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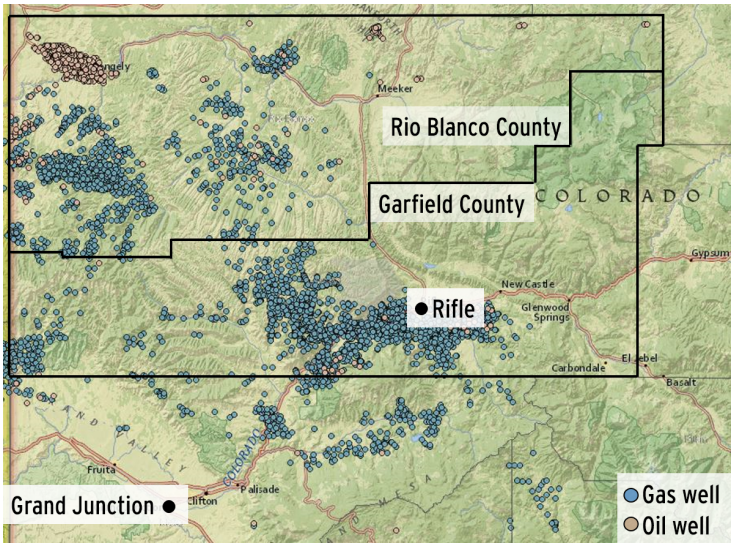
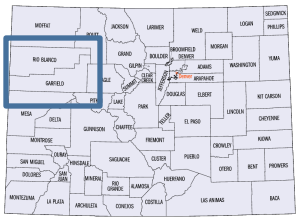
Colorado's Piceance basin:

Variation in the local public finance effects of oil and gas development





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About this report

This report is one in a series to be produced by the authors on shale public finance, supported by the Alfred P. Sloan Foundation. The Shale Public Finance project is examining the financial implications for local governments associated with increased domestic oil and gas production, largely from shale resources. Other reports focus on the net fiscal impacts of increased oil and gas production for local governments, and the collection and allocation of revenue from oil and gas production for local governments. For more information, to view interactive maps showing some of our key findings, or to be notified when new publications are released, visit http://energy.duke.edu/shalepublicfinance.

We thank the local officials and experts who provided their time and expertise through on-site interviews and communication over phone and e-mail. In particular, we thank finance director Ann Driggers, assessor Jim Yellico, and oil and gas liaison Kirby Wynn at Garfield County, Mayor Sam Sasuras and city manager Rich Englehart at Grand Junction, city manager Matt Sturgeon and finance director Charles Kelty at Rifle, and Commissioner Shawn Bolton at Rio Blanco County. Thank you to Grant Nülle of the U.S. Energy Information Administration, Nathan Ratledge of Apogee EP, Yifei Qian of the Duke University Energy Initiative, Ann Driggers, and Matt Sturgeon for reviewing and commenting on an earlier draft of this paper.

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Colorado's Piceance Basin:
Variation in the local public finance effects of oil and gas development

Daniel Raimi and Richard G. Newell

Abstract

A large increase in natural gas production occurred in western Colorado's Piceance basin in the mid- to late-2000s, generating a surge in population, economic activity, and heavy truck traffic in this rural region. We describe the fiscal effects related to this development for two county governments: Garfield and Rio Blanco, and two city governments: Grand Junction and Rifle. Counties maintain rural road networks in Colorado, and Garfield County's ability to fashion agreements with operators to repair roads damaged during operations helped prevent the types of large new costs seen in Rio Blanco County, a neighboring county with less government capacity and where such agreements were not made. Rifle and Grand Junction experienced substantial oil- and gas-driven population growth, with greater challenges in the smaller, more isolated, and less economically diverse city of Rifle. Lessons from this case study include the value of crafting road maintenance agreements, fiscal risks for small and geographically isolated communities experiencing rapid population growth, challenges associated with limited infrastructure, and the desirability of flexibility in the allocation of oil- and gas-related revenue.

Key Words: Shale gas, tight oil, local public finance, Piceance basin, severance tax, property tax, property values, sales tax, hydraulic fracturing, tax incentives

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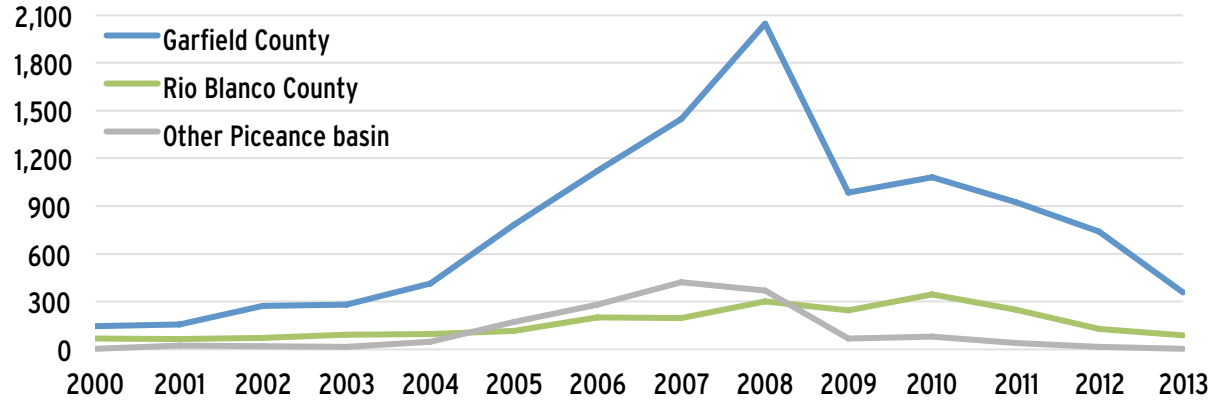
1. Report summary

Rapid growth in natural gas production in the mid- to late-2000s created substantial fiscal challenges and opportunities for local governments in western Colorado's Piceance (pronounced PEA-awnce) basin. Although production has slowed in recent years, the fiscal effects of the boom reverberate, with some local governments struggling throughout, some seeing continuous benefits, and others experiencing some of both. Variations in government capacity, infrastructure, and policy combined to create these varying outcomes, offering lessons for local officials, state policymakers, and industry stakeholders.

Garfield and Rio Blanco counties, where most new drilling has occurred (see Figure 1-1), have seen divergent fiscal outcomes. In Garfield County, officials work closely with operators to maintain and repair roads damaged by heavy trucks used for exploration and production. This approach has substantially limited government costs, and a rapid increase in property tax revenues has created large fiscal benefits.

In contrast, Rio Blanco County, geographical limitations and a lack of existing infrastructure has led one road in particular to bear a large proportion of oil- and gas-related traffic. Although revenues have increased significantly, local officials estimate that needed repairs would cost over $100 million, more than twice Rio Blanco County's annual revenues. Officials have been unable to reach an agreement to share repair costs with operators, and instead imposed an impact fee on each well drilled in the county. This fee, despite raising millions of dollars, has not been sufficient to cover the costs of increased road damage.

Figure 1-1: Piceance basin oil and gas well completions by county



Data source: DI Desktop. Accessed Feb. 9, 2015. Note: Other Colorado Piceance basin counties are Chaffee, Delta, Eagle, Gunnison, Mesa, Montrose, and Pitkin.

Municipalities in our case study have also experienced differing effects. In Rifle, located at the center of drilling activity, population surged rapidly, largely due to oil and gas development. Limited infrastructure coupled with a rapidly growing population created fiscal challenges for Rifle

during the most active drilling years. As time passed, many of these challenges subsided, but population projections made during the peak of industry activity proved to be too high, and the city overbuilt its water and wastewater systems, saddling residents with large new costs.

At the periphery of the most active drilling region in the larger and more economically diverse city of Grand Junction, new service demands and new revenues associated with the oil and gas industry were smaller relative to Rifle. Despite a general economic downturn in the city associated with a crash in the housing market, the oil and gas industry appears to have helped Grand Junction weather a general downturn in the local economy since the recession of 2008 and 2009.

1.1 Lessons for policy

As we have described in previous reports (Raimi & Newell 2014a, b), most local governments in Colorado and around the United States have experienced net fiscal benefits associated with increased oil and gas production in recent years. In this case study, we focus on several local governments that have faced challenges to illustrate key learning points. Therefore, the experiences described in this case study should not be seen as representative of all local governments in Colorado or around the United States. Instead, the lessons here are intended to educate policymakers, industry, and other stakeholders seeking to enable positive fiscal outcomes for *all*, rather than for *most*, local governments.

Local governments in the Piceance basin, as in Colorado more widely, generate and receive oil- and gas-related revenue from a variety of sources. The leading source for counties is property taxes levied on oil and gas production and equipment, while for cities, the leading sources are allocations of the state's severance tax and federal mineral lease revenues (distributed by the state's Department of Local Affairs, or DOLA), along with sales taxes from increased economic activity associated with the industry.[1] In most cases, these revenue mechanisms appear to be adequate to manage increased service demands associated with oil and gas activity.

Colorado's state government, through DOLA, also administers a grant program that makes awards to local governments from state severance taxes and federal lease revenues. This program provides flexibility in the allocation of oil- and gas-related revenue to local governments, and in principle allows the state to direct revenue to where it is most needed.

However, the state did not award grants in 2011 or 2012, and grant awards to date have not alleviated the fiscal challenges faced by two local governments described in this report: Rio Blanco County and the city of Rifle. Limited infrastructure and government capacity have both contributed

[1] For details, see Raimi and Newell 2014, "Oil and gas revenue allocation to local governments in eight states." Available online at http://energy.duke.edu/shalepublicfinance

to these challenges, with industry traffic relying heavily on one particular road in Rio Blanco County, and rapid population growth straining infrastructure in Rifle. These challenges lead to lessons that can inform local governments in Colorado and other states experiencing increased oil and gas activity:

- **Local fiscal impacts are not uniform**, and can vary substantially within states, sometimes affecting neighboring jurisdictions in distinct ways.
- **Collaboration between local governments and operators**, especially on road maintenance and repair, can play a major role in securing positive fiscal outcomes for local governments.
- **Local revenue streams may not be sufficient** to manage growth during a large increase in oil and gas activity. Mechanisms for state governments to share revenue to manage local fiscal impacts can help alleviate challenges associated with population growth, especially for communities with limited infrastructure and government capacity.
- **State revenue sharing programs that offer flexibility** in allocation of funds, such as Colorado's grant program, create the opportunity to direct oil- and gas-related revenue to the areas that are most in need.
- **Larger cities in regions with diverse economies** tend to face fewer challenges adjusting to potentially rapid population changes associated with the oil and gas industry.
- **Oil and gas activity can be volatile**, and local economies with a heavy reliance on this sector may face fiscal challenges during industry downturns. This is especially true for municipalities, which tend to be heavily reliant on sales taxes, a more volatile revenue source than property taxes.
- **Financial data alone** may not adequately describe the fiscal situation of a local government. Unmet service demands may not be captured by such data, and detailed local information is often necessary to fully understand local fiscal issues.

2. Introduction

This report is one in a series that describes the fiscal effects of recent increases in oil and gas development for local governments in the United States. Building on our previous survey of county and municipal governments in eight states (Newell & Raimi 2015b) and our analysis of revenue allocation to local governments in those states (Newell & Raimi 2015a), this report goes into detail on our findings from western Colorado's Piceance basin, with the goal of highlighting some of the geographic, demographic, and policy issues that have produced useful lessons. Those lessons are intended to educate policymakers, industry operators, and other stakeholders when considering how local governments can maximize the benefits and minimize the challenges associated with oil and gas development.

The Piceance basin was selected for this case study for several key reasons: it illustrates how local governments in a single region can experience divergent fiscal effects; it illustrates the implications of certain policy approaches; it has experienced a range of fiscal effects over time; and adequate data were available to establish our findings. Importantly, the local government experiences here are not representative of the most common fiscal outcome that we have observed in Colorado. Indeed, we have found that most local governments in the United States have experienced net fiscal benefits associated with increased oil and gas production in recent years.

In this case study, we focus on several local governments that have faced challenges to illustrate key learning points. Therefore, the experiences described here should not be seen as representative of all local governments in Colorado or around the United States. Instead, the lessons here are intended to educate all stakeholders as they try to create positive fiscal outcomes for *all*, rather than for *most*, local governments.

2.1 Background

Increased oil and gas production in the United States, largely from shale resources, has generated interest and debate on a range of topics, including local environmental concerns over air and water pollution, the climate implications of developing shale resources, and geopolitical issues related to international trade and domestic energy security. This report focuses on the local government implications of increased domestic oil and gas production by examining how local governments receive revenue from oil and gas activity, what types of new or increased service demands might be placed on those governments, and what lessons can be learned.

Economists and other researchers with regional expertise have looked closely at the local government implications of shale development in certain regions, with a number of reports based on experience in the Marcellus shale region in Pennsylvania (e.g., Jacquet 2009; Christopherson & Rightor 2012; Costanzo & Kelsey 2012; Hardy & Kelsey 2015; Kelsey & Hardy 2015), the Bakken

region in western North Dakota and eastern Montana (e.g., Upper Great Plains Transportation Institute 2012; Headwaters Economics 2013; Hodur *et al.* 2013), the Eagle Ford region in south Texas (e.g., Oyakawa *et al.* 2012; Porter 2013; Tunstall *et al.* 2013; Tunstall 2015), and other regions. Two recent case studies document experience with socioeconomic impacts and governance issues in rural western regions, including the Piceance basin (Haggerty & McBride 2014; Jacquet 2014). Research conducted during a smaller surge in energy production in certain western states during the late 1970s and early 1980s also looked at local government finance issues associated with resource extraction (e.g., Gray 1977; Leistritz *et al.* 1981; Gulley 1982; Hecox 1984; Merrifield 1984).

This work has shown that in some rural regions, rapid and large-scale energy development can create challenges for local governments by creating a surge in population and heavy truck traffic, which in turn can lead to increased demand for public services, especially infrastructure such as roads and bridge repair, and sewer and water systems (Upper Great Plains Transportation Institute 2012; Porter 2013; Jacquet & Kay 2014; Newell & Raimi 2015b). At the same time, oil- and gas-specific taxes and fees, coupled with an increase in regional economic activity associated with the industry, have tended to boost government revenues in these same regions (Booz Allen Hamilton 2008; Perryman Group 2011; Costanzo & Kelsey 2012; Kelsey *et al.* 2012a, b, c, d, e; Oyakawa *et al.* 2012; Univ. of AR Center for Business and Economic Research 2012; Bangsund & Hodur 2013; Lewandowski & Wobbekind 2013; Newell & Raimi 2015a).

