

ECONOMIC IMPACT OF THE OIL & GAS INDUSTRY ON OKLAHOMA

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RegionTrack, Inc. (regiontrack.com) is an Oklahoma City-based economic research firm specializing in regional economic forecasting and analysis. Principal authors of the report are RegionTrack economists Mark C. Snead, Ph.D. and Amy A. Jones, M.A.

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I. Executive Summary

Oklahoma's oil and gas industry is currently undergoing transformative change as it transitions toward new technology-driven long-run growth opportunities. State tax policy toward the industry will undoubtedly shape this growth going forward. As an aid to policymakers and the public, this report examines the current objectives of Oklahoma's oil and gas tax policy and the economic implications of renewed growth in the industry. For policymakers, the volatile and ever-changing environment for oil and gas makes balancing the need for tax revenue with the desire to foster growth in the state's trademark industry more challenging than ever.

What are the current economic objectives of state oil and gas tax policy?

Current state tax policy promotes the oil and gas industry as a key component of the state's overall economic development framework and works to achieve the following six major goals:

1. Encourage sustained long-term growth in Oklahoma's oil and gas sector
2. Generate spillover business activity and jobs in the broader state economy
3. Encourage increased production and full utilization of the state's oil and gas resources
4. Generate tax revenue for state and local governments to support public services
5. Dampen the effects of fluctuating energy prices on the industry and state economy
6. Enhance the overall quality of life and economic wellbeing across Oklahoma communities

The report evaluates the following six foundational questions concerning each of the economic objectives of state tax policy toward oil and gas:

1. What are the economic contributions of the oil and gas industry that make it a desirable focus of targeted economic growth?

- In 2015, the oil and gas industry employed 53,500 Oklahomans who earned \$5.6 billion
- 95,000 Oklahomans earned \$10 billion in self-employment income from oil and gas activity
- In total, nearly 150,000 Oklahomans are either wage and salary workers or self-employed in the oil and gas sector
- Household earnings (\$15.6 billion) from the oil and gas sector total 13.2% of total state earnings
- Average wages in the oil and gas sector (\$104,000) are more than double the state average (\$44,178)
- Crude oil and natural gas are projected to remain critical fuels in the U.S. economy for decades
- Oklahoma has abundant natural energy reserves and strong prospects for future growth
- State crude production reached 157.8 million barrels in 2015, a 157% increase from 2005
- State natural gas output is up by 60% since 2003, to 2.5 trillion cubic feet in 2015
- Oklahoma now ranks fifth among the states in oil production and third in natural gas production
- The state produced \$15.4 billion annually in crude oil and natural gas the past decade
- Oklahoma is the second largest oil and gas hub in the U.S., trailing only Texas
- Oklahoma ranks as the 3rd most attractive oil and gas market among 126 markets worldwide
- Oil and gas activity accounts for more than half the fixed investment (\$20.3 billion) in Oklahoma
- The state exported both crude oil and natural gas valued at \$7.1 billion in 2015
- Growth in the mining sector has far outpaced growth in the non-mining sectors since 2002

The economic characteristics of Oklahoma's oil and gas sector make it an excellent candidate for long-term state economic development efforts. Oklahoma continues to rank among the most attractive regions worldwide for oil and gas investment.

2. To what degree does the oil and gas industry produce spillover benefits to the broader state economy?

The amount of direct economic activity produced by the industry remains substantial. Over the past five years, the oil and gas industry produced an average of \$37.1 billion in output of goods and services annually, employed an average of 56,400 wage and salary workers and 77,400 self-employed proprietors, and generated household earnings of \$6.44 billion in employee compensation and \$8.91 billion in proprietor income annually. This activity spills over to nearly every sector of the state economy.

- Activity in the industry supports an estimated \$28.6 billion in additional spillover output of goods and services in other industry sectors statewide
- In total, the oil and gas industry supports an estimated \$65.7 billion in total state output
- Direct earnings in the industry support an additional \$17.2 billion in estimated spillover earnings statewide
- Including spillover effects, approximately \$32.6 billion (27%) of total state household earnings are supported by the energy sector
- Each new direct oil and gas job supports slightly more than two additional jobs statewide
- Almost 1 in 5 (424,800) wage and salary workers and self-employed proprietors in Oklahoma are employed directly or indirectly by the oil and gas sector
- Estimates indicate that state energy firms made an average of \$11.3 billion in purchases annually from other state-based suppliers
- An estimated \$1.7 billion in oil and gas royalties were paid to Oklahomans in 2015

3. Does current tax policy encourage increased production and full utilization of the state's oil and gas resources?

The state's energy sector has experienced a dramatic revival the past decade. Despite recent slowing in response to falling crude oil prices, current EIA outlooks suggest that growth in the industry is likely to persist for many years. The key change is the increased number of economically viable drilling opportunities now available in Oklahoma and other producing states.

- Oklahoma is the only major producing state to experience substantial increases in both crude oil and natural gas production in recent years
- The industry spent \$10.0 billion in the state to complete an estimated 1,822 wells in 2015 at a cost of \$5.46 million per well
- Over the past five years, drilling expenditures in Oklahoma totaled an estimated \$61.0 billion, or an average of \$12.1 billion annually
- More drilling rigs have been operating in Oklahoma (180 rigs) on average the past five years than in all states but Texas (777 rigs)
- Since 2001, drillers in the state completed between 2,200 and 3,500 wells annually, an average pace of nearly 2,700 wells per year
- Recent drilling expenditures in the state are roughly equal to the inflation-adjusted level from 1981 near the height of the Oil Boom

A dramatic surge in capital expenditures on drilling new wells underlies the rebound in state oil and gas production. This is why Oklahoma tax policy cannot simply view the ongoing transition from conventional to unconventional drilling as a one-for-one swap in wells. Each well drilled is now 4 to 5 times costlier based on current well costs.

4. How is the oil and gas industry taxed, how much does it pay, and what is the revenue used for?

Oklahoma recently simplified the structure of the severance tax on the production of crude oil and natural gas. New production now incurs a tax rate of 2% for the first 36 months and 7% thereafter.

- The oil and gas industry is the largest single source of tax revenue in the state, paying total direct state taxes of \$2.0 billion in FY2015, or 22% of all state taxes in the period
- Energy firms paid an additional \$463 million to local governments in Oklahoma in FY2015
- In total, oil and gas firms and their employees paid \$2.55 billion in state and local taxes in FY2015
- The industry pays 22% of total state taxes yet accounts for only 6.5% of total employment, 13% of state household earnings, and 17% of state gross domestic product
- Oil and gas producers paid \$542.1 million in net severance taxes in FY2015
- Of the \$542.1 million in severance taxes apportioned in FY2015, \$328.7 million went to dedicated uses and \$213.4 was directed to the state's General Revenue Fund
- The largest use of dedicated severance tax revenue in FY2015 is \$224 million for public education
- Education also received approximately 50% of the \$213.4 million in severance taxes distributed to the General Revenue Fund in FY2015
- In total, public education received \$331 million in oil and gas severance tax revenue in FY2015
- Other dedicated uses in FY2015 include \$81.9 million returned to counties for roads and \$22.8 million allocated across a range of other dedicated uses
- In the ten-year period from FY2006 to FY2015, the state's oil and gas producers made total gross severance tax payments before incentives of \$10.18 billion, or more than \$1 billion annually.
- Through incentives, producers were refunded a total of \$1.21 billion in prior payments
- Severance tax payments after refunds the past decade totaled \$8.98 billion, or \$898 million annually
- Public education received \$4.7 billion in oil and gas severance taxes (through both dedicated uses and General Revenue Fund) the past ten fiscal years, or \$469 million annually
- Counties received a cumulative \$746 million in severance tax revenue in the ten-year period for roads, or \$74.6 million annually
- A number of competing states offer exemptions from severance taxes for drilling modern unconventional wells, primarily horizontal wells and wells in tight formations. The two largest and most significant exemptions are offered by Texas and Louisiana, Oklahoma's nearest neighbors and strongest competitors for both drilling activity and white-collar oil and gas employment.
- The average severance tax rate paid by Oklahoma producers is slightly below the rate paid in Texas and higher than the rate paid in Kansas, Colorado and Utah.
- Using a broad measure of federal, state, and local taxes, the mining industry's share is one-fourth (25%) of the total taxes paid by all industries within the state
- Primarily due to taxes unique to the oil and gas industry, high wages among proprietors and employees in the industry, and high corporate tax payments, the oil and gas industry pays more than \$1 billion annually in additional state taxes than it otherwise would if it were an average tax-paying industry

By maintaining severance taxes at current levels, policymakers can expect to avoid a series of incremental negative economic outcomes within the industry and state economy, many of which may be unintended. Most of the direct losses from higher severance taxes would be borne almost entirely by producers, royalty owners, refiners, and consumers of energy (including households) in the state. These losses would trigger further spillover effects in productive industries across the broader state economy.

5. To what degree is the state economy tied to activity in the energy industry?

The state remains as sensitive to the energy sector as it was in 1982 as measured by the share of household earnings statewide (13.2%) derived from the industry. The state's economic cycle remains closely tied to energy prices as evidenced by the current oil price-induced slowdown in the state economy.

- Oklahoma remains a top-tier energy-producer and the state economy remains highly sensitive to energy price fluctuations
- The recent collapse in oil prices was capable of producing a recession at the state level, despite a backdrop of strong national hiring conditions
- Severance tax receipts have become more volatile since 2000, reflecting swings in oil and gas prices
- Total state tax revenue has similarly become more volatile since 2000, due in large part to increased volatility in severance tax revenue
- Despite increased volatility in severance taxes and rebates to the oil and gas industry, both total taxes and taxes from sources other than severance taxes remain in a long-run uptrend
- In the FY2011 to FY2015 period following the recent national recession, state tax receipts minus severance taxes increased by an average of 6.2% annually while total state tax receipts increased 5.8% annually, only a 0.4% difference annually due to weakness in severance taxes
- Severance taxes continue to serve as the key source of deposits to the state's Rainy Day Fund and have provided much needed budget stabilization in recent recessions

The oil and gas industry continues to make an outsized contribution in terms of both economic activity and tax payments. Oklahoma's oil and gas firms face a relative tax burden that is four times greater than the average business in the state on a per worker basis.

6. What are the broader economic benefits to the state of tax policy that encourages growth in the oil and gas industry?

Oil and gas is the most important contributor to economic growth in Oklahoma since the rebound in the industry began in 2002. This activity is providing a number of key economic benefits to the state economy.

- Oil and gas-driven income gains have pushed state per capita income to 95% of the U.S. average in recent years, up from 85% just a decade ago
- Migration into the state surged beginning in 2006 as state population growth moved above 1% annually for the first time since the early 1980s
- The ongoing supply-induced drop in natural gas prices has saved state consumers an estimated \$1.5 billion annually since 2009
- Due to falling oil prices, annual state petroleum expenditures in 2015 and 2016 will be an estimated \$3.3 billion lower than the average annual expenditures realized from 2008 to 2014
- Only 46,000 total jobs were created in the non-metro counties between 1999 and 2015, and the mining sector alone accounted for more than 1 in 4
- Since 1965, Oklahoma's job base has increased 186.2%, roughly 55% more than the average of the non-energy producing states

Renewed growth in Oklahoma's oil and gas industry has enhanced the strength and competitiveness of the state economy. Residents are enjoying a range of economic benefits including higher relative incomes, a lower relative tax burden, greater rural job growth, reduced energy costs, and stronger state population gains.

A dramatic surge in capital expenditures on drilling new wells underlies the rebound in state oil and gas production. The industry spent \$10.0 billion in the state to complete an estimated 1,822 wells in 2015 at a cost of \$5.46 million per well. Over the past five years, drilling expenditures in Oklahoma totaled an estimated \$61.0 billion, or an average of \$12.1 billion annually.

II. Introduction: The economic role of Oklahoma's tax policy toward the oil and gas industry

Renewed growth in Oklahoma's oil and gas industry has important implications for policymakers and the state economy. Oklahoma is at the epicenter of what began as a natural gas boom a little over a decade ago and has since become a dynamic revival of the broader oil and gas industry and its supply chain. The industry has roughly doubled in size the past decade and presents future growth potential for the Oklahoma economy.

The task of forming tax policy in a top-tier energy-producing state has always been a complex task. Oklahoma's overall economic cycle remains tied to the energy sector and effective tax policy must recognize the closely intertwined nature of the industry and the broader state economy. In fact, the state currently derives 13.2% of total earnings statewide from the oil and gas industry, the same approximate share as in the late 1970s and early 1980s.

The new growth environment has also brought along with it new challenges for the industry and policymakers. There is now fierce competition underway nationally and globally to attract expanding oil and gas investment. The recent upward shift in energy prices set off a massive scramble to scale up activity and position assets for further long-term growth. Many competing energy-producing states recognize the market opportunity and are aggressively using tax policy to retain and attract energy industry activity.

The industry's new competitive framework similarly presents additional financial and operational challenges to the state's oil and gas firms. The industry is now more capital-intensive than ever and remains highly susceptible to commodity price fluctuations and macro-economic risk. The state is also currently in a mini-recession linked directly to the collapse in oil prices beginning in late 2014.

For policymakers, the volatile and ever-changing environment for oil and gas makes balancing the need for tax revenue with the desire to foster growth in the state's trademark industry more challenging than ever. The oil and gas industry remains the largest single source of state tax revenue, and important shifts have taken place in the types and amounts of taxes paid by the industry. The channels of economic influence on the state economy have also changed, as ownership and investment in the industry are now as important as employment and wages as a source of economic stimulus.

Major goals of Oklahoma's oil and gas tax policy

As an aid to policymakers and the public, this report examines the current objectives of state oil and gas tax policy and the economic implications of renewed growth in Oklahoma's oil and gas industry. Current state tax policy toward the oil and gas industry pursues at least the following six economic objectives:

1. Encourage sustained long-term growth in Oklahoma's oil and gas industry

Fostering long-run growth in the state's trademark industry has long been the primary objective of Oklahoma oil and gas tax policy. This objective is embodied as a formal component of the state's current economic development strategy. The state actively targets growth in the energy sector and four other economic *ecosystems* - aerospace and defense, agriculture and biosciences, information and financial services, and transportation and distribution.¹ These industries are believed to offer the greatest economic growth potential among industry sectors that already have a high concentration in Oklahoma. These sectors also offer the potential for meaningful growth in the number of high-wage jobs within the state.

Research findings generally confirm that the state's strategy of focusing on key growth industries and clusters can provide significant economic payoffs to a region. Comprehensive research on the payoff to regional specialization by Michael Porter's Harvard-based Institute for Strategy and Competitiveness illustrates the broad range of potential gains from fostering growth in key clusters.²

“We find... significant evidence for cluster-driven agglomeration. Industries participating in a strong cluster register higher employment growth as well as higher growth of wages, number of establishments, and patenting. Industry and cluster level growth also increases with the strength of related clusters in the region and with the strength of similar clusters in adjacent regions. Importantly, we find evidence that new regional industries emerge where there is a strong cluster environment. Our analysis also suggests that the presence of strong clusters in a region enhances growth opportunities in other industries and clusters. Overall, these findings highlight the important role of cluster-based agglomeration in regional economic performance.”

The underlying expectation of tax policy toward the oil and gas industry is that the sector offers meaningful long-run growth potential and that this growth will generate added high-wage jobs and earnings opportunities in the state.

2. Generate spillover business activity and jobs in the broader state economy

Ideally, tax policy should encourage activities that result in extensive business linkages with other business sectors statewide. Targeted growth in the oil and gas industry should provide business opportunities to a range of industries outside oil and gas. Most desirable from a state policy perspective is the creation of direct and spillover high-wage, high-skill jobs. The oil and gas industry also tends to produce the types of middle-tier jobs that have been challenging for most states to generate in recent years. The oil and gas industry is also a source of significant investment and should create an ongoing stream of capital expenditures that spill over to other industries.

Oil and gas should produce large spillover effects to the broader state economy including the purchase of state-manufactured goods, the use of state-based professional services, and the replacement of imports into the state.

3. Encourage increased production and full utilization of the state’s oil and gas resources

Much of the tax policy currently in place was designed for the challenges presented by declining oil and gas production levels and the potential long-run decline of the industry. State oil production declined every year between 1984 and 2005, falling by nearly two-thirds from 168 million barrels to only 61 million barrels. Natural gas production similarly peaked in 1990 at 2.26 trillion cubic feet (tcf) before declining by one-third to its most recent bottom at 1.56 tcf in 2003.

Since 2002, this view of the industry’s long-run growth potential has been reversed by a sharp rebound in production of both crude oil and natural gas. The state is fully participating in the ongoing revival of the industry and faring well against competing producing regions. In fact, Oklahoma is the only major energy-producing state to experience a sharp rebound in both crude oil and natural gas production in recent years.

From a tax policy point of view, efforts to stimulate activity in the industry should be contingent upon strong production growth potential and increased reserves suggesting further growth going forward.

4. Generate tax revenue for state and local governments to support public services

Activity in the oil and gas industry should serve as a key source of tax revenue to fund state and local public services. Extraction industries are desirable, in part, because they generate significant revenue through dedicated taxes levied on the recovery of natural resources. The severance tax is unique to the mining sector and has long played a key role in the overall funding of public services in Oklahoma. Most energy resources in the state are generally located on private land in Oklahoma but are nonetheless subject to the state severance tax. State-owned lands similarly generate tax revenue from leases and royalties paid by private sector operators. The industry should also provide tax revenue through the earnings of workers and owners. Royalty payments to land and mineral rights owners located within the state are an added source of earnings.

The direct and spillover economic activity generated by the oil and gas industry should produce significant tax revenue to state and local governments.

5. Dampen the effects of fluctuating energy prices on the industry and state economy

Tax policy in a top-tier energy-producing state must recognize the highly intertwined nature of the industry and the overall state economy. Changes in energy prices can quickly translate into changes in overall state economic conditions. Top-tier energy states have a much different economic cycle than the nation and often move countercyclical relative to the national economy. This presents unusual challenges for state and local governments in forming budgets as energy prices fluctuate.

The unique economic cycle of the energy states is usually most visible during recessions. This behavior was evident during the most recent national recession and recovery as the major energy states consistently ranked among the top performers. Top-tier energy states entered the recession later, had smaller downturns, and exited the recession at a faster pace than the group of non-energy states.³

The unique economic cycle of the energy states is evident once again following the recent collapse in oil prices. Although the national economy continues to grow at a moderate pace, Oklahoma has been mired in a mini recession since early 2015. Fluctuations in energy prices can contribute to vast differences in the timing of state tax revenues and expenditures relative to the nation.

For tax policy, the concern is whether the current linkage between energy prices and the Oklahoma economy is well understood and whether appropriate measures are being used to counterbalance the tax effects of the energy cycle in the state.

6. Enhance the overall quality of life and wellbeing across Oklahoma communities

The historical dependence of the state economy upon the oil and gas industry cannot be overstated. Towns all across Oklahoma such as Tulsa, Cushing, Ponca City, Bartlesville, Enid, and many others, owe much of their heritage and current economic influence to the boom of the oil and gas industry over the past century. The most visible economic contribution of the oil and gas sector has always been jobs and earnings provided by the state's oil and gas firms. The unique market for high-valued oil and gas products allowed them to pay well above average wages but also provided the wherewithal to fund an enormous number of city development and philanthropic activities. These companies have served as the financial engines behind the expansion of many Oklahoma cities. Energy firms, along with their owners and employees, have been instrumental in funding educational endeavors, health care facilities, recreational amenities, arts, and other important social assets across the state.

For tax policy, the question is whether the presence of a larger oil and gas industry is likely to provide greater economic wellbeing across the state in the form of greater job opportunities, higher standards of living, lower living costs, and sufficient public resources.

How well is state policy working on these six measures?

The degree to which state tax policy toward the oil and gas industry is achieving these six goals is evaluated in detail in the next six sections of the report. In short, under current state tax policy, the sector should offer suitable economic growth potential, generate significant spillover effects to the broader state economy, encourage production and full utilization of the state's natural resources, contribute tax revenue sufficient for funding public services, allow for provisions to moderate volatility introduced to the state economy and budget, and enhance the overall economic wellbeing and quality of life for Oklahoma residents.

The remainder of the report evaluates the following six questions concerning Oklahoma's tax policy toward oil and gas:

- 1) What are the economic characteristics of the energy sector that make it desirable for using tax policy to encourage economic growth?
- 2) To what degree does the oil and gas industry produce spillover benefits to the broader state economy?
- 3) Is current state tax policy driving increased exploration and production and encouraging the full utilization of the state's oil and gas resources?
- 4) How is the oil and gas industry taxed, how much does it pay, and what is the revenue used for?
- 5) To what degree is the state economy tied to energy prices and the economic health of the industry?
- 6) What are the broader economic benefits of the oil and gas industry that affect overall quality of life and economic wellbeing in Oklahoma?

Understanding these issues is vital to forming effective and predictable tax policy in the current environment. As home to the nation's second largest concentration of oil and gas activity behind only Texas, tax policy set in Oklahoma will undoubtedly influence the industry within the state's borders and beyond.

III. What economic characteristics make the energy sector a desirable target for using tax policy to encourage economic growth?

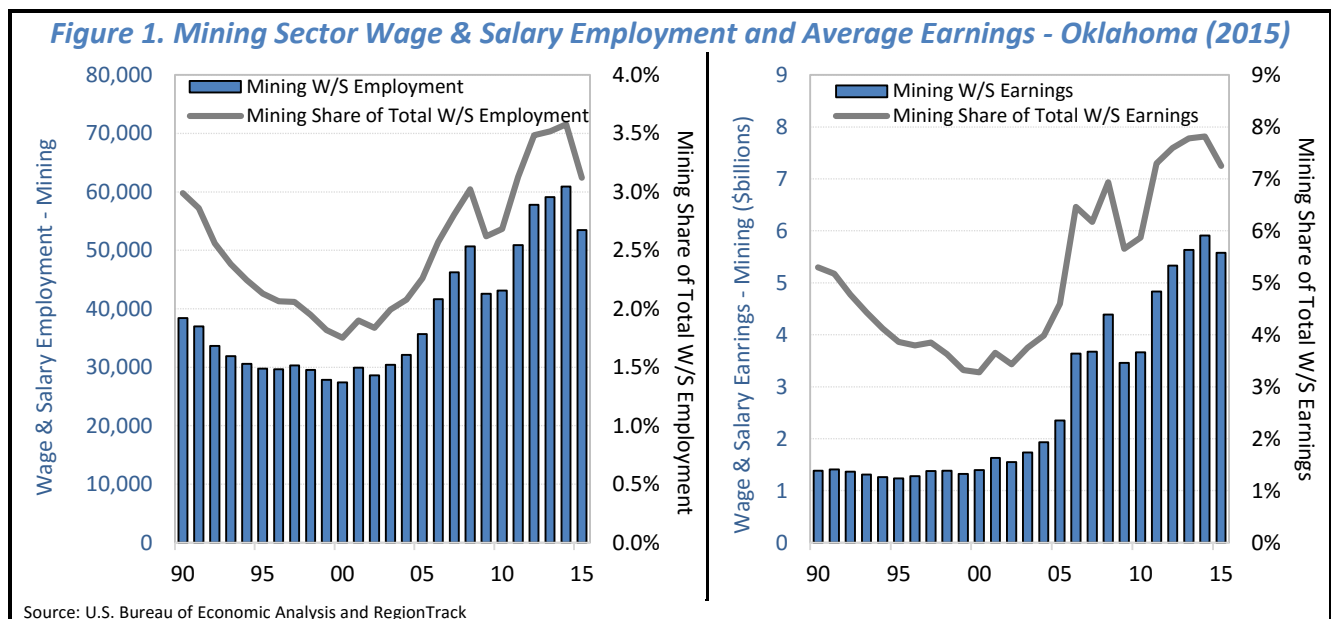
The energy industry has reemerged as a focal point of Oklahoma tax policy because of the dramatic rebound in oil and gas exploration and production the past decade. A large number of newly discovered and existing formations are now accessible and under active development using modern unconventional drilling and stimulation techniques. More importantly, from an economic point of view, the process of drilling wells with these new techniques is now considerably more capital-intensive and a much more significant economic event.

The economic growth potential of the industry underlies the reason why oil and gas tax policy is such a desirable tool for use in statewide economic development. The direct economic effects generated by the industry are large and widespread. The energy sector is a source of a significant number of high-wage jobs and self-employment opportunities and a key source of income for households in Oklahoma. The industry is also the largest source of capital investment in the state. Ongoing investments in drilling have increased state oil and gas production, and forecasts suggest that output can grow significantly going forward. Oklahoma is also now a net exporter of both crude oil and natural gas and the second largest oil and gas hub among the states. These economic characteristics of the industry are examined in detail in this section.

