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Effect of natural resource extraction on school performance: Evidence from Texas

Anita Schiller[*] Aurelie Slechten[†]

Abstract

This study examines the effects of oil and gas extraction activities on the educational outcomes of high school students in Texas, focusing on potential variations in these impacts among different demographic groups. We use school-level data from the Texas Academic Performance Reports between 2012-2020, with school performance measured by average scores on the *American College Test* (ACT). The primary variable of interest is the exposure to oil and gas activities, measured by changes in oil and gas revenues within each school district. The empirical approach controls for school characteristics, and student demographics. To address endogeneity concerns, we adopt an instrumental variable approach. Although the overall impact of oil and gas operations on average school ACT scores is not statistically significant, these activities do influence the relationship between student socioeconomic status and academic achievement. Specifically, for schools situated within districts that receive substantial oil and gas revenues, a small increase in the proportion of economically disadvantaged students is associated with a substantial decline in ACT scores.

KEYWORDS: natural resources, oil and gas activities, school performance, human capital, education.

JEL Codes: H75, I21, I24, R23

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1 Introduction

The relationship between natural resource exploitation and human capital accumulation has long drawn the attention of economists. Prior research has identified multiple channels by which oil and gas extraction activities may impact a range of educational outcomes, particularly those pertaining to high school students. Localized economic shocks induced by natural resource booms can provide additional revenues for schools in those areas (Newell and Raimi, 2018; James, 2017), potentially leading to enhanced educational outcomes and improved performance among students.[1] They also entail higher wages and increased job prospects that can go beyond the mining industry, particularly within roles accessible to high school students. For example, Feyrer et al. (2017) report that the benefits from the fracking boom in the United States (U.S.) extended beyond the oil and gas sector, affecting low-skill service industries such as construction, hospitality, transportation, and retail. Both of these effects can influence the educational decisions and attainment of high school students, who are faced with an important trade-off between leaving school to enter the workforce and investing in skills and further education that contribute to future earnings growth.

This paper investigates the narrower yet significant question of whether natural resource extraction activities have differentiated impacts on high school students with various socio-demographic backgrounds. To this end, we leverage school-level data from the state of Texas, which offers an interesting setting for this analysis. As the leading crude oil producer in the U.S., the state's energy sector remains a major driver of its economy in terms of economic output and job creation. Additionally, Texas is one of fifteen U.S. states that levy property taxes on oil and gas wells. This means that the revenues generated by these energy operations directly contribute to the state's and local governments' budgets, with a significant portion allocated to funding K-12 public education.

We use data obtained from the Texas Academic Performance Reports (TARP) spanning the period 2012-2020. The TARPs provide comprehensive information on students' performance, demographic characteristics, and schools' attributes. School performance is evaluated based on the average scores of high school graduates on the *American College Test* (ACT) across the four key areas: English Language Arts (ELA), mathematics, reading, and scientific reasoning. Our primary variable of interest is the exposure to oil and gas extraction activities during the academic year immediately prior to when the majority of them take the ACT college entrance exam. This exposure is quantified by the revenues generated by oil and gas extraction activities within the school district where the school is situated.

To mitigate the influence of cohort-level characteristics on ACT scores, we control for factors such as school-level participation in gifted and talented or special education programs, proportion of students identified as "economically disadvantaged", and racial composition of the school. We introduce interaction terms between oil and gas revenues and school demographic characteristics to explore variations in the relationship among different demographic groups within the student cohort. Additionally, we account for school attributes such as school size, class size, and teachers' experience. Finally, district-level characteristics including the property tax base, and median household income are incorporated to capture variations in economic conditions among school districts.

To address concerns about endogeneity raised by potential measurement errors in our primary variable of interest or omitted variables that could simultaneously affect oil and gas revenues and student performance, we adopt an instrumental variable (IV) approach.

[1] For example, Hægeland et al. (2012) find that additional revenues generated by nearby hydro-power plants enhanced the academic performance of 16-year-old pupils.

Our IV approach is based on the methodology outlined in Cai et al. (2019) who use variants of the shift-share instrument to instrument county-level oil and gas employment shares in Texas. In our context, the spatial variation relies on differences in oil and gas production across school districts in 2005, which is considered the onset of the fracking boom (De Silva et al., 2020; Cascio and Narayan, 2022). The temporal variation is derived from changes in oil and gas revenues observed in the rest of the U.S., excluding Texas.

Across all model specifications, our findings consistently indicate a small positive impact of exposure to oil and gas activities on average ACT scores. However, this effect is outweighed by the negative impact on schools with higher proportions of economically disadvantaged students. One of our key findings is that, despite the statistical insignificance of the coefficient associated with economically disadvantaged students alone, its interaction with oil and gas revenues is both statistically significant and economically meaningful. Specifically, for a school located in a school district with oil and gas revenues at their mean sample level, a one percentage point increase in the proportion of economically disadvantaged students is associated with a 14% decrease in ACT scores. We conduct additional robustness checks by utilizing alternative samples and changing the definition of exposure to oil and gas activities, and our main results remain qualitatively unchanged. We also estimate our model for different school-level outcomes. Taken together, our findings suggest that the abundance of oil and gas revenues may exacerbate educational disparities by reducing college readiness and high school completion rates among economically disadvantaged populations in these energy-rich areas.

This paper contributes to the expanding literature investigating the influence of natural resource abundance on human capital accumulation decisions. Previous studies have predominantly examined the enrollment and dropout decisions of high-school students in the context of resource booms and busts in the U.S.. Cascio and Narayan (2022) shows that a shale boom, characterized by increased demand for less educated male labor, leads to higher dropout rates and reduced enrollment in 11th and 12th grades among males across U.S. commuting zones. This effect is particularly pronounced in counties located in states where students aged 17 and older are legally permitted to drop out (Zuo et al., 2019). James (2017) finds that high-school graduation rates declined in oil-rich states experiencing a resource boom.

Additionally, a recent body of literature has highlighted a decrease in schooling attainment in response to fracking. Marchand and Weber (2020) leverage variations in shale geology across school districts in Texas and temporal fluctuations in energy prices over the period 2001-2014. The authors suggest that teacher turnover and the prevalence of inexperienced teachers contributed to the decline in student achievement (in terms of attendance and performance on State's standardized tests). However, they do not find any clear shifts in participation and performance on college entrance exams.[2]

While prior research primarily focused on educational attainment and enrollment at broader geographic levels (such as state, commuting zone, county, or school district), our study examines measures of educational outcomes, such as standardized test scores and absence rates, at a finer level of granularity (school-level). One exception is Kovalenko (2023), who tracks individuals throughout high school, college, and the labor market. She analyzes the impact of local economic conditions on educational outcomes, such as high school attendance and graduation likelihood, as well as employment decisions, including future earnings. While Kovalenko (2023) investigates the differentiated impacts of oil and

[2] Recent contributions to the literature extend beyond the oil and gas boom in the U.S. They encompass studies examining diverse topics such as the impact of the U.S. wind energy installations on school district finances and student achievement (Brunner et al., 2022), the effect of gold mining on primary school enrollment, and test scores and college enrollment in Colombia (Mejía, 2020) or the influence of oil royalties on primary and secondary schools completion rates in Ecuador (Acuna et al., 2024).

gas booms on low-ability and high-ability students' labor market outcomes, our research focuses on the effects of students' socio-demographic characteristics and their interaction with exposure to oil and gas activities on students' achievement.

2 Background

Texas provides an ideal setting for observing the effects of oil and gas operations on educational outcomes. The combination of high energy prices during the first decade of the 2000s and advancements in drilling and fracturing technologies led to a significant increase in oil and gas drilling across shale formations in the U.S.. Texas, in particular, experienced a pronounced and concentrated boom. With four major shale formations within its borders, Texas stands as the largest crude oil-producing state (US EIA, 2022). Since 2012, it has consistently contributed over 30% of the annual U.S. crude oil production and approximately one-fourth of U.S. natural gas output.[3]

Additionally, public schools in Texas operate under the governance of independent school districts (ISDs). An ISD is an autonomous body with fiscal authority responsible for the operation and funding of elementary and secondary public schools within its jurisdiction. Each ISD possesses the authority to determine its own property tax rate, and the property tax revenues are utilized to support public schools within the district. In Texas, oil, gas and minerals interests are treated as property and therefore subject to property taxes based on the assessed value of their production.[4] Increased revenues from oil and gas extraction could lead to a higher value of property tax bases, positively affecting ISDs funded by such revenues. For example, Marchand and Weber (2020) have documented that the fracking boom in Texas resulted in a threefold increase in the tax base for the average shale school district.

Figure 1 shows the evolution of the oil and gas production in Texas, alongside the corresponding oil and gas price data employed in our empirical analysis. The dashed vertical line in the year 2012 marks the starting point for the oil and gas data used in our main analysis. Studying changes in oil and gas activities after 2012 is particularly interesting because this period captures the end of the oil boom in Texas and the subsequent oil price collapse of 2014-2016 (shaded area in Figures 1 and 2), which had a significant impact on the revenues generated by oil and gas extraction activities (as shown in Figure 2). This price collapse was one of the largest in modern history, with oil prices plummeting from mid-2014 to early 2016. The initial drop in oil prices from mid-2014 to early 2015 was primarily driven by supply factors, including the booming U.S. oil production, which had been fueled by the shale revolution.

