Local public fiscal effects of fracking: The case of Texas

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Abstract

This paper extensively analyzes the local public fiscal effects of the fracking boom. It does so by analyzing the effects over time, exploring a potential boom-bust structure and fiscal health implications associated with it. Furthermore, it decomposes the effects into the effects for the different types of local governments (county, municipality, special district, and school district). Additionally, the paper investigates potential spatial interaction effects, where counties are affected by the fracking-boom activities in a neighboring county. The results show that local public revenues and expenditures per capita grow by about the same, with no clear signs of fiscal health issues. Affected counties experience a growth in *property tax* revenues, used for increased spending on *highways, police, parks and recreation*, and *judicial administration*. Affected school districts also experience an increase in *property tax* revenues, which they use to increase *elementary and secondary education* spending per capita, and, with weaker significance, per student. No clear fiscal effects are fund for municipalities and special districts. The effects for counties and school districts are most visible after around five years. Positive spatial effects are found for oil and gas production value on neighboring *sales and gross receipts tax* revenues. Positive spatial effects for new active wells are found for neighboring *health* and *highways* expenditures. We also find negative *higher education* effects associated with fracking, both for the neighboring counties as for the fracking counties themselves, indicative of a resource curse. The results are used to discuss the benefits and issues for local communities associated with fracking.

Keywords: Fracking, local public finance, fiscal health, diff-in-diff, spatial durbin model

JEL classification: H7, L71, Q35, R51,

Declarations of interest: none

1. Introduction

From 2000 onwards, the United States has experienced a "fracking boom". The fracking boom is the result of a combination of two novel methods: horizontal drilling and hydraulic fracturing (Jackson et al., 2016; Zwick, 2018). The new technology was first used to re-drill older vertical wells to extract remaining oil, but starting in 2009, new well designs were created (Zwick, 2018). While there are economic benefits associated with fracking (Fetzer, 2014; Feyrer, Mansur, & Sacerdote, 2017; Weber, 2014), it is not without controversy as local communities may bear the costs related to environmental risks (Zwick, 2018). These are among the reasons the production and use of shale gas wells is restricted across numerous States in the US (Zwick, 2018).

If the necessary local public expenditures/costs are higher than the increased revenues in the long-run, this poses an issue on how to finance the increased expenditures. There may also be a discrepancy between the increased local public revenues and expenditures, where expenditures are needed beforehand or during the fracking boom whereas the increased revenues may lag months or years behind (Zwick, 2018). A major budget deficit may put local governments in a dilemma between underinvestment or being overleveraged (Zwick, 2018). It is therefore argued by some that local governments bear a disproportionate share of the expenses in relation to the revenue that they receive, posing possible fiscal health issues (Zwick, 2018). However, evidence thus far seems to find fracking to be largely budget neutral, or even positive, with slightly higher positive revenue effects than expenditure effects (Bartik, Currie, Greenstone, & Knittel, 2019; Newell & Raimi, 2015). Although, rural Colorado and Wyoming show some initial fiscal issues in managing the oil and gas booms (Newell & Raimi, 2015).

While Bartik *et al.*(2019) provide an excellent overview of the welfare effects associated with the fracking-boom, we argue that the specific local public fiscal effects deserve a more detailed exploration of their specific effects and what this means to the local communities. We still do not know how the local public fiscal effects developed over time, if there is a sign of a boom-bust structure, to what extent the different types of local governmental entities are affected differently, and how counties are affected by the fracking activities of neighboring counties. Furthermore, we further decompose some of the fiscal components, through which we show that the effects on education are not insignificant, but rather negative for higher education, while being positive for elementary and secondary education. This has major implications for our understanding of the effects of the fracking-boom. Answers to these questions should bring us closer to understanding the effects the fracking-boom have on the local community and whether or not local communities should be welcoming of major fracking activities.

This paper thus extends our current knowledge on the fiscal effects of fracking in four ways. First, we analyze the development of the fiscal effects of fracking over time, thereby analyzing the development of the local public fiscal effects. Furthermore, we use a longer time period. This allows us to identify the potential end of the fracking boom and possible start of a bust. Secondly, we decompose the fiscal effects into the effects on the four types of local governments: county, municipalities, special districts, and school districts in order to derive which types of local governments have been most affected by the fracking boom[1]. Thirdly, we estimate spatial interaction effects associated with fracking, as we anticipate counties to be affected by the fracking activities of their neighboring counties. Finally, we use more detailed fiscal components to explore potential adverse effects within grouped fiscal components (e.g. education). The first two novel insights are established through a diff-in-diff approach. The third is gained through five-year average differenced estimations with spatial lags, and the final novelty may be found in both types of estimations.

The case of Texas is used, given that it is one of the most affected states and because of the detailed data availability for Texas. The diff-in-diff estimations are guided by existing empirical work of Bartik *et al.* (2019), making use of their Rystad identification. The spatial econometric model uses data on the location and production value of oil and gas wells from the Railroad Commission of Texas (Railroad Commission of Texas, 2019).

This paper continues with a description of the literature on the effects of fracking, subdivided into the effects on local public revenues, local public expenditures, potential local public fiscal health issues, and local public spatial effects associated with fracking. Next, a description of the data is presented for the diff-in-diff estimations and the spatial estimations. Subsequently, the diff-in-diff estimation strategy is presented followed by the estimation results. After that, the spatial estimation strategy is described, followed by the estimation results. The discussion

[1] Note that some states also include townships as a separate type of local governmental entity. Given that Texas does not have townships, this type of governmental entity is not listed in this paper.

section brings all the results together in a discussion on the local public fiscal effects associated with fracking. Finally, the conclusion presents a short conclusion to the paper.

2. Effects of fracking

The fracking is the combination of using horizontal drilling with hydraulic fracturing (Jackson et al., 2016; Zwick, 2018). These novel technologies were development through a combination of private investments and US government funded R&D programs in the late 1970s, early 1980s as a response to a gas shortage at the time (Wang & Krupnick, 2015). The new technologies opened up the opportunity of accessing previously unreachable oil and gas minerals[2].

The fracking-boom terminology already suggests a boom-bust cycle associated with it. This is substantiated by the structure of the fracking activities. The creation of a well takes between three to six months on average, during which, at peak time, around 900 workers are needed for only a short period of time, resulting in only around 13 full-time employees for a year (Zwick, 2018). Once the well is constructed, a small number of workers can service the wells. Some argue that the boom-bust cycle associated with fracking is harmful for municipal fiscal health (Zwick, 2018). Although, evidence thus far seems to suggest fracking to be largely budget neutral (Bartik et al., 2019).

While fracking has come with a lot of economic benefits (Fetzer, 2014; Weber, 2014), it is also associated with negative externalities, such as decreased livability (Zwick, 2018), water safety issues, wastewater disposal and air quality concerns (Jackson et al., 2016; Zwick, 2018), traffic (Bartik et al., 2019), noise pollution (Bartik et al., 2019; Zwick, 2018), and minor man-made earthquakes (Goho, 2012; Zwick, 2018). Furthermore, fracking locations often struggle with issues of declines in health, depression, family stress, addiction, and crime, including violence towards women (Bartik et al., 2019; Jacquet, 2009; Shandro, Veiga, Shoveller, Scoble, & Koehoorn, 2011; Zwick, 2018). For these reasons, some states have prohibited fracking (Zwick, 2018).

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[2] Besides fracturing oil and gas, the new technology also opened up new opportunities sand mining. This is not part of our analysis. However, another paper found that it is associated with lower population growth, positive income effects, and no employment growth effects (Deller & Schreiber, 2012).

On the other hand fracking increases fracking jobs and also jobs in related and unrelated industries (Christopherson & Rightor, 2014; Fetzer, 2014; Feyrer et al., 2017; Weber, 2012). Each million dollar of new production is estimated to create $80.000 in wage income and $132.000 in royalty and business income within a county (Feyrer et al., 2017). The restriction of fracking in some states may therefore impose significant opportunity costs. Bartik *et al.* (2019) estimate the willingness-to-pay for negative externalities of fracking at around $2.500, although it is heterogenous running from practically $0 to $10.000.

Besides various environmental and social issues, and the positive economic effects of fracking, it is also argued to increase local public spending and revenues (Christopherson & Rightor, 2014). However, there is a debate on which is increased more and if this potentially leads to fiscal health issues over the longer term (Zwick, 2018). Below, these arguments are further explored.

2.1. Revenues

Property tax is the main source of revenue for local governments, and may increase as a result of increased property value (Weber, Burnett, & Xiarchos, 2016). Although there is also evidence of negative property value effects from fracking due to the risk of groundwater contamination (Boxall, Chan, & McMillan, 2005). Muehlenbachs, Spiller, and Timmins (2016) find small positive house price changes within two kilometers of a well, but a negative effect if the house is dependent on well water. Property taxes may also increase due to a reclassification from agricultural land, which often has a low tax rate, to industrial land, which has a higher tax rate (Bamberger & Oswald, 2015). However, county governments may take years to reassess property values thereby creating a lag between drilling activity and reassessment (Zwick, 2018). This means that most value may already be extracted before the property is properly reassessed.

The estimated population growth effect associated with fracking also mean that local public revenues may increase due to an increased tax base (Christopherson & Rightor, 2014; Newell & Raimi, 2015), although this does not have to translate into increased per capita revenues. Fracking may also result in increased sales tax revenues from the fact that landowners receive royalty payments through which they have extra money to spend (Christopherson & Rightor, 2014; Newell & Raimi, 2015). Furthermore, State government may give more aid to local governments to mitigate the negative externalities from fracking (Newell & Raimi, 2015; Zwick, 2018), and local governments may also collect mineral royalties on their lands (Newell & Raimi, 2015; Zwick, 2018) or receive in-kind contributions from gas and oil companies (Newell & Raimi, 2015).

Through extensive interviews with local governmental officials, Newell and Raimi (2015) show that the local public revenue effects of fracking may differ across states. For Texas, they find no severance tax, impact fee, or in-kind-transfers from the oil and gas companies. They do find that affected counties in Texas profit from increased property taxes, and affected municipalities source more sales tax, and fee-for-service or lease revenues. Bartik *et al.* (2019) show that the fracking boom increased property tax revenues, and sales tax revenues.

2.2. Expenditures

The increased population resulting from the fracking-boom may mean that local governments are forced to increase their spending on providing services and infrastructure needed to support the increase of population and industry (Newell & Raimi, 2015; Zwick, 2018). Abramzon *et al.* (2014) estimated that each hydraulically-fractured well in Pennsylvania was responsible for damage to local roads between $13,000 and $23,000. In order to combat some of these costs, local governments may negotiate Road Use and Maintenance Agreements (RUMAs) with fracking companies in which fracking companies bear some of the costs. Taking into account such RUMAs, Abramzon *et al.* (2014) still find road damage of between $5,000 - $10,000 per well.