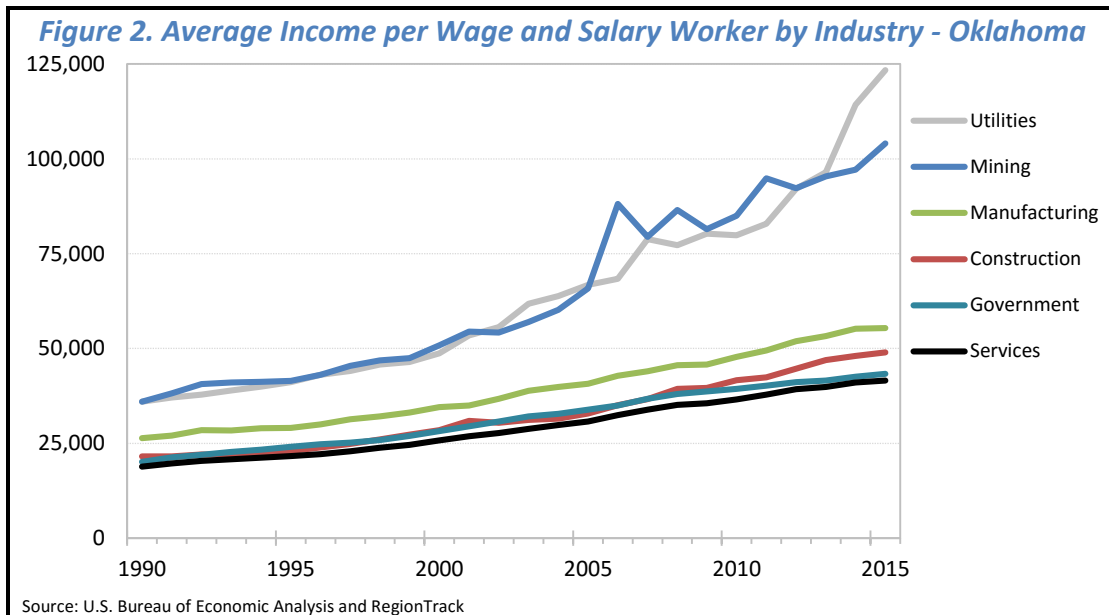
Oil and gas is a critical source of high wage jobs in Oklahoma

The oil and gas industry has long served as a unique and critical source of high wage jobs in Oklahoma. The creation of high-wage, high-skill jobs remains one of the greatest challenges facing policymakers in every state. High wage jobs generally require higher education and training levels which presents challenges in Oklahoma, a relatively low education state historically. Education levels change only slowly over time, and it is doubly difficult to make up ground relative to other states as they simultaneously pursue education gains.

Since the revival of the industry began in 2002, the number of wage and salary workers in the state’s mining sector has roughly doubled to an average of 53,500 in 2015 (see Figure 1).⁴ The 26,000 jobs added by the mining sector in the period represent 1 in 7 (15.4%) of every wage and salary job created statewide in the period. The share of total state wage and salary workers in the mining sector increased from 1.8% in 2002 to 3.1% in 2015.



Despite comprising a relatively small share of the state workforce, wage and salary workers in the mining sector earned a combined \$5.6 billion (7.3% of state total) in income in 2015 (see Figure 1). However, it is the high average wage per worker in mining that underlies the economic impact exerted by the sector on the rest of the state economy. Average wage and salary income in the industry topped \$104,000 in 2015, more than double the average in government (\$43,353) and the private services sectors (\$41,518), as well as the \$44,178 average statewide (see Figure 2). Mining sector wages are also nearly double the rate earned in manufacturing (\$55,386) and more than double the average in construction (\$48,994). The Utility sector is the only major industry group with a higher average wage (\$123,378) than mining, although it employs only one-fifth as many workers (approximately 12,000 in 2015). High-wage jobs in the mining sector are one of the key factors that has allowed Oklahoma incomes to rise above nearby peer states that are similar in most demographic respects.



Oil and gas is the largest source of self-employment opportunities and earnings in Oklahoma

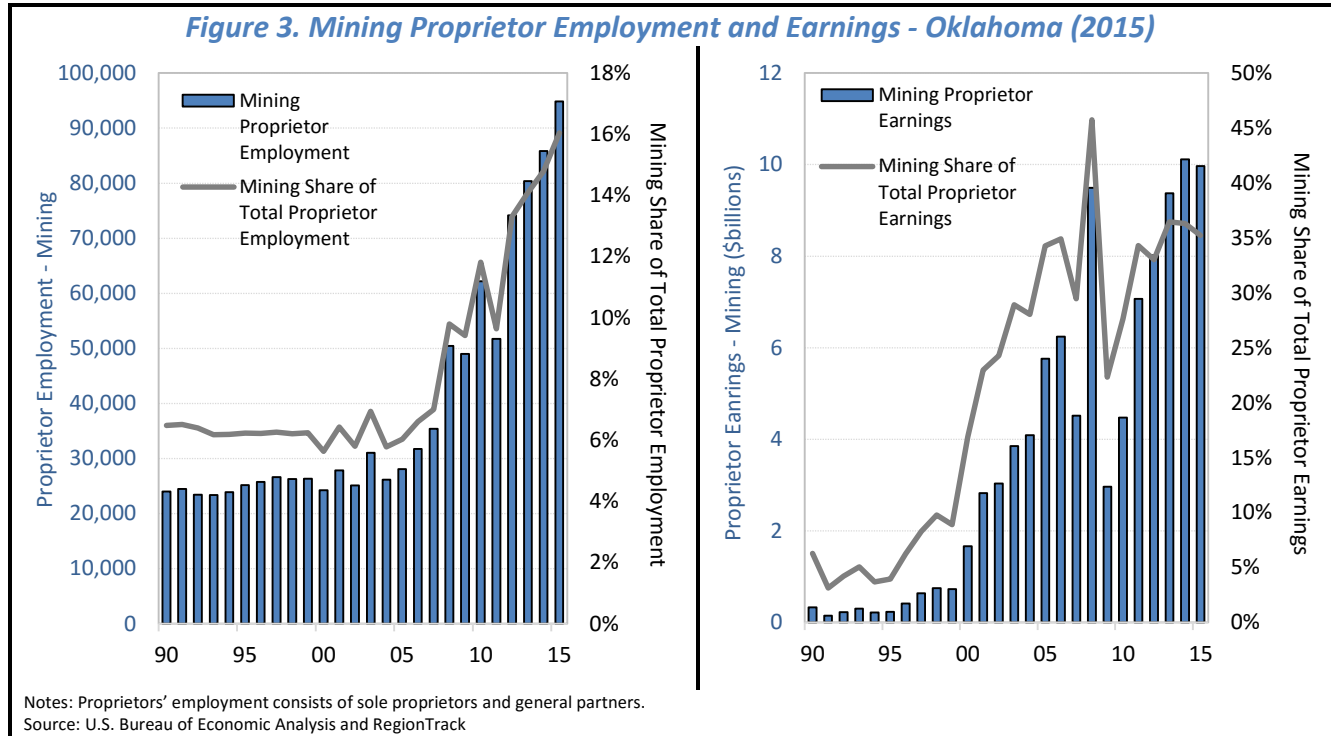
Self-employment activity is a key characteristic of the oil and gas industry but is often overlooked as a source of earnings for Oklahoma households. Self-employed proprietors include sole proprietors and partners in various forms of partnerships.⁵ These include oil and gas firm operators, royalty owners, drilling groups, and a range of other business entities.

The role of self-employed proprietors in oil and gas activity has long been a large source of business activity in the state, but its importance made a dramatic upswing the past decade along with the rebound in the energy sector (see Figure 3). The number of self-employed proprietors in the mining sector more than tripled from about 28,000 in 2005 to 94,900 in 2015.⁶ Self-employed proprietors in the mining sector now comprise 16% (1 in 6) of all proprietors located in the state, up from a 6% share only a decade ago.

The economic role of proprietors in the mining sector is most noteworthy when viewed by earnings growth. Proprietor earnings in the mining sector nearly doubled the past decade from about \$6 billion in 2005 to \$10 billion in 2015. Again, proprietors' income consists primarily of the income of individuals who operate a business that is formed as either a sole proprietorship or partnership. Mining proprietors alone now account for more than one-third (35.2%) of all proprietor earnings across all industries statewide in 2015. Oil and

gas proprietors reported average earnings of \$105,060 in 2015. In total, oil and gas proprietors (\$10 billion) now earn nearly twice as much as oil and gas wage and salary workers (\$5.6 billion) in the state.

The oil and gas sector is easily the most important source of self-employed proprietor earnings in Oklahoma. The \$10 billion in proprietor income earned in the mining sector is three times larger than the next closest sectors - Construction (\$3.1 billion) and Transportation and Warehousing (\$3.0 billion).

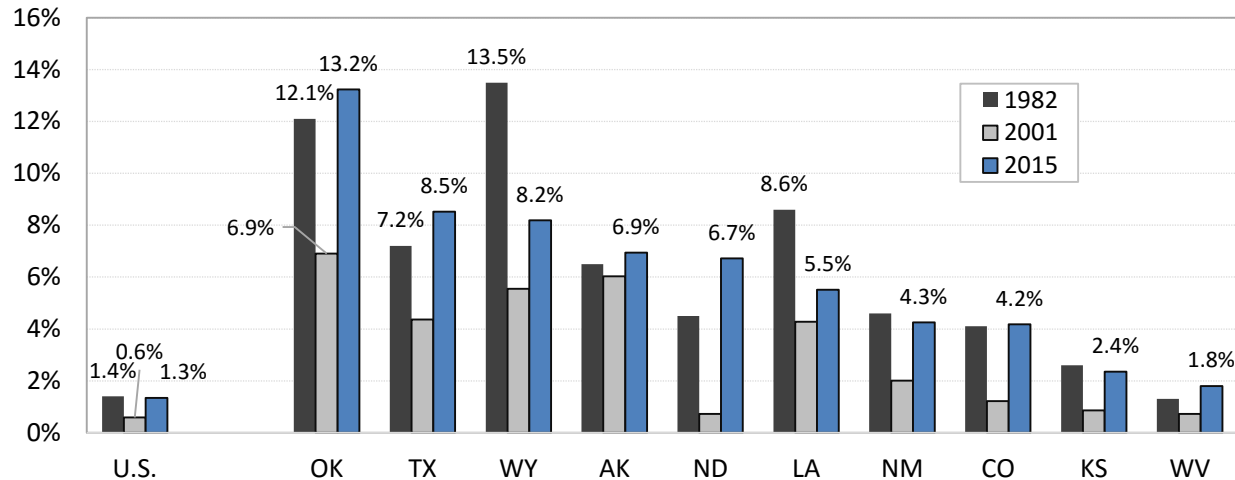


Oklahoma households derive 1 in 7 dollars of earnings directly from the oil and gas industry

The combined \$15.6 billion in wage and salary income and proprietor income derived from mining suggests that Oklahoma households remains highly dependent upon the oil and gas sector for earnings⁷ (see Figure 4). **Currently, Oklahoma has the distinction of having the highest share of total household earnings paid directly from the oil and gas industry among the energy states – a remarkable 13.2% in 2015.** In fact, Oklahoma now has the second highest share ever posted by a state in the modern energy era, slightly trailing only Wyoming's 13.5% share in 1982. Oklahoma's current share is also nearly double the 6.9% share posted at the bottom of the prior energy cycle in 2001.

The oil and gas-dependence of the household sector across the energy-producing states drops off sharply after Oklahoma. Households in Texas (8.5%) and Wyoming (8.2%) are closest in share to Oklahoma but are about one-third less dependent upon the oil and gas industry for earnings. Alaska (6.9%), North Dakota (6.7%), and Louisiana (5.5%) have roughly half the dependence of Oklahoma. The economies of the six states with the highest share of oil and gas earnings have either slowed sharply or are contracting through the mid-point of 2016 under pressure from the collapse in oil prices. Second-tier energy states including New Mexico (4.3%) and Colorado (4.2%) have 3 to 4 times the U.S. average share (1.3%) of household earnings from oil and gas but only one-third the dependence of Oklahoma. Other energy-producing states with a roughly 2% share of total household earnings derived from the oil and gas industry include Kansas (2.4%), West Virginia (1.8%), Mississippi (1.8%), and Montana (1.7%).

Figure 4. Share of Total State Household Earnings from Oil and Gas Industry



Notes: BEA defines earnings as employee compensation plus proprietors' income. The share of household earnings in each state derived from oil and gas activity is calculated as the sum of NAICS 201 (Oil and gas extraction) plus a share of NAICS 203 (Support activities for mining). The share of NAICS 203 included is determined by the ratio of NAICS 201 / (NAICS 201 + NAICS 202 (Mining – except oil and gas)).
 Source: Bureau of Economic Analysis and RegionTrack

Possibly most remarkable is that Oklahoma households are now more dependent upon the oil and gas industry for earnings than at the peak of the Oil Boom in 1982 when only 12.1% of household earnings were received directly from the oil and gas industry. Along with Oklahoma, other energy states including Texas, Alaska, North Dakota, Colorado, and West Virginia currently have a higher share of household earnings derived from oil and gas than in 1982.

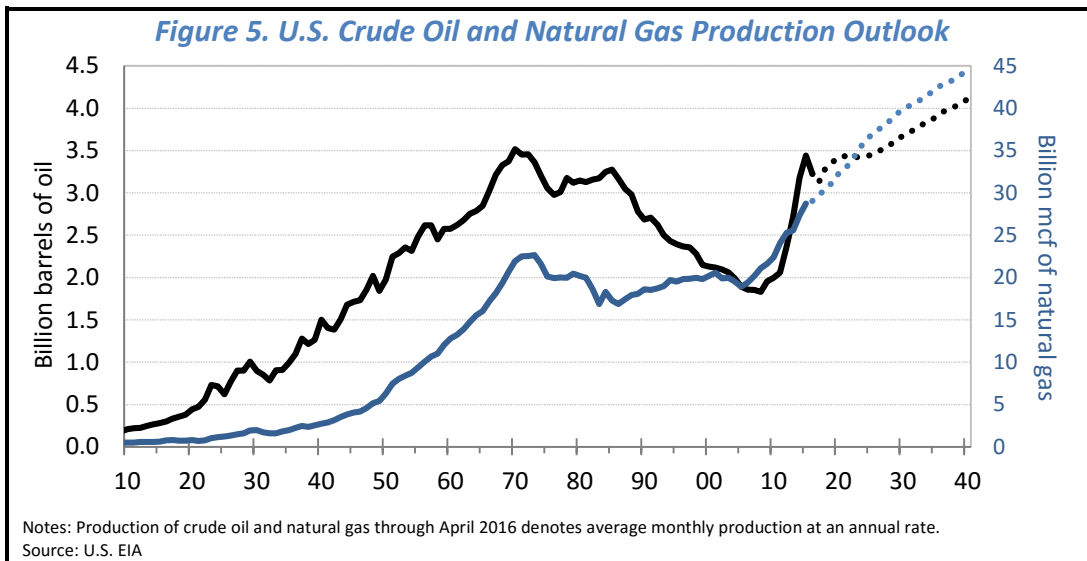
Oil and natural gas are projected to remain key fuels in the U.S. economy for decades

Crude oil and natural gas remain crucial fuels driving Oklahoma, U.S., and global economic growth and are unlikely to be displaced in the near- to intermediate-term. Crude oil remains the dominant fuel underlying most modes of transportation, while natural gas is used extensively in electricity generation, industrial processing, and the heating of residential and nonresidential buildings. Securing reliable future sources for these fuels is critical given the relatively small but growing role played by renewables to date, particularly in the oil-dependent transportation sector that relies heavily upon imported crude oil.

Oklahoma's policy toward the energy sector is closely intertwined with federal efforts to encourage increased domestic production of crude oil and natural gas. Economic security concerns and an overreliance on imports of crude oil are direct results of the 50% decline in domestic crude oil production between 1970 and 2008. Even during the oil boom of the late 1970s and early 1980s, most of the economic gains in the industry were tied to rising prices, while the industry's prospects for supplying increased amounts of crude oil for domestic use seemed bleak.

The nearly 40-year decline in U.S. oil production has since been sharply reversed in less than a decade (see Figure 5). Recent U.S. Energy Information Administration (EIA) estimates indicate that domestic crude oil production reached 3.44 billion barrels in 2015, a near doubling (88%) from the recent bottom in output in 2008. Annual U.S. oil production is now only slightly below the all-time high of 3.52 billion barrels set in 1970. Despite the sharp rise in crude oil production, imports continue to comprise more than half of all crude oil used in the U.S. today.

U.S. natural gas output has similarly risen more than 50% since the recent bottom in 2005 to 28.8 billion mcf in 2015, an all-time high in domestic gas production (see Figure 5). The U.S. has long been self-sufficient in natural gas production.



EIA forecasts suggest that these recent supply trends are likely to persist for many years as U.S. production of both crude oil and natural gas climb well above current levels to meet projected demand growth (see Figure 5). Current projections suggest that domestic oil production will drop slightly in 2016 to 3.22 billion barrels under pressure from weak crude oil prices before rising by 27% to more than 4 billion barrels annually by 2040. U.S. natural gas production is expected to rise more than 50% by 2040 to 44.5 billion mcf per year. The underlying annualized growth rates suggest that crude oil output will rise 1.0%, and natural gas 1.8%, annually in the period.

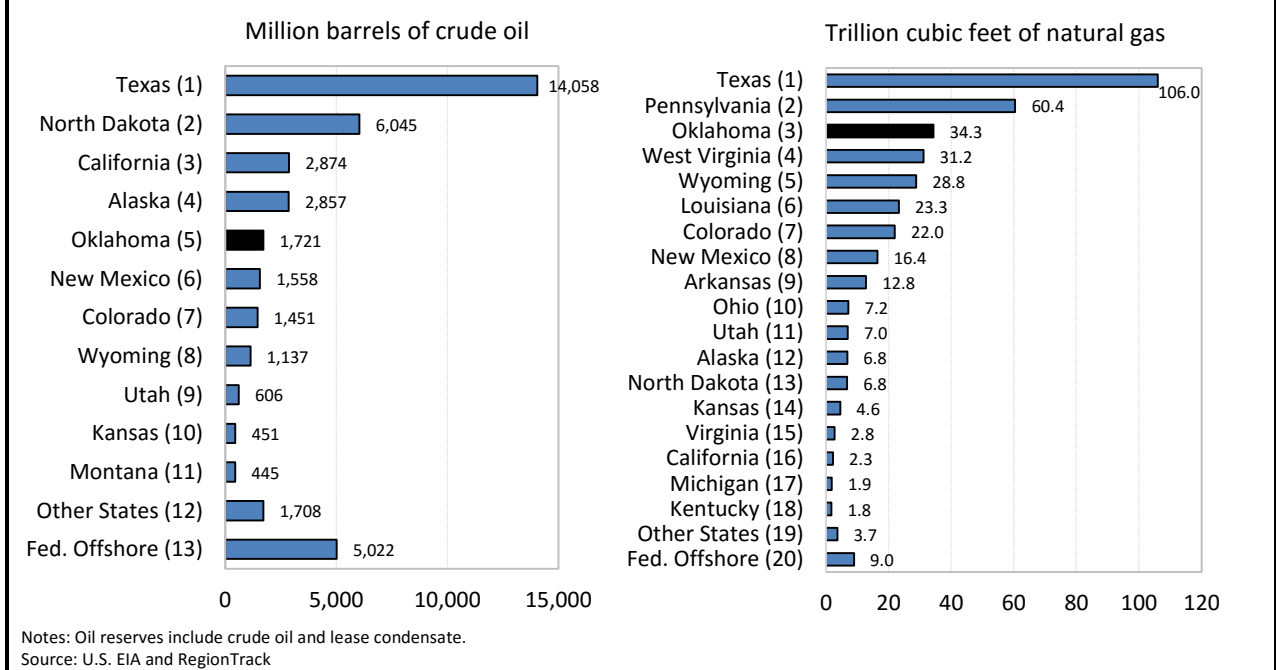
From the perspective of state tax policy, attaining these production forecasts will require significant ongoing investment in drilling and exploration on the part of the domestic oil and gas industry. For Oklahoma and other producing states, EIA forecasts suggest that the growth in the industry over the next 25 years will closely resemble the growth that took place over the past decade. This was a period of remarkable expansion in the sector and in the state. On the oil side, the output increase through 2040 is projected to nearly match the size of the gain realized in the 2008 to 2015 period. Natural gas output growth is expected to nearly double the production gain from 2005 to 2015. This suggests strong long-run growth prospects and continued market potential for Oklahoma-produced crude oil and natural gas.

Oklahoma still has abundant natural energy resources

The projected growth in U.S. oil and gas production through 2040 suggests that Oklahoma will play a key role in the ongoing expansion of the industry. Measured by the most recent EIA study of domestic reserves in 2014, Oklahoma is one of only a handful of key energy states with abundant proved reserves of both crude oil and natural gas (see Figure 6).⁸ Oklahoma’s crude oil reserves rank fifth among the states with 1.72 billion barrels, or 10.9 years of production based on 2015 crude output. The state’s natural gas reserves rank third, with 34.3 trillion cubic feet, or 13.7 years of production based on 2015 natural gas output.

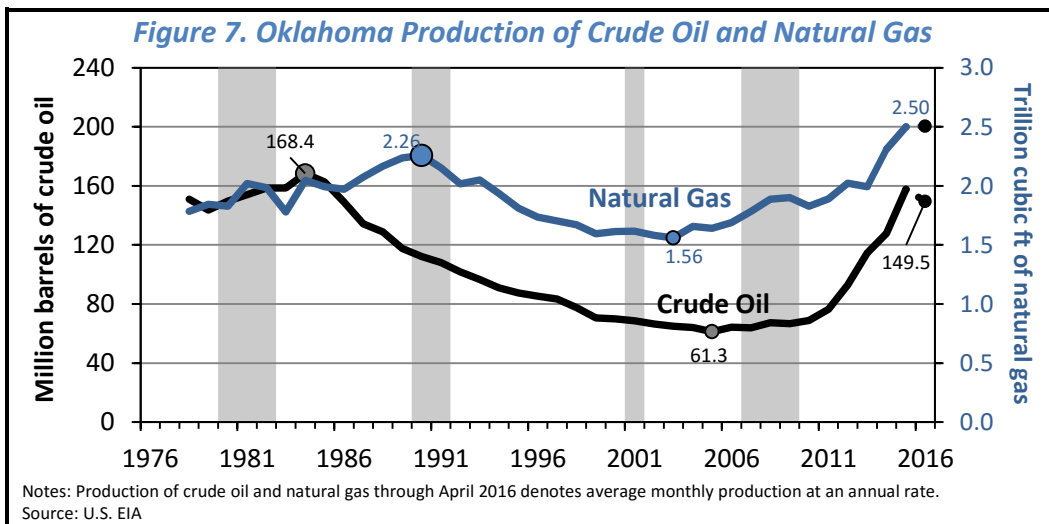
Much of the projected gains in U.S. natural gas output through 2040 are expected to come from shale deposits. In 2014, 51% of total U.S. natural gas reserves were in the form of shale reserves. In Oklahoma, proved shale gas reserves totaled 16.7 trillion cubic feet in 2014, the fourth largest shale reserve among the states and 49% of total Oklahoma natural gas reserves. For state policymakers, existing reserves within the state fully support the notion that state production of crude oil and natural gas can continue to rise in the future.

Figure 6. Proved Reserves of the Top Crude Oil and Natural Gas-Producing States (2014)



Oklahoma’s percentage increase in oil and gas production in this growth cycle has surpassed the respective national gain for both fuels. **Recent EIA estimates place 2015 state crude production at 157.8 million barrels, a 157% increase in production from the recent bottom of 61.3 million barrels in 2005** (see Figure 7). The state gain in crude oil production is more than double the national gain in this cycle. Total oil production has also roughly returned to the peak level of 168.4 million barrels set in 1984.

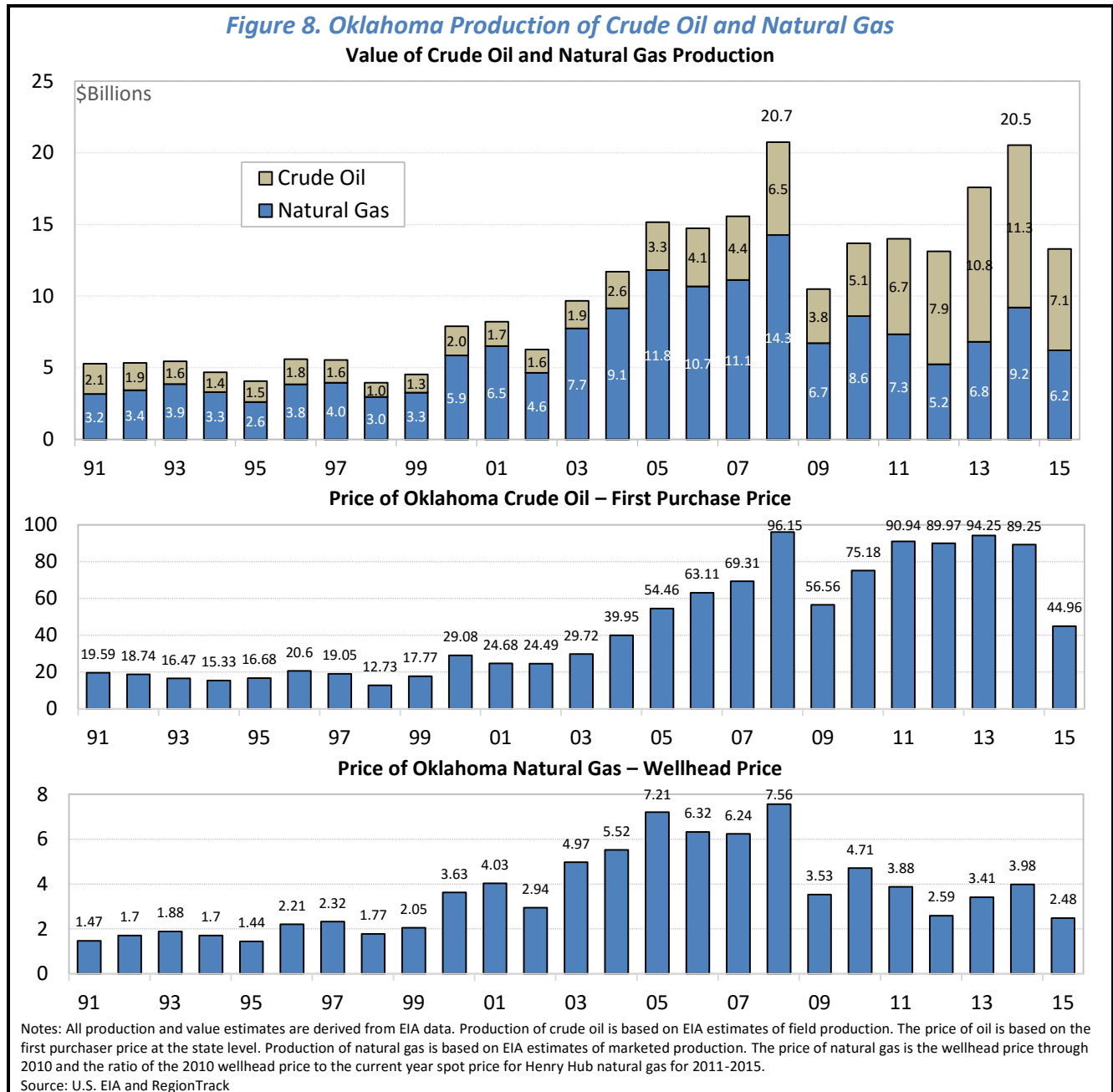
Similarly, **state natural gas output is up by 60% since 2003, from 1.56 trillion cubic feet to 2.5 trillion cubic feet in 2015**. This slightly exceeds the 50% gain at the national level in this cycle.



