due to the subsequent expiration of the moratorium. *See* Lenape Res., Inc. v. Town of Avon, No. 1060-2012, 2013 WL 9885336, at *5–6 (N.Y. Sup. Ct. Mar. 15, 2013), *dismissed as moot*, 121 A.D.3d 1591,1591 (N.Y. App. Div. 2014); *see also* Christopher J. Hilson, *Litigation Against Fracking Bans and Moratoriums in the United States: Exit, Voice and Loyalty*, 40 WM. & MARY ENVTL. L. & POL'Y REV. 745, 747–48 (2016) (finding that small oil-and-gas companies and surface landowners have brought the majority of these lawsuits).

102 The initial lawsuits were Anschutz Exploration Corp. v. Town of Dryden, 940 N.Y.S.2d 458, 461 (N.Y. Sup. Ct. 2012), and Cooperstown Holstein Corp. v. Town of Middlefield, 943 N.Y.S.2d 722, 723 (N.Y. Sup. Ct. 2012).

103 *Anschutz*, 940 N.Y.S.2d at 461; *see also Cooperstown*, 943 N.Y.S.2d at 722.

104 *See Anschutz*, 940 N.Y.S.2d at 458, 474; *Cooperstown*, 943 N.Y.S.2d at 722, 724.

105 *See infra* Table 4 (listing the number of anti-fracking measures before 2012 and after 2012).

106 *In re* Norse Energy Corp. USA v. Town of Dryden, 964 N.Y.S.2d 714 (N.Y. App. Div. 2013).

107 *Id.* at 724; Cooperstown Holstein Corp. v. Town of Middlefield, 964 N.Y.S.2d 431, 431 (N.Y. App. Div. 2013).

108 Matter of Wallach v. Town of Dryden, 16 N.E.3d 1188, 1191 (2014).

property rights, entitling owners to just compensation under the Fifth and Fourteenth Amendments.[109]

B. Motivations

To inform the selection of variables for the empirical analysis, I examined polling data on New York preferences on fracking during the study period. Although there is no poll that provides town-level preferences on fracking, there have been a few state-level polls on fracking views in New York. These polls tend to show New Yorkers are divided on the issue, with typically a slight majority opposing the practice. One detailed 2011 poll of 941 adults found that statewide, 38% of adults supported fracking, 41% opposed it, and 21% were unsure.[110] Of those adults living in upstate New York, 37% supported fracking, 47% opposed it, and 16% were unsure.[111] Overall, Democrats were more likely to oppose fracking, with about 47% opposing the practice.[112] Republicans were more likely to support fracking, with about 49% supporting it.[113] The relationship between fracking opposition and income was counterintuitive, with New Yorkers who made less than $50,000 being most likely to oppose fracking (at 43% , compared to 33% that supported it), while those who made between $50,000 and $100,000 and those who made more than $100,000 were relatively split on the issue (with 44% and 42%, respectively, supporting it compared to 40% opposing it).[114] Finally, men were more likely to support fracking (at 48% supporting it compared to 41% opposing it), while women and nonwhite respondents were more likely to oppose fracking (at 42% and 45%, respectively, opposing it compared to 29% and 34%, respectively, supporting it).[115]

When the tradeoffs associated with shale development were made explicit, New Yorkers were similarly divided. When asked which was more important, "making us more independent from foreign oil" or "preserving water supplies and the environment," 51% of New Yorkers living in upstate New York chose the environment, 45% chose energy independence, and 4%

109 *See* Spence, *Local Vetoes*, *supra* note 19, at 413 (citing a draft complaint contending that New York's moratorium constitutes a taking of mineral rights owner's property interests under both the U.S. and New York constitutions); *see also* Alfred R. Light, *Fracturing Moratoria Under the Dormant Commerce Clause: The Need to Shape Rather Than Resist the Shale Gale*, 44 ENVTL. L. REP. NEWS & ANALYSIS 10035 (2014).

110 The question was worded as follows: "[h]ydraulic fracturing, often referred to as hydrofracking, is a process of splitting rocks underground to remove natural gas. From what you have read or heard, do you generally support or oppose hydrofracking?" The survey was conducted between April 25 and April 29, 2011, and participants were contacted by land line and through random dialing of cell phones. MARIST COLL. INST. FOR PUB. OP., NY1/YNN-MARIST POLL: HYROFRACKING IN NYS: NO CONSENSUS AMONG RESIDENTS . . . ABOUT ONE IN FIVE UNSURE (2011), https://perma.cc/K673-78SX [hereinafter HYDROFRACKING POLL].

111 *See id.* (providing statistics of adults who either support or oppose "hydrofracking" in upstate New York).

112 *Id.*

113 *Id.*

114 *Id.*

115 *Id.*

were unsure.[116] Similarly, when asked which is more important, "creating jobs" or "preserving water supplies and the environment," 52% of upstate New Yorkers chose preserving the environment, 43% chose creating jobs, and 6% were unsure.[117] Though these data do not provide information on how resident preferences form and how they vary among towns, the data highlight which demographic characteristics might be relevant. The survey questions also emphasize the tradeoffs that are relevant for residents when they make their decisions: water supplies, the environment, energy independence, and jobs.

V. DATA AND EMPIRICAL SPECIFICATION

To examine the motivations behind town anti-fracking actions, I constructed relevant variables from various state and local sources. These variables are summarized in Table 3. First, I considered only New York towns located atop the Utica or the Marcellus shale formations in order to focus on the towns with residents who faced a nonzero probability of fracking and might reasonably balance the competing costs and benefits of shale development.[118] Because there is some uncertainty regarding the exact contours of the shale formations, I applied a simple decision rule: if a shale formation was known to underlie a part of a county, then I included all the towns in the county in my analysis.[119] This procedure limited the sample to 688 towns out of the 932 towns in New York.

