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# The Potential Impact of Increasing Natural Gas Severance Tax Rates on Business Activity in Arkansas


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# INTRODUCTION

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- Oil and gas exploration and production has long been a source of stimulus for the north central Arkansas economy. The **development of shale formations in recent years has added to substantial conventional natural gas reserves** in the Arkoma Basin and Gulf Coastal Plain to **greatly increase the importance of the energy sector to the state economy**.

- The oil and gas sector leads to substantial economic benefits through exploration, production, transportation, refining, and related activity. **Direct spending in the energy sector leads to multiplier effects through the economy which, in turn, initiate a chain of spillover business stimulus throughout the state. These spillover benefits are quite substantial in that (1) the industry is a very high-value added source of production, and (2) Arkansas has a large base of support industries allowing much of the spinoff activity to remain within the state.**

- Oil and gas exploration and production activity **also benefits both state and local governments** through mechanisms apart from severance taxes, such as property taxes, corporate income taxes, personal income taxes on royalties, enhanced retail sales and real estate development (both of which are direct sources of fiscal revenues), permits and fees, and other types of levies such as hotel/motel occupancy taxes and receipts stemming from various taxable activities. Furthermore, money received by local governments, schools, businesses, and individuals in the form of royalties and bonuses paid by natural gas operators can enhance the quality of life as well as economic opportunities.

- Recently, proposals have surfaced to raise severance tax rates in Arkansas. Such an increase would have a negative effect on the industry and would likely result in curtailment of development in the state, as regions with major shale opportunities currently find themselves competing for a limited supply of drilling resources. These effects would be particularly notable at lower natural gas prices, which serve to magnify the relative effects of cost differentials.

- The Perryman Group (TPG) was asked to evaluate the potential impact of increasing the Arkansas natural gas severance tax rate on the economy of the state. This report presents the findings from TPG's analysis.

## Highlights of Study Findings

- An **important consideration in any change in the Arkansas severance tax rate is how it compares to other major gas-producing states. Such comparisons are difficult due to the complicated interaction of stated rates and incentives, but some conclusions can be drawn.**
  - Currently, tax rates in Arkansas are competitive with those in Texas (the largest gas-producing state in the United States and site of another large shale development) and other major producers.
  - **Raising the rate in Arkansas to a flat 7% with no adjustment for marketing costs would, thus, place taxes several percentage points higher there than in Texas (and other major producing areas) and adversely affect the relative cost environment in which current resource allocation decisions are made.**

- Industry experts as well as key individuals in oil and gas firms have noted the role of taxes in investment decisions.
    - **If Arkansas raises its severance tax rate to a flat 7% with no incentives for new wells or high-cost drilling, there will be curtailment in drilling activity in the state as resources are shifted to other areas with lower rates such as the Marcellus Shale (where there is no severance tax) or nearby opportunities such as the Barnett Shale and the Haynesville Shale.**
    - The Perryman Group estimates that, over time, well **completions and production will be reduced by almost 8.5% compared to what they would be** under the current tax structure and baseline expectations regarding responsiveness to overall costs.

- **Any investment or corporate activity generates multiplier effects throughout the economy.** The Perryman Group quantified the **potential harms from reduced oil and gas exploration and production associated with raising the severance tax rate.**

- The Perryman Group estimated that, under a baseline responsiveness scenario, **increasing the severance tax on natural gas as proposed would lead to losses including $2.7 billion in total spending and $960 million in output (gross product) each year as well as 8,322 permanent jobs**. Even when adjusted for potential offsetting positive effects of spending the incremental tax receipts, the **net economic harms** remain substantial and were estimated to include **$2.0 billion in total spending and $649 million in output (gross product) each year as well as 4,678 permanent jobs**.

- **Increasing tax rates in Arkansas both reduces the level of production that is economically feasible and decreases the**

**state's position relative to other areas with oil and gas fields which can be developed, thereby decreasing economic performance in the state.**

## The Perryman Group's Perspective

- TPG is an economic research and analysis firm based in Waco, Texas. The firm has more than 30 years of experience in assessing the economic impact of corporate expansions, regulatory changes, real estate developments, public policy initiatives, and myriad other factors affecting business activity. TPG has conducted hundreds of impact analyses for local areas, regions, and states throughout the US. Impact studies have been performed for hundreds of clients including many of the largest corporations in the world, governmental entities at all levels, educational institutions, major health care systems, utilities, and economic development organizations.

- Dr. M. Ray Perryman, founder and President of the firm, developed the US Multi-Regional Impact Assessment System (used in this study) in the early 1980s and has consistently maintained, expanded, and updated it since that time. The model has been used in hundreds of diverse applications and has an excellent reputation for reliability.

- The firm has conducted numerous investigations related to the oil and gas industry. These analyses have included, among others, forecasts, impact assessments, regulatory and environmental issues, and legislative and policy initiatives. Previous work by The Perryman Group includes an assessment of the effects of offshore drilling for the US Department of the Interior, several studies of specific production areas, and projections of natural gas prices and

output. Information has been prepared for the Interstate Oil Compact Commission, the US Department of Energy, the Texas Railroad Commission, and numerous legislative committees regarding energy policy. Additionally, over the past several years, TPG has performed multiple comprehensive assessments of the impact of the Barnett Shale on the local northeast Texas area and the state of Texas, as well the impact of Barnett Shale-related activity on local and state taxing authorities, as well as a detailed analysis of the Permian Basin oil and gas producing area of west Texas. The firm has also completed in-depth analyses of numerous refineries and petrochemical facilities, as well as various aspects of natural gas taxation in Texas.

- In addition, TPG has conducted several projects related to the Arkansas economy, including assessments of judicial reforms in the state, the manufacturing benefits associated with a major international pipeline project, and the role of undocumented workers. The firm has also completed numerous studies specifically dealing with changes in the cost of energy resources, including electricity, oil, and natural gas on both a regional and national basis.

# ARKANSAS OIL AND GAS INDUSTRY

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## Overview of Arkansas Oil and Gas Production

- The oil and gas industry in Arkansas traces its roots to the early part of the past century, and some formations first discovered in the 1940s are still producing today.

- From levels near 400 per year in the early 1970s, Arkansas drilling permits trended upward during the late 1970s and early 1980s to a peak exceeding 1,200. A sharp one-year drop in 1986 again placed levels at just over 400 per year during the latter years of the 1980s before falling off to the 200 per annum range for a number of years. It was only with the development of the Fayetteville Shale formation that activity picked up, rising rapidly through the mid-2000s.

- Oil production in Arkansas, almost exclusively in the southern part of the state, peaked decades ago. Although the state was once a notable source of oil with annual production of 15-20 million barrels before the market drop in 1987, volumes since that time have declined to reach less than 6 million barrels in 2010.

- Natural gas production in southern Arkansas (predominately conventional deposits in the Upper Smackover) has also fallen rapidly, from more than 55 million mcf per year in 1970 to just over 8 million mcf in 2010.