Oklahoma now ranks fifth among the states in oil production, trailing only Texas, North Dakota, California, and Alaska. The state ranks third in natural gas production, trailing only Texas and Pennsylvania.

Oklahoma produced \$15.4 billion in oil and natural gas annually the past decade

The total market value of Oklahoma’s oil and gas production has also taken a large upward shift the past decade and is exerting a much greater economic influence on the state economy. Figure 8 illustrates the total market value of Oklahoma oil and gas produced annually since 1991. From 1991 to 1999, annually production averaged only approximately \$5 billion, with natural gas comprising about two-thirds of the total. Sharply rising natural gas prices beginning in 2000 and rising gas volumes beginning in 2004 quickly doubled the value of production to more than \$10 billion per year by 2004. Natural gas prices then increased to an average of more than \$6.50 per mcf between 2004 and 2008 and pushed the value of gas production to an all-time peak of \$14.3 billion by 2008. Falling natural gas prices beginning in 2009 have since reduced the value of natural gas to an average of \$7.2 billion per year between 2009 and 2015.



On the crude oil side, annual production remained in a narrow range of \$2 to \$3 billion between 1991 and 2004, far below the value of natural gas output. The value of crude production moved up to the \$3 to \$4 billion range between 2005 and 2007 as oil prices edged upward. Beginning in 2008 rising oil prices began to increase the value of oil production and encourage sharply increased oil exploration. State crude output began a sharp ascent in 2011 that pushed the value to an average of \$8.8 billion annually between 2011 and 2015. Beginning in 2012, the value of oil has exceeded the value of natural gas.

Overall, the combined value of crude oil and natural production in Oklahoma averaged \$15.4 billion annually between 2005 and 2015. This is more than triple the \$4.9 billion average value produced between 1991 and 1999 and almost double the \$8.7 billion in average value produced between 2000 and 2004.

Oklahoma is the second largest oil and gas hub in the country

For state policymakers, one of the underlying economic goals of oil and gas tax policy is to enhance Oklahoma’s competitive posture relative to other competing oil and gas regions and create a deeper concentration of the industry in the state. As an established oil and gas hub, Oklahoma is well positioned to benefit from the ongoing expansion within the domestic oil and gas industry. Along with drilling activity, corporate and regional offices and the associated white collar and high-skilled workers that accompany them serve as an important source of economic stimulus to the state.

The state has been remarkably successful in this respect. **Oklahoma continues to have the second highest overall concentration of oil and gas industry activity in the nation, trailing only Texas, and has extended its lead over third-ranked Louisiana in recent years** (see Figure 9). Other than Texas, Oklahoma has the highest number of oil and gas wage and salary workers, highest number of self-employed proprietors in the industry, and highest total household earnings derived directly from the industry. Louisiana is a close third measured by number of wage and salary workers, but has far fewer self-employed proprietors and only a bit more than half the household earnings from oil and gas activity relative to Oklahoma.

Figure 9. Mining Industry Comparison in Key Energy-Producing States (2015)

	AK	CA	CO	LA	NM	ND	OK	PA	TX	WV	WY
Business Establishments	261	842	1,734	1,839	1,223	867	3,704	1,432	10,459	903	1,057
Employment:											
Wage & Salary	16,404	27,227	29,840	50,886	23,576	19,422	53,485	31,369	260,690	31,098	27,689
Proprietors	6,509	46,947	38,807	35,042	14,100	10,969	94,881	29,260	296,360	18,008	10,226
Total Employment	22,913	74,174	68,648	85,928	37,676	30,391	148,366	60,629	557,050	49,105	37,915
Income: (\$millions)											
Wage & Salary Income	\$2,449	\$3,665	\$3,675	\$4,379	\$1,997	\$2,378	\$5,598	\$2,750	\$34,277	\$2,009	\$2,135
Employee Compensation	2,846	4,239	4,277	5,022	2,327	2,672	6,581	3,269	39,172	2,390	2,490
Proprietor's Income	33	2,736	5,085	3,050	708	303	9,971	2,395	46,204	591	944
Total Household Earnings	2,879	6,975	9,363	8,071	3,035	2,975	16,552	5,664	85,376	2,982	3,434
Value of Oil & Gas Production (\$billions)											
Oil Value	7.245	9.205	4.830	3.066	6.633	17.751	7.093	0.287	56.727	0.279	3.558
Gas Value	0.620	0.651	3.699	5.154	2.963	1.138	6.206	12.494	21.156	3.455	3.970
Total Value	\$7.865	\$9.857	\$8.529	\$8.220	\$9.597	\$18.889	\$13.299	\$12.782	\$77.883	\$3.735	\$7.527

Source: Bureau of Economic Analysis, Bureau of Labor Statistics, Energy Information Administration, and RegionTrack

Colorado’s oil and gas industry remains only about half the size of Oklahoma’s but is growing rapidly and is now the fourth largest hub overall and the center of development in the Rocky Mountain region. California’s energy sector is also about half the size of Oklahoma’s, with a much larger presence of multi-nationals but a much smaller base of self-employed proprietors. Both North Dakota and Wyoming have a large wage and salary job base, but both remain hampered in attracting corporate development by a remote location and intense winters.

Oklahoma's corporate presence is even more impressive when viewed alongside the combined value of crude oil and natural gas production. While Texas, North Dakota, California, and Alaska produce more oil by value, Oklahoma has a much larger corporate presence than all but Texas. Similarly, on the natural gas side, Texas and Pennsylvania produce significantly more natural gas by value, but Pennsylvania derives only about one-third the earnings produced in Oklahoma from the mining industry.⁹

The historical attractiveness of Oklahoma to oil and gas producers is a combination of many factors - good geology; supportive regulatory climate; competitive tax structure; responsive legal environment; developed markets for equipment, supplies, and labor; and other factors. **External reviews of Oklahoma relative to other potential markets for oil and gas development suggest that state policy toward the industry matters a great deal and is one of the distinguishing factors for Oklahoma in the broadening global market place for oil and gas investment.**

The Fraser Institute forms its annual Policy Perception Index of global oil and gas markets by asking oil and gas executives and managers to rank oil and gas markets on their attractiveness based on obstacles to investment.¹⁰ **In the 2015 report, Oklahoma ranks as the 3rd most attractive investment market among 126 markets worldwide, trailing only Netherlands (Offshore) and Alabama. This follows three consecutive years in which Oklahoma held the top ranking worldwide. Among markets with a medium level of reserves, Oklahoma was ranked the most attractive oil and gas market in the world based on the fewest obstacles to investment.**

Other neighboring and competing states that rank among the top ten include Texas (4th), Kansas (6th), and Arkansas (7th). However, Oklahoma and other traditional Oil Patch states are not alone in offering an attractive operating environment. The emerging states of Mississippi (5th) and North Dakota (9th) also rank among the top ten. Opportunities remain strong in Canada as well. Canadian markets with high rankings for oil and gas investment include nearby Saskatchewan (8th) and Manitoba (10th). The stakes are high and competition to capture this industry growth has intensified considerably.

Not all U.S. oil and gas markets are ranked among the leaders as measured by obstacles to investment. On the specific question of whether taxation in general would deter oil and gas investment in a region, the Fraser survey assigned Oklahoma the second highest score among all regions. (In the survey, the highest scoring regions receive the lowest share of respondents that indicate that taxation would serve as a deterrent to oil and gas investment.) Only 5% of respondents said that taxation would serve as a deterrent to investment in Oklahoma. Other competing U.S. states viewed as having limited tax hurdles to investment include Alabama (0% and the highest score), Texas (6%), Arkansas (7%), North Dakota (8%), and Mississippi (9%). In contrast, the responses are much less favorable for the competing U.S. markets of New York (77%), U.S. Offshore – Pacific (75%), California (73%), Pennsylvania (57%), Colorado (50%), and West Virginia (38%). **This regional variation suggests that oil and gas industry executives are well aware of differing policy views toward the industry and continue to view taxation as an important factor in allocating oil and gas investments around the globe and among the U.S. states.**

Oklahoma is also ranked among the most attractive regions on the questions of whether investment decisions would be deterred by political stability (0%), quality of infrastructure (3%), uncertainty regarding protected areas (9%), and labor availability and skills (9%). Very few oil and gas executives view these factors as hurdles to investment in Oklahoma.

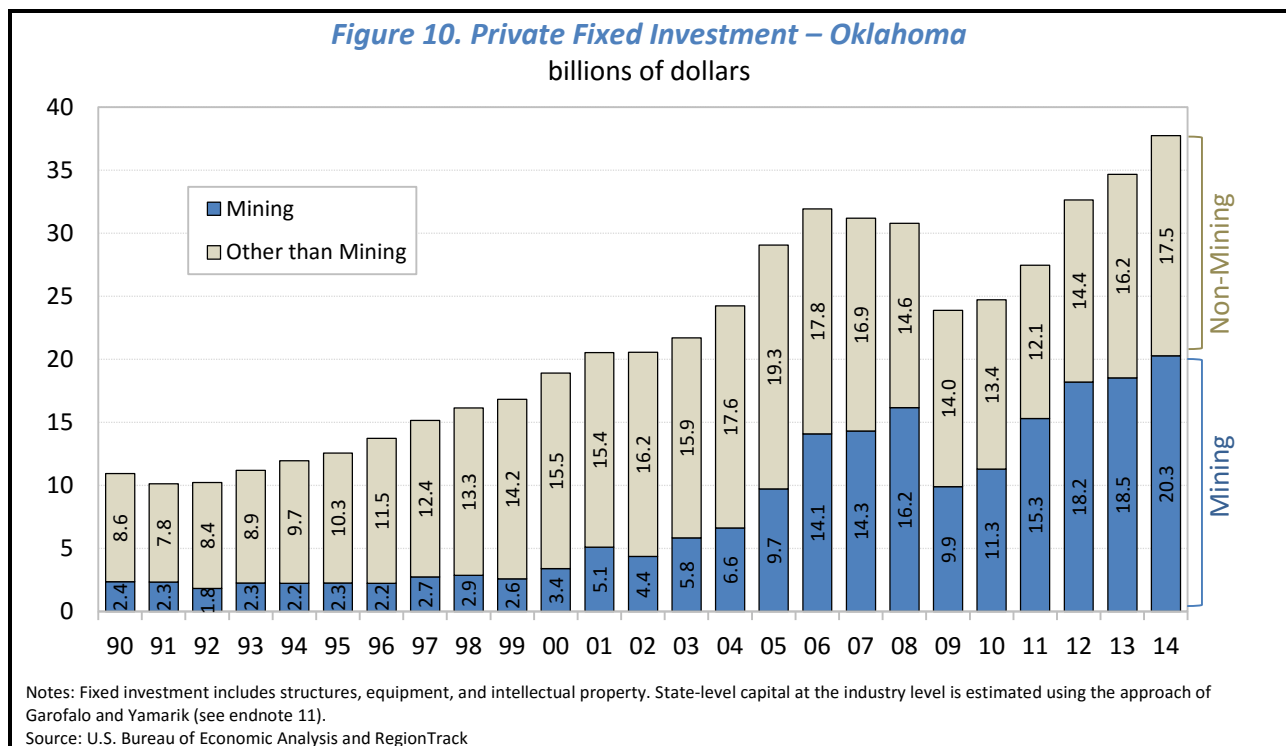
Oklahoma's weakest market attractiveness rankings include deterred investment due to the cost of regulatory compliance (21%), environmental regulations (18%), and uncertainty concerning the administration, interpretation, and enforcement of regulations (13%). However, even on its weakest measures, Oklahoma remains ranked among the most attractive markets for oil and gas investment by the Fraser report.

Oil and gas is the largest single source of capital investment in Oklahoma

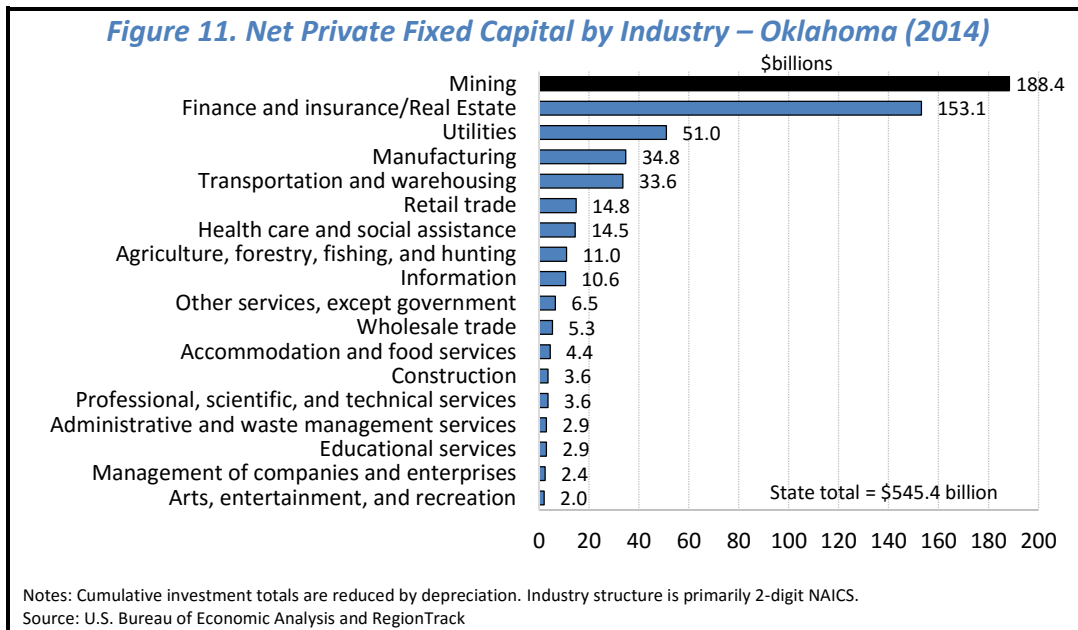
State tax policy and economic development strategy often strives to attract industries that are highly capital-intensive and make significant ongoing capital expenditures. Large capital investments are desirable in part because they are generally tied to the state and cannot easily be relocated outside the region. For the oil and gas industry, capital investments are largely in the form of construction and improvement of producing oil and gas wells and related equipment.

Historically, the mining sector has been extremely capital-intensive but has become increasingly so in recent years. The investment activity of the industry can easily sway overall statewide capital investment activity. **Of the \$37.8 billion in estimated fixed private investment made in the state in 2014, \$20.3 billion (54%) was made by the mining sector alone** (see Figure 10).¹¹ All other industries combined made capital investments totaling \$17.5 billion in 2014 (46%).

Capital investment in the mining sector has increased sharply since the revival of growth in the industry beginning in the early 2000s. Total investment spending in mining averaged only about \$2 to \$3 billion annually in the 1990 to 1999 period before steadily increasing more than five-fold to \$16.2 billion just prior to the national recession in 2008. Following the national recession, capital spending by the industry more than doubled from \$9.9 billion in 2009 to \$20.3 billion in 2014.



In the decade between 2005 and 2014, the mining sector in Oklahoma made cumulative investments of \$154.5 billion, or an average of \$15.5 billion annually. The share of total state investment coming from the oil and gas industry has gone from less than 20% in much of the 1990 to 1999 period, to more than half in recent years. **In every year since 2011, the mining sector has made more fixed investments than all other industries in Oklahoma combined.**



The extended surge in investment spending by the oil and gas industry now makes it the largest holder of capital assets in the state. **Of the \$545.4 billion in estimated total net private capital (minus depreciation) in place in the state in 2014, more than one-third (\$188.4 billion or 34.5%) is traced to the mining sector** (see Figure 11). Capital used in the industry averaged only about \$30 billion from 1990 to 1999 before increasing more than five-fold to \$165 billion just prior to the national recession in 2008. Following the recession, the net capital base of the state’s oil and gas industry increased from \$130 billion in 2009 to \$188.4 billion in 2014, a \$58 billion (45%) increase after depreciation. Finance and Insurance/Real estate is the second largest owner of capital in the state, primarily in the form of commercial and residential real estate for lease. While real estate is typically the dominant category of fixed capital assets in most states, Oklahoma’s real estate sector maintains only about 80% as much capital as the outsized mining sector. The utility sector, another traditional capital-intensive industry, is third but holds only a little more than one-fourth as much net fixed capital as the oil and gas sector. Manufacturing ranks a distant fourth with \$34.8 billion in capital assets in 2015.

Comparisons to construction activity can help place the significant scale of capital spending by the oil and gas industry in recent years into perspective. While the construction industry itself engages in relatively little capital spending, it is an outlet for capital investment for nearly every other industry sector, including oil and gas, the public sector, and households.

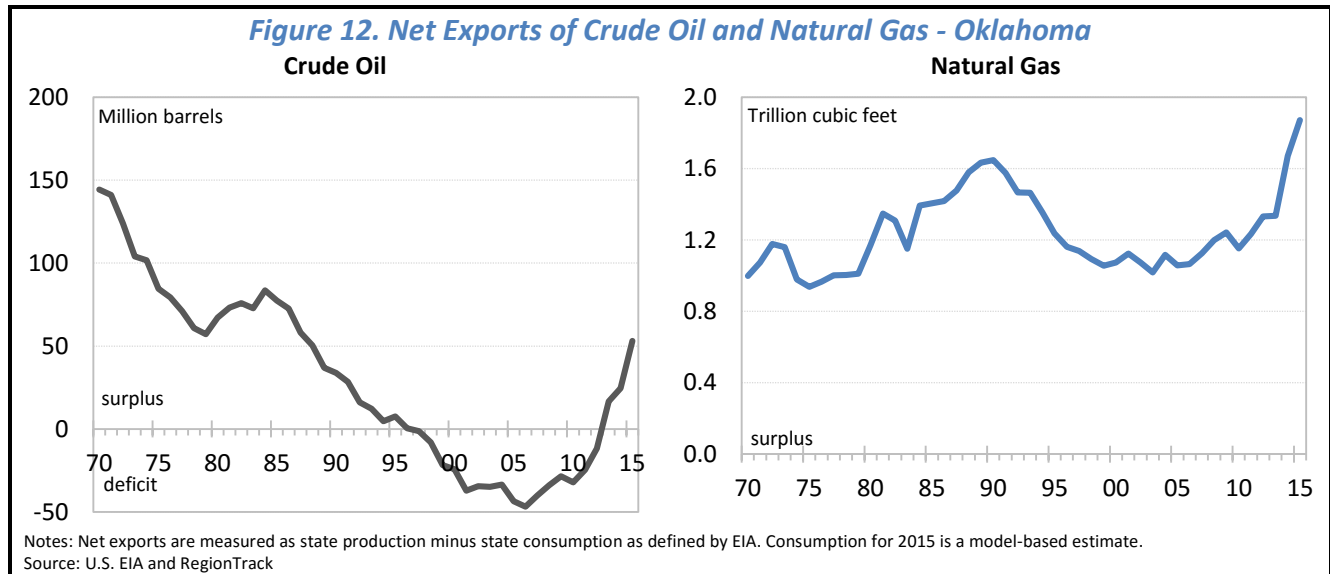
In terms of single family housing, the \$20.3 billion in capital investment spending by the state’s oil and gas industry in 2014 is equivalent to constructing almost 116,000 single family homes valued at \$175,000 in a single year. This is equal to roughly 10 years of single family housing stock for Oklahoma. Only about 10,000 single-family building permits were issued in 2015, and the state has added only about 10,000 to 15,000 total housing units annually since 2000.

Measured by commercial construction, \$20.3 billion in spending is equivalent to completing the construction of more than 27 Devon Towers annually at its original estimated cost of \$750 million (even though the building took three years to complete).

In short, **the oil and gas industry is the single largest source of annual capital spending and the largest holder of net capital assets among all major industry sectors in Oklahoma.**

Crude oil and natural gas are growing export products of the state

The surge in crude oil and natural gas production the past decade has reversed long-run concerns over a decline in the export share of state oil and gas production. On the crude oil side, Oklahoma shifted steadily from net exports of approximately 150 million barrels per year in the early 1970s to a deficit position by 1997. The state's crude oil deficit reached 50 million barrels annually by 2006 (see Figure 12). The state's crude oil deficit reached 50 million barrels annually by 2006 (see Figure 12).



The recent surge in crude oil production reversed this trend and returned the state to a positive net export position in 2013. The state produced a net 55.3 million barrels of oil for export in 2015, approximately one-third of the 157.8 million barrels produced.

Natural gas has remained a consistent export product for the state the past several decades but similarly weakened beginning in 1990, with net exports falling from 1.6 trillion cubic feet to a little more than 1 trillion cubic feet by 1998. Exports of natural gas remained relatively flat between 1998 and 2008 at approximately 1.1 trillion cubic feet, but increased sharply beginning in 2008 as state production increased, reaching 1.84 trillion cubic feet in 2015. The natural gas export share is currently approximately 75% of total state output.

Crude oil and natural gas have once again become critical export products of the state. **The market value of oil and gas exports from Oklahoma in 2015 totaled an estimated \$7.1 billion.**¹² The 55.3 million barrels of exported oil valued at \$2.49 billion are a little more than one-third of the total export value. The 1.84 trillion cubic feet of state natural gas exports are valued at \$4.58 billion and represent two-thirds of the total export value.

From an economic policy perspective, producing exports of oil and gas for external consumption is a far more significant economic event for the state economy than producing for in-state consumption. In the case of crude oil, funds formerly sent out of state to import crude oil are now received as payment from purchasers outside the region. **This external infusion of spending into the state is the cornerstone of the economic base theory of regional development in which industries that bring in spending and wealth from outside the region have a larger spillover economic impact.**

Economic growth in the mining sector has far outpaced the non-mining sectors

The overall growth in Oklahoma's oil and gas industry in recent years has been remarkable (see Figure 13). Since the industry resurgence began in 2002, the number of oil and gas business establishments increased by almost 75% and gross domestic product in the industry nearly tripled. Wage and salary jobs almost doubled to 53,500 while wage income more than tripled from \$1.55 billion to \$5.6 billion. Average total compensation for employees in the industry reached more than \$123,000 per worker in 2015.

Figure 13. Oklahoma Mining Industry Economic Profile - 2002 and 2015

Economic Measure	Mining			Non-Mining Sectors			State Total		
	2002	2015	%Chg.	2002	2015	%Chg.	2002	2015	%Chg.
Business Establishments: (by firm size)	2,130	3,722	74.7%	82,797	98,503	19.0%	84,927	102,225	20.4%
Gross Domestic Product (millions)	\$5,325	\$20,083	277.1%	\$93,452	\$160,342	71.6%	\$98,777	\$180,425	82.7%
Employment: (by firm size)									
Wage & Salary Employment:	28,592	53,485	87.1%	1,527,978	1,675,430	9.7%	1,556,570	1,728,915	11.1%
Proprietor's Employment	25,104	94,881	278.0%	398,897	496,536	24.5%	424,001	591,417	39.5%
Total Employment	53,696	148,366	176.3%	1,926,910	2,156,314	11.9%	1,980,606	2,304,680	16.4%
Income: (millions)									
Wage & Salary Income	\$1,550	\$5,598	261.1%	\$43,622	\$71,205	63.2%	\$45,172.3	\$76,803	70.0%
Employee Compensation	1,826	6,581	260.4%	54,221	88,723	63.6%	56,047.0	95,304	70.0%
Proprietor's Income	3,033	9,971	228.7%	9,457	18,349	94.0%	12,490.4	28,320	126.7%
Total Earnings	4,859	\$16,552	240.6%	63,678	107,071	68.1%	68,537.3	123,624	80.4%
Key Industry Ratios:									
Compensation per Employee	\$63,861	\$123,048	92.7%	\$35,485	\$52,955	49.2%	\$36,007	\$55,124	53.1%
Income per Proprietor	120,825	105,090	-13.0%	23,708	36,953	55.9%	29,456	47,884	62.6%
GDP per Employee	186,241	375,488	101.6%	61,161	95,702	56.5%	63,458	104,357	64.5%
GDP per Establishment	2,500,000	5,395,755	115.8%	1,128,688	1,627,788	44.2%	1,163,081	1,764,979	51.8%

Source: Bureau of Economic Analysis, Bureau of Labor Statistics, and RegionTrack

Relative to the non-energy sectors of the economy, oil and gas business formation was nearly four times higher, the pace of employment growth was 9 times faster, and industry output expanded four times as much. The earnings of oil and gas proprietors grew more than twice as much as their counterparts in the non-mining sectors. And both GDP per employee and compensation per employee in mining increased roughly twice as fast as in the non-mining sectors.

The growth of the industry between 2002 and 2015 has contributed in a large way to overall state economic performance. For example, the state added more than \$55.1 billion to total household earnings in the period, with the mining sector alone contributing \$11.7 billion (21%) of the gain. The state similarly added 324,000 wage and salary workers and proprietors in the period, with the oil and gas industry producing 91,700 (29%). The oil and gas industry also contributed \$14.8 billion of the \$81.6 billion (18.1%) in state GDP added in the period. The outsized influence of the mining sector on overall state economic performance is visible across most economic measures in Figure 13.