Our central question is whether this increase in demand for services is accompanied by sufficient revenue for local governments to provide those services. If so, local governments may maintain or perhaps improve the services they provide, reduce taxes, or provide other benefits to residents. If not, the inability to maintain local government services such as infrastructure and education may reduce quality of life, property values, and impede economic growth (Oates 1969; Mathur 2008). This case study examines both sides of the fiscal ledger in an attempt to answer this question. An important related question that we do not examine is whether U.S. communities benefit in the longer-term from natural resource extraction (Brunnschweiler & Bulte 2008; Boyce & Herbert Emery 2011; James & Aadland 2011; Peach & Starbuck 2011; Macke 2012; Allcott & Keniston 2014; Brown 2014; Haggerty *et al.* 2014; Weber 2014).

2.2 Methodology

Measuring the fiscal condition of local governments is complex, and little consensus exists as to which metrics are best suited to allow researchers to make straightforward and cross-jurisdictional comparison. Financial reporting requirements vary by state, and dozens of approaches to the use of fiscal indicators have been employed by researchers and state governments to evaluate fiscal

conditions in local governments (Peterson 1977; Brown 1993; Hough 2003; Maher & Nollenberger 2009; State of Washington 2010; Hendrick 2011; Plerhoples & Scorsone 2011; DiNapoli 2014).

One key challenge of evaluating local government fiscal health relates to quantifying service demand levels. For example, fiscal indicators do not allow for the quantification of unmet needs, such as road damage that goes unrepaired or other needs that are not met to the satisfaction of local residents and businesses. As a result, our evaluation of fiscal condition takes into account quantifiable indicators (such as those presented in Appendix B) along with qualitative information gathered through interviews with dozens of local officials in the Piceance basin. Researchers in the field of local government finance take similar approaches, often utilizing survey data from local government financial officers alongside financial reports to assess whether local government finances are becoming weaker or stronger over time (e.g., McFarland & Pagano 2014).

We present findings based on data collected during 2013 and 2014, including structured interviews with local government officials in western Colorado, unstructured interviews with state government officials and industry experts, analysis of local and state government financial data, analysis of local and state fiscal policies, and additional information gathered during two trips to the region in 2013 and 2014.

During a 2013 visit, we interviewed local officials from Garfield and Rio Blanco Counties and the municipalities of Carbondale, Glenwood Springs, and Grand Junction. During a subsequent visit and telephone calls during 2014, we interviewed officials from the municipalities of Rifle, Meeker, and Parachute. We examined detailed financial information for each of these jurisdictions along with Mesa County and the city of Fruita. We focus here on select local governments that illustrate some of the key lessons emerging from the region. For details on other local governments in the Piceance basin, see Newell and Raimi (2015b).

We examine local government revenues and costs primarily through Comprehensive Annual Financial Reports (audited government financial statements) and local property tax reports. We also examine state-collected data on sales tax revenues, along with allocations of revenue from Colorado's severance tax and federal mineral leases.

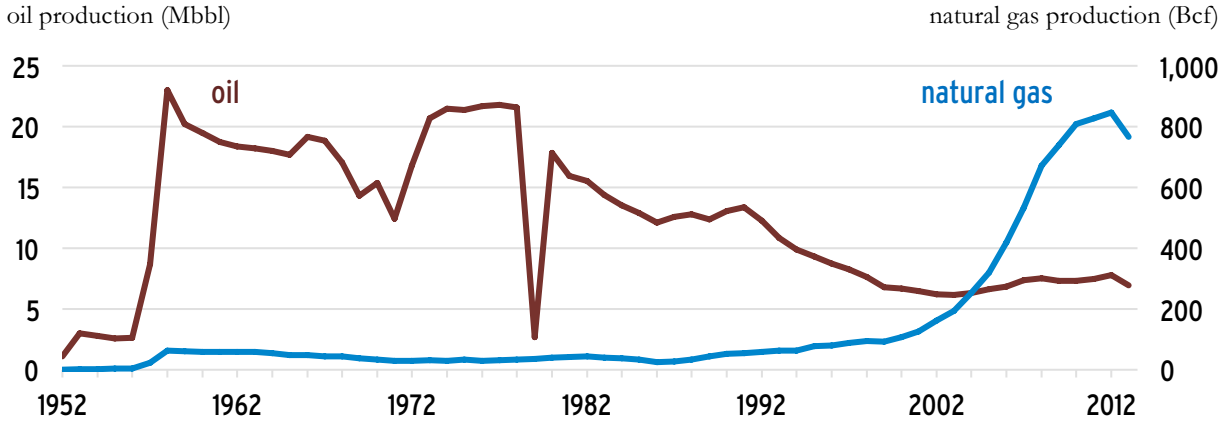
As noted above, some costs may not be apparent from a simple analysis of expenditures. For example, service demands may go unmet (e.g., needed road repairs that are not made), and opportunity costs for government employees may be substantial (e.g., time devoted to oil- and gas-related issues that takes away from other government priorities). We attempt to understand these costs through interviews with local officials and analysis of third party reports, and include this information as part of our assessment of local government costs.

Finally, it is important to note that our research focuses solely on revenues and service demands (i.e., costs) for local governments. As a result, we do not examine external costs regarding potential environmental or health issues from oil and gas development, nor do we examine the direct effects of the industry on local economies and employment. However, when these issues affect local government's ability to provide services and raise revenue, they do enter our realm of analysis. For example, Garfield County has conducted costly air and water quality monitoring programs in response to concerns over health and environmental effects of oil and gas activity. Similarly, an increase in oil and gas activity tends to increase population, which increases economic activity and therefore sales tax revenue for local governments.

3. Local government experience

Energy production has a long history in the Piceance basin. Since the 1950s, oil companies and the U.S. government have experimented with ways to tap the vast oil shale reserves in the region, with interest in these reserves waxing and waning as oil prices and technologies have evolved (Bartis *et al.* 2005). In the late 1960s, the federal government backed experiments using unconventional techniques to produce natural gas from the region's tight sand formations (Reynolds Jr. *et al.* 1970). Though these efforts met with limited success, the region has produced oil and gas since the 1960s. In the mid- to late-2000s, the application of directional drilling and hydraulic fracturing enabled operators to economically tap those tight gas formations, resulting in a rapid and large-scale surge in natural gas production (see Figure 3-1).

Figure 3-1: Annual oil and natural gas production in Colorado's Piceance basin



Data source: DI Desktop. Note: Includes all Piceance basin production, which includes wells from Colorado counties Chaffee (1 well), Delta (147), Eagle (7), Garfield (15,120), Gunnison (138), Mesa (3,027), Montrose (88), Pitkin (24), and Rio Blanco (8,582). The drop in oil production in 1979 was due to reductions in Rio Blanco County. The reason(s) for this decline in production is unclear.

Similar to other regions that have experienced a major increase in oil or gas activity, this growth brought with it a surge of workers to lease land, operate equipment, haul water and

machinery, construct pipelines, compressors, and processing facilities, manage operations, and more. This rapid influx created challenges in the Piceance basin, where cities and towns are few and far between, and demand was already high for the limited supply of existing housing stock (McCormick and Associates & RRC Associates 2006). Much of this pre-existing (and ongoing) demand is related to service workers commuting to higher-cost resort areas such as Aspen, just over one hour Southeast of Rifle.

Local and state officials anticipated large-scale and long-term population growth associated with the oil and gas industry, along with growth from other sectors including tourism and construction (BBC Research and Consulting 2008a, b). However, the collapse of the housing market in 2007 and 2008, subsequent recession, limited development of the region's oil shale resources, and decline in natural gas prices combined to halt this projected growth, rendering previous projections largely obsolete.

Throughout this period, the oil and gas industry has affected local governments in distinct ways. Because of differences in infrastructure, government capacity, and policy, adjacent counties experienced distinct challenges, as did neighboring cities. As the downturn in natural gas prices slowed drilling activity, cities and counties were similarly left with a range of effects. Section 3.1 explores the experience in the adjacent counties of Garfield and Rio Blanco. Section 3.2 examines the cities of Grand Junction and Rifle.

3.1 Garfield and Rio Blanco Counties

Garfield and Rio Blanco Counties have a number of demographic and geographic traits in common, suggesting they may experience similar fiscal effects from oil and gas development. Both are made up largely of federal lands: roughly 60 percent for Garfield and 90 percent for Rio Blanco (U.S. Department of Interior via Headwaters Economics 2014). Both host significant energy production, and both have experienced large increases and decreases in oil and gas activity during previous decades. Populations in both counties are, on average, less educated and lower-income than Colorado as a whole (see Appendix A for detailed demographic traits).

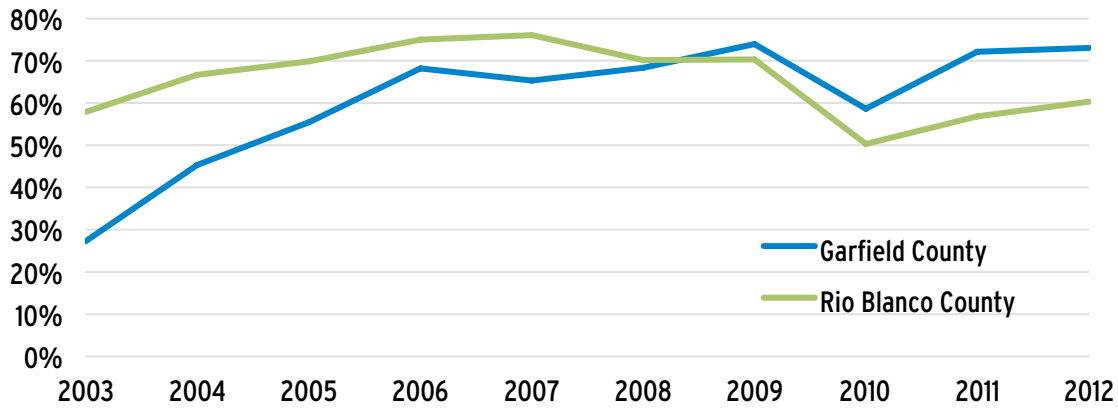
However, several differences between the counties have worked together to create divergent fiscal outcomes, with Garfield experiencing a large boost and Rio Blanco continuing to face challenges. The first difference is one of government capacity: total annual revenues for Garfield County have been 2.5 to 3.5 times greater than those of Rio Blanco County over the past decade, and Garfield County's population is roughly nine times that of Rio Blanco's. The second difference is geographic isolation: while both counties are more rural than the Colorado average, Rio Blanco County receives a rurality score of 9 (the most rural designation on the U.S. Department of Agriculture's rural-urban continuum) while Garfield receives a score of 5 (U.S. Department of

Agriculture 2013). The third difference has to do with policy over the management of road damage caused by heavy industry truck traffic. We explore the implications of these differences below.

3.1.1 Major county revenues associated with the oil and gas industry

Counties in the Piceance basin and across Colorado rely largely on property taxes to fund the construction and maintenance of county roads and provision of other essential services such as law enforcement, emergency services, record-keeping, and more. Garfield and Rio Blanco Counties rely heavily on oil and gas property to provide this tax base. Oil and gas property, which includes produced hydrocarbons as well as surface equipment, has provided 50 percent or more of Rio Blanco County's property tax revenues for nearly a decade, and oil and gas property for Garfield County has grown to account for over 70 percent (see Figure 3-2).

Figure 3-2: Oil and gas assessed property value, as a share of total assessed property value



Data source: Colorado Department of Local Affairs (2003-2012).

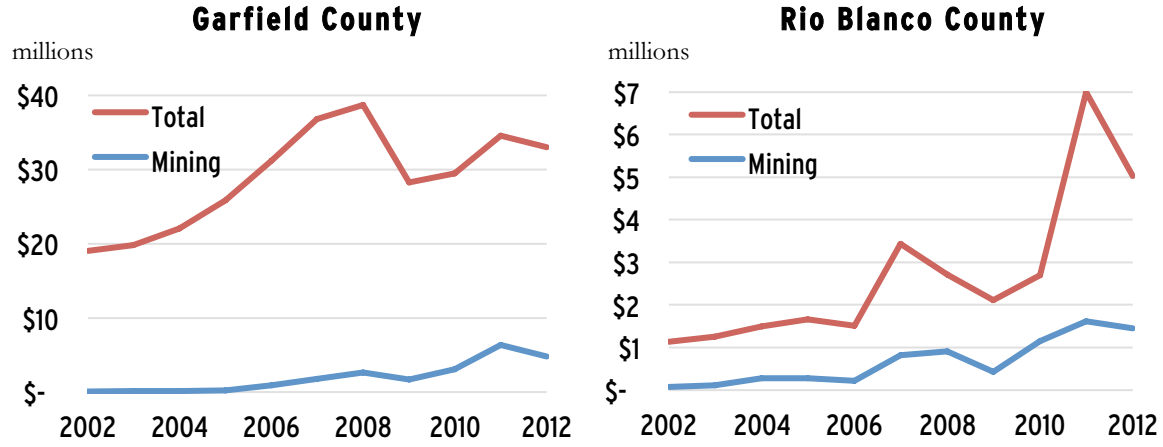
In 2012, property taxes on oil and gas property provided roughly $39 million for Garfield and $7 million for Rio Blanco counties, 37 and 19 percent of total revenues, respectively (Garfield County Assessor's Office 2003-2013; Rio Blanco County Finance Department 2003-2013; Garfield County Department of Finance 2004-2013).

Sales taxes also provide an important, though more volatile revenue source for both counties. Estimating the precise amount of sales taxes attributable to the oil and gas sector is complex, and depends on two main factors: the number of companies and workers supported directly or indirectly by the industry, and the value of purchases subject to sales tax made by those groups. Although we are not able to make precise estimates, it is clear that sales tax revenues surged during the most active years of oil and gas development, and that at least some of that increase was attributable to the oil and gas industry.

Sales taxes from mining industry purchases have grown substantially for both counties this decade. Not all of these purchases are attributable to oil and gas development, as coal mining also plays a role in the local economy, particularly Rio Blanco County. However, no major expansion in local coal mining has occurred in recent years, suggesting that a majority of the increase is attributable to oil and gas.

The increasing share of sales attributable to the mining sector corresponded with overall increases in sales tax collections for both counties. Revenue trends from both counties show a clear correlation between the share of sales attributable to mining and the overall level of sales taxes collected (see Figure 3-3). The larger revenue changes in Rio Blanco County suggest that mining-related sales taxes have had a greater proportional effect on county-wide sales tax revenues.