While many expected the U.S. shale industry to be severely impacted by the low oil prices, it proved to be more flexible and resilient than anticipated. Although drilling activity declined sharply, production from existing shale oil wells was sustained (see Figure 1), and the industry rapidly adapted through efficiency gains, technological innovations, and cost reductions (Stocker et al., 2018). Analyzing this period can shed light on how the oil and gas sector responds to such revenues fluctuations, and the potential implications for the local economies and educational systems that depend on it.

Texas counties exhibit substantial variations in oil and gas production, as shown in Figures 3-5. These disparities in oil and gas endowments likely lead to an unequal distribu-

[3]These data come from the U.S. Energy Information Agency: `https://www.eia.gov/petroleum/` and `https://www.eia.gov/naturalgas/`.

[4]Wells are included in the property tax base once production commences. County-contracted independent private assessors evaluate each well, considering factors such as projected production and prices, with annual reassessments being conducted.

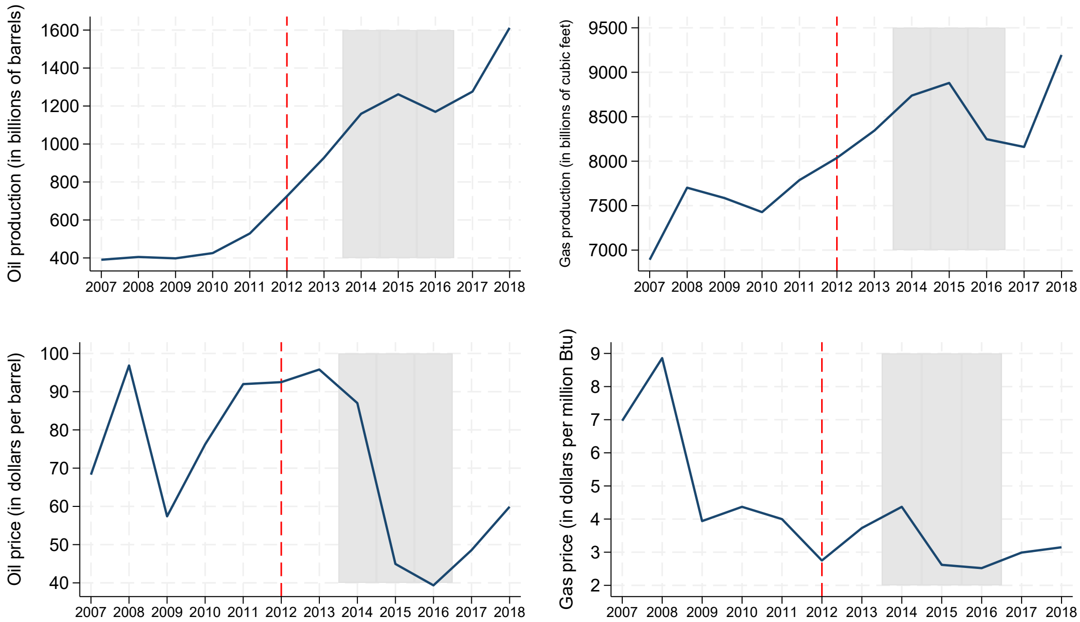


Figure 1: Oil and gas production in Texas, oil prices and gas prices between 2007 and 2018

tion of impacts on local labor markets and school finances across the state. Consequently, the influences on high school students' motivations to pursue higher education may diverge significantly among school districts in Texas.

3 Data

To address the question whether being situated in an oil-producing school district contributes to improved educational outcomes compared to schools in non-oil-producing districts, we combine school-level and ISD-level data from the the Texas Education Agency (TEA) and the U.S. Census Bureau. We match these data with oil and gas production data from The Railroad Commission of Texas (RRC).

3.1 School-level data

We collect school-level data from the Texas Academic Performance Reports (TARP), which are released annually by the Texas Education Agency (TEA). These reports are available for both traditional and charter schools, and cover elementary to secondary grades (i.e., K-12). They provide comprehensive information on student performance, as well as demographic characteristics of both staff and students at the school-level. One interesting feature of the data available in TARPs is the disaggregated information on school outcomes, including breakdowns by student groups such as ethnicity and economic status.

3.1.1 Educational outcome

As an educational outcome, we consider a school's average scores on the American College Test (ACT). Since this is a standardized test, it serves as a good measure for evaluating

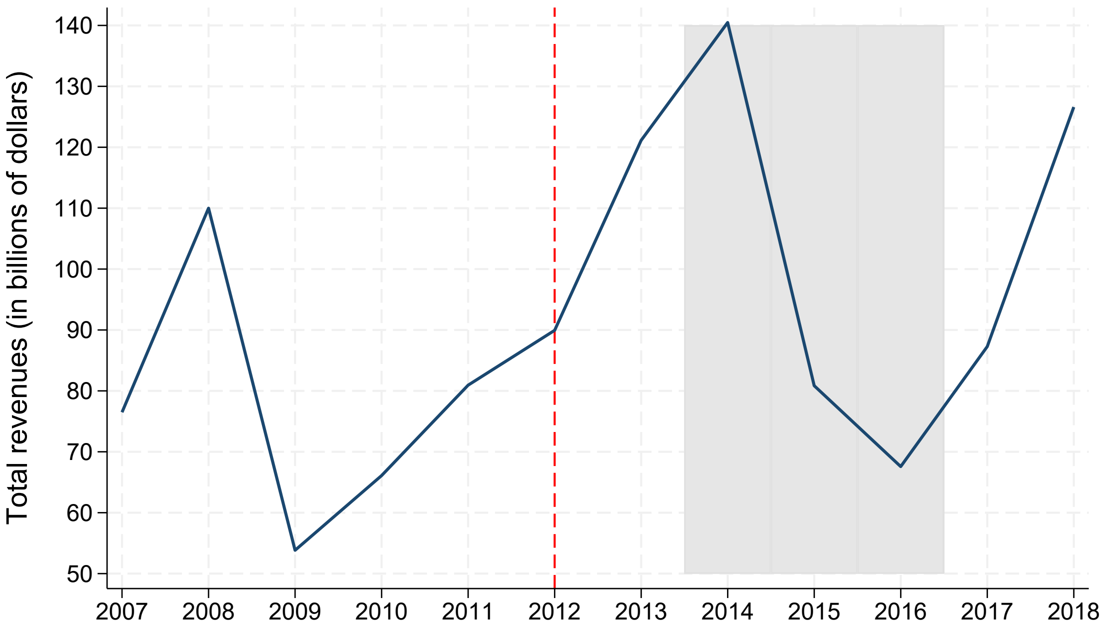


Figure 2: Oil and gas revenues in Texas between 2007 and 2018

student performance across various schools. It is also a good indicator of student willingness to pursue higher levels of education. At the time of our study, most colleges required students to take either the ACT or the Scholastic Aptitude Test (SAT) and submit their scores to their prospective universities. Nationally, these two standardized University admission tests have been equally popular for several years.[5] We chose to focus on ACT rather than SAT scores because the SAT was redesigned in 2016 when the exam went from its 2400-point to a 1600-point format.

In the TARPs, the average ACT score for a school in a particular year is determined by calculating the average score achieved by the graduates of that year on the ACT. For instance, the ACT score of a school in 2014 reflects the average score attained by students who graduated from that school in 2014 (at the end of the academic year 2013-2014). The ACT covers four areas: English, mathematics, reading, and scientific reasoning. The four ACT sections are individually scored on a scale of 1–36, and a composite score (the rounded whole number average of the four sections) is provided. For each year, the TARP decomposes the performance of annual graduates on the ACT assessment in 4 different scores: *ACT - All Subjects* (the average ACT composite score), *ACT- English Language Art (ELA)* (the average ACT score on the English and Reading sections combined), *ACT - Math* (the average ACT score on the mathematics section), and *ACT - Science* (the average ACT score on the science section).[6]

[5]Note that due to concerns that the ACT or SAT are unfair to low-income students, several colleges adopted test-optional admissions policies for the academic year 2022-2023. As a result, according to an article from the New York Times (Goldstein, 2023), only 43 percent of applicants submitted SAT or ACT scores in 2021 (compared to 74% before the Covid-19 pandemic).

[6]If a student takes the ACT more than once, the best result by subject area is selected, and the ACT composite score is calculated as the average of the highest section scores.

3.1.2 School characteristics

To control for differences in student attributes that could influence ACT scores, we include the share of students who are economically disadvantaged, participating in the gifted and talented program or the special education program. A student is identified as economically disadvantaged if he is eligible for free or reduced-priced meals under The National School Lunch Program (NSLP). Gifted and talented programs are geared towards children showing the potential for performing at *remarkably high level of accomplishment*, while special education programs are designed to support children with disabilities.[7]

Several studies document that on every subject at every grade level, there are large achievement differences between races (see for example, Fryer 2011 or Chetty et al. 2020). We therefore control for the percentage of non-white students, but we also disaggregate this ratio into percentages of Black, Hispanic, Asian and multi-race students.