IV. To what degree does the oil and gas industry produce spillover benefits to the broader state economy?

How are spillover effects generated?

Activity in the oil and gas industry produces spillover economic activity that reaches nearly every sector of the state economy. The process begins as the decision to drill for crude oil and natural gas triggers a large and long-lived stream of economic impacts within the state. Upfront lease payments and other forms of compensation are provided to landowners and mineral rights owners to conduct geological and geophysical activity and reserve the right to drill. Significant capital spending is then incurred for drilling and completing a well. Infrastructure needs include roads, electricity, water delivery, fencing, and other site preparations.

When a well is brought online it begins a multi-year stream of production that generates revenue for firms and operators, payments to royalty owners, and tax revenue to state and local governments. Related activities include chemical refining and processing, pipeline and truck transportation, and storage. Wells must also be monitored and serviced on a continual basis by local servicing firms. Manufactured goods produced within the state support the entire process from initial drilling to final shut-in. This activity also requires the ongoing use of significant legal, financial, human resources, and engineering services. The industry uses large amounts of food services and accommodations for workers in the field and traveling across the state.

The spillover from this activity produces tangible added economic output of goods and services in other industry sectors across the state. This added output generates new wage and salary employment and self-employment opportunities. New household earnings are also created statewide. Estimates of these broad spillover effects are formed in the remainder of this section.

Estimating economic linkages and spillovers

Numerous past studies provide traditional economic impact estimates of the indirect spillover effects generated by Oklahoma's oil and gas industry.¹³ These studies routinely conclude that direct activity within the industry is believed to support at least as much indirect economic activity outside the industry.

Spillover effects from the industry have increased in size along with the industry since the early 2000s. Estimates of the current economic spillover effects from oil and gas activity in Oklahoma are formed using a detailed input-output model of the state economy.¹⁴ Multipliers derived from input-output models are used to estimate the impact that activity in a given industry has on total gross output, earnings, and employment within a regional economy.¹⁵ In other words, multipliers provide a convenient method for estimating the effects that a change in *output*, *employment*, or *earnings* within the oil and gas industry may have on broader economic activity in Oklahoma. It is important to note that the estimates represent *gross* economic effects and do not account for any public or private costs associated with oil and gas activity.¹⁶

An average of the activity within the industry in the five-year period from 2011 to 2015 is used to estimate spillover effects to the broader state economy. The multi-year period smooths the cyclical fluctuations in the industry and provides a better gauge of the likely effects going forward. The direct economic effects generated within the industry in the five-year period can be summarized with the following measures of output, employment, and earnings:

1. Output – the oil and gas industry produced \$37.1 billion in output of goods and services annually
2. Employment – the industry employed an average of 56,400 wage and salary workers and 77,400 self-employed proprietors
3. Earnings – employees earned \$6.44 billion in employee compensation and proprietors received \$8.91 billion in income annually

Oil and gas spillover effects in Oklahoma

Figure 14 summarizes annual estimated spillover effects resulting from direct activity in the oil and gas sector in the five-year period from 2011 to 2015. At the state level, \$37.1 billion in direct output generated within the industry supports an estimated \$28.6 billion in additional indirect and induced output in other industry sectors statewide. In other words, each dollar of direct revenue produced by the energy sector supports an additional 77 cents in output in other industry sectors nationwide. **In total, direct output in the oil and gas industry supports an estimated \$65.7 billion in total state output, both directly and through indirect and induced multiplier effects.** The direct and spillover output produced by the energy sector represents 21% of total state economic output (\$316.5 billion) in 2015.

The \$15.4 billion in employee compensation and proprietor’s earnings generated directly within the industry is associated with an additional \$17.2 billion in estimated spillover earnings statewide. This suggests that more than one dollar (\$1.12) of additional earnings in the broader state economy is supported by each new dollar earned by workers and proprietors in the energy sector. **In total, multiplier-based estimates suggest that approximately \$32.6 billion in earnings in the state is supported directly and indirectly by energy sector earnings.** These earnings represent approximately 21% of total state household earnings (\$123.6 billion) in 2015.

In terms of employment, 133,800 proprietors and wage and salary employees working in the oil and gas sector support an estimated 291,015 jobs in other industry sectors through indirect and induced effects. Each new direct oil and gas job supports slightly more than two additional jobs statewide, a reflection of the relatively large employment multiplier (3.18) for the energy sector. **In total, an estimated 424,800 self-employed proprietors and wage and salary workers are supported both directly and indirectly by the oil and gas sector in Oklahoma.** These direct and spillover jobs comprise 18.4% of total employment statewide.

Figure 14. Estimated Economic Impact of Oklahoma Oil and Gas Activity

2011-2015 average				
Economic Measure	Direct Effect	Multiplier Effects		Total Effect
		Indirect	Induced	
Output (\$Billions)	\$37.1	\$17.8	\$10.8	\$65.7
Employment (Jobs + Proprietors)	133,800	145,006	146,009	424,815
Earnings (\$Billions)	\$15.4	\$11.1	\$6.1	\$32.6

Source: Bureau of Economic Analysis, IMPLAN, RegionTrack

A key element of the spillover impact is spending by the industry on goods and services in other sectors of the state economy. **Estimates suggest that Oklahoma oil and gas firms made an average of \$11.3 billion in purchases annually from Oklahoma-based firms from 2011 to 2015.**¹⁷ Key industry sectors receiving large amounts of purchases from oil and gas firms include machinery manufacturing, construction, transportation, utilities, and several professional and technical service industries. However, nearly every industry sector in the state receives some level of purchases from the sector.

The interrelationships between the energy sector and other industries are highly visible across the state. Many sectors in the state operate downstream from the production side of the oil and gas industry, with manufacturing and transportation key among them. Of a total of \$17.8 billion in state GDP derived from manufacturing in 2015, petroleum products manufacturing (refining) accounted for \$2.7 billion (15.2%). And of the \$7.8 billion in transportation-related GDP in the state, pipeline transportation accounted for \$2.5

billion (32%). Other transportation-related evidence of the broader impact of the oil and gas industry on the state economy includes the ongoing expansions at the Cushing oil hub and additions to the massive intra- and interstate pipeline systems within the state’s boundaries.

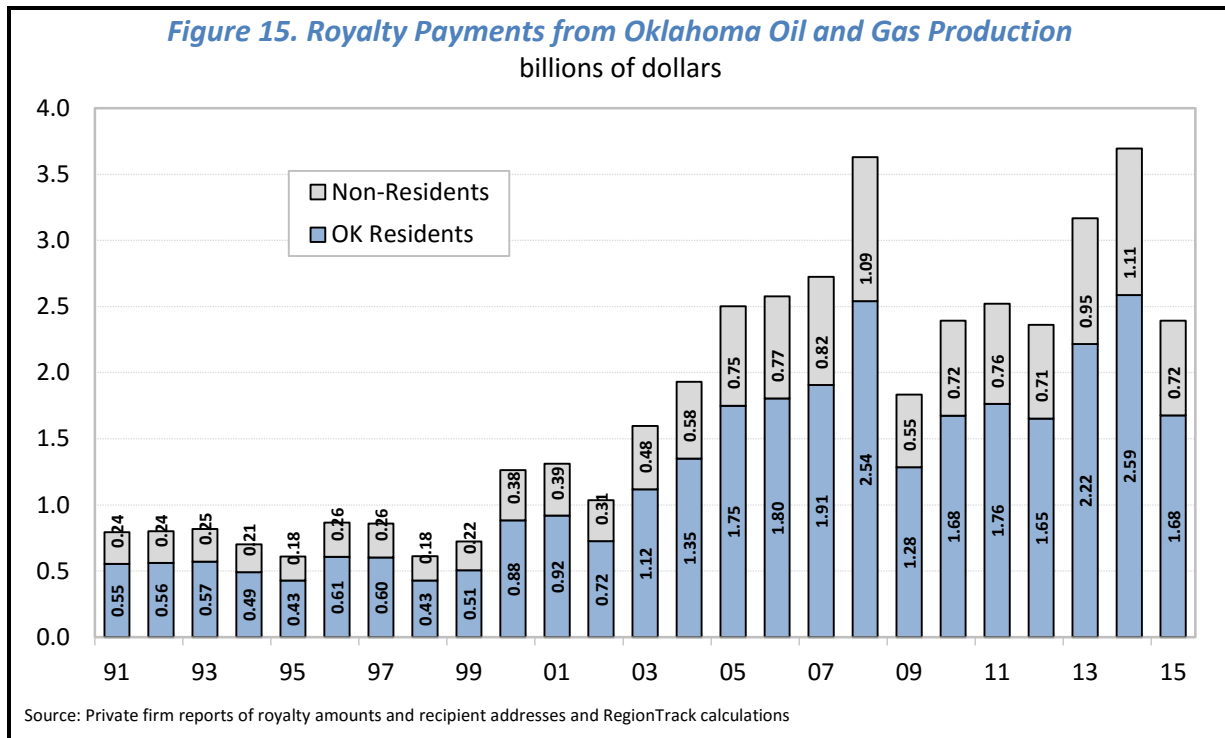
Recent knowledge spillovers from the oil and gas industry include the construction of the \$110 million GE global oil and gas research center¹⁸ in Oklahoma City and substantial ongoing contributions by energy firms to fund research and scholarships at both public and private universities in the state. Perhaps no sign of the reemergence of oil and gas is more visible than the Devon Tower now anchoring downtown Oklahoma City.

Royalty payments are an added source of economic spillover

An often overlooked spillover effect from oil and gas production is the large stream of royalty payments paid to mineral rights holders. After production costs, royalty payments often represent the next largest use of oil and gas revenue. Royalties are typically based on the value of the oil and gas produced, minus any associated costs assumed by the royalty holder. The increasing value of oil and gas production in Oklahoma the past decade to an average of more than \$15 billion annually has provided a critical boost to the state economy through increased royalty payouts.

Estimated royalty payments generated from oil and gas production within the state reached \$2.4 billion in 2015 (see Figure 15).¹⁹ Of the total payments, an estimated \$1.7 billion was paid to Oklahomans. Royalty payments represent a considerable additional income stream to residents and state-based businesses and are a component of the sizeable earnings spillover effects estimated in the prior section. To put the size of royalty payments from oil and gas production into perspective, the \$1.7 billion in payments to Oklahoma residents and firms represents 1.4% of total household income earned in the state in 2015.

Over the decade from 2006 to 2015, Oklahoma residents and firms received a cumulative \$19.1 billion in royalty payments, or an average of \$1.9 billion each year. Royalty payments from Oklahoma production peaked at \$3.7 billion in 2014, with an estimated \$2.6 billion going to Oklahoma firms and residents.



V. Does state policy encourage increased production and full utilization of the state's oil and gas resources?

State tax policy has long encouraged increased production of crude oil and natural gas and full utilization of the state's hydrocarbon resources. A concern underlying tax policy toward the oil and gas industry in Oklahoma is whether there is ample evidence that the state's oil and gas fields offer sufficient near- and long-term growth potential. Increased future production will require access to both economically-feasible reserves and increased drilling activity. The degree to which the state's oil and gas fields are able to attract investment spending and produce production gains will play a large role in determining whether policy can shape utilization of the state's resources.

Drilling is producing strong production gains in Oklahoma

The recent surge in drilling activity has produced a dramatic turnaround in state oil and gas output. **Oklahoma is the only major producing state to experience substantial increases in both crude oil and natural gas production in recent years.**

Production trends for crude oil and natural gas in the U.S., Oklahoma, and the other major producing states are shown in Figures 16 and 17. The surge in U.S. crude production since early 2010 is not evenly distributed across the major producing states. North Dakota has posted the largest gain in oil production, with a four-fold increase; Oklahoma and New Mexico production has more than doubled, while Texas production is up 75%; Wyoming output is up about 50%, while Louisiana has seen only modest increases. Alaska and California have not seen their long-run declines in production reversed or ended. Oil production is off roughly 5% in California and 20% in Alaska in the short run, and off 20% and 50%, respectively, the past decade.

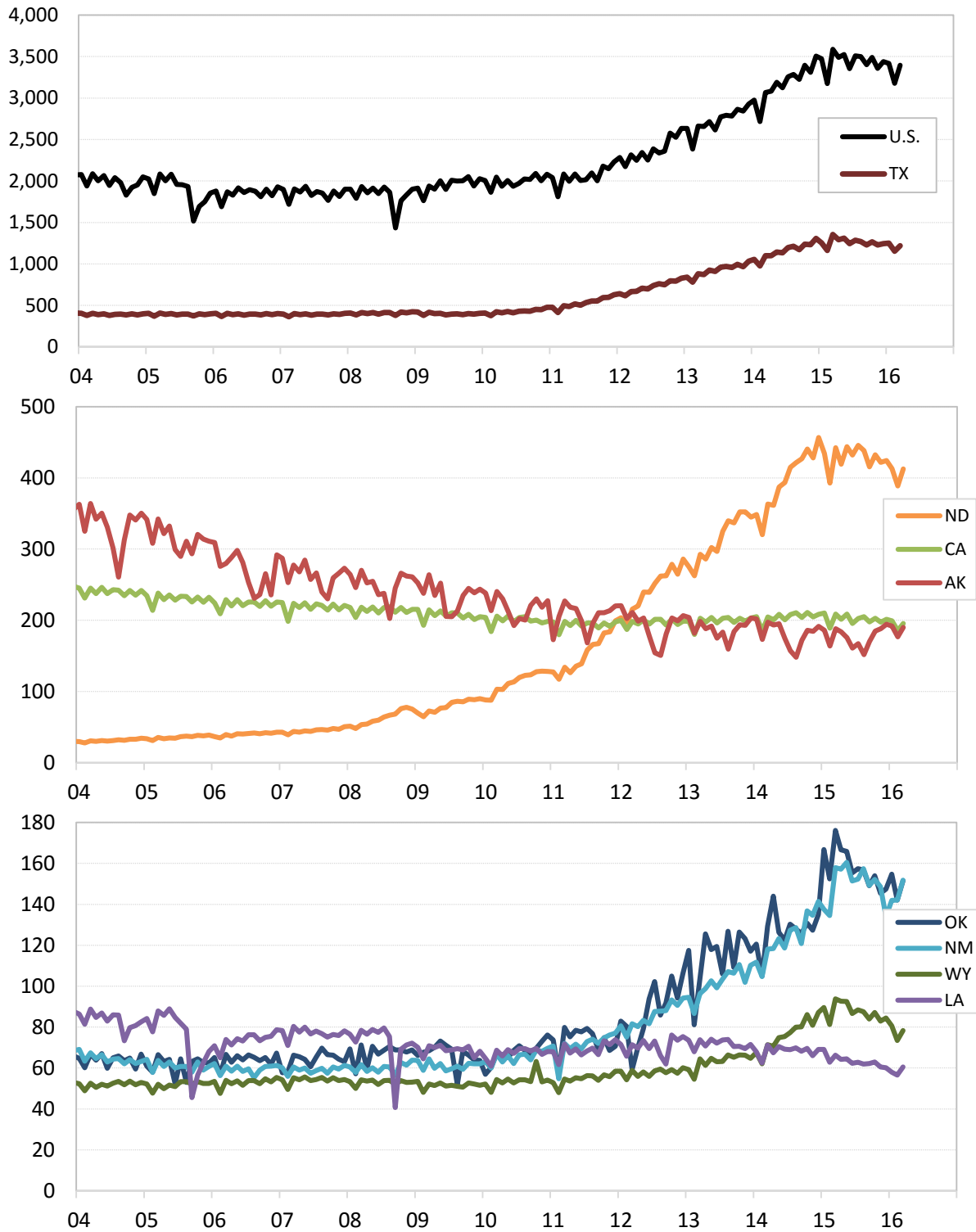
The geography underlying the nearly 3.5 billion barrels of crude oil currently produced annually in the U.S. is roughly 1.25 billion barrels from Texas; 800 million barrels combined from North Dakota, Alaska, and California; 425 million barrels combined from Oklahoma, New Mexico, Louisiana, and Wyoming; and 1 million barrels from all other states combined (see Figure 16).

Natural gas production gains since early 2006 are similarly concentrated among only a few producing states (see Figure 17). Approximately half the U.S. gain in natural gas output is traced to explosive growth since 2010 in the relatively new gas fields of Pennsylvania. Ohio and West Virginia have similarly produced large gains from a very small initial base. Oklahoma gas production is up almost 75% in the period. Louisiana production initially more than doubled, but has since given up nearly all of the gain under weak gas prices and a slowdown in drilling in the Haynesville Shale. Texas production is flat in the period, while production in the Gulf of Mexico has fallen by half. New Mexico has seen little change in gas production in recent years, with a more than 15% decline over the past decade. Wyoming gas production peaked in late 2008 and has since declined steadily by more than one-third.

The strong gains in Oklahoma's production of both crude oil and natural gas relative to the other producing states suggests that continued drilling activity can sustain or expand future state production. This would also provide continued underlying support to the state's stream of severance tax revenue going forward.

Figure 16. Crude Oil Production – U.S. and Major Producing States

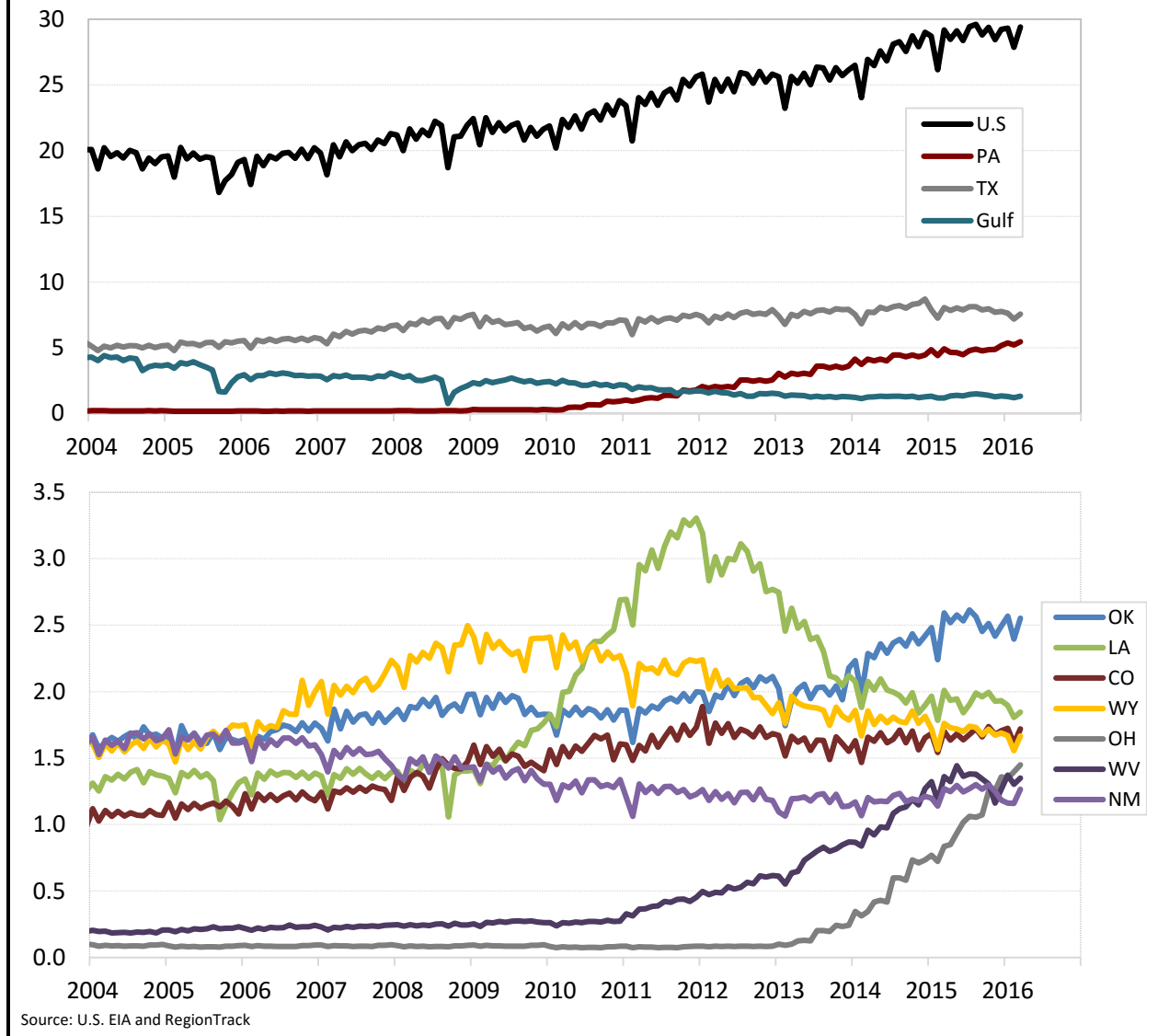
millions of barrels at annual rate



Source: U.S. EIA and RegionTrack

Figure 17. Natural Gas Production – U.S. and Major Producing States

trillion cubic feet at annual rate

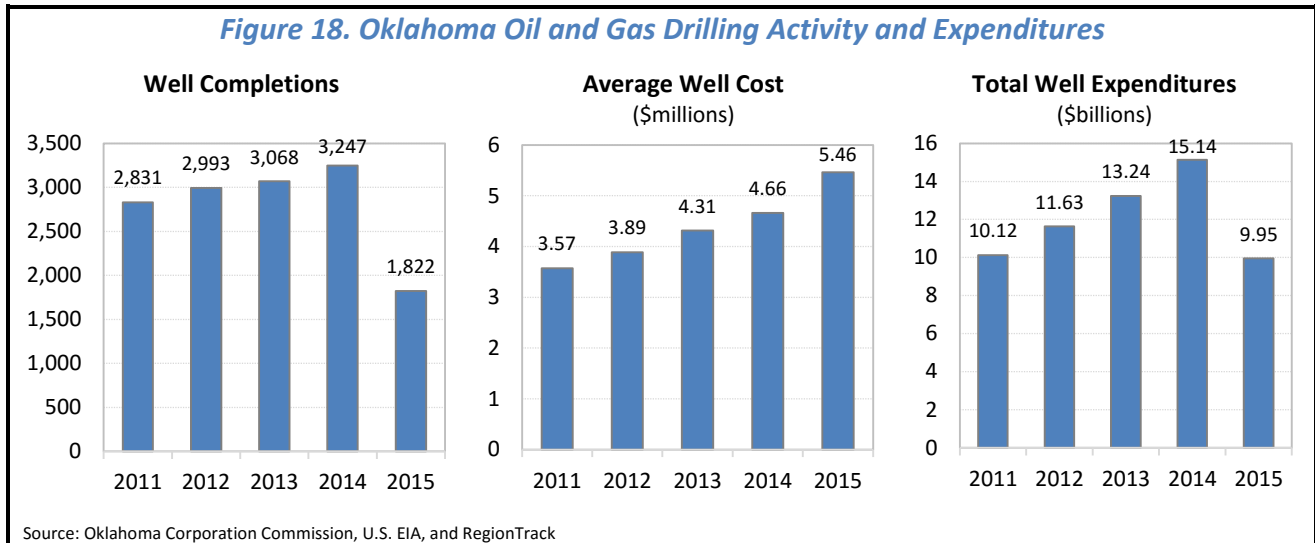


Drilling and exploration is now much more capital intensive

The rising costs of drilling and exploration underlie the rising capital expenditures made by the state’s oil and gas industry. The industry spent \$10.0 billion to complete an estimated 1,822 wells in 2015 at an average cost of \$5.46 million per well (see Figure 18).²⁰ Total spending declined by roughly one-third from 2014 when the industry spent an estimated \$15.1 billion to complete 3,247 wells. In 2014, well costs represented three-fourths of the estimated \$20.3 billion in total fixed private investments made by the industry.

Over the past five years, drilling expenditures in Oklahoma totaled an estimated \$61.0 billion, or an average of \$12.1 billion annually. The \$10 billion in drilling expenditures in 2015 in Oklahoma represent 9.3% of an estimated \$108.0 billion in oil and gas-related investment nationally.²¹ This is consistent with Oklahoma capturing a roughly 7% to 10% share of total domestic drilling spending in recent years. At the peak of drilling in 2014, Oklahoma’s \$15.1 billion in drilling spending represents an estimated 8.5% of a total \$178.3 billion in domestic oil and gas related investment.²²

Figure 18. Oklahoma Oil and Gas Drilling Activity and Expenditures



For historical perspective, Oklahoma drillers spent \$4.62 billion, to drill and complete 11,699 wells in 1981, or approximately \$395,000 per well.²³ Drilling activity in the state in 1981 accounted for about 8.4% of the \$55 billion in national oil and gas related investment. Adjusted for inflation, total drilling expenditures in Oklahoma in 1981 equates to \$12.0 billion in current 2015 dollars. In other words, drilling expenditures in the state the past five years are roughly equal to the inflation adjusted level experienced near the peak of the drilling frenzy back in 1981.