- By contrast, **natural gas production in north central Arkansas has surged over the past several years** as technological advances and improved recovery methods in shale gas deposits, together with

a favorable natural gas price environment, have improved the economics of exploration and production in such formations. In 2011, natural gas production in the B-43 area (in north central Arkansas) was almost 943.4 million mcf, up from 777.7 million mcf in 2010 and 519.5 million mcf in 2008.

## Role of Shale Gas in the US Energy Supply

- Shale gas formations, such as the Fayetteville in northern Arkansas, are a crucial component of the nation's natural gas supply. Estimates of the total potential US supply of natural gas from shale sources is rising rapidly over time as new fields are discovered and explored.

- The US Energy Information Administration (EIA) estimates that shale gas comprised 14% of the total US supply in 2009, but is expected to account for 46% of supply in 2035.[1]

- In a recent study for America's Natural Gas Alliance, IHS Global Insight (USA) indicated even greater importance of shale gas, estimating that in 2010, such gas represented 27% of the total, with the share rising to 60% by 2035. IHS Global Insight also projected that there will be $1.9 trillion in capital investment (both upstream and infrastructure) between 2010 and 2035.[2]

- This industry development will contribute to lower natural gas prices in the future (compared to what they would be in the absence of shale gas development). By allowing consumer and business resources to be expended in more productive ways, lower prices will

[1] "What is shale gas and why is it important?;" US Energy Information Administration; Updated August 4, 2011; Retrieved January 2012 from http://www.eia.gov/energy_in_brief/about_shale_gas.cfm.
[2] "The Economic and Employment Contributions of Shale Gas in the United States;" IHS Global Insight (USA); December 2011.

contribute to economic growth. A recent study by Navigant Consulting found that Arkansas consumers have saved more than $600 million per year due to declines in natural gas prices; lower prices are related to supply increases which are largely the result of shale gas development.[3]

- Natural gas also has desirable environmental properties compared to many fuels and will likely serve as an important energy source given efforts to reduce carbon dioxide emissions. An interdisciplinary study by MIT, for instance, stated that "natural gas provides a cost-effective bridge to...a low-carbon future."[4]

- In addition, by increasing domestic supplies, these reserves contribute to US energy security.

## Current Arkansas Oil and Gas Exploration Activity

- As of the end of March 2012, Baker Hughes rig count data indicated that **26 rigs were operating in Arkansas.**

- **The vast majority current drilling is for natural gas in the north central area of the state**.

- In addition, there are indications that some of the oldest fields in the state (such as the Lower Smackover Brown Dense) may experience a resurgence in activity utilizing newer methods such as horizontal drilling.

[3] "The Impact of Natural Gas Abundance on Arkansas Consumers; A Study by Navigant Consulting Inc.;" Navigant Consulting; September 2011.
[4] "The Future of Natural Gas: An Interdisciplinary MIT Study;" Massachusetts Institute of Technology; 2011.

# SEVERANCE TAXES AND THEIR POTENTIAL EFFECT ON ARKANSAS OIL AND GAS EXPLORATION AND PRODUCTION

# SEVERANCE TAXES AND THEIR POTENTIAL EFFECT ON ARKANSAS OIL AND GAS EXPLORATION AND PRODUCTION

## Severance Tax Rates in Key Oil and Gas Producing States

- An **important consideration in any change in the Arkansas severance tax rate is how it compares to other major gas-producing states**. **Such comparisons are difficult due to the complicated interactions between stated rates and incentives, but some conclusions can be drawn.**

- Most states utilize a tax rate based on the market value of production, but many offer significant incentives which reduce the effective tax rates paid.

- In Texas, which is by far the largest producer of natural gas, baseline severance tax rates are 7.5% of market value of natural gas produced and saved and 4.6% of the market value of oil produced. However, the state offers substantial incentives including the following.
    - Marketing costs (including compression and delivery) can be deducted to determine taxable market value.
    - High cost wells are eligible for a severance tax reduction until one half of drilling and completion costs are recovered through severance tax incentive relief (not gross sales as used to calculate cost recovery in Arkansas).

- Severance tax relief is also available for marginal wells when prices fall below price thresholds.
- Texas incentives can last up to 10 years for qualifying wells.

- In Wyoming, the base natural gas and oil severance tax rates are both 6.0%, but new wells pay at a 2.0% rate. Incentives are also offered for marginal production (stripper wells).

- Oklahoma utilizes a tax on gross production which varies depending on price, but offers a 1% incentive rate for 48 months for horizontal wells to recover drilling costs. Marketing costs are also deducted to quantify taxable market value.

- Louisiana's tax rates are set each year at a flat rate per MCF, currently $0.164. Exemptions are offered for up to two years on taxes for horizontally drilled wells such as those in the Haynesville Shale formation.

- Currently, tax rates in Arkansas are competitive with those in Texas (the largest gas-producing state in the United States and site of another large shale development) and other major areas with substantial drilling and exploration activity.

- **Raising the rate in Arkansas to a flat 7% with no adjustment for marketing costs would, thus, place taxes several percentage points higher there than in Texas, which generally has rates in the 1%-2% range depending on specific cost factors.** Moreover, a significant tax rate change would **raise the relative cost of investing in resources in Arkansas, which is the critical parameter for decision-making on the part of producers**.

# Importance of Severance Taxes in Drilling and Exploration Decisions

- A number of studies have examined the effects of taxes on oil and gas exploration and production and found that the tax environment is a relevant factor in the level of activity. Industry experts as well as key individuals in oil and gas firms have also noted the role of taxes in investment decisions.

- State and local agencies in other gas-producing regions are on record as supporting preferential tax treatment.
  - For example, according to the Railroad Commission of Texas, which regulates the state's oil and gas industries, "Severance tax incentives continue to be needed in the future to encourage production and expansion of oil and gas operations, and sustain a vital segment of the state's economy."[5]
  - The Harrisburg Regional Chamber & CREDC (located in and near the Marcellus Shale formation region), stated in a position paper that "at this point in time, the benefits from Marcellus Shale far outweigh the risks and the imposition of a state severance tax has the potential to hinder the benefits without adequately addressing the risks."[6]
  - A number of other agencies have expressed similar positions.

- Empirical studies of the responsiveness of drilling activity to changes in various factors (including severance taxes) also indicate that higher taxes can shift resources to other geographic areas and curtail development.[7] In particular, marginal wells are not drilled

[55] "Texas Severance Tax Incentives: Past and Present;" Railroad Commission of Texas; http://www.rrc.state.tx.us/programs/og/severancetax.php; retrieved January 2012.
[6] "Position Statement: Proposed Severance Tax on Natural Gas/Marcellus Shale;" Harrisburg Regional Chamber & CREDC; Retrieved January 2012.
[7] Deacon, Robert T.; "Taxation, Depletion, and Welfare: A Simulation Study of the U.S. Petroleum Resource;" *Journal of Environmental Economics and Management;* March 1993. Nehring, R; "The Discovery of Significant Oil

and operations resources are diverted to areas offering better overall prospects. This latter issue is particularly relevant for the current situation, as firms have the capacity to transfer activity to the relatively proximate Barnett and Haynesville Shale formations.