Next, I created variables that indicated whether a town adopted a ban or a moratorium from 2010 through the end of 2013. I used town websites, news articles, and pro-fracking/anti-fracking group websites to generate a list of all towns that adopted bans or moratoria through 2013, the year in which they first adopted the anti-fracking measure, and the adopted duration of any moratoria. FracTracker Alliance, for example, provided an excellent starting point for much of my research.[120] I supplemented its lists of anti-

116 The question was worded as follows: "Those who support this process say it makes us more independent from foreign oil and creates jobs. Those who oppose this process say it contaminates community water supplies and the environment. Which do you think is more important: Making us more independent from foreign oil or preserving water supplies and the environment?" *Id.*

117 The preference breakdown for upstate residents was similar to the statewide preference breakdown on this question. *Id.*

118 Towns that do not lie on a shale basin may still adopt fracking bans or moratoria, but their actions may be driven more by the consumption value of the action than by the expected costs and benefits of the action. *Id.* In fact, there were six towns that adopted an anti-fracking measure during the sample period that were excluded from this analysis because the towns do not lie on a shale formation. *Id.*

119 This decision rule excluded towns in the following counties: Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Hamilton, Nassau, Putnam, Rensselaer, Richmond, Rockland, Saratoga, St. Lawrence, Suffolk, Warren, Washington, Westchester, and New York City counties (Bronx, Kings, New York, and Queens). *See infra* Table 1 and Note.

120 *Fracking Bans and Moratoria in NY*, FRACTRAKER ALL., https://perma.cc/9PFD-P4QQ (last updated Oct. 9, 2017). My research has led me to make a few changes to the initial categorizations of the FracTracker Alliance.

fracking actions with original documents from the Food and Water Watch website[121] and town websites. Of these 688 towns, 57 adopted fracking bans and 123 adopted fracking moratoria during the study period. Table 4 summarizes the types of actions that I identified per year.

Most of the fracking bans were adopted as amendments to (or new versions of) local zoning laws under the towns' home-rule authority. Typically, the towns enacted language to clarify or reiterate that horizontal drilling and fracking in particular (*e.g.*, Camillus) or all natural gas activities generally (*e.g.*, Lumberland) were incompatible land uses in all zoning districts.[122] In some cases, the town also listed reasons for its actions. For example, the town of Tusten explicitly wrote that the law was "intended to protect drinking water supplies."[123] One exception was the town of Wales, which enacted its ban as a rights-based ordinance instead of a zoning local law, asserting the right of the community to protect its environment from harmful activities.[124] Specifically, the town cited "the inherent right of the residents of the Town of Wales to govern and protect their own community" as the authority for its ban and noted that the town "relie[d] exclusively on the existence and usage of natural well water as its sole source of water."[125] In Table 2, I provide detail on some of the language used by towns that banned fracking in 2010 or 2011. Towns that banned fracking in 2012 or 2013 used similar language.

I defined anti-fracking moratoria as temporary bans on natural gas exploration, extraction, and production activities that ranged in duration from three months (Onondaga) to until proven safe (Westmoreland), although the most common duration was one year.[126] These moratoria were often extended or renewed, though some town boards allowed moratoria to expire. The towns often explicitly noted that the moratoria address matters of local concern and were enacted pursuant to the towns' home-rule authority. Many towns also cited environmental and, in particular, water concerns as reasons for adopting moratoria. For example, the town of Avon noted that "[m]any residents [were] dependent upon aquifers and wells for life sustaining water [and] maintaining the quality of water resources within the Town [was] critical to protecting the natural environment of the Town, the general health and welfare of Town residents, and the local economy."[127] Twenty-seven towns that adopted a ban on fracking activities between 2010 and 2014 had previously adopted a moratorium on fracking.

For my analysis, I created separate variables for bans and moratoria because these actions were vastly different in scope and effect, especially in

121 *Local Resolutions Against Fracking*, *supra* note 8.

122 *See infra* Table 2.

123 Town of Tusten Zoning Law, art. XIV § 14.3 (4) (2011), https://perma.cc/48XU-PKJ6.

124 *See infra* Table 2.

125 TOWN OF WALES, N.Y. CODE § 162-1 (2018).

126 *See infra* Table 3. The adopted duration of 72% of moratoria was twelve months.

127 Moratorium on and Prohibition of Gas and Petroleum Exploration and Extraction Activities Underground Storage of Natural Gas and Disposal of Natural Gas or Petroleum Extraction Exploration and Production Wastes, Town of Avon Local Law No. T-A-5-2012, https://perma.cc/RG7V-VB2L.

light of the state's moratorium on fracking. According to Table 4, the number of towns adopting moratoria peaked in 2012 and declined in 2013. In addition, twenty-seven towns that adopted moratoria switched to a ban.

Next, I generated variables to capture the value of clean water to each town's residents. As discussed briefly in Part II, the potential for water contamination is a high-priority issue in public fracking discussions.[128] The expected damages from any contamination depend on the value of the town's water resources, which may become polluted. Water risks are especially important in New York because so many residents rely on private well water.[129] Private wells are not inspected, treated, or otherwise regulated by the state, making residents and livestock more vulnerable to negative health effects of any contamination.[130] In addition, agriculture is a large and important industry for many towns in upstate New York.[131] Because of this, residents (or agricultural interest groups) might also be concerned about water quality for crop irrigation purposes.