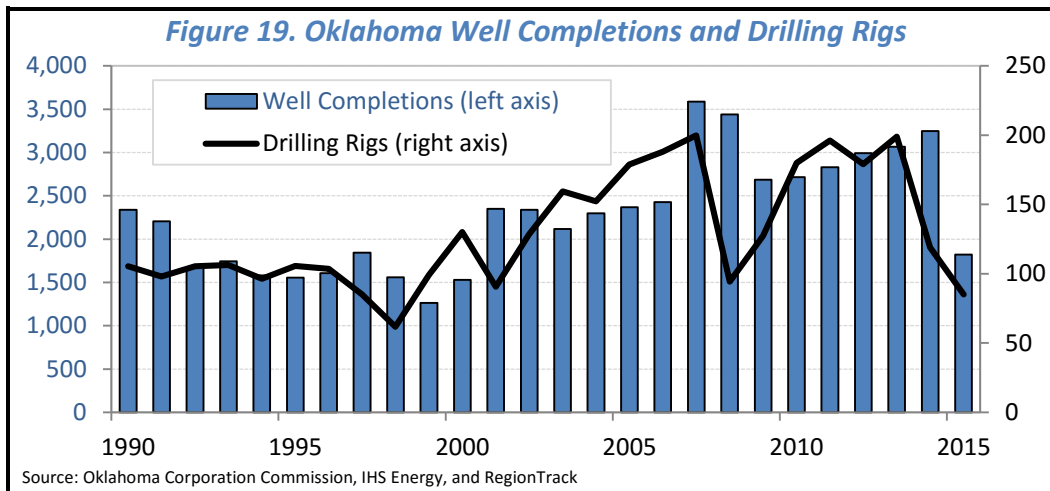
Between 2000 and 2007, a period when mostly conventional drilling took place and that mostly pre-dates the shift to horizontal drilling, average annual spending on drilling in Oklahoma was only \$3.12 billion. This reflect an average of 2,600 well completions at an average cost of only \$1.2 million. Spending on drilling in the period was only roughly one-fourth the current level.²⁴

Because of the sharp rise in cost per well, the drilling and completion of an average well today is a much more significant economic event than it was as recently as a decade ago. Increased current spending is due in part to a rise in the number of well completions, but more importantly to an increase in spending to nearly \$5.5 million per well. **This is why Oklahoma tax policy cannot simply view the recent transition to unconventional drilling as a one-for-one swap in drilling investment. Each well drilled is now 4 to 5 times costlier based on current well costs.**

More wells at an increasingly higher cost

The increased scale of drilling activity in Oklahoma in the current cycle is not well understood. **More rigs have been operating in Oklahoma (180 rigs) on average the past five years than in all states but Texas (777 rigs), with North Dakota (158 rigs) third.**²⁵ No other state has managed to attract half the number of rigs deployed in Oklahoma over the past five years.

Well completions in Oklahoma have nearly doubled from the lull in the 1991 to 2000 period when only about 1,600 wells were drilled annually (see Figure 19). Since 2001, the point when natural gas prices first spiked, drillers completed between 2,200 and 3,500 wells annually, an average pace of nearly 2,700 wells per year.²⁶ Completions accelerated again in 2007 as crude prices spiked and have since averaged slightly more than 3,000 annually. An estimated 3,247 wells were completed at the recent peak in 2014. The collapse in oil prices beginning in 2015 pushed completions down to only 1,822 in 2015, the smallest number since 2000.



Most wells completed in Oklahoma are now drilled horizontally and hydraulically fractured. **Nearly all rigs operating in Oklahoma in the first half of 2016 are drilling horizontally with a 15% to 20% share drilling below 15,000 feet. Only a few rigs are drilling for natural gas, and no active rigs are drilling for deep gas.**²⁷

Drilling costs across Oklahoma formations

Drilling costs in Oklahoma continue to vary considerably by well type, drilling method, and formation, ranging from \$500,000 for a shallow vertical well to \$15 million for a deep horizontal well. The cost of most horizontal wells lies within a broad range of \$2.5 million to \$12 million depending upon well depth, number of laterals, lateral lengths, number of fracturing stages, and other characteristics of the basin in question. Deep wells drilled below 15,000 feet become increasingly costly to drill as depth increases and can easily double or triple the cost relative to a shallower well. Deep vertical wells have averaged \$5 million to \$8 million to complete in recent years, although relatively few have been completed the past five years as horizontal wells have become the norm.²⁸

Although drilling efficiencies are slowly lowering per-well costs for horizontally drilled wells in most active plays, the average well cost has risen significantly as drilling shifts to more challenging formations in the state and lower-cost conventional drilling is dropped. Recent reports of drilling costs across a range of formations in Oklahoma include \$2.5 million to \$3.5 million for wells in the Marmaton formation in the Oklahoma Panhandle; \$3 million to \$3.7 million in the Mississippi Lime formation in north central Oklahoma; \$5 million to \$9 million in the Granite Wash in western Oklahoma; and \$7.5 to \$10 million for Cana-Woodford (SCOOP) wells in south central Oklahoma.²⁹ Recently completed wells in the STACK (Sooner Trend Anadarko Basin Canadian and Kingfisher Counties) play located largely in Canadian and Kingfisher counties cost \$7.5 to \$10.0 million.³⁰

Average well costs in some Oklahoma formations are much lower than in other competing domestic formations. For a comparison with other basins around the country, a recent U.S. EIA report prepared by IHS suggests that well costs in 2015 averaged \$5.9 million in the Bakken, \$6.5 million in the Eagle Ford, \$6.1 million in the Marcellus, \$7.2 million in the Midland Basin (Permian), and \$5.2 million in the Delaware Basin (Permian). Average well costs are generally reported as \$9 million to \$11 million in the gas-rich Haynesville Shale formation in Louisiana.³¹

Threshold cost of production in Oklahoma

For policymakers, an increasingly important question is whether the state's oil and gas formations will remain competitive in the new environment of increasing global supply and reduced prices. The available evidence suggests that Oklahoma will remain a highly competitive market.

A recent analysis by energy consultancy Wood Mackenzie³² evaluates which fields are likely to provide economical production opportunities through 2025. In examining the production potential for various formations around the world by cost of production, the report suggests that Oklahoma's oil and gas fields are well positioned cost-wise for future development. In particular, the SCOOP and STACK plays in Oklahoma are ranked among key formations in the world. They are projected to have a breakeven price of production in the \$18 to \$65 range. This is among the lowest breakeven prices reported for formations worldwide that are viewed as having the potential for increased production.

A recent Dallas Fed survey³³ indicates that respondents operating in Oklahoma reported needing an average of \$56 per barrel to profitably drill a new well in the state. This is slightly above the \$51 to \$55 average reported for most of Texas, and \$50 per barrel in Louisiana. It is roughly in line with the \$55 price reportedly needed across other U.S. states and below the \$62 per barrel reported for onshore Gulf Coast wells.

Respondents to the Dallas Fed survey also suggest that existing wells in Oklahoma will remain competitive in a reduced-price production environment. Oklahoma wells matched the Eagle Ford and Permian Basin as needing only an average of \$29 per barrel to cover operating expenses for existing wells. The reported costs in Oklahoma ranged from \$20 to \$48 per barrel. This matched the lowest cost among all reported regions including the remainder of Texas, Louisiana, other states, and the onshore Gulf Coast.

VI. How is the oil and gas industry taxed, how much does it pay, and what is the revenue used for?

Changes to Oklahoma severance taxes and drilling incentives³⁴

Oklahoma's severance tax laws were streamlined in 2014 by the passage of HB2562. Under new rules effective July 1, 2015:

- A basic 7% severance tax rate is applied to all crude oil and natural gas production.
- For all new wells spudded on or after July 1, 2015, the severance tax rate is 2% for the first 36 months of production. Production is taxed at a rate of 7% thereafter.
- Horizontal wells spudded prior to July 1, 2015 will remain under the prior rate of 1% for 48 months.
- Deep wells spudded prior to July 1, 2015 will remain at a 4% rate for 48 months.
- Production incentives for secondary recovery projects (up to five years), tertiary recovery projects (up to ten years), enhanced recovery projects, inactive wells, and production enhancement are extended through July 1, 2020.
- A sunset date of July 1, 2015 is established for the deep wells (below 15,000 feet) incentive, new discovery wells incentive, and 3-D seismic shoot incentive.

More recently enacted in July 2016, total tax credits paid through the Economically At-Risk Lease credit are capped at \$12.5 million annually for calendar years 2015-2020. These are 'marginal' wells that produce 10 barrels of crude oil or 60 mcf of natural gas or less per day.

Are production incentives a significant portion of severance tax collections?

The economic significance of recent oil and gas rebates can only be evaluated when placed in context with total gross payments made by the industry in recent years. Figure 20 summarizes gross severance tax payments, refunds, and net payments after refunds for FY2005 through FY2015.

It is important to note that the severance tax refunds reported in Figure 20 are adjusted to reflect the appropriate year in which each refund was filed and approved, not the year in which the refund was ultimately paid by the state. Recent estimates of net severance tax payments by the industry for FY2013, FY2014, and FY2015 are artificially reduced by a total of \$297 million as a result of severance tax refunds that were incurred in FY2011 and FY2012 but delayed by the legislature and repaid over the following three years.

For FY2015, gross severance tax receipts paid by oil and gas producers totaled \$584.4 million. After \$42.3 million in refunds, the industry paid \$542.1 million in net severance tax receipts.

In the decade between FY2006 and FY2015, the state's oil and gas producers made total gross severance tax payments before refunds of \$10.18 billion, or more than \$1 billion annually. Through incentives, state producers were refunded a total of \$1.21 billion. Net of refunds, Oklahoma oil and gas producers paid a total of \$8.98 billion in severance taxes over the past decade, or a \$898 million annually. Refunds averaged \$121 million annually, with the largest totaling \$298.9 million in FY2011.³⁵ Total refunds in the ten-year period averaged approximately 11.8% of gross severance taxes paid by the industry and represent about 0.8% of the \$154 billion in oil and gas produced in the decade.

Refunds have dropped sharply since FY2011 and are no longer a key factor influencing overall state severance tax revenue. Refunds declined from a peak of \$299 million in FY2011 to only \$42.3 million in FY2015. The new severance tax rules, which changed the tax rate on new wells and eliminated most refunded tax credits, do not allow a direct comparison of reduced tax rates to refunds going forward.

Figure 20. Oklahoma Severance Tax Revenue and Refunds
millions of dollars

Fiscal Year	Value of Oil and Gas Production	Gross Severance Tax Payments	Refunds Filed	Net Severance Tax Payments	Refund Share of Gross Receipts
2005	\$15,155.8	\$961.1	-\$97.2	\$863.9	10.1%
2006	14,728.3	1,263.1	-110.1	1,153.0	8.7%
2007	15,562.6	1,048.6	-60.6	988.0	5.8%
2008	20,739.9	1,333.4	-83.5	1,250.0	6.3%
2009	10,481.5	1,263.5	-104.9	1,158.6	8.3%
2010	13,675.2	985.2	-127.7	857.5	13.0%
2011	14,005.9	1,263.9	-298.9	964.9	23.7%
2012	13,120.4	1,078.8	-196.1	882.7	18.2%
2013	17,594.2	613.5	-100.0	513.6	16.3%
2014	20,531.5	747.1	-81.7	665.5	10.9%
2015	13,299.2	584.4	-42.3	542.1	7.2%

Notes: A total of \$297 million in severance tax refunds incurred in FY2011 and FY2012 were delayed by the legislature and eventually repaid in FY2013, FY2014, and FY2015. The refund amounts above are adjusted to place the refunds in the fiscal year in which the refund was filed and became an obligation to the state, not the year in which the refund was paid.
Source: Oklahoma Tax Commission and RegionTrack

What is the effective severance tax rate paid in Oklahoma and how does it compare to other producing states?

Comparing the relative severance tax burden across the energy-producing states is complicated by differences in the state tax regimes currently in place. The range of exemptions, deductions, credits, price-tiers, and marginal tax rates that ultimately determine the severance tax burden vary widely across the states.

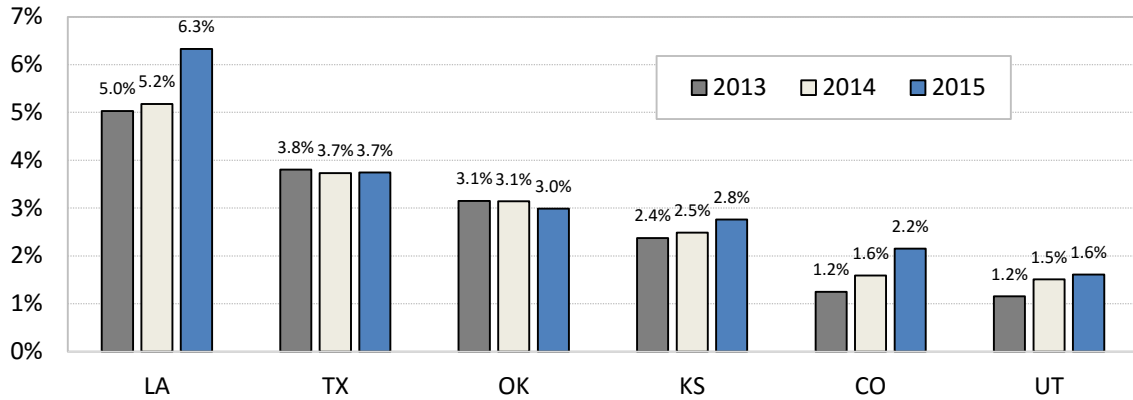
The most transparent overall measure of the severance tax burden in a state is the average severance tax rate paid across all oil and gas production. This provides a simple, comparative measure that abstracts away from approaches that isolate the tax treatment of certain well types and exemptions or focus on the role of rebates. The average severance tax rate is measured as the total amount of severance taxes paid by the industry as a percentage of the total value of oil and gas produced.

Figure 21 provides an estimate of the average severance tax rate paid by oil and gas producers in the three Oil Patch states of Oklahoma, Texas, and Louisiana as well as the competing energy states of Kansas, Colorado, and Utah. These six states provide a useful peer group because they are all relatively large producers of both crude oil and natural gas and have a history of oil and gas tax policy that stretches back several decades. Both taxes and the value of production are reported on a fiscal year basis to better match taxes with production and facilitate the comparison across the states. Any timing issues due to lags between the period in which production occurs and the period in which taxes are ultimately paid are smoothed out by calculating the rate over three successive fiscal years (FY2013 to FY2015). The three-year period used in the analysis also exhibits a wide price range for both crude oil and natural gas prices.

The results suggest that the average severance tax paid in Oklahoma ranks near the middle of the comparison group of producing states. Oklahoma producers paid approximately 3% of the value of oil and gas production to the state in severance taxes in the FY2013 to FY2015 period. The rate in Oklahoma is well below the 6.3% average rate in Louisiana and slightly below the 3.7% rate in Texas. Oklahoma's rate is also well above those in the lowest rate states, including 2.8% in Kansas, 2.2% in Colorado, and 1.6% in Utah.

For policymakers, Oklahoma's current severance tax structure places the state in the upper middle of a large group of peer states and slightly below the dominant producing state, Texas. Recent changes to the severance tax structure will likely raise the average severance tax rate paid beginning in FY2016.

Figure 21. Average Severance Tax Rate on Oil and Gas Production by State



Notes: The average tax rate is calculated as total severance taxes paid on oil and gas divided by the total value of production of oil and gas. Oil value is calculated using EIA estimates of volume and first purchase price. Gas value is calculated using EIA estimates of volume and historical ratios of state wellhead prices to Henry Hub spot prices. Severance tax and production data are stated on a fiscal year basis for each state. All states other than Texas (Sep 1 to August 31) have a fiscal year from July 1 to June 30.
 Source: U.S. EIA, OK Tax Commission, LA Department of Natural Resources, TexasTransparency.org, Colorado Department of Revenue, Utah Department of Revenue, Kansas Department of Revenue, and RegionTrack calculations

How are Oklahoma oil and gas severance tax revenues used?

Under current apportionment rules, severance taxes are first distributed to a range of dedicated funds, and the remaining balance is applied to the General Revenue Fund. The historical uses of severance tax revenue in the past ten fiscal years are detailed in Figure 22.

In FY2015, a total of \$542.1 million in oil and gas severance taxes was apportioned, with \$328.7 million going to dedicated uses and \$213.4 directed to the state’s General Revenue Fund. Historically, education is the largest single recipient of severance tax revenue. Education receives the majority of dedicated severance taxes and approximately half of all severance taxes contributed to the General Revenue Fund. Other dedicated uses include revenue returned to counties for local road development and a range of other smaller uses.

Education received a total of \$330.7 million in severance tax revenue in FY2015. Dedicated education-related uses include \$81.9 million to local school districts, \$47.4 million to the Common Education Technical Fund, \$47.4 million to the Higher Education Capital Fund, and \$47.4 million for the Oklahoma Student Aid Revolving Fund. Education also received approximately 50% of General Revenue Fund contributions, or an additional \$106.7 million in FY2015.

Other dedicated uses of severance tax revenue include \$81.9 million returned to counties for roads and \$22.8 million allocated across a range of other dedicated uses. An additional \$106.7 million was contributed to the General Revenue Fund for non-education appropriations.

Over the past ten fiscal years, apportioned severance tax contributions have totaled \$8.98 billion, or an average of \$898 million annually. Of this revenue, \$5.1 billion was added to the General Revenue Fund and \$3.9 billion was used for dedicated purposes. Education received a total of \$4.7 billion in severance tax revenue the past ten years, or an average of \$469 million annually.

Other dedicated uses over the past ten years include \$746 million returned to counties for roads and an additional \$1 billion for a range of other dedicated uses.

Figure 22. Distribution of Oklahoma Severance Taxes (FY2006 to FY2015)

Fiscal Year	Total Apportionment*	General Revenue Fund	Dedicated Uses						Total Education-Related Distributions*
			Returned to Counties for Roads	To School Districts	Common Education Technical Fund	Higher Education Capital Fund	Oklahoma Student Aid Revolving Fund	Other*	
2006	\$1,153,000,311	\$729,650,586	\$82,075,804	\$82,075,804	\$45,007,000	\$45,007,000	\$45,007,000	\$124,177,117	\$581,922,097
2007	987,972,285	639,515,862	69,727,349	69,727,349	45,007,000	45,007,000	45,007,000	73,980,725	524,506,280
2008	1,249,985,305	825,190,148	89,009,642	89,009,642	47,372,299	47,372,299	47,372,299	104,658,976	643,721,613
2009	1,158,639,145	727,272,067	80,108,185	80,108,185	47,372,299	47,372,299	47,372,299	129,033,811	585,861,116
2010	857,470,764	444,359,631	60,899,931	60,899,931	47,372,299	47,372,299	47,372,299	149,194,374	425,196,644
2011	964,935,884	509,858,904	68,749,447	68,749,447	47,372,299	47,372,299	47,372,299	175,461,189	465,795,796
2012	882,660,378	430,478,292	70,326,434	70,326,434	47,372,298	47,372,298	47,372,298	169,412,324	427,682,474
2013	513,576,262	221,610,957	62,542,178	62,542,178	47,372,298	47,372,298	47,372,298	24,764,055	315,464,551
2014	665,470,660	333,239,402	80,971,420	80,971,420	47,372,295	47,372,296	47,372,295	28,171,532	389,708,007
2015	542,074,273	213,359,735	81,878,193	81,878,193	47,372,290	47,372,290	47,372,290	22,841,281	330,674,931
10-year Total	\$8,975,785,266	\$5,074,535,584	\$746,288,583	\$746,288,583	\$468,992,377	\$468,992,378	\$468,992,377	\$1,001,695,384	\$4,690,533,507
10-year Average	897,578,527	507,453,558	74,628,858	74,628,858	46,899,238	46,899,238	46,899,238	100,169,538	469,053,351

Source: Historical issues of Apportionment of Statutory Revenues by the Oklahoma Tax Commission.

* Total apportionments in the FY2011 to FY2015 period are adjusted to reflect the timing of refunds as described in Figure 20. "Other" includes, but is not limited to: Community Water Infrastructure Development Revolving Fund, Conservation Commission Infrastructure Revolving Fund, County Bridge and Road Fund, OK Water Resources Board, Tourism & Recreation Capital Expenditure Revolving Fund, and the Statewide Circuit Engineering District Revolving Fund. Funds not included here received only a one-time payment from Severance Taxes. "Education-Related Distributions" include School Districts, Common Education Technical Fund, Higher Education Capital Fund, Oklahoma Student Aid Revolving Fund, and 50% of General Revenue Fund.

Oil and gas activity is the largest single source of tax funding for public services in Oklahoma

Tax revenue paid by the oil and gas industry extends well beyond the state severance tax. The Bureau of Economic Analysis (BEA) provides a broad measure of a range of business taxes paid on production and purchases by industry sector.³⁶ The BEA measure captures both state and local taxes (primarily non-personal property taxes, licenses, and sales and gross receipts taxes) and Federal taxes (excise taxes on goods and services) associated with the production of goods and services and any related imports.

In 2014, the mining sector in Oklahoma paid a reported \$3.0 billion in total taxes on production and purchases, the highest among all major sectors in the state (see Figure 23). **The mining industry's share is one-fourth (25%) of the total taxes paid across all industries within the state.** Taxes paid by the mining sector have also increased more than four-fold since 2000, roughly the date at which the sector's recent rebound began.

The two industry sectors with the next highest tax contributions are wholesale trade and retail trade, each paying approximately \$2 billion primarily in the form of (collected and forwarded) sales and use taxes. Real estate is the only other sector paying more than \$1 billion in taxes in 2014, primarily in the form of property taxes. The utilities sector paid \$475 million (4.0%) in taxes in 2014, while manufacturers paid \$408 million (3.4%).

Figure 23. Taxes on Production and Imports by Industry

Industry	Taxes (millions)				Share of Total Private Taxes			
	2000	2005	2010	2014	2000	2005	2010	2014
Private Industries	6,307	7,979	10,141	12,001	100.0%	100.0%	100.0%	100.0%
Mining	770	1,424	2,529	3,001	12.2%	17.8%	24.9%	25.0%
Wholesale trade	1,422	1,554	1,651	2,135	22.5%	19.5%	16.3%	17.8%
Retail trade	1,190	1,441	1,636	1,921	18.9%	18.1%	16.1%	16.0%
Real estate and rental and leasing	600	851	1,086	1,142	9.5%	10.7%	10.7%	9.5%
Finance and insurance	329	370	391	609	5.2%	4.6%	3.9%	5.1%
Accommodation and food services	240	320	404	515	3.8%	4.0%	4.0%	4.3%
Utilities	241	309	407	475	3.8%	3.9%	4.0%	4.0%
Manufacturing	279	296	384	408	4.4%	3.7%	3.8%	3.4%
Health care and social assistance	175	224	292	312	2.8%	2.8%	2.9%	2.6%
Information	393	397	323	280	6.2%	5.0%	3.2%	2.3%
Transportation and warehousing	145	170	200	222	2.3%	2.1%	2.0%	1.8%
Professional, scientific, & technical	108	138	162	197	1.7%	1.7%	1.6%	1.6%
Arts, entertainment, and recreation	58	57	140	176	0.9%	0.7%	1.4%	1.5%
Administrative & waste management	81	102	134	152	1.3%	1.3%	1.3%	1.3%
Agriculture, forestry, fishing, & hunting	91	103	124	139	1.4%	1.3%	1.2%	1.2%
Other services, except government	81	94	108	118	1.3%	1.2%	1.1%	1.0%
Management of companies & enterprises	45	56	82	101	0.7%	0.7%	0.8%	0.8%
Construction	37	46	54	59	0.6%	0.6%	0.5%	0.5%
Educational services	20	27	34	38	0.3%	0.3%	0.3%	0.3%

Notes: Taxes on production and imports (TOPI) consist of tax liabilities, such as general sales and property taxes, that are chargeable to business expense in the calculation of profit-type incomes. Also included are special assessments. TOPI is the sum of state and local taxes, primarily non-personal property taxes, licenses, and sales and gross receipts taxes, and Federal taxes, which is composed of excise taxes on goods and services.
Source: Bureau of Economic Analysis and RegionTrack

State budgets shortfalls since the recent collapse in oil prices have intensified debate over the question of whether the energy sector in Oklahoma is paying sufficient tax revenue according to its economic means. Answering this question first requires an estimate of the total tax payments made by the industry. Figure 24 provides a comprehensive estimate of direct taxes paid at the state and local level by oil and gas industry firms, proprietors, and employees in FY2015. Several steps are taken to provide a representative estimate of the direct tax contribution of the industry. FY2015 is a relatively current period in which industry profitability

was well off peak levels from prior years, especially FY2008. Energy prices were also well off recent peaks, particularly for crude oil (West Texas Intermediate crude oil averaged \$69.33 per barrel while Henry Hub natural gas averaged \$3.35 per mcf in the fiscal year). The estimates are also based on a narrow definition of the oil and gas industry that excludes oil and gas refining, pipeline activity, oil- and gas-related manufacturing, and construction related to oil and gas development. The estimate further excludes minor state tax payments made by the industry for motor vehicles and motor fuels. **Most importantly, the estimates do not attempt to account for any indirect or spillover effects on other industries.**

In fiscal year 2015, direct state and local tax payments by oil and gas firms and employees totaled an estimated \$2.55 billion. Tax payments to the state totaled \$2 billion, or 22% of the \$9.29 billion in total state tax revenue collected in FY2015. **By any measure of industry size, the mining sector is paying proportionately more taxes than any other major industry sector in the state.** In FY2015, the industry paid a 22% share of total state taxes yet accounted for only 7.4% of total state employment, 13% of state household earnings, and 17% of state gross domestic product.

Tax payments to local government totaled an additional \$463 million in FY2015. It is important to note that a portion of the revenue received by the state is automatically transferred to local government based on fixed apportionment rules described in a prior section.

State tax payments by the industry in FY2015 came from four primary sources: 1) severance and excise taxes and mineral payments on the production of oil and gas (\$665 million); 2) income tax payments by corporations, proprietors, and partnerships (\$658 million); 3) sales and use tax on industry purchases and sales (\$284 million) and 4) personal income and sales taxes paid by employees (\$397 million). Payments to local governments are largely through property, sales, and use taxes, as well as transfers from the state.