Besides students' characteristics, the TARPs provide detailed information about schools' attributes that might be correlated with performance on the ACT examination. We use the number of students in fall enrollment to measure school size. Average class size is given by the total number of students divided by the total full-time equivalent (FTE) teachers employed at the school. We account for teachers' experience by including school-level average years of experience of teaching staff.

3.2 ISD-level data

Since a significant portion of school funding is derived from local property taxes, we account for the total assessed value of taxable properties within each school district (obtained from the TEA). We compute a *Taxable Value Index*, defined as the ratio between the district total taxable value and the yearly average taxable values in our sample.[8]

Additionally, we control for differences in socio-economic conditions among ISDs by including the district-level median household income and the population aged 16 and over, obtained from the American Community Surveys (U.S. Census Bureau).

3.3 Oil and gas revenues

The Railroad Commission of Texas (RRC) provides data on crude oil production (in barrels), condensate oil production (in barrels), gas-well gas production (in thousands of cubic feet), and casing-head gas production (in thousands of cubic feet) at the county level. Due to the unavailability of precise well locations, we allocate county-level production to ISDs based on the proportion of the district's area relative to the county's total area. To accomplish this, we obtain information on land areas of ISDs and counties from the School District Geographic Relationship Files. This methodology allows us to attribute the relevant production data to the corresponding ISDs in proportion to their geographic coverage within each county. Using the average yearly price of oil in dollars per barrel and gas in dollars per thousand cubic feet (from the U.S. Energy Information Administration), we calculate the revenues generated by oil and gas extraction at the ISD-level.[9]

[7] See `https://tea.texas.gov/academics/special-student-populations/special-populations` for details regarding gifted/talented and special education programs.

[8] Five school districts (corresponding to 16 schools) do not have a taxable value (either because they are bordering military installations or because they are magnet school districts).

[9] We use the Henry Hub spot price (Dollars per Million Btu, converted in dollars per thousand cubic feet) and the Texas Crude Oil First Purchase Price (Dollars per Barrel).

Table 1: Summary statistics

Variables	Mean	SD	Min	Max
Panel A: School-level outcomes				
ACT *All Subjects*	20.04	2.65	10.60	32.20
ACT ELA	19.67	2.97	9.70	32.90
ACT Math	20.03	2.47	11.60	31.40
ACT Science	20.29	2.41	11.60	31.20
Graduates who took SAT/ACT (%)	71.22	20.28	1.90	100.00
Panel B: School-level characteristics				
Number of students	1,044.23	960.67	22.00	5,098.00
Nonwhite students ratio	0.60	0.29	0.03	1.00
Economically disadvantaged students ratio	0.54	0.23	0.00	1.00
Special education ratio	0.09	0.04	0.00	0.37
Gifted students ratio	0.09	0.08	0.00	1.00
Teacher to students ratio	13.51	3.68	1.40	48.50
Teacher experience	11.87	3.21	0.00	25.80
Charter school	0.06	0.24	0	1
Panel C: School district-level characteristics				
Oil and gas revenues	108.36	436.28	0.00	9,566.14
Median household income (dollars)	51,683.92	17,273.48	15,917.00	219,315.00
Taxable value (million dollars)	2,261.69	7,680.95	0.00	174,202.42
Taxable value index	100.33	334.06	0.00	6,558.19
Population (over 16)	22,802.91	66,546.57	52	1,157,699
District is in MSA	0.52	0.50	0	1

Note: Panels A and B are based on the 9,551 school-cohort observations used in our empirical analysis. Panel C is based on the corresponding 6,158 ISD-cohort observations.

3.4 Summary statistics

Our main sample consists of 1,521 high schools (grades 9-12) that report ACT scores. These schools are distributed across 938 school districts spanning 252 counties, with 82 of these counties being part of a Metropolitan Statistical Area (MSA). We observe 7 cohorts of students who graduated between 2014 and 2020. We define cohorts by the academic year in which students graduated from high school. After eliminating observations with missing information, we have 9,551 school-cohort observations.

Most students take their ACT/SAT assessments in grade 11 (to apply for college during their final year of high school). To account for this, all the school-level and ISD-level characteristics are lagged by one year. For example, for students who graduated in 2014 (and most likely sat their ACT assessment during the academic year 2012-2013), we use school-level information from the 2012-2013 academic year and ISD-level variables from 2012.

In Table 1, we provide summary statistics for the variables used in our empirical analysis. In Panel A, we provide school-level educational outcomes. We observe that the average ACT score is about 20 across all subjects. The proportion of students within a cohort who take the SAT/ ACT is about 71 percent.

Panel B reports the school-level characteristics. On average, each school has about 1,044 students. Out of them, 60 percent are nonwhite. Further, 54 percent of the students are categorized as "economically disadvantaged." Students on gifted and special education programs account for about 9 percent each. Teacher to student ratio is about 13.5, while teachers have about 12 years of experience. Overall, about 6 percent of schools are Charter schools. Charter schools in Texas are not overseen by the school district's board of education but are authorized by the TEA through a contract (or charter).[10]

ISD-level variables are reported in Panel C. Average oil and gas revenues per school district are about \$108 million. The average median household income is about \$51,700. The taxable value is about \$2.26 billion per school district, while there are about 23,000 people aged over 16 in each school district. Finally, 52 percent of school districts are in MSA counties.

4 Empirical strategy

4.1 Regression Model

We estimate linear regressions using both ordinary least squares (OLS) and an IV approach. Our baseline model is:

$$y_{idt} = \beta_0 + \beta_1 \ln(G_{dt-1}) + \boldsymbol{S}'_{idt-1}\boldsymbol{\beta_2} + (\boldsymbol{S}'_{idt-1} \times \ln(G_{dt-1}))\boldsymbol{\beta_3} + \boldsymbol{X}'_{idt-1}\boldsymbol{\sigma} + \boldsymbol{D}'_{dt-1}\gamma + \alpha_i + \tau_t + \epsilon_{idt} \quad (1)$$

where our dependent variable, y_{idt}, is the log value of the average ACT score in all subjects, ELA, mathematics and science of graduates from cohort (t) in school (i) in district (d). G is the district oil and gas revenues, vector $\boldsymbol{S}$ contains school-level demographic attributes, $\boldsymbol{X}$ represents the other school-level variables (school size, class size, and teachers' experience), and $\boldsymbol{D}$ accounts for ISD-level characteristics. We also incorporate interaction terms between oil and gas revenues and all cohort demographic characteristics.

Finally, our identification strategy relies on school and year (cohort) fixed effects. School fixed effects account for time-invariant unobserved heterogeneity among schools that may affect the average ACT scores of their students. Year fixed effects account for macroeconomic fluctuations or federal/state policies that affect all school districts in Texas in a given year. We cluster standard errors at the school-level.

4.2 Instrumental Variable

Schools' ACT scores may depend on numerous factors beyond those included in our control variables. Some of these unaccounted variables could influence both ACT scores and oil and gas revenues, potentially biasing our OLS results. By using a two-way fixed effects model, we control for unobservable school heterogeneity and common time varying effects. However, certain omitted variables may still fluctuate across schools and over time. Additionally, measurement errors in our primary variable of interest, oil and gas revenues, can further contribute to bias in the OLS estimates.

To mitigate endogeneity concerns, we use an IV approach based on the methodology outlined in Cai et al. (2019) who use variants of the shift-share instrument to measure county-level oil and gas employment shares in Texas. Our instrument, $IV2005$, is constructed as follows:

$$IV2005_{dt} = OilGasProdShare_{d,2005} \times G_{US,t} \quad (2)$$

where $OilGasProdShare_{d,2005}$ is the share of the total oil and gas production in Texas that can be attributed to school district d in 2005, and $G_{US,t}$ is the oil and gas revenues in the U.S., excluding Texas, in year t. In our context, the spatial variation relies on

[10] Charter schools have their own Local Education Agency and are not associated with an ISD in our dataset. We obtain their address (manual search on the internet) and map them to ISDs.

differences in oil and gas production across school districts in 2005, which is considered the onset of the fracking boom (De Silva et al., 2020; Cascio and Narayan, 2022). The temporal variation is derived from changes in oil and gas revenues observed in the rest of the U.S., excluding Texas.

We use $IV2005_{dt}$ as an instrument for a district oil and gas revenues, G_{dt}, in equation (1). Moreover, we use $IV2005_{dt}$ interacted with $\boldsymbol{S}_{idt}$ as instruments for the interaction terms between oil and gas revenues and cohorts' demographics included in equation (1).

