Economic Impacts of Marcellus Shale in Pennsylvania:
Employment and Income in 2009

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The Marcellus Shale Education & Training Center (MSETC) is a partnership of the Pennsylvania College of Technology and Penn State Extension

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Abstract

This study examines how several key unexplored aspects of Marcellus Shale natural gas development in Pennsylvania will affect the overall economic impact occurring in the Commonwealth. Where leasing and royalty dollars are actually going, and how they are being spent, has not been examined in previous economic studies. The economic impact will be very different depending upon how many dollars go to Pennsylvania households, to the state government, and to non-residents. In addition, how many of those dollars are immediately spent by recipients, and how many dollars are saved, similarly will affect the economic impacts, as will the proportion of wages being paid to non-Pennsylvania workers.

The study includes surveys of landowners, local businesses, and local government officials, and a GIS analysis of land ownership patterns related to Pennsylvania residents, non-residents, and the Commonwealth. We combined this information with industry spending data to estimate the distribution of natural gas company spending, both spatially and temporally. These numbers were then entered into an input-output model of the Pennsylvania economy generated with the economic impact tool IMPLAN so we could estimate the multiplier effects.

According to our analysis, approximately 51 percent of the land in Marcellus counties is owned by residents within the county, 25 percent is owned by someone living elsewhere in Pennsylvania, and 7.7 percent is owned by people living outside of Pennsylvania. The remaining 17 percent is owned by the public sector, primarily the Commonwealth. The survey of 1,000 landowners within a thousand feet of active Marcellus wells in Bradford and Tioga counties (501 replies, for a response rate of 50.1 percent) suggests that landowners save or invest about 55 percent of the total leasing dollars in the year they receive such payments, rather than spending them immediately. They also save or invest about 66 percent of all the royalty dollars they receive. This means a significant portion of leasing and royalty dollars are not spent in Pennsylvania in the year those dollars are received, reducing their potential economic impact in the year the companies pay mineral right owners for leases and royalties.

We estimated the economic impact of these dollars under two alternative scenarios of out-of-state ownership (7.7 percent and 15.4 percent), but suspect that both may underestimate the amount of leasing and royalty dollars immediately leaving Pennsylvania because mineral right ownership patterns do not correspond directly with land ownership patterns. Many of these rights were severed generations ago and have subsequently been passed down through families, splintering into multiple ownership across children and grandchildren, many of whom likely no longer live in Pennsylvania.

We surveyed 1,000 randomly selected businesses in both Bradford and Washington counties (for a total of 2,000 businesses) to identify the impacts they are experiencing from Marcellus Shale development (619 replies, for a response rate of 31 percent). Questions were asked about possible negative and

positive impacts. The survey responses indicated positive economic impacts are occurring broadly across the economy in the communities where drilling is very actively occurring. About one-third of all the businesses in Bradford County, for example, reported that their sales had increased due to natural gas development, and only 3 percent reported sales had declined. Businesses across the economy reported positive effects, though hotels, construction, transportation, eating and drinking places, wholesale trade, and financial service businesses were most likely to report higher sales.

We also surveyed all 494 municipal governments in the 12 Pennsylvania counties with the most Marcellus Shale activity (293 replies, for a response rate of 59 percent). One hundred thirty-one of the governments said that Marcellus development activity was occurring in their jurisdiction. There was little pattern to their answers in relation to the amount of drilling activity occurring within their jurisdiction. Only 18 percent of the governments experiencing Marcellus development activity said their tax revenues had increased, which indicates that most local governments being affected are not seeing more tax revenue as a result. In comparison, 26 percent of the local governments indicated that their costs had increased, particularly related to road expenses. This confirms that considering both revenues and costs is critical for having a complete understanding of the impacts of Marcellus Shale. These findings from local officials contrast with prior economic studies which predicted that there would be large local tax impacts, but which did not verify what is actually occurring.

We used the economic input-output model IMPLAN to look at the economy-wide impacts, modifying the information with results from the GIS analysis and surveys. We used detailed published natural gas company spending information in Pennsylvania from 2008, scaling it up to 2009 using other published data about how spending changed between the two years. We modified payroll spending, using data from a recent Marcellus workforce study which indicated that about 37 percent of the Marcellus workforce are non-Pennsylvania residents. We estimated two alternative scenarios about the payroll going to non-Pennsylvanians, recognizing that workers from out of state send some of their income back to their home state community; this included assuming that non-Pennsylvania workers spend 50 percent of their Marcellus-earnings inside Pennsylvania, and alternatively, that they spend 75 percent of their earnings here. We also accounted for how their spending likely differs from typical resident workers.

Our findings suggest that the economic impact of Marcellus Shale in Pennsylvania during 2009 ranged between 23,385 and 23,884 jobs, and $3.1 and $3.2 billion in that year. This included about $1.2 billion in labor income and almost $1.9 billion in value added to the Pennsylvania economy. In addition, there will be additional economic impacts of 2009 Marcellus Shale activity in future years as mineral right owners spend the leasing and royalty income they received in 2009 but saved for later use. These are large economic impacts, especially since much of this impact is occurring in relatively small counties. We did not estimate tax impacts of Marcellus Shale activity because we were not comfortable with the reliability of IMPLAN's tax analysis.

These results are about half the size of those estimated in previous economic impact studies of Marcellus, but this is not surprising because we had more detailed information about leasing and royalty income. Our findings are consistent with several other recent employment studies of Marcellus Shale

which focused on industry spending. Our results confirm that where leasing and royalty dollars are going has a significant effect on the estimated overall economic impacts of Marcellus Shale development. Because only about half of the land in a typical Marcellus county is owned by residents of that county, it would suggest that a large portion of the economic benefits immediately leaves the communities being impacted by drilling.

We did not try to quantify many important but even more difficult to measure costs of Marcellus Shale development, such as effects on the environment and health. We hope that future economic studies can consider such costs as better information becomes available about the incidence and extent of such impacts. In addition, we did not address the distribution of benefits and costs, even though the equity of how these are distributed underlies much of the current policy debate about Marcellus Shale. The long run implications of Marcellus Shale development are as of yet still unknown. Jobs and income in the short run are important, but many would argue that other factors are equally (if not more) important, such as clean water, healthy forests and other ecosystems, clean air, and good public health. In addition to affecting quality of life, these are important resources for the future of Pennsylvania communities, including future economic opportunities, social and physical infrastructure, well-functioning local government and institutions, and community well-being. We believe our results must be viewed as a preliminary, short-run view of the economic impacts of Marcellus Shale and be placed in a broader context of these other important concerns.

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I. Introduction

The potential of the Marcellus Shale region to become a major national source for natural gas has generated significant interest in Pennsylvania over the past several years. Counties across the Marcellus Shale region of the Commonwealth have experienced significant economic activity as natural gas companies have begun to explore and then actively develop the resource. The pace of development varies across the region, with some counties, such as Bradford, Tioga, Susquehanna, Washington, and Greene, becoming a major focus for gas drilling activity. Other counties, such as Lycoming, are becoming major hubs for the companies working on Marcellus, while others have seen significant pipeline construction required to get the gas to market. Drilling activity is expanding in the Commonwealth, growing from 27 wells in 2007, to 1,445 wells in 2010 (DEP).

Travel through these counties and anecdotes from residents and others indicate that the development of Marcellus Shale is bringing major change, including many new dollars to mineral right owners to lease their resource for development and subsequent royalty dollars to them once wells become active. Additionally, many communities are seeing new sales and expanded activity for existing businesses working with the gas companies or providing services to their workers, new jobs within the community for both residents and non-residents, and much more local spending. In addition to these income and job effects, there are non-monetary effects, such as significant increases in truck and other traffic, road damage, and new roads, well pads, and pipelines cutting through forest and farmland, with potential health, environment, social, and other impacts.

Public debate over Marcellus Shale development seems increasingly polarized between those who believe it is good for Pennsylvania and others who believe that it is not. Because development is still in its early stages, much is not known about the short- or long-run effects, so it is critical that what is occurring be studied to help policymakers, communities, and citizens understand its full implications. This study uses the well-known and widely-used economic impact model IMPLAN and results from surveys of landowners, local businesses, and municipal governments, paired with GIS analysis of land ownership patterns, to better understand the current job and income impacts of Marcellus Shale development. Economic analysis is useful to help understand what influences the impact of change, and in many ways this is more important than the actual job and income estimates that economic modeling creates. This study explores how several key and unexplored aspects of natural gas development in Pennsylvania will affect the overall economic impacts.

II. What Affects the Economic Impacts of Marcellus Shale?

Development of the Marcellus Shale region will affect Pennsylvania's economy through several primary means, including (1) leasing and royalty income paid to mineral right owners; (2) purchasing of services and equipment, and employment by the companies directly involved in the development of the gas play (e.g. those businesses that find, extract, and process the gas); (3) employment and purchases by companies that may move to Pennsylvania because of the supply of natural gas (e.g. those businesses

that want to use the gas); and (4) effects of gas development on businesses, communities, and residents that affect their competitiveness and quality of life, such as loss of qualified employees to gas industry jobs, increases in local government costs, changes in environmental or water quality, health effects, and other impacts of production.