- **If Arkansas raises its severance tax rate to a flat 7% with no adjustment for marketing costs and no incentives for new wells or high-cost drilling, there will be some curtailment in drilling activity in the state.** In order to estimate these losses, TPG implemented a well-established econometric model for measuring the responses of drilling to increased severance taxes.[8] The system was modified to reflect the specific proposal and current pricing patterns. It was also implemented based on its impact on breakeven prices relative to a typical well in the Barnett and Haynesville areas.[9] Based on this process under conservative assumptions, **The Perryman Group estimates that, over time, well completions and production will be reduced by almost 8.5% compared to what they would be under the current tax structure.** The total economic effects of such a reduction were analyzed as the "baseline" case.

- Reducing this activity would have notable negative economic effects; the overall impact of these direct losses is described below.

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and Gas Fields in the United States;" The Rand Corporation; 1981. Yucel, Mine K.; "Dynamic Analysis of Severance Taxation in a Competitive Exhaustible Resource Industry; *Resources and Energy*; September 1986. Yucel, M.K.; "Severance Taxes and Market Structure in an Exhaustible Resource Industry; *Journal of Environmental Economics and Management*; March 1989.

[8] Deacon, Robert T.; "Taxation, Depletion, and Welfare: A Simulation Study of the U.S. Petroleum Resource;" *Journal of Environmental Economics and Management;* March 1993. Nehring, R; "The Discovery of Significant Oil and Gas Fields in the United States;" The Rand Corporation; 1981.

[9] The pricing data for this analysis was obtained from "The Future of Natural Gas: An Interdisciplinary MIT Study;" Massachusetts Institute of Technology; 2011.

# Measuring Economic Impacts

- **Any investment or corporate activity generates multiplier effects throughout the economy.** Exploration, drilling, production, servicing, pipeline development and operations, royalty payments, and other direct expenditures associated with natural gas exploration and production involve substantial gains. They also lead to spillover benefits for a wide range of businesses throughout the area.

- As noted, The Perryman Group developed a model some 30 years ago (with continual updates and refinements since that time) to describe these interactions. This dynamic input-output assessment model uses a variety of data (from surveys, industry information, and other sources) to describe the various goods and services (known as resources or inputs) required to produce another good/service. The submodels used in the current analysis reflect the specific industrial composition and characteristics of the state of Arkansas.

- Impacts are expressed in terms of several different indicators of business activity.
    - **Total expenditures** (or total spending) measures the dollars changing hands as a result of the economic stimulus.
    - **Gross product** (or output) is production of goods and services that will come about in each area as a result of the activity. This measure is parallel to the gross domestic product numbers commonly reported by various media outlets and is a subset of total expenditures.
    - **Personal income** is dollars that end up in the hands of people in the area; the vast majority of this aggregate derives from the earnings of employees, but payments such as interest and rents are also included.

- **Job gains** are expressed as person-years of employment (one person working for one year) or as permanent jobs.

- All results are expressed on an annual basis in constant (2011) dollars. Additional information regarding the methods and assumptions used in this report may be found in the Appendices.

## Potential Economic Harms from Increasing the Severance Tax Rate in Arkansas

- The Perryman Group estimated the **potential harms from reduced oil and gas exploration and production associated with raising the severance tax rate.** These economic harms reflect the relative decrease in competitiveness of Arkansas and a site for development of natural gas fields and the associated curtailment in future activity. They stem from the reduction in **exploration, drilling, and related activity from the baseline levels which could be expected otherwise. In addition, the reduced activity will lead to fewer pipeline investments and related operations as well as lower royalties and lease bonuses**.

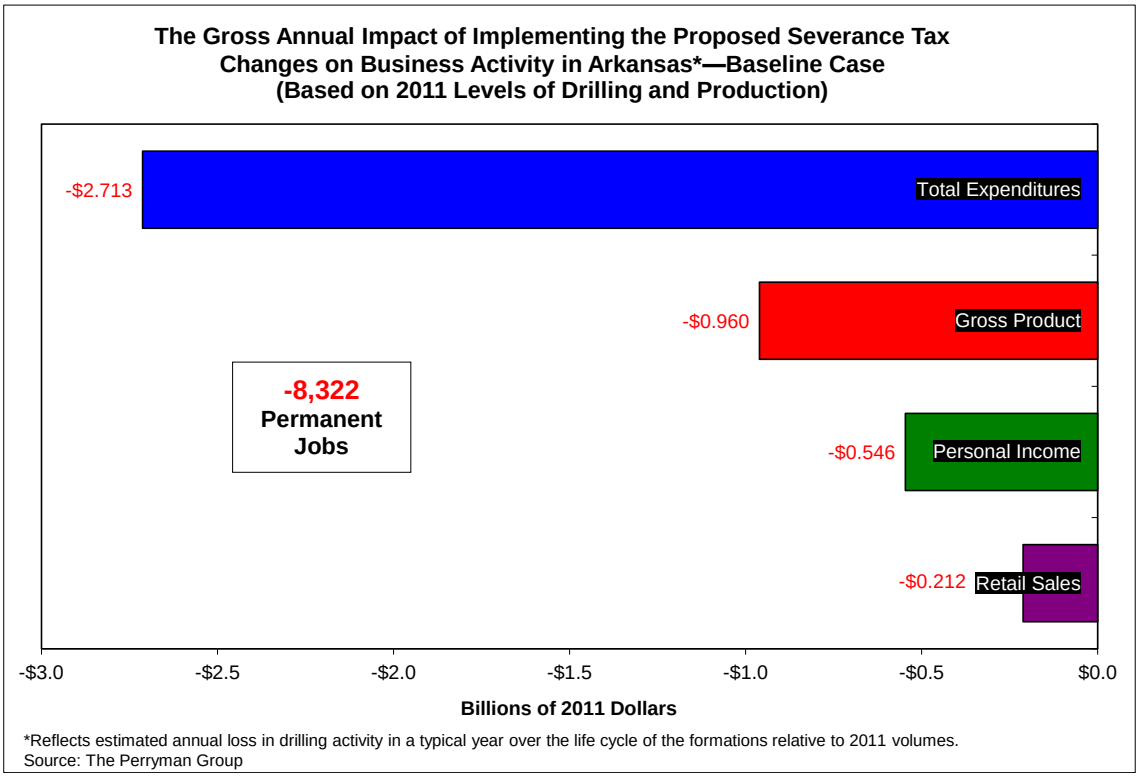
- Economic harms from the tax increase were quantified on a "gross" and "net" basis.
  - The gross measure reflects the total negative effect of implementing the tax increase (and the associated decrease in drilling and production).
  - The net effects are adjusted for the offsetting positive economic activity generated when the State of Arkansas spends the potential incremental tax collections. For purposes of this adjustment, The Perryman Group assumed the additional funds were spent for highway construction.