To construct variables reflecting the value of clean water across towns, I collected county-level and town-level data on water use.[132] The county-level data come from the United States Geological Survey for the year 2005.[133] These data contain estimates of the total population served by the public water supply in each county, and I used this information to construct a measure of the proportion of the population that relies on private water wells in each county. I also constructed estimates of the million gallons of water privately withdrawn from groundwater and surface water sources each day for livestock and crop-irrigation use from these data.

I also created town-level variables that reflect the number of domestic drinking water wells and agricultural wells drilled in each town since April 2000. I obtained these data from NYSDEC, after submitting a request via New York's Freedom of Information Law.[134] I treated all wells categorized as

128 *See supra* Part II.

129 *See Groundwater Supply and Use*, NAT'L GROUNDWATER ASS'N, https://perma.cc/2RZR-P2BV (last visited Nov. 25, 2018) (stating New York has the fourth-highest number of households served by private water wells).

130 Three studies have connected reliance on private water wells near shale development to negative property-value effects. *See* Sathya Gopalakrishnan & H. Allen Klaiber, *Is the Shale Energy Boom a Bust for Nearby Residents? Evidence from Housing Values in Pennsylvania*, 96 AM. J. AGRIC. ECON. 43, 44 (2014); Lucija Muehlenbachs et al., *Shale Gas Development and Property Values: Differences Across Drinking Water Sources* 30–31 (Nat'l Bureau of Econ. Research, Working Paper No. 18390, 2012); Caroline Cecot, *Property Values and Risks: Evidence from Shale Development*, 1–2 (George Mason Univ. Law & Econ. Research Paper Series 17–39, 2017), https://perma.cc/W42K-8AZJ. At least one study links cases of illness and death among farm animals and other wildlife to contamination from nearby shale development. *See* Michelle Bamberger & Robert E. Oswald, *Impacts of Gas Drilling on Human and Animal Health*, 22 NEW SOLUTIONS 51, 51–52, 54, 72 (2012).

131 THOMAS P. DINAPOLI, OFFICE N.Y. STATE COMPTROLLER, AGRICULTURE IN NEW YORK STATE (2018), https://perma.cc/6QAG-3Y48.

132 *See infra* Table 3 (providing summary statistics).

133 *Estimated Use of Water in the United States County-Level Data for 2005*, U.S. GEOLOGICAL SURV. (Dec. 9, 2016), https://perma.cc/PL9N-VM7B (follow "New York County data file" hyperlink).

134 *See* N.Y. PUB. OFF. LAW § 84–85 (McKinney 2018).

iterations of "Domestic," "Drinking," or "Potable" as domestic water wells and summed these wells for each town. I treated all wells categorized as iterations of "Agricultural," "Farm," or "Irrigation" as agricultural or irrigation wells and summed these wells for each town. Although these data are not complete, they were the only town-level data on water-well reliance that I could find. I have no reason to suspect that the missing pre-2000 data would systematically affect town well totals in a way that is correlated with adopting anti-fracking actions, but unfortunately, the data contain many zero entries for towns.

In addition, I generated variables that measure the history of drilling in each town using data from the NYSDEC.[135] I calculated the number of vertical, horizontal, oil, and gas wells in each town that had a drilling, completion, permit-application, or permit-issue date that was before January 1, 2010. These variables could also approximate the presence and influence of industry groups in those towns.

I also approximated the proportion of active political party members in each town's population using county-level voter registration data for November 2008 from the New York Board of Elections.[136] A higher proportion of residents actively engaged in politics might be associated with a higher likelihood of engaging in collective action. I separated active membership into two groups—Democratic Party and Green Party members, and Republican Party members and Independents—because preferences about fracking tend to vary by political party, as demonstrated in the previously discussed polling results.[137] In particular, active Democrats and Greens are more likely to be attentive to environmental concerns associated with fracking.

In addition, I included an estimate of county-level recycling rates, as measured by a representative national survey administered by Knowledge Networks.[138] This variable would capture both environmental preferences and, because recycling rates are influenced by targeted state and local programs,[139] the prior successful adoption of environmentally favorable policies. Towns with a high proportion of environmentalists might have residents with a high consumption value of banning fracking or with strong connections to environmental organizations.[140]

135 *See infra* Table 3 (providing summary statistics).

136 *Id.*

137 I grouped active Green Party members with active Democrats, and I grouped active Independents with active Republicans. The qualitative results remain the same when I omit Greens and Independents, group them together, or include them separately.

138 The Knowledge Networks panel is based on probability sampling of both online and offline populations, providing the necessary hardware and Internet access if a respondent does not have access to a computer or the Internet. These data were purchased by Vanderbilt Law School.

139 W. Kip Viscusi et al., *Discontinuous Behavioral Responses to Recycling Laws and Plastic Water Bottle Deposits*, 15 AM. L. ECON. REV. 110, 112–13 (2013).

140 Thomas Fujiwara et al., *Habit Formation in Voting: Evidence from Rainy Elections*, AM. ECON. J., Oct. 2016, at 160–62, 185–86.