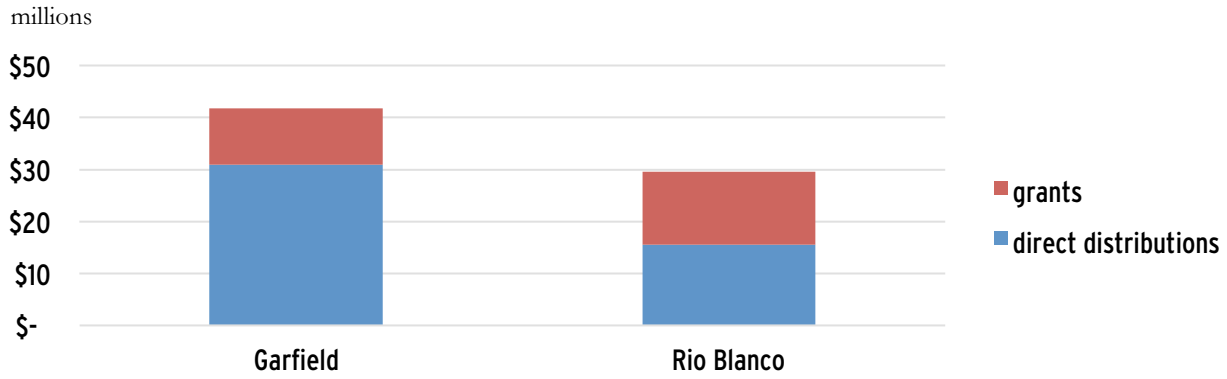
Figure 3-3: Sales tax collections



Source: Colorado Department of Revenue (2013). Note: Figures include state and local sales tax collections.

Along with county revenues collected directly from property taxes, sales taxes, and other sources, Colorado allocates to local governments a substantial portion of its statewide severance tax and royalties from oil and gas leases on federal land. These revenues are allocated through two mechanisms: direct distributions to local governments, determined by a formula incorporating production levels, oil and gas employment, and other factors; and grants awarded through a competitive bid process administered by the Colorado Department of Local Affairs (DOLA) that takes into account local industry impacts. These distributions have provided substantial new revenues for each county. Garfield County, where far more production occurs, has received over $40 million, primarily from direct distributions. Rio Blanco County has seen nearly $30 million, with roughly half coming from DOLA grants (see Figure 3-4).

Figure 3-4: Allocations of state severance tax and federal mineral lease revenues, 2005-2014



Data source: Colorado Department of Local Affairs (2014). Note: Due to legislative changes, direct distributions began in 2007. The revenues shown here are only for county governments, and do not include revenues for municipalities or other local governments within the counties.

Finally, some counties in Colorado lease county-owned land for oil and gas production, in some cases generating millions of dollars in additional revenue. However, Garfield County holds only one lease, which generated the modest sum of $40,000 in 2012. Rio Blanco County does not generate any revenues from oil and gas leases.

3.1.2 Major county costs associated with the oil and gas industry

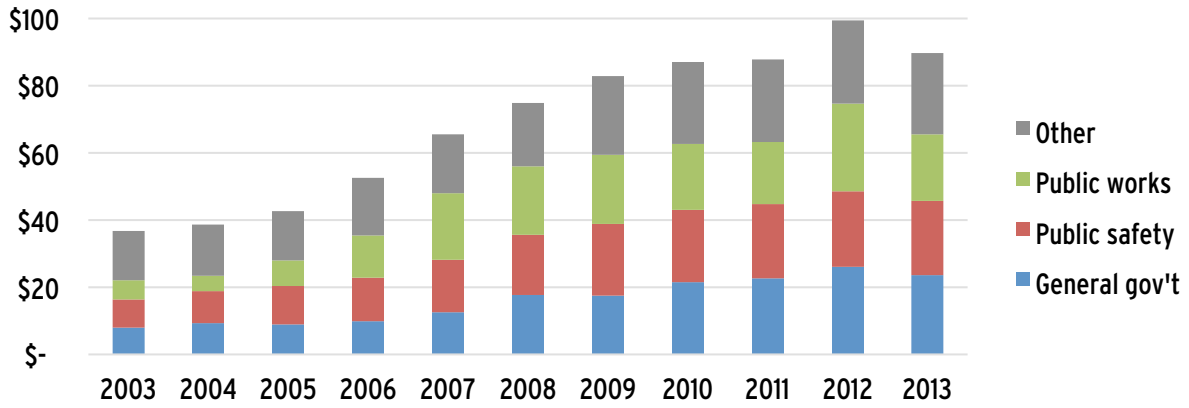
The leading cost for Colorado counties associated with the oil and gas industry comes from road maintenance and repair. Thousands of heavy truck trips are typically required to construct, drill, and complete a hydraulically fractured oil or gas well, and much of this traffic travels along rural roads not originally designed to handle such traffic. While the state maintains some of the region's main arteries, a substantial portion of traffic utilizes two-lane county roads that wind through the region's mountains and mesas.

Demand for other services has also increased for these counties, largely associated with population growth. This includes increased demand for law enforcement and administrative services such as the county clerk's office, which administers land records. Both counties have expanded staff in these and other areas, requiring new outlays in the form of wages, benefits, equipment such as vehicles and computer systems, and new or expanded office space.

Figure 3-5 shows where some of this new spending has occurred. In Garfield County, spending on public works—primarily county roads—has increased more than 4-fold since 2003, while the addition of new staff, equipment, and office space has increased general government spending 3-fold. Some of this spending, including general government and public safety costs, is largely associated with population growth—an indirect cost attributable primarily to oil and gas industry growth. Other costs are more directly tied to oil and gas operations, such as public works (i.e., roads and bridges). In addition, Garfield County implemented a variety of environmental

monitoring projects in response to community concerns regarding water and air quality, totaling roughly $3.4 million from 2008 through mid-2014.

Figure 3-5: Garfield County expenditures by type (million)



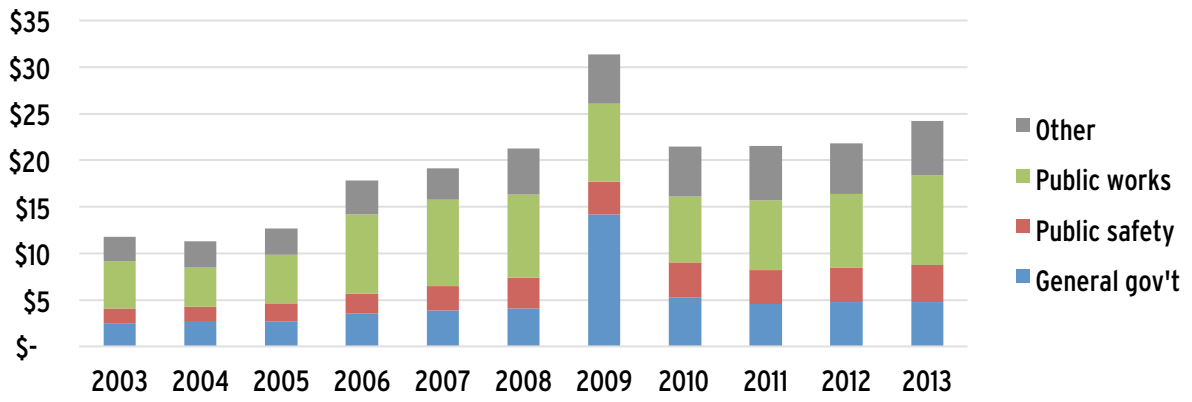
Data source: Garfield County Annual Audited Financial Reports (2004-2013). Data includes transfers.

In Rio Blanco County, expenditure increases have been smaller, and mask some important challenges. Most notably, spending on public works (primarily county roads) has remained relatively flat since 2007, though certain county roads have been in need of repair due to heavy oil and gas traffic. It is unclear why the county has not invested more of its new revenues in these repairs, as their substantial revenue growth suggests that additional spending on roads could in part alleviate the challenges associated with oil and gas activity.

The large spike in general government spending in 2009 was due to a court ruling that found the county had improperly collected over $9 million in use taxes from two oil and gas companies during the preceding years (see Figure 3-6).[2] Public safety costs have risen 2.5-fold since 2003, reflecting an expansion in law enforcement staff.

[2] See Rio Blanco County 2009 Annual Audited Financial Statement, p. A-8.

Figure 3-6: Rio Blanco County expenditures by type (million)



Data source: Rio Blanco County Annual Audited Financial Statements (2003-2013). Data includes transfers.

As the Rio Blanco experience with road repair shows, not all new costs can be captured by examining financial data. Indeed, local officials estimate that at least $100 million in road repairs are needed due to increased oil and gas activity.[3] Other potential costs that are not observable on financial statements include opportunity costs for staff in both counties, where demands on their time from oil- and gas-related issues has to some extent crowded out time spent on other priorities. These opportunity costs have been substantial for some officials, though most tend to see time spent on oil- and gas-related issues as simply part of their responsibility given the sector's importance in the regional economy.

3.1.3 Key local factors

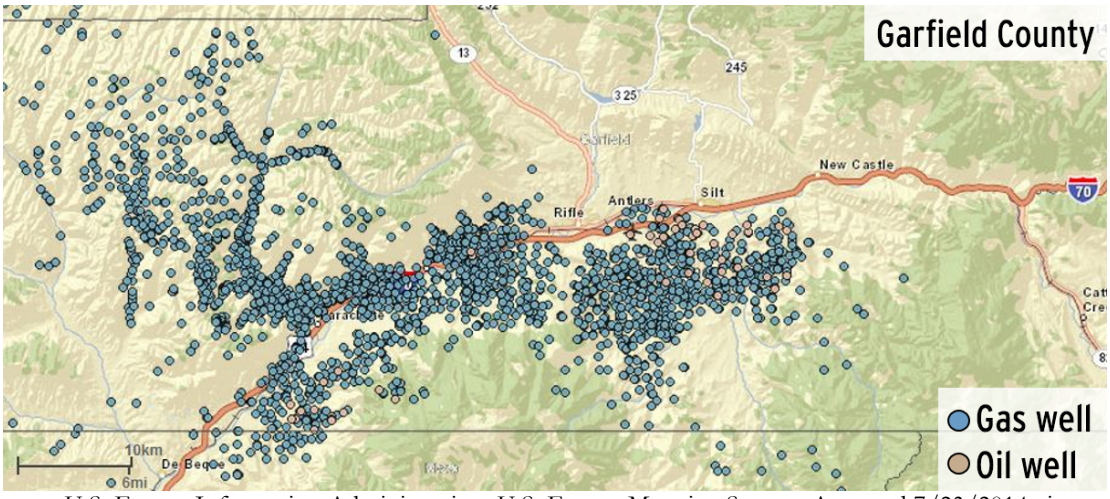
Garfield and Rio Blanco Counties have experienced distinct net fiscal effects from recent oil and gas development. One might expect Garfield County, which has seen far more drilling and production than its northern neighbor, to experience larger impacts and perhaps larger fiscal challenges from oil and gas activity. However, it is Rio Blanco County that has struggled to manage new costs, primarily attributable to oil and gas industry traffic. Much of the difference can be attributed to a single road, and the experience of that road gives insight into how several major factors—infrastructure, capacity, and policy—can affect fiscal outcomes.

Infrastructure and capacity

In Garfield County, operators use a variety of county roads that wind through the mountains and mesas surrounding the city of Rifle, with wellpads scattered across the landscape. While these roads endure substantial wear and tear, a large share of the impact is mitigated by the presence of Interstate 70, which bisects the most active drilling regions of Garfield County and serves as an industry corridor (see Figure 3-7).

[3] Based on interview with Rio Blanco County Commissioner Shawn Bolton.

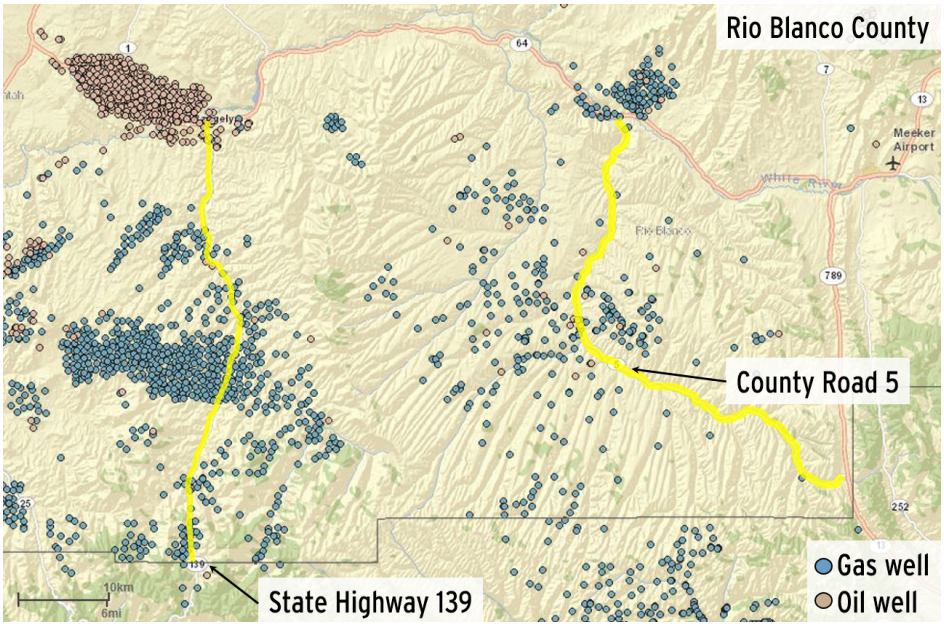
Figure 3-7: Oil and gas wells along the I-70 corridor, Garfield County CO



Map source: U.S. Energy Information Administration, U.S. Energy Mapping System. Accessed 7/23/2014 via http://www.eia.gov/state/maps.cfm. Annotations added by the authors.

In Rio Blanco County, there are no interstates, and the region's rugged topography implies there are limited options for roads. As a result, industry traffic follows two main corridors through the mountains: State Highway 139 and Rio Blanco County Road 5 (CR5). Dozens of wells are scattered along the east and west side of CR5, with dozens more located near the road's northern terminus at State Highway 64. While the state government maintains Highway 139 and most of the other routes shown in Figure 3-8, the responsibility to maintain CR5 falls upon the county.

Figure 3-8: Oil and gas wells in Rio Blanco County, CO



Map source: Map source: U.S. Energy Information Administration, U.S. Energy Mapping System. Accessed 7/23/2014 via http://www.eia.gov/state/maps.cfm. Annotations by the authors.

While both counties have faced substantial impacts from oil- and gas-related truck traffic, the concentration of traffic along CR5 has created a distinct challenge for Rio Blanco County. In Garfield County, the main artery for oil and gas traffic is Interstate 70, and county roads experience intermittent industry traffic traveling a limited number of road-miles. In Rio Blanco County, CR5 experiences a steady stream of traffic along a much longer stretch of road. This concentration of traffic is one of the major factors leading to large new costs for Rio Blanco County.