- The ultimate economic harms depend on a number of factors including natural gas prices, current and future tax rates and cost parameters in other states, technological changes, and potential new discoveries. The Perryman Group therefore quantified a low and high scenario in addition to the baseline scenario described above in order to provide a reasonable range of potential outcomes.

*Baseline Case*

- As noted, raising the severance tax rate in Arkansas is likely to curtail future oil and gas development. Based on various empirical studies of the responsiveness of exploration and production activity to taxes, The Perryman Group estimates that future activity would be reduced by approximately 8.5% in this baseline case.

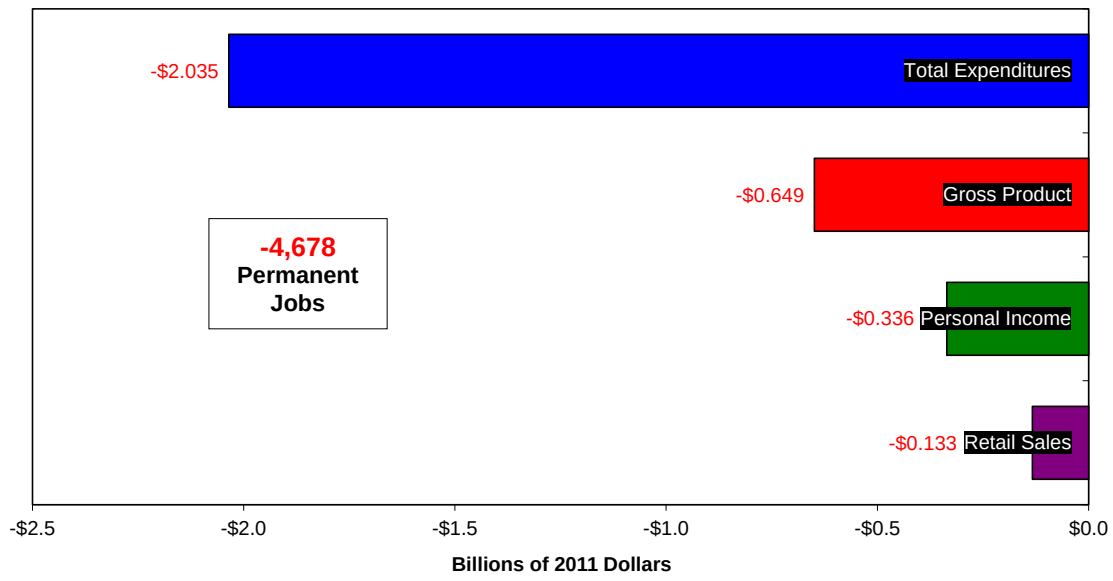
- The Perryman Group estimated that **increasing the severance tax on natural gas as proposed would lead to losses including $2.7 billion in total spending and $960 million in output (gross product) each year as well as 8,322 permanent jobs in the baseline case**.




*Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes.
Source: The Perryman Group

- Even when adjusted for potential offsetting positive effects of spending the incremental tax receipts, the **net economic harms** remain substantial and were estimated to include **$2.0 billion in total spending and $649 million in output (gross product) each year as well as 4,678 permanent jobs in the baseline case**.

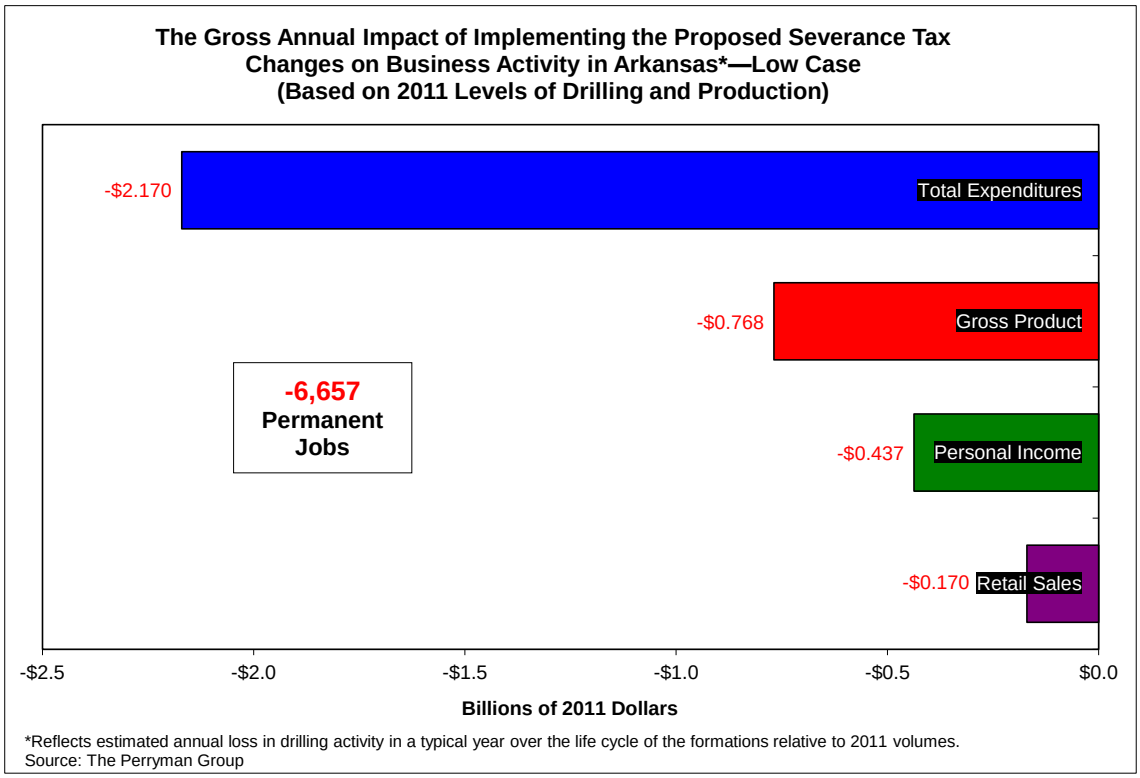
**The Net Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas*—Baseline Case (Based on 2011 Levels of Drilling and Production)**




*Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes. Includes offsetting effects of using increased severance tax revenues for highway construction.
Source: The Perryman Group