Finally, I matched each town to various demographic characteristics from the American Community Survey (ACS).[141] These characteristics include the median household income, the total population, the percent of the population under nineteen-years-old, the percent of the population that is African American, the percent of owner-occupied homes, the percent of the population twenty-five-years and older that only completed high school, and the percent of the population twenty-five-years and older that have more than a high school degree. I also include a variable reflecting the percent of each town employed in the agriculture industry. The agriculture industry might be opposed to fracking for risk-based reasons, and this variable should pick up the industry's relative influence in each town. Unfortunately, however, the ACS includes "mining" in addition to agriculture, forestry, fishing and hunting industries in its "agriculture" category, which might affect the results, even though statewide about 90% of residents are employed in the non-mining industries within this category.[142] These data on demographic characteristics come from the ACS's five-year average estimates for 2006 to 2010, which provide town-level demographic characteristics before the adoption of the bans and moratoria in this study.

To test whether my empirical model predicts the adoption of a ban or a moratorium, I estimate the following cross-sectional equation based on observable data:

$$\Pr(B_i = 1) = \rho\big(Water'_{i,j}\alpha_1 + Drilling'_i\alpha_2 + Political'_j\alpha_3 + \alpha_4 Recycling_j + X'_i\alpha_5 + \varepsilon\big),$$

where the probability that town i in county j adopts a ban or a moratorium ($\Pr(B_i = 1)$) depends on a vector of measures of the town's vulnerability to risks to water ($Water_{i,j}$), a vector of variables representing the town's experience with oil-and-gas drilling and expectations for future drilling ($Drilling_i$), a vector of the proportion of the county's residents who are active members of relevant political parties ($Political_j$), the county recycling rate ($Recycling_j$), and a vector of town-level demographic characteristics (X_i).

Specifically, B_i is a binary variable equal to 1 if town i adopted a ban or, in other specifications, a moratorium. I use probit estimation, clustering standard errors at the county level and reporting marginal effects. I regress B_i on variables that proxy the relevant features of the town decision, based

141 *See infra* Table 3 (providing summary statistics).

142 The ACS provides more detailed statistics for the entire state, which show that the overwhelming majority of New Yorkers that fall into this category—about 90%—are employed in the agriculture industry as opposed to the mining industry. *See* ACS, SEX BY INDUSTRY FOR THE CIVILIAN EMPLOYED POPULATION 16 YEARS AND OVER, https://perma.cc/WL42-7V9W. Nonetheless, even though mining is a much smaller industry in New York as a whole, its inclusion in the variable is likely to affect the estimation of the coefficient and its standard error.

on my theoretical framework. The vector $Water_{i,j}$ includes variables that proxy the expected environmental and health costs of an adverse well event, particularly water-contamination risks, measured on either the county or the town level. This includes the proportion of county residents who rely on private water wells, the daily millions of gallons of water used in the county for livestock, and the number of private water wells and agricultural or irrigation wells drilled in the town since April 2000. I expect the coefficients on these variables to be positive, denoting an increased probability of adopting a ban or a moratorium.

The next vector, $Drilling_i$, includes town-level variables such as the number of oil-and-gas wells drilled in the town prior to 2010 and the number of horizontal well applications on file with NYSDEC prior to 2010. These variables show the history of oil-and-gas drilling in each town, and previous experience with oil-and-gas drilling could be related to residents' perceptions of the risks of shale development. In addition, the variables could approximate the presence and influence of industry groups in the area, directly contributing to Z_i in the model or indirectly affecting residents' risk perceptions and, therefore, their preferences. If so, then I expect the coefficients, summarized in vector α_3 to be negative—indicating a lower likelihood of adopting a ban.

Next, $Political_j$ is a vector of county-level variables that indicate the proportion of the county's residents who are active members of the Democratic, Republican, and other parties. These variables reflect both preferences and the ease of collective action. I expect the coefficient on the proportion of active Republicans to be negative while the coefficient on the proportion of active Democrats to be positive.

Finally, I include a vector of town-level demographic characteristics X_i, specifically the median household income, the town population, the percent of the population twenty-five-years and older that graduated only high school, the percent twenty-five-years and older that graduated with more than a high school degree, the percent under nineteen-years-old, the percent that is African American, the percent of owner-occupied homes in the town, and the percent employed in the agriculture industry.

VI. RESULTS

In Table 5, I summarize the main results for the adoption of a ban. I find that relative exposure to water risks plays a robust role in predicting the adoption of bans. In the decision to adopt a ban on fracking, towns in counties with a higher proportion of their population relying on private water wells and those in counties that use more water for livestock are associated with a statistically significant higher probability of adopting a ban. A higher number of private water wells within the town is also associated with a higher probability of adopting a ban. Increased reliance on water for agriculture, whether measured by crop irrigation withdrawals in the county or by the number of agricultural wells in the town, was not associated with a statistically significant increased probability of adopting a

ban. These results are consistent with the idea that towns adopt bans due to concerns about risks to people and livestock, but not to crops.[143]

Meanwhile, towns with previous oil-and-gas development and towns that anticipate operator interest in horizontal development are associated with a statistically significant lower probability of adopting a ban. These results suggest the role of experience in diminishing perceptions of expected environmental damages (cost-benefit story) or the pro-fracking influence of industry in these towns (interest-group story).

In addition, I find evidence that organized preferences matter. Towns in counties with a higher proportion of Democrats and Greens are associated with a statistically significant higher probability of adopting a ban, while those with a higher proportion of Republicans and Independents are associated with a statistically significant lower probability of adopting a ban. Towns in counties with high recycling rates are also more likely to ban fracking.

I also find that demographic characteristics, with a few exceptions, predict ban enactment. I find that towns with a higher percent of residents with only a high school degree are associated with a statistically significant lower probability of banning fracking, while towns with a higher percent of residents with more than a high school degree are associated with a statistically significant higher probability of adopting a ban. I also find that towns with a higher percent of young residents are associated with a statistically lower probability of banning fracking. These results are likely driven by the relative attractiveness of oil-and-gas jobs to those who have only a high school degree. Most oil-and-gas jobs only require a high school degree (or equivalent), provide on-the-job training, and pay well.[144] There is already concern that high school graduates in shale-gas-rich areas will forego college for lucrative oil-and-gas jobs.[145] Those with more education and those who are older, on the other hand, tend to have other employment options. In addition, towns with a higher percent of owner-occupied homes are associated with a statistically significant higher probability of adopting a ban. When owners live elsewhere, they could reap the rewards of fracking activities by collecting rental and royalty payments without facing the costs. Those who live on their properties, however, would have to tolerate the costs of shale development. I also find statistically significant and negative associations between median income and town population and the probability of adopting a ban. My results are consistent with New York polling data that indicates that support for fracking is higher among higher

143 That said, the probability associated with each additional water risk exposure, all else equal, is low. In this empirical specification, the coefficients represent the marginal effect of increasing the independent variable by one unit evaluated at the mean of each of the variables. Summing effects, the likelihood of adopting a ban, holding the other variables constant, rises by roughly 1% for a one standard deviation increase in the proportion of county residents relying on well water, in the daily livestock water withdrawals in the county, and in the number of private water wells within the town.

144 *See Drilling or a College Diploma*, SHALE STUFF (May 14, 2013), https://perma.cc/WNZ6-R746.

145 *Id.*

income groups. And, to the extent that NIMBY-based behavior is associated with more affluent communities, this result cuts against NIMBY-ism as a dominant source of fracking resistance. As to population size, as the size of the town's population increases, the ease of organizing against fracking decreases, making towns with large populations face higher costs to banning fracking.

Interestingly, I do not find any statistically significant effect of higher percent of unemployed residents and higher percent employed in the agriculture industry on ban adoption. The latter result is likely related to the ACS's inclusion of the "mining" industry in addition to "agriculture, forestry, fishing and hunting" industries in its agriculture variable. Those employed in the "mining" industry are likely to have different views on whether to ban fracking, and although smaller, the mining industry may be more motivated on the issue, making it difficult to estimate any effect. That said, the coefficients for variables that reflected the size and water-risk exposure of the agriculture industry in New York are similarly statistically insignificant, suggesting that fracking might not have been a high-priority issue for the agriculture industry.

Finally, I find that towns with a higher percentage of African American residents are associated with a statistically significant higher probability of adopting a ban. Studies have found that African Americans are more likely to be exposed to poor water quality,[146] and, for this reason, they may have stronger concerns about the water-contamination risks of nearby fracking activities. For example, W. Kip Viscusi, Joel Huber, and Jason Bell have documented that African Americans are more likely than others to drink bottled water because they perceive bottled water to be safer.[147] The opposition of African American residents to fracking could be related to fears about further deterioration in water quality. To test whether the opposition of African American residents might be driven by water-risk vulnerability, I interacted the percent African American variable with the number of private water wells in each town. These results are summarized in Table 6. I found that the coefficient on this interaction term is positive and statistically significant. In fact, after controlling for the increased vulnerability to risks to water faced by African-American residents, towns with a higher percent of African American residents are no longer more likely to ban fracking. This result supports the idea that African American opposition to fracking activities can be explained by their vulnerability to and concerns about the risks of low-quality water.

146 *See* U.S. DEP'T OF HOUSING & URBAN DEV., H150/09, AMERICAN HOUSING SURVEY FOR THE UNITED STATES: 2009 18 (2011), https://perma.cc/R8PN-4A5W. The water crisis in Flint, Michigan, a majority-African American city, provides one prominent example. Due to a change in water source and mismanagement by local, state, and federal government officials, Flint residents were exposed to severely elevated lead levels in their drinking water. *See* FLINT WATER ADVISORY TASK FORCE, FINAL REPORT 15–21 (2016), https://perma.cc/QYT5-TL7W.

147 W. Kip Viscusi et al., *The Private Rationality of Bottled Water Drinking*, 33 CONTEMP. ECON. POL'Y 450, 464–65 (2014).

Next, I present the results for the adoption of moratoria in Table 7. I found that towns in counties that have a higher recycling rate—the variable that proxies for environmental preferences—are associated with a statistically significant higher probability of adopting a moratorium. Meanwhile, towns with a greater history of drilling, towns with a higher percent of residents with only a high school degree and, unexpectedly, towns with a higher number of agricultural wells are associated with a statistically significant lower probability of adopting a moratorium. All other results for moratoria adoption are statistically insignificant.

The results suggest that an alternative theoretical framework—and not one based on an evaluation of benefits and costs—may better explain moratoria adoption.[148] It is worth noting that a local moratorium would become meaningful in New York only if the state lifted its moratorium on shale development during the relatively short lifetime of the town's moratorium. As these moratoria were often only in effect for a few months, any real effect on mitigating perceived net costs of fracking was unlikely. Moratoria adoption, then, could be seen as the adoption of a "wait-and-see" approach. It could eventually lead to a decision based on perceived costs and benefits of shale development—perhaps after the town gathers more information—but it is not necessarily based on the current perception of costs and benefits. But if the town's residents already had any real concerns about the negative effects of fracking, they would pressure their town board to adopt a ban instead of a moratorium. In that sense, it is also possible to view moratoria adoption as purely symbolic gestures of support for the anti-fracking movement. Under either account, it is not surprising that some of the strongest predictors of moratoria adoption are the variables indicating previous drilling experience, which proxies for industry influence and local knowledge and experience, and the county recycling rate, which proxies for environmental preferences.

VII. CONCLUSION

Across the United States, local governments and states have adopted measures to restrict the use of fracking within their borders, hindering a national energy policy that relies on continued access to natural gas trapped within shale formations.[149] In particular, before New York banned fracking, more than one hundred New York towns restricted fracking within their borders.[150] This Article empirically investigates what predicts these local decisions. Overall, I find that vulnerability to risks to water played a robust role in the decision to adopt a ban on fracking activities. Towns with more

148 In robustness checks, I found that results for shorter moratoria were more similar to the results for bans, possibly because shorter moratoria were associated with subsequent ban adoption.

149 *See New Energy Institute Report Finds that U.S. Could Lose Nearly 15 Million Jobs If Hydraulic Fracturing Is Banned*, GLOBAL ENERGY INST., https://perma.cc/4KUZ-4ENA (discussing the impact of fracking bans on U.S. energy policy).

150 *See infra* Table 4.

residents that rely on wells for drinking water or for the needs of healthy livestock were associated with a statistically significant higher probability of adopting a ban. In addition, industry presence and previous experience with drilling tended to decrease the probability that a town adopted a ban. Finally, environmental preferences, demographic characteristics, and organized political interests also predicted whether a town adopted a ban. These variables, however, did not consistently predict moratoria adoption.

Towns have a variety of tools available to them to address emerging risks. Deploying a tool such as a local moratorium, especially in light of a statewise moratorum, is unlikely to have immediate consequences. Deciding to impose a ban, in contrast, is more likely to have some near-term consequences and therefore more likely to reflect careful consideration. The results suggest that such town decisions are more likely to be associated with the perceived costs and benefits of fracking. In other words, the results are consistent with the idea that New York town residents, especially those that rely on their water sources, appeared unconvinced that the proposed NYSDEC regulations would sufficiently protect their water sources from contamination and, in the case of contamination, provide adequate assurances of compensation and remediation.

There are three potential implications worth discussing. First, the pattern of results suggests that, outside of the New York context, decisions to ban fracking might be even more strongly associated with perceived costs and benefits. The New York results are confirmation that, even when the stakes, overall, are relatively weak, the perceived costs and benefits to local communities might still matter—but only in the context of a potentially consequential final determination. And in areas where fracking is not otherwise on hold for analysis, the stakes are higher and the consequences of banning, or even pausing, development are more immediate—simply put, reasoned decision making is even more valuable.

Second, although the analysis suggests that town residents were acting rationally, basing their decisions on their exposure to perceived costs and benefits, it tells us nothing about whether their perceptions of the risks of fracking were accurate and whether local control of fracking is desirable. On one hand, research suggests that people are prone to various biases that lead them to overreact to certain risks.[151] If these biases play a role in evaluating the risks of fracking, then local governments, presumably most responsive to people's preferences, may be ill-suited to regulating such risks. On the other hand, local communities know the most about their surroundings; they are likely to have information—such as the locations of nearby private drinking water wells—that would be helpful to regulators who are evaluating specific permit applications.

Finally, the results lend support to state efforts to reduce local opposition by facilitating responsible shale development. Ideally, states would incorporate feedback from local governments in their efforts to

151 *See, e.g.*, Spence, *Local Vetoes*, *supra* note 19, at 412 (discussing some of these biases in the context of fracking); Spence, *Responsible Shale Gas Production*, *supra* note 38, at 174–85 (discussing the potential impact of biases with respect to fracking on policymaking).

develop comprehensive risk-mitigation systems. The resulting systems should also strive to strike the right balance between the importance of providing comprehensive environmental protection and the importance of innovation in this area. In particular, states should consider all tools at their disposal, possibly making use of liability standards and insurance mandates along with tailored risk-based regulations.[152] Together, these tools could create incentives for optimal activity levels, acceptable risk-taking, and comprehensive environmental protection against all categories of harms to water as shale development continues to evolve and expand.

[152] For proposals for regulating fracking, see, *supra*, note 34.

VIII. TABLES

Table 1. Towns Adopting Bans or Moratoria in Counties on Shale Formations, 2010 to 2013.

Bans		Moratoria		
Andes	Milford	Alfred	Hopewell	Palatine
Augusta	Moravia	Andes	Huron	Paris
Bethel	New Hartford	Annsville	Italy	Penfield
Brighton	New Lisbon	Augusta	Jerusalem	Portage
Butternuts	New Paltz	Ava	Kirkland	Preble
Camillus	Niles	Avon	LaFayette	Remsen
Caroline	Olive	Barrington	Lansing	Rensselaerville
Cherry Valley	Onondaga	Benton	Ledyard	Richmond
Danby	Otisco	Berne	Lenox	Richmondville
DeWitt	Otsego	Blenheim	Lima	Rush
Dryden	Paris	Boonville	Lincoln	Sangerfield
Elbridge	Perinton	Brighton	Little Falls	Schoharie
Enfield	Plainfield	Bristol	Livonia	Scipio
Forestburgh	Pompey	Brookfield	Locke	Sennett
Fulton	Rochester	Burns	Manchester	Seward
Geneva	Roseboom	Butternuts	Manheim	Sidney
Guilderland	Rosendale	Caledonia	Marbletown	Skaneateles
Highland	Rush	Camden	Marcellus	South Bristol
Ithaca	Skaneateles	Canandaigua	Marshall	Spafford
Jerusalem	Spafford	Caroline	Mendon	Sparta
LaFayette	Springfield	Chester	Middleburgh	Springwater
Lumberland	Summerhill	Colden	Middlesex	St. Johnsville
Marbletown	Tusten	Conesus	Milo	Stafford
Marcellus	Ulysses	Cortlandville	Minden	Starkey
Marshall	Wales	Danube	Moravia	Torrey
Mendon	Warwick	DeWitt	Mount Morris	Trenton
Meredith	Wawarsing	Deerfield	Naples	Tully
Middlefield	Woodstock	Eaton	New Hartford	Vernon
		Elbridge	Newfield	Verona
		Enfield	Newport	Vienna
		Fabius	Niles	Wales
		Florence	Niskayuna	Waterloo
		Floyd	North	Wayne
		Forestport	Dansville	West Bloomfield
		Fulton	Nunda	West Sparta
		Geneseo	Olive	Westerlo
		Genoa	Oneonta	Westmoreland
		Gorham	Onondaga	Whitestown
		Hartwick	Otego	Yorkshire
		Highland	Otisco	
			Owasco	

Notes. This list does not include towns in counties without known shale reserves.

Table 2. Sample Detail on Town Bans.

Town	Type	Prohibition
Camillus	Zoning	"The exploration of land for natural gas by horizontal drilling and hydraulic fracturing" is a prohibited use in all districts.
Cherry Valley	Zoning	"Heavy industry" is prohibited in all districts, and the definition of heavy industry includes "exploration for natural gas; extraction of natural gas; natural gas processing facilities."
Danby	Zoning	Added a section on the "prohibition against the exploration for or extraction of natural gas and/or petroleum."
Dryden	Zoning	Clarifying that oil and gas development activities, including fracking, were prohibited uses of land within the town.
Ithaca	Zoning	Clarifying that natural gas exploration, extraction, and related operations could not interpreted as allowable uses in the "light industrial zone."
Lumberland	Zoning	Natural gas exploration, extraction, and related operations are listed as explicitly prohibited uses in all districts.
Middlefield	Zoning	Heavy industry and all oil, gas, or solution mining and drilling are prohibited uses in all districts.
New Lisbon	Zoning	Unlawful for any person to conduct "heavy industry" within the town, with the definition of heavy industry including exploration for natural gas; extraction of natural gas; natural gas processing facilities, among other things.
Plainfield	Zoning	"Heavy industry" is prohibited in all districts, with the definition of heavy industry including exploration for natural gas; extraction of natural gas; natural gas processing facilities, among other things.
Springfield	Zoning	Unlawful for any person to conduct "heavy industry" within the town, with the definition of heavy industry including exploration for natural gas; extraction of natural gas; natural gas processing facilities, among other things.
Tusten	Zoning	Activities expressly and explicitly prohibited in any zoning district include natural gas exploration, extraction, or production activities.
Ulysses	Zoning	Natural gas exploration, extraction, and support activities are not permitted in any zoning district.
Wales	Rights-Based Ban	"It shall be unlawful for any individual or corporation to engage in the extraction of natural gas or oil utilizing in whole or in part the process commonly known as and herein defined as hydraulic fracturing within the Town of Wales ."

Notes. The assorted bans detailed above were adopted in 2010 or 2011. Later bans tended to use similar language.

Table 3. Summary Statistics – New York Towns, in Counties on Shale Formations.

Variables	Obs.	Mean	Std. Dev.
Legislative Actions			
Adopted a ban on fracking activities, 2010-2013 (0/1)	688	0.081	0.274
Adopted a moratorium on fracking activities, 2010-2013 (0/1)	688	0.173	0.378
Adopted a ban or moratorium on hydraulic fracturing activities, 2010-2013 (0/1)	688	0.215	0.411
Adopted duration of moratoria, in months*	116	11.250	3.501
Water Variables			
Proportion Relying on Well Water, by county	688	0.326	0.183
Livestock Withdrawals, Million Gallons per Day, by county	688	0.672	0.398
Crop Irrigation Withdrawals, Million Gallons per Day, by county	688	0.323	0.376
Domestic Water Wells, by town (count)	688	65.201	71.944
Agriculture or Irrigation Wells, by town (count)	688	0.443	3.217
Drilling Variables			
Vertical Well Development, before 2010 (count)	688	46.190	216.700
Horizontal Well Development, before 2010 (count)	688	0.544	2.880
Gas Well Development, before 2010 (count)	688	13.330	40.370
Oil Well Development, before 2010 (count)	688	16.010	139.800
Political Variables (county level)			
Proportion Active Democrats, Nov. 2008	688	0.243	0.093
Proportion Active Republicans, Nov. 2008	688	0.296	0.055
Proportion Active Independents, Nov. 2008	688	0.032	0.008
Proportion Active Green Party, 2008	688	0.002	0.001
Recycling Variable (county level)			
Recycling Rate, by county	688	0.761	0.102
American Community Survey (5-year, 2006-2010)			
Median Household Income	688	52,028	11,517
Total Population Estimate	688	6,180	10,920
% Age 25+ w/ High School Degree Only	688	37.740	8.477
% Age 25+ w/ More than a High School Degree	688	49.935	11.455
% Unemployed	688	6.903	3.028
% African American	688	2.360	4.114
% Under 19 Years Old	688	25.740	4.861
% Owner-Occupied Housing	688	80.604	8.735
% Employed in Agriculture Industry	688	3.958	4.081

Notes. This list excludes towns in counties without known shale reserves.
* Excludes moratoria that did not specify a duration. The longest duration specified was thirty-six months (in Niskayuna).

Table 4. Anti-Fracking Actions Adopted per Year.

	Bans	Moratoria
2010	2	8
2011	13	33
2012	21	75
2013	21	7
Total	57	123

Table 5. Main Results for Bans in New York Towns, Cross-Sectional Probit (reporting marginal effects).

Variables	Coefficient	Std. Errors
Water Variables		
Proportion Relying on Private Well Water, by county	0.015*	(0.009)
Livestock Private Withdrawals, by county	0.009**	(0.004)
Crop Irrigation Private Withdrawals, by county	0.00002	(0.004)
Domestic Water Wells/1,000	0.029***	(0.011)
Agriculture or Irrigation Wells/1,000	0.267	(0.209)
Drilling Variables		
Vertical Well Development/1,000	-0.128**	(0.052)
Horizontal Well Development/1,000	-3.802***	(1.118)
Political Variables		
Prop. Active Democrats/Greens, by county	0.079***	(0.027)
Prop. Active Republicans/Independents, by county	-0.063*	(0.034)
Recycling Variable		
Recycling Rate, by county	0.056***	(0.019)
Demographic Variables		
Logarithm of Median Income	-0.013*	(0.007)
Logarithm of Town Population	-0.003***	(0.001)
% Age 25+ w/ High School Degree Only/1,000	-0.580**	(0.283)
% Age 25+ w/ More than a High School Degree/1,000	0.413***	(0.153)
% Unemployed/1,000	-0.017	(0.318)
% Under 19 Years Old/1,000	-0.560***	(0.168)
% African American/1,000	0.447**	(0.198)
% Owner-Occupied Homes/1,000	0.215*	(0.120)
% Employed in Agriculture Industry/1,000	-0.127	(0.282)
Observations	688	

Notes. Robust standard errors, clustered by county, in parentheses. Coefficients have been transformed to reflect the marginal effects on the probability of a ban.
*** p<0.01, ** p<0.05, * p<0.1.

Table 6. Results for Bans with Race-Risk Interaction, Cross-Sectional Probit.

Variables	Coefficient	Std. Errors
Water Variables		
Proportion Relying on Private Well Water, by county	0.015	(0.010)
Livestock Private Withdrawals, by county	0.010**	(0.004)
Crop Irrigation Private Withdrawals, by county	0.001	(0.004)
Domestic Water Wells/1,000	0.023*	(0.014)
Agriculture or Irrigation Wells/1,000	0.328	(0.282)
Drilling Variables		
Vertical Well Development/1,000	-0.135**	(0.055)
Horizontal Well Development/1,000	-3.971***	(1.115)
Political Variables		
Prop. Active Democrats/Greens, by county	0.083***	(0.029)
Prop. Active Republicans/Independents, by county	-0.061*	(0.036)
Recycling Variable		
Recycling Rate, by county	0.062***	(0.021)
Demographic Variables		
Logarithm of Median Income	-0.014*	(0.008)
Logarithm of Town Population	-0.003**	(0.001)
% Age 25+ w/ High School Degree Only/1,000	-0.577*	(0.342)
% Age 25+ w/ More than a High School Degree/1,000	0.479**	(0.188)
% Unemployed/1,000	-0.047	(0.345)
% Under 19 Years Old/1,000	-0.598***	(0.195)
% African American/1,000	0.005	(0.408)
% Owner-Occupied Homes/1,000	0.194	(0.140)
% Employed in Agriculture Industry/1,000	-0.067	(0.290)
Interaction Domestic Water Wells x % African American	0.024*	(0.014)
Observations	688	

Notes. Robust standard errors, clustered by county, in parentheses. Coefficients have been transformed to reflect the marginal effects on the probability of a ban.
*** p<0.01, ** p<0.05, * p<0.1.

Table 7. Main Results for Moratoria in New York Towns, Cross-Sectional Probit.

Variables	Coefficient	Std. Errors
Water Variables		
Proportion Relying on Private Well Water, by county	-0.244	(0.214)
Livestock Private Withdrawals, by county	0.090	(0.069)
Crop Irrigation Private Withdrawals, by county	-0.025	(0.066)
Domestic Water Wells/1,000	0.033	(0.257)
Agriculture or Irrigation Wells/1,000	-39.025	(23.806)
Drilling Variables		
Vertical Well Development/1,000	-0.840**	(0.405)
Horizontal Well Development/1,000	-8.051	(6.286)
Political Variables		
Prop. Active Democrats/Greens, by county	0.126	(0.335)
Prop. Active Republicans/Independents, by county	0.060	(0.457)
Recycling Variable		
Recycling Rate, by county	0.592**	(0.245)
Demographic Variables		
Logarithm of Median Income	-0.031	(0.108)
Logarithm of Town Population	-0.010	(0.018)
% Age 25+ w/ High School Degree Only/1,000	-12.003***	(3.222)
% Age 25+ w/ More than a High School Degree/1,000	-3.612	(2.622)
% Unemployed/1,000	-2.663	(5.595)
% Under 19 Years Old/1,000	-4.037	(2.920)
% African American/1,000	-6.056	(4.352)
% Owner-Occupied Homes/1,000	0.550	(1.423)
% Employed in Agriculture Industry/1,000	1.535	(4.861)
Observations	688	

Notes. Robust standard errors, clustered by county, in parentheses. Coefficients have been transformed to reflect the marginal effects on the probability of a moratorium.
*** p<0.01, ** p<0.05, * p<0.1.