Local public expenditures are argued to increased due to an increase in need for public services (Christopherson & Rightor, 2014; Newell & Raimi, 2015). Furthermore, there is a need for additional administrative capacity meaning increased staffing levels, buying equipment and hiring outside expertise (Christopherson & Rightor, 2014; Newell & Raimi, 2015; Zwick, 2018). The increase in (especially young male population) is argued to also increase needed spending on public safety (Jacquet, 2009; Zwick, 2018). In line with those arguments is the finding that fracking increases sex ratios due to male in-migration resulting in an increase in the use of prostitution markets and enhanced gonorrhea transmission effects (Cunningham & DeAngelo, 2020).

It is also hypothesized that there are local public judicial administrative costs associated with fracking. The initial reaction of local governments to the fracking boom has sometimes been to ban fracking, perhaps because smaller municipalities lack the administrative capacity to regulate new environmental issues (Hanna, 2005; Miller et al., 2009; Wilson, 2006; Zwick, 2018). But local fracking bans have been struck down by state courts and pre-empted by state legislatures (Zwick, 2018). These procedures also come at administrative and staff costs to local public governments.

Finally, it is unclear what the relationship between fracking and education expenditures should be. On the one hand, increased revenues may free up money to invest in education. Furthermore, the influx of workers may mean an influx of children along with them, although this should not necessarily increase education expenditures per capita. On the other hand, the literature on the resource curse shows how there may be a negative relationship. The observation of countries or regions that are rich in natural resources, showing relatively lower economic growth is known as the resource-curse and has been well documented (Weber, 2014). Typically, empirical studies on the resource curse use cross-country studies (Auty, 2001; Sachs & Warner, 2001; Van Der Ploeg, 2011), but there is also growing within-country evidence (A. James & Aadland, 2011; Papyrakis & Gerlagh, 2007). One of the ways in which the resource curse is created, is through a decline in educational attainment (Weber, 2014). The argument here is that resource industries may increase wages of low-skilled workers relatively more than high-skilled workers, thereby decreasing the incentive for the local population to invest in education (Weber, 2014). Thus, as the local population is less incentivized to invest in education, local public education expenditures may simply decline as a result of a decline in demand.

In their interviews, Newell and Raimi (2015) find that affected counties in Texas increased spending on roads and staff, while affected municipalities in Texas increased spending on sewerage and water, and staff. Through a diff-in diff approach, Bartik *et al.* (2019) show that the fracking boom increased expenditures on public safety and infrastructure and utilities. They find no significant effects on welfare and hospitals, and education expenditures.

2.3. Spatial effects

The fiscal effects of fracking are likely to not be constrained by county borders. Incoming workers may choose to reside in a neighboring county, or to a nearby metropolitan area with better services, infrastructure and future job opportunities (Zwick, 2018). Surrounding counties may also experience increased business upstream and downstream supply linkages (Zwick, 2018). Negative externalities may be experienced in the form of road damage from through traffic.

The risks of fracking are often localized and long lasting (Brasier et al., 2011; Perry, 2012), whereas the benefits may be more regional in the form of increased investment and jobs (Christopherson & Rightor, 2014). This means that the benefits of fracking may be disproportionally distributed relative to the risks. Given the unevenly distributed fiscal benefits and costs, it is important for local governments to work together to solve the spatial fiscal issues (Zwick, 2018). The fiscal impacts of fracking are likely to be regionally, rather than locally, also affecting nearby cities and counties (Christopherson & Rightor, 2014).

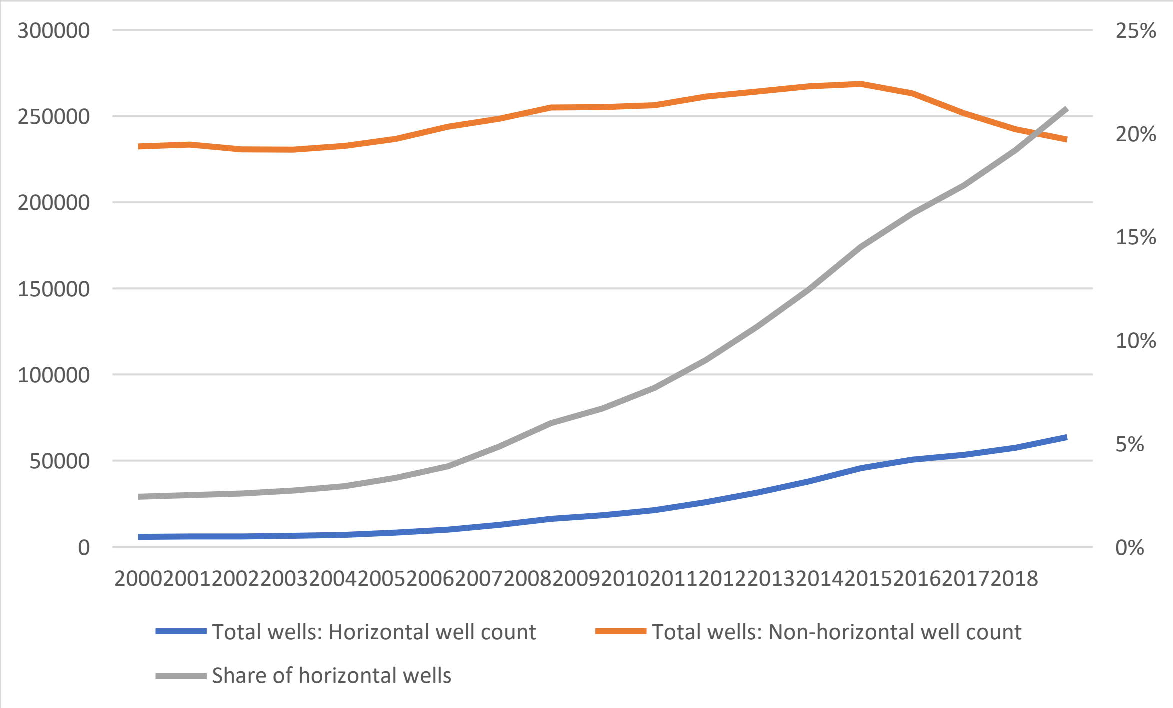
In their response to a paper by Feyrer *et al.* (2017), James and Smith (2020) address the importance of accounting for spatial affects, arguing that "fracking counties" tend to be clustered and receive inward spillovers from neighboring counties. Without controlling for such spatial interactions, the effects of fracking are overestimated (A. G. James & Smith, 2020). This may be either using spatial lags up to a certain distance (Allcott & Keniston, 2018; Richter, Salanguit, & James, 2018), or through the use of contiguous counties (Weber, 2014; Weinstein, Partridge, & Tsvetkova, 2018). Given our fiscally standardized county system, we opt for the latter.

As highlighted in the introduction of this paper, we set out to analyze roughly two aspects associated with fracking and local public finance. First, we establish a new level of detail in the long-run fracking effects on local public finance through the use of a diff-in-diff structure, with a decomposition into the four different types of governmental entities. Secondly, we explore the spatial effects associated with fracking through a contemporaneous five-year average estimation approach, using a spatial lags.

3. Data

The fracking-boom describes the boom in horizontal-hydraulically fractured oil, and gas wells. The fracking-boom is evidenced by the growth in the share of horizontal wells as shown in figure 1. Non-horizontal wells show no increase over the period 2000-2018, whereas horizontal wells increase dramatically. This also increased horizontal wells as the share of total wells from around 4% up to over 20% from 2000 till 2018.

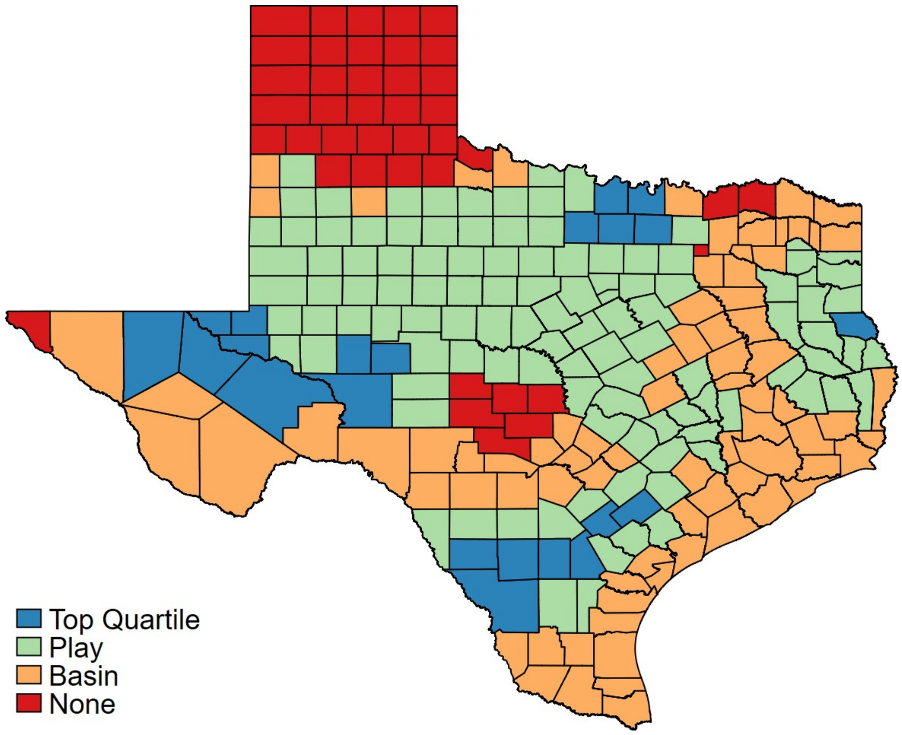
Figure 1: Hydraulically fractured horizontal wells accounted for most new oil and natural gas wells in Texas



Authors own elaborations using data from the Texas Commission on Environmental Quality (U.S. Energy Information Administration, 2019).

The diff-in-diff estimations uses the Rystad identification as developed by Bartik *et al.* (2019). The identification comes from the Rystad Energy prospectivity index, which *"captures the potential productivity of different portions of shale plays based on a nonlinear function of the different geological inputs"* (Bartik et al., 2019). Bartik *et al.* (2019) aggregate the Rystad prospectivity index up to the county level and subsequently divide the counties in each shale play into Rystad score quartiles. This identification has the benefit of ensuring exogeneity as it is constructed from the geological features of the area. The identification as used by Bartik *et al.* (2019) may be found in figure 2.

Figure 2: County Prospectivity Score Classifications as identified by Bartik *et al.* (2019)



Note: The prospectivity score classification comes from Bartik *et al.*(2019). The authors of this paper created this map with the prospectivity score classifications just for Texas for the sake of this paper.

The spatial lag models use data on the oil and gas production value and number of active oil and gas wells in Texas. While the direct effects of these fracking variables on the fiscal components may not be exogenous, the spatially lagged fracking variables, our variables of interest, are exogeneous. We use data on the location of oil and gas wells from the Railroad Commission of Texas (Railroad Commission of Texas, 2019). It includes data on the well distribution per Texas county in February and September for the years 2000-2019. Besides containing information on the total number of oil/gas wells, it also has information on the number of wells that are regular producing wells, inactive wells, and the number of wells (capable of) injecting fluid into a productive formation. The regular producing and injection wells are combined to create the number of active wells. The number of active wells are normalized per capita before entering the estimations.