$IV2005$ is a relevant instrument to measure the revenues generated by the oil and gas industry in a given ISD. First, we expect oil and gas production shares in 2005 to be correlated with future changes in oil and gas revenues within the district. Second, the fluctuations in oil and gas revenues within Texas school districts coincide with national trends. These changes across the U.S. reflect the changes in energy prices and further advancements in extraction techniques, such as horizontal drilling and hydraulic fracturing. Moreover, conditional on other observable school and school-district characteristics, we expect this instrument to be uncorrelated with the error term in the second stage equation (i.e. equation (1)). The school-district oil and gas production shares date back to 2005, preceding by more than five years the initial year of the sample period used to estimate equation (1). Additionally, fluctuations in oil and gas revenues across the rest of the U.S. are primarily driven by technological advancements and prices, factors that are arguably external to students' scores in Texas during the same period. Consequently, we expect that $IV2005$ should serve as a valid instrument.

4.3 Share of oil and gas revenues in total taxable value

The majority of revenues for public school funding in Texas is generated through property taxation. As mentioned earlier, oil, gas, and minerals interests are regarded as taxable property. As a result, the total taxable value might capture both the size of a school district and the presence of abundant oil and gas resources. To disentangle the specific effects of changes in oil and gas revenues from changes in ISD tax bases on school outcomes, we employ a methodology similar to that of De Silva et al. (2016) and De Silva et al. (2020).

Initially, we model the ISD total taxable value (V_{dt}), treating it as a function of oil and gas revenues and district characteristics, such as income (I) and population (P), as illustrated in equation (3). This regression operates at the ISD-level rather than the school-level.

$$\ln(V_{dt}) = \lambda_1 \ln(G_{dt}) + \lambda_2 \ln(I_{dt}) + \lambda_3 \ln(P_{dt}) + \varphi_d + \theta_t + \nu_{dt} \tag{3}$$

Subsequently, we eliminate the effects of oil and gas revenues from the ISD total taxable value. This is achieved by calculating predicted values from equation (3), excluding oil and gas revenues. These derived values represent the total taxable values that would have been observed in the absence of oil and gas developments—an approximation of a counterfactual value ($\widehat{V}^*_{d,t}$). Formally:

$$\ln(\widehat{V}^*_{d,t}) = \ln(\widehat{V}_{d,t}) - \lambda_1 \ln(G_{dt}) \tag{4}$$

Finally, in the third step, we estimate equation (1), instrumenting oil and gas revenues with $IV2005$, while utilizing the stripped-out or counterfactual taxable values ($\widehat{V}^*_{d,t}$) as a control variable.

5 Results

5.1 Effect of oil and gas revenues and cohort demographics on ACT scores

Our regression results, with the average score of a school cohort by ACT subject as the dependent variable, are summarized in Table 2. Columns 1-4 present the OLS results, while columns 5-8 report the IV results using *IV2005* as an instrument. In all specifications, the ISD-level control variables are the taxable value index (district relative size) and median household income (socio-economic conditions). For the IV specifications, relevant F-statistics are reported.

Our findings for the ACT composite scores (*All Subjects* in columns 1 and 5) highlight an interesting relationship between oil and gas operations and student academic performance. While there is a small positive effect of oil and gas revenues on average ACT scores, this is outweighed by the negative impact on schools with higher proportions of economically disadvantaged students. The coefficients associated with the other interaction terms are very small and not statistically significant. Based on the estimated coefficients from column 5, the overall marginal effect at the mean of a 1% increase in oil and gas revenues is 0.0004%, which is statistically not different from zero.

Turning to the relationship between cohort attributes and school performance, there are two takeaways from the estimates in Table 2 (IV results). First, even though the coefficient associated with the proportion of economically disadvantaged students is statistically not significant, its interaction with oil and gas revenues is statistically significant and economically meaningful. Specifically, holding oil and gas revenues at their mean sample value and using the coefficients estimated in column 5, a 1 percentage point increase in the proportion of economically disadvantaged students is associated with a 14% decrease in ACT scores. Second, the ratio of gifted and talented students is positively associated with higher ACT scores, indicating that schools with a greater proportion of high-achieving students tend to have better overall performance on the ACT.

Aside from these findings of interest to us, schools with more experienced teachers and schools located in more affluent school districts (as indicated by the taxable value index) also exhibit better student outcomes.[11]

The coefficients associated with oil and gas revenues and the interaction term between oil and gas revenues and economically disadvantaged students exhibit consistent signs, albeit with varying magnitudes, across ACT subjects. In particular, for the IV results, the coefficients related to oil and gas revenues are the largest for the ELA section (column 6), while for the math and science sections, these coefficients are only marginally significant (at the 10% level).

As previously discussed, the total taxable value takes into account not only the size of a school district, but also the availability of abundant oil and gas resources. Furthermore, property tax value is contingent upon housing prices, which are in turn correlated with household incomes, as noted by De Silva et al. (2016). Table 3 presents the estimation results of equation (1) when we strip out the effects of oil and gas revenues from the ISD total taxable value, as shown in equations (3) and (4).

Column 1 reports the findings when we estimate the total value of the district property tax base as a function of oil and gas revenues as well as other ISD characteristics, such as income levels and population size (equation (3)). This regression is at the ISD-level rather than the school-level, resulting in fewer observations (one per school district per

[11] We also conduct estimations of these empirical specifications by incorporating interaction terms between oil and gas revenues and the number of students, student-to-teacher ratio, and teacher experience. These results remain qualitatively unchanged and are available upon request.

year) compared to school-level regressions. Interestingly, results from column 1 reveal that our simple specification for estimating taxable value explains nearly 99 percent of the variation in ISD-level taxable value.

In columns 2-4, we re-estimate our baseline model (1) using the stripped-out or counterfactual taxable values, obtained from equation (4). Note that the coefficients are estimated with the IV approach. The sign and magnitude the coefficients associated with oil and gas revenues and their interaction with the ratio of economically disadvantaged students are very similar to the estimates in columns 5-8 of Table 2. The stripped-out taxable value is positively correlated with schools' ACT overall scores, and scores on the ELA sections. For the math and science sections, the estimated coefficients are positive but not statistically significant at the conventional levels.

5.2 Robustness Checks

We conduct a series of robustness checks using alternative samples and changing the definition of exposure to oil and gas activities. All the results from these robustness checks are obtained by estimating equation (1), using $IV2005$ as an instrument for oil and gas revenues and the the stripped-out taxable values as a control variable (same specification as in Table 3).

5.2.1 Disaggregating the nonwhite student ratio

In Table 4, we disaggregate the nonwhite student ratio into Black, Hispanic, Asian, and multi-race student ratios. Results in columns 1-4 suggest that, across ACT subjects, cohorts with a large proportion of multi-race students tend to have lower scores. Interestingly none of the coefficients associated with the interaction terms between racial/ethnic groups and oil and gas revenues are statistically significant at the conventional levels. All the other variables indicate similar qualitative patterns as those discussed in section 5.1.

5.2.2 Alternative samples

In Table 5 (Panel A), we report estimation results for various samples of schools. As a benchmark, in column 1, we provide the results for the full sample of schools used in the main analysis (column 2 of Table 3).

Excluding charter schools. The results reported thus far encompass both public and charter schools. While charter schools (as traditional public schools) receive state funds based on the average daily attendance, they are not funded by local property tax revenues. They can receive charitable donations from private sources and are eligible for grants from the TEA. Charter schools have more flexibility (in terms of their curriculum or rules) than traditional public schools but are subject to additional academic and financial accountability from the TEA. It is therefore possible that our results might be influenced by the presence of charter schools in our sample. As a robustness check, we re-estimate our model by excluding charter schools. The results are reported in column 2 of Table 5 (Panel A). They indicate that our main findings are not driven by the presence of charter schools in our pooled regressions.

MSA and non-MSA school districts. Next, we conduct separate estimations of our baseline model, for MSA and non-MSA ISDs. The outcomes of these analyses are summarized in columns 3 and 4 of Table 5 (Panel A). The results for MSAs align qualitatively with those presented in Table 3, whereas the results for non-MSAs are statistically insignificant.

Excluding largest counties. Finally, we exclude from our sample all the schools located in the largest 5% of counties (in terms of land area) to mitigate potential inaccuracies in estimating ISD-level oil and gas revenues; the main results (reported in column 5 of Table 5, Panel A) are qualitatively unchanged.

5.2.3 Alternative definition of oil and gas exposure.

As an alternative way to assess a cohort's exposure to oil and gas extraction activities, we compute the average oil and gas revenues within the school district where the school is situated during the time this cohort attended high school, up to the year these students undertook the ACT examination (from grade 9 to grade 11). For instance, for the cohort that underwent the ACT assessment in the academic year 2012-2013 (grade 11), we use the average oil and gas revenues between 2010 and 2012. This definition shares a similar essence with the measure of oil and gas exposure used in Kovalenko (2023), where the study explores the effects of oil and gas exposure during high school (from grade 9 to grade 12) on subsequent education and employment decisions.

The results reported in Panel B of Table 5 are very similar to those obtained with our original measure of oil and gas exposure.