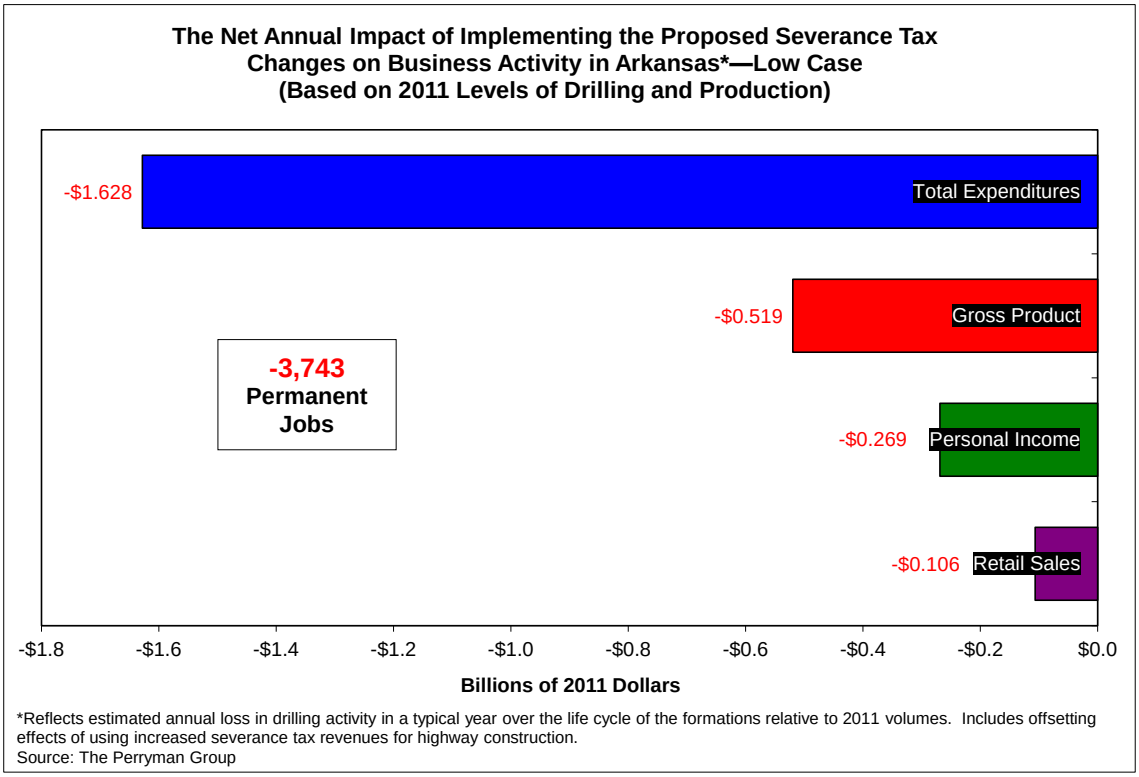
*Low Case*

- In the Low Case, where the effects of the severance tax increase are muted by various factors, The Perryman Group calculated potential **losses to be $2.2 billion in total spending and $768 million in output (gross product) each year as well as 6,657 permanent jobs**.




*Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes.
Source: The Perryman Group

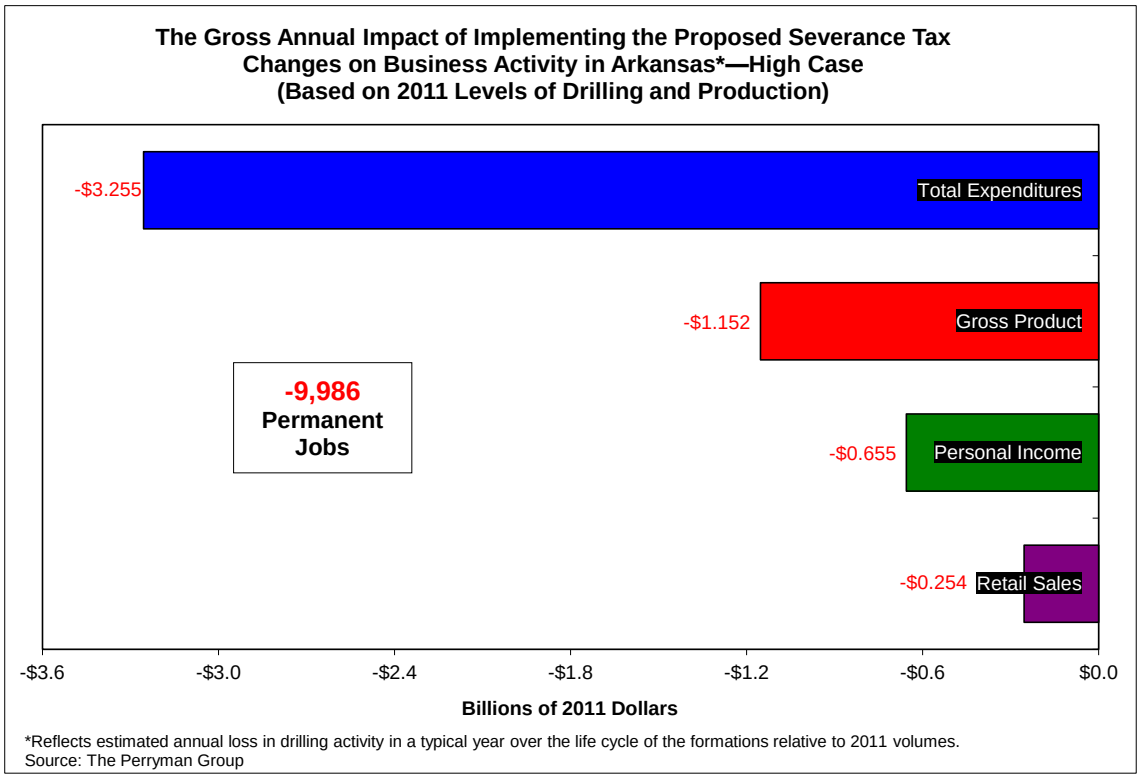
- The Low Case scenarios adjusted for potential offsetting positive effects of spending the incremental tax receipts includes losses of some **$1.6 billion in total spending and $519 million in output (gross product) each year as well as 3,743 permanent jobs**.




*Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes. Includes offsetting effects of using increased severance tax revenues for highway construction.
Source: The Perryman Group