Currently available information only allows economists to examine the economic impacts of leasing and royalty income and of gas company spending, so most previous economic studies of Marcellus Shale (as does this study) have focused on just these two drivers of economic change. The latter impacts might be large in the long run, which is why many local and regional economic development groups are beginning to focus on encouraging growth of businesses that use natural gas, and many environmental agencies and organizations are focusing on better understanding the environmental implications of gas development. Even though the latter impacts have not been modeled, they are important to keep in mind and should be the subject of additional economic studies.

Several key elements will affect the economic impact of Marcellus, such as the timing of development, including its scale and pace. These elements are important for the full range of impacts, and strongly influence the subset of impacts focused on in this study. In addition, how many of the dollars remain in the community versus immediately leave (what economist call 'leakage') also plays a critical role in influencing the magnitude of the economic impacts. Each will be discussed in turn.

A. Timing, Scale, and Pace

It is critical to recognize that the economic impacts will change throughout the development of the Marcellus Shale play, most particularly related to leasing and royalty income, and workforce. In addition, natural gas development by its nature has a limited time span because it is a non-renewable resource. Experts don't agree on how many years Marcellus Shale drilling will occur in Pennsylvania, but many estimates are 20 years or more. Other shales under Pennsylvania have the potential of extending natural gas drilling activity, so natural gas development could be a longer process, but at some point the gas will be gone or otherwise will no longer be commercially viable. Many factors will influence pace and scale, including the health of the economy as a whole, the productivity of shale wells, technological change and innovation, foreign policy, domestic energy policy, and the relative prices of different fuels.

1. Timing and Leasing/Royalty Income

In the early years of a gas play, a large share of spending by gas companies is for lease payments to mineral right owners to acquire the right to explore and develop wells. Leasing dollars are mostly upfront, early in the development of the play as companies compete to gain control of the resource. As wells are drilled and come on-line, the mineral right owners receive royalty payments insofar as their wells are productive. Pennsylvania law specifies that mineral right owners must receive at least one eighth of the value of production, but some owners have negotiated for higher royalty values. The majority of these royalty dollars go to mineral right owners in the first few years of a well's active life, because production from individual Marcellus wells drops very quickly before leveling off to a slow but steady decline. This means that the majority of all the royalty dollars will be paid to mineral right owners during the active drilling phase of the Marcellus Shale play and will decline quickly once drilling ends.

The timing of the use of those leasing and royalty dollars by mineral right owners has important implications for the economic impacts from Marcellus Shale development. Prior studies of the economic impacts of Marcellus Shale in Pennsylvania have assumed that such owners spend leasing and royalty dollars on the same goods and services, and in the same proportion, as they spend their current income. This is a particularly strong and untested assumption because it implies that most of those dollars immediately begin circulating through the economy. By comparison, anecdotes from individuals receiving those dollars and from local bankers suggest that mineral right owners are spending more money on different kinds of goods and saving much of the money they're receiving for later years. This is good from a long-run economic development perspective, since it means that the economic impacts of Marcellus Shale development will be spread over a longer time within a community, rather than occurring only in those years where leasing and royalty dollars are received, potentially smoothing the boom/bust cycle. It also may mean there is more capital within the community, spurring more local investment, with long-run benefits. But such savings result in a lower current economic impact, so it is important to account for them as accurately as possible in economic impact studies.

2. Timing and Workforce

Labor requirements are significantly different during the drilling phase of gas development than in the subsequent production phase, which occurs once all wells have been drilled. Brundage et al (2010), for example, found that each wet gas well in southwest Pennsylvania requires the equivalent of 13.1 full time jobs, spread across almost 150 occupations and 420 individuals, during the year when drilling and well completion occur on the well site, but only 0.18 full time job equivalents during each of that well's subsequent producing years. Labor requirements (and therefore most of the employment-based economic development) are highest during the active drilling years and largely are driven by the number of wells drilled per year. This pace of drilling has important consequences for other impacts of gas development, including the need for worker housing, the number of trucks on the road, other

infrastructure requirements, the quantity of water used and needing to be disposed of, and other environmental effects.

3. Other Timing Issues

The economic impact of Marcellus Shale development within an individual community will depend upon the scale and pace of activity within that community, not necessarily the duration of drilling activity statewide. Even though some estimate that it may take 20 or more years to drill all the planned Marcellus Shale wells, the drilling phase in any one community likely will be shorter, as the crews complete work in one area before moving on to another. Whether the workers live within the communities where the drilling is occurring similarly is important, because the residence of the workers determines which municipality and school district receive their earned income tax and where the workers and their families will tend to spend much of their earnings.

A fast pace of development, with a high number of wells drilled in a single year, means the drilling activity within a community will be concluded more quickly than if the drilling activity occurs over a longer timeframe. Because the labor requirements per well are relatively constant, a faster pace means more workers are needed per year, with more truck traffic, higher housing and other local infrastructure needs, and greater difficulty for the community to easily accommodate the scale of activity. A slower pace of development thus generally will be less disruptive and will extend the benefits over a longer period of time, though it may affect company costs and therefore landowner returns.

B. Leakage

When considering the economic impacts of an activity, such as development of Marcellus Shale, it is important to track where the dollars are actually going. Money immediately leaving the community, such as purchases from businesses outside of the region, has less local impact than money spent at local businesses. The spatial distribution of the new dollars from Marcellus Shale activity thus can be as important as the total number of dollars involved. Leakage is particularly an issue with leasing and royalty dollars, and with worker payroll.

1. Leakage and Leasing/Royalty Income

Who actually receives leasing and royalty dollars, and how those dollars are spent, has an important influence on the economic impacts of gas development. Not all mineral right owners live within the community where they own the rights, so the leasing and royalty dollars they receive immediately leave the community. Although this is very significant for county-level economic impact analysis, from a statewide economic impact perspective (which is the framework for this study), it does not matter whether the mineral right owner lives in the county where they own their parcel, provided they live elsewhere in the Commonwealth, since most of those dollars will circulate somewhere in the Pennsylvania economy. Leasing and royalty payments to owners who live outside of Pennsylvania, in contrast, have little local or state impact since those dollars immediately leave the Commonwealth.

How the dollars are spent also has important implications for the economic impacts. Given the relatively large size of some of the checks mineral right owners are receiving, it is expected that many households will treat lump-sum payments differently than regular income. Anecdotes from areas with substantial Marcellus activity suggest that many landowners are spending more on consumer durables, or saving or investing the dollars. For example, new tractors, vehicles, and four wheelers are being purchased, many houses and barns are being repaired, and mineral right owners are otherwise using the dollars in special ways.

The Commonwealth of Pennsylvania itself owns a significant share of the mineral rights being leased, such as on state forest and state game land. Leasing and royalty dollars for these lands go to the Commonwealth, immediately leaving the communities where drilling is occurring. The economic impact of these dollars is different than the impact of payments going to private individuals because the state spends those dollars very differently than do individual households. Some local governments and school districts likewise have leased their mineral rights, and their use of those dollars similarly differs from household spending.

Prior economic impact studies of Marcellus Shale in Pennsylvania have not addressed the distribution of leasing and royalty income, nor how those dollars are spent, but instead have assumed that all the dollars accrue to Pennsylvania households and are spent like normal income. This has the potential of significantly affecting overall results, since 69 percent of total industry spending in 2008 was leasing and royalty payments (Considine, et al. 2009) and about 38 percent of total spending in 2009 (Considine et al. 2010), and thus these dollars are a very large driver of the overall economic impact.

Several studies of gas development in other states have attempted to consider the influence of savings. In a study of the Haynesville Shale in Louisiana, Scott (2009) assumed only 5 percent of leasing and royalty payments were spent in the year received. In their study of West Virginia, the National Energy Technology Lab (2010) instead estimated how much was saved by assuming that people saved leasing and royalty dollars in the same proportion as they do regular income. No studies to date have based their estimates on the observed or actual behavior of lease and royalty recipients, an important limitation which this study begins to remedy.

2. Leakage of Employee Wages and Salaries

Loss of economic impact also occurs to the extent that workers receiving wages, salaries, and other compensation spend their incomes outside of the community – an eventuality that is much more likely if they live elsewhere. Wages to transient workers typically do have some local economic impact, since such workers spend part of their income in the area where they are temporarily living (such as rent, hotel or campground fees, food, entertainment, and other basic living expenses). But since their permanent residence is elsewhere, a larger share of their earnings immediately leave the community than do wages going to local workers.

The proportion of natural gas workers who are from out of state has been a source of controversy and sensitivity in some regions of Pennsylvania, in part because little concrete information has been available about the residence of such workers. There is little doubt that many workers in highly specialized fields, such as directional drillers, perforators, and well completion supervisors, currently are from outside the Commonwealth. Relatively few Pennsylvanians have the skills or training to immediately fill such positions, and until local training programs ramp up and Pennsylvanians get on-the-job experience to do these jobs safely, such jobs likely will remain largely held by non-residents. At the same time, however, there is also little doubt that a substantial number of the new jobs in the gas industry are going to Pennsylvanians. Many of the jobs are in occupations already existing within Pennsylvania, such as construction, commercial drivers, and diesel mechanics, so Pennsylvanians have the skills and experience for these new job openings.