Figure 24. Oklahoma Oil and Gas Industry State & Local Taxes
FY2015, millions of dollars

<i>Severance tax:</i>	
Gross severance tax	\$584.4
Refunds	-42.3
Net severance tax	542.1
Energy resources revolving fund (voluntary)	16.6
Petroleum excise tax	14.3
Marginal well (voluntary)	1.0
State Land Office mineral revenue ³⁷	91.9
State sales and use tax – industry sales	91.1
State sales and use tax – industry purchases	187.3
Corporate income tax	159.1
Personal income tax - proprietors and partnerships	498.4
Personal income tax - employees	237.0
Sales tax - employee purchases	160.1
Total Direct State Tax Revenue	\$2,004.9
Property taxes	154.6
Local sales and use tax - all sources	308.4
Total Direct Local Tax Revenue	\$462.9
Total Direct State and Local Tax Revenue	\$2,554.6

Source: Oklahoma Tax Commission, IMPLAN, Oklahoma Land Office, and RegionTrack

How low would state tax revenue be without the oil and gas sector?

The high overall tax burden carried by the industry and its employees is well-known. Much of the added burden is in the form of severance taxes. There is no other tax stream paid by any other state industry that is comparable to oil and gas production taxes. The industry also pays a disproportionately high share of statewide corporate taxes, paying an estimated 22% in FY2015.³⁸ The share of total corporate taxes is likely much higher (approaching 50%) in years of peak oil and gas prices such as 2007 and 2008. Oil and gas proprietors earn nearly 40% of proprietor income statewide and bear much more than 40% of the state tax burden on these earnings given their relative high average earnings. Employees of oil and gas firms earn twice the average compensation of workers outside the energy sector and bear more than double the share of income tax burden given progressive personal income tax rates in the state.

Similarly, in evaluating whether to extend the High-Cost Gas exemption in Texas, the Select Committee on Economic Development of the Texas Legislature recently recommended that the exemption be continued.³⁹ They cited the already large tax burden carried by the industry.

“The sub-group heard testimony about the high-cost, gas tax incentive and the overall tax burden imposed on the oil and gas industry. The sub-group learned that the overall tax burden on the oil and gas industry is approximately five times greater than the overall tax burden imposed on the average business in Texas when considering all taxes levied. Even though the high-cost, gas tax incentive allows certain natural gas producers to pay less than the full natural gas severance tax, natural gas producers are still paying approximately four to five times more in taxes than the average business in Texas.”

Select Committee on Economic Development of the Texas Legislature on whether to extend the High-Cost Gas Exemption

Similar estimates for Oklahoma in the 2014 version of this report suggest that the nearly \$1.96 billion in direct tax payments made by the state’s oil and gas firms, owners, and employees in FY2012 equates to \$17,700 per worker and proprietor in the industry as compared to an average of \$3,986 across all industries. Much as in Texas, **Oklahoma’s oil and gas firms face a relative tax burden that is four to five times greater than the average business in the state on a per job basis.**

While the prior section of the report describes the *total* tax contribution of the oil and gas industry, this measure may not provide an adequate gauge of the *net* contribution of the industry to the state tax base. An alternative experiment for evaluating the net tax impact of the industry is to estimate the tax position of the state without the oil and gas sector. One approach to forming an answer to this question is to assume that the oil and gas sector is replaced by an industry that is representative of the remainder of the overall state economy. Employment and wages in the oil and gas industry, earnings by proprietors, sales tax payments, and other drivers of tax payments would equal the average of all other industries in the state. This would provide a useful estimate of the net value of the oil and gas industry to the state in terms of net tax collections.

The resulting calculations can be easily approximated. For example, \$665 million in state taxes reported in Figure 24 that are unique to the oil and gas industry would be eliminated. These include severance taxes, energy resources revolving fund, petroleum excise tax, marginal wells tax, and state mineral revenue. State sales taxes from the sales and purchase of taxable items would likely rise given that the oil and gas industry comprised 15% of state gross domestic product but produced only an estimated 11.7% of state sales taxes through sales and purchases in FY2015. This suggests that converting the oil and gas industry to the average of the remainder of the economy would produce an additional \$53 million in sales tax receipts from industry transactions. Estimates indicate that the oil and gas industry pays roughly twice as much corporate income tax per dollar of output as other industry sectors. This adjustment would reduce state corporate income tax receipts by \$80 million. Proprietor’s in the oil and gas sector earn roughly three times the income per

proprietor relative to other sectors of the economy. This adjustment would reduce income taxes paid by proprietors by \$333 million. Employees in the oil and gas industry earn slightly more than double the average income of the remaining sectors of the economy. Cutting personal income tax and sales tax receipts by 50% would reduce tax payments by an additional \$198 million. There would also be other negative spillover effects that would likely shrink the non-mining portion of the economy but are ignored for this exercise.

In short, if the oil and gas industry paid taxes at approximately the same rate as the remainder of the state economy, total state tax revenue in FY2015 would decline by an estimated \$1.2 billion. This represents 12.8% of the \$9.29 billion in total tax revenue received by the state in FY2015. While errors are possible in any of the component calculations, the overall estimated change in tax revenue is believed to represent a useful view of the comparatively high tax contributions of the industry. **In other words, primarily due to taxes unique to the oil and gas industry, high wages among proprietors and employees, and high corporate tax payments, the oil and gas industry pays more than \$1 billion annually in additional state taxes than it otherwise would if it were simply an average tax-paying industry.**

Nearby states offer significant incentives

Because of the broad range of economic benefits beyond severance taxes that are generated by oil and gas activity, Oklahoma faces tremendous incentive-based competition from other energy-producing states. Nearly all oil- and gas-producing states offer incentives designed to encourage production from a range of well types. Most commonly these include economically marginal wells, wells in need of stimulation, and low-output wells.

However, a number of states also offer exemptions from severance taxes for drilling modern unconventional wells, primarily horizontal wells and wells in tight formations. The two largest and most significant exemptions are offered by Texas and Louisiana, Oklahoma's nearest neighbors and strongest competitors for both drilling activity and white-collar oil and gas employment.

1. Texas: High-Cost Gas Exemption.⁴⁰ Texas offers a total exemption from the basic 7.5% severance tax for up to 50% of drilling and completion costs for a ten-year period for qualifying gas wells. Gas is classified as high-cost if produced from tight formations such as tight sands and shale utilizing fracking techniques. The Texas Comptroller reports that gas wells receiving the exemption the past decade were taxed at an average rate of 1.5%. The exemption covered more than half of the natural gas production in Texas between FY2005 and FY2014 and nearly two-thirds of gas production in the peak years of FY2011 and FY2012. The share has since fallen back to just below 50% of gas production. Total exemptions to producers reached \$11.5 billion between FY2005 and FY2014, or \$1.15 billion annually. The high-cost gas incentive reached a peak value of \$2.0 billion in FY2008.
2. Louisiana: Horizontal Wells Exemption. Louisiana fully exempts producers from severance taxes on both oil and gas wells drilled using horizontal techniques for two years or until well payback for all wells drilled before July 1, 2015. Exemptions to producers totaled \$239 million in FY2010, \$236 million in FY2011, \$272 million in FY2012, \$235 million in FY2013, and \$166 million in FY2014.⁴¹ For horizontal wells drilled after July 1, 2015, the severance tax exemption remains in place for oil wells when the price of oil is \$70 per barrel or less and for natural gas when the price is \$4.50 per million Btu or less. Oil and gas prices above these thresholds result in a phase out of the exemption in five 20% increments, with no exemption for oil prices above \$110 per barrel and natural gas prices above \$7 per million Btu.⁴²

Significant incentives are also being offered by third-tier and emerging energy states that are eager to secure a stronger foothold in future unconventional oil and gas production. Examples include:

3. Arkansas: High-Cost and Newly Discovered Natural Gas. Arkansas offers a severance tax rate of 1.5% for 24 months for new natural gas discoveries and 36 months for high-cost gas.
4. Mississippi: Horizontal Wells. Mississippi assesses a severance tax rate of 1.3% for 30 months or until payout of well costs for all horizontal drilling in the Tuscaloosa Marine Shale, an emerging liquid-rich play.
5. Pennsylvania: Natural Gas. Pennsylvania has long assessed no severances taxes on production from unconventional natural gas wells, making them subject only to an ongoing annual impact fee based on the age of the well and price of natural gas. Producers paid an average impact fee of only \$27,000 per unconventional well in 2015, or a total of \$187.7 million across 6,949 eligible wells.⁴³

What happens if the state raises severance taxes?

Proponents of higher tax rates also suggest that severance taxes can be raised and incentives reduced or eliminated with few economic consequences. Frequently cited is a 2000 paper by Gerking and others⁴⁴ examining severance taxes in Wyoming as evidence that oil and gas production is highly insensitive to tax rates. In one scenario, production rises by only 1.7% in the long-run in response to a 4% reduction in the severance tax rate. The conclusion of the research is that lowering severance tax rates produces only a small positive impact on future drilling and production activity and overall state economic activity, while having a large negative impact on future tax revenue.

This isn't the full story though. The model developed in the paper is quite useful in that it provides a framework for making simulation-based estimates of future drilling activity and production in response to changes in severance tax rates. However, it is greatly limited in an important way in evaluating the impact of incentives in the current environment of rapidly expanding supply. The simulations in the paper are structured for a world of declining production and based on fixed relationships concerning production, reserves, and drilling intensity. In short, a low response of production and drilling to tax rate changes is estimated and then imposed on the model. This was perfectly consistent with historical data available at the time through 1997. As described in the paper:

“A key question regarding these simulation results is: Why is the response of oil and gas output so small when production taxes are changed or tax incentives are applied?”

Four reasons are noted: 1) production taxes only indirectly stimulate drilling, which is what drives future production; 2) added federal tax liability may offset some of the gain in certain states; 3) incentives are only designed to work at the margin as they increase the producer's cost only by an estimated \$0.40 per barrel at a \$25 wellhead price; and 4)

“... most importantly, production of (as contrasted with exploration for) oil and gas is driven mainly by reserves, not by prices, production tax rates, or production tax incentives. This is a basic fact of geology and petroleum engineering and is easily illustrated by Wyoming's own history of oil production..... Thus, even comparatively large price increases or tax reductions are not expected to call forth much additional output.”

In recent years we have seen that energy price increases *can* call forth large changes in both drilling activity and production when a technology or geology driven supply shift takes place. Oklahoma production has done just that in recent periods of elevated prices (most of the period from 2007 to the present for crude oil and most of 2001 to 2008 for natural gas). The study further treats well types and well costs as uniform over time and cannot differentiate between the production potential and cost-differential of older conventional wells versus modern horizontally drilled wells and deep wells. The current world of drilling, production, and reserves bears little resemblance to the parameters estimated in the model when the study was prepared.

In the short-run, production changes driven by changes in tax incentives are always likely to be modest. However, only going forward will we be able to form better estimates of the long-run response of oil and gas production to incentives. Although existing research suggests that incentives will produce only marginal changes in future drilling and production activity above what would have taken place otherwise, prior estimates are highly likely to understate the potential effect in the current environment. Oklahoma, for example, has witnessed a rather large rebound in oil and gas production the past few years that was accompanied by strong growth in tax incentives. We do not know precisely how much of the new drilling and production activity in the state is directly due to enhanced incentives, but a marginal portion of it almost certainly is.

In short, the concern remains that prior studies were conducted in an era when almost nothing influenced production. Not higher prices for oil and gas, lower drilling costs, cheaper labor costs, or the presence of financial incentives. Production in the short-run was dominated by geology, with supply essentially capped and declining at a relatively steady rate, particularly for oil. But the biggest problem may be that focusing on production alone ignores a range of other possible effects triggered by higher severance taxes.

Possible effects of higher taxes extend well beyond drilling and production

The economic reality is that, in exchange for the incremental severance tax revenue raised, policymakers can expect to trigger a series of incremental negative economic outcomes within the industry and state economy, many of which may be unintended. In Oklahoma, most of the effects of higher severance taxes will be borne almost entirely by producers, royalty owners, and refiners in the state. A portion of the increased tax will also be borne by employees, suppliers, and offsetting losses of state tax revenue.

The range of potential effects from raising severance taxes include:

1. [Marginal reduction in current production from existing wells.](#) There will be a small decline in short-run production from existing wells. Economists generally agree that any tax-induced production declines will likely be small for all but the largest increases in tax rates. This is because current production from existing wells is driven largely by geology and reserves. Tax incentives are only able to slightly push activity higher or lower at the margin in the short-run. Production is most likely to fall for existing wells near shut-in⁴⁵ or with discretionary production.
2. [Well investment effects and a marginal reduction in future production.](#) It is the long-run effect on production that matters most and is the least predictable. A severance tax-hike adds additional costs onto the burden of cash flows from existing and prospective wells. The primary channel through which higher severance taxes work is a reduction or delay in new investment in wells. **A comprehensive Rand study⁴⁶ examining the mechanics linking higher severance taxes to oil production in California illustrates the inevitable result that some investment activity will not take place as severance taxes rise.** From a capital budgeting perspective, some of the lowest graded drilling options in Oklahoma will be delayed, downsized, or bypassed. This is commonly referred to as ‘high-grading’ in the natural resources literature.⁴⁷
3. [Reduced royalty income.](#) One of the biggest losers under a severance tax increase is the group of Oklahoma land and mineral rights owners receiving oil and gas royalties who have typical “net” leases with oil and gas operators. Their royalty payments are calculated only after severance taxes and other expenses are paid. **Increased severance taxes result in a direct reduction in the income of royalty owners in Oklahoma, which subsequently reduces state taxable income and income tax payments and sales tax collections.**

4. Cost pass-through downstream. Along with sharing the cost of higher severance taxes with royalty owners, another option for oil and gas producers is to pass some of the cost increase downstream to refiners. In general, however, the more integrated the market for crude available to state refiners, the less able state producers will be to pass any cost increase to them. Given the role of Cushing as the primary transshipment point for West Texas Intermediate crude, state refiners are likely to have little difficulty in finding alternative sources of crude. Hence, state producers will have limited pricing power with refiners and any cost pass-through that may occur would be modest. What can't be passed on is borne by producers.
5. Profitability and corporate income effects. Severance tax increases result in a direct cost increase and profit reduction for oil and gas operators and investors. This produces an incremental reduction in state corporate and non-corporate earnings for those producers based in the state, which then reduces corporate tax payments and personal tax payments by proprietors and partnerships. Some of this effect is reduced by producers based outside Oklahoma.
6. Employment and personal income effects. **Reduced profitability of state oil and gas firms will incrementally reduce in-state employment and income earned by wage and salary workers.** This subsequently reduces personal income tax and sales tax payments to the state.
7. Property value effects. The value of land and mineral rights related to oil and gas production are determined in part by the value of current and future lease and royalty payments generated. Higher severance taxes work through this channel to reduce the market value of oil- and gas- producing real estate in the state. This is particularly true in the rural and agricultural counties of the state. A recent working paper⁴⁸ from the Federal Reserve Bank of Kansas City estimates that payments related to energy development added about \$104,000 to the net worth of farm households in the region receiving payments in recent years. Three-quarters of the estimated effect is through increased property values. Higher severance taxes will work to reduce these wealth effects.
8. Shut-in effects. Higher severance taxes directly increase the operating cost of a well and increase the likelihood of a financial decision to shut-in a well. This will incrementally reduce the life of all existing wells subject to the tax increase. **Accelerated well shut-ins have long-run implications for the severance tax stream, income taxes paid on income received by well participants, and royalty payments.**
9. Small-firm effects. The increased capital-intensive nature of drilling makes incentives more valuable to small firms. Those with intentions to drill only a single well or a small number of wells are impacted disproportionately by increased severance taxes relative to large firms with a diversified drilling base. The risk undertaken by small producers drilling a single well at a cost of \$4 to \$8 million remains substantial. In addition, Oklahoma's oil and gas industry is still heavily represented by small firms, with 75% of firms having fewer than 10 employees and 97% having fewer than 100 employees. Oil and gas firms with fewer than 100 employees currently employ 50% of all oil and gas workers in the state.⁴⁹

These effects extend well beyond just a pullback in short-run production, but there are yet other potential economic concerns with increasing severance taxes.

1. Unexpected and seemingly erratic changes to state tax policy toward the oil and gas industry may have a persistent destabilizing effect. Having a stable tax backdrop in place when making investment decisions greatly aids the long-run planning process faced by private oil and gas firms. The expected lifetime of a well remains decades, despite recent acceleration in the production profile of modern horizontal wells.

2. A tax rate change will alter any competitiveness effects in place relative to other competing states. Texas, Louisiana, and Pennsylvania continue to offer large incentives for production from unconventional wells. Higher severance tax rates will also send an important signal to industry participants about the state's broader stance toward the oil and gas industry.
3. Some deadweight loss in the private sector results from added taxation. This is the economic loss to society of forgone production in the private sector as a result of levying a tax to pay for public services. These costs can potentially be quite large and are recognized by economists as a significant factor in determining overall state growth, vitality, and competitiveness, as well as the long-run growth path of the state economy. Estimates in the economics literature suggest a deadweight loss from severance taxes of 4% to 6% of the tax revenue raised.⁵⁰
4. Only a share of any severance tax increase will be exported outside the state. It is often suggested that severance taxes are simply exported out of state along with the minerals and that the tax is ultimately borne by non-Oklahomans. Even with the recent rebound in the state's export position, only one-third of state crude production and three-fourths of state natural gas production is exported outside the state.⁵¹ By market value, \$7.1 billion of the \$13.3 billion (53%) in oil and gas produced in Oklahoma in 2015 was exported outside the region. The remaining \$6.2 billion (47%) was used within the state. **This suggests that almost half of the costs from higher severance taxes that are passed-through to the end-user will ultimately be paid by Oklahomans.**
5. There may also be unintended effects on state philanthropy. Oil and gas producers are well-known to be among the most important state benefactors in years past and present. It is reasonable to expect that some of the marginal dollars forfeited by the industry in higher severance taxes may in fact be the same dollars otherwise used to make financial donations that can carry extremely high social value.

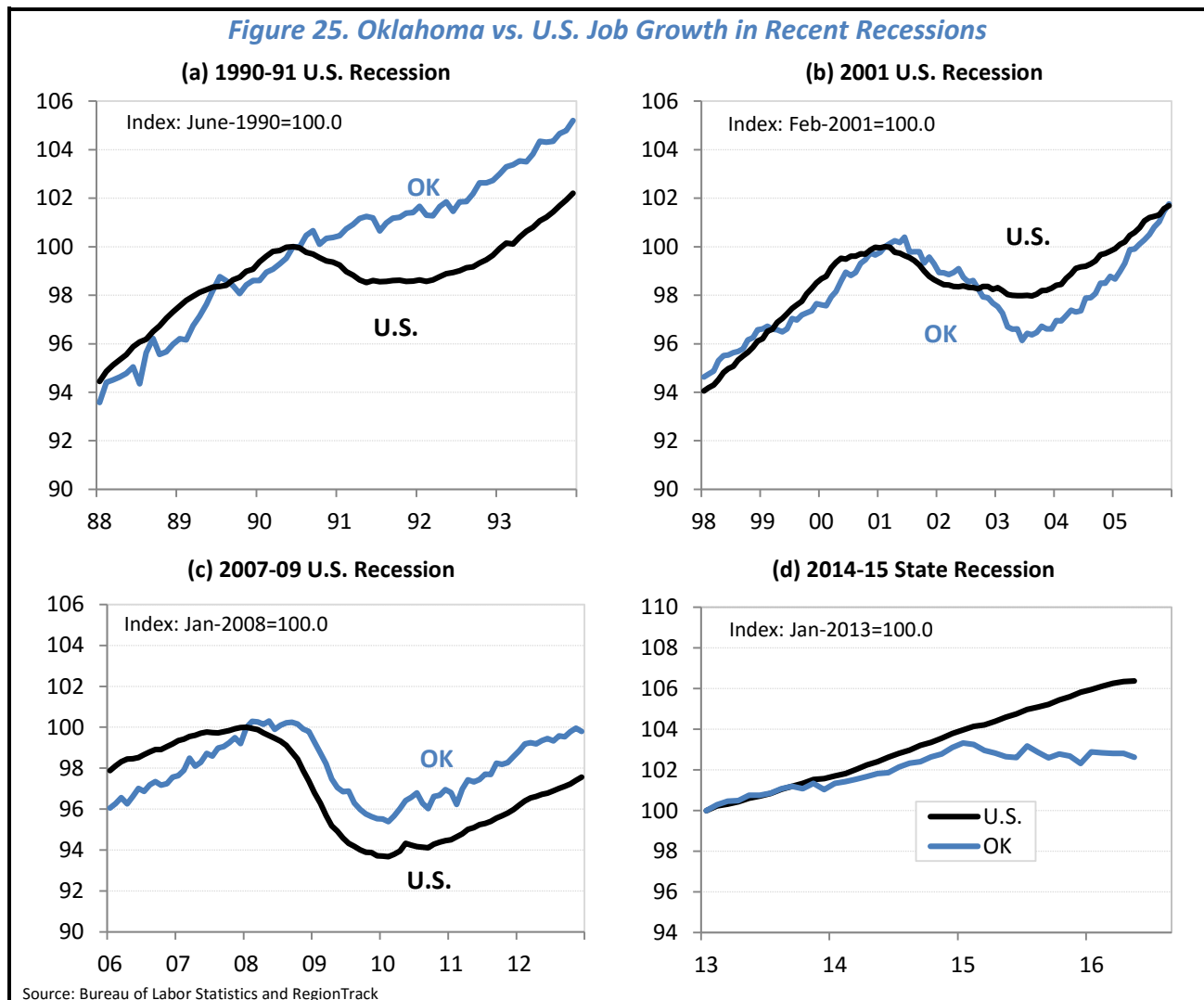
It is important to note that none of the potential individual effects from higher severance taxes in any single year represent more than an incremental reduction in activity in the oil and gas sector. **It is only when viewed jointly and across several years that the cumulative effect of tax policy that leans against economic activity in the state's most dynamic industry sector begins to add up.** This is precisely the economic rationale for providing the industry with a range of incentives that are seemingly unimportant individually or in any single year, but that when viewed jointly and over a period of many years add up to much desired incremental economic activity in the industry and in the state.

VII. To what degree is the state economy tied to the health of the oil and gas industry?

Tax policy must reflect the unique economic cycle of the state's trademark industry

The current high share of total state earnings derived from the oil and gas sector suggests that the Oklahoma economy will likely remain closely tied to economic activity in the energy sector for many years. Most of the top energy-producing states are currently experiencing severe economic drag from the recent collapse in oil prices while the non-energy states continue to add jobs at a rapid pace.

Figure 25 illustrates state job growth relative to the nation during the past four economic slowdowns in Oklahoma. The slowdowns illustrate the marked tendency of the state to move countercyclical to the nation as energy prices fluctuate. In the 1990-91 period (see panel (a)), the Oklahoma economy essentially ignored the national recession while sustaining only a modest slowing of employment during the depths of the recession. The state benefitted from a spike in crude oil prices above \$30 per barrel prior to the recession, the first sustained upward move in oil prices since bottoming around \$12 per barrel in 1986. The U.S. economy suffered a job loss of 1.7% during the recession and was very slow to recover. Oklahoma increased its job base by 3.5% by the time the nation managed to return to its pre-recession peak two years later.



The countercyclical nature of the Oklahoma economy is traced to the fact that every national recession in the Post-War period has been accompanied by rapid increases in energy prices. High energy prices typically provide the state with added stimulus entering a recession, which is then reversed as energy prices slow along with economic activity. Once the recession ends, the direction and pace of energy prices dictates the path of the state economy in the recovery. This basic economic cycle has characterized Oklahoma and the other top-tier energy states for decades and continues to do so.

The 2001 recession in Oklahoma also had a unique pattern driven in large part by oil and gas activity (see panel (b)). Both crude oil and natural gas prices increased sharply prior to the recession and were fueling strong job growth in Oklahoma. The U.S. economy, propelled by Y2K concerns and the growing Tech Bubble, was expanding at such a rapid pace prior to the recession that energy-fueled Oklahoma only managed to match the pace of U.S. job formation. As the recession progressed, oil and natural gas prices collapsed much more quickly than anticipated and created a deeper, but slightly shorter, recession in Oklahoma. The cumulative state job decline was twice as large as the nation, however both oil and gas prices started upward again in late 2002 as the state promptly started a much more rapid job recovery than the nation. This is also the point at which the current expansionary cycle in oil and gas began.

The 2007-09 national recession revealed a more typical recession pattern for a top-tier energy-producing state (see panel (c)). The Oklahoma economy, boosted by high energy prices, was creating jobs much more quickly than the nation heading into the recession. The state avoided the recession for several months after job losses took hold at the national level. **The state lost a total of 80,000 jobs in the recession, but the cumulative job loss was nearly 2% smaller than the nation's. An additional 30,000 jobs would have been lost had the state job loss matched the national decline.** The rebound in Oklahoma then resumed at a more rapid pace relative to the non-energy states as crude oil prices surged once again.