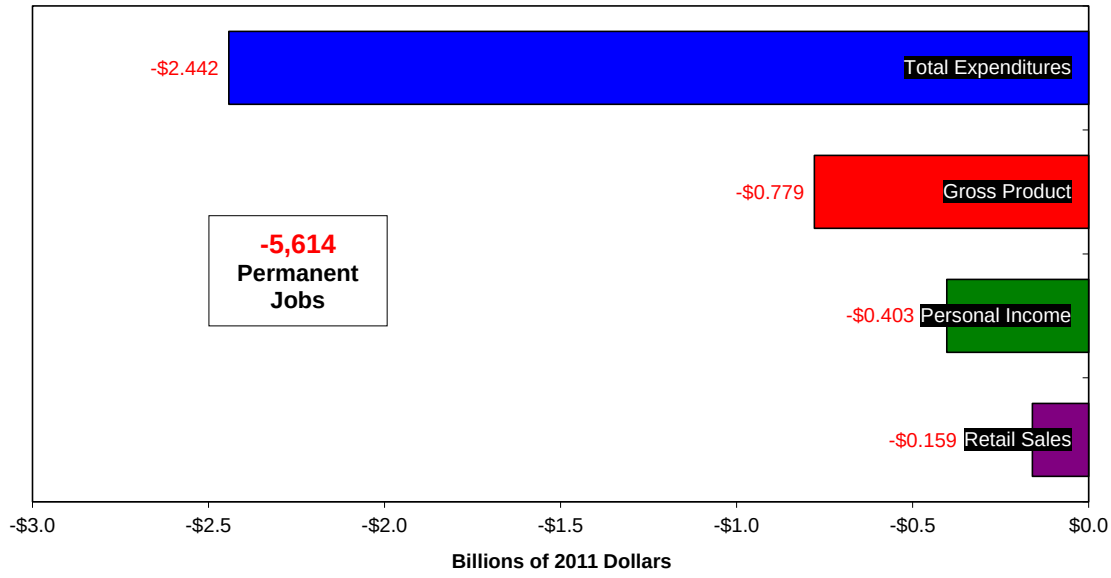
*High Case*

- If drilling and production activity is somewhat more responsive to the change in severance tax, The Perryman Group estimated that **losses could rise to almost $3.3 billion in total spending and $1.2 billion in output (gross product) each year as well as 9,986 permanent jobs**.



- Under High Case assumptions adjusted for the potential offsetting positive effects of spending incremental tax receipts stemming from the severance tax increase, the **net economic harms** were estimated to include **$2.4 billion in total spending and $779 million in output (gross product) each year as well as 5,614 permanent jobs**.

**The Net Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas*—High Case (Based on 2011 Levels of Drilling and Production)**




*Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes. Includes offsetting effects of using increased severance tax revenues for highway construction.
Source: The Perryman Group

# CONCLUSION

# CONCLUSION

- Arkansas has recently seen substantial development in the energy sector, particularly in natural gas development in the north central portion of the state. This **exploration and production has become a notable source of economic stimulus to the state.** Recent proposals to increase severance tax rates have the potential to dampen the pace of development. While geology and potential production are the driving factors in drilling decisions, any factor affecting the profitability of exploration and production has the potential to affect development patterns.

- The **economic harms associated with increasing the Arkansas natural gas severance tax rate and, thus, decreasing energy sector activity in the state are substantial and are estimated to range from**
  - **$2.2 to $3.3 billion in total spending and $768 million to $1.2 billion in output each year as well as 6,657 to 9,986 permanent jobs (on a gross basis) and**
  - **$1.6 to $2.4 billion in total spending and $519 to $779 million in output (gross product) each year as well as 3,743 to 5,614 permanent jobs even when offset for the potential positive effects of spending the incremental tax revenue.**

- Like virtually any fuel source, oil and natural gas resources are subject to market forces, and exploration, production, and development will fluctuate over time. Even so, given technological advances and growing energy demand, **the energy segment is likely to serve as an important source of economic stimulus for Arkansas and communities through much of the state.**

- Oil and gas company decisions regarding investments in new leasing activity and drilling are based on many factors, all of which ultimately boil down to economics. **Presented with a range of viable potential options for development, factors such as comparative tax rates play a systematic and well-documented role.**

- **Increasing tax rates in Arkansas both reduces the level of production that is economically feasible and decreases the state's position relative to other areas with oil and gas fields which can be developed, thereby decreasing economic performance in the state.**

# APPENDICES

# APPENDIX A: US Multi-Regional Impact Assessment System Methodology

## US Multi-Regional Impact Assessment System

- The basic modeling technique employed in this study is known as dynamic input-output analysis. This methodology essentially uses extensive survey data, industry information, and a variety of corroborative source materials to create a matrix describing the various goods and services (known as resources or inputs) required to produce one unit (a dollar's worth) of output for a given sector. Once the base information is compiled, it can be mathematically simulated to generate evaluations of the magnitude of successive rounds of activity involved in the overall production process.
- There are two essential steps in conducting an input-output analysis once the system is operational. The first major endeavor is to accurately define the levels of direct activity to be evaluated; this process was described within the report. The second step is the simulation of the input-output system to measure overall economic effects. In the case of a prospective evaluation, it is necessary to first calculate reasonable estimates of the direct activity.
- Once the direct input values were determined, the present study was conducted within the context of the US Multi-Regional Impact Assessment System (USMRIAS) which was developed and is maintained by The Perryman Group. This model has been used in hundreds of diverse applications across the country and has an excellent reputation for accuracy and credibility. In addition, the model has been in operation and continually updated for over two decades. The systems used in the current simulations reflect the unique industrial structure of the Arkansas economy.
- In this instance, The Perryman Group utilized a variety of sources of data regarding oil and gas exploration and production in Arkansas, relevant tax rates in other states, analysis of relative costs in various production areas, and other information necessary to the analysis.
- The direct inputs for assessing the value of exploration, drilling, and production activity were obtained from (1) data from the Arkansas Oil and Gas Commission and various industry sources and (2) employment information from the US Department of Commerce
- As noted earlier, as the direct effects are determined, they are simulated within the context of the relevant geographic submodels of the USMRIAS. The USMRIAS is somewhat similar in format to the Input-Output Model of the United States and the Regional Input-Output Modeling System, both of which are maintained by the US Department of Commerce. The model developed by TPG, however, incorporates several important enhancements and refinements. Specifically, the expanded system includes (1) comprehensive 500-sector coverage for any county, multi-county, or urban region; (2) calculation of both total expenditures and value-added by industry and region; (3) direct estimation of expenditures for multiple basic input choices (expenditures, output, income, or employment); (4) extensive parameter localization; (5) price adjustments for real and nominal assessments by sectors and areas; (6) measurement of the induced impacts associated with payrolls and consumer spending; (7) embedded modules to estimate multi-sectoral direct spending effects; (8) estimation of retail spending activity by consumers; and (9) comprehensive linkage and integration capabilities with a wide variety of econometric, real estate, occupational, and fiscal impact models. The models used for

the present investigation have been thoroughly tested for reasonableness and historical reliability.