A second factor related to infrastructure is that Rio Blanco's maintains more roadway (~900 lane miles) than Garfield County (~700 lane miles), and those roadways are generally built to lower standards. 81 percent of Rio Blanco's lane-miles are unpaved, compared with 52 percent in Garfield County (Colorado Department of Transportation 2012). Paved roads are more expensive to construct, but require less maintenance and repair than unpaved roads experiencing frequent heavy truck traffic (Abramzon *et al.* 2014).

As described in section 3.1.1, Rio Blanco County's property tax base is far smaller and generates far less revenue than its southern neighbor, partly due to less oil and gas activity and partly due to the fact that roughly 90 percent of the county's land is federally-owned. As a result, their capacity to pay for necessary upgrades and repairs—even as government revenues have grown in recent years—is more limited than Garfield County. Grants from DOLA have increased Rio Blanco County's ability to manage these issues, but appear to be insufficient to manage all the new costs.

These infrastructure and capacity issues do not by themselves explain why Rio Blanco County has been unable to keep up with road maintenance costs while Garfield County prospers. A second factor—policy—has played a central role in driving these divergent fiscal outcomes.

Policy

In the mid-2000s, as road damage on CR5 came to the fore as a concern for Rio Blanco County commissioners, they attempted to enter into road maintenance agreements with operators much as Garfield County had done. However, the parties were unable to reach an agreement. As a result, the county turned to another option: assessing an impact fee on all new development activities, including oil and gas wells.

Although some of the same companies were operating in both counties during the 2000-2013 period, several were active primarily in one county or the other (see Table 3-1). It is possible that differences in operating strategies and/or personalities also contributed to differences in the extent of collaboration between county governments and operators. However, we were unable to reach a clear understanding of why agreements occurred in Garfield County and not in Rio Blanco.

Table 3-1: Leading Piceance basin operators, 2000-2013

Garfield County	Well completions	Rio Blanco County	Well completions
WPX	3,762	ExxonMobil	775
Encana	2,405	WPX	601
Bill Barrett Corp	1,487	Encana	124
Noble Energy	605	Whiting Petroleum	97
Ursa Operating	582	Bopco	77
Oxy USA	474	Koch Exploration	68
Caerus Piceance LLC	294	Chevron	55
Chevron	217	Foundation Energy	27

Data source: DI Desktop. Accessed July 23, 2014.

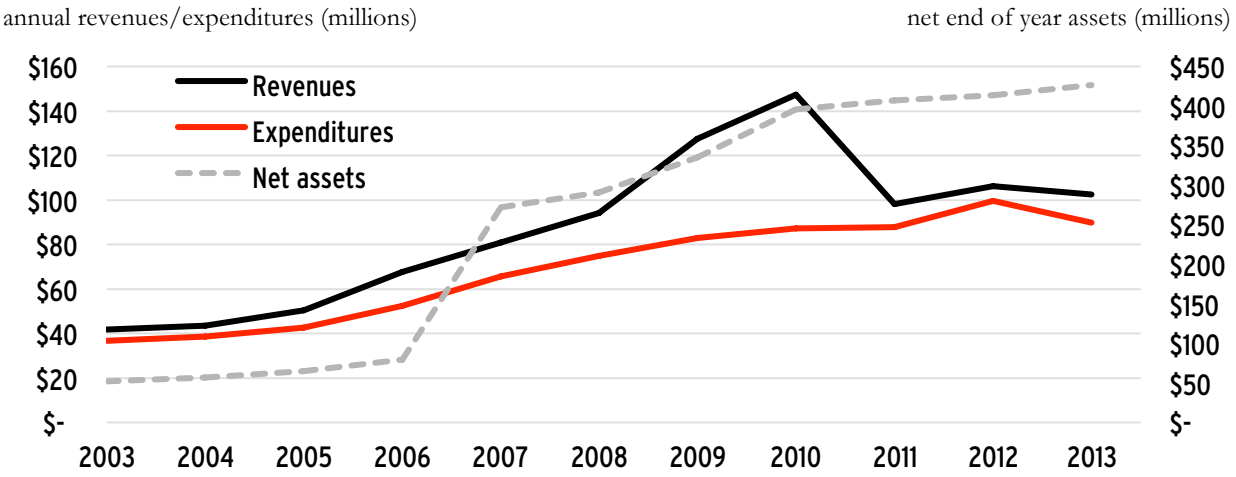
Multiple studies were commissioned by Rio Blanco County to determine whether it had legal authority to impose an impact fee, which activities were contributing to the needed repairs, what improvements would be necessary to manage these impacts moving forward, and what would be a "fair" fee to mitigate the public costs associated with different development activities, including oil and gas operations (RPI Consulting 2007a, b, 2008). Based on these studies, the impact fee for oil and gas development is set according to a formula including well depth, expected vehicle traffic, and other factors. A sample well drilled to a depth greater than 5,500 feet would face an impact fee of roughly $18,000 (Rio Blanco County 2014). Total collections from the impact fee were roughly $1.3 million in 2013, roughly three percent of total county revenue in that year (Rio Blanco County Finance Department 2003-2013), and just above one percent of the total estimated repair bill for CR5. As a point of reference, Pennsylvania's impact fee (which allocates roughly 18 percent of total impact fee revenues to counties) would generate roughly $55,000 per well over 15 years for county governments.[4]

3.1.4 Net fiscal effects

All told, Garfield County has seen a large boost in its fiscal health, while Rio Blanco County has seen large revenue increases accompanied by larger new service demands. Figure 3-9 and Figure 3-10 show the annual revenues, expenditures, and net assets (which includes all asset classes and liabilities) for both counties. Although Rio Blanco County has roughly tripled its net assets over the past decade, it would not be able to afford the estimated $100 million repair costs for CR5 even if it liquidated its unrestricted net assets, worth $62.5 million at the close of 2013. Garfield County, on the other hand, has grown its net assets by roughly 800 percent since 2003, and does not face the same level of infrastructure needs.

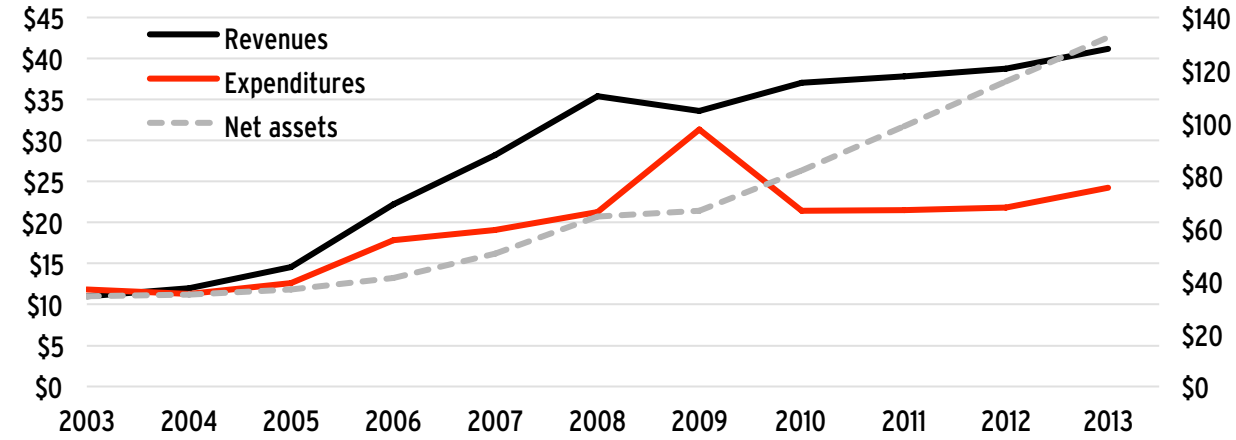
[4] Assuming a natural gas price of between $3.00 and $4.99 per thousand cubic feet. For details on Pennsylvania's Impact Fee allocation, see Raimi and Newell (2014a).

Figure 3-9: Garfield County revenues, expenditures, and net assets



Data source: Garfield County Annual Audited Financial Reports (2004-2013). Data includes transfers.

Figure 3-10: Rio Blanco County revenues, expenditures, and net assets



Data source: Rio Blanco County Annual Audited Financial Statements (2003-2013). Data includes transfers.

3.1.5 Lessons

Partnership with oil and gas operators has played a major role in limiting costs for Garfield County. The lack of such a partnership in Rio Blanco County is a major factor in the fiscal challenges faced by the county.

Limited road infrastructure related to topographical constraints has contributed to fiscal challenges for Rio Blanco County. The presence of state- and federally-maintained roadways in Garfield County has helped limit costs.

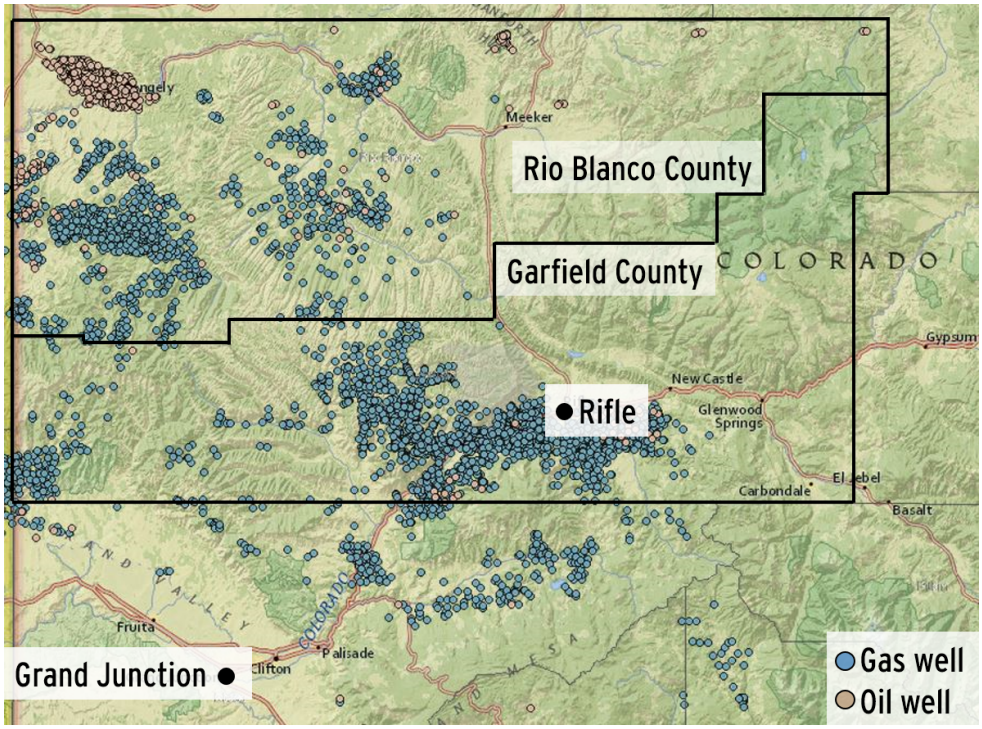
Limited government capacity for Rio Blanco County—primarily due to limited revenue—has contributed to its fiscal challenges.

Local government fiscal indicators such as those shown in Appendix B are not sufficient to accurately describe the challenge of unmet service demands such as needed road repairs.

3.2 Municipalities in the Piceance Basin

The two cities examined here have been affected by oil and gas development in different ways. Rifle (pop. ~9,200), the seat of Garfield County, has been near the center of the heaviest drilling activity in the Piceance basin. Grand Junction (pop. ~60,000) is the largest city in the region and the seat of Mesa County. It lies at the periphery of activity, and has served as a corporate base and population center for much of the oil and gas workforce.

Figure 3-11: Regional map

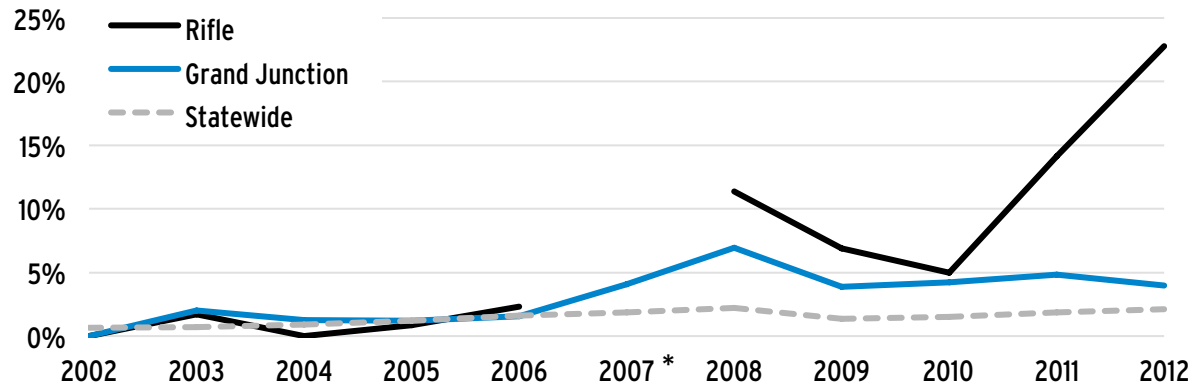


Map source: U.S. Energy Information Administration U.S. Energy Mapping System. Accesed via http://www.eia.gov/state/maps.cfm, 7/18/2014.

Unlike the counties in the Piceance basin, oil and gas property does not make up a large portion of the municipal tax base, and does not provide substantial tax revenue for either municipality. Although the oil and gas industry has indirectly affected property tax revenues by increasing population and economic activity, generating new construction, and potentially affecting property values, quantification of these indirect effects is beyond the scope of this report. Additionally, these effects are likely to be small relative to other revenue sources, as property taxes account for less than 10 percent of annual revenues for both cities.

Sales and use taxes are a much larger revenue source. As with county sales taxes, it is difficult to attribute a precise share of revenue to the oil and gas sector. However, trends in mining sector purchases indicate that oil and gas activity provided a substantial boost for revenues for both cities, particularly in 2007 and 2008. As Figure 3-12 shows, sales taxes from the mining sector have been volatile, especially for Rifle.