Oklahoma has been in a moderate state-level recession since early 2015 following the collapse in oil prices beginning in late 2014 (see panel (d)). The unique behavior of the state economy again contrasts sharply with the strong, steady job growth present at the national level in this cycle. The U.S. economy has been adding jobs at a roughly 1.8% annual pace since January 2015, while state employment has declined slowly in the period. This is a clear reflection of the continued linkage between the oil and gas industry and the broader state economy. **A pullback in the oil and gas industry is still capable of producing a recession at the state level, despite a backdrop of strong national hiring conditions.**

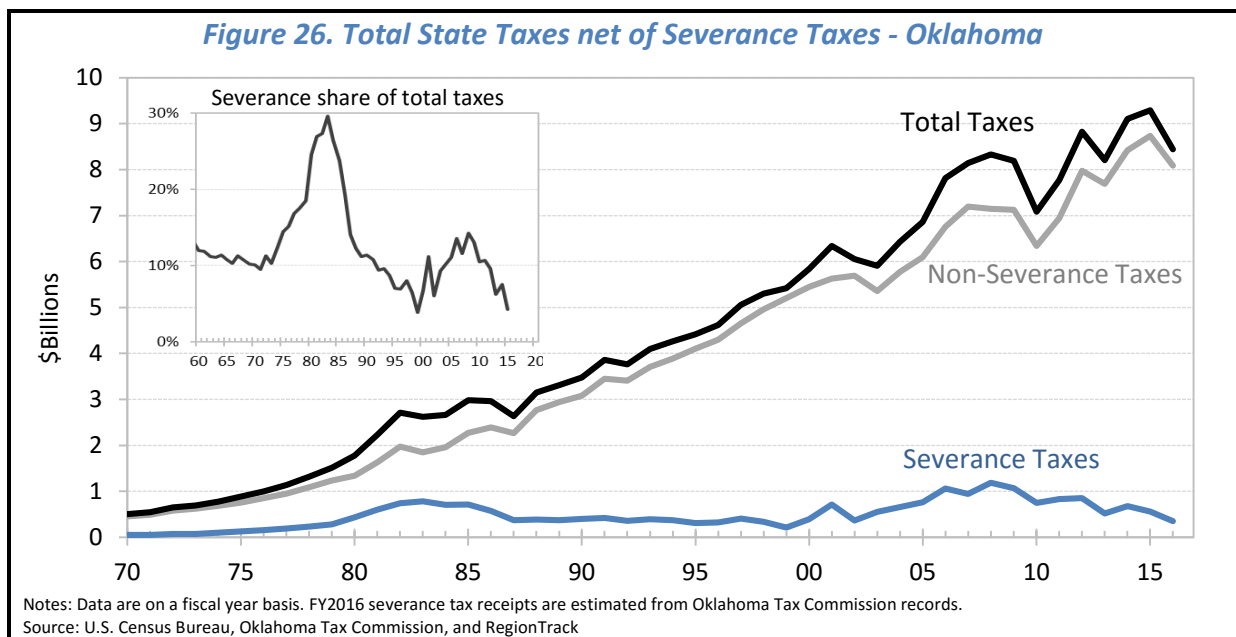
Severance taxes play a key role in budget stabilization

It is also important to recognize the critical historical role played by severance taxes as a buffer against recessions and the state's unique economic cycle. Most recessions are accompanied by rising energy prices which tends to raise severance taxes to the state and increase the share of the budget supported by oil and gas production. This countercyclical budget support is especially evident in the 1973-75, 1980-83, 2001, and 2007-09 periods. Similar but smaller budget support is found in earlier recessions in 1954 and 1957. Recent volatility in oil and gas prices and continued production gains suggest that severance taxes are likely to continue to transmit volatility to state tax collections going forward.

Figure 26 illustrates the composition of total state taxes in Oklahoma by separating the total into severance taxes and all other taxes. The share of total taxes derived from severance taxes has fallen from a peak of 14.2% in FY2009 to 4.2% in FY2015 as oil prices have fallen and the total tax base has increased significantly. The data in Figure 26 suggest several things about the ongoing link between severance taxes and total state tax revenue:

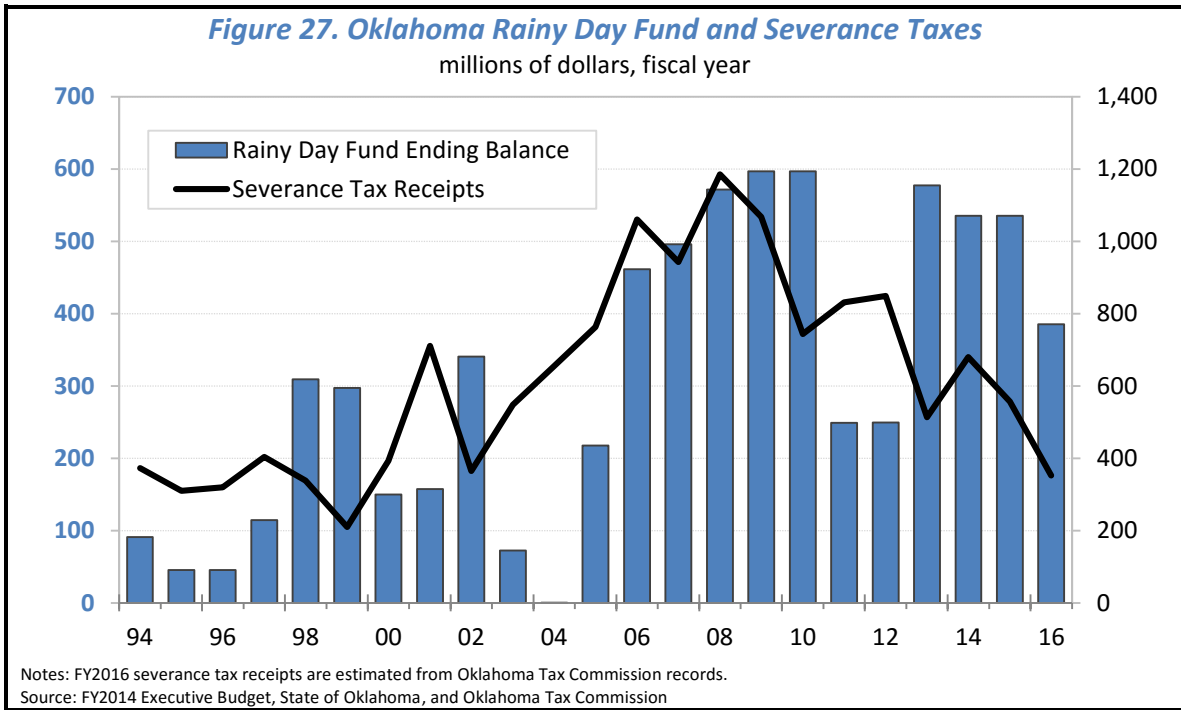
1. Severance tax receipts have become more volatile since 2000, reflecting large swings in crude oil and natural gas prices in the period.

2. Total state tax revenue has become more volatile since 2000. This is traced in large part to increased volatility in severance tax revenue.
3. Severance taxes are becoming an increasingly minor share of total state tax receipts. This is due to both lower severance tax payments in recent years, and continued strong growth in tax receipts other than severance taxes. Even at the recent peak of severance tax collections of \$1.2 billion in FY2008, severance taxes comprised only 14.2% of total tax collections. This represents less than half the 30% share realized in FY1983.
4. Volatility in non-severance taxes mirrors the volatility in severance taxes which reflects the overall sensitivity of the state economy to activity in the oil and gas sector.
5. **Despite increased volatility and severance tax rebates to the oil and gas industry, both total taxes and taxes from sources other than severance taxes remain in a steady long-run uptrend.** In the FY2011 to FY2015 period following the recent national recession, tax receipts other than severance taxes increased by an average of 6.2% annually while total receipts increased 5.8% annually. Declining severance tax revenue pulled down total tax revenue growth by only 0.4% annually. Total annual state taxes collected increased by more than \$1.5 billion (34% increase) in the period, from \$6.95 billion to \$8.49 billion.



Severance tax revenue plays an added role in budget stabilization through the state’s Rainy Day Fund.⁵² Historically, deposits to the Fund are highly correlated with years when severance tax receipts exceed budget projections. **No other industry in the state is capable of generating enough unanticipated tax revenue to influence the overall state budget.**

Figure 27 compares the Rainy Day Fund balance with severance receipts in the FY1994 to FY2016 period. Even after refunds, severance taxes made a major contribution to stabilizing the state budget in this period. Extremely large severance tax payments in FY2001 and from FY2005 to FY2009 underwrote much of the contribution to the Rainy Day Fund in the periods. **Appropriations from the Rainy Day Fund during the past two recessions played a key role in softening the effect of the recessions on state spending.**



Severance tax revenue has consistently provided ample revenue to fund dedicated spending and General Revenue Fund contributions, as well as support significant ongoing balances in the Rainy Day Fund. The balance of approximately \$385 million in FY2016 will likely play a key role in the budgetary actions taken in the current state economic slowdown.

VIII. What are the broader benefits of oil and gas activity that enhance the overall quality of life & economic wellbeing across Oklahoma?

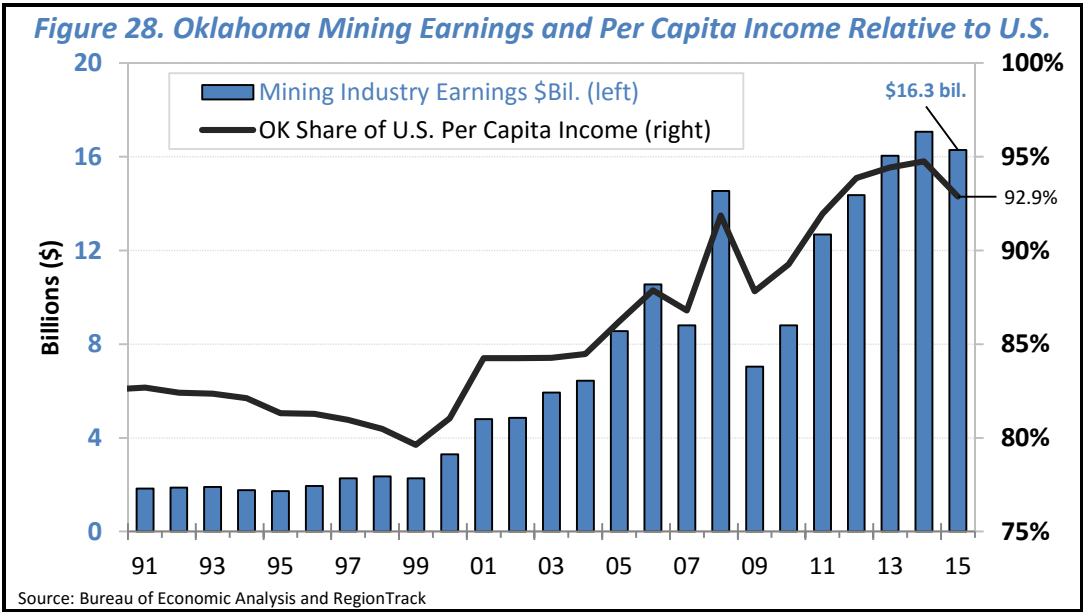
The transformative effects the revitalized oil and gas industry is having on the state economy are clearly visible in recent economic data. The added employment, income, and output generated within the sector are producing significant long-run economic spillover benefits to nearly every sector of the state economy. Translating these economic gains into greater quality of life and economic wellbeing is commonly done using well known measures such as relative income levels, quality of jobs being created, and the potential to increase the long-run economic growth rate of the state. For others, important economic outcomes include a narrowing of the income gap relative to the nation, added population growth and migration into the state, and high-wage job growth in rural counties.

Strong state income gains relative to the nation

One of the most noteworthy economic success stories in Oklahoma in recent years is the progress made in closing the state’s long-standing gap in per capita personal income relative to the nation. State income bottomed at 79% of the U.S. level in 1999 after fluctuating between 80% and 85% of the national average throughout the 1990s. Income growth then surged beginning in 2000 as the U.S. economy entered recession and Oklahoma entered the early stages of the ongoing boom in natural gas development.

Following more than a decade of oil and gas-fueled growth, state per capita income rose steadily to a recent high of 95% of the national average in 2014 (see Figure 28). The turnaround is traced primarily to remarkable earnings growth in the state’s oil and gas industry. Total earnings in the sector surged from only about \$2 billion in 2000 to \$16.3 billion in 2015 and is the largest single factor underlying the gain relative to the nation.

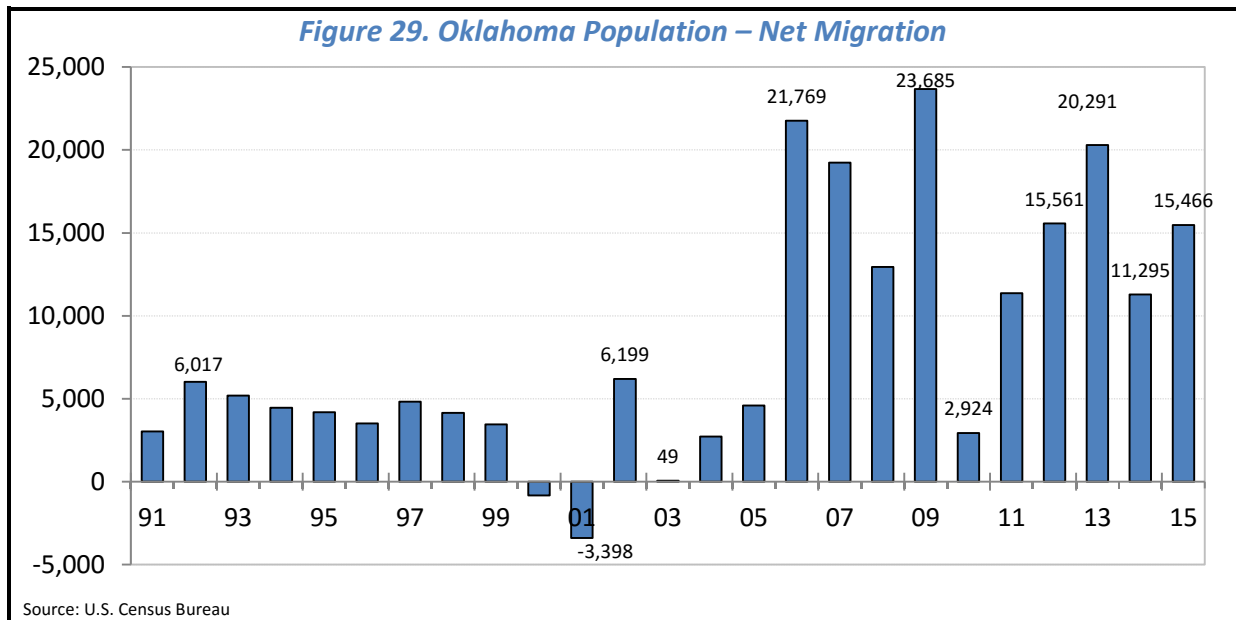
In 2015, per capita income in Oklahoma dropped slightly to 93% of the U.S. average but remains one of the highest shares enjoyed by the state other than at the height of the Oil Boom in the early 1980s when the state approached parity with the nation.



Increased population growth and migration into Oklahoma

The impact of the oil and gas industry is also clearly visible in the sharp acceleration in migration of new residents into the state in recent years (see Figure 29). Migration surged beginning in 2006 as the state unemployment rate began to bottom around 4% and the oil and gas industry continued to expand hiring at a rapid pace.

Migration averaged nearly 20,000 persons per year between 2006 and 2009 as state population growth surged above 1% annually for the first time since the early 1980s. The demand for workers in oil and gas and related industries underlies the bulk of these population gains.



In-migration subsequently slowed in 2010 following both the national recession and extreme weakness in the oil and gas industry in 2009. This was consistent with the overall pattern of migration nationally in the period. Migration into the state quickly bounced back to more than 15,000 persons in 2012 as hiring in the oil and gas industry accelerated once again. The state has added an average of 15,650 net new residents annually since 2012. Even during the collapse in oil prices throughout much of 2015, the state still added an estimated 15,500 new residents.

Growing oil and gas supply is containing energy costs for Oklahoma consumers and firms

Prior to the recent surge in oil and gas production, U.S. energy consumers were facing all-time high prices for petroleum-based products and natural gas. EIA forecasts continued to suggest that energy prices would likely climb even higher going forward. Instead, high prices provided a strong incentive to the domestic energy industry to find new oil and gas reserves, and the resulting surge in production is history.

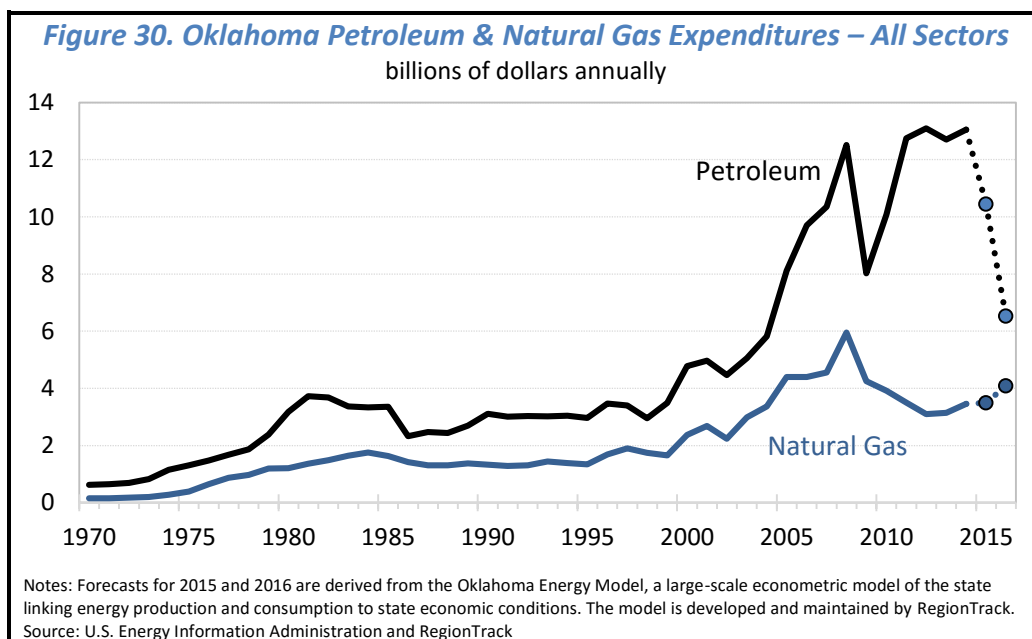
The tremendous increase in domestic crude oil and natural gas output that followed has now put sharp downward pressure on market prices for both fuels. Possibly the greatest benefit to the state of the resurgence in oil and gas activity in recent years is the reduced cost of energy. While this is now working against the state's energy firms, it is providing significant cost savings to state households and firms.

Figure 30 details total expenditures on petroleum products and natural gas in Oklahoma annually since 1970. On the natural gas side, expenditures doubled between 2001 and 2008 to \$6 billion annually as natural gas

prices appeared to be on a steadily rising trend. Rising U.S. natural gas production finally tipped the price balance in 2009 and started a sustained drop in both natural gas prices and expenditures in the state. The volume of natural gas consumption in the state peaked in 2008 and has since declined by about 8%. However, total state expenditures on natural gas have dropped by nearly half to the \$3.0 to \$3.5 billion range in the 2012 to 2014 period. Model-based estimates suggest that natural gas expenditures will rebound to about \$4 billion annually in 2015 and 2016 driven by a rebound in natural gas prices.

Estimates of the gross cost savings to state natural gas consumers from the pullback in natural gas prices since 2009 can be formed. For example, had natural gas prices leveled off in the range seen in the 2006 to 2008 period and stayed there through 2015, state natural gas expenditures would have been roughly \$10.1 billion higher on a cumulative basis between 2009 and 2015. In other words, the supply-induced drop in the price of natural gas saved state purchasers nearly \$1.5 billion annually since 2009. In contrast, EIA forecasts at the time suggested flat natural gas expenditures going forward at the national level.

Natural gas savings will accrue largely to industrial, commercial, and residential users. Assuming the estimated \$1.5 billion in annual natural gas savings are allocated relative to usage, savings would total \$811 million annually for industrial users, \$245 million for commercial users, and \$440 million for residential users. Total residential savings on natural gas represent an average of \$260 per year for each of the 1.7 million housing units in the state.



The same historical pattern of a run-up in price that drives added production is present on the oil side. Oil prices crossed \$50 per barrel for the first time in late 2004. Prices then moved upward to an average of \$81 per barrel over a ten-year period between late 2004 and late 2014. Petroleum expenditures in Oklahoma more than doubled from \$5.8 billion in 2004 to more than \$13 billion in 2014.

Elevated oil prices ultimately led to a remarkable increase in domestic drilling activity that began to push up domestic production in 2010 and eventually halt a 40-year decline in U.S. oil production. Much as it did on the natural gas side, the rebound in U.S. oil production eventually led to a collapse in oil prices in late 2014. State consumers are now enjoying similar cost savings on petroleum products. Oil prices dropped from more than \$100 per barrel in late 2014 to below \$30 in early 2016. Prices have since moved up to the \$40 to \$50 range, roughly half the level prior to the collapse. Estimates in Figure 30 suggest that petroleum expenditures in Oklahoma fell to \$10.4 billion in 2015 and will fall further to only \$6.5 billion in 2016.

The savings on petroleum products realized by state consumers in coming years could potentially far exceed the savings on natural gas. Between 2008 and 2014, state petroleum expenditures averaged \$11.7 billion annually. In 2015 and 2016 alone, state petroleum expenditures are estimated to be a cumulative \$6.5 billion lower than the average expenditures realized from 2008 to 2014. This suggests an annual savings of \$3.25 billion annually for state consumers in 2015 and 2016. Again, EIA forecasts from 2010 suggested continued elevated crude oil prices and little relief in total expenditures on petroleum products.

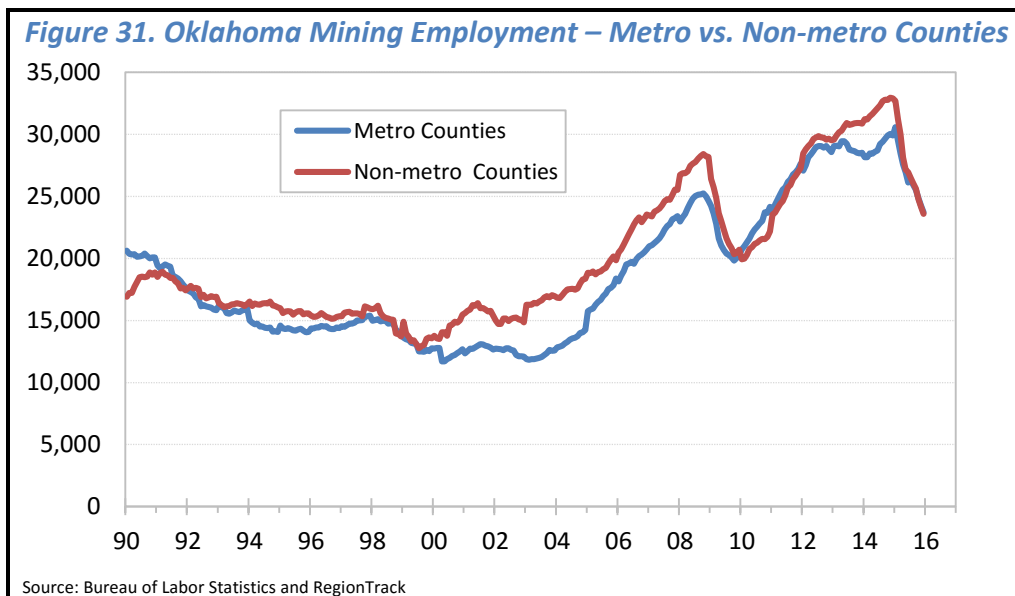
Petroleum savings will accrue primarily to transportation and industrial users. Assuming the estimated \$3.25 billion in annual petroleum savings are allocated relative to usage, savings would total \$2.8 billion for transportation users and \$335 million for industrial users in the state in both 2015 and 2016. For transportation users, the savings is equivalent to 5.9 cents for each of the 47.7 billion vehicle miles traveled in Oklahoma in 2014.⁵³ Based on an average driver who logs almost 13,500 miles per year, the savings on petroleum is an estimated \$790 per year.⁵⁴

Oil and gas activity is driving rural and state development

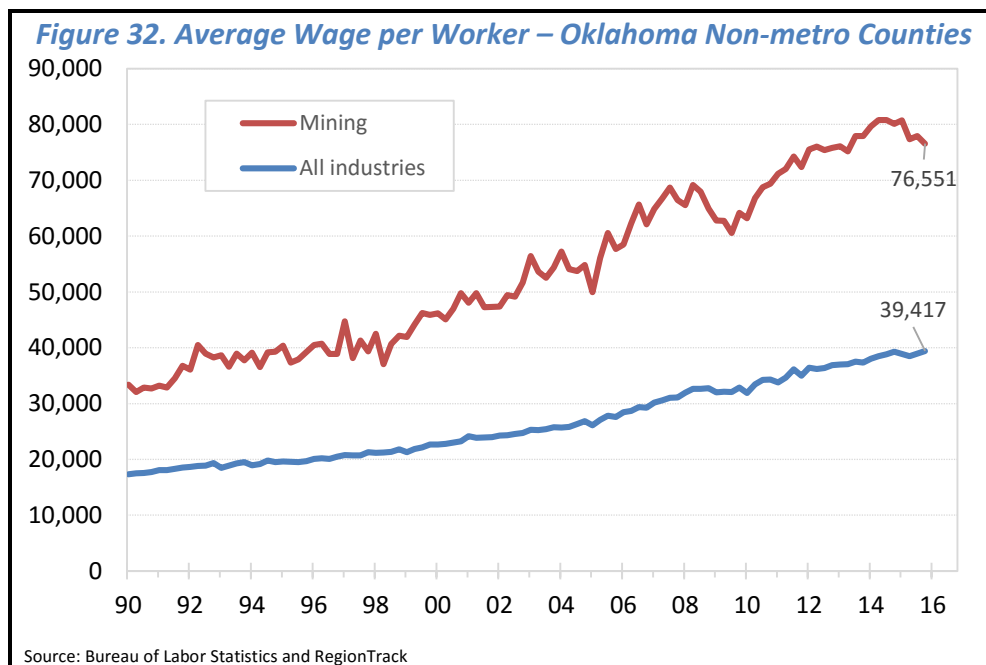
Rural development, particularly the creation and attraction of high-wage jobs in smaller communities, remains one of the toughest economic challenges faced in the U.S. One of the key aspects of the oil and gas industry from an economic development viewpoint is the large presence of the industry in the non-metropolitan counties of the state. **Roughly half of all mining wage and salary jobs in Oklahoma are located in non-metro counties** (see Figure 31). This roughly equal split between the metro and non-metro counties has been the case for decades.