5.3 Alternative educational outcomes

Previous studies have documented the impact of the oil and gas boom in Texas on high school enrollment, completion rates and attendance rates (Zuo et al., 2019; Marchand and Weber, 2020; Cascio and Narayan, 2022), typically at higher levels of geographic aggregation. Using the same specification as in Table 3, we examine the effect of oil and gas revenues on various schools' educational outcomes (available in the TARPs): the proportion of high school graduates who sat one of the college entrance examinations (ACT or SAT), the number of high school graduates, the number of students in grades 9-12 who dropped out, and the school attendance rate. The results are reported in Table 6. Panel A presents the results for all graduates/students, while Panel B summarizes the results for economically disadvantaged students only. Note that due to some missing data, the number of observations in all columns is slightly lower than the number of observations in the ACT regressions.

Interestingly, oil and gas revenues do not seem to be correlated with any of the educational outcomes, except for student daily attendance. This is consistent with prior findings from Marchand and Weber (2020) who show that, for a different time period (2001-2014), attendance rates declined only slightly and completion rates were unaffected in shale oil district relative to districts outside of any shale formation in Texas.

However, when focusing on economically disadvantaged students, a different pattern emerges. These students are less likely to participate in college entrance exams and have lower graduation rates in areas with higher oil and gas revenues. Moreover, their attendance rates tend to be slightly lower in schools located in districts with significant oil and gas activities, although the coefficient associated with oil and gas revenues is only statistically significant at the 10% level.

Marchand and Weber (2020) have argued that higher wages associated with oil and gas activities may have contributed to a decrease in the proportion of economically disadvantaged students. This could occur as the additional household income enables some families to rise above the economic threshold for being classified as disadvantaged. This decline could potentially account for the observed decrease in both the number of economically disadvantaged graduates and their participation rates in college entrance examinations.

However, we mitigate this potential confounding factor by controlling for the proportion of economically disadvantaged students within each school.

5.4 Discussion

Taken together, our findings suggest that increased oil and gas revenues may exacerbate educational disparities by reducing participation and performance on college entrance exams and high school completion rates among economically disadvantaged populations in energy-rich areas.

Several studies have documented that the oil and gas boom of the early 2000s led to higher wages and expanded job opportunities, both within the mining sector and across other industries in Texas (Weber, 2012; Cascio and Narayan, 2022; Kovalenko, 2023). These changes in the returns to education may have had heterogeneous effects on students' incentives to participate and prepare for college entrance exams, depending on their socioeconomic background.

Human capital theory (Becker, 1964) has long been used by economists to understand high school students' decisions about college attendance. This line of research suggests that family background plays a crucial role in schooling choices. Family income, for example, has consistently been found to be an important determinant of the decision to attend college (Carneiro and Heckman, 2002; Nguyen and Taylor, 2003; Bastian and Michelmore, 2018).

Students from wealthier families may be less sensitive to variations in labor market incentives if factors associated with family socioeconomic status, such as parental tastes for education, outweigh economic considerations in their schooling decisions. In contrast, students from poorer families may tend to place more weight on economic factors, responding more strongly to changes in labor market conditions. As a result, the improved labor market conditions driven by oil and gas abundance may disproportionately draw economically disadvantaged students away from academics, potentially exacerbating achievement gaps.

6 Conclusion

In this study, we examined the impact of oil and gas extraction activities on high school students' educational outcomes in Texas using comprehensive school-level data from the TARPS. Our analysis focused on the relationship between revenues generated by oil and gas activities within each school district and student performance on the ACT. One of the main challenges in estimating the relationship between oil and gas extraction activities and educational outcomes lies in the potential endogeneity of companies' decisions to extract oil and gas resources. These decisions may be influenced by various unobserved factors that could also impact educational outcomes, leading to biased estimates. To address these endogeneity concerns and account for potential omitted variable bias, we employed an IV approach as our empirical strategy.

Our study highlights important insights into the relationship between economic factors, educational outcomes, and local resources abundance. Despite the coefficient associated with the proportion of economically disadvantaged students not being statistically significant on its own, its interaction with oil and gas revenues is both statistically significant and economically meaningful. Specifically, our findings suggest that in areas with larger oil and gas revenues, a marginal increase in the proportion of economically disadvantaged students is associated with a considerable decrease in ACT scores. Moreover, we observe that economically disadvantaged students in regions with higher oil and gas revenues exhibit lower participation rates in college entrance exams and lower graduation rates. These findings suggest that economic factors, influenced by the presence of resource extraction activities, play a significant role in shaping educational opportunities and outcomes for this student population.

We propose a potential mechanism to explain these findings, drawing on insights from human capital theory and existing literature on the effects of local labor market shocks induced by oil and gas operations on educational decisions. Further research tracking individual students' employment and long-term outcomes would shed light on this proposed mechanism and how different population groups respond to local labor market shocks resulting from natural resource extraction. As the U.S. oil production has continued to surpass other major oil-producing nations over the last few years, ensuring that the potential educational benefits of oil and gas exploitation extend equitably to economically disadvantaged students requires careful consideration.

References

Acuna, J., Balza, L. H., and Gomez-Parra, N. (2024). From wells to wealth? government transfers and human capital. *Journal of Development Economics*, 166:103206.

Bastian, J. and Michelmore, K. (2018). The long-term impact of the earned income tax credit on children's education and employment outcomes. *Journal of Labor Economics*, 36(4):1127–1163.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. Columbia University Press, New York.

Brunner, E., Hoen, B., and Hyman, J. (2022). School district revenue shocks, resource allocations, and student achievement: Evidence from the universe of US wind energy installations. *Journal of Public Economics*, 206:104586.

Cai, Z., Maguire, K., and Winters, J. V. (2019). Who benefits from local oil and gas employment? Labor market composition in the oil and gas industry in Texas and the rest of the United States. *Energy Economics*, 84:104515.

Carneiro, P. and Heckman, J. J. (2002). The evidence on credit constraints in post-secondary schooling. *The Economic Journal*, 112(482):705–734.

Cascio, E. U. and Narayan, A. (2022). Who needs a fracking education? The educational response to low-skill-biased technological change. *ILR Review*, 75(1):56–89.

Chetty, R., Hendren, N., Jones, M. R., and Porter, S. R. (2020). Race and economic opportunity in the United States: An intergenerational perspective. *The Quarterly Journal of Economics*, 135(2):711–783.

De Silva, D. G., McComb, R. P., and Schiller, A. R. (2016). What Blows in with the Wind? *Southern Economic Journal*, 82(3):826–858.

De Silva, D. G., McComb, R. P., and Schiller, A. R. (2020). Do localities benefit from natural resource extraction? *The Energy Journal*, 41(5):185–212.

Feyrer, J., Mansur, E. T., and Sacerdote, B. (2017). Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution. *American Economic Review*, 107(4):1313–1334.

Fryer, R. G. J. (2011). Racial inequality in the 21st century: The declining significance of discrimination. In *Handbook of labor economics*, volume 4, pages 855–971. Elsevier.

Goldstein, D. (2023). ACT Reports Record Low Scores as Admissions Landscape Shifts.

Hægeland, T., Raaum, O., and Salvanes, K. G. (2012). Pennies from heaven? using exogenous tax variation to identify effects of school resources on pupil achievement. *Economics of Education Review*, 31(5):601–614.

James, A. (2017). Natural resources and education outcomes in the United States. *Resource and Energy Economics*, 49:150–164.

Kovalenko, A. (2023). Natural resource booms, human capital, and earnings: Evidence from linked education and employment records. *American Economic Journal: Applied Economics*, 15(2):184–217.

Marchand, J. and Weber, J. G. (2020). How local economic conditions affect school finances, teacher quality, and student achievement: evidence from the Texas shale boom. *Journal of Policy Analysis and Management*, 39(1):36–63.

Mejía, L. B. (2020). Mining and human capital accumulation: Evidence from the Colombian gold rush. *Journal of Development Economics*, 145:102471.

Newell, R. G. and Raimi, D. (2018). US state and local oil and gas revenue sources and uses. *Energy Policy*, 112:12–18.

Nguyen, A. N. and Taylor, J. (2003). Post-high school choices: New evidence from a multinomial logit model. *Journal of Population Economics*, 16:287–306.

Stocker, M., Baffes, J., Some, Y. M., Vorisek, D., and Wheeler, C. M. (2018). The 2014-16 oil price collapse in retrospect: sources and implications. *World Bank Policy Research Working Paper*, 8419.

US EIA (2022). Texas and New Mexico led U.S. crude oil production in 2022. Technical report, US Energy Information Agency.

Weber, J. G. (2012). The effects of a natural gas boom on employment and income in Colorado, Texas, and Wyoming. *Energy Economics*, 34(5):1580–1588.

Zuo, N., Schieffer, J., and Buck, S. (2019). The effect of the oil and gas boom on schooling decisions in the US. *Resource and Energy Economics*, 55:1–23.