Data on the oil and gas production also comes from the Railroad Commission of Texas (Railroad Commission of Texas, 2020). Oil production is measured in BBL and gas production is measured in MCF. The production value is measured by multiplying the oil production with the global price of WTI crude (Federal Reserve Bank of St. Louis, 2020), and multiplying the gas production by the Texas Natural Gas Industrial Price (U.S. Energy Information Administration, 2020). The production value is in one-million USD per capita in real 2015 USD.

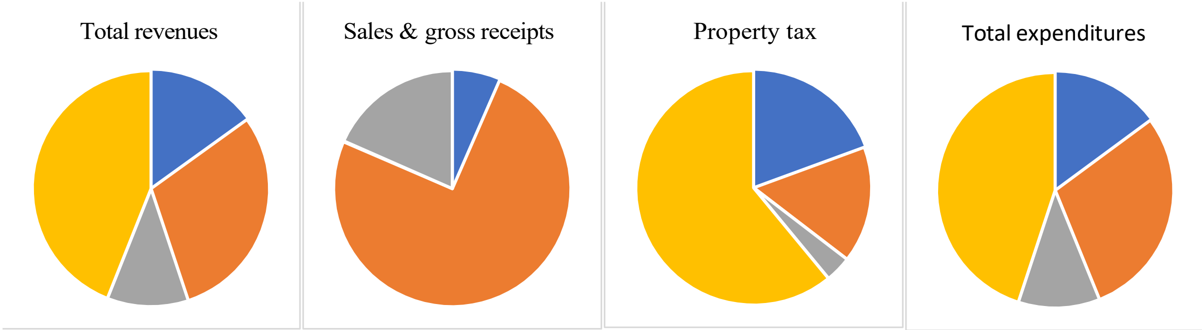
Data on the fiscal components comes from the quinquennial Census of Government Finance and the Annual Surveys of State and Local Government Finance, of the US Census Bureau. This has local public fiscal data for independent local governmental entities. Given the complex system of local governmental entities in the US, we fiscally standardize counties in line with the work on Fiscally Standardized Cities Database by the Lincoln Institute of Land Policy (Langley, 2016) and Bartik *et al.* (2019). This means that we collapse all local governmental entities (county, municipality, special districts, and school districts) into one fiscally standardized county. Intergovernmental transfers between local governments are deducted from total revenues, total expenditures and total intergovernmental transfers in order to avoid double counting. The fiscal components are measured in $1000 per capita.

Any missing data values are interpolated for the individual governmental entities before summing up all values into fiscally standardized counties. Additionally, we explore which types of local governmental entities are most affected by the fracking-boom. We do this by summing up the local public finance data for each specific type of local governmental entity in a given county. Thus, we create total public finance for municipalities, special districts, and school districts in a given county, as well as county government itself.

A selection of fiscal components is made based on our expectations from the literature. For example, instead of including public safety as a group of fiscal components (including the fire department, correction facilities, and inspection and regulation), we only include police expenditures as we expect it to best capture the hypothesized crime and public safety effects.

The relative importance of the four different types of local government becomes apparent through their share of revenues and expenditures as visualized in figure 3 below. School districts make up the largest share of total revenues and expenditures at around 45%. Second, are the municipalities at around 30%, followed by counties at 15% and special districts at around 10%. However, school districts do not source any sales and gross receipts tax revenues. Instead it sources nearly all its revenues through property tax. Property tax revenue makes up the largest share of total local public revenues (not shown here), as does expenditures on education (not shown here), which naturally follows from the relative size of school districts.

Figure 3: Share of total Texas fiscal components by type of governmental entity

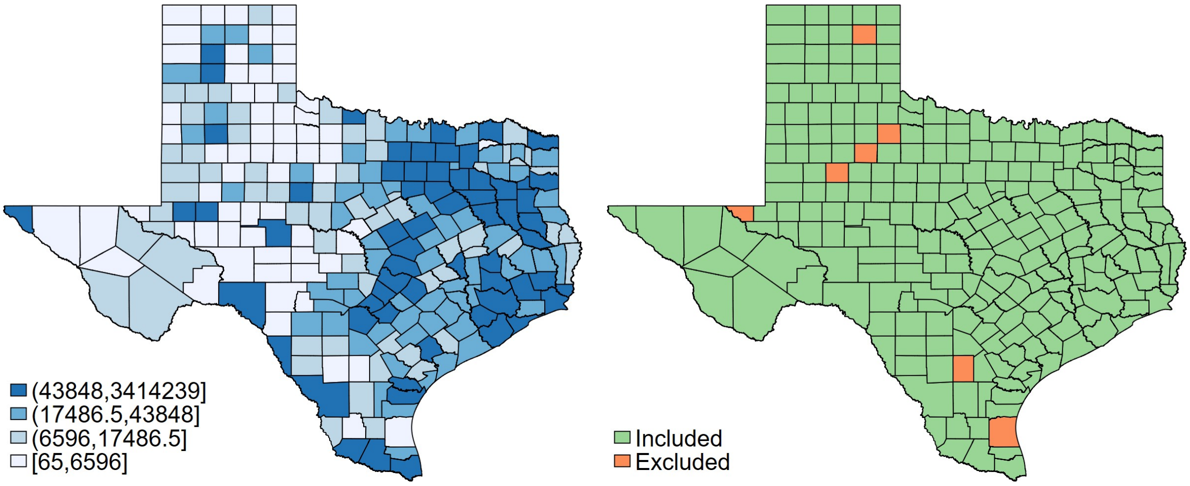


Authors own elaboration using the data from the US Census Bureau. The data represents total 1997-2017 fiscal components for local governments in Texas. The colors represent the following: blue = county, red = municipality, grey = special district, and yellow = school district.

Texas is home to some of the least populous counties in the country, such as Loving County, and King County which only have populations of around 100 and 300 respectively. Similar to Feyrer *et al.* (2017) we exclude the least populated counties because the results are sensitive to the inclusion of these counties. Especially Loving County is found to be an outlier affecting our results[3]. However, instead of using the 2% threshold like Feyrer *et al.* (2017), we use a threshold of a population of 1000 (in the year 2000) as to exclude McMullen county which is also found to be an outlier heavily affecting the results. Our threshold means that we exclude 7 out 254 counties, or around 2.75%. Figure 3 shows the population per county in 2000, as well as the counties that are excluded from the estimations. The appendix includes descriptive information about the data used for the diff-in-diff and spatial estimation models. It also includes information on student enrollment taken from the NCES (National Center for Educational Statistics, 2020), which is used to capture expenditures per student instead of per capita.

[3] Loving County has a big oil industry, which appears to have been affected by the fracking-boom. Total revenues per capita increased from around 15 thousand real USD per capita in 2000 to around 55 thousand in 2008, which has been slowly declining ever since.

Figure 4: Population per county and counties excluded from the estimations



Authors own elaboration using population data from the Bureau of Economic Analysis. Left shows the population per county in the year 2000. Right shows the counties that are excluded for having a population of less than 1000.

4. Difference in difference

4.1. Estimation strategy

For the longitudinal effects, we follow the estimation strategy as set out by Bartik *et al.* (2019). In their paper, Bartik *et al.* (2019) estimate the welfare effects of fracking, where welfare effects are captured through various economic estimators. The authors use an extensive diff-in-diff approach with annual data. However, in their estimations exploring the fracking effects on local public finance, they use a more limited diff-in-diff approach with only two time periods (2002 - 2012 in the paper and 1997 – 2012 in the appendix). We extend this analysis by using annual data from 1997 – 2017, using the more extended (time-series) diff-in-diff approach used by Bartik *et al.* (2019) for their other welfare measures. The annual data allows us to explore the fracking effects over time. Furthermore, given that data is now available until 2017, it allows us to explore a longer time period, thereby checking for a possible (boom-)bust effect.

The estimations follow the work of Bartik *et al.* (2019). This means that we start with the following equation for outcome fiscal component y, in county *c,* shale play *p,* and year *t*:

$$(1)\quad y_{cpt} = \mu_{pt} + \gamma_c + \delta\left(1[Post-fracking]_{pt} * 1[Rystad\ top\ quartile]_c\right) + \epsilon_{cpt}$$

The equation includes year-by-play fixed effects (μ_{pt}) and county fixed effects (γ_c). *Post-fracking* equals 1 in the year that fracking initiated and all subsequent years. The *Rystad top quartile* is the identification as used by Bartik *et al.* (2019). It has a value 1 when the maximum prospectively value within county *c,* is in the top quartile for counties in shale play *p.*

Given that fracking was initiated at different points in time in the various shale plays, there is a difference in the number of years pre- and post-fracking for the shale plays. This means that a county located in a shale play which initiated fracking in 2000, has 3 years pre-fracking and 17 years post-fracking in our dataset. However, counties where fracking initiated in 2008, show 11 years pre- and 9 years post-fracking. This creates an unbalanced dataset and means that we have a balanced dataset for 3 years pre-fracking, and 9 years post-fracking. An indicator is included for the observations that fall outside this time-frame:

$$(2)\quad y_{ct} = \mu_{c} + \gamma_{t} + \delta_1 \left(1[Post-fracking]_{ct} * 1[Rystad\ top\ quartile]_c\right) + \delta_2 \left(1[Unbalanced\ data]_{ct} * 1[Post-fracking]_{ct} * 1[Rystad\ top\ quartile]_c\right) + \epsilon_{ct}$$

As Bartik *et al.* (2019) point out, this estimation has two limitation. First, δ_1 may confound any treatment effect with differential pre-trends in the in the Rystad top-quartile counties. Secondly, the equation assumes fracking to affect only the level of the local public fiscal component, ignoring possible growth rate effects. These limitations are solved in our estimation procedure exploring the fracking-effects over time. Here, we adjust the equation (1) by replacing *post-fracking* for *event-year* indicators, where the *event-year* indicators are defined as the calendar year minus the year in which fracking was initiated in the specific shale play:

$$(3)\quad y_{ct} = \mu_{c} + \gamma_{t} + \delta_1 \left(Event\ year_{ct} * 1[Rystad\ top\ quartile]_c\right) + \epsilon_{ct}$$

This also means that the indicator for the unbalanced data is no longer needed, as long as we only look at the balanced event years (minus 3 - 9). We set year zero, when fracking is initiated, as the control group, from where the pre- and post-fracking effects are estimated.

4.2. Diff-in-diff results

First, the standard diff-in-diff estimation is performed (equation 2), in order to explore general diff-in-diff effects for the local public fiscal components. Three control strategies are used. The results are summarized in table 1 below.