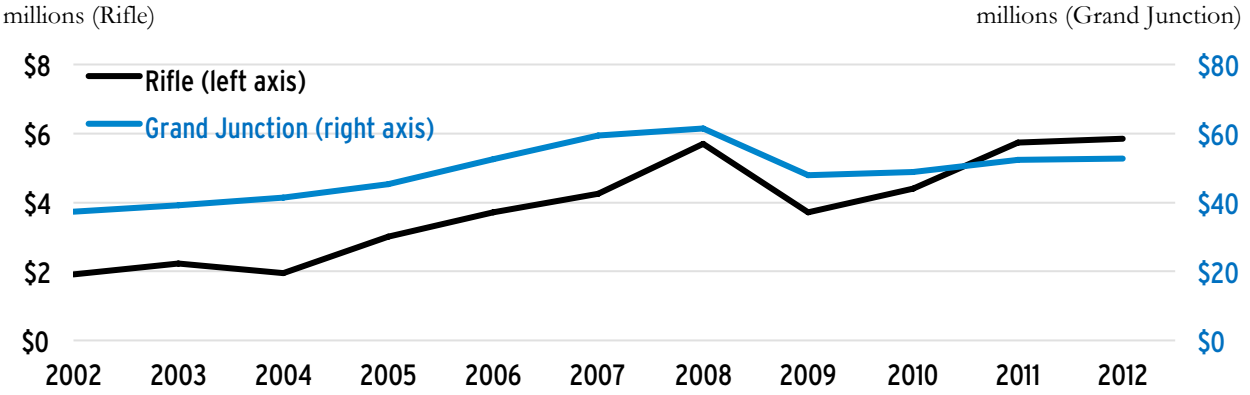
Figure 3-12: Mining industry sales taxes, as a percent of total sales taxes



Data source: Colorado Department of Revenue (2013). Note: Totals include sales taxes retained by state and municipal governments. * 2007 data for Rifle are not available due to confidentiality.

A 2007-2008 spike in mining-related sales taxes corresponded with a substantial increase in overall sales taxes for both cities during the most active years of drilling and industry-related population growth (see Figure 3-13). But in 2009, both saw declines in overall sales tax revenues brought about by the housing crisis, financial crisis, recession, and falling natural gas prices. During this period, mining sales taxes declined even more rapidly than overall sales taxes, indicating that the mining sector was especially hard-hit by the financial crisis and fall in natural gas prices. However, mining-related sales taxes have grown rapidly since 2009 in Rifle, accounting for much of the large increase in total sales taxes. Mining and overall sales taxes for Grand Junction have been roughly flat over the same period, but are well above the levels of the early 2000s.

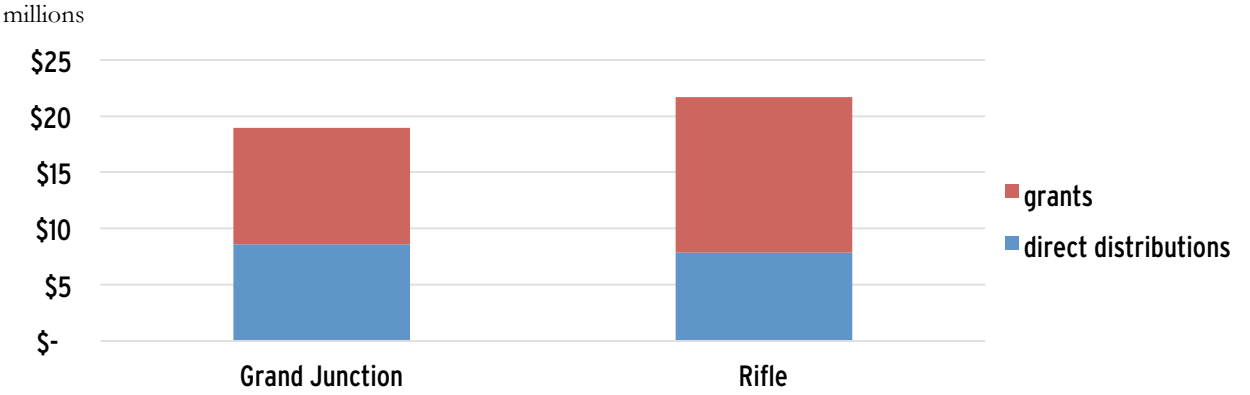
Figure 3-13: Total municipal sales taxes



Data source: Colorado Department of Revenue (2013). Note: Totals include sales taxes retained by state and municipal governments.

As noted in section 3.1.1, Colorado allocates a substantial share of its severance tax and federal mineral lease revenues to local governments through direct distributions and a grant program. Rifle has received roughly $21 million since 2005, while Grand Junction has received roughly $19 million, the highest two totals among all municipalities in Colorado. Both cities benefited substantially from the state's grant program, which has awarded roughly $10 million to Grand Junction and $14 million to Rifle (see Figure 3-14).

Figure 3-14: Municipal severance tax/federal mineral lease revenue, 2005-2014



Data source: Colorado Department of Local Affairs (2014).

Some local governments in Colorado generate substantial revenue from oil and gas leases on municipal land. However, neither city examined here generates large revenue from such leases.

Finally, fees for services provide major revenue streams for each city, especially fees for water and wastewater connections and use. While these fees provide a large amount of revenue, they are generally used to offset costs of providing the relevant service. As we discuss in the following section, water and wastewater fees have in some cases been insufficient to cover the costs of major upgrades and expansions.

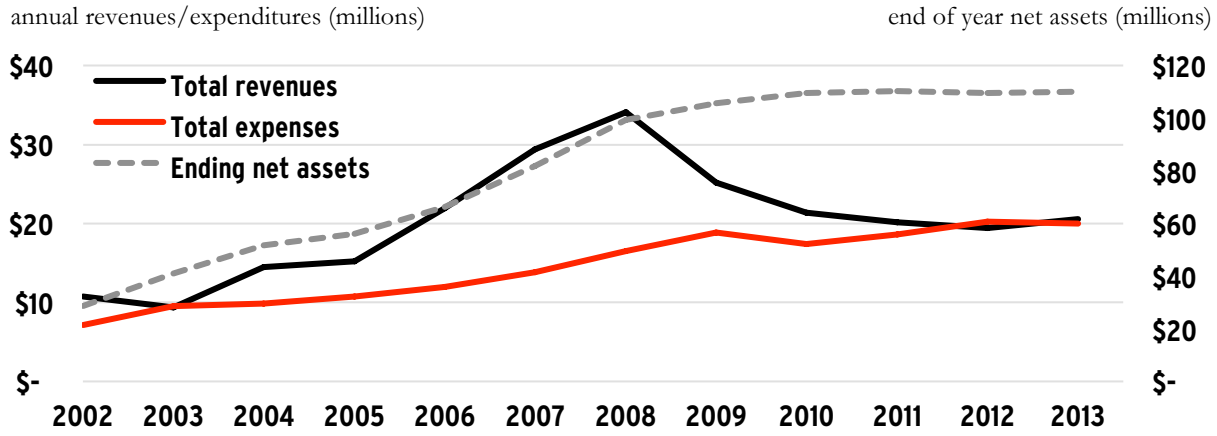
3.2.1 Rifle

Rifle experienced the most significant population growth of any municipality we examined in Colorado, and this growth was in large part attributable to increased oil and gas activity (see Figure 6-1). Situated in the heart of the natural gas-producing region, Rifle saw its population grow from roughly 7,000 to 9,000 during the 2000s, a slightly faster growth rate than Grand Junction. Growth was accompanied by a building boom of residential neighborhoods and businesses, and was led by natural gas development, along with a smaller number of retirees, second home buyers, and service industry workers commuting to higher-cost resort areas near Aspen (BBC Research and Consulting 2008a).

Fueled largely by natural gas and oil shale development, Rifle's population was projected to roughly triple by 2025. City officials described their situation as a "perfect storm" of oil shale, natural gas, and housing development that would drive growth for decades (see Figure 6-3).

Tax revenues grew very quickly from 2002 to 2008, the peak of regional natural gas development, rising from $2.6 million to $12.4 million, led by sales taxes. A variety of capital grants, including DOLA grants from severance tax and federal mineral lease revenues, added an additional $11.6 million in 2008 (Rifle Department of Finance 2002-2013). Overall revenues grew from roughly $10 million in 2002 to a peak of $34 million in 2008.

Figure 3-15: Rifle revenues, expenditures, and net assets



Data source: Rifle Department of Finance (2002-2013). Data includes transfers.

With this rapid revenue and population growth projected to continue, city officials took on roughly $18 million of low-interest debt in 2007 to begin construction of major infrastructure projects, namely an expanded wastewater treatment plant (Rifle Department of Finance 2007). Around the same time, the city began planning for a complementary water treatment plant that would add an additional $24 million in low-interest debt (Rifle Department of Finance 2012).

However, the rise in government revenues abruptly stopped and began to fall in 2009, leaving the city with large liabilities and declining revenues. As a result, officials were forced to take multiple steps to manage the city's debt burden: wastewater service rates more than doubled, and water service rates increased by roughly 50 percent, which was in addition to a voter-approved 0.75 percent sales tax increase to limit further rate increases for water service. The city has since been able to manage its debt burden, but the new costs for residents and businesses has been substantial.[5]

City staff costs also grew quickly during the past decade, led by law enforcement costs. The addition of new officers doubled the annual operating budget from $1 million to $2 million, and the city built a new justice center costing roughly $3.5 million. The city manager notes that Rifle had been understaffed in law enforcement prior to surge in natural gas development, and that these additions helped enable the city to provide more adequate law enforcement. He estimates that the oil and gas workforce did not disproportionately increase crime rates, but did contribute to the need for officers by driving population growth. Other major costs included upgrades to city streets (~$5 million over the decade) and a new park maintenance facility ($4 million, funded entirely by a dedicated one percent sales tax increase).

The city also struggled with workforce retention associated with rising local wages, especially among the street maintenance workforce, whose skills operating heavy machinery gave them ample opportunities in the oil and gas sector. Additionally, the city was unable to afford the rising rates of many local contractors for projects such as sidewalk construction or maintenance, as private construction firms saw rising demand for oil- and gas-related projects.

Grants from DOLA helped manage many of these new costs, especially road and street repair. But by far the dominant fiscal challenge for the city has been sewer and water infrastructure. Overall, the city manager describes the surge in natural gas development in the mid-2000s as a net benefit for Rifle's fiscal health, as new businesses and buildings have boosted the city's tax base far above the levels of the early 2000s. However, the challenges during the middle part of the decade were substantial, and local ratepayers have had to bear water and wastewater rate increases of 150 percent, plus additional sales taxes, to support the city's ill-timed infrastructure expansion. As of early 2015, the city's central water tank has begun to fail, and repairs are likely to cost $5 to $6 million dollars. These upgrades will require additional city borrowing and rate increases for residents.[6]

[5] Based on interview with Rifle city manager Matt Sturgeon, Jan. 23 2014.

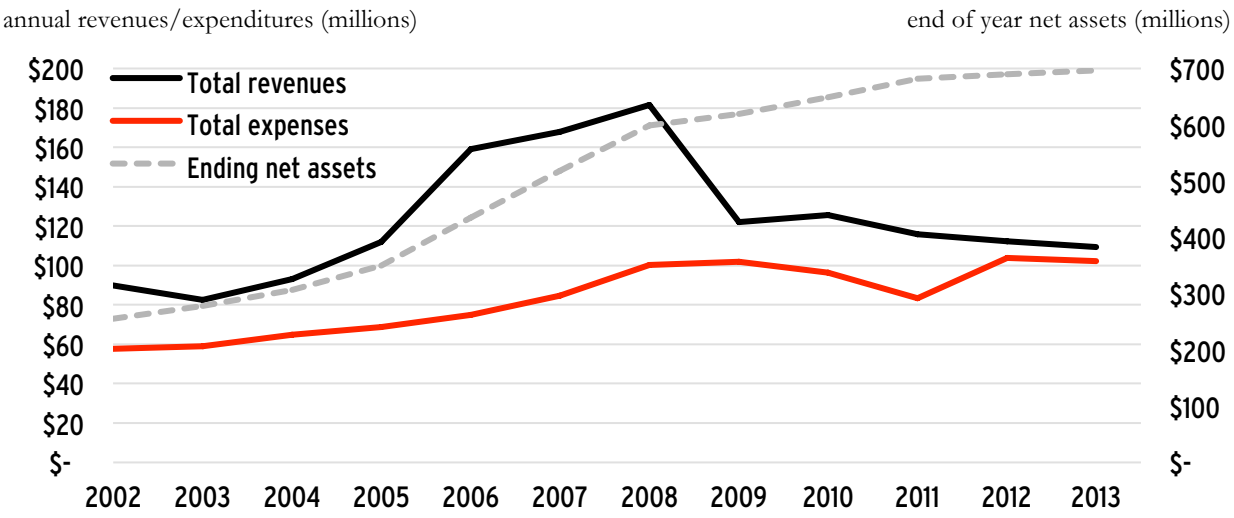
[6] Based on email communication with Rifle city manager Matt Sturgeon, Jan. 29 2015.

3.2.2 Grand Junction

Grand Junction also saw rapid growth during the mid-2000s, partly due to natural gas development, but more importantly due to a boom in construction for new residents and second-homeowners. Although the city is an hour's drive from the heart of the producing region, a substantial oil and gas workforce located in Grand Junction, which has roughly six times the population of Rifle and offers amenities such as movie theaters, shopping centers, and other attractions. A number of oilfield service firms such as Halliburton located their field headquarters in Grand Junction, with dozens of trucks departing each morning towards the producing region.

Growth in population and economic activity, partly attributable to oil and gas development, drove a large increase in revenue from 2003 through 2008. Sales and use tax revenue grew from $37 million to nearly $60 million during this period, and charges for services nearly doubled from $18.5 to $35 million. External grants for capital projects also grew during this period, increasing from $17 million to $64 million (Grand Junction Financial Operations Department 2002-2013). A substantial share of these capital grants came from the DOLA energy impact program, which provided roughly $10 million for a variety of infrastructure projects (Colorado Department of Local Affairs 2014). As Figure 3-16 shows, revenues far outpaced expenditures in the middle part of the decade.

Figure 3-16: Grand Junction revenues, costs, and net assets



Data source: Grand Junction Financial Operations Department (2002-2013). Data includes transfers.

After this robust growth, the confluence of the national housing bust, financial crisis, and declining natural gas prices drove city revenues down by roughly one third in 2009. Since that time, revenues have slowly declined, and local officials report that they have struggled to maintain a variety of services. In 2009, Grand Junction cut 82 staff positions across city departments, and has added few back. Sales taxes declined to roughly $50 million in 2013 (17 percent below their 2008

peak), and capital grants have fallen to a low of $7.5 million in 2013 from a peak of $64 million in 2008 (Grand Junction Financial Operations Department 2002-2013).

Despite these declines in revenue, Grand Junction did not have to make the kind of investments in new water and wastewater infrastructure that have created long-term fiscal challenges in Rifle. In addition, the relative size and diversity of Grand Junction's economy has made it less dependent on the oil and gas industry alone. While mining sales taxes have grown to represent over 20 percent of Rifle's total sales tax base, Grand Junction relies on the mining sector for less than five percent of its sales taxes, and these revenues have been less volatile for Grand Junction than for Rifle.