- The impact assessment (input-output) process essentially estimates the amounts of all types of goods and services required to produce one unit (a dollar's worth) of a specific type of output. For purposes of illustrating the nature of the system, it is useful to think of inputs and outputs in dollar (rather than physical) terms. As an example, the construction of a new building will require specific dollar amounts of lumber, glass, concrete, hand tools, architectural services, interior design services, paint, plumbing, and numerous other elements. Each of these suppliers must, in turn, purchase additional dollar amounts of inputs. This process continues through multiple rounds of production, thus generating subsequent increments to business activity. The initial process of building the facility is known as the *direct effect*. The ensuing transactions in the output chain constitute the *indirect effect*.
- Another pattern that arises in response to any direct economic activity comes from the payroll dollars received by employees at each stage of the production cycle. As workers are compensated, they use some of their income for taxes, savings, and purchases from external markets. A substantial portion, however, is spent locally on food, clothing, healthcare services, utilities, housing, recreation, and other items. Typical purchasing patterns in the relevant areas are obtained from the *ACCRA Cost of Living Index*, a privately compiled inter-regional measure which has been widely used for several decades, and the *Consumer Expenditure Survey* of the US Department of Labor. These initial outlays by area residents generate further secondary activity as local providers acquire inputs to meet this consumer demand. These consumer spending impacts are known as the *induced effect*. The USMRIAS is designed to provide realistic, yet conservative, estimates of these phenomena.
- Sources for information used in this process include the Bureau of the Census, the Bureau of Labor Statistics, the Regional Economic Information System of the US Department of Commerce, and other public and private sources. The pricing data are compiled from the US Department of Labor and the US Department of Commerce. The verification and testing procedures make use of extensive public and private sources. Note that all monetary values are given in constant (2011) dollars to eliminate the effects of inflation.
- The USMRIAS generates estimates of the effect on several measures of business activity. The most comprehensive measure of economic activity used in this study is **Total Expenditures**. This measure incorporates every dollar that changes hands in any transaction. For example, suppose a farmer sells wheat to a miller for $0.50; the miller then sells flour to a baker for $0.75; the baker, in turn, sells bread to a customer for $1.25. The Total Expenditures recorded in this instance would be $2.50, that is, $0.50 + $0.75 + $1.25. This measure is quite broad, but is useful in that (1) it reflects the overall interplay of all industries in the economy, and (2) some key fiscal variables such as sales taxes are linked to aggregate spending.
- A second measure of business activity frequently employed in this analysis is that of **Gross Product**. This indicator represents the regional equivalent of Gross Domestic Product, the most commonly reported statistic regarding national economic performance. In other words, the Gross Product of Arkansas is the amount of US output that is

produced in that state; it is defined as the value of all final goods produced in a given region for a specific period of time. Stated differently, it captures the amount of value-added (gross area product) over intermediate goods and services at each stage of the production process, that is, it eliminates the double counting in the Total Expenditures concept. Using the example above, the Gross Product is $1.25 (the value of the bread) rather than $2.50. Alternatively, it may be viewed as the sum of the value-added by the farmer, $0.50; the miller, $0.25 ($0.75 - $0.50); and the baker, $0.50 ($1.25 - $0.75). The total value-added is, therefore, $1.25, which is equivalent to the final value of the bread. In many industries, the primary component of value-added is the wage and salary payments to employees.

- The third gauge of economic activity used in this evaluation is **Personal Income**. As the name implies, Personal Income is simply the income received by individuals, whether in the form of wages, salaries, interest, dividends, proprietors' profits, or other sources. It may thus be viewed as the segment of overall impacts which flows directly to the citizenry.
- The fourth measure, **Retail Sales**, represents the component of Total Expenditures which occurs in retail outlets (general merchandise stores, automobile dealers and service stations, building materials stores, food stores, drugstores, restaurants, and so forth). Retail Sales is a commonly used measure of consumer activity.
- The final aggregates used are **Permanent Jobs and Person-Years of Employment**. The Person-Years of Employment measure reveals the full-time equivalent jobs generated by an activity. It should be noted that, unlike the dollar values described above, Permanent Jobs is a "stock" rather than a "flow." In other words, if an area produces $1 million in output in 2010 and $1 million in 2011, it is appropriate to say that $2 million was achieved in the 2010-2011 period. If the same area has 100 people working in 2010 and 100 in 2011, it only has 100 Permanent Jobs. When a flow of jobs is measured, such as in a construction project or a cumulative assessment over multiple years, it is appropriate to measure employment in Person-Years (a person working for a year). This concept is distinct from Permanent Jobs, which anticipates that the relevant positions will be maintained on a continuing basis.

# APPENDIX B: Detailed Sectoral Results

| The Gross Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—Baseline Scenario* (Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($25,282,485) | ($7,396,047) | ($4,876,402) | (79) |
| Mining | ($1,305,728,080) | ($286,690,155) | ($132,853,445) | (672) |
| Construction | ($155,873,675) | ($92,631,406) | ($76,334,050) | (1,103) |
| Nondurable Manufacturing | ($194,605,307) | ($53,184,776) | ($27,552,819) | (452) |
| Durable Manufacturing | ($84,948,935) | ($33,178,751) | ($21,933,304) | (309) |
| Transportation and Utilities | ($140,203,400) | ($52,561,772) | ($30,177,627) | (340) |
| Information | ($32,271,601) | ($19,871,233) | ($8,563,498) | (81) |
| Wholesale Trade | ($59,797,575) | ($40,416,181) | ($23,304,329) | (267) |
| Retail Trade | ($211,888,348) | ($158,093,576) | ($91,726,092) | (2,906) |
| Finance, Insurance, and Real Estate | ($295,513,997) | ($97,159,714) | ($30,867,656) | (317) |
| Business Services | ($67,493,096) | ($39,440,494) | ($32,173,336) | (401) |
| Health Services | ($48,163,174) | ($33,660,286) | ($28,460,083) | (482) |
| Other Services | ($90,742,188) | ($46,080,783) | ($37,196,790) | (911) |
| **TOTAL** | **($2,712,511,860)** | **($960,365,173)** | **($546,019,430)** | **(8,322)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes.

| The Net Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—Baseline Scenario* (Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($15,417,118) | ($4,193,329) | ($2,745,076) | (45) |
| Mining | ($1,290,350,917) | ($282,020,590) | ($130,236,961) | (650) |
| Construction | $15,535,406 | ($24,860,370) | ($20,486,496) | (296) |
| Nondurable Manufacturing | ($115,109,813) | ($33,177,853) | ($17,268,578) | (289) |
| Durable Manufacturing | ($31,544,120) | ($11,572,195) | ($8,789,350) | (99) |
| Transportation and Utilities | ($90,193,453) | ($29,720,230) | ($16,249,221) | (165) |
| Information | ($19,914,792) | ($12,280,117) | ($5,291,107) | (50) |
| Wholesale Trade | ($37,030,131) | ($25,009,821) | ($14,420,885) | (165) |
| Retail Trade | ($132,861,199) | ($98,539,620) | ($57,056,444) | (1,827) |
| Finance, Insurance, and Real Estate | ($227,209,896) | ($79,076,886) | ($23,221,469) | (235) |
| Business Services | ($4,980,719) | $695,111 | $567,033 | 7 |
| Health Services | ($29,871,547) | ($20,857,089) | ($17,634,861) | (298) |
| Other Services | ($55,902,552) | ($28,553,225) | ($23,061,244) | (566) |
| **TOTAL** | **($2,034,850,850)** | **($649,166,213)** | **($335,894,660)** | **(4,678)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes. Includes offsetting effects of using increased severance tax revenues for highway construction.