Table 1: Diff-in-diff estimation results

Variable	2.1 Coef.	Std. Err.	2.2 Coef.	Std. Err.	2.3 Coef.	Std. Err.
Fiscal health components						
Total revenues	**1.677*****	(0.426)	**1.690*****	(0.420)	**1.252*****	(0.364)
Total expenditures	**1.532*****	(0.413)	**1.542*****	(0.407)	**1.093*****	(0.367)
Budget surplus	0.130	(0.0912)	0.148	(0.107)	0.159	(0.119)
Outstanding debt	0.366	(0.386)	0.407	(0.386)	0.572	(0.374)
Cash holdings	0.657	(0.435)	**0.722***	(0.431)	**0.800****	(0.353)
Expenditures by character						
Current operations	**0.604***	(0.312)	**0.593***	(0.306)	0.351	(0.232)
Capital outlay	**0.351*****	(0.0941)	**0.382*****	(0.0990)	**0.290*****	(0.0962)
Interest on general debt	0.0233	(0.0144)	**0.0256***	(0.0144)	**0.0324***	(0.0166)
Salaries/wages	0.161	(0.107)	0.141	(0.0992)	**0.155***	(0.0856)
Revenue components						
Intergovernmental	-0.0291	(0.100)	-0.0254	(0.104)	-0.00424	(0.101)
Property tax	**1.488*****	(0.371)	**1.499*****	(0.367)	**1.138*****	(0.375)
Sales and gross receipts	**0.0361***	(0.0211)	**0.0469****	(0.0217)	0.0319	(0.0217)
Utilities	-0.0313	(0.0225)	-0.0293	(0.0219)	-0.0343	(0.0313)
Expenditures by function						
Higher education	**-0.0397*****	(0.0121)	**-0.0394*****	(0.0118)	**-0.0563****	(0.0268)
Elem. & sec. education	**0.634*****	(0.191)	**0.633*****	(0.185)	**0.401****	(0.198)
´´ per student	**2.951*****	(0.875)	**2.962*****	(0.847)	**1.724***	(0.921)
Public welfare	-0.00359	(0.0188)	-0.00194	(0.0187)	-0.0117	(0.0270)
Hospitals	0.0378	(0.118)	0.0294	(0.117)	-0.0743	(0.118)
Health	-0.000735	(0.00990)	0.000325	(0.0100)	-0.00504	(0.0118)
Highways	**0.0519***	(0.0287)	**0.0538***	(0.0294)	0.0491	(0.0320)
Police	0.0150	(0.0168)	0.0146	(0.0173)	**0.0338****	(0.0149)
Natural resources	0.00605	(0.00748)	0.00539	(0.00772)	0.00260	(0.00943)
Parks & recreation	**0.0194***	(0.0114)	**0.0191***	(0.0113)	**0.0187***	(0.0105)
Housing & comm. dev.	0.000757	(0.0108)	-0.000473	(0.0115)	-0.00111	(0.0131)
Financial administration	0.0123	(0.0117)	0.0105	(0.0123)	0.0178	(0.0130)
Judicial administration	**0.0487*****	(0.0173)	**0.0489*****	(0.0172)	**0.0494*****	(0.0157)
Utilities	-0.0476	(0.0323)	-0.0377	(0.0327)	-0.0541	(0.0465)
Time FE	Yes		Yes		No	
County FE	No		Yes		Yes	
Play-year FE	No		No		Yes	

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All three estimations use equation 2. The errors are clustered at the county level. Even though the coefficients are shown below one another, they represent separate estimations. "*Per student*" represents expenditures on elementary and secondary education per student instead of per capita.

We find the diff-in-diff results for *total revenues* and *expenditures* to both be positive and significant, with total revenues being slightly higher, although not significantly different from total expenditures. *Outstanding debt* is insignificant and *cash holdings* significantly increase. Thus, we find no clear indication of any fiscal health issues associated with fracking. If anything, fracking seems to increase *total revenues* slightly more than *total expenditures*, with the additional sourced revenues potentially being invested/stored into *cash holdings*.

The decomposition of the expenditures by character shows that all types of expenditures increase. However, *current operations* turns insignificant once the play-year fixed effects are introduced. *Capital outlay* significantly increases, whereas *interest on general debt* and *salaries and wages* only show weak significance.

The decomposition of the revenue sources shows that the significant increase in revenues is mainly due to a significant increase in *property tax*. We also find an indication of an increase in *sales and gross receipts tax*, although its significant disappears as play-year fixed effects are introduced. *Intergovernmental revenues* and *utility revenues,* show no significant effects.

Finally, the decomposition of expenditures by function shows increases in expenditures on *elementary and secondary education, police, judicial administration,* and a minor increase in *parks and recreation* expenditures. The results for *elementary and secondary education* expenditures are shown in per capita, as well as per student. We find that the increase per student is higher but less significant. Furthermore, we find a negative effect for expenditures on *higher education*. Expenditures on *highways* show a weak positive effect, which disappears once play-year fixed effects are introduced. Other expenditure components show no significant effects: *Hospitals, public welfare, health, natural resources, housing and community development, financial administration,* and *utilities.*

The same estimations are performed for the four different types of local governmental entities separately. These results are shown in table 2 below. The results show that most of the overall diff-in-diff significance comes from counties and school districts. Both show increases in *total expenditures* and *total revenues,* with school districts also showing increases in *outstanding debt* and *cash holdings.* When looking at expenditures by character, we find significant diff-in-diff effects for all expenditures in counties, except for *interest on general debt.* School districts show no significant effects for *current operations* and *wages and salaries.* The significant *property tax* diff-in-diff effects are also found in counties and school districts. Additionally, there are some weak differences in *intergovernmental transfers,* suggesting that counties receive more *intergovernmental transfers* at the cost of other local governmental entities. Finally, the expenditures by function decomposition shows that the significant education effects are found in the school districts. The remaining significant effects mostly come from the counties in the form of higher expenditures on *highways, police, parks and recreation,* and *judicial administration.* Municipalities also show a weak positive effect for *judicial administration*. Negative health effects are found in the *special districts.*

Table 2: Diff-in-diff estimation results per type of local governmental entity

	County		City		Special district		School district	
Variable	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Fiscal health components								
Total revenues	**0.551*****	(0.186)	-0.00693	(0.0499)	-0.0289	(0.123)	**0.748****	(0.338)
Total expenditures	**0.450*****	(0.171)	-0.0124	(0.0501)	-0.113	(0.126)	**0.780****	(0.338)
Budget surplus	0.102	(0.0627)	0.00543	(0.0207)	0.0845	(0.0611)	-0.0313	(0.0438)
Outstanding debt	0.0730	(0.0997)	-0.115	(0.122)	-0.0821	(0.196)	**0.700****	(0.293)
Cash holdings	0.161	(0.107)	-0.119	(0.0995)	-0.0742	(0.134)	**0.838*****	(0.281)
Expenditures by character								
Current operations	**0.317****	(0.139)	-0.0135	(0.0364)	-0.0827	(0.114)	0.139	(0.157)
Capital outlay	**0.0992***	(0.0506)	-0.00300	(0.0178)	-0.0205	(0.0279)	**0.216*****	(0.0758)
Interest on general debt	0.00731	(0.00666)	0.000384	(0.00686)	0.00246	(0.0106)	**0.0226****	(0.0110)
Salaries/wages	**0.145*****	(0.0534)	0.00236	(0.0205)	-0.0378	(0.0528)	0.0477	(0.0309)
Revenue components								
Intergovernmental	**0.169****	(0.0849)	**-0.0334****	(0.0157)	**-0.0389***	(0.0217)	-0.102	(0.0638)
Property tax	**0.257*****	(0.0917)	0.0124	(0.00941)	0.0227	(0.0331)	**0.848****	(0.348)
Sales and gross receipts	0.0174	(0.0146)	0.0195	(0.0141)	-0.000543	(0.00272)	0	(0)
Utilities	0.000888	(0.00112)	-0.0267	(0.0231)	-0.00600	(0.0228)	0	(0)

Note: these notes belong to table 2 from the previous page. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All estimations use equation 2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Table 2: *continued*

Variable	County Coef.	County Std. Err.	City Coef.	City Std. Err.	Special district Coef.	Special district Std. Err.	School district Coef.	School district Std. Err.
Expenditures by function								
Higher education	-9.43e-08	(1.01e-07)	0	(0)	0	(0)	**-0.0563****	(0.0268)
Elem. & sec. education	0.000799	(0.00203)	1.23e-05	(2.83e-05)	0	(0)	**0.401****	(0.199)
´´ per student							**1.724***	(0.923)
Public welfare	-0.00292	(0.0256)	0.000330	(0.000384)	-0.00914	(0.00915)	0	(0)
Hospitals	-0.0310	(0.0531)	-0.00106	(0.00140)	-0.0423	(0.118)	0	(0)
Health	0.00865	(0.00789)	0.00297	(0.00456)	**-0.0162****	(0.00817)	0	(0)
Highways	**0.0616****	(0.0306)	-0.000779	(0.00892)	-0.0111	(0.00911)	0	(0)
Police	**0.0287****	(0.0134)	0.00662	(0.00759)	-4.54e-07	(4.60e-07)	0	(0)
Natural resources	0.00336	(0.00366)	-7.81e-05	(0.000220)	-0.000699	(0.00974)	0	(0)
Parks & recreation	**0.0228****	(0.00914)	-0.00384	(0.00414)	-3.43e-05	(0.000125)	0	(0)
Housing & comm. dev.	-0.00175	(0.0108)	0.00136	(0.00213)	-0.000635	(0.00907)	0	(0)
Financial administration	0.0196	(0.0128)	-0.00199	(0.00485)	0	(0)	0	(0)
Judicial administration	**0.0403****	(0.0157)	**0.00982***	(0.00569)	0	(0)	0	(0)
Utilities	0.00109	(0.00238)	-0.0177	(0.0237)	-0.0353	(0.0375)	0	(0)

Note: these notes belong to table 2 from the previous page. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All estimations use equation 2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects. "*Per student*" represents expenditures on elementary and secondary education per student instead of per capita.

4.3. Results over time

The effects are explored over time through the use of an event-study type of analysis, estimated using equation 3. The results for the fiscal health components are shown in table 3. The results show that *total revenues* and *total expenditures* are higher and increasing. However, the standard error and the negatively associated significance also quickly goes up after around five years, resulting in increasingly less significant results from around five years onwards. *Outstanding debt* and *cash holdings* are only briefly and weakly significantly different at around three years.