There have been substantial oil- and gas-related costs for the city, but local officials estimate that these costs have been more than offset by oil- and gas-related revenues. For example, heavy trucks associated with oilfield service firms have caused damage to some city streets, but DOLA energy impact grants coupled with industry-related tax revenues have been sufficient to manage these costs. Grand Junction also increased its spending on municipal buildings, making upgrades to city fire and police buildings that were in need of repair. Officials state that these upgrades would not have been possible without the new revenues generated by the oil and gas industry.[7]

Overall, it appears that natural gas development provided a boost to city finances during the mid-2000s, but those benefits have decreased substantially since 2008, the peak year of industry-related revenues. Grand Junction has in recent years struggled to balance its budget, and while revenues related to natural gas production have declined since 2008, other factors such as the bust in the local housing market appear to have played a larger role. A number of oilfield service firms continue to operate out of Grand Junction, generating government revenue that did not exist prior to the expansion of large-scale natural gas activity in the area.

Unlike Rifle, which built infrastructure with the expectation of a doubling or tripling of population, Grand Junction did not need to expand its water or wastewater services. Although oil- and gas-related population growth was substantial, it had a smaller relative impact due to more robust existing infrastructure designed to serve a larger population base. And while the city's fiscal health has deteriorated in the previous five years, local officials believe that the addition of new oil and gas-related businesses and economic activity has helped it weather the more harmful downturn in the housing market.

[7] Based on interview with Mayor Sam Sasuras, city manager Rich Englehart, deputy city manager Tim Moore, and financial operations director Jodi Romero, Nov. 12, 2013.

3.2.3 Lessons

Volatile industry activity can create planning challenges. Economies that are heavily-dependent on oil and gas development like Rifle face planning challenges associated with often-volatile industry activity and associated population growth. Larger cities with more diverse economies such as Grand Junction may be less dramatically affected by such volatility.

Smaller communities face additional challenges. Because of its smaller size, relative isolation, and location near the center of drilling activity, Rifle faced additional challenges due to industry population growth concentrating within its borders. Simply put, a given increase in population affects smaller cities more substantially than large ones.

4. Conclusion

This case study shows how extensive oil and gas development can present fiscal opportunities and challenges for local governments. Those opportunities and challenges are not uniform; indeed, they can vary substantially from county to county and from city to city.

Geographically isolated local governments with limited infrastructure capacity and limited tax bases may face the greatest fiscal challenges associated with growth in oil and gas development. One example is Rio Blanco County, which has a smaller tax base, is more geographically isolated, and is more vulnerable to increased demands on county roads than its neighbor Garfield County. In addition, Garfield County's collaboration with oil and gas companies to maintain county roadways has substantially limited costs, while Rio Blanco County has not established widespread collaboration on this issue.

Another example is the city of Rifle, which when faced with a rapid increase in population associated with the oil and gas industry, rapidly expanded its water and wastewater systems. Grand Junction, a much larger city with a more diverse economic base, also experienced population growth, but did not need to expand city services to such an extent. When a downturn in drilling activity occurred in the late 2000s, the large population growth projected for Rifle did not materialize. As a result, the city was faced with large fixed costs and a smaller-than-expected customer base. Rifle residents approved new taxes to pay for this infrastructure, and the city was forced to increase water and wastewater rates by 150 percent, creating substantial new costs for city residents.

4.1 Lessons for policy

- Collaboration between local governments and industry operators, especially on road maintenance, can limit public costs and increase the likelihood of fiscal benefits for local governments.

- Local government property taxes and sales taxes may not be sufficient to manage rapid growth in population and heavy truck traffic associated with the oil and gas industry. Therefore, state governments should prepare to share revenue to manage local fiscal impacts, especially for geographically isolated regions with limited infrastructure.
- State revenue sharing policies that offer flexibility in allocation of funds creates the opportunity to direct oil- and gas-related revenue to the areas that are most in need. Colorado's Energy Impact Grant program provides this opportunity, but it appears that further revenue may have been needed for geographically isolated communities such as Rifle and Rio Blanco County.
- Oil and gas activity can be volatile, and rapid increases or decreases in activity can create planning challenges for local governments. Utilizing revenue from economic activity spurred by oil and gas development in operating budgets or for lowering local tax rates can create fiscal challenges when oil and gas activity slows. Instead, revenue from oil- and gas-related activity may be best utilized in long-term capital projects that create opportunities for economic diversification. However, assuming large debt based on expected industry growth can lead to large fiscal burdens that ultimately will be borne by taxpayers.
- State governments may be able to alleviate some of these challenges by holding a portion of oil- and gas-related revenues such as severance taxes in a reserve account. These revenues may be most valuable during "boom" times, which infrastructure demands are the greatest, or during "bust" times, when local government revenues decrease but financial obligations remain.

5. References

Abramzon, S., Samaras, C., Curtright, A., Litovitz, A., Burger, N., 2014. Estimating the Consumptive Use Costs of Shale Natural Gas Extraction on Pennsylvania Roadways. Journal of Infrastructure Systems 0, 06014001.

Allcott, H., Keniston, D., 2014. Dutch Disease or Agglomeration? The Local Economic Effects of Natural Resource Booms in Modern America. National Bureau of Economic Research, Working Paper 20508.

Bangsund, D., Hodur, N.M., 2013. Petroleum industry's economic contribution to North Dakota in 2011. ND State University Center for Agribusiness and Applied Economics, Report No. 710, Fargo, ND.

Bartis, J.T., LaTourrette, T., Dixon, L., Peterson, D.J., Cecchine, G., 2005. Oil shale development in the United States: prospects and policy issues. RAND Corporation.

BBC Research and Consulting, 2008a. City of Rifle: a case study of community renewal, growth and change in northwest Colorado. Prepared for the City of Rifle.

BBC Research and Consulting, 2008b. Northwest Colorado Socioeconomic Analysis and Forecasts. Prepared for the Associated Governments of Northwest Colorado, Rifle.

Booz Allen Hamilton, 2008. Wyoming oil and gas economic contribution study. Casper, WY.

Boyce, J.R., Herbert Emery, J.C., 2011. Is a negative correlation between resource abundance and growth sufficient evidence that there is a "resource curse"? Resources Policy 36, 1-13.

Brown, J., 2014. Production of natural gas from shale in local economies: a resource blessing or curse? , Federal Reserve Bank of Kansas City.

Brown, K.W., 1993. The 10-point test of financial condition: toward an easy-to-use assessment tool for smaller cities. Government Finance Review December.

Brunnschweiler, C.N., Bulte, E.H., 2008. The resource curse revisited and revised: A tale of paradoxes and red herrings. Journal of Environmental Economics and Management 55, 248-264.

Christopherson, S., Rightor, N., 2012. How shale gas extraction affects drilling localities: Lessons for regional and city policy makers. Journal of City and Town Management 2.

Colorado Department of Local Affairs, 2003-2012. Division of Property Taxation Annual Reports, 2003-2012. Denver, CO.

Colorado Department of Local Affairs, 2014. Funding Decisions and Annual Reports. URL http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251594722445.

Colorado Department of Revenue, 2013. County and municipal sales tax data by sector, provided via email. .

Colorado Department of Transportation, 2012. 2012 County Road Mileage. Denver, CO.

Costanzo, C., Kelsey, T.W., 2012. Marcellus Shale and Local Collection of State Taxes: What the 2011 Pennsylvania Tax Data Say. Penn State Center for Economic and Community Development, University Park, PA.

DiNapoli, T.P., 2014. Fiscal Stress Monitoring System. Office of the New York State Comptroller, Albany, NY.

Garfield County Assessor's Office, 2003-2013. Annual Property Valuation Summaries. Garfield County, CO.

Garfield County Department of Finance, 2004-2013. Garfield County Annual Audited Financial Reports, 2004-2013. Glenwood Springs, CO.

Grand Junction Financial Operations Department, 2002-2013. Comprehensive Annual Financial Reports.

Gray, J.R., 1977. Socio-economic impacts of coal mining on communities in northwestern New Mexico. Surface Environment and Mining division, U.S. Forest Service, U.S. Department of Agriclture. In cooperation with New Mexico State University. Las Cruces, NM.

Gulley, D.A., 1982. Models and mitigation in energy boom-towns. Resources and Energy 4, 87-104.

Haggerty, J., Gude, P.H., Delorey, M., Rasker, R., 2014. Long-term effects of income specialization in oil and gas extraction: the U.S. West, 1980–2011. Energy Economics.

Haggerty, J.H., McBride, K., 2014. Navigating beyond the resource curse: Do local monitoring programs empower fracking host communities? Headwaters Economics, Bozeman Montana.

Hardy, K., Kelsey, T., 2015. The Shale Gas Economy in the Northeast Pennsylvania Counties. In: Hefley WE & Wang Y (eds.) Economics of Unconventional Shale Gas Development. Springer International Publishing, pp. 71-91.

Headwaters Economics, 2013. North Dakota not returning adequate oil revenue to local governments. Bozeman, MT.

Hecox, W.E., 1984. Regional resource management techniques: The case of Colorado oil shale development. Resources Policy 10, 37-51.

Hendrick, R.M., 2011. Managing the Fiscal Metropolis: The Financial Policies, Practices, and Health or Suburban Municipalities. Georgetown University Press.

Hodur, N.M., Bangsund, D., Rathge, R., Olson, K., 2013. Estimates of enrollment projections: Ray, Stanley, Williston and DIckinson. North Dakota State University Center for Agribusiness and Applied Economics, Report No. 708-S, Fargo, ND.

Hough, J.A., 2003. The IndiKit: The Municipal Financial Indicators Evaluation Kit. International City/County Management Association.

Jacquet, J., 2009. Energy boomtowns and natural gas: implications for Marcellus shale local governments and rural communities. Northeast Regional Center for Rural Development.

Jacquet, J., Kay, D., 2014. The Unconventional Boomtown: Updating the impact model to fit new spatial and temporal scales. Journal of Rural and Community Development 9.

Jacquet, J.B., 2014. The Battlement Mesa Health Impact Assessment: A case study and oral history of process and lessons learned. Headwaters Economics, Bozeman, MT.

James, A., Aadland, D., 2011. The curse of natural resources: An empirical investigation of U.S. counties. Resource and Energy Economics 33, 440-453.

Kelsey, T., Hardy, K., 2015. Marcellus Shale and the Commonwealth of Pennsylvania. In: Hefley WE & Wang Y (eds.) Economics of Unconventional Shale Gas Development. Springer International Publishing, pp. 93-120.

Kelsey, T.W., Shields, M., Ladlee, J.R., Ward, M., Brundage, T.L., Michael, L.L., Murphy, T.B., 2012a. Economic impact of Marcellus Shale in Sullivan County: employment and income in 2010. Marcellus Shale Education and Training Center, University Park, PA.

Kelsey, T.W., Shields, M., Ladlee, J.R., Ward, M., Brundage, T.L., Michael, L.L., Murphy, T.B., 2012b. Economic impacts of Marcellus Shale in Bradford County: employment and income in 2010. Marcellus Shale Education and Training Center, University Park, PA.

Kelsey, T.W., Shields, M., Ladlee, J.R., Ward, M., Brundage, T.L., Michael, L.L., Murphy, T.B., 2012c. Economic impacts of Marcellus Shale in Susquehanna County: employment and income in 2010. Marcellus Shale Education and Training Center, University Park, PA.

Kelsey, T.W., Shields, M., Ladlee, J.R., Ward, M., Brundage, T.L., Michael, L.L., Murphy, T.B., 2012d. Economic impacts of Marcellus Shale in Tioga County: Employment and income in 2010. Marcellus Shale Education and Training Center.

Kelsey, T.W., Shields, M., Ladlee, J.R., Ward, M., Brundage, T.L., Michael, L.L., Murphy, T.B., 2012e. Economic impacts of Marcellus Shale in Wyoming County: employment and income in 2010. Marcellus Shale Education and Training Center, University Park, PA.

Leistritz, P.L., Toman, N.E., Murdock, S.H., De Montel, J., 1981. Cash flow analysis for energy impacted local governments—a case study of Mercer county, North Dakota. Socio-Economic Planning Sciences 15, 165-174.

Lewandowski, B., Wobbekind, R., 2013. Assessment of the oil and gas industry: 2012 industry economic and fiscal contributions in Colorado. Business Research Division, Leeds School of Business, University of Colorado Boulder, Boulder, CO.

Macke, D., 2012. Redefining the "Crowding Out" Effect: Economic Development Capacity and Long-Term Resilience in the Face of an Energy Boom. Center for Rural Entrepreneurship.

Maher, C., Nollenberger, K., 2009. Revisiting Kenneth Brown's "10-Point Test". Government Finance Review October.

Mathur, S., 2008. Impact of Transportation and Other Jurisdictional-Level Infrastructure and Services on Housing Prices. Journal of Urban Planning and Development 134, 32-41.

McCormick and Associates, RRC Associates, 2006. Garfield County Housing Assessment. URL http://garfieldhousing.com/wp-content/uploads/2013/04/garfield_county.pdf.

McFarland, C., Pagano, M.A., 2014. City Fiscal Conditions 2014. National League of Cities, Center for City Solutions and Applied Research.

Merrifield, J., 1984. Impact Mitigation in Western Energy Boomtowns. Growth and Change 15, 23-28.

Newell, R.G., Raimi, D., 2015a. Oil and Gas Revenue Allocation to Local Governments in Eight States. National Bureau of Economic Research Working Paper w21615.

Newell, R.G., Raimi, D., 2015b. Shale Public Finance: Local Government Revenues and Costs Associated with Oil and Gas Development. National Bureau of Economic Research Working Paper w21542.

Oates, W.E., 1969. The effects of property taxes and local public spending on property values: an empirical study of tax capitalization and the Tiebout hypothesis. Journal of Political Economy 77, 957-971.

Oyakawa, J., Eid, H., Castillo, J., Tomes, E., Wald, S., Sanchez, I., Rivera, R., Morua, D., Tunstall, T., 2012. Eagle Ford Shale: Economic impact for counties with active drilling. Univ. of TX at San Antonio, Center for Community and Business Research, San Antonio, TX.

Peach, J., Starbuck, C.M., 2011. Oil and gas production and economic growth in New Mexico. Journal of Economic Issues 45.

Perryman Group, 2011. A Decade of Drilling: The Impact of the Barnett Shale on Business Activity in the Surrounding Region and Texas: An Assessment of the First Decade of Extensive Development. Prepared for the Fort Worth Chamber of Commerce, Waco, TX.

Peterson, J.E., 1977. Simplification and standardization of state and local government fiscal indicators. National Tax Journal 30.

Plerhoples, C., Scorsone, E., 2011. Proposed alterations to the local government fiscal stress indicator system for the state of Michigan. Michigan State University, East Lansing, MI. Department of Agricultural, Food, and Resource Economics Staff Paper.