| The Gross Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—Low Scenario*<br>(Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($20,225,988) | ($5,916,838) | ($3,901,121) | (63) |
| Mining | ($1,044,582,464) | ($229,352,124) | ($106,282,756) | (538) |
| Construction | ($124,698,940) | ($74,105,125) | ($61,067,240) | (883) |
| Nondurable Manufacturing | ($155,684,246) | ($42,547,821) | ($22,042,255) | (362) |
| Durable Manufacturing | ($67,959,148) | ($26,543,001) | ($17,546,643) | (247) |
| Transportation and Utilities | ($112,162,720) | ($42,049,417) | ($24,142,101) | (272) |
| Information | ($25,817,281) | ($15,896,986) | ($6,850,799) | (65) |
| Wholesale Trade | ($47,838,060) | ($32,332,945) | ($18,643,463) | (214) |
| Retail Trade | ($169,510,678) | ($126,474,861) | ($73,380,874) | (2,325) |
| Finance, Insurance, and Real Estate | ($236,411,197) | ($77,727,771) | ($24,694,125) | (253) |
| Business Services | ($53,994,477) | ($31,552,395) | ($25,738,669) | (321) |
| Health Services | ($38,530,539) | ($26,928,229) | ($22,768,066) | (385) |
| Other Services | ($72,593,750) | ($36,864,626) | ($29,757,432) | (729) |
| **TOTAL** | **($2,170,009,488)** | **($768,292,138)** | **($436,815,544)** | **(6,657)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes assuming relatively low responsiveness of drilling to changes in tax rates.

| The Net Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—Low Scenario*<br>(Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($12,333,695) | ($3,354,663) | ($2,196,061) | (36) |
| Mining | ($1,032,280,733) | ($225,616,472) | ($104,189,569) | (520) |
| Construction | $12,428,325 | ($19,888,296) | ($16,389,197) | (237) |
| Nondurable Manufacturing | ($92,087,851) | ($26,542,282) | ($13,814,863) | (231) |
| Durable Manufacturing | ($25,235,296) | ($9,257,756) | ($7,031,480) | (79) |
| Transportation and Utilities | ($72,154,763) | ($23,776,184) | ($12,999,377) | (132) |
| Information | ($15,931,834) | ($9,824,094) | ($4,232,886) | (40) |
| Wholesale Trade | ($29,624,105) | ($20,007,857) | ($11,536,708) | (132) |
| Retail Trade | ($106,288,959) | ($78,831,696) | ($45,645,155) | (1,461) |
| Finance, Insurance, and Real Estate | ($181,767,917) | ($63,261,509) | ($18,577,175) | (188) |
| Business Services | ($3,984,575) | $556,089 | $453,627 | 6 |
| Health Services | ($23,897,237) | ($16,685,671) | ($14,107,889) | (239) |
| Other Services | ($44,722,041) | ($22,842,580) | ($18,448,995) | (453) |
| **TOTAL** | **($1,627,880,680)** | **($519,332,971)** | **($268,715,728)** | **(3,743)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes assuming relatively low responsiveness of drilling to tax rate changes. Includes offsetting effects of using increased severance tax revenues for highway construction.

| The Gross Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—High Scenario* (Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($30,338,982) | ($8,875,257) | ($5,851,682) | (95) |
| Mining | ($1,566,873,696) | ($344,028,185) | ($159,424,134) | (807) |
| Construction | ($187,048,410) | ($111,157,687) | ($91,600,859) | (1,324) |
| Nondurable Manufacturing | ($233,526,369) | ($63,821,731) | ($33,063,382) | (543) |
| Durable Manufacturing | ($101,938,722) | ($39,814,501) | ($26,319,965) | (371) |
| Transportation and Utilities | ($168,244,080) | ($63,074,126) | ($36,213,152) | (408) |
| Information | ($38,725,922) | ($23,845,479) | ($10,276,198) | (98) |
| Wholesale Trade | ($71,757,090) | ($48,499,418) | ($27,965,195) | (320) |
| Retail Trade | ($254,266,017) | ($189,712,292) | ($110,071,310) | (3,487) |
| Finance, Insurance, and Real Estate | ($354,616,796) | ($116,591,657) | ($37,041,188) | (380) |
| Business Services | ($80,991,715) | ($47,328,592) | ($38,608,003) | (481) |
| Health Services | ($57,795,809) | ($40,392,343) | ($34,152,099) | (578) |
| Other Services | ($108,890,625) | ($55,296,939) | ($44,636,148) | (1,094) |
| **TOTAL** | **($3,255,014,232)** | **($1,152,438,207)** | **($655,223,316)** | **(9,986)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes assuming relatively high responsiveness of drilling to tax rate changes.

| The Net Annual Impact of Implementing the Proposed Severance Tax Changes on Business Activity in Arkansas by Industrial Sector—High Scenario* (Based on 2011 Levels of Drilling and Production) | | | | |
|---|---|---|---|---|
| **Sector** | **Total Expenditures** | **Real Gross Product** | **Personal Income** | **Employment** |
| | *(2011 Dollars)* | *(2011 Dollars)* | *(2011 Dollars)* | *(Permanent Jobs)* |
| Agriculture | ($18,500,542) | ($5,031,995) | ($3,294,092) | (54) |
| Mining | ($1,548,421,100) | ($338,424,708) | ($156,284,354) | (780) |
| Construction | $18,642,487 | ($29,832,444) | ($24,583,795) | (355) |
| Nondurable Manufacturing | ($138,131,776) | ($39,813,424) | ($20,722,294) | (347) |
| Durable Manufacturing | ($37,852,943) | ($13,886,633) | ($10,547,220) | (119) |
| Transportation and Utilities | ($108,232,144) | ($35,664,276) | ($19,499,066) | (198) |
| Information | ($23,897,750) | ($14,736,141) | ($6,349,329) | (60) |
| Wholesale Trade | ($44,436,157) | ($30,011,785) | ($17,305,061) | (198) |
| Retail Trade | ($159,433,438) | ($118,247,544) | ($68,467,733) | (2,192) |
| Finance, Insurance, and Real Estate | ($272,651,875) | ($94,892,263) | ($27,865,763) | (282) |
| Business Services | ($5,976,863) | $834,134 | $680,440 | 9 |
| Health Services | ($35,845,856) | ($25,028,507) | ($21,161,833) | (358) |
| Other Services | ($67,083,062) | ($34,263,870) | ($27,673,493) | (679) |
| **TOTAL** | **($2,441,821,020)** | **($778,999,456)** | **($403,073,592)** | **(5,614)** |

Source: US Multi-Regional Impact Assessment System, The Perryman Group

*Note: Reflects estimated annual loss in drilling activity in a typical year over the life cycle of the formations relative to 2011 volumes assuming relatively high responsiveness of drilling to tax rate changes. Includes offsetting effects of using increased severance tax revenues for highway construction.