Table 3: Diff-in-diff estimation results over time for the fiscal health components

Year	Total revenues	Total expenditures	Budget surplus	Outstanding debt	Cash holdings
-3	-0.170	-0.0851	-0.0852	0.256	0.154
	(0.123)	(0.127)	(0.0587)	(0.297)	(0.233)
-2	**-0.166***	-0.0768	-0.0889	0.0968	0.0225
	(0.0867)	(0.0996)	(0.0740)	(0.200)	(0.169)
-1	**-0.148****	-0.0618	-0.0858	-0.0264	-0.0848
	(0.0731)	(0.0622)	(0.0743)	(0.0750)	(0.132)
0 = Reference					
1	0.113	0.186	-0.0721	0.115	0.153
	(0.108)	(0.125)	(0.0826)	(0.164)	(0.148)
2	**0.300***	**0.347***	-0.0463	0.631	**1.369***
	(0.179)	(0.204)	(0.108)	(0.399)	(0.720)
3	**0.398****	**0.494****	-0.0960	**0.722****	**0.718***
	(0.182)	(0.245)	(0.134)	(0.360)	(0.393)
4	**0.446***	**0.723***	-0.277	0.685	0.438
	(0.254)	(0.384)	(0.209)	(0.498)	(0.395)
5	**0.719*****	**0.915*****	-0.196	0.655	0.215
	(0.272)	(0.318)	(0.201)	(0.504)	(0.321)
6	**1.319*****	**1.114*****	0.205	0.970	0.715
	(0.403)	(0.364)	(0.147)	(0.589)	(0.580)
7	**1.797*****	**1.404****	0.393	0.949	0.998
	(0.542)	(0.613)	(0.294)	(0.668)	(0.634)
8	**1.737*****	**1.584****	0.153	0.539	0.373
	(0.622)	(0.718)	(0.351)	(0.656)	(0.512)
9	**1.501****	**1.477****	0.0242	0.903	0.756
	(0.588)	(0.626)	(0.276)	(0.664)	(0.634)
Constant	**3.965*****	**4.062*****	**-0.0977***	**3.124*****	**2.723*****
	(0.101)	(0.116)	(0.0573)	(0.249)	(0.241)
Observations	5,187	5,187	5,187	5,187	5,187
R-squared	0.617	0.609	0.067	0.207	0.138
# Counties	247	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

The results for expenditures by character are included in table 4. The results show no significant increases in *current operations*. *Capital outlay* is most significant and positive after around five years. *Interest on general debt* turns most significant one or two years later. *Salaries and wages* are mostly insignificant.

Table 4: Diff-in-diff estimation results over time for expenditures by character

Year	Current operations	Capital outlay	Interest on general debt	Salaries/wages
-3	-0.134	0.0472	0.00360	**-0.119****
	(0.108)	(0.0478)	(0.0105)	(0.0461)
-2	-0.103	0.0249	-0.00151	**-0.0874****
	(0.0788)	(0.0498)	(0.00811)	(0.0341)
-1	-0.0702	0.00633	-0.00316	**-0.0546****
	(0.0574)	(0.0293)	(0.00537)	(0.0263)
0 = Reference				
1	0.0970	0.0950	-0.000433	0.0171
	(0.0904)	(0.0780)	(0.00425)	(0.0214)
2	0.166	**0.183***	0.0145	0.0206
	(0.151)	(0.101)	(0.0107)	(0.0392)
3	0.228	**0.280****	0.0304	0.0311
	(0.150)	(0.136)	(0.0196)	(0.0462)
4	0.180	**0.538****	0.0318	0.0119
	(0.209)	(0.230)	(0.0248)	(0.0532)
5	0.272	**0.629*****	**0.0490***	0.0512
	(0.223)	(0.200)	(0.0254)	(0.0528)
6	0.343	**0.316****	**0.0522****	**0.103***
	(0.246)	(0.138)	(0.0236)	(0.0590)
7	0.133	0.306	**0.0636****	-0.00386
	(0.352)	(0.197)	(0.0298)	(0.118)
8	0.144	0.376	**0.0509***	-0.0365
	(0.268)	(0.276)	(0.0287)	(0.117)
9	0.196	**0.477****	**0.0499***	0.00518
	(0.233)	(0.188)	(0.0257)	(0.0666)
Constant	**3.107*****	**0.500*****	**0.127*****	**1.490*****
	(0.0708)	(0.0513)	(0.00992)	(0.0351)
Observations	5,187	5,187	5,187	5,187
R-squared	0.601	0.226	0.151	0.230
# Counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

The revenue component results are shown in table 5. *Intergovernmental revenues* are negative between 5-7 years, suggesting that the increased own-sourced revenues mean that the local governments receive less *intergovernmental revenues. Property tax* is significantly higher at around 5-8 years, after which it slowly comes back down. *Sales and gross receipts* show no real significance over time. Revenues sourced through *utilities* are weakly significant and lower after some years.

Table 5: Diff-in-diff estimation results over time for the revenue components

Year	Intergovernmental	Property tax	Sales and gross receipts	Utilities
-3	0.0175	-0.101	-0.0107	0.000259
	(0.0343)	(0.0729)	(0.00686)	(0.0122)
-2	0.000994	**-0.107***	-0.00482	-0.00217
	(0.0269)	(0.0598)	(0.00510)	(0.00985)
-1	0.000679	**-0.105***	-0.00161	-0.00437
	(0.0192)	(0.0594)	(0.00356)	(0.00893)
0 = Reference				
1	-0.0260	0.0860	0.00152	-0.000772
	(0.0362)	(0.0858)	(0.00346)	(0.00446)
2	-0.0571	0.192	0.000827	-0.00607
	(0.0382)	(0.151)	(0.00690)	(0.00916)
3	0.0287	**0.222***	0.00582	-0.00439
	(0.0599)	(0.127)	(0.0107)	(0.00845)
4	-0.0586	0.355	0.0120	**-0.0188***
	(0.0765)	(0.222)	(0.0138)	(0.0113)
5	**-0.166***	**0.702*****	0.0191	-0.0328
	(0.0883)	(0.256)	(0.0157)	(0.0218)
6	**-0.265****	**1.380*****	0.0259	**-0.0433***
	(0.106)	(0.442)	(0.0187)	(0.0249)
7	**-0.242****	**1.830*****	0.0285	**-0.0491***
	(0.118)	(0.591)	(0.0221)	(0.0260)
8	0.0814	**1.728*****	0.0327	**-0.0560****
	(0.250)	(0.665)	(0.0238)	(0.0268)
9	0.156	**1.455****	**0.0432***	**-0.0879****
	(0.254)	(0.575)	(0.0258)	(0.0400)
Constant	**1.044*****	**1.571*****	**0.154*****	**0.288*****
	(0.0270)	(0.0729)	(0.00564)	(0.0222)
Observations	5,187	5,187	5,187	5,187
R-squared	0.508	0.457	0.063	0.184
# Counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Finally, the expenditures by function show where the increased expenditures are going. These are shown in table 6 below. We find that the negative effect for *higher education* loses its significance, likely due to the low number of counties with *higher education* expenditures, and thus low number of observations for each year (see descriptive statistics in the appendix). *Elementary and secondary education* is mostly positive and weakly significant, with most significance at around 5 years. Expenditures on *highways* are higher after around 7 years. Expenditures on *police* are higher after around 5 years, and remain apparently stable at a higher rate after that. Expenditures on *parks and recreation* only show a weak increase after around 3-5 years. Finally, we find higher *judicial administration* expenditures, still visibly significant after 9 years.

Table 6: Diff-in-diff estimation results over time for the expenditures by function

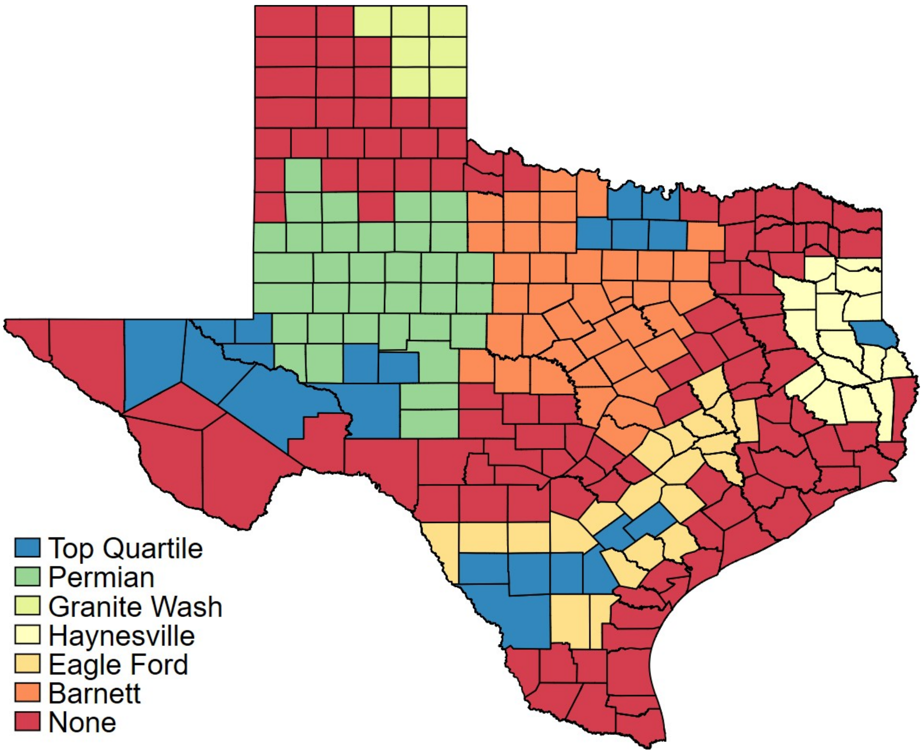
Year	Higher education	Elementary & secondary education	Highways	Police	Parks & recreation	Judicial administration
-3	0.00819	0.0752	-0.00905	-0.00990	-0.0118	**-0.0162***
	(0.00922)	(0.0665)	(0.00891)	(0.00730)	(0.00882)	(0.00830)
-2	0.00324	0.0623	-0.00771	-0.00757	-0.0117	**-0.0116****
	(0.00771)	(0.0555)	(0.00616)	(0.00511)	(0.00783)	(0.00584)
-1	**0.00834***	0.0128	-0.000620	-0.00161	-0.00591	**-0.00566***
	(0.00445)	(0.0355)	(0.00496)	(0.00264)	(0.00390)	(0.00310)
0 = Reference						
1	-0.00562	**0.172***	0.00674	0.00594	0.00638	**0.00682***
	(0.00522)	(0.103)	(0.00441)	(0.00370)	(0.00446)	(0.00347)
2	-0.00987	**0.283***	0.00912	0.00833	0.0116	**0.0131***
	(0.00791)	(0.171)	(0.00705)	(0.00689)	(0.00846)	(0.00724)
3	**-0.0254***	**0.403***	0.0143	**0.0131***	**0.0103***	**0.0162***
	(0.0153)	(0.207)	(0.00993)	(0.00773)	(0.00625)	(0.00912)
4	-0.0156	**0.612***	0.0142	**0.0175***	**0.00946***	**0.0261****
	(0.0158)	(0.359)	(0.0187)	(0.00948)	(0.00493)	(0.0110)
5	-0.0277	**0.713****	0.0271	**0.0255****	**0.0132***	**0.0334*****
	(0.0176)	(0.304)	(0.0216)	(0.0110)	(0.00764)	(0.0121)
6	-0.0356	**0.454***	**0.0434***	**0.0312****	0.00814	**0.0365****
	(0.0220)	(0.269)	(0.0258)	(0.0134)	(0.00898)	(0.0149)
7	-0.0370	**0.509***	**0.0755****	**0.0402****	-0.00223	**0.0496*****
	(0.0260)	(0.289)	(0.0369)	(0.0161)	(0.0143)	(0.0174)
8	-0.0366	**0.528***	0.0678	**0.0393****	0.00424	**0.0484*****
	(0.0280)	(0.277)	(0.0565)	(0.0158)	(0.0128)	(0.0159)
9	-0.0373	**0.514****	0.0626	**0.0413****	0.00675	**0.0491*****
	(0.0341)	(0.232)	(0.0775)	(0.0178)	(0.0132)	(0.0170)
Constant	**0.0848*****	**1.722*****	**0.172*****	**0.139*****	**0.0350*****	**0.0735*****
	(0.0112)	(0.0478)	(0.0179)	(0.00541)	(0.00192)	(0.00272)
Observations	5,187	5,187	5,187	5,187	5,187	5,187
R-squared	0.088	0.456	0.231	0.240	0.239	0.567
# Counties	247	247	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

4.4. Results across shale plays

In order to investigate which shale plays are driving the positive diff-in-diff results, we estimate the effects for each play separately. By analyzing the effects over time, we are also able to distinguish between calendar years and years since fracking initiated. Figure 5 below shows the map of the five shale plays, with the top quartile Rystad counties. The figure shows that Granite Wash does not have a top quartile Rystad county, while Haynesville only has one.