Porter, D., 2013. Eagle Ford Shale Task Force Report. Railroad Commission of Texas, Austin, TX.

Reynolds Jr., M., Bray, B.G., Mann, R.L., 1970. Project Rulison: A status report. In: Society of Petroleum Engineers Eastern Regional Meeting, Pittsburgh, PA.

Rifle Department of Finance, 2002-2013. Annual Financial Reports. Rifle, CO.

Rio Blanco County, 2014. Impact Fee Schedule. URL http://www.co.rio-blanco.co.us/attachments/pdfs/Planning/Impact Fee Schedule.pdf.

Rio Blanco County Finance Department, 2003-2013. Rio Blanco County Annual Audited Financial Statements. Meeker, CO.

RPI Consulting, 2007a. Fiscal Impact Analysis: General Fund Operations Existing Conditions & Year 2022. Prepared for Rio Blanco County, CO.

RPI Consulting, 2007b. Rio Blanco County Public Facilities Mitigation Fee Support Study. Prepared for Rio Blanco County, CO.

RPI Consulting, 2008. Road & Bridge Department Impact Fee Support Study. Prepared for Rio Blanco County, CO.

State of Washington, 2010. Washington State local government financial health indicators. Office of the State Treasurer.

Tunstall, T., 2015. Eagle Ford and the State of Texas. In: Hefley WE & Wang Y (eds.) Economics of Unconventional Shale Gas Development. Springer International Publishing, pp. 121-148.

Tunstall, T., Oyakawa, J., Roberts, S., Eid, H., Abalos, R., Ting Wang, Calderon, E., Melara., K., 2013. Economic Impact of the Eagle Ford Shale. University of Texas at San Antonio Center for Community and Business Research, San Antonio, TX.

U.S. Department of Agriculture, 2013. 2013 Rural-Urban Continuum Codes.

U.S. Department of Interior via Headwaters Economics, 2014. Federal Land Payment Programs. Economic Profile System - Human Dimensions Toolkit.

Univ. of AR Center for Business and Economic Research, 2012. Revisiting the economic impact of the natural gas activity in the Fayetteville Shale: 2008-2012. University of Arkansas Sam M. Walton College of Business, Fayetteville, AR.

Upper Great Plains Transportation Institute, 2012. An assessment of county and local road infrastructure needs in North Dakota. North Dakota State University, Report submitted to the 63rd North Dakota Legislative Assembly, Bismarck, ND.

Weber, J.G., 2014. A decade of natural gas development: The makings of a resource curse? Resource and Energy Economics 37, 168-183.

6. Appendix A: Demographic traits and drilling activity

Table 6-1: Background demographics

	Statewide	Garfield County	Rio Blanco County	Grand Junction	Rifle
Population (2012)	5,187,582	56,953	6,857	59,899	9,267
Percent female (2013)	50%	49%	48%	51%	49%
White (2013, not including Hispanic and Latino)	69%	69%	84%	82%	66%
High school degree or higher (2008-2012)	90%	85%	93%	90%	82%
Bachelor's degree or higher (2008-2012)	37%	25%	22%	29%	12%
Housing units (2013)	2,247,238	23,239	3,328	26,170	3,626
Per capita money income past 12 months (2008-2012)	31,039	26,989	26,473	27,431	23,371
Median household income (2008-2012)	58,244	60,215	58,393	47,598	53,849
Persons below poverty level (2008-2012)	13%	11%	14%	16%	8%
Land area (sq. miles)	103,642	2,948	3,221	38	6
Persons per square mile (2012)	50	19	2	1567	447

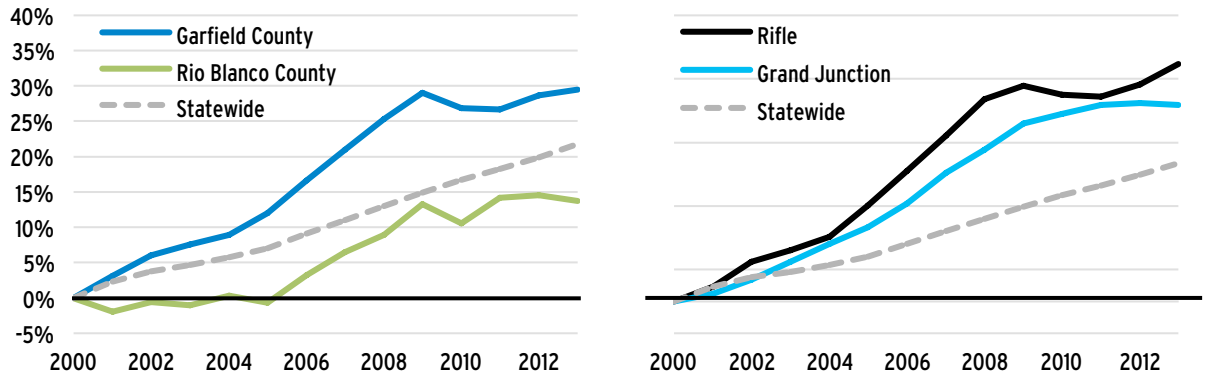
Data source: U.S. Census Bureau, 2014. http://quickfacts.census.gov/qfd/states/08/08103.html.

Table 6-2: Estimated annual population

	Statewide	Garfield County	Rio Blanco County	Grand Junction	Rifle
2000	4,326,921	44,257	5,986	45,652	6,909
2001	4,425,687	45,636	5,868	46,192	7,072
2002	4,490,406	46,925	5,951	47,223	7,340
2003	4,528,732	47,622	5,923	48,479	7,462
2004	4,575,013	48,193	6,007	49,776	7,608
2005	4,631,888	49,579	5,945	50,963	7,952
2006	4,720,423	51,594	6,176	52,660	8,329
2007	4,803,868	53,534	6,373	54,867	8,710
2008	4,889,730	55,449	6,522	56,537	9,106
2009	4,972,195	57,089	6,779	58,444	9,255
2010	5,049,071	56,139	6,620	59,104	9,153
2011	5,116,302	56,042	6,836	59,757	9,135
2012	5,187,582	56,953	6,857	59,899	9,267
2013	5,268,367	57,302	6,807	59,778	9,489

Source: U.S. Census, Intercensal population estimates. Accessed via http://www.census.gov/popest/data/historical/index.html.

Figure 6-1: Cumulative population growth, 2000=0



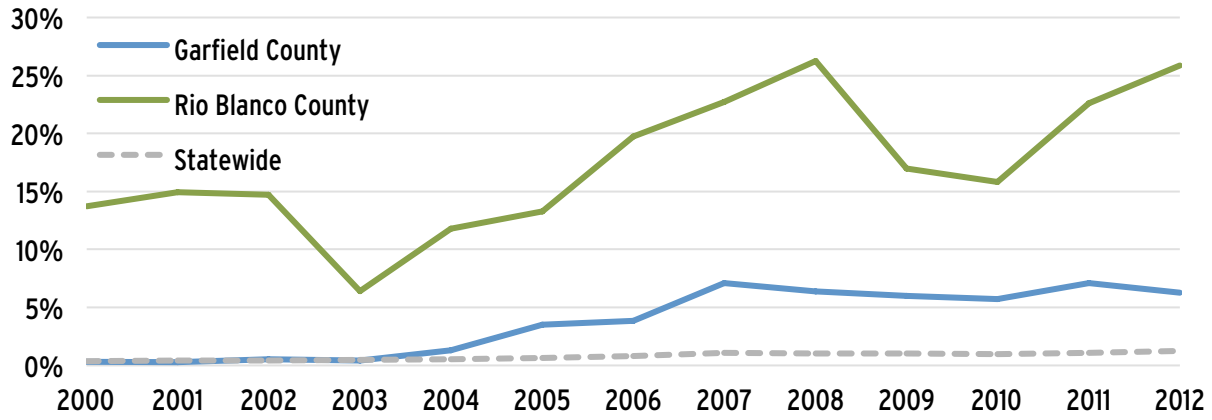
Source: U.S. Census, Intercensal population estimates. Accessed via http://www.census.gov/popest/data/historical/index.html.

Table 6-3: Well completions by county

Year	Well completions		Completions per 100 sq. miles		Completions per 100 residents	
	Garfield	Rio Blanco	Garfield	Rio Blanco	Garfield	Rio Blanco
2000	146	67	5.0	2.1	0.3	1.1
2001	155	65	5.3	2.0	0.3	1.1
2002	274	73	9.3	2.3	0.6	1.2
2003	280	93	9.5	2.9	0.6	1.6
2004	414	98	14.0	3.0	0.9	1.6
2005	783	117	26.6	3.6	1.6	2.0
2006	1121	202	38.0	6.3	2.2	3.3
2007	1447	196	49.1	6.1	2.7	3.1
2008	2045	301	69.4	9.3	3.7	4.6
2009	984	244	33.4	7.6	1.7	3.6
2010	1082	344	36.7	10.7	1.9	5.2
2011	923	249	31.3	7.7	1.6	3.6
2012	741	130	24.7	3.9	1.3	1.9
2013	357	90	12.1	2.8	0.6	1.3

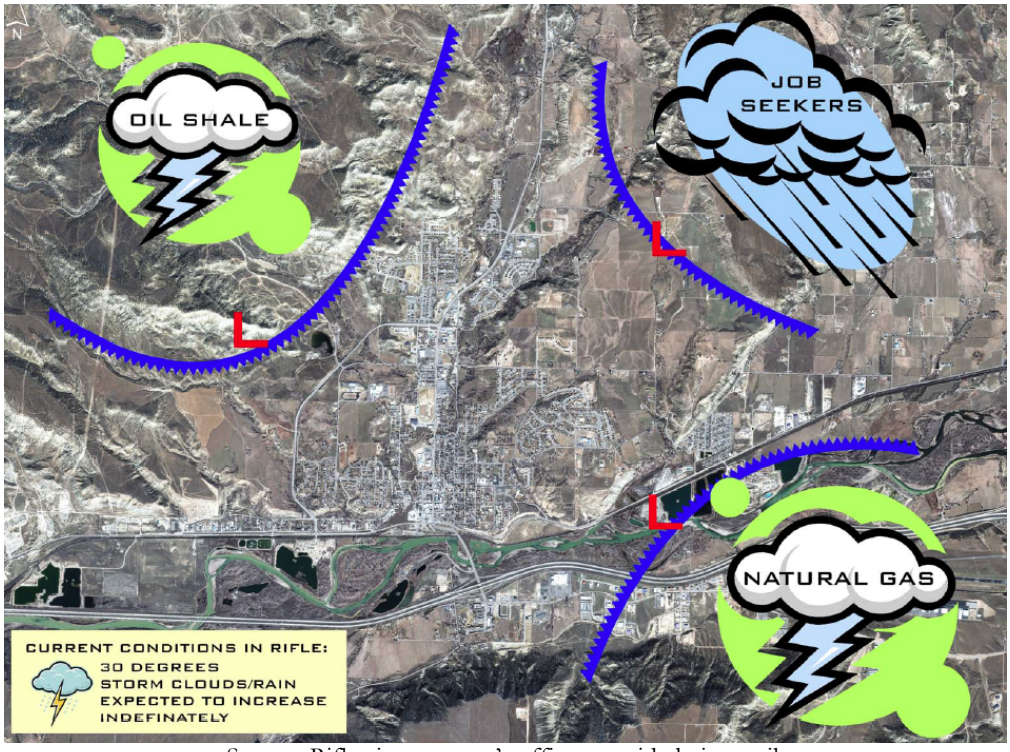
Data sources: DI Desktop for well completions. Accessed Feb. 9, 2015. U.S. Census for county area and population estimates.

Figure 6-2: Oil and gas employment as a percent of total employment



Data source: U.S. Bureau of Labor Statistics via Headwaters Economics EPS-HDT System. Available online at http://headwaterseconomics.org/tools/eps-hdt. Oil and gas employment categories include NAICS codes 2111 (oil and gas extraction), 213111 (support activities for drilling oil and gas), 213112 (support activities for oil and gas operations), and 237120 (oil and gas pipelines).

Figure 6-3: Rifle's "Perfect Storm"



Source: Rifle city manager's office, provided via email.

7. Appendix B: Local government fiscal indicators

As we describe in Section 2.2, a substantial body of literature has examined how local government financial data can help understand changing fiscal conditions over time. However, little consensus exists as to which fiscal indicators are most useful, with a variety of indexes and formulae created by various practitioners to assess local government fiscal health.

We compiled several indicators that are common to various methodologies, and present them below for those interested in the issue. All data come from the relevant jurisdictions annual audited financial statements and the U.S. Census Bureau (for population estimates).

Interestingly, the jurisdiction that displays the most favorable trends for most fiscal indicators is Rio Blanco County. This contrasts with the experience we describe in the main body of the paper, which focuses on Rio Blanco County's inability to finance needed repairs to one particular road affected by the oil and gas industry. Such a contrast demonstrates that quantitative data alone may not be sufficient to explain the changing fiscal health of a government entity.