Identifying the portion of gas-related workers who are Pennsylvania residents is important from an economic impact perspective, since it affects how many wage and salary dollars remain within the Commonwealth. As with leasing and royalty dollars, from a statewide economic impact perspective it doesn't matter whether workers' permanent residence is in the county where they work or if their permanent residence is elsewhere in Pennsylvania, since those dollars will circulate somewhere in Pennsylvania. Workers retaining an out-of-state permanent residence typically will spend their income differently, with a larger share immediately leaving the Commonwealth.

3. Leakage of Business Activity

Whether the businesses providing services to the natural gas industry are located in Pennsylvania or outside the Commonwealth has similar effects on the economic impact of such spending. More of the dollars going to local businesses typically will re-circulate within the Pennsylvania economy than will dollars going to firms located outside of the Commonwealth. Locally owned businesses mean the profits are more likely to remain in the community. Location of the business also may affect the composition of the workforce, particularly the share that are long-term residents.

III. Study Methods

This economic impact study used several means to estimate the employment and income impacts of Marcellus Shale development. We relied upon the economic input-output model IMPLAN as the main tool of analysis, modifying the information with results from several surveys that we conducted. IMPLAN is among the most commonly used economic impact models, and has been frequently used to estimate the job and income effects of natural gas development (Center for Business and Economic Research, 2008; Considine, Watson, and Blumsack, 2010; Considine, Watson, Entler, and Sparks, 2009; National Energy Technology Lab, 2010; Pennsylvania Economy League, 2008; Scott and Associates, 2009). Yet there are clear cautions to its use and interpretation for natural gas development (Kay, 2011; Kinnaman, 2011).

Our study included surveys of landowners, local businesses, and local government officials to better understand how they are using dollars and the impacts they are seeing. We used Geographic Information System (GIS) data to analyze land ownership patterns related to Pennsylvania residents, non-residents, and the Commonwealth. We combined this information with industry spending data to estimate the distribution of natural gas company spending, both spatially and temporally. These numbers were then entered into the input-output model IMPLAN to estimate the multiplier effects.

A. Company Spending

1. General Spending

We attempted to gather information from the major gas companies about their economic activity, but none ultimately provided such information for use in this study. We thus relied upon published company spending information, as collected and reported by Considine, Watson and Blumsack (2009 and 2010). We adjusted the spending impacts to reflect 2009 activity levels, using the 2008 proportions shown in Table 1 of their “Emerging Giant” report and applied to the 2009 total spending from the "Update" report.

Considine et al. reported that their 2010 survey was completed by twelve companies, who collectively accounted for about 74 percent of total wells started during 2009. Since their responses accounted for such a large percentage of drilling activity, the effect of non-response bias is likely to be low. They used these responses to estimate total industry spending that year. To provide a secondary verification source, we used Pennsylvania Department of Environmental Protection data on the number of wells drilled in 2009 to estimate the per well cost that their data implies and found that it was approximately $3.6 million per well. This is consistent with the $3 to $4 million per well cost that companies independently have reported in public presentations and personal conversations.

Table 1. Natural Gas Company Spending in Pennsylvania, 2009	
Lease and Bonus	$1,728,765,000
Exploration	$243,831,000
Upstream: Drilling and Completion	$1,700,435,000
Midstream: Pipeline and Processing	$695,801,000
Royalties	$54,683,000
Other	$111,787,000
Source: Considine, Watson and Blumsack, 2010	

We used IMPLAN's modeled industry production function of purchasing relationships between business sectors, which are largely based upon the level of gas drilling activity in Pennsylvania prior to Marcellus. These likely underrepresent the number and type of supporting businesses that have either expanded or moved into the Commonwealth due to Marcellus activity. As a result, our estimates of the economic impacts of general spending by the natural gas companies may overestimate the amount of business spending leaving Pennsylvania.

2. Workforce

Wages and salaries paid to natural gas company and subcontractor employees have additional economic impacts because these workers spend their earnings on food, housing, recreation, and other household needs. The size of these multiplier effects, however, depends upon where those workers live, and thus where they spend those dollars. This distinction is critical to understanding the degree of economic impact produced by the development of the region. If natural gas company employees maintain their primary residence in the community where the drilling is occurring, or elsewhere in Pennsylvania, workers will be spending a significant amount of their wages and salaries within the Commonwealth, resulting in additional economic impact as those dollars circulate through the economy. If the workers are non-Pennsylvania residents, some of their earnings will immediately leave the Commonwealth as they send wages back 'home' to family.

For this study, the proportion of resident and non-resident workers was set using data from a Marcellus Shale Education & Training Center online survey of gas companies conducted in 2010 as part of a workforce needs assessment (Brundage et al, 2011). The responses indicated that 62.7 percent of the workers are Pennsylvania residents and 37.3 percent are non-residents. This percentage likely slightly overestimates the actual percentage of Pennsylvania workers in 2009, and thus our results likely slightly overestimate the economic impact of payroll spending.

Total company payroll spending in 2009 was estimated by taking the $66 million total payroll in 2008 reported by Considine et al (2009) and adjusting it upwards by 40 percent, based upon their 2010 report that companies' total gas expenditures increased by about 40 percent between 2008 and 2009. This total payroll, including benefits and taxes, was divided between Pennsylvania and non-Pennsylvania

labor using the proportions from the online survey. The payroll going to Pennsylvania workers was added to IMPLAN as new tax-adjusted household income. Because spending patterns differ by household income, we assumed workers typically were in the median family of four income category (which is about $72,000 a year).[1]

We generated two scenarios about payroll going to non-Pennsylvanians, in recognition that workers from out of state send some of their income back to their home state community. We ran the model under the assumption that non-Pennsylvania workers spend 50 percent of their Marcellus-earnings inside Pennsylvania, and alternatively that they spend 75 percent of their earnings here. Because non-resident workers likely have different local spending patterns than typical resident workers, we estimated the impacts of their spending using a lower income category in the IMPLAN model more typical of renting households.

B. Leasing and Royalties

Not all leasing and royalty dollars are immediately spent in the local or state economy, since some of the dollars go to non-Pennsylvania residents (and thus immediately leave the state), and mineral right owners typically save at least a portion of such dollars for use in later years. In addition, how dollars are spent has important implications for that economic impact. The Commonwealth of Pennsylvania itself is a significant mineral right owner, and thus is receiving significant leasing and royalty dollars. Its use of these dollars differs from households, so it has its own economic impact which must be analyzed separately

We used GIS analysis and a survey of households receiving leasing and royalty income to estimate how many leasing and royalty dollars went to Pennsylvania households, how many went to the Commonwealth, and how households spent those funds. Each of these will be explained in turn.

1. GIS Analysis of Ownership

In Pennsylvania, as in most other states, surface land owners do not necessarily own the mineral rights under their land. Surface and mineral rights can be severed, and be owned (and sold) separately from each other. This is relatively common in areas of Pennsylvania which historically have experienced coal mining and natural gas or petroleum development. Many of these rights were severed generations ago

[1] Per the suggestion of an outside reviewer, we conducted sensitivity analysis on the "income type" of household that receives the royalty payments. We re-ran the analysis providing identical income shocks to IMPLAN household income cohorts immediately below ($35,000-$50,000) and above ($75,000-$100,000) the median cohort. The resulting differences in total employment impacts were very small (less than 10 jobs) compared to the results when we used the median income category.

when resource development first began there. Mineral rights can be owned by companies (such as coal companies) or by private individuals.

We could find no publicly available documentation that tracks ownership of mineral rights, other than on a deed-by-deed basis. We talked with several county tax assessors, and they confirmed that they were unaware of any resource that provides clear information about who owns mineral rights. Indeed, this is why natural gas companies are conducting intensive deed research on each parcel they want to lease. There is no easy way to identify what percentage of mineral rights are owned by the Commonwealth, by companies, and by private individuals (much less what percentage of these individuals are residents of the county, residents elsewhere in Pennsylvania, or live outside Pennsylvania).

Unlike mineral rights, all county governments maintain active records of surface ownership, compiled so it is possible to clearly and easily identify owners of parcels and to identify aggregate patterns of ownership. GIS data on land ownership is available in each county within the Marcellus region, which allowed us to calculate the percentage of land owned by the state and by the private sector. For six of the primary Marcellus counties (Bradford, Fayette, Greene, Lycoming, Tioga, and Washington counties, which collectively accounted for 68 percent of all Pennsylvania Marcellus Shale wells drilled from 2007 through fall 2010), available data from the Conservation Biology Institute's United States Protected Areas shape file allowed us to further split private ownership patterns into the percentage of land owned by residents of each county, owned by residents elsewhere in Pennsylvania, and owned by people living in other states. We weighted this information by acreage to calculate an average proportional breakdown of private ownership patterns and assumed that these proportions applied in other counties (see Table 2).

Table 2. Percent of Acres in Marcellus Counties, by Ownership Type

	Percent Public	Percent Private	Percent Private, Owned in County	Percent Private, Owned Elsewhere in PA	Percent Private, Owned Out-of-State
Calculations Based Upon GIS Analysis					
All counties with Marcellus	17%	83%	-	-	-
Bradford	8%	92%	60%	22%	10%
Fayette	13%	87%	64%	14%	9%
Greene	4%	96%*	55%	31%	9%
Lycoming	33%	67%	14%	49%	4%
Tioga	25%	75%*	47%	19%	8%
Washington	4%	96%*	80%	9%	7%
Private Ownership Estimates based upon the GIS Analysis					
Weighted estimate for all counties with Marcellus*			50.6%	24.7%	7.7%

**Numbers do not add to the 'Percent Private' ownership due to rounding error*

We assumed that leasing and royalty dollars are distributed across landowners based upon these ownership percentages, even though the productivity of individual wells will vary, and actual lease values and royalty percentages vary based upon when mineral right owners signed and how well they were able to negotiate. This should not make a difference for the overall impacts of household spending, but it does mean that the study likely overestimates the amount of dollars going to such households and underestimates the amount going to the state, since the Commonwealth has been able to negotiate better leasing terms than many mineral right owners.

2. Survey of Landowners

How leasing and royalty dollars are being spent was estimated through a household survey we sent to 1,000 landowners located within one thousand feet of active Marcellus wells in Pennsylvania's Bradford and Tioga counties. In both counties, most landowners do own their mineral rights, making it possible to use landownership records to contact mineral right owners. We identified the landowners using GIS property records and drew a 1,000 foot radius circle around active wells in the two counties using the wells' longitude and latitude information listed in Pennsylvania Department of Environmental Protection reports. One thousand landowners were randomly selected from this list, and they were sent paper surveys in the fall of 2010. The sample included 516 landowners from Bradford County and 484 from Tioga County. Two follow up reminders were sent to non-responders.

Surveys were received back from 501 landowners, for a response rate of 50.1 percent. Surveys were returned from 23 people who said their oil and gas rights had not been leased for natural gas drilling in the Marcellus Shale; their answers were dropped from the analysis. The final breakdown of responses was 254 from Bradford County, and 224 from Tioga County.

i. Where the Owners Live

About 71 percent of the Bradford County land was owned by respondents whose primary residence was in that county, and 65 percent of the Tioga County land was owned by respondents whose primary residence was in that county. About 6 percent of the respondents reported that their primary residence was outside of Pennsylvania, with the most common states being New Jersey (10 respondents), New York (6 respondents), and Florida (5 respondents). The percentage of local land owners differs from the county-wide GIS analysis of land ownership, but it isn't clear if the difference is due to response bias (e.g. Bradford and Tioga county residents were more likely to respond to the survey than were owners living outside the county), if the ownership patterns around the active wells in those counties are not representative of patterns across each county, or if non-county residents tend to own larger parcels than local residents.

ii. Dollars Received for Leasing

The amount of leasing dollars received per acre varied dramatically amongst landowners, ranging from $1 per acre to $5,750 per acre. Equal percentages of landowners reported receiving either less than $50 per acre or from $1,000 to $3,000 per acre (about 30 percent, respectively). These percentages are about equal across both Bradford and Tioga counties. The majority of the less than $50 per acre leases were signed in 2006, while the majority of the $1,000 to $3,000 per acre leases were signed in 2008. About 70 percent of the leases receiving over $3,000 per acre were signed in 2009.

iii. Use of Leasing and Royalty Dollars

Four hundred and twelve of the respondents had leased their land for natural gas drilling (rather than a prior owner having done so). The vast majority received their lease payment as a one-time payment, with only 15 percent receiving the payment split over multiple years. Of those landowners leasing their rights, 161 respondents had received royalty income, with the vast majority receiving royalties (73 percent) reporting they received $25,000 or less so far. About ten percent of respondents reported receiving $100,000 or more in royalties, and four (2 percent) said they had received $250,000 or more in royalties. Many of the parcels which had been leased by prior owners had been leased decades previously.

When weighted by the amount of dollars each landowner was paid, about 55 percent of the total leasing dollars were saved in the year they were received (see Table 3), rather than being immediately spent. About 66 percent of all the royalty dollars were similarly saved for the future. Other common uses included paying state and federal taxes (17 percent of leasing dollars), purchasing vehicles (9 percent of leasing dollars), and real estate (5 percent of leasing dollars). Other than the state and federal taxes, these are not typical consumer spending, indicating that households receiving lease and royalty dollars are using these dollars differently than normal income.

Table 3. Mineral Right Owners' Use of Leasing Dollars

Sectors	Total Spent	%
Consumer Goods	$ 4,738	0.2%
Food	$ 229	0.01%
Farming	$ 103,191	4.36%
Motor Vehicles	$ 213,658	9.02%
Health Services and Insurance	$ 38,977	1.65%
Investments, Savings, & Finances	$ 1,307,501	55.19%
New Building Construction/Home Improvements	$ 41,561	1.75%
Real Estate	$ 122,100	5.15%
Taxes	$ 415,130	17.52%
Vacations, Travel, & Entertainment	$ 8,430	0.36%
Other	$ 113,387	4.79%
Total	$ 2,368,902	100.00%
		N= 42

The spending on 'farming' reflects that much of the leasing and royalty dollars are going to farmers, which is not surprising given that farmers own a significant proportion of Pennsylvania's land. Such spending is consistent with anecdotes and written comments in the survey that many farmers are using Marcellus dollars to buy new tractors, fix barns, and build new structures.

We estimated the impacts of household spending by increasing household expenditures using the categories identified in Table 3. We subsequently aggregated the IMPLAN sectors representing each of the broader spending categories. We applied default IMPLAN margins to the consumer goods, food, automotive, and health services category. For farm spending, within IMPLAN we separated out hard expenses (machinery and buildings) from operating expenses and calculated the ratio of machinery and building expenses to operating expenses, which was about 2:1. We then used this ratio to allocate farm spending between these two categories of farm investments.

From an economic impact perspective, spending on 'real estate' primarily involves simply shifting existing assets between owners rather than creating new economic value. The commissions paid to realtors, financing costs, deed searches, and other costs associated with buying and selling real estate do have an economic impact, however, since these are payments for services. For this study, we assumed that 10 percent of the spending on real estate went for such commissions and activities, and the remaining 90 percent was simply a transfer of existing assets between owners. Improvements to real estate, such as new building construction and home improvements, also have an economic impact, since these are spending to create assets, but this was a separate category in the survey and was included directly in the analysis.

3. Allocation of Leasing and Royalty Dollars in the Study

We allocated leasing and royalty dollars within the study based upon the GIS and survey analysis. For the purposes of this study, we assumed that mineral right ownership patterns are identical to land ownership patterns, but we believe that this likely overestimates the amount of leasing and royalty dollars going to Pennsylvanians and thus the economic impact of such dollars. Many of these rights were severed generations ago and have subsequently been passed down through families, splintering into multiple ownership across children and grandchildren. Given the relatively high amount of outmigration from Pennsylvania over the past decades, it is expected that many of the current mineral right owners do not live in the Commonwealth.

Because of the uncertainty about how mineral right ownership varies from surface right ownership, we estimated two scenarios about the impacts of leasing and royalty payments on private property owners. The first scenario used the GIS analysis about out-of-state land ownership to assume that 7.7 percent of all leasing and royalty payments go to non-Pennsylvania residents (as in Table 2), while the second scenario assumed that 15.4 percent of all those payments go out-of-state.

The GIS analysis indicated that seventeen percent of land in Pennsylvania counties with Marcellus is owned by the public sector, which primarily is the Commonwealth. In the analysis, we thus allocated 17 percent of all leasing and royalty dollars directly to the state. We assumed that these dollars went directly into the General Fund and were spent the same way as other General Fund monies. This assumption overestimates the current economic impact of the leasing and royalty dollars the Commonwealth is receiving because many of those dollars are instead going into the Oil and Gas Fund,

or similar savings funds managed by the Pennsylvania Game Commission or other agencies, and thus were not spent in 2009.

We estimated the impact of leasing dollars by increasing household expenditures in the spending categories identified from the household survey. Income the respondents said they paid in taxes was allocated between federal and state taxes based upon the ratio of individual federal income taxes paid by Pennsylvanians (Internal Revenue Service) and personal income tax collections reported by the Pennsylvania Department of Revenue. Most local municipalities and school districts in Pennsylvania levy an earned income tax, but since leasing dollars are not subject to that tax, we did not include it in the ratio. According to these calculations, about 18 percent of total personal income taxes paid in Pennsylvania went to the Commonwealth with the remainder going to the Federal government. We divided state tax payments between non-education state government spending and education state spending using the actual proportions of General Fund spending in 2009-2010 (63 percent and 37 percent, respectively) (Commonwealth of Pennsylvania, 2009). Because the spending detail from the landowner survey does not match up well with aggregated IMPLAN spending categories, the scenario had to be run in IMPLAN's disaggregated model, whose level of detail is difficult to include in a report. We thus only present the total effects rather than all the detail.

Survey respondents indicated that they saved about 66 percent of the royalty dollars they received. Savings generate a minor amount of new economic activity for the financial firms handling the funds, so in our analysis we assumed that savings would generate service fees of 1.5 percent, generating new activity within the financial services sector. Forty-two respondents completed the question about the percentage of royalty income they spent in the year they received those dollars, but only 10 completed the detailed questions about where they actually spent those 34 percent of royalty dollars. Due to this relatively small number of responses, we estimated the impact of the royalty dollars respondents spent in 2009 by increasing household income in the median income household spending category for Pennsylvania.

C. Local Business Effects

IMPLAN estimates the secondary economic impacts across all economic sectors by extrapolating from economic relationships within the model. As a means of verifying whether such secondary impacts are occurring, as part of this study we surveyed 1,000 businesses in both Bradford and Washington counties (for a total of 2,000 businesses). Businesses were randomly selected using a commercially available list of active businesses having an office or location physically within the county. Bradford County was selected because it has experienced the most Marcellus drilling activity of any Pennsylvania county through the end of 2010, with 482 wells drilled since 2008 (and 355 of these in 2010). Washington County was selected because it has experienced the third highest amount of Marcellus drilling activity and the most of any county in southwest Pennsylvania. The county has had 305 Marcellus wells drilled since 2008, with 135 in 2010. Because of the significant population size difference between the two counties (60,384 residents in Bradford County in 2009, according to the U.S. Census, compared to

200,505 in Washington county), we expected that business impacts would be more visible in Bradford County than in Washington County.

The paper survey was mailed to business owners or local branch managers during October 2010, and two follow-up reminders were sent to non-responders. Surveys were received back from 619 businesses, for a response rate of 31 percent. This included 360 responses from Bradford County and 259 from Washington County. Surveys were returned from 82 people who said they did not own or manage the business; their answers were dropped from the analysis. The overall responses were generally consistent with the actual business composition of each county's economy, so they are representative of actual conditions.

1. Business Impacts

One-third of all the Bradford County businesses said that their sales have increased due to drilling activity, and only 3 percent reported that sales had declined. About 23 percent of the Washington County businesses reported increased sales, and only 2 percent reported decreased sales. (See Table 4)

Table 4. Changes in Business Activity

	Percent (number) responding "yes"		
	All responses	Bradford County	Washington County
Have your business activities changed due to natural gas drilling?	17% (89)	22% (70)	9% (19)
Have your annual sales changed due to natural gas drilling?	31% (160)	35% (108)	25% (52)
Sales increased	28% (147)	32% (100)	23% (47)
Sales decreased	3% (13)	3% (8)	2% (5)

2. Changes by Business Type

Not surprisingly, the responses varied by type of business (see Table 5). Eighty percent of the hotels and campgrounds in Bradford County reported that their business activity has changed due to natural gas drilling, and 100 percent reported higher sales. Construction (35 percent), transportation (30 percent), eating and drinking places (29 percent), and wholesale trade and financial services firms (both 28 percent) in Bradford County similarly were more likely to report changes in business activity than were other business types. Half of the financial businesses in Bradford County reported higher sales due to natural gas activity, as did 44 percent of retail trade, 38 percent of eating and drinking places, and 33 percent of wholesale trade and business services establishments.

Table 5. Changes in Business Activity by Business Type				
	Have your business activities changed due to natural gas drilling?		Have your annual sales increased due to natural gas drilling?	
	Percent (number) saying "yes"		Percent (number) saying "yes"	
Business Type	Bradford County	Washington County	Bradford County	Washington County
Agriculture, Forestry, Fishing	9% (2)	0%	9% (2)	23% (3)
Mining	—	50% (1)	—	0%
Construction	35% (8)	16% (3)	27% (6)	15% (3)
Manufacturing	11% (3)	8% (1)	25% (7)	33% (4)
Transportation, Communications, Utilities	30% (3)	0%	22% (2)	0%
Wholesale Trade	28% (5)	20% (2)	33% (6)	50% (5)
Retail Trade	25% (13)	8% (3)	44% (23)	28% (11)
Financial, Insurance, Real Estate	28% (7)	10% (1)	50% (12)	40% (4)
Business Services	20% (10)	6% (3)	33% (16)	16% (8)
Professional Services	15% (9)	9% (4)	23% (13)	16% (7)
Eating and Drinking Places	29% (6)	0%	38% (8)	33% (1)
Hotels and Campgrounds	80% (4)	50% (1)	100% (5)	50% (1)

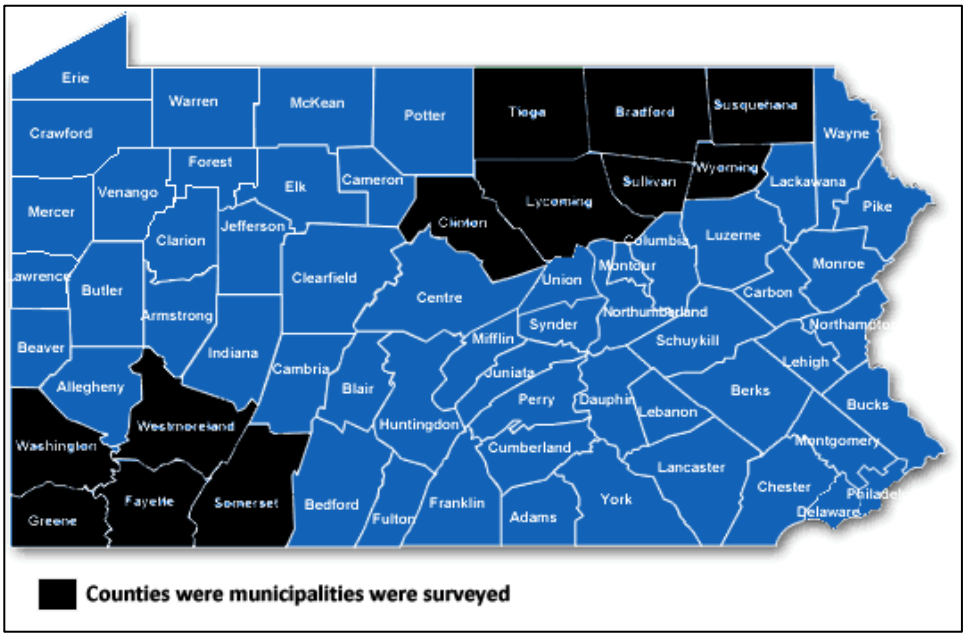
The differences between the two counties suggest that economic impacts are much more visible in smaller than in larger communities. Businesses in Bradford County typically were more likely to report impacts associated with Marcellus activity than were businesses in Washington County. Though we did not attempt to place dollar values on these survey responses, the results confirm independently from IMPLAN that many local businesses, irrespective of sector, are experiencing sales increases due to Marcellus activity. Natural gas company, worker, and mineral right owner spending related to Marcellus Shale is broadly affecting local economies in Pennsylvania.

D. Local Government Effects

IMPLAN can estimate the impact of economic activity on state and local tax collections, and this sometimes is reported with economic analysis. Yet within academic circles, the assumptions and method IMPLAN uses to make these tax estimates is recognized as potentially overly strong, particularly related to indirect and induced effects, so some analysts choose to not use or report this information. Because of these concerns, we likewise did not estimate state or local tax implications as part of this study. As an alternative, we surveyed municipal governments in Pennsylvania counties with Marcellus Shale activity to ask them directly how their tax revenues are being affected by gas development. We

also asked them how their services and costs have changed, because new tax revenues must be compared to new costs to more completely understand the impact on local governments.

The survey included all townships, boroughs, and cities in Bradford, Clinton, Fayette, Greene, Lycoming, Somerset, Sullivan, Susquehanna, Tioga, Washington, Westmoreland, and Wyoming counties, which totaled 494 jurisdictions (see Map 1). At the time of the study, these counties accounted for 76 percent of all the Marcellus Shale wells that had drilled in Pennsylvania from 2008 until fall 2010. A paper survey was sent to the Chair of the Township Supervisors or Borough or City Council President in each municipality during fall 2010, and a follow up postcard and subsequent letter were sent to non-respondents. Responses were received from 293 of these municipal governments for an overall response rate of 59 percent.



Map 1. Municipal Government Survey Counties

Of the 293 responses, 131 reported that Marcellus development activity is occurring within their jurisdiction. Such activity included drilling, but can include pipeline construction, major truck traffic, pipe yards or other staging areas, worker housing, or other Marcellus-related activity. Of these municipalities directly experiencing development activities, about 75 percent said that Marcellus Shale development had not affected their tax or non-tax revenue. About 18 percent said that revenues had increased, and one reported revenues had decreased due to Marcellus development. Another 6 percent did not know how revenues had changed.

The level of drilling activity does not seem closely related to whether a municipality reported higher revenues (see Table 6). There were differences between municipalities based upon the number of wells being drilled, but due to the relatively small numbers in some categories, these differences are not significant and should be viewed with caution. Of the 23 municipalities reporting higher revenues, only 5

said their Earned Income Tax collections had increased, 5 reported higher Real Property Tax collections, and 3 reported the Local Services Tax had increased. An additional five reported higher permit fee collections.

Table 6. Municipal Revenues and Level of Drilling Activity

Drilling Activity in Municipality	Has development or drilling of Marcellus Shale affected the tax or non-tax revenues your municipality receives? *Percent (number) responding*			
	No change	Revenues Increased Overall	Revenues Decreased Overall	Don't Know
No wells	82% (18)	18% (4)		
1-10 wells	74% (57)	18% (14)		8% (6)
11-25 wells	77% (10)	8% (1)	8% (1)	8% (1)
26-50 wells	40% (2)	60% (3)		
51-75 wells		100% (1)		
Over 75 wells	100% (1)			

The number of municipalities reporting higher earned income and local services tax collections seems unusually low, since higher employment in these townships to drill the wells should increase the number of workers and residents owing both taxes. The low responses may be occurring for several reasons, including how taxes are paid when employees work in multiple municipalities, that not all municipalities levy these taxes, or problems with withholding and submitting the taxes. They could also occur if the local officials' perceptions were inaccurate.

State law specifies that taxpayers working in multiple municipalities only pay these two taxes in one municipality, rather than in each municipality where they work. Earned income tax is paid to the municipality where the taxpayer lives, regardless of where they work, unless they work in Philadelphia or unless that jurisdiction does not levy the tax (in which case it is paid to the jurisdiction where they primarily work), and the Local Services Tax also is paid to their primarily place of occupation. Because natural gas development work moves frequently from site to site, without regard for municipal boundaries, many company employees typically work in many different municipalities each year. Only one will receive their Earned Income Tax and Local Services tax payments. The local tax impacts clearly require more study to clarify what is occurring and why. Regardless of the cause, the low numbers of municipal officials reporting higher tax revenues indicate that the majority of municipalities where drilling is occurring believe they are not receiving more tax revenues as a result of the activity.

Taxes are only one half of the potential financial impact on local governments. Equally important are the impacts on local services and on local government expenditures. About 67 percent of the 131 municipalities experiencing Marcellus activity said the services they provide have not changed. About 28 percent reported their services have increased due to natural gas development activity and 4 percent (5 municipalities) said their services have decreased overall due to Marcellus development activity. The survey did not ask about the size of such increases or decreases, so we are not able to describe how

significant these changes were. All municipalities who had to increase services identified roads as being affected and 13 (10 percent of all the 131 municipalities) said building and code enforcement had increased. Four percent said police service needs had increased, as did 2 percent who cited fire and emergency services. The latter relatively low percentage likely reflects that few municipalities themselves directly provide fire and emergency services and instead rely upon volunteers, so they either may be unaware of such change or consider such changes as not affecting their local government.

Of the municipalities indicating the need for municipal services had decreased, four said that municipal road services had decreased, and one said the need for vegetation control had decreased. The road service responses likely reflect that gas companies are repairing and rebuilding roads in affected communities, and so the need for the municipality itself to do such repairs in these four jurisdictions has decreased. There are service need differences between the municipalities based upon the amount of drilling activity (see Table 7), but these differences are not significant.

Table 7. Municipal Services and Level of Drilling Activity

Drilling Activity in Municipality	Has development or drilling of Marcellus Shale affected the services your municipality provides? *Percent (number) responding*			
	No change	Services Provided Have Increased Overall	Services Provided Have Decreased Overall	Don't Know
No wells	78% (18)	22% (5)		
1-10 wells	65% (47)	28% (20)	6% (4)	1% (1)
11-25 wells	38% (5)	46% (6)	8% (1)	8% (1)
26-50 wells	80% (4)	20% (1)		
51-75 wells	100% (1)			
Over 75 wells		100% (1)		

About 71 percent of the municipalities with Marcellus activity indicated their local government's total expenditures had not been affected by the gas development. Twenty-six percent said expenditures had increased overall, and one reported that expenditures had decreased. Three of the municipalities (2 percent) did not know how gas development had affected their expenditures. Most of the respondents reporting higher expenditures cited greater road maintenance costs, and indeed, this was 22 percent of all the municipalities with Marcellus activity. Higher spending on clerical services (8 percent of all municipalities), permitting and code enforcement, legal services (both 3 percent), and police (2 percent) were also mentioned by respondents. There were no clear patterns of expenditures when analyzed by the level of drilling activity (see Table 8).

Table 8. Municipal Expenditures and Level of Drilling Activity				
	Has development or drilling of Marcellus Shale affected your municipality's total expenditures? *Percent (number) responding*			
Drilling Activity in Municipality	No change	Expenditures Increased Overall	Expenditures Decreased Overall	Don't Know
No wells	74% (17)	26% (6)		
1-10 wells	71% (52)	26% (19)		3% (2)
11-25 wells	62% (8)	31% (4)	8% (1)	
26-50 wells	100% (5)			
51-75 wells				100% (1)
Over 75 wells		100% (1)		

The lack of clear patterns by level of drilling activity across revenues, services, and expenditures may occur because drilling is only one of multiple activities related to Marcellus that can affect municipal budgets. Prior to a well being drilled, significant work must be done conducting seismic and other studies, obtaining permits, creating access roads and well pads, and creating staging areas for companies and workers. These often occur in neighboring municipalities, rather than directly where the drilling is taking place. In addition, traffic and pipelines by necessity cross municipal boundaries. The 'per well' focus in Tables 6, 7, and 8 thus may be too narrow to adequately represent the level of Marcellus activity in a community and thus its impact on the local government.

IV. Economic Impact Results

Below we discuss the results from each type of economic impact from Marcellus Shale development and then report the overall estimated economic impact. Detailed tables for each appear in the Appendix. It is important to note that these impacts are those estimated to have occurred in 2009 due to activities in that year, not the overall impact, which will occur in subsequent years as dollars saved in 2009 later are spent.

The *direct* impacts represent the direct increase in the number of jobs due to the spending by natural gas companies, including land men, geologists, roustabouts, government relations specialists, and other company employees. The *indirect* impacts measure the additional jobs and output gained in those sectors from whom the natural gas industry contracts or purchases to develop Marcellus Shale, such as seismic and well completion companies, trucking and construction companies, gas processing, and even janitorial services. *Induced* impacts measure the additional jobs due to an increase in household and government expenditures. The total economic impact is the combination of these direct, indirect, and induced effects.

Employment is the number of jobs created as a result of the activity. Labor Income (sometimes referred to as "Employee Compensation") in IMPLAN is total payroll cost paid by the employer, including wages and salary, all benefits, and payroll taxes. Total Output is the value of industry production, which is sales minus inventory changes for manufacturers, total sales for service sectors, and gross margin for retail and wholesale trade. Value Added is the difference between total output and the cost of inputs, so in many ways is the best measure of overall economic impact.

A. Company Spending and Payroll

Natural gas company spending has impact on both general spending on purchases and services, and spending on the workforce via payroll. Based upon the amount of non-payroll industry spending in 2009 reported by Considine (2010), we estimate that the total employment effect was 13,626 jobs. This included 6,741 Pennsylvania jobs directly within the major gas companies and an additional 6,885 indirect or induced jobs (see Table 9).

Table 9. Economic Impact of Natural Gas Company Non-Payroll Spending, 2009

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	6,741	$398,405,378	$626,335,174	$1,200,667,093
Indirect Effect	2,631	$146,829,148	$250,664,416	$428,097,138
Induced Effect	4,254	$184,097,066	$316,891,277	$517,027,001
Total Effect	13,626	$729,331,592	$1,193,890,867	$2,145,791,232

Spending by these workers created an additional 704 or 817 jobs, depending upon how much non-Pennsylvania workers spend within the Commonwealth or send home to their state of residence (see Table 10).

Table 10. Economic Impact of Natural Gas Company Payroll, 2009

Impact Type	Employment	Labor Income	Value Added	Output
If 50 percent of non-resident employee income stays in PA				
Total Effect	704	$30,955,834	$52,988,161	$86,952,840
If 75 percent of non-resident employee income stays in PA				
Total Effect	817	$34,850,239	$59,674,181	$97,772,457

B. Leasing and Royalties

Leasing and royalty dollars being paid by the gas companies as a result of Marcellus Shale development in Pennsylvania primarily go to the Commonwealth of Pennsylvania and to private households. We discuss the estimated impact of each in turn.

1. Pennsylvania Government

Leasing dollars received by the Commonwealth of Pennsylvania supported approximately 5,409 total jobs in 2009 (see Table 11). This included approximately $268 million in total wages and $477 million in total output. Royalty dollars to the Commonwealth were estimated to have supported about 171 total job, and almost $16 million in total output (see Table 11). In reality, these impacts in 2009 likely were lower because the Commonwealth saved some of these leasing and royalty dollars for future use.

Table 11. Economic Impact of Lease and Royalty Payments to State Government, 2009

Lease Payments to State Government, 2009				
Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct Effect	3,718	$193,319,220	$227,647,326	$259,010,759
Indirect Effect	203	$9,640,917	$15,046,706	$26,648,423
Induced Effect	1,488	$64,765,566	$114,898,509	$191,686,833
Total Effect	5,409	$267,725,703	$357,592,541	$477,346,015
Royalty Payments to State Government, 2009				
Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct Effect	118	$6,366,637	$7,497,164	$8,723,184
Indirect Effect	6	$317,495	$495,519	$883,007
Induced Effect	47	$2,132,939	$3,783,978	$6,302,518
Total Effect	171	$8,817,071	$11,776,661	$15,908,709

2. Pennsylvania Households

The lease and royalty dollars received by Pennsylvania households similarly generated new jobs and greater economic output. Our estimates ranged from 3,360 to 3,733 new jobs created by leasing dollars received in 2009, depending upon the assumption about out-of-state mineral right ownership (see Table 12), and between 114 and 127 new jobs created by the royalty dollars. Since not many wells were on-line during 2009, it would be expected that the amount of royalty income going to households will increase significantly in later years, and thus the number of jobs will increase, while jobs created due to leasing will decline as leasing activity wanes.

Table 12. Economic Impact of Lease and Royalty Payments to Pennsylvania Households, 2009

Lease Payments to Pennsylvania Households, 2009

Impact Type	Employment	Labor Income	Value Added	Output
If 15.4 percent of mineral rights are owned out-of-state				
Direct Effect	1,939	$97,098,174	$129,963,234	$213,731,744
Indirect Effect	523	$24,836,241	$39,103,622	$69,483,690
Induced Effect	898	$39,084,680	$69,369,287	$115,692,020
Total Effect	3,360	$161,019,095	$238,436,143	$398,907,454
If 7.7 percent of mineral rights are owned out-of-state				
Direct Effect	2,154	$107,886,860	$144,403,593	$237,479,715
Indirect Effect	581	$27,595,823	$43,448,469	$77,204,100
Induced Effect	998	$43,427,422	$77,076,986	$128,546,689
Total Effect	3,733	$178,910,105	$264,929,048	$443,230,504

Royalty Payments to Households, 2009

Impact Type	Employment	Labor Income	Value Added	Output
If 15.4 percent of mineral rights are owned out-of-state				
Total Effect	114	$5,006,261	$8,605,902	$14,088,728
If 7.7 percent of mineral rights are owned out-of-state				
Total Effect	127	$5,575,826	$9,585,000	$15,691,609

C. Overall Economic Impact

1. Total Impact

The estimated total economic impact of Marcellus Shale development activity in Pennsylvania in 2009 ranged between 23,385 and 23,884 jobs and $3.1 and $3.2 billion (see Table 13). This included about $1.2 billion in labor income and almost $1.9 billion in total value added. We did not estimate tax impacts of Marcellus Shale activity because we were not comfortable with the reliability of IMPLAN's tax analysis.

Table 13. Summary of Economic Impacts and Total Economic Impact, 2009

Impact Type	Employment	Labor Income	Value Added	Output
Summary of Economic Impacts				
Natural Gas Company Non-Payroll Spending	13,626	$729,331,592	$1,193,890,867	$2,145,791,232
Natural Gas Company Payroll	704 – 817	$30,955,834 - $34,850,239	$52,988,161 - $59,674,181	$86,952,840 - $97,772,457
Lease Payments to State Government	5,409	$267,725,703	$357,592,541	$477,346,015
Royalty Payments to State Government	171	$8,817,071	$11,776,661	$15,908,709
Lease Payments to Pennsylvania Households	3,360 – 3,733	$161,019,095 - $178,910,105	$238,436,143 - $264,929,048	$398,907,454 - $443,230,504
Royalty Payments to Pennsylvania Households	114 – 127	$5,006,261 - $5,575,826	$8,605,902 - $9,585,000	$14,088,728 - $15,691,609
Total Economic Impact				
Lower Bound: if 50% of non-resident employee income stays in PA and 15.4% of mineral rights are owned out-of-state				
Total Economic Impact	23,385	$1,202,855,556	$1,863,290,275	$3,138,994,978
Upper Bound: if 75% of non-resident employee income stays in PA and 7.7% of mineral rights are owned out-of-state				
Total Economic Impact	23,884	$1,225,210,536	$1,897,448,298	$3,195,740,526

2. Multiplier

The economic multiplier we estimated varies between these two scenarios, ranging from 1.86 to 1.90, depending upon non-resident worker spending and mineral right ownership patterns. Our results suggest that for every $1 in Marcellus industry spending in the state between $1.86 and $1.90 in total economic output is generated.

3. Economic Impact on a Per Well Basis

The total economic impacts in 2009, divided by the number of wells drilled in 2009, suggest that each new Marcellus well generated 30 jobs in Pennsylvania during 2009 and around $4 million in total output within Pennsylvania's economy (see Table 14). This includes the jobs created by direct gas industry spending and indirectly through the companies with whom they contract, by worker spending of earnings, and by mineral right owner spending of leasing and royalty dollars. This estimate likely will change as the Marcellus play develops and the proportion of leasing income declines while royalty income increases. The estimate is consistent with the Brundage et al. studies of per well workforce needs, which suggest approximately 13 full time jobs are created per well. Unlike those workforce need studies, this economic impact analysis includes the employment impacts resulting from leasing and royalty income, and indirect and induced employment occurring from worker spending within the local economy.

The economic impacts within any individual Pennsylvania county or community will be much less on a per well basis because a larger share of the business spending, payroll, and leasing and royalty income will go outside those boundaries than occurs at the state level. Our GIS analysis suggests that an average of only 51 percent of land in Marcellus counties is owned by residents within each county, which means about half of leasing and royalty dollars immediately leave the community. Yet as suggested by the survey of local businesses, the economic activity likely will be much more visible in small communities due to the scale and size of Marcellus development activity.

Table 14. Total Economic Impact by Well, 2009

Impact Type	Employment	Labor Income	Value Added	Output
Lower Bound: if 50% of non-resident employee income stays in PA and 15.4% of mineral rights are owned out-of-state				
Total Economic Impact	30	$1,532,300	$2,373,618	$3,998,720
Lower Bound: if 75% of non-resident employee income stays in PA and 7.7% of mineral rights are owned out-of-state				
Total Economic Impact	30	$1,560,778	$2,417,132	$4,071,007

V. Discussion/Implications

The study results indicate that development of Marcellus Shale in Pennsylvania is having significant employment and income effects in Pennsylvania. We examined the impacts in 2009, as drilling activity began to increase substantially in the Commonwealth, so it would be expected that the economic impacts are even greater today as the industry activity has grown. A total of 785 Marcellus wells were drilled in 2009, and this number increased by 85 percent to 1,445 new wells in 2010 (PA DEP). If the per-well economic impacts from 2009 are consistent with the impacts in 2010, this would suggest that the total employment impact of Marcellus Shale activity in Pennsylvania in 2010 was around 44,000 jobs (this number includes the 23,000 plus jobs supported in 2009).

The economic impact resulting from Marcellus Shale development activity in 2009 will be spread over multiple years, rather than all occurring in 2009, because our survey of households indicated they are saving more than half of their lease and royalty dollars for later use. Our estimates focus only on the economic impact actually occurring within 2009 due to drilling activity in that year. How much impact these saved dollars had in 2010 and will have in future years depends upon how quickly the households spend those dollars and how many of those dollars are spent in Pennsylvania (for example, if some landowners are saving the money to retire in Florida). There has been some concern that Marcellus Shale development could be a boom/bust cycle, similar to what Pennsylvania experienced with prior natural resource-based economic development. The fact that households are saving a significant portion of their leasing and royalty dollars should help spread the economic impacts across multiple years, irrespective of drilling activity, helping somewhat reduce any boom/bust phenomenon.

These results, like other economic impact studies, depend critically upon the assumptions used in the analysis. Our estimates of the economic impacts of leasing and royalty income may overestimate the actual impacts because data is unavailable about who specifically owns the mineral rights, and thus who is receiving those dollars. We estimated under two scenarios (7.7 percent and 15.4 percent ownership out of state), but both could still be somewhat low. In addition, anecdotal evidence suggests that some of the mineral rights in southwest Pennsylvania are owned by coal and other companies, so those leasing and royalty dollars would not have the same impact as if they go to households.

Our results also overestimate the impact of the dollars the Commonwealth itself receives in leasing and royalty dollars, since we assumed that the state spent all those dollars in 2009. This assumption had a large effect on the overall results because state lease receipts accounted for around 23 percent of all the estimated job creation and around 15 percent of total economic output. The actual economic impacts will be less in the year the dollars are received, depending upon the extent that the state agencies and commissions receiving those dollars save them for later use.

We had to make assumptions about the proportion of wages and salary non-resident workers spend in Pennsylvania and ran the analysis using both 50 percent and 75 percent. There were differences in the results between the scenarios, but only of 113 workers. This is an approximate 16 percent difference in total payroll-related impacts, so the assumptions do not appear to have a meaningful impact on our overall results. Our results likely understate the impact of gas company non-payroll spending since we

could not accurately reflect their current purchasing patterns and particularly how the growth of the industry and supporting businesses in Pennsylvania will have increased the amount of industry spending which stays within Pennsylvania.

The responses to the survey of local business, with a relatively large number of firms saying that they are experiencing higher sales due to Marcellus Shale development, supports the IMPLAN results that gas development activity is having broad effects across the economy. This includes all sectors, not just those with a direct relationship to the drilling companies.

Our findings are less than what several previous studies have estimated as the economic impact of Marcellus Shale development in Pennsylvania, but this is not surprising because we were able to use more detailed information on where leasing, royalty, and payroll were going, and thus were able to directly consider the associated leakage. Our employment estimate of between 23,385 and 23,884 new jobs is about 52 percent of the 44,098 jobs Considine, Watson and Blumsack (2010) estimated for 2009. We conducted some sensitivity analysis of our results and determined that roughly half of this difference occurs due to our more specific leasing, royalty, and payroll data. We were able to better account for how many such dollars actually remain within the Pennsylvania economy and were spent in 2009. We believe that the remaining difference occurs because of the updates they were able to make to IMPLAN based upon the purchasing data companies provided them. Despite these differences in estimated total impact, the economic multipliers we estimated (1.86 and 1.90, depending upon scenario) are consistent with what they found.

The difference in the findings between these studies indicates that where leasing and royalty dollars go substantially affects the economic impacts of Marcellus activity. This will be even more significant when considering economic impacts at a county level or regional level. Because only about half of land in a typical Marcellus county is owned by residents of that county, it would suggest that a major portion of the economic benefits immediately leave the communities being impacted by drilling.

Importantly, our findings are consistent with several other recent employment studies of Marcellus Shale which either relied upon company interviews about employment needs (Brundage, et al. 2011) or direct observation of hiring and employment trends (Herzenberg, 2011, using Pennsylvania Department of Labor and Industry data). Brundage, et al estimated that 8,752 direct and indirect jobs were created as a result of industry spending on drilling activity in Pennsylvania during 2009, which compares to our estimate of 6,741 direct jobs resulting from industry spending and an additional 2,631 indirect jobs, for a total of 9,372 jobs. Their analysis did not include the impacts of leasing and royalty income nor all indirect and induced economic impacts as industry, worker, and mineral owner dollars flow through the economy, so is not directly comparable to our overall estimated impact of around 23,000 jobs.

Herzenberg used Pennsylvania Department of Labor and Industry data about new job creation and calculated that between the fourth quarter of 2007 and the fourth quarter of 2010, there were 9,288 new jobs within the Marcellus Core industry. This is somewhat lower than our estimate and spans several years rather than just 2009. But the definition of 'Marcellus Core' industry is narrower than the actual business relationships natural gas companies have within Pennsylvania communities, and which

IMPLAN models, so the Labor and Industry numbers undercount related employment. In addition, the data and Herzenberg's analysis do not consider leasing and royalty dollars, so is not directly comparable to our overall estimated economic impacts.

The survey responses from municipal governments similarly suggest that the local tax impacts of Marcellus Shale development are significantly lower than reported in prior studies, which had simply estimated those tax impacts without verifying what is actually occurring. In contrast, our survey results provide direct insights from local government officials that are based on their actual experience, including impacts on both revenues and expenditures, which are essential to consider together to have a complete picture of the effects on local governments.

A. Limitations of Our Study

When interpreting the results of this study, there are important limitations that must be kept in mind. This study estimated impacts in 2009, very early in the development of Marcellus. The pace of drilling activity increased in 2010, and all indications are that it will continue to increase in future years. The long run economic impacts of Marcellus Shale development, particularly for resource-dependent sectors of the economy like tourism and agriculture, likely will be very different than what occurs in the early years of development due to cumulative and scale effects as the number of wells drilled and in operation increase. Some have argued that tourism will decline (either because of actual physical changes to the landscape or because controversy over drilling scares tourists away), though others have argued that tourism may increase because access roads and pipeline rights of way are opening up previously inaccessible hunting lands and creating better ecosystems for white tailed deer, which could attract more hunters.

In addition, the composition of company spending will change significantly as the play develops with leasing activity declining and royalty dollars increasing. The proportion of worker spending remaining within Pennsylvania will rise as the share of Pennsylvania workers increases. Likewise, as the Marcellus play matures, the proportion of gas-related companies located in Pennsylvania likely will increase, reducing leakage of dollars out of the Commonwealth and increasing the economic impact. State economic policy can influence this.

The economic impact model we used for conducting the analysis, IMPLAN, has been widely used by economists for a wide variety of economic impact studies and is generally recognized as working well when studying small changes within an economy. Its widespread use allows some consistency for comparing across different studies on the same topic. In addition, many economists are familiar with its strengths and weaknesses. It does have limitations for studying significantly large economic changes which affect core relationships within the economy because the model assumes that those relationships do not change. This is the situation with Marcellus Shale, which means the results of any IMPLAN-based economic analysis of Marcellus Shale need to be viewed with caution. Despite this limitation, we chose to use IMPLAN for the study because we wanted to investigate the influence of leasing and royalty

dollars, and out of state workers, and its use allowed us to directly compare our results to previous studies of Marcellus which were not able to consider these factors.

Most importantly, this study only focused on the job and income effects of gas industry spending. These economic elements must be understood in balance with other significant effects, such as impacts on the environment, human health, society, local government, and quality of life. The full extent of these impacts is not yet known (nor likely will be known until later in the play), but current experience suggests that such changes will be occurring. Undoubtedly, the effect of Marcellus development on the environment and these other important issues will have economic implications, but it is too early in the development of the play to reliably identify the incidence of such costs and benefits.

B. What No One Knows (But Should be Known)

During the course of this study, we became increasingly aware of several critical economic aspects related to Marcellus Shale development that are either misunderstood or completely unknown, but yet are essential for a complete and comprehensive understanding of the implications and impacts of Marcellus Shale. These include the costs associated with development, the distribution of costs and benefits, the long-run implications, and what is actually occurring on a real-time basis.

1. Costs

Existing economic impact studies of Marcellus development, including this one, have focused almost exclusively on job and income creation resulting from gas industry spending, including leasing and royalty payments, payroll, and purchases from other businesses. In contrast, no economic study has included the potential costs of Marcellus Shale development, such as the impact on existing businesses losing employees due to Marcellus activity, damage and cleanup costs resulting from accidents or environmental degradation, or higher state and local government costs due to activity. There clearly are and will be costs associated with Marcellus Shale development, both out-of-pocket and non-monetary (such as the ecosystem effects of forest fragmentation or water quality impacts). There may also be opportunity costs, such as businesses who may choose not to locate or expand within Pennsylvania due to the changes resulting from Marcellus Shale development. Yet because Pennsylvania is still relatively early in the Marcellus play, these currently cannot be fully identified or quantified. Some costs may not show up until much later in the development of the play, such as when the amount of activity passes currently unknown thresholds or achieves a critical mass. That the costs currently cannot be comprehensively measured does not mean that such costs do not or will not exist, but rather means it is vital to investigate and identify them. To focus only on jobs, income, or tax revenue without putting those into a broader context can be very misleading and costly in the long run.

2. Who Is Benefiting and Who Is Bearing the Costs

The distribution of the benefits and the costs associated with Marcellus Shale development has not been fully investigated. Economic Input-Output models, such as IMPLAN, estimate total dollars across sectors and categories, but do not identify how those dollars are distributed within those sectors. In addition, since the modeling ignores costs, studies do not help understand how costs relate to the benefits, and most particularly, who bears the costs and who gets the benefits. Yet much of the publicly expressed concern about Marcellus development relates directly to such equity issues, which some would characterize as 'social justice.' The distribution of benefits and costs matters to many Pennsylvanians.

Equity issues (and conflicts) about Marcellus Shale can occur at multiple levels, including within families whose members disagree on whether to lease, between neighbors who have different visions for the community and for quality of life, between the owner of the subsurface mineral rights and the owner of the land above that parcel, between newcomers and long-term residents, between traffic-impacted boroughs with few wells and surrounding townships with many wells, between regions within Pennsylvania (such as between Philadelphia and upstream communities with Marcellus), and even between current and future generations.

We are not arguing here for or against the fairness of Marcellus activity, but rather we are stressing that differing viewpoints about its fairness do exist. Indeed, judgments about equity and fairness already underlie much of the rhetoric and public policy debate about the Marcellus Shale gas play, such as whether a severance tax is needed (and if it is, how the dollars should be distributed), to what extent local governments should be allowed to regulate and control gas development, and whether mineral right owners under some circumstances should be forced to allow drilling (e.g. forced pooling). Objective information about the costs AND the benefits of Marcellus Shale development, and particularly how these are distributed, should help people make informed value judgments about whether or how policy should change. Currently these distribution issues are not adequately known.

3. Long-Run Implications

Most of the existing uncertainty about Marcellus Shale development relates to its possible long-term effects, including water quality, land use, forest, health, and social impacts. In addition, there is uncertainty about whether the economic activity will conform to the boom/bust cycles that have occurred with energy development in the west and which have characterized Pennsylvania's prior experience with timber, coal, and petroleum development. Much of this depends upon the scale and pace of the development, plus whether there are unforeseen cumulative effects as the play is developed and the number of wells (and supporting access roads, miles of pipeline, and other infrastructure) increases. In addition, it depends upon how individuals and communities respond (for example, to what extent will recipients of leases and royalties sell the surface rights and move away with that stream of income, taking the economic benefit with them? Will communities use the current economic benefits to

strategically invest for the future?) and whether the gas is mostly exported and used out-of-state, or if it instead is used to attract other industries, and thus helps build a more diversified and strong economy in the Commonwealth. No one knows the answers to these questions because much of this will occur in the future, but it is important to be gathering appropriate information now so we can predict and anticipate these earlier rather than later. In addition, local, state, and federal policy will influence this future.

4. What Is Actually Occurring

A variety of secondary data is being collected that provides insights into the impacts of Marcellus Shale, such as at the state level by the Department of Environmental Protection, the Department of Revenue, and the Department of Labor and Industry, and at the federal level by the U.S. Census Bureau. Such data collection and monitoring is critical to identify any problems before they grow too large and to identify opportunities when there is time to take full advantage of them. Yet existing datasets often lag by several years, which means our knowledge is of the past rather than of the present, which can be misleading with fast-paced development like Marcellus. In addