

RFF REPORT

Public Education Impacts of Unconventional Oil and Gas Development

Laura Zachary and Nathan Ratledge

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Resources for the Future (RFF) is an independent, nonpartisan organization that conducts rigorous economic research and analysis to help leaders make better decisions and craft smarter policies about natural resources and the environment.

Summary

This report reviews the resource economics literature examining the effect of unconventional oil and gas development on public education via three main channels—student population, school finances, and the labor market.

- In all, 15 studies were reviewed, covering the following education impacts: student enrollment and demographics, student-teacher ratios, school finances (changes to revenue and expenditure streams), and educational attainment (graduation rates, completion rates, and dropout rates).
- A limited number of studies specifically examine the relationship between unconventional oil and gas development and public education outcomes.
- Existing literature that pools data across many plays masks interpretation of the impacts that clearly vary substantially across states; research that distinguishes across individual states appears far more telling.
- This literature review finds diverging trends in student enrollment in boom districts across western states such as Texas, North Dakota, and Montana seeing increases in student enrollment and yet a decrease in student numbers in eastern states such as Pennsylvania, Ohio, and West Virginia.
- Funding per student and the resulting impacts on education vary based on the ability for districts to tax oil and gas based on production, how these taxes interact with state education funding formulas, local pressures on how to spend revenue windfalls and the spending and saving restrictions for school districts within a state.
- Substantial revenue coming in relatively rapidly due to resource booms leads to

volatility and uncertainty in school finances that further impacts the ability of districts to strategically use increased funding to improve student outcomes. Without knowing if increased revenues would continue in the future, districts cannot commit to permanent expenditures such as increases to teacher salaries.

To draw conclusions about the net effect of unconventional oil and gas development on educational outcomes as well as inform decisions to help mitigate and harness, respectively, the potential negative and positive impacts on public education, policymakers need more research and analysis that employ a combination of statistical and qualitative methods.

Community Risk-Benefit Matrix

The Community Risk-Benefit Matrix identifies specific areas of concern related to impacts addressed by the team’s literature review (left column of the matrix below), as well as impacts for which RFF experts have conducted original research and analysis. (See page 3 for the section of the matrix related to this review, on the public education impacts of unconventional oil and gas development.)

The matrix indicates the quality of the literature for each impact, judged subjectively with the color indicating whether we find the studies analyzing an impact to be, on average, of a certain quality. Impacts may be assessed by multiple low-quality studies and a medium-quality study, for example, and we would consider this body of literature to be low quality. A high-quality classification indicates that we trust the results of such studies, including the accuracy, magnitude, and direction of the results—meaning, in a practical sense, that it has no serious or fatal flaws (such as inadequate methodologies) that would lead us to question the results. A study is considered low quality if we believe we

cannot trust the results because the study has multiple, serious flaws (e.g., methodology, data, focus, or study design are inadequate to reliably estimate outcomes). A study is considered medium quality if it does not fit in the other two categories. A study is therefore medium quality if it has any such major flaw or if either the methodology, data, focus, or study design lead to questionable results for a number of reasons. Generally, we find the magnitude and direction of these results to be informative, but question the precision.

Lastly, we summarize the findings reported by the literature for each impact—whether the studies as a whole report increases, decreases, or no relationship between the impact and an increase in unconventional oil and gas development. The “heterogeneous” classification indicates that the literature reports different outcomes across areas. The “inconsistent” classification indicates that the literature reports contradictory results (i.e., two studies find an increase or decrease for a certain impact in the same context).

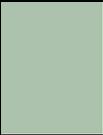
View or download the entire matrix, including all sections that correspond with each of the literature reviews by topic produced as part of this initiative:

[WHIMBY \(What’s Happening in My Backyard?\): A Community Risk-Benefit Matrix of Unconventional Gas and Oil Development](#)

COMMUNITY RISK-BENEFIT MATRIX LITERATURE REVIEW: PUBLIC EDUCATION IMPACTS OF UNCONVENTIONAL OIL AND GAS DEVELOPMENT

K-12 Education		
Impact	Findings	Results
Student-teacher ratio	↑↓	Large variation exists across regions. Increase in number of students per teacher found for Texas and North Dakota, yet significant decreases found in the Marcellus region. Appears to be led by change in student numbers and does not indicate a change in teachers.
Revenue	↑↓	Several higher-quality studies report large variation across regions with varying tax policies. One study found an increase in total revenue per pupil in the Marcellus, but a decrease in North Dakota.
Education expenditures	↑↓	Several higher-quality studies report large variation across regions. Increase in the Marcellus region, but decrease in North Dakota and Texas.
Capital expenditures	↑∅	Several studies analyzing different regions report differing results. One higher-quality study found increases for Texas and several studies found an increase for capital spending per pupil in North Dakota. However, no statistically significant association found for other regions.
Educational attainment	~	Two studies with data-related limitations (particularly for rural areas) report decreases. One study found no evidence of increased dropouts in the Marcellus region, Bakken region, or Colorado.
Performance	~	One study finds a number of mixed results across grades and subjects. One study finds slight decrease in student achievement in Texas.

KEY

	Higher quality: The majority of studies reviewed for an impact are of higher quality. Where there is one study of higher quality, it is marked as such.
	Medium quality: The majority of studies reviewed for an impact are of medium quality. Where there is one study of medium quality, it is marked as such.
	Lower quality: The majority of studies reviewed for an impact are of lower quality. Where there is one study of lower quality, it is marked as such.
	Not reviewed: Research on an impact was not reviewed.
↑	Increase: Studies show a positive, robust association with an impact (an increase in incidence or magnitude).
↓	Decrease: Studies show a negative, robust association with an impact (a decrease in incidence or magnitude).
↑↓	Heterogeneous: Across regions or areas, studies report robust results that differ.
∅	No association: Studies report results that showed no association.
~	Inconsistent: Studies report differing (contradictory) results.

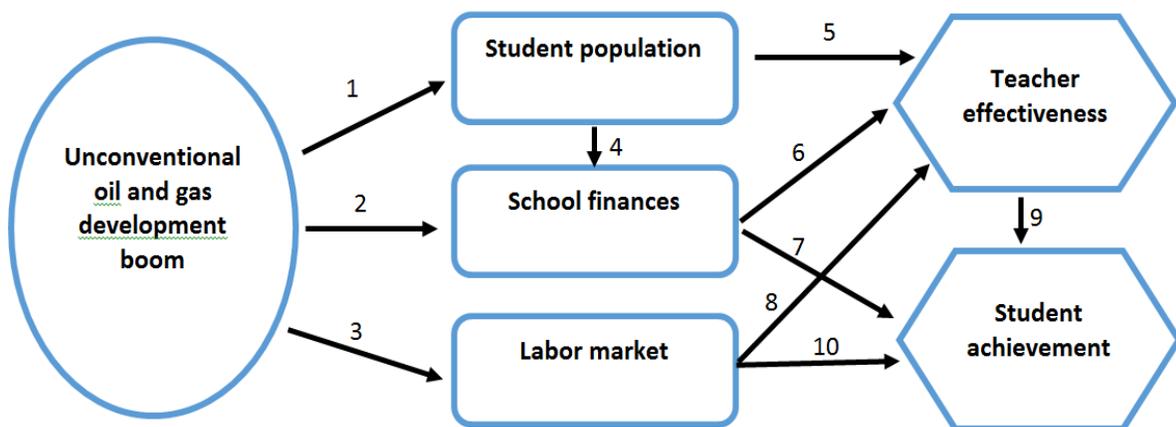
1. Introduction

Rapid resource development affects local communities through numerous channels that may impact public education. Figure 1 shows the three main channels explored in the existing literature—student population, school finances, and the labor market—and the possible pathways through each channel that link unconventional oil and gas development booms to student achievement in local communities.

First, the student population may change during a boom if an influx of workers with school-age children moves to a community (link 1 shown in Figure 1 below). Sudden increases in student populations may put greater strain on school resources by effectively lowering revenue per pupil (link 4 and then 7). If schools are unable to hire enough staff to meet the needs of new students while continuing to provide the same quality of education to students already in the community, student achievement may suffer (link 5 and then 9). However, if growth in revenue per student due to the boom outpaces required expenditures per student before the boom, funding windfalls may enable schools to hire and retain qualified teachers and offer more educational resources associated with increasing student achievement.

Second, state fiscal policies vary substantially in the way and degree that they distribute increased tax revenue from expanded oil and gas development to local school districts impacted by the boom (link 2). The resulting impacts to student achievement depend on the ways that states levy taxes on unconventional oil and gas, as well as whether or not state fiscal policy directs revenues to locations facing population growth and makes sufficient funds available in the time needed to maintain or build additional infrastructure as well as to provide services (link 6 and 9 or directly through link 7). Even if schools do receive more revenue per pupil, choices or funding policies may not promote spending in ways that effectively improve student achievement. Finally, a boom in unconventional oil and gas development results in higher wage competition (link 3) and greater labor demand in the oil and gas industry may pull teachers and students out of schools (links 8 and 10). A higher student-teacher ratio could, in turn, impact the ability of schools to provide quality education and thus harm student performance (link 9). If the demand for workers pulls students into the labor force directly, it could increase dropout rates and lower the educational attainment of people in the community (link 10).

FIGURE 1. LINKAGES FROM AN UNCONVENTIONAL OIL AND GAS DEVELOPMENT BOOM AND STUDENT ACHIEVEMENT IN LOCAL COMMUNITIES



Source: Adapted from Marchand and Weber (2015; Figure 1).

2. Gaps in Existing Literature

Understanding how such impacts might materialize is critical for local and state policymakers to help communities capitalize on the potential benefits of a resource boom as well as mitigate potential negative impacts on public education. Very few studies, however, specifically examine the relationship between unconventional oil and gas development and public education outcomes, or the mechanisms described in Figure 1, though a number of studies discuss education tangentially as part of larger economic analyses (see Table 1). Within resource economics literature, this lack of focus on public education outcomes associated with unconventional oil and gas development is in part related to limited historic discussion between resource economists and education experts. In addition, a limited amount of standardized education metrics makes legitimate comparisons of data across regions and years difficult.

The bulk of existing studies focused on education and unconventional oil and gas development either pursue solely qualitative work that highlights important issues but cannot measure the effects of development on education—or are heavily quantitative and miss out on important nuances that fail to appear in available data alone. To develop strategies for education systems aimed at capitalizing on the gains and mitigating the potentially harmful effects of booms in unconventional oil and gas development, decisionmakers must be able to understand the strength and direction of the linkages in Figure 1—as well as the nuances not captured in commonly reported education data. As such, a critical need exists for more research that employs a combination of statistical and qualitative methods to synthesize information and answer open questions.

The remainder of this report reviews the major literature on the various linkages depicted in Figure 1. Metrics covered include:

student enrollment and demographics, student-teacher ratios, school finances (changes to revenue and expenditure streams), and educational attainment (graduation rates, completion rates, and dropout rates). Taking a step back and looking at the literature as a whole, both statistical analysis and in-person interviews of education professionals in states experiencing major unconventional oil and gas development over the past decade reveal diverging trends in student populations, student-teacher ratios, as well as finances among school districts across states. For example, studies found an increase in student enrollment in boom districts across western states such as Texas, and in North Dakota and Montana in the Bakken and a decrease in student enrollment in eastern states including Pennsylvania, Ohio, and West Virginia in the Marcellus, discussed further in the next section.

3. Student Population

Education professionals in boom districts across all regions examined in the literature—Texas, Colorado, Montana, North Dakota, Ohio, Pennsylvania, and West Virginia—expressed initial concern that the booms would result in rapid increases of student populations and that rural districts would not be able to adjust swiftly enough to meet changing needs (Schafft, Kotok, and Biddle 2014; Ratledge and Zachary 2017). Employing both qualitative and statistical research methods, Ratledge and Zachary (2017) find that rapid growth in student enrollment occurred in the Bakken region, but opposite outcomes occurred in the Marcellus. In fact, whereas, North Dakota’s boom districts experienced an increase in student numbers, top boom districts across states in the Marcellus region had a statistically larger drop in student populations compared to non-boom districts.

TABLE 1. SUMMARY OF STUDIES REVIEWED

Study	Location	Analysis time period	Metrics	Methods
Ratledge and Zachary (2017)	ND, CO, MT, WV, PA, OH	2000/01–2014/15	Unconventional oil and gas development, student-teacher ratio, student population, school finances, educational attainment and outcomes	Difference-in-difference analysis of districts across 5 states and interview-based study in 6 states
Rickman, Wang, and Winters (2017)	Montana, North Dakota, and West Virginia	2006–2013	Unconventional oil and gas, educational attainment	Synthetic control method
Bartik et al. (2016)	9 shale plays across the United States	Varies by play, 1992–2013	Shale oil and gas, local level net welfare impacts	Difference-in-difference analysis with Rystad potential for fracking index
Genareo (2016)	Two districts in ND	2011–2012	Unconventional oil, transient students, student-teacher ratio, school finances; staff	Qualitative single-case study (interviews and classroom observations)
Weber et al. (2016)	Barnett shale region, TX	1997–2013	Shale gas, property tax base changes, school finances	Normalized difference and propensity score matching
Cascio and Narayan (2015)	Entire US shale reserve regions covering 30 of lower 48 states	2000–2013	Shale oil and gas, labor markets, dropout (student attainment), school finances, teacher attrition	Difference-in-difference Analysis with an instrumental variable and restricted event study estimates
Marchand and Weber (2015)	1,012 school districts in TX	2000–2013	Shale oil and gas, labor market, school finances, student-teacher ratio, teacher quality, and student achievement	Instrumental variable and fixed effects estimation
Schafft et al. (2014)	Marcellus shale region, PA	2011	Unconventional gas, education professionals' perceptions of community, economic, and education impacts	Interview and focus group. Using survey data conduct Kruskal-Wallis statistical significance test
Schafft, Kotok, and Biddle (2014)	Four top producing counties in PA	2000–2013	Shale gas, Student population, demographics, and achievement, school finances, dropout rates	Analysis of school district data and focus group surveys
Schafft and Biddle (2014)	Marcellus shale region, PA	2011–2013	Shale gas, educational and instructional decision making, uncertainty	Interview and focus group-based
Weber (2014)	Louisiana, Texas, Arkansas, and Oklahoma	1995–2010	Shale gas, educational attainment of adult population	Difference-in-difference analysis and two stage least-squares design
Kelsey et al. (2012)	Marcellus shale region, PA	2007–2010	Shale gas, school finances, student population, Special Education	Descriptive statistical analysis

Explaining the divergent trend in student enrollment in the Bakken versus the Marcellus regions is not straightforward as it is not necessarily the result of one dominant effect. Several plausible factors could each have contributed to the outcome. For example, it's reasonable to believe that given the extremely rural nature of northwest North Dakota, the size of complementary development (roads, services, restaurants, etc.) in the Bakken was simply that much larger than in the Marcellus as a region. In the Marcellus region, most of the districts with unconventional oil and gas development fell within a drive of 15 minutes to an hour to a larger town or city, whereas in North Dakota that drive may take an entire day. As a result, it seems likely that the existing population could not provide the labor force to fill oil jobs as well as others related to the complementary/secondary economy (such as in hospitality, public service, etc.). A final factor could have also been the higher actual or even expected value that comes from oil production as opposed to natural gas. The higher profit in oil may have encouraged more people to move with their children to the region for work in the oil industry.

3.1. Student Population and Student-Teacher Ratio

Researchers from Penn State University have published several survey-based analyses over the past decade, polling educators and school administrators in the Marcellus shale region regarding the opportunities and challenges facing their districts due to unconventional oil and gas development (Schafft et al. 2014; Schafft, Kotok, and Biddle 2014; Schafft and Biddle 2014; Kelsey et al. 2012). Despite concerns that the boom would bring a sudden influx of students to districts overlaying the Marcellus play, enrollments in these typically rural districts actually continued on the previous trajectory of a steady, long-term decline (Schafft, Kotok,

and Biddle 2014). Ratledge and Zachary (2017), Kelsey et al. (2012), and Schafft, Kotok, and Biddle (2014) all found a negative association between energy development and larger decreases in enrollments in Pennsylvania. Between 2005–2006 and 2010–2011 Schafft, Kotok, and Biddle (2014) found that the four top producing counties in Pennsylvania experienced a nearly 8 percent decline in student enrollment compared to a state average decline of around 2 percent. Ratledge and Zachary (2017) confirmed this finding, as summarized in Table 2. The authors estimate that top producing districts in Pennsylvania had on average between 14 and 21 fewer students enrolled in first through sixth grades (grouped in two-year cohorts) than non-boom districts at the end of the boom period measured in the study. In Ohio and West Virginia, also in the Marcellus region, Ratledge and Zachary (2017) found a larger drop in student populations compared to non-boom districts.

Less research has focused specifically on education impacts due to the boom in unconventional oil and gas development in the Bakken region. As shown in Table 2, Ratledge and Zachary (2017) found a rise in student enrollment numbers leading to an increase in the student-teacher ratio in North Dakota boom districts. Genareo (2016) is the only Bakken region-specific study found in this review. The study conducts an interview-based assessment of education in two top oil-producing districts in North Dakota. The study's investigation reported increasing concerns regarding transient students resulting in increases to staff workload and decreases in per-pupil funding.

TABLE 2. IMPACT OF UNCONVENTIONAL OIL AND GAS DEVELOPMENT ON STUDENT ENROLLMENT AND TEACHER POPULATIONS

	Student numbers	Student-teacher ratio
Marcellus	↓	↓
Pennsylvania	↓	↓
Ohio	–	–
West Virginia	↓	↓
North Dakota	↑	↑
Colorado (except Piceance)	–	+

Source: Ratledge and Zachary (2017).

Notes: Arrows imply statistical significance. +/– signs imply a trend direction but no statistical significance. Difference-in-difference regression runs show average results for boom districts (meaning school districts located in top 10% oil or gas producing areas) compared to non-boom districts. Runs dropped neighboring districts to control for spillover and to better isolate the effect of being a boom district versus a non-boom district on these outcomes.

3.2. Student Demographics

Schafft, Kotok, and Biddle (2014) looked at Pennsylvania, finding little evidence that an increase in unconventional oil and gas development is associated with changes in student demographics or other outcomes, such as changes in the number of English Language Learners (ELL) students or the share of students with special education accommodations. The study also finds that rates of students qualifying for free or reduced-price lunch programs increased at a lesser rate in top producing counties compared to counties in the rest of Pennsylvania. Examining all three states in the Marcellus region, Ratledge and Zachary (2017) found statistically significant decreases in the rate of students eligible to enroll in the free lunch program in boom districts compared to non-boom districts in both Pennsylvania and Ohio, suggesting that either students from lower-income families were driven out of the community due to increases in the cost of living or that average household income increased overall in these communities during the boom. In contrast, however, the authors did not find a statistically significant difference in the rate of students eligible to participate in free or reduced lunch programs in North Dakota due to the boom.

Ratledge and Zachary (2017) is the only study to combine extensive in-person interviews with statistical analysis of education impacts across multiple regions. The authors conducted interviews with teachers, school staff, administrators, school board officials, as well as state and nonprofit staff. The interviews revealed that additional students coming and going in the middle of a school year caused strain on school resources and that the official annual enrollment data, typically collected only once a year in mid-October, failed to capture these higher student turnover rates. Education professionals cited concern about increased numbers of transient students in Pennsylvania, Ohio, West Virginia, and Colorado during different stages of the boom; those in North Dakota and Montana in the Bakken region in particular stressed issues with high student turnover rates during the boom.

4. School Finances

Annual data from the National Center for Education Statistics' National Public Education Financial Survey, indicates that for most states, around 45 percent of public school funding comes from local revenue sources, 45 percent from state funds, and around 10 percent from the federal government (NCES 2017). The majority of

local funds come from property taxes (Turner et al. 2016). In most major oil- and gas-producing states, much of the property tax income going to counties and school districts comes from the value of the commodity itself (Raimi and Newell 2016). As such, a problem can arise when a community's property values and taxes become too dependent on these commodities, especially when prices decline. This dependence exacerbates issues of funding volatility and uncertainty for public schools, making it even more difficult for districts to plan ahead.

Examining all nine major producing regions, Bartik et al. (2016) found an increase in total school revenues that resulted from a 13 percent increase in property tax revenues as well as a 26 percent increase in all other revenue sources combined. The authors also found a “small, and noisily estimated, 2.5 percent increase in education expenditures” while spending per pupil remained “virtually unchanged” (Bartik et al. 2016, 23), though the data used in this study are reported every five years and analysis is conducted across nine shale regions. Raimi and Newell (2016), using structured interviews and local public financial data to assess financial impacts, concluded that local governments have received increased income from unconventional oil and gas development and that the majority of regional governments had neutral to positive net financial impacts. One important finding to note from this study is that energy development may expand the local tax base and directly generate revenues for education, or it may increase revenue to state governments that is then redistributed to school districts or to school funds. Additional revenue from one source, however, does not mean greater overall school revenue. In fact, an increase in funds for school districts coming from a local severance tax, for example, may crowd out revenue from federal or state sources (Gordon 2004; Dahlberg et al. 2008; Litschig and Morrison 2013).

Studies focusing on specific regions are better able to reveal nuance in the relationship between education finance and unconventional oil and gas development. Funding per students and the impacts on education greatly vary based on a number of factors, such as the ability of districts to tax oil and gas based on production, how these taxes interact with state education funding formulas, and the spending restrictions and criteria for school districts within a state. A large factor in these outcomes is whether a state taxes oil and gas production as property.

A survey-based study focusing on Pennsylvania (which for most of its history did not tax oil and gas wells as property) reported that most education professionals interviewed felt that the state directed relatively little of the financial benefit of increased tax revenues from oil and gas development to public schools (Kelsey et al. 2012). Ratledge and Zachary (2017) found no statistically significant change to revenues or expenditures per pupil due to the boom in Pennsylvania. In contrast, boom districts in Ohio and West Virginia, two states that do tax oil and gas as property, saw average increases in revenue per pupil compared to non-boom districts during the treatment years examined in the study (Ratledge and Zachary 2017).

Marchand and Weber (2015) found that unconventional oil and gas development in Texas slightly decreased the percentage of students passing state exams. Although this study indicates that the larger contributor to the overall negative impact of unconventional oil and gas development on student achievement in Texas stems from a pull in the labor market that led to a decline in teacher quality, Marchand and Weber also found evidence that the boom decreased overall student performance because districts chose not to spend revenue windfalls from the boom on areas that improve student performance, such as maintaining and recruiting qualified

teachers. To put it simply, how schools spend additional revenues matters. The authors note that resource-rich districts in Texas often responded to expanded tax bases by lowering tax rates and/or allocating additional funds to capital projects such as new football fields or gymnasiums rather than to educational expenditures such as increasing teacher pay. Marchand and Weber find that “unless funding is allocated disproportionately to districts where the production occurs, and is used to improve teacher quality, rising wages may reduce student performance as districts struggle to retain teachers” (2015, 41). On average, the authors estimate that a 10 percent increase in non-payroll spending is associated with a decrease in passing rates for state exams of 1 to 2 percentage points.

In a second paper, Weber et al. (2016) conducted a statistical analysis in Texas using housing values as a proxy for changes in the oil and gas property tax base, finding that increased shale development caused a substantial increase in the property tax base, and subsequently increased school revenues and expenditures per student in the Barnett shale region. Due to large variation in oil and gas taxation and education funding policies across states, these findings only apply to Texas and cannot be generalized to other states.

Ratledge and Zachary (2017) conducted statistical analysis assessing the impacts of

unconventional oil and gas development on education finance (see overview of trends depicted in Table 3). The study found that, on average, North Dakota boom districts received \$1,212 fewer dollars in total state revenue per pupil than non-boom districts during the treatment period captured in the study, and yet capital spending per pupil rose. The region experienced significant increases in student populations during the boom and needed to build new classrooms to meet the growth in enrollment. On the other hand, the Marcellus region saw per-pupil expenditures rise—a finding supported by the relative decline in student populations (discussed above) in Marcellus districts and the increase in revenue.

Substantial evidence from the education literature shows that increased funding can lead to improved student outcomes. In a comprehensive evaluation of peer-reviewed quantitative analyses on the impact of money in education, Baker (2016) concluded that per-pupil spending is positively associated with improved or higher student outcomes. Jackson, Johnson, and Persico (2015) found that a “10 percent increase in per-pupil spending each year for all twelve years of public school leads to 0.27 more completed years of education, 7.25 percent higher wages, and a 3.67 percentage-point reduction in the annual incidence of adult poverty” (3).

TABLE 3. IMPACTS OF UNCONVENTIONAL OIL AND GAS DEVELOPMENT BOOM ON PUBLIC EDUCATION FINANCE

	Total revenue per pupil	Local revenue per pupil	State revenue per pupil	Education spending per pupil	Capital spending per pupil
Marcellus	↑	+	↑	↑	+
Pennsylvania	+	–	+	+	+
Ohio	+	↑	+	+	+
West Virginia	↑	↑	↓	↑	–
North Dakota	↓	–	↓	↓	↑
Colorado (except Piceance)	–	–	–	–	+

Source: Ratledge and Zachary (2017).

Note: Arrows imply statistical significance. + /– signs imply a trend direction but no statistical significance.

How schools spend additional funds matter: even if school spending increases, for example, it may not affect student achievement (Baker 2016; Sander 1993, 1999; Chaudhary 2009; Cobb-Clark and Jha 2013). In their longitudinal study of school finance reforms across the United States, Jackson, Johnson and Persico (2015) found that exogenous school spending increases were associated with significant gains in metrics used to measure school quality, such as reductions in student-teacher ratios and increases in teacher salaries. Local governments can treat tax revenue differently. As Marchand and Weber (2015) explain, without guidance in place to help schools evaluate their spending options, combined with pressures on local policymakers from constituents to use revenue windfalls to decrease local tax rates, school districts may find themselves unprepared to use the money in ways targeted to improve educational outcomes in the long run.

In addition, substantial revenue coming in relatively rapidly due to resource booms leads to volatility and unpredictability in school finances that further impacts the ability of districts to strategically use increased funding to improve student outcomes. This issue holds especially true when school districts are unable to save excess funds without risking corresponding drops to other revenue sources as a result. Recent research from Davis, Vedder, and Stone (2016) suggests the importance of the predictability of funding on student achievement. Ratledge and Zachary (2017) found that stress from financial uncertainty was also acute and a commonly cited concern for educators in boom districts across states in the Marcellus region (Pennsylvania, West Virginia, and Ohio), the Bakken region (North Dakota and Montana), as well as in Colorado. In particular, administrators across all states said that without knowing if increased revenues would continue in the future, districts could not

commit to permanent annual costs such as increases to teacher salaries.

The literature assessing education finance and unconventional oil and gas development specifically reveals a variety of findings that overall show substantial volatility in local funds as a result of increased drilling. Studies focusing on specific regions are better able to reveal nuance in the relationship between education finance and unconventional oil and gas development. Funding per student and the resulting impacts on education vary based on the ability for districts to tax oil and gas based on production, how these taxes interact with state education funding formulas, local pressures on how to spend revenue windfalls and the spending and saving restrictions for school districts within a state.

5. Labor Market

5.1. Labor Market Pull on Educational Attainment

Only a handful of studies attempt to measure statistically the effect of oil and gas development on educational attainment, meaning the highest degree of education an individual completes. As a whole, these few studies find conflicting results. Furthermore, data limitations limit the robustness of any study's findings. A key issue is that most of these studies relied on the American Community Survey (ACS) to measure dropouts or high school completions on an individual basis (Weber 2014; Rickman, Wang, and Winters 2017; Cascio and Narayan 2015). The ACS only produces three- or five-year estimates for geographic areas with populations under 65,000. Because many of the communities impacted by the shale oil and gas boom are quite rural and have small populations, this limitation makes it hard to isolate the impacts of a sudden increase in unconventional oil and gas development on school dropouts, completions, or graduation rates. These large gaps in the time series and

the use of multi-year averages for less-populated regions make these impacts inherently difficult to study quantitatively. However, with no other dataset including educational attainment metrics for individuals across states, ACS data do have some value even though results should be interpreted with a grain of salt.

As part of RFF's research initiative on the [Community Impacts of Shale Gas and Oil Development](#) (of which this report is a part), researchers used data regarding high school completion and dropouts from the National Center for Education Statistics (NCES), although the data are not available on the individual level. Problematically, as the research was underway, NCES retracted these data due to issues regarding quality and inconsistent definitions across states, leading the RFF research team to try instead to collect a unique data set on dropouts and completions from state resources. Ratledge and Zachary (2017), however, also found the consistency of definitions (even within one state across years) to be inadequate for employing their statistical analysis.

Past resource development booms resulted in a decrease in school enrollment during a boom due to a low-skilled labor bias associated with the majority of industry positions, although studies did not necessarily find a decrease in ultimate educational attainment (Black et al. 2005; Emery et al. 2012). Weber (2014) was the first to use ACS data to assess the impacts of the recent boom in unconventional oil and gas development on education outcomes and did not find statistically significant evidence that increased shale gas production in nonmetropolitan counties across Arkansas, Louisiana, Texas, and Oklahoma contributed to lower educational attainment of the resident adult population. Rather, the study found that shale gas production increased the share of the population with a high school degree and

some college education. Looking at the educational attainment of the adult population in communities during a boom, however, does not eliminate concerns regarding long-term impacts of educational attainment due to potential impacts on public education that younger students might have experienced.

Using ACS data to assess the effect of unconventional oil and gas development on dropout rates across all shale reserve regions (including 30 states), Cascio and Narayan (2015) estimate that the boom caused the gender gap in high school dropout rates among 17- and 18-year-olds to widen by 11 percent between 2000 and 2013. The study, however, does not differentiate results across states and instead pools data for regions above shale reserves across the entire United States. While this contributes to our understanding of the issue, such a generalization may be problematic for interpreting the results considering studies such as Ratledge and Zachary (2017) find a large amount of heterogeneity across states.

With workers and their families often moving in and out of these areas for only short periods of time during boom stages of unconventional oil and gas development, researchers must employ additional methods to isolate the impact on pre-boom residents of the communities. Examining ACS data from 2006 to 2013 for 18- to 24-year-olds, Rickman, Wang, and Winters (2017) reported significant reductions in both high school and college attainment for populations living in the studied areas prior to the boom in Montana, North Dakota, and West Virginia. The authors estimated that unconventional oil and gas development in Montana reduced high school attainment (defined as obtaining a high school or GED diploma) by 6 percentage points. Furthermore, the study estimates that it resulted in a decrease in Montana's college attainment (including individuals who attended and did not necessarily graduate) of 4

percentage points. In addition, Rickman, Wang, and Winters (2017) found a decrease in both high school and college attainment of over 5 percentage points in North Dakota, as well as a reduction in high school and college attainment of 2.6 percentage points and 5.5 percentage points, respectively, in West Virginia.