Figure 5: Shale plays and Top Quartile counties



We use estimation (3) as described in the estimation strategy, but a dummy for each shale play: (4) yy_{cccccc}

$$= \mu\mu_{cccc} + \gamma\gamma_{cc} + \delta\delta_1(SShffqqqq\ ttqqffyy_{cc} * EEEEqqffPP\ yyqqffff_{cccc} * 11[RRyyPPPPffRR\ PPPPtt\ qqqqffffPPffqqqq]_{cc}) + \epsilon\epsilon_{cccccc}$$

Where $SShffqqqq\ ttqqffyy_{cc}$ are indicators for the type of shale play. The results are plotted in figures 6A and 6B. We find no diff-in-diff effects for Barnett and Haynesville, neither in terms of revenues nor expenditures. The Permian play initiated fracking in 2005, which is shown to result in increased revenues and expenditures. However, the expenditures go down in 2009 whereas the revenues still slowly increase. From 2013 onwards, total revenues and expenditures show a major increase again. This falls around the same time when Eagle Ford shows a massive increase in total revenues and expenditures. After showing no fiscal effects for around 4 years after fracking was initiated, there is a major increase. It appears that the financial crisis period from around 2008-2012 has postponed some of the fracking effects. Another interesting thing to note is that the Eagle Ford shows a larger increase in total expenditures than revenues, whereas our overall results as well as the Permian result shows a bigger increase in total revenues.

Figure 6A: The total revenues diff-in-diff effect per shale play

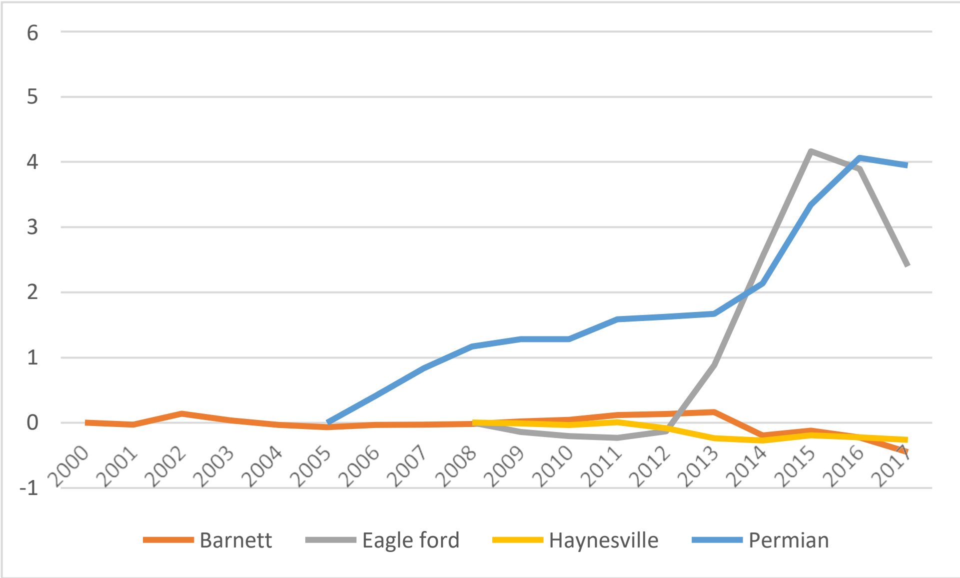
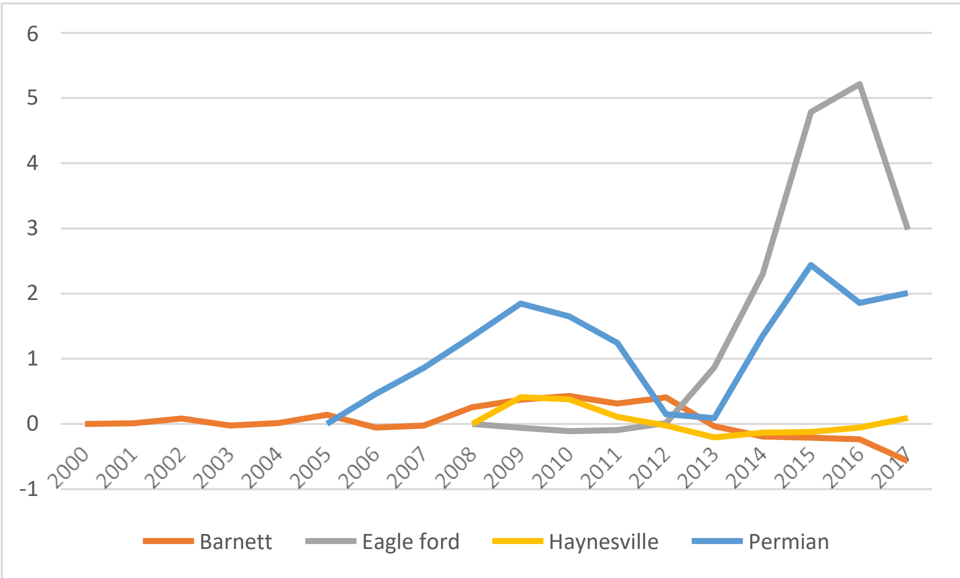


Figure 6B: The total expenditures diff-in-diff effect per shale play



5. Spatial interactions

As explained in the theoretical section, one may also expect spatial interaction effects associated with the fracking boom. In this section we explore such spatial interactions.

5.1. Estimation strategy

The results in our diff-in-diff estimations show that the fracking effects generally turn most significant at around 5 years, after which the standard errors increase and the result turns less significant. In order to accommodate this lagged effect, we use five-year time periods for our spatial estimations. This has the additional positive effect of mostly using the more detailed quinquennial Census of Government Finance, fiscal data which is published every five years. The detailed fiscal data are available every five years, starting in 1977. Given the detailed oil and gas data is available from 2000 onwards (more on this below), we therefore use fiscal data for the years 2002, 2007, 2012, and 2017.

Fracking intensity is captured through two measures: the number of active wells, and the production value. While these are related, they may capture differences in terms of public revenues and expenditures. For example, the creation of a new well is argued to be associated with short employment booms and possible public investments, whereas the production value may be more reflected in public revenues through increased tax revenues such as property tax revenues. Separate estimations are performed for these two fracking variables, as well as a combined estimation.

We perform the estimations in first difference to tease out any fixed effects. All variables capture the five-year average annual difference in the fiscal component or fracking variable respectively. This first results in the following equation:

$$\Delta\Delta yy_{cccccc} = \beta\beta_1 \Delta\Delta ttffPPRRqqffPPffPPff_{cccc} + \beta\beta_2 \Delta\Delta\Delta\Delta qqqqqqPP_{cccc} + \omega\omega_{cccc} + \epsilon\epsilon_{cccccc}. \quad (5)$$

Where, $\Delta\Delta yy_{cc,cc}$ represents the fiscal component in county *c* at time *t*, $\Delta\Delta ttffPPRRqqffPPffPPff_{cc,cc}$ represents the production value in one-million USD per capita in real 2015 USD, $\beta\beta_2\Delta\Delta\Delta\Delta qqqqqqPP_{cccc}$ captures the number of active wells per capita, and $\omega\omega_{cccc}$ captures the play-year fixed effects. The fiscal components are measured in $1000 per capita. Thus, the ratio between production value and the fiscal components is 1000:1.

Given the likelihood of spatial spillovers relating to the dependent variables (fiscal competition (Blöchliger & Pinero, 2011)) as well as the explanatory variables (e.g. influx of workers due to fracking activities in a neighboring county), there is a clear argument for spatial spillover effects. Spatial econometric estimations are performed to estimate and control for these spatial spillover effects. Spatial Autoregressive Model (SAR) and Spatial Durbin Model (SDM estimations are performed, where the SAR includes spatial lags of the dependent variable and the SDM additionally includes spatial lags for the explanatory variables. The SDM estimation formula therefore takes the following shape:

(6) $\Delta\Delta yy_{cc,cc} = \rho\rho\rho\rho\Delta\Delta yy_{ii,cc} + \beta\beta_1\Delta\Delta ttffPPRRqqffPPffPPff_{cc,cc} + \beta\beta_2\rho\rho\Delta\Delta ttffPPRRqqffPPffPPff_{cc,cc} + \beta\beta_3\Delta\Delta\Delta\Delta qqqqqqPP_{cc,cc} + \beta\beta_4\rho\rho\Delta\Delta\Delta\Delta qqqqqqPP_{cc,cc} + \omega\omega_{cc} + \epsilon\epsilon_{cc,cc}.$

Where, $\rho\rho\rho\rho\Delta\Delta yy_{ii,cc}$ captures the spatial interaction in the dependent variable (fiscal competition), and $\beta\beta_1\rho\rho\Delta\Delta ffffffffffffffff_{cc,cc}$ captures the spatial effect of the fracking variable. The SAR estimation only includes the spatial interaction in the dependent variable, whereas the SDM estimation includes both.

5.2. Results

First, we explore the direct and spatial effects of total revenues and expenditures to get an idea of the total fiscal effects. The results are shown in table 7 below. Four estimations are performed for both fiscal components: an OLS, SAR, and two SDM models, where the second model includes play-year fixed effects, instead of simply time fixed effects. The results show positive direct effects for the production value as well as the number of active wells. We find that the positive production value is higher for total revenues, than total expenditures, whereas the number of active wells is higher for total expenditures than for total revenues. Given that production naturally follows the creation of the wells, this result suggests that the creation of the wells is associated with a bigger increase in expenditures than revenues, which is subsequently offset once the wells go into production, which have a larger positive impact on total revenues. We do not find any spatial effects from our production value or number of active wells. However, we do find a positive spatial effect for the dependent variable shown by the positive rho, suggestive of fiscal competition. However, this positive effect disappears when play-year fixed effects are included. The inclusion of the play-year fixed effects naturally captures a similar spatial effect, which makes it likely for the spatial effects to disappear or decline.