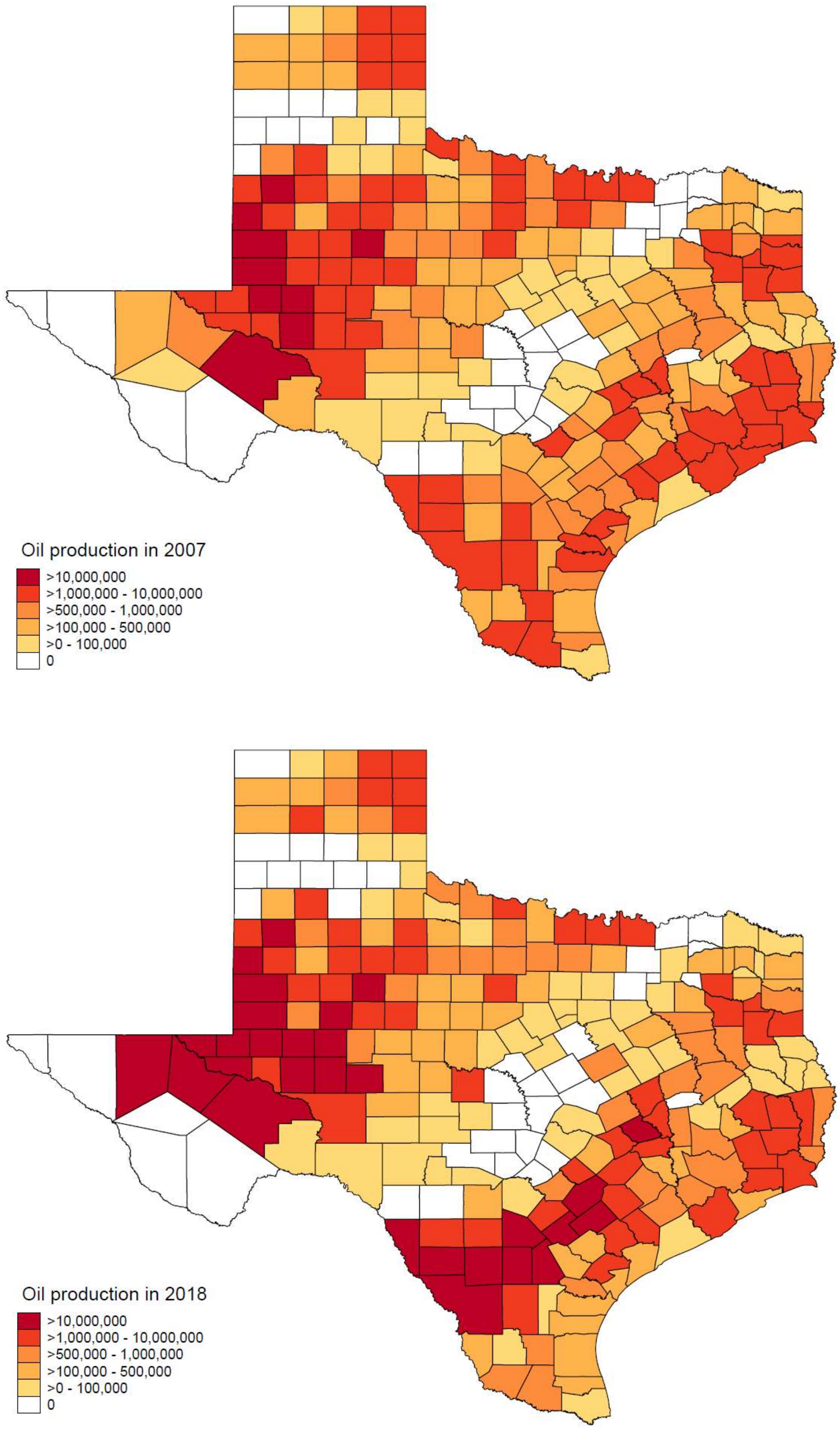
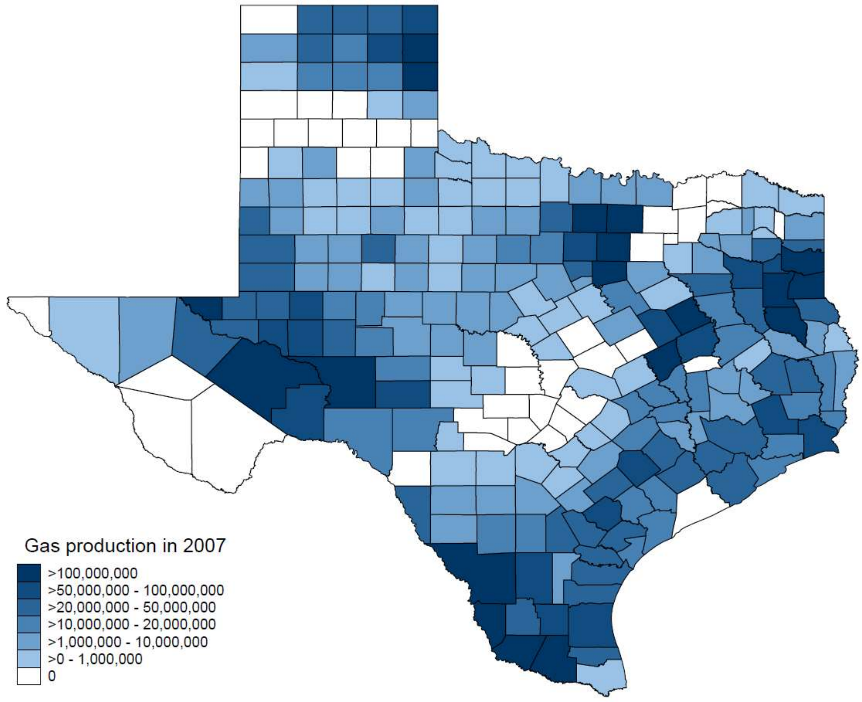


Figure 3: Oil production (barrels) by county in Texas in 2007 and 2018



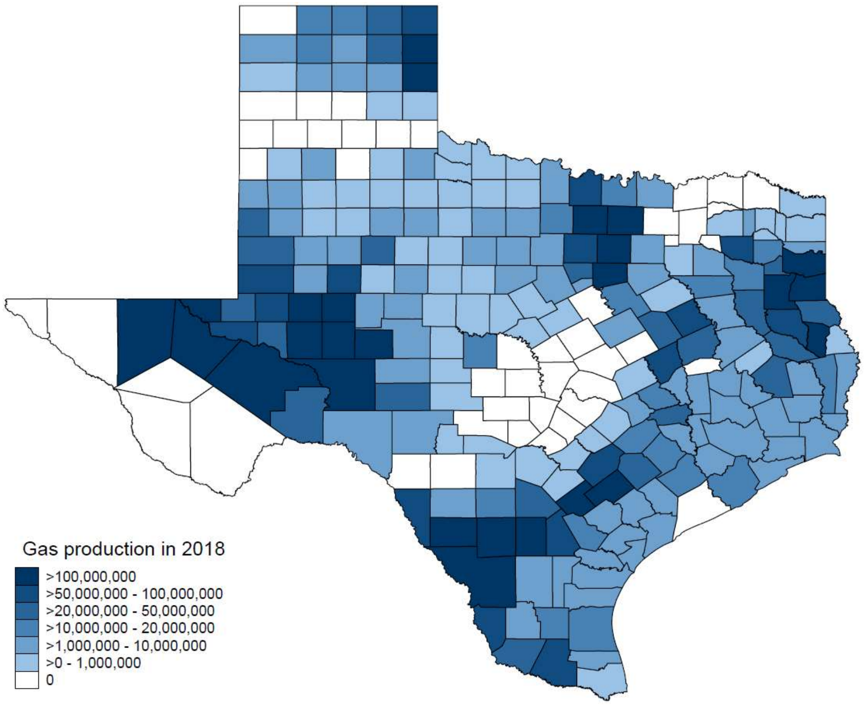


Figure 4: Gas production (thousand cubic feet) by county in Texas in 2007 and 2018

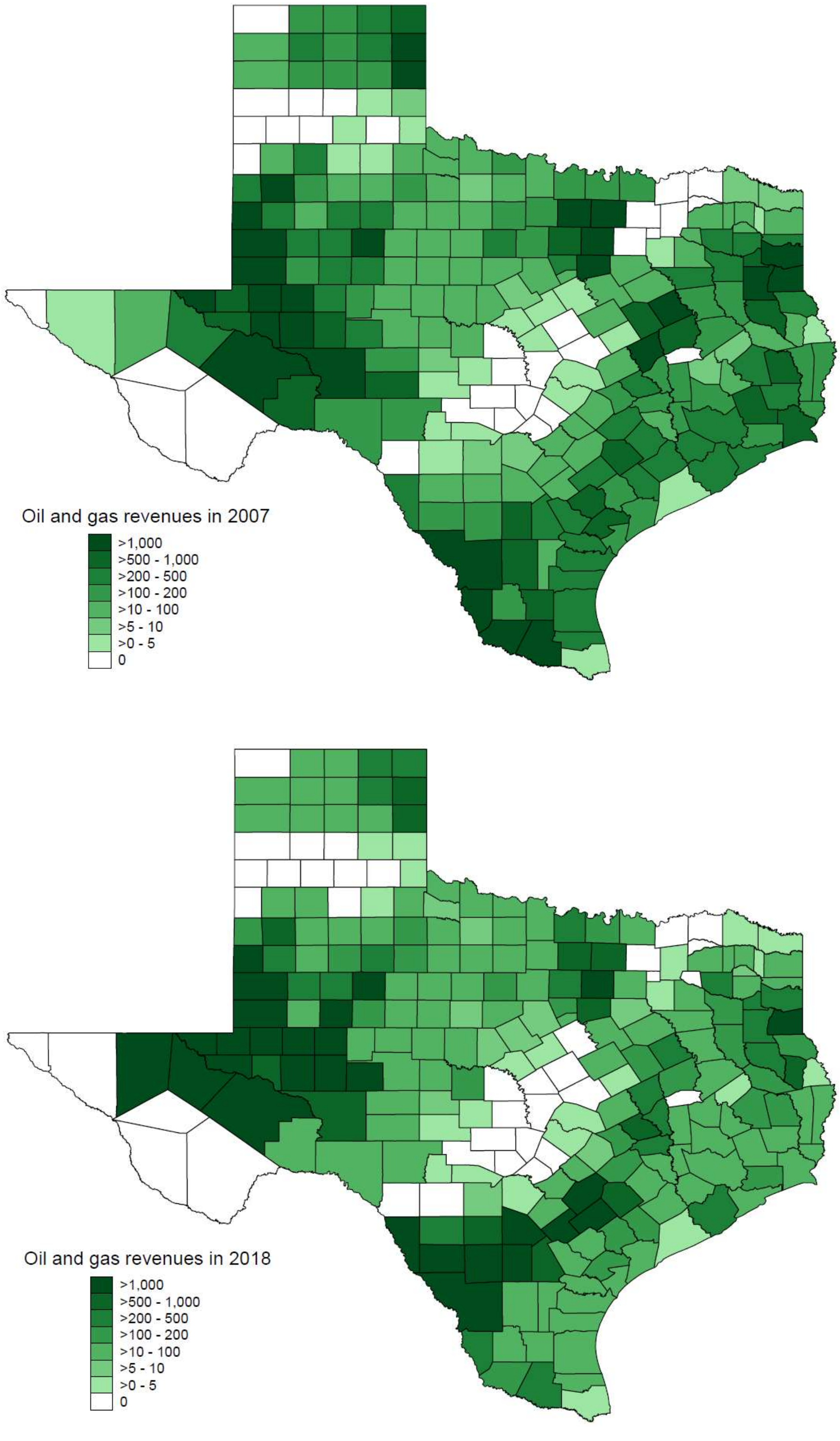


Figure 5: Oil and gas revenues (million dollars) by county in Texas in 2007 and 2018

Table 2: Effect of oil and gas revenues on schools' ACT scores

Variables	OLS results				IV results			
	ACT All Subjects (1)	ACT ELA (2)	ACT Math (3)	ACT Science (4)	ACT All Subjects (5)	ACT ELA (6)	ACT Math (7)	ACT Science (8)
log(Oil & gas revenues)	0.024***	0.031***	0.016***	0.019***	0.021***	0.030***	0.014*	0.015*
	(0.006)	(0.007)	(0.006)	(0.006)	(0.008)	(0.010)	(0.008)	(0.008)
Nonwhite students ratio	-0.008	-0.007	-0.022	0.014	-0.059	-0.064	-0.058	-0.040
	(0.040)	(0.049)	(0.037)	(0.039)	(0.045)	(0.054)	(0.041)	(0.043)
Economically disadvantaged students ratio	-0.017	-0.031	-0.002	-0.011	0.017	0.012	0.014	0.021
	(0.025)	(0.031)	(0.022)	(0.024)	(0.030)	(0.038)	(0.025)	(0.028)
Special education ratio	-0.095	-0.096	-0.059	-0.115	-0.014	0.015	-0.038	-0.048
	(0.098)	(0.119)	(0.091)	(0.095)	(0.108)	(0.131)	(0.098)	(0.104)
Gifted students ratio	0.262***	0.317***	0.224***	0.197***	0.217***	0.276***	0.173***	0.159**
	(0.053)	(0.060)	(0.050)	(0.058)	(0.063)	(0.073)	(0.058)	(0.066)
Nonwhite × oil & gas revenues	-0.027***	-0.041***	-0.011	-0.021***	-0.007	-0.018	0.003	0.000
	(0.007)	(0.009)	(0.007)	(0.007)	(0.010)	(0.013)	(0.009)	(0.010)
Eco. disadv. × oil & gas revenues	-0.021***	-0.020**	-0.021***	-0.021***	-0.033***	-0.036***	-0.026***	-0.033***
	(0.007)	(0.009)	(0.006)	(0.007)	(0.009)	(0.012)	(0.008)	(0.009)
Special education × oil & gas revenues	0.036	0.037	0.017	0.044	0.004	-0.006	0.008	0.018
	(0.030)	(0.036)	(0.029)	(0.029)	(0.035)	(0.042)	(0.033)	(0.033)
Gifted × oil & gas revenues	-0.014	-0.019	-0.008	-0.007	0.008	0.002	0.015	0.012
	(0.016)	(0.019)	(0.015)	(0.017)	(0.022)	(0.026)	(0.020)	(0.023)
log(Students)	0.005	0.009	-0.002	0.005	0.006	0.009	-0.002	0.005
	(0.008)	(0.010)	(0.008)	(0.009)	(0.009)	(0.010)	(0.008)	(0.009)
log(Teacher to students ratio)	-0.007	-0.002	-0.009	-0.008	-0.007	-0.003	-0.009	-0.009
	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)	(0.008)
log(Teacher experience)	0.015***	0.018***	0.012**	0.015***	0.015***	0.018***	0.013***	0.015***
	(0.005)	(0.007)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)
log(Median household income)	-0.023*	-0.028*	-0.015	-0.023*	-0.023*	-0.028*	-0.015	-0.023*
	(0.012)	(0.014)	(0.011)	(0.012)	(0.012)	(0.014)	(0.011)	(0.012)
log(Taxable value index)	0.011*	0.012*	0.009*	0.008	0.012**	0.013*	0.010*	0.009
	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,551	9,551	9,551	9,551	9,551	9,551	9,551	9,551
R-squared	0.850	0.834	0.846	0.825				
Kleibergen-Paap Wald F-statistic					118.4	118.4	118.4	118.4

Robust standard errors clustered at school-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Effect of oil and gas revenues on schools' ACT scores - separated tax revenues

Variables	Taxable Value	ACT All subjects	ACT ELA	ACT Math	ACT Science
	(1)	(2)	(3)	(4)	(5)
log(Oil & gas revenues)	0.016***	0.021***	0.029***	0.015*	0.015*
	(0.006)	(0.008)	(0.010)	(0.008)	(0.008)
Nonwhite students ratio		-0.055	-0.059	-0.054	-0.037
		(0.045)	(0.054)	(0.041)	(0.044)
Economically disadvantaged students ratio		0.020	0.016	0.016	0.023
		(0.030)	(0.038)	(0.025)	(0.028)
Special education ratio		-0.019	0.009	-0.041	-0.053
		(0.108)	(0.131)	(0.099)	(0.104)
Gifted students ratio		0.213***	0.271***	0.171***	0.155**
		(0.063)	(0.073)	(0.058)	(0.066)
Nonwhite $\times$ oil & gas revenues		-0.009	-0.020	0.002	-0.001
		(0.010)	(0.013)	(0.009)	(0.010)
Eco. disadv. $\times$ oil & gas revenues		-0.034***	-0.038***	-0.027***	-0.034***
		(0.009)	(0.012)	(0.008)	(0.009)
Special education $\times$ oil & gas revenues		0.006	-0.004	0.010	0.020
		(0.035)	(0.042)	(0.033)	(0.033)
Gifted $\times$ oil & gas revenues		0.008	0.002	0.015	0.012
		(0.022)	(0.026)	(0.020)	(0.023)
log(Students)		0.006	0.010	-0.001	0.005
		(0.009)	(0.010)	(0.008)	(0.009)
log(Teacher to students ratio)		-0.007	-0.003	-0.010	-0.009
		(0.008)	(0.010)	(0.008)	(0.008)
log(Teacher experience)		0.015***	0.018***	0.013***	0.015***
		(0.005)	(0.007)	(0.005)	(0.006)
log $(\widehat{V}^*)$		0.059**	0.076**	0.038	0.043
		(0.027)	(0.033)	(0.024)	(0.027)
log(Median household income)	0.222***				
	(0.051)				
log(Population over the age of 16)	0.375***				
	(0.072)				
ISD fixed effects	Yes				
School fixed effects		Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Observations	6,122	9,551	9,551	9,551	9,551
R-squared	0.989				
Kleibergen-Paap Wald F-statistic		104.7	104.7	104.7	104.7

Robust standard errors clustered by schools are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Effect of oil and gas revenues on schools' ACT scores by subject and race/ethnicity

Variables	ACT All Subjects	ACT ELA	ACT Math	ACT Science
	(1)	(2)	(3)	(4)
log(Oil & gas revenues)	0.018**	0.026**	0.011	0.012
	(0.008)	(0.010)	(0.008)	(0.008)
Black students ratio	-0.082	-0.102	-0.100	-0.007
	(0.078)	(0.099)	(0.066)	(0.073)
Hispanic students ratio	-0.058	-0.059	-0.064	-0.045
	(0.052)	(0.062)	(0.047)	(0.049)
Asian students ratio	0.165	0.159	0.188	0.163*
	(0.118)	(0.139)	(0.120)	(0.094)
Multi-race students ratio	-0.510**	-0.502*	-0.492***	-0.473**
	(0.211)	(0.260)	(0.184)	(0.199)
Economically disadvantaged students ratio	0.013	0.010	0.011	0.017
	(0.031)	(0.040)	(0.026)	(0.029)
Special education ratio	-0.007	0.022	-0.029	-0.045
	(0.109)	(0.132)	(0.099)	(0.104)
Gifted students ratio	0.205***	0.261***	0.164***	0.151**
	(0.064)	(0.075)	(0.059)	(0.067)
Black $\times$ oil & gas exposure	-0.033	-0.047*	-0.005	-0.036*
	(0.020)	(0.026)	(0.018)	(0.020)
Hispanic $\times$ oil & gas exposure	-0.011	-0.021	-0.003	-0.002
	(0.011)	(0.014)	(0.010)	(0.011)
Asian $\times$ oil & gas exposure	0.057	0.049	0.079*	0.055
	(0.047)	(0.053)	(0.044)	(0.048)
Multi-race $\times$ oil & gas exposure	0.108	0.087	0.130**	0.108
	(0.071)	(0.088)	(0.065)	(0.066)
Eco. disadv. $\times$ oil & gas revenues	-0.031***	-0.035***	-0.024***	-0.031***
	(0.010)	(0.012)	(0.008)	(0.009)
Special education $\times$ oil & gas revenues	0.008	-0.001	0.010	0.023
	(0.035)	(0.042)	(0.033)	(0.033)
Gifted $\times$ oil & gas revenues	0.008	0.002	0.015	0.011
	(0.022)	(0.026)	(0.020)	(0.023)
log(Students)	0.004	0.008	-0.003	0.004
	(0.008)	(0.010)	(0.008)	(0.008)
log(Teacher to students ratio)	-0.008	-0.004	-0.010	-0.009
	(0.008)	(0.010)	(0.008)	(0.008)
log(Teacher experience)	0.015***	0.018***	0.013***	0.015***
	(0.006)	(0.007)	(0.005)	(0.006)
log $(\widehat{V}^*)$	0.057**	0.074**	0.033	0.043*
	(0.026)	(0.031)	(0.024)	(0.025)
School fixed effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Observations	9,551	9,551	9,551	9,551
Kleibergen-Paap Wald F-statistic	73.70	73.70	73.70	73.70

Robust standard errors clustered at school-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Regression results for ACT scores (*All Subjects*) - Robustness Checks

PANEL A: Alternative samples

	Full Sample (1)	No Charter (2)	MSA ISD (3)	non-MSA ISD (4)	Excl. Largest Counties (5)
log(Oil & gas revenues)	0.021***	0.022***	0.019*	0.011	0.021**
	(0.008)	(0.008)	(0.010)	(0.016)	(0.008)
Nonwhite students ratio	-0.055	-0.064	-0.107*	0.002	-0.047
	(0.045)	(0.046)	(0.055)	(0.085)	(0.045)
Economically disadvantaged students ratio	0.020	0.002	0.080**	-0.081	0.016
	(0.030)	(0.030)	(0.037)	(0.054)	(0.030)
Special education ratio	-0.019	0.029	0.008	-0.047	-0.041
	(0.108)	(0.107)	(0.146)	(0.175)	(0.112)
Gifted students ratio	0.213***	0.228***	0.163**	0.323**	0.206***
	(0.063)	(0.063)	(0.069)	(0.135)	(0.064)
Nonwhite × oil & gas revenues	-0.009	-0.012	0.012	-0.026	-0.011
	(0.010)	(0.010)	(0.014)	(0.018)	(0.010)
Eco. disadv. × oil & gas revenues	-0.034***	-0.030***	-0.066***	0.004	-0.033***
	(0.009)	(0.009)	(0.014)	(0.013)	(0.010)
Special education × oil & gas revenues	0.006	-0.013	-0.002	0.017	0.014
	(0.035)	(0.035)	(0.053)	(0.050)	(0.036)
Gifted × oil & gas revenues	0.008	0.002	0.018	-0.032	0.006
	(0.022)	(0.022)	(0.029)	(0.035)	(0.022)
School fixed effects	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Observations	9,551	8,979	6,568	2,983	9,381
Kleibergen-Paap Wald F-statistic	104.7	104.9	63.52	45.18	100.3

PANEL B: Alternative definition of oil and gas exposure: 3-year average

	Full Sample (1)	No Charter (2)	MSA ISD (3)	non-MSA ISD (4)	Excl. Largest Counties (5)
log(Oil & gas exposure)	0.024**	0.026**	0.020	0.007	0.022**
	(0.011)	(0.011)	(0.012)	(0.022)	(0.011)
Nonwhite students ratio	-0.052	-0.074	-0.104*	-0.010	-0.050
	(0.049)	(0.050)	(0.060)	(0.094)	(0.050)
Economically disadvantaged students ratio	0.016	-0.001	0.085**	-0.100*	0.013
	(0.033)	(0.032)	(0.042)	(0.056)	(0.033)
Special education ratio	-0.046	0.005	-0.013	-0.045	-0.066
	(0.113)	(0.112)	(0.152)	(0.182)	(0.117)
Gifted students ratio	0.225***	0.242***	0.167**	0.341**	0.215***
	(0.066)	(0.065)	(0.072)	(0.140)	(0.066)
Nonwhite × oil & gas exposure	-0.009	-0.008	0.012	-0.021	-0.009
	(0.012)	(0.012)	(0.016)	(0.021)	(0.012)
Eco. disadv. × oil & gas exposure	-0.031***	-0.027***	-0.065***	0.009	-0.030***
	(0.010)	(0.009)	(0.015)	(0.014)	(0.010)
Special education × oil & gas exposure	0.017	-0.004	0.007	0.018	0.023
	(0.036)	(0.036)	(0.054)	(0.052)	(0.037)
Gifted × oil & gas exposure	0.003	-0.004	0.016	-0.038	0.003
	(0.022)	(0.023)	(0.029)	(0.036)	(0.023)
Observations	9,551	8,979	6,568	2,983	9,381
Kleibergen-Paap Wald F-statistic	91.42	85.25	77.01	18.58	89.85

Robust standard errors clustered at school-level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. In all specifications, we control for number of students, teacher to students ratio, teacher experience, and V^*.

Table 6: Effect of oil and gas revenues on other educational outcomes

PANEL A: All students

Variables	Test-Taking	Graduates	Dropout	Attendance
	(1)	(2)	(3)	(4)
log(Oil & gas revenues)	0.038	0.031	-0.004	-0.003**
	(0.033)	(0.024)	(0.073)	(0.001)
Nonwhite × oil & gas revenues	-0.067	-0.056*	-0.067	0.006***
	(0.043)	(0.029)	(0.092)	(0.002)
Eco. disadv. × oil & gas revenues	0.007	0.003	-0.125*	0.004***
	(0.032)	(0.025)	(0.076)	(0.001)
Special education × oil & gas revenues	0.284**	0.114	-0.128	-0.003
	(0.128)	(0.090)	(0.267)	(0.006)
Gifted × oil & gas revenues	-0.047	-0.043	0.287	-0.001
	(0.080)	(0.060)	(0.185)	(0.003)
School fixed effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Observations	9,287	9,539	9,549	9,546
Kleibergen-Paap Wald F-statistic	95.23	104.5	103.1	103.1

PANEL B: Economically disadvantaged students

Variables	Test-Taking	Graduates	Dropout	Attendance
	(1)	(2)	(3)	(4)
log(Oil & gas revenues)	-0.132**	-0.099**	-0.001	-0.003*
	(0.057)	(0.039)	(0.067)	(0.001)
Nonwhite × oil & gas revenues	0.006	0.063	-0.036	0.008***
	(0.068)	(0.048)	(0.086)	(0.002)
Eco. disadv. × oil & gas revenues	0.077	0.023	-0.090	0.004*
	(0.057)	(0.044)	(0.075)	(0.002)
Special education × oil & gas revenues	0.233	0.008	0.043	-0.003
	(0.197)	(0.139)	(0.235)	(0.006)
Gifted × oil & gas revenues	-0.136	-0.030	0.330**	0.001
	(0.126)	(0.105)	(0.158)	(0.003)
School fixed effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Observations	8,976	9,539	9,520	9,520
Kleibergen-Paap Wald F-statistic	91.02	104.5	102.2	102.1

Robust standard errors clustered at school-level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. In all specifications, we control for number of students, teacher to students ratio, teacher experience, V^*, and cohort demographics.