New jobs created since the recent bottom in mining employment in 1999 have also been split roughly equally between metro and non-metro counties. Of the state’s nearly 27,500 new jobs created in the mining sector between 1999 and 2015, roughly half 12,800 (47%) are in nonmetropolitan counties, with the remaining 14,600 (53%) added in metropolitan area counties.

Mining jobs represent a substantial share of all job growth in the non-metro counties in the period. **Only 46,000 total jobs were created in the non-metro counties between 1999 and 2015, and the mining sector alone accounted for more than 1 in 4.** For workers in these rural counties, oil and gas jobs represent a critical source of high-wage employment.



The high average wages paid by oil and gas jobs also has a major influence on the overall level of wages in the non-metro counties of the state. **The average annual wages per worker in the mining sector in the non-metro counties averaged \$76,550 in 2015, nearly double the overall average of \$39,400 across all industries in the non-metro areas** (see Figure 32). It has long been the case that energy industry jobs rank among the most attractive positions available for workers in many of the rural areas of the state. Overall, wage and salary income from mining jobs is roughly twice as important to the economies in the non-metropolitan counties, where mining earnings represent 11.1% of total wage and salary income versus only 6.6% in the metro area counties.



Oil and gas activity continues to have a transformative effect in many smaller, non-metro counties of the state.⁵⁵ Most notably, a group of fifteen non-metro counties with heavy oil and gas activity are generating a large share of state job growth. These counties include Alfalfa, Beaver, Beckham, Canadian, Dewey, Ellis, Garfield, Grady, Grant, Kingfisher, Major, Noble, Roger Mills, Woods, and Woodward.

Some of these counties easily qualify as ‘hyper-growth’ regions, especially Roger Mills, Beckham, Alfalfa, Woods, Ellis, and Beaver. They have all added 20% or more to their local employment base since early 2010, and retail sales gains have exceeded 100% year-over-year, at some point in their surge. Geographically they line up along the western and north central borders of the state.

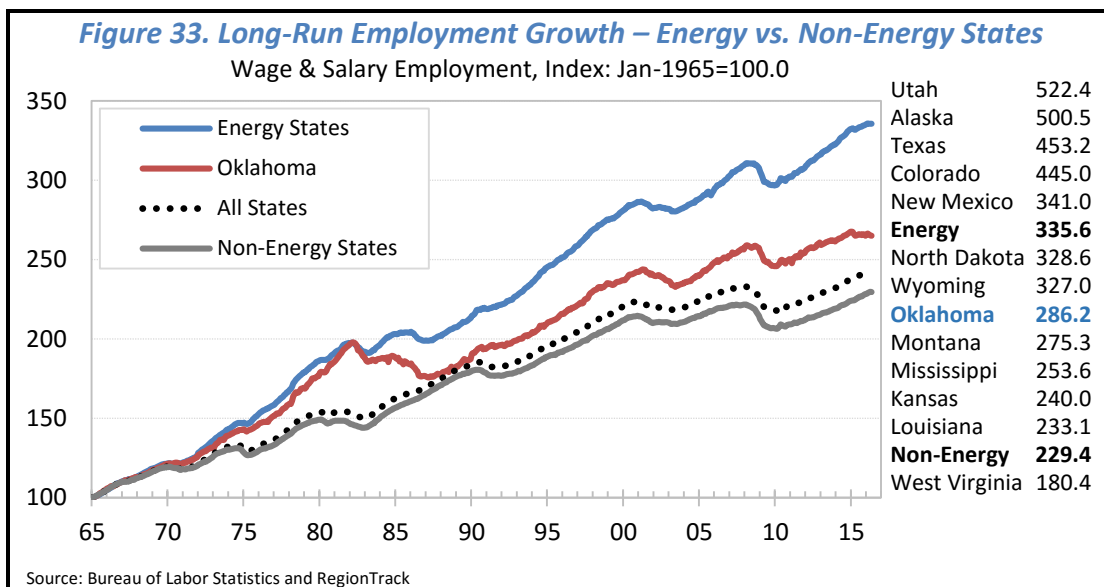
Also worth noting is the economic revival the past decade in some of the long-ago established oil and gas hubs around the state such as Anadarko, Blanchard, Newcastle, Clinton, El Reno, Elk City, Enid, Weatherford, and Woodward. Oil and gas activity has long played a central role in the economic performance of these regions.

It’s good to be an energy state in the long run

Questions continue to be raised over whether it is economically desirable to have a large oil and gas presence in the state. A recent comprehensive study⁵⁶ closely examines the specific question of the long-term growth consequences of resource-based specialization for oil abundant counties in Oklahoma, Texas, and Louisiana. These oil abundant counties are compared to others within a 200-mile radius while accounting for other geographic and economic factors that explain long-term growth. The findings indicate that in the period between 1940 and 1990, the oil abundant counties had higher employment density in mining, manufacturing,

and agriculture; higher population growth; higher education levels; and higher per capita income. These counties also enjoyed better infrastructure and were much more likely to be crossed by an interstate or have a local civilian or public airport. Employers were attracted to these counties and willing to pay higher prices for land and labor due to the productive advantage of the oil-abundant counties. In short, being an oil-producing region has produced a range of positive economic benefits for many years.

These rural effects are an important part of the broader story underlying economic growth in Oklahoma the past several decades. Figure 33 illustrates the long-run difference in job formation in the energy states versus the non-energy states. **Since 1965, Oklahoma’s job base has increased 186.2%, roughly 55% more than the average of the non-energy producing states.** This out-performance is not just confined to Oklahoma. Every energy state except West Virginia has outperformed the group of non-energy states in job growth since 1965. While most of the leading energy states such as Utah, Texas, New Mexico, and Colorado are also high in-migration states, several of the moderate population growth energy states including North Dakota, Wyoming, Oklahoma, Montana, Mississippi, Kansas, and Louisiana far outperformed the group of non-energy producing states in job formation.



Taxes have been falling for Oklahoma households

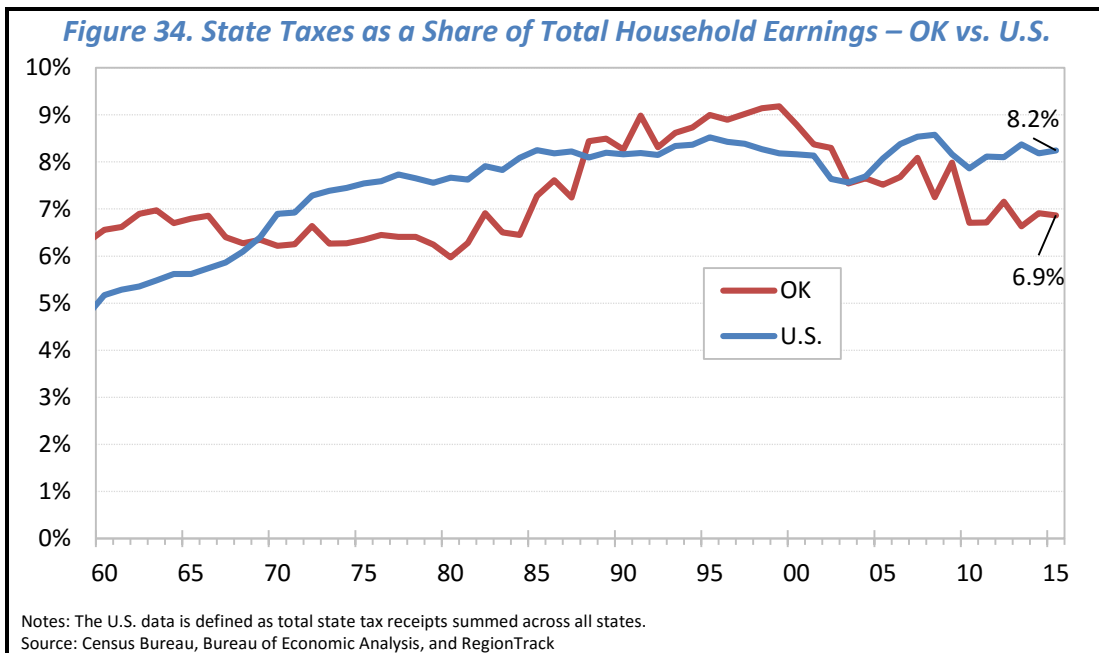
The strong economic performance of the state in recent years has provided Oklahomans with significant tax relief relative to income. Since 2000, the share of state taxes relative to household earnings has dipped significantly from 9.2% of earnings in FY1999 to just below 6.9% of earnings in FY2015 (see Figure 34).⁵⁷ Oklahomans are now paying the lowest share of household earnings in state taxes since 1984.

The drop in share since 2000 is due to a combination of rapid increases in earnings and only moderate increases in total taxes in recent years. Household earnings doubled (99.8% increase) in the period while total state taxes increased by only a bit more than half (56% increase).

A comparison to the U.S. is helpful in understanding why the tax share has dropped in Oklahoma, as well as how it is related to the oil and gas industry. Earnings growth across all states in the period was a much lower 68.4% since 2000, fully one-third less than in Oklahoma. Oil and gas-driven income gains underlie much of the unusually high earnings growth rate for the state, as well as the progress made relative to the nation in per capita income.

In contrast, tax revenue growth across all the states was 66.8% in the period, about 10% faster than the 56% rise in Oklahoma. The combination of much faster income growth and slower tax revenue growth in the period pushed the state's share below the nation beginning in 2004, and the gap has widened since.

This has not pushed the average tax share down to historical lows but has instead returned it to the average seen throughout the 1960s and 1970s. The same pattern relative to the nation occurred in the 1960s and 1970s during the oil boom. Following the Oil Bust, the average tax share climbed steadily from 6.5% in 1984 to 9.2% in 1999. Since 2000, the share has slowly made its way back down to the historical average of about 7% as the state's energy sector has rebounded.



IX. Endnotes

¹ A detailed description of the research underlying Oklahoma’s targeted Key Business Ecosystems is available at: <http://okcommerce.gov/energy/>

² See: “Clusters, Convergence, and Economic Performance.” Mercedes Delgado, Michael E. Porter, and Scott Stern. NBER Working Paper No. 18250, July 2012.

³ See Table 4 of: Mark C. Snead. “Are the Energy States Still Energy States?” 2009. *Economic Review*. Federal Reserve Bank of Kansas City. Available online at: <http://www.kc.frb.org/PUBLICAT/ECONREV/pdf/09q4Snead.pdf>

⁴ The level of wage and salary employment represents the annual average for 2015. The number of wage and salary workers continued to drop in the first two quarters of 2016 under pressure from low crude oil prices. Mining employment totaled a reported 43,900 in the June 2016 Current Employment Statistics survey.

⁵ Proprietor’s income consists primarily of the income of sole proprietors and partnerships.

⁶ Some proprietors under BEA’s methodology may be counted more than once if they participate in multiple partnerships.

⁷ Household earnings is defined by Bureau of Economic Analysis as employee compensation plus proprietors’ income.

Proprietor’s income consists primarily of the income of sole proprietors and partnerships. The share of household earnings in each state derived from oil and gas activity is calculated as the sum of NAICS 201 (Oil and gas extraction) plus a share of NAICS 203 (Support activities for mining). The share of NAICS 203 included is determined by the ratio of NAICS 201 / (NAICS 201 + NAICS 202 (Mining – except oil and gas)).

⁸ From: *U.S. Crude Oil and Natural Gas Proved Reserves*. U.S. Energy Information Administration. Available online at: <http://www.eia.gov/naturalgas/crudeoilreserves/>

⁹ Pennsylvania’s mining sector earnings also include a significant share of coal-related activity and will overstate the role of oil and gas activity.

¹⁰ Available online at: <https://www.fraserinstitute.org/studies/global-petroleum-survey-2015>.

¹¹ State-level capital at the industry level is estimated using the approach of Garofalo and Yamarik as described in: Garofalo, Gasper A. and Steven Yamarik. 2002. “Regional Convergence: Evidence from a New State-by-State Capital Stock Series.” *Review of Economics and Statistics*, 84:2, pp.316-323. The approach apportions state-level estimates from national investment data using state level earnings by industry.

¹² Net exports are measured as state production minus state consumption as defined by EIA in the State Energy Data System (SEDS). Available online at: <http://www.eia.gov/state/seds/>

¹³ See for example: Mark C. Snead and Dolores A. Willett. “The Economic Impact of Oil and Gas Production and Drilling on the Oklahoma Economy.” December 2006. Center for Applied Economic Research. Oklahoma State University. Available online at: <http://digitalprairie.ok.gov/cdm/singleitem/collection/stgovpub/id/22158/rec/42>; Mark C. Snead and Suzette Barta. “The Economic Impact of Oil and Gas Production and Drilling on the Oklahoma Economy.” October 2008. Center for Applied Economic Research. Oklahoma State University. Available online at: <http://digitalprairie.ok.gov/cdm/singleitem/collection/stgovpub/id/8629/rec/7>; and Russell Evans. “Oklahoma’s Oil and Natural Gas Industry Economic Impact and Jobs Report.” Steven C. Agee Economic Research and Policy Institute. Available online at: <http://www.oerb.com/about/media/2014-economic-impact-report-released>

¹⁴ The estimated spillover effects include both indirect and induced effects. The indirect effect is the statewide inter-industry economic activity resulting from purchases by the state’s oil and gas producers, while the induced effect reflects the economic activity resulting from new household spending out of employee earnings received as part of the direct and indirect effects. For convenience, the spillover impacts are typically summarized using economic impact multipliers. The multipliers quantify the amount of spillover activity resulting from each dollar of activity in the state oil and natural gas sector. The indirect and induced effects are derived using Type II multipliers calculated as (direct + indirect + induced)/direct. More generally, output multipliers provide an estimate of the amount of output generated statewide per dollar of new output generated in the oil and natural gas industry. Employment multipliers provide an estimate of the number of full- and part-time jobs generated statewide per new job added in the oil and gas industry. Earnings multipliers provide an estimate of the amount of new labor income received by households statewide per new dollar of labor income added in the oil and natural gas industry. The multipliers are based on the 2013 regional update of the IMPLAN model.

¹⁵ Caution must always be used when using input-output multipliers to assess the total economic activity ‘supported’ by an existing industry or firm. Input-output multipliers are intended to predict the change in economic activity that results from an incremental change in the current state of a regional economy. More specifically, the estimates provided for the energy sector reflect predictions from the IMPLAN input-output model of the incremental impact that would result if activity in the industry increased only incrementally.

¹⁶ A well-known limitation of input-output models is that they do not account for subsequent general equilibrium-type effects such as changes in the relative prices of goods and services or changes in wage rates at the industry level.

¹⁷ Expenditure estimates are derived from the 2013 Oklahoma state dataset for the IMPLAN input-output model (www.implan.com).

- ¹⁸ See: <http://newsok.com/general-electric-to-build-energy-research-center-in-oklahoma/article/3779406>.
- ¹⁹ Royalty rates are based on data provided by three major oil and gas producers in Oklahoma. The assumed rate rises from 15% in 1990 to 18% in 2015. The share of royalties paid to recipients with an Oklahoma address in the survey data is approximately 70%.
- ²⁰ The estimate is based on a weighted average from a sample of both published and unpublished estimates that center around \$1.85 million per vertical well drilled and \$5.65 million per horizontal well. An estimated 95% of completed wells in 2015 were horizontal and 5% vertical.
- ²¹ The estimate of U.S. oil and gas-related investment in 2015 is estimated using published data for the decline in Mining exploration, shafts, and wells (a 39.435% decline from 2014 to 2015) to adjust the 2014 estimate of oil and gas-related investment. See the National Income and Product Accounts (NIPA) available online at Bureau of Economic Analysis (www.bea.gov), Table 5.3.5 Private Fixed Investment by Type.
- ²² See the National Income and Product Accounts (NIPA) available online at Bureau of Economic Analysis (www.bea.gov), Table 5.3.5 Private Fixed Investment by Type. Most of the investment spending reported for “Mining exploration, shafts, and wells” represents activity within the oil and gas sector.
- ²³ See article online at: <http://newsok.com/drilling-costs-4.62-billion/article/1974894>.
- ²⁴ Suzette Barta and Mark C. Snead: “The Economics of Deep Drilling in Oklahoma: Update 2000-2007.” April 2008. Center for Applied Economic Research. Oklahoma State University.
- ²⁵ See Baker-Hughes rig counts by state as of November 1, 2013. Available online at: <http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-reportsother>.
- ²⁶ See Oklahoma Corporation Commission annual reports and data files available online at: <http://www.occeweb.com/og/ogdatafiles2.htm>.
- ²⁷ See Baker-Hughes rig counts by drilling type for each basin and state. Available online at: <http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-reportsother>
- ²⁸ See: Mark C. Snead. “The Economics of Deep Drilling in Oklahoma.” February 2005. Center for Applied Economic Research. Oklahoma State University. Available online at: http://economy.okstate.edu/caer/files/economics_of_deep_drilling.pdf; and Suzette Barta and Mark C. Snead: “The Economics of Deep Drilling in Oklahoma: Update 2000-2007.” April 2008. Center for Applied Economic Research. Oklahoma State University. A sample of a 304 deep wells drilled in Oklahoma between 2000 and 2007 suggests an average cost of \$6.7 million per well, with a range from \$4.0 million to \$10.0 million for most deep wells. Wells drilled below 17,500 feet cost an average of \$8.7 million per well.
- ²⁹ For a detailed discussion of drilling costs and performance across Oklahoma’s major plays, see: <http://www.naturalgasintel.com/oklahomaliquinfo>. Unit Corp. reports estimated drilling costs of \$2.7 million for a group of wells in the Marmaton formation in the Oklahoma Panhandle: see http://www.oilandgasinvestor.com/Exploration-Production-Industry-News/About-Marmaton_117980. QEP reports on Marmaton well production and cost: http://media.corporate-ir.net/media_files/irol/23/237732/qepenergy-southernregion_qepanalystday_nov2011.pdf. SandRidge, Chesapeake, and Eagle Energy report well costs of \$3 million to \$3.7 million in the Mississippi Lime formation in north central Oklahoma and south central Kansas: see http://www.epmag.com/item/Mississippi-Lime-moves-mainstream-oil-production-two-years_101719. For Granite Wash costs see: <http://investor.apachecorp.com/releasedetail.cfm?ReleaseID=763023> and http://www.ugcenter.com/Granite-Wash/Granite-Wash-Operators-Await-Gas-Prices-Target-Oilier-Zones_116704; Continental Resources reports Cana-Woodford well costs of \$9.5 to \$10 million in south central Oklahoma: see <http://www.worldoil.com/January-2013-Woodford-Shale-SCOOP-helps-advance-Oklahomas-drive-for-oil.html> and <http://www.reuters.com/article/2012/11/28/column-kemp-shale-oklahoma-idUSL5E8MSCY120121128>.
- ³⁰ STACK <http://www.worldoil.com/news/2016/5/17/continental-resources-reports-record-stack-oil-well>
- ³¹ See: <http://www.ogj.com/articles/print/volume-112/issue-1/exploration-development/north-louisiana-drilling-costs-vary-slightly-2007-12.html>
- ³² See: Wood Mackenzie. July 2016. “Pre-FID Oil Projects: Global Breakeven Analysis and Cost Curves.” Available online at: <http://www.woodmac.com/reports/upstream-oil-and-gas-pre-fid-oil-projects-global-breakeven-analysis-and-cost-curves-39973687>
- ³³ Available online at: <http://www.dallasnews.com/business/energy/20160620-are-crude-oil-prices-high-enough-for-new-drilling-dallas-fed-has-some-answers.ece>
- ³⁴ There are other miscellaneous tax exemptions offered to the oil and gas industry. For example, there is a sales tax exemption for the sale of electricity for use in enhanced recovery methods of oil production and in reservoir dewatering projects. Many oil and gas firms have also filed for and received Quality Jobs Acts rebates in recent years. These rebates are not considered specific to the oil and gas industry because they are generally available to all businesses that qualify under Act rules.
- ³⁵ The refund amounts are adjusted to reflect the year in which the refund was filed and approved, not the year in which it was paid.
- ³⁶ Taxes on production and imports (TOPI) consist of tax liabilities, such as general sales and property taxes, that are chargeable to business expense in the calculation of profit-type incomes. Also included are special assessments. TOPI is the sum of state

and local taxes, primarily non-personal property taxes, licenses, and sales and gross receipts taxes, and Federal taxes, which is composed of excise taxes on goods and services.

³⁷ The state manages 1.2 million mineral acres in 75 of the State's 77 counties with 5,545 active oil and gas leases. Total minerals revenue received by the state from these lands was \$91.9 million in FY15. The Land Office experienced mineral lease sales of nearly \$30,000,000 of distributable income in FY2015. These funds are used to support local education and higher education. In addition, this division operates a gas marketing program to assist state agencies in lowering natural gas costs.

³⁸ The 22% estimate is derived from a quarterly regression model linking Oklahoma corporate tax receipts to the market value of oil and gas production and the profitability and tax payments of oil and gas firms nationally.

³⁹ See: Interim Report to the 83rd Texas Legislature, Select Committee on Economic Development. Available online at: http://webcache.googleusercontent.com/search?q=cache:XrhBT3ZWm0QJ:gov.texas.gov/files/ecodev/Select_Committee_Report.pdf+&cd=1&hl=en&ct=clnk&gl=us.

⁴⁰ For a description of the administrative code to the High-Cost Gas Exemptions, see: [https://texreg.sos.state.tx.us/public/readtac\\$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=34&pt=1&ch=3&rl=21](https://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=34&pt=1&ch=3&rl=21)

⁴¹ See Louisiana Department of Revenue. Available online at: <http://www.rev.state.la.us/>.

⁴² See: [http://app.lla.state.la.us/PublicReports.nsf/0/65C7443D8D09105F86257EA6007174D9/\\$FILE/00009E0B.pdf](http://app.lla.state.la.us/PublicReports.nsf/0/65C7443D8D09105F86257EA6007174D9/$FILE/00009E0B.pdf)

⁴³ Pennsylvania natural gas well impact fee information is available online at: <https://www.act13-reporting.puc.pa.gov/Modules/PublicReporting/Overview.aspx>

⁴⁴ See: "Mineral Tax Incentives, Mineral Production, and the Wyoming Economy." Shelby Gerking, William Morgan, Mitch Kunce, Joe Kerkvliet. December 1, 2000; available online at: <http://eadiv.state.wy.us/mtim/StateReport.pdf> See also: Mitch Kunce & Shelby Gerking & William Morgan & Ryan Maddux, 2003. "State Taxation, Exploration, and Production in the U.S. Oil Industry." *Journal of Regional Science*, Vol. 43(4), pages 749-770; available online at: <http://legisweb.state.wy.us/2001/interim/app/reports/oiltaxpaper%2011-26-01.pdf>

⁴⁵ Leighty and Lin (2012) find that production from marginally productive wells is the most sensitive type of production to tax rate changes in Alaska oil production. See: Wayne Leighty and C.Y. Cynthia Lin. 2012. "Tax Policy Can Change the Production Path: A model of Optimal Oil Extraction in Alaska." *Energy Policy*. Vol. 41, p. 759-774.

⁴⁶ See: Frank Camm, Christopher W. Myers, R. Yilmaz Arguden, Susan J. Bell, and Thomas Jacobsson. "Effects of a Severance Tax on Oil Produced in California." Sep. 1982. Rand Corporation. Available online at: <http://www.rand.org/pubs/reports/R2940.html>.

⁴⁷ See: Robert T. Deacon. 1993. "Taxation, Depletion, and Welfare: A simulation Study of the U.S. Petroleum Resource." *Journal of Environmental Economics and Management*. Vol. 24, p. 159-197.

⁴⁸ See "Rural Wealth Creation and Emerging Energy Industries: Lease and Royalty Payments to Farm Households." June 2013. Jeremy G. Weber, Jason P. Brown, and John Pender. Federal Reserve Bank of Kansas City, Research Working Paper RWP 13-07. Available online at: <http://www.kansascityfed.org/publicat/reswkpap/pdf/rwp13-07.pdf>

⁴⁹ Special state-level tabulations of employment by firm size at the industry level are available online from the Bureau of Labor Statistics at <http://www.bls.gov/cew/cewsizes.htm>.

⁵⁰ See: Robert T. Deacon. 1993. "Taxation, Depletion, and Welfare: A simulation Study of the U.S. Petroleum Resource." *Journal of Environmental Economics and Management*. Vol. 24, p. 159-197; and Mine K. Yucel. 1989. "Severance Taxes and Market Structure in an Exhaustible Resource Industry." *Journal of Environmental Economics and Management*. Vol. 16, p. 134-148.

⁵¹ The U.S. Department of energy tracks energy consumption and production by fuel type at the state level. See the State Energy Data System, available online at: <http://www.eia.gov/state/seds/>. 2014 is the latest year for which comprehensive data are available on state-level energy production and consumption.

⁵² The state's Constitutional Reserve Fund (CRF) is more commonly known as the Rainy Day Fund.

⁵³ Vehicle miles traveled by state are available online at: <https://www.fhwa.dot.gov/policyinformation/statistics/2014/vm2.cfm>

⁵⁴ Miles driven annually by age group and sex are available online at: <https://www.fhwa.dot.gov/ohim/onh00/bar8.htm>

⁵⁵ See: "Local and Regional Growth Patterns in the Recovery." *Oklahoma Economic Outlook*. April 5, 2013. RegionTrack, Inc. <http://www.regiontrack.com>.

⁵⁶ See: Guy Michaels. "The Long Term Consequences of Resource-Based Specialisation." *The Economic Journal*. Vol. 121, March 2010, pp. 31-57.

⁵⁷ Taxes are stated on a fiscal year basis while earnings are stated on a calendar year basis in the analysis. This timing difference does not alter the relationship over time.

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