Table 7: Total revenues and total expenditures

Variables	Total revenues OLS	SAR	SDM	SDM	Total expenditures OLS	SAR	SDM	SDM
ΔProd. value	7.380***	7.154***	7.032***	7.225***	5.472***	5.109**	4.515**	4.814**
	(1.289)	(1.348)	(1.410)	(1.356)	(2.067)	(2.085)	(1.916)	(2.014)
W*ΔProd. value			1.087	1.956			5.183	5.258
			(2.308)	(2.625)			(5.636)	(6.032)
ΔWells	3.406***	3.350***	3.358***	3.095***	4.850***	4.820***	4.842***	4.580***
	(1.007)	(0.977)	(0.993)	(0.894)	(1.401)	(1.322)	(1.424)	(1.222)
W*ΔWells			-0.623	-1.483			-2.881	-2.931
			(2.488)	(2.648)			(4.365)	(4.534)
Rho		0.0968**	0.0932**	0.00646		0.125**	0.111**	-0.0126
		(0.0474)	(0.0472)	(0.0498)		(0.0522)	(0.0539)	(0.0637)
Constant	0.249***			0.227***	0.226***			0.201***
	(0.0123)			(0.0174)	(0.0140)			(0.0191)
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes	No	No	No	Yes
Observations	741	741	741	741	741	741	741	741
R-squared		0.252	0.253	0.312		0.174	0.183	0.234
# counties	247	247	247	247	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

For the sake of conciseness, the remainder of this section only shows and discusses those fiscal components which show significant spatial effects for the production value or number of active wells[4]. While the direct effects are also interesting, these follow similar patterns as found in the diff-in-diff estimation. Furthermore, they may not be considered fully exogeneous. Similarly, the spatial lag of the dependent variable is interesting from a fiscal competition point of view, but this is not the focus of our analysis. However, the appendix includes an overview of the SDM estimation results, both year fixed effects and play-year fixed effects. Furthermore, the discussion section subsequently also takes into consideration some of the direct effects estimation results, as well as any insignificant spatial effects.

Our fiscal components grouped as "fiscal health", do not show any significant spatial production value or active wells coefficients. The expenditures by character do show a significant spatial effect for *interest on general debt.* The results are shown in table 8. We find that the creation of new active wells is associated with a weak increase in *interest on general debt*, which disappears as rho is included. However, this positive effect is stronger and

[4] The threshold used to determine if something is "significant" is that it shows at least one spatial effect that is significant at a 5% significance level.

remaining significant for the creation of new active wells in neighboring counties. This suggest that the counties may also need to make investments when their neighboring counties are creating new active wells. We also find a minor suggestion that the debt is decreasing as these new active wells start to produce, evidenced by the weakly significant negative effect for the spatially lagged production value.

Table 8: Interest on general debt.

Variables	OLS	SAR	SDM	SDM
ΔProd. value	0.140	0.141	0.112	0.107
	(0.140)	(0.140)	(0.145)	(0.141)
W*ΔProd. value			-0.352*	-0.335
			(0.196)	(0.230)
ΔWells	0.122*	0.117*	0.0789*	0.0724
	(0.0643)	(0.0642)	(0.0437)	(0.0481)
W*ΔWells			0.672***	0.598**
			(0.240)	(0.258)
Rho		0.0269	-0.00265	-0.0410*
		(0.0294)	(0.0220)	(0.0219)
Constant	0.00775***			0.00995*
	(0.00291)			(0.00532)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.009	0.024	0.043
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

From the four revenue components, we only find significant spatial effects for the *sales and gross receipts tax* revenues. In line with what one may expect, these spatial effects are significant in the form of positive spatial production value effects (table 9). Thus, as a neighboring county increases its production value, the population from the neighboring county is likely to spend some of that increased income in your county, thereby increasing the sales and gross receipts tax. Interestingly, no significant direct effects are found.

Table 9: Sales and gross receipts tax

Variables	OLS	SAR	SDM	SDM
ΔProd. value	0.0135	0.0124	-0.0436	-0.0353
	(0.0830)	(0.0832)	(0.0715)	(0.0696)
W*ΔProd. value			0.273***	0.241**
			(0.0878)	(0.106)
ΔWells	0.0289	0.0288	0.0157	0.0200
	(0.0248)	(0.0248)	(0.0278)	(0.0259)
W*ΔWells			0.0109	0.0676
			(0.124)	(0.132)
Rho		0.0136	-0.00636	-0.0571
		(0.0512)	(0.0511)	(0.0502)
Constant	0.00858***			0.00731***
	(0.000551)			(0.000777)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.002	0.014	0.059
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

Finally, in the expenditures by function, we find spatial effects for *higher education* (table 10)*, health* (table 11)*, highways* (table 12)*,* and *natural resources* (table 13). Starting with *higher education,* we find that weakly significant negative effects for the production value and more significant negative effects for the spatially lagged number of active wells. The negative relationship between resource dependency/activity and education has been discussed in the relation to the resource curse. This negative relationship may therefore suggest such underlying mechanisms to be present. The spatially lagged variable may show higher significance, simply because only few counties have *higher education* expenditures. Thus, one is more likely to have a neighbor with *higher education* expenditures than oneself is. However, the resource curse argumentation remains the same. As there are good job-opportunities in the oil and gas industry, especially for lower skilled workers, the local population may be less inclined to invest in their own education. It is therefore also unsurprising that the negative effect is shown for the number of active wells, given that these especially require a lot of employment, whereas the subsequent production is less labor demanding.

Table 11 shows the effects on health expenditures. Here we find positive effects for the spatially lagged number of active wells. The definition of *health* expenditures is the following: *"Provision of services for the conservation and improvement of public health, other than hospital care, and financial support of other governments' health programs"* (U.S. Bureau of the Census, 2006). This includes expenditures on a list of health activities, such as health-related inspections, community health care programs, and regulation of air and water quality. Especially the regulation of air and water quality may be expected to go up in response to creation of the active wells.

Table 10: Higher education

Variables	OLS	SAR	SDM	SDM
ΔProd. value	-0.0150*	-0.0354***	-0.0303*	-0.0186*
	(0.00789)	(0.0121)	(0.0172)	(0.0108)
W*ΔProd. value			0.0441	0.0189
			(0.0712)	(0.0627)
ΔWells	-0.0112	-0.0282	-0.0219	-0.0104
	(0.00754)	(0.0174)	(0.0140)	(0.00835)
W*ΔWells			-0.0954***	-0.119**
			(0.0336)	(0.0539)
Rho		-0.149***	-0.154***	-0.0828***
		(0.0233)	(0.0242)	(0.0173)
Constant	0.00493***			0.00610***
	(0.00102)			(0.00173)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.002	0.003	0.008
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

Table 11: Health

Variables	OLS	SAR	SDM	SDM
ΔProd. value	-0.0876*	-0.0871*	-0.0978*	-0.0972**
	(0.0515)	(0.0519)	(0.0510)	(0.0477)
W*ΔProd. value			-0.0251	-0.0678
			(0.0592)	(0.0712)
ΔWells	0.0157	0.0191	0.0109	0.0177
	(0.0240)	(0.0275)	(0.0237)	(0.0216)
W*ΔWells			0.107**	0.133**
			(0.0483)	(0.0522)
Rho		-0.0360	-0.0401	-0.0844***
		(0.0298)	(0.0291)	(0.0326)
Constant	0.00157**			0.00156
	(0.000735)			(0.00107)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.005	0.008	0.029
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

The expenditure component with significant spatially lagged fracking variables, is expenditures on *highways* (table 12). Expenditures on *highways* are generally expected to go up with fracking activities. However, we do not find this to be the case for the non-spatially lagged fracking variables. We do find this positive effect for the spatially lagged number of active wells. The significance disappears once the year fixed effects are replaced by the play-year fixed effects. This suggests that the entire play increases its *highways* expenditures as a response to the fracking-boom.

Table 12: Highways

Variables	OLS	SAR	SDM	SDM
ΔProd. value	-0.229*	-0.229*	-0.287**	-0.272*
	(0.132)	(0.133)	(0.139)	(0.143)
W*ΔProd. value			0.00504	-0.00102
			(0.329)	(0.361)
ΔWells	0.154	0.155	0.122	0.105
	(0.191)	(0.191)	(0.178)	(0.169)
W*ΔWells			0.380**	0.297
			(0.178)	(0.216)
Rho		-0.0148	-0.0296	-0.0911***
		(0.0254)	(0.0277)	(0.0325)
Constant	0.00667***			0.00733***
	(0.000891)			(0.00115)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.006	0.012	0.044
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

Finally, we find a lot of significance for the *natural resources* fracking variables (table 13). The explanatory power is also high relative to the other expenditure components, which may natural follow from how directly related it is to the oil and gas industry. The definition reads: *"Conservation, promotion, and development of natural resources (soil, water, energy, minerals, etc.) and the regulation of industries which develop, utilize, or affect natural resources"*(U.S. Bureau of the Census, 2006). The interpretation of the fracking variables are difficult however. The production value and active well variables show opposite effects, as do the spatially lagged variables. Again, we find the significance of the spatially lagged variables decreasing as the play-year fixed effects are introduced.

The next (discussion) section will further discuss these results by also including the diff-in-diff estimation results, thereby presenting our full interpretation of the results.

Table 13: Natural resources

Variables	OLS	SAR	SDM	SDM
ΔProd. value	0.348*	0.348**	0.369**	0.373**
	(0.179)	(0.177)	(0.183)	(0.180)
W*ΔProd. value			-0.221**	-0.196*
			(0.110)	(0.115)
ΔWells	-0.258***	-0.261***	-0.267***	-0.274***
	(0.0725)	(0.0716)	(0.0636)	(0.0599)
W*ΔWells			0.171***	0.119*
			(0.0597)	(0.0702)
Rho		0.103	0.147	0.0978
		(0.0898)	(0.0960)	(0.0992)
Constant	0.000783			0.00165***
	(0.000534)			(0.000639)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.207	0.219	0.269
# counties	247	247	247	247

Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

6. Discussion

This discussion presents a discussion of our interpretation of the estimation results. The discussion is divided into four sections: fiscal health, revenues, expenditures, and policy implications. In these subsections, the fiscal components are separately discussed, combining the diff-in-diff results, with the spatial estimation results. Note that also touch upon some of the direct effects from the spatial estimations when deemed relevant, even though these are not the focus of the paper and may have endogeneity issues.

6.1. Fiscal health

One of the main concerns related to fracking and local public finance is that the fracking-boom may negatively impact the fiscal health of local governmental entities (Zwick, 2018). We find no clear indication of such fiscal health issues. We find both revenues and expenditures to be positively affected by the fracking-boom, with the revenues being more affected than the expenditures, although the difference is not significant. These results are in line with previous empirical work (Bartik et al., 2019; Newell & Raimi, 2015). Being identified as a fracking county adds around $1250 revenues and $1100 expenditures per capita annually, with around 60% of that going to school districts and the remaining to county governments.

We do find a minor indication of increased debt in school districts, also evidenced by the increase in *interest on general debt* expenditures, but this quickly disappears and is also associated with increased cash holdings. The increase in total revenues and expenditures is found for the county governments and school districts. Furthermore, we find that the positive effect for the production value is higher for the revenues than for expenditures, whereas the change in active wells is higher for expenditures than revenues. This again indicates that there may be some short-term costs associated with building the new wells. This is further evidenced by the significant positive effect between new active wells and *outstanding debt*, while at the same time a positive effect for production value on *cash holdings* (both results in the appendix).

The initial increase in expenditures followed by the increase in revenues may naturally follow from the expenditures necessary for the creation of the wells, followed by the revenues that come from the subsequent production of these wells. However, one could also argue that the revenues follow the expenditures simply because of strict budget requirements that are common for local governments (Mahdavi & Westerlund, 2011; Westerlund, Mahdavi, & Firoozi, 2011). This relates to the debate whether governments tax-and-spend, or spend-and-tax (Anderson, Wallace, & Warner, 1986; Chang, Liu, & Caudill, 2002; Westerlund et al., 2011). In this case, it may be that tax rates (e.g. property tax) are increased in order to source more property taxes.

In terms of the boom-bust structure, there are also no clear signs of a nearing bust. Our dataset includes up to 9 years after the introduction of fracking in the specific shale-plays found in Texas. After 9 years, we still find total revenues and expenditures to be higher in the counties associated with the fracking-boom, with the positive revenue effect remaining higher than the expenditure effect, although not significantly different. We do find the positive revenue and expenditure effects to decrease in significance. When looking at the diff-in-diff effects for each shale play separately, we find that the positive diff-in-diff effect of Eagle Ford are declining, and the Permian Basin is no longer increasing.

The spatially lagged estimations show no spatially lagged effects for the fracking variables. We do find an indication of spatial clusters in the development of total expenditures and revenues as evidenced by the significant spatially lagged dependent variable, which disappears once the play-year fixed effects are included.

6.2. Revenues

Nearly all positive revenue effects stem from increased property tax revenues, in line with previous work (Bartik et al., 2019; Newell & Raimi, 2015). These positive effects are therefore found in the government types that source most property tax revenues: counties and school districts. Being identified as a fracking county adds around $1150 in property taxes. The positive effect turns significant after around 5 years, and remains significant for the remaining years. The long-run diff-in-diff results show that *intergovernmental* revenues and *utility* revenues actually decrease a little bit. The *intergovernmental* transfers between 5-7 years after fracking initiated, which may relate to the decreased need for such revenues given the increase in *property taxes*. We also find a shift in *intergovernmental* revenues, moving away from municipalities and special districts towards county governments. The *utility* revenues are lower from 6 years onwards, which may also relate to a decrease in need of such taxes (tax cuts), although the decrease is only minor.

The spatial effects show an increase in *sales and gross receipts tax* revenues. Thus, the neighboring counties profit from the population and income growth, which is spent in their counties. An increase in production value of one-million USD, increases *sales and gross receipts tax* revenues in neighboring counties by around $240. Interestingly, and contrary to previous empirical work (Bartik et al., 2019; Newell & Raimi, 2015), we do not find any increase in *sales and gross receipts tax* revenues in the fracking county itself when controlling for the play-year fixed effects, neither in the diff-in-diff estimations, nor the spatial estimations. It therefore seems likely that the increase in *sales and gross receipts tax* revenues are spread out across the region or play instead of being localized in the specific fracking county. Finally, we find evidence of revenue clusters, with significant rho coefficients for *intergovernmental transfers* and *property tax* revenues.

6.3. Expenditures

The increased revenues are accompanied by increased *current operations* expenditures for county governments and increased *capital outlay* for school districts, and to a lesser extent county governments. Furthermore, we find *interest on general debt* to increase for school districts as observed before, as well as increased *salaries and wages* for county governments in line with the work by Newell and Raimi (2015).

With school districts being one of the main beneficiaries of the increased revenues, through their sourcing of *property tax*, the additional funds are invested into *elementary and secondary education,* while expenditures on *higher education* actually go down. These opposing findings may point to why Bartik *et al.* (2019) find no significant effects for total education expenditures (elementary and secondary, and higher education). The decline in *higher education* links well with the resource curse literature. The increase in lower-skilled jobs associated with the fracking boom may increase the opportunity costs of going to higher education instead of working in the fracking industry, with the consequence of less high school students and less funds going to *higher education.* We find that neighboring counties experience this drop in *higher education* expenditures, likely for similar reasons.

Counties spend their increased public funds on *highways, police, parks & recreation,* and *judicial administration.* The increased highways expenditures are needed given the road damage that is likely to be associated with increased use of the road network by the gas and oil industry trucks. The result is also in line with previous work (Bartik et al., 2019; Newell & Raimi, 2015), although the effect is weak over time. The spatial estimations furthermore show that this is also the case for neighboring counties or counties located in the same play.

The increased police expenditures are also in line with the work by Bartik *et al.* (2019). The increased police expenditures are remain relatively robust over time, still clearly visible 9 years after fracking initiated. Expenditures on *parks and recreation* on the other hand, are only briefly significant between years 3-5. Finally, we find positive effects for *judicial administration* which links well with the argumentation of the administrative capacity needed to regulate the new environmental issues (Hanna, 2005; Miller et al., 2009; Wilson, 2006; Zwick, 2018), also evidenced by the increase in *salaries and wages.*

No significant effects are found for *public welfare* and *hospitals,* in line with the work by Bartik *et al.* (2019). We do find expenditures on *health* to decrease in special districts. Similarly, it is negatively associated with production value. However, we find a stronger opposing effect for the spatially lagged active wells. It is likely that the increase in *health* expenditures is used for healthcare programs specific to the fracking industry, such as the regulation of air and water quality (Jackson et al., 2016; Zwick, 2018).

6.4. Policy implications

With all fracking-boom effects in mind, should local communities be welcoming of the fracking-boom and fracking activities? From a policymaker perspective, that is ultimately the question. While it is difficult to answer that question, and preferences may be heterogeneous, we may philosophize somewhat about the results ultimately mean for local communities in our opinion.

It may be important to keep in mind that Texas has a lot of small, thinly populated counties in general, and that the “fracking counties” are generally even smaller. Seventy-five percent of the “fracking-counties”, as identified through the top quartile of Bartik *et al.* (2019), have a population of less than 23 thousand. So what happens to these communities?

First, local communities may experience negative environmental impacts, such as water safety issues, wastewater disposal and air quality concerns (Jackson et al., 2016; Zwick, 2018), traffic (Bartik et al., 2019), noise pollution (Bartik et al., 2019; Zwick, 2018), and minor man-made earthquakes (Goho, 2012; Zwick, 2018). These all result in decreased livability (Zwick, 2018). The fracking-boom attracts workers, generally young-male, coming into their local communities, with various sorts of potential issues, such as depression, family stress, addiction, and crime, including violence towards women (Bartik et al., 2019; Jacquet, 2009; Shandro et al., 2011; Zwick, 2018).

This increase in workers increases housing values (Bartik et al., 2019), through which the local government sources increased property tax, which is the main way in which local public revenues increase. There is also some indication that the Texas State transfers more funds to the counties affected, but at the same time, transfers less to municipalities and special districts, creating a net insignificant result. Furthermore, there is only a very weak indication of increased revenues sourced through sales and gross receipts tax.

The main increase in local public revenues per capita sourced through increased property tax means that the home-owners of the local community benefit by an increase in wealth. The question is however, who exactly benefits? Probably big property owners, which could sell property for a much higher value than they bought it at initially. However, most households with just one property cannot access the additional wealth, unless they sell their property. In that case however, they will probably need to move out of their county as the other houses in their county also increased in price. Renters also do not benefit as they will see their rents going up (Bartik et al., 2019).

However, while only a minor share of the local community may actually benefit from the increase in housing prices, the increase in local public funds could be given back to the local community in the form of investments in better healthcare, education, parks and recreation, social benefits and more. The question then becomes, do we find this in our results? Or do we find that the additional funds are mostly used to cope with the increase in population and fracking activity? Our results suggest a little bit of both.

We find that the main beneficiaries of the increased property tax revenues are the county government and school districts. The county government uses the increased per capita funds mostly to deal with the negative externalities of fracking by increasing per capita spending on police, highways, and judicial administration. However, they also give back to the community by increasing expenditures on parks and recreation. The school districts spend their increased funds on elementary and secondary education. The per capita increase could suggest more students per capita, but also more expenditures per student. The expenditures per student results show that these go up, although its significance decreases. This suggests that school districts indeed use part of the additional funds to invest in school quality, although it is weak in significance. We do not find any per capita increases in health, hospitals, or public welfare however. The health expenditures of special districts actually go slightly down. Furthermore, expenditures on higher education go down, suggestive of the resource curse.

The main benefit for local communities is probably the increase in employment and wages. However, if this means that educational attainment goes down, one may wonder what the long-term effects will be once the fracking-boom turns into a bust. Furthermore, as a large share of these new jobs are taken by the population influx, one may wonder how much the local community actually benefits.

Finally, there our spatial estimations show the potential effects for neighboring counties. We find that neighboring counties benefit from increased sales and gross receipts tax per capita associated with the fracking production value increase. Total revenues and expenditures do not increase with the fracking activities, although there is a positive spatial interaction in the dependent variable, meaning that the increase in revenues and expenditures in the fracking county may affect revenues and expenditures in the neighboring county through policy competition. We find the same negative higher education effect, suggesting that the resource curse affects a wider region. Furthermore, we find a positive spatial correlation for the production of new wells and interest on general debt, which may relate to the increase in expenditures on highways. Thus, neighboring counties may experience a decrease in higher education quality/quantity, and increased highway costs and interest on debt payments, which seem to be covered by the increase in per capita sales and gross receipts tax.

With all results in mind, do the local communities actually benefit from the fracking-boom? The answer is mostly likely, there are winners and losers, and for some, time will tell how the long-term effects develop.

7. Conclusion

This paper attempts to enhance our understanding of the local public fiscal effects associated with the fracking boom, using the case of Texas. A diff-in-diff analysis is presented where we estimate the fracking effects over time for the four different types of local government (county, municipality, special district, and school district). The results show increased revenues and expenditures for county governments and school districts. No clear signs of fiscal health issues are found, nor do we find a clear indication that the increased local public revenues per capita are used to give back to the local community. Rather it seems most of it is used to cope with the negative externalities associated with fracking.

The increase in county government revenues is sourced through increased intergovernmental transfers (excluding other local governments), and property tax. These increased revenues are spend on highways, police, parks and recreation, and judicial administration. School districts increase their revenues through increased property tax revenues, which they spend on elementary and secondary education. Expenditures on higher education actually go down, indicative of the resource curse. Positive spatial effects are found for the oil and gas production value on the sales and gross receipts tax revenues of neighboring counties. New active wells show positive spatial effects on the expenditure side, through health and highways expenditures.

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