Because ACS is the only dataset used to assess educational attainment across states, some studies that analyze specific states or differentiate across states in their analysis attempt to use state-provided data when available—but state administrative data often use definitions and reporting guidelines that differ both from state to state and across years. For Pennsylvania, Schafft, Kotok, and Biddle (2014) found negligible changes in dropout rates overall in the top four producing counties. Looking at state data covering all of Pennsylvania’s non-urban districts, Ratledge and Zachary (2017) found no statistically significant differences in male, female, or total dropout rates between boom and non-boom districts.

5.2. Labor Market Pull on Education Professionals

Marchand and Weber (2015) focus on the impacts in Texas of the boom in unconventional oil and gas development on student achievement through the labor market pull of education staff out of schools in order to work for the industry. They found that an increase in the wage gap between public sector teaching positions and private sector jobs, such as positions related to the shale energy industry boom, impacted the labor market by pulling teachers out of public schools. They also found that unconventional oil and gas development slightly decreased the percentage of students passing state exams and that this impact primarily stemmed from a pull in the labor market that led to a decline in teacher quality. The labor market pull

negatively impacts schools not only by increasing teacher turnover, but also by lowering the average years of teacher experience. Specifically, Marchand and Weber (2015) estimate that a 10 percent increase in the wage gap for a district in Texas resulted in an increase in the number of inexperienced teachers (defined as having less than five years of experience) of 2–3.5 percentage points.

In comparison, Ratledge and Zachary (2017) did not report any notable concern about teacher attrition due to the boom from their interviews in districts across the Marcellus region. Educators across the Bakken region, however, noted severe difficulty with teacher recruitment and retention in general for such rural districts. Adding to the stress on teachers, reports of rapid student turnover increased teacher burnout. Teachers in boom districts in western states also expressed having problems due to high costs of living. In interviews with educational professionals across all six states involved in their study (Colorado, Pennsylvania, West Virginia, Ohio, North Dakota, and Montana), Ratledge and Zachary (2017) heard repeatedly that bus drivers were the only common school-related type of professional to leave the education system during the boom for work in the industry, where commercially licensed drivers could earn substantially more (note, however, that this aspect was not quantitatively studied).

The impacts of unconventional oil and gas development on the labor market for both teachers and students remain inconclusive from a review of the existing literature. Two of the main studies to date that attempt to measure the statistical effect of unconventional oil and gas development on student educational attainment found a decrease in educational attainment (Cascio and Narayan 2015; Rickman, Wang, and Winters 2017). However, due to the

heterogeneity of many impacts across different plays and states, studies examining the impacts on boom districts within states separately are more telling. In addition, ACS data limitations, especially for rural areas, limit the robustness of any of these studies' statistical findings. While the only study to date that has attempted to measure the impact of the boom in unconventional oil and gas development on teacher turnover, focused solely on Texas (Marchand and Weber 2015). Ratledge and Zachary's (2017) qualitative findings for other states again suggests significant heterogeneity in the impacts of booms on different states. To draw conclusions about the impacts of the unconventional oil and gas development boom on both educational attainment and teacher turnover, better data are needed to facilitate robust analysis of individual states.

5. Conclusion

To date, only a handful of studies specifically examine the influence of unconventional oil and gas development on public education. This report reviews the existing literature that examines three main channels—student population, school finances, and the labor market—through which changes in outcomes may materialize and the possible pathways that link unconventional oil and gas development booms to student achievement in local communities. Issues with education data make legitimate comparisons across states, regions, and years difficult. Existing literature that pools data across many plays masks the impacts that clearly vary substantially across states; research that differentiates between individual states appears far more telling. Although the existing literature does not raise significant concern for school districts in many high-producing unconventional oil and gas states regarding lower educational attainment or short-term impacts from the recent boom on student performance, the

future examination of long-term impacts on student achievement should continue. In particular, issues such as classroom congestion and qualitative reports of high rates of both student and teacher turnover in western rural districts in states such as North Dakota and Montana suggest a potential for lower educational achievement in the long run for these students. To draw conclusions about the net effect of unconventional oil and gas development on educational outcomes as well as inform decisions to help mitigate or harness the potential negative and positive impacts on public education, policymakers need more research and analysis that employ a combination of statistical (including state-provided data) and qualitative methods.

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