Figure 7-1: Government revenue per capita ($2012), 2002=1

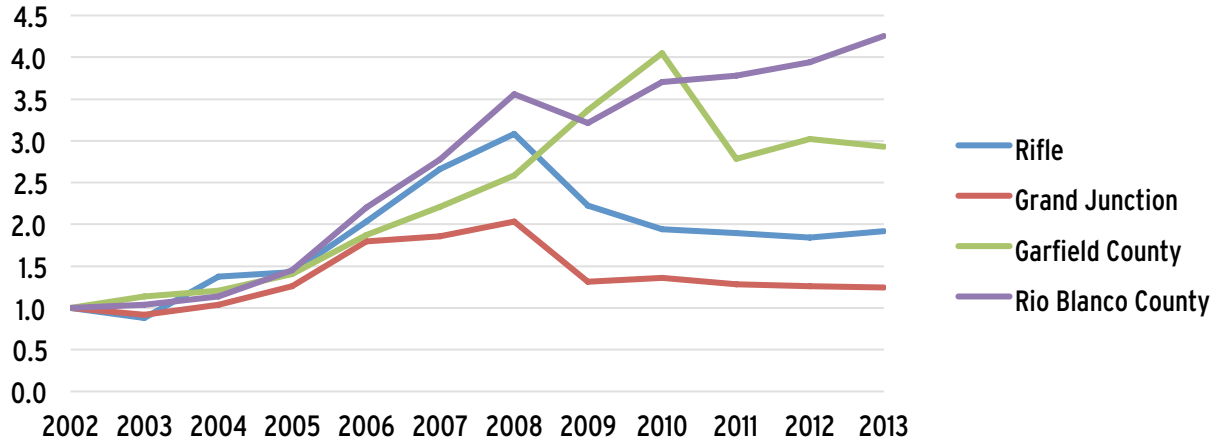


Figure 7-2: Unrestricted net assets as a percentage of annual revenue

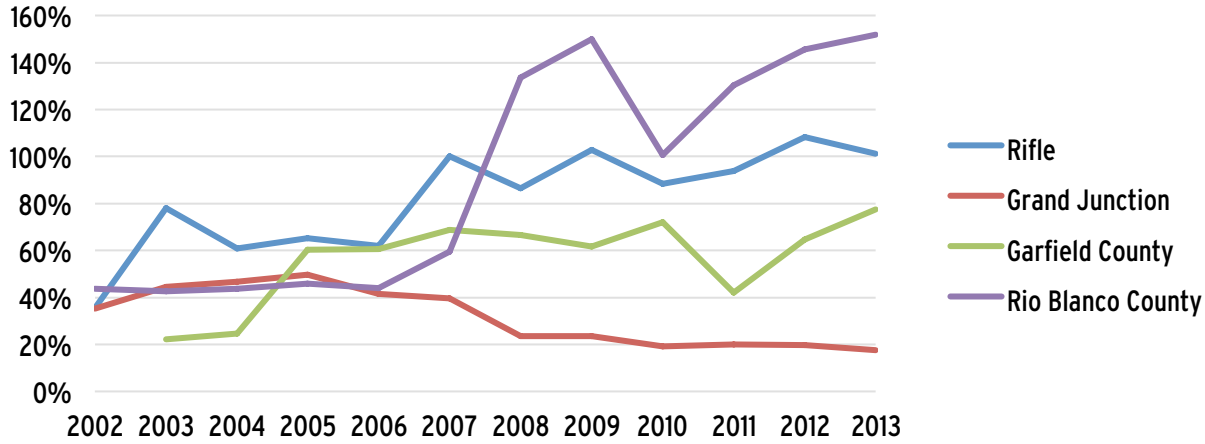


Figure 7-3: End of year fund balance (all funds) as a percentage of annual revenues

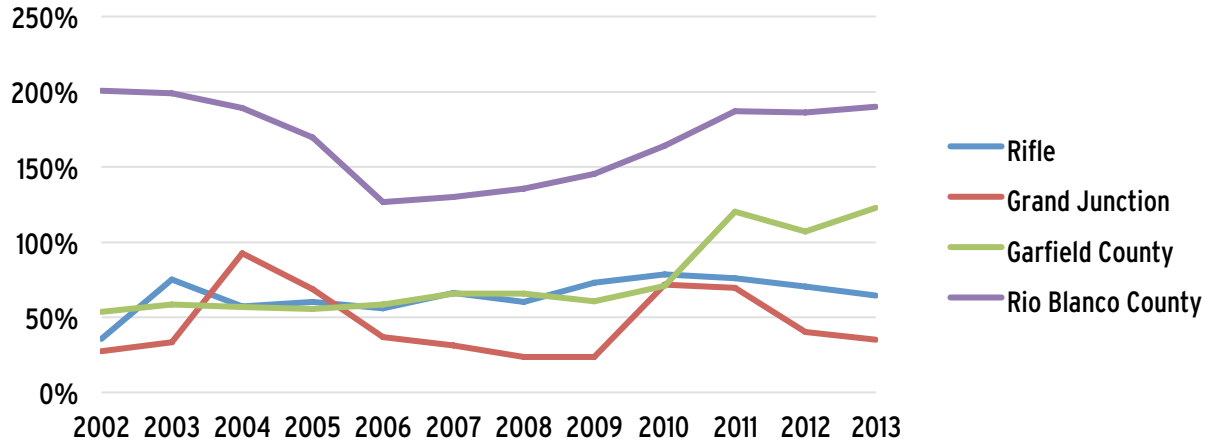


Figure 7-4: Intergovernmental revenue as a percentage of annual revenues

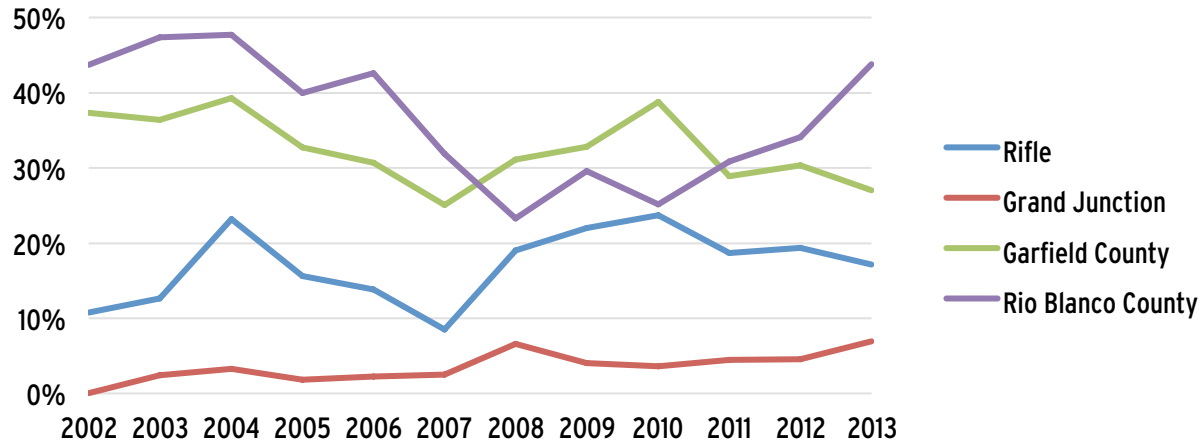


Figure 7-5 Annual debt service payments as a percentage of annual revenues

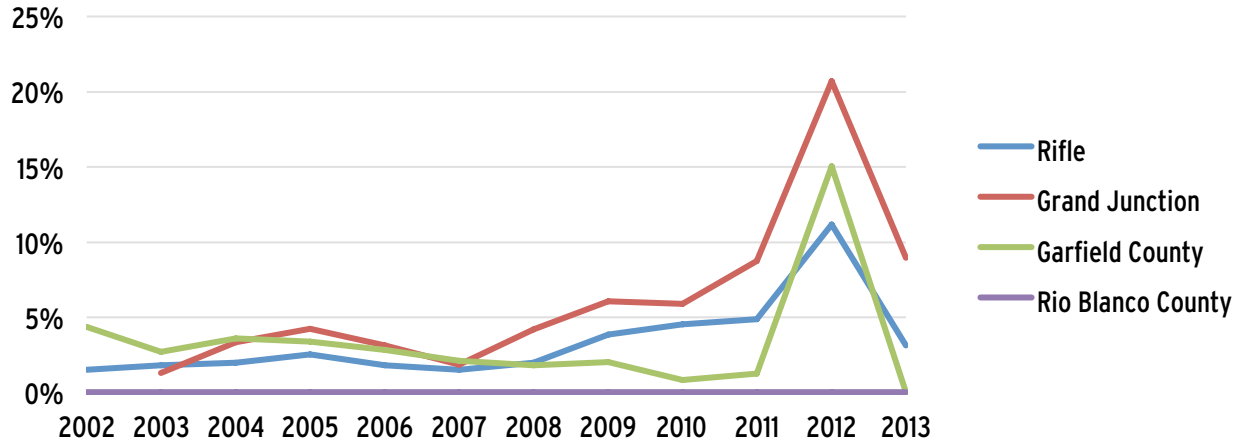


Figure 7-6 Annual ratio of revenues to expenditures

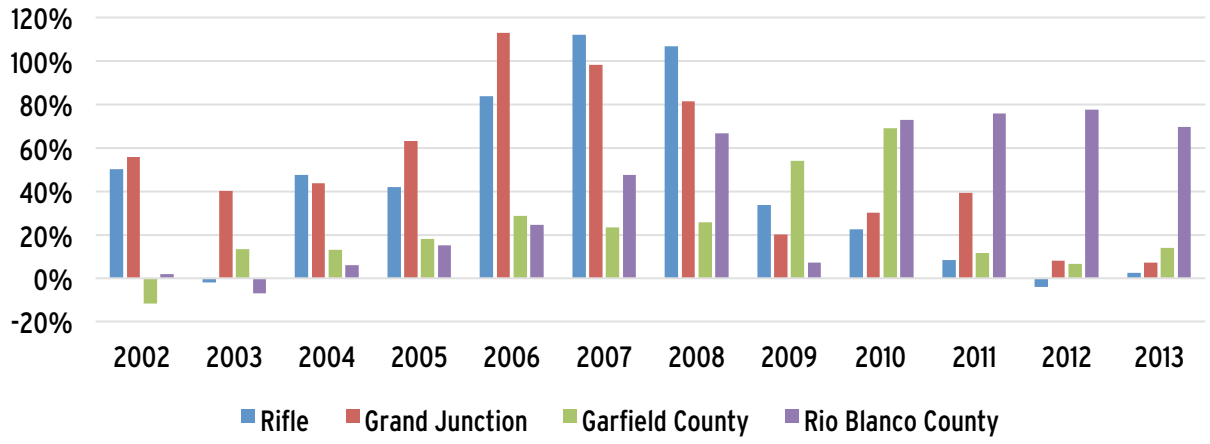


Figure 7-7 Locally assessed property value growth ($2012), 2004=1

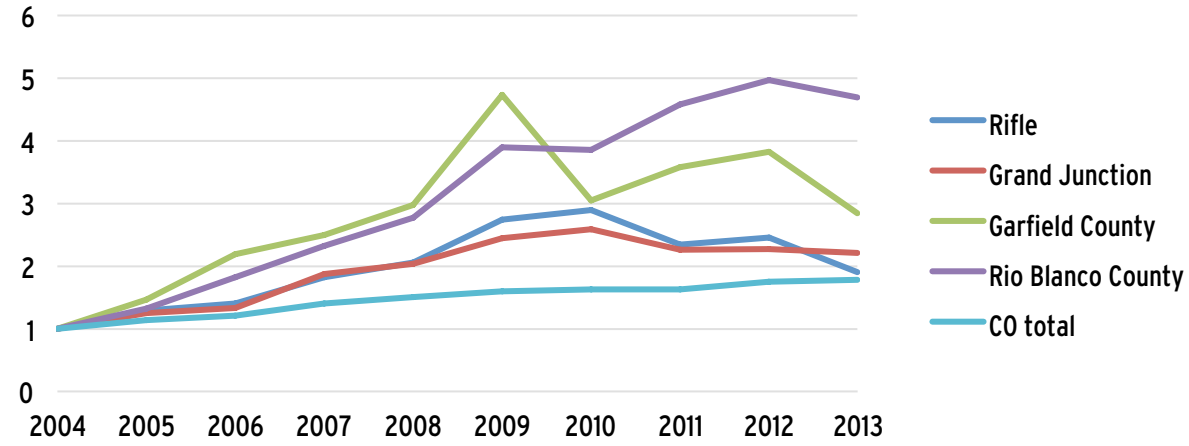
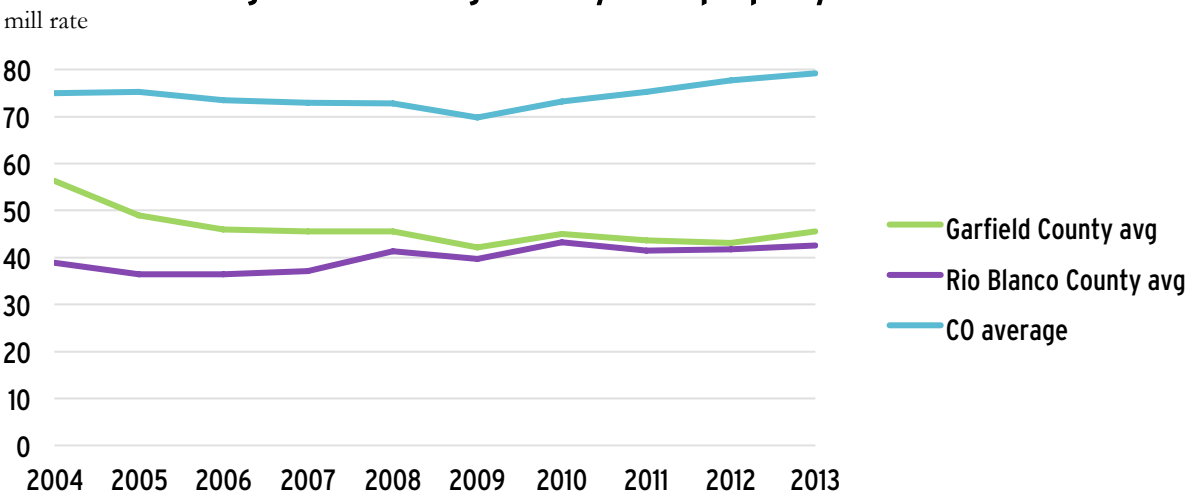
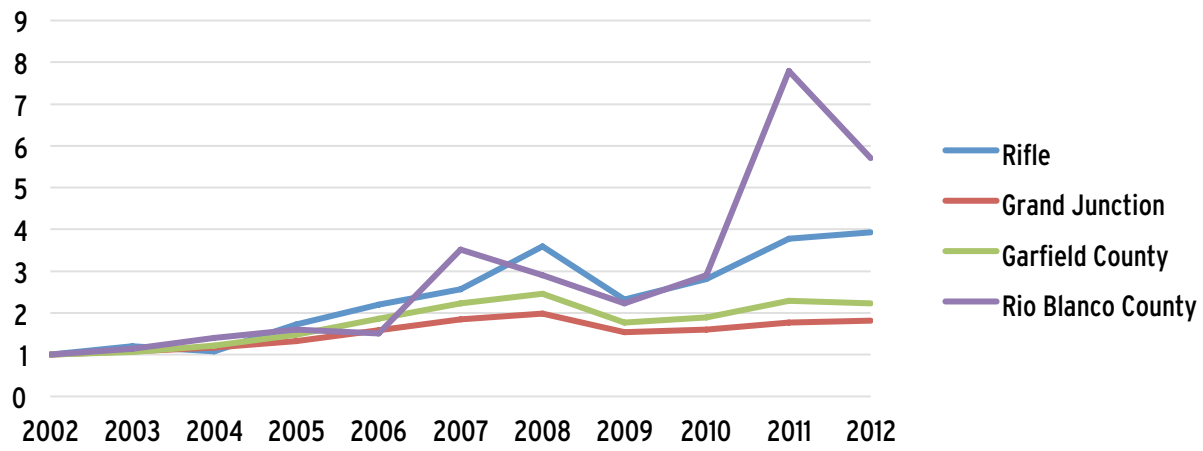


Figure 7-8 Average county-wide property tax burden



Note: includes property tax rates for county government and average rates of school districts, municipalities, and special districts within the county.

Figure 7-9 Sales tax base growth ($2012), 2002=1



Note: Includes sales tax revenues for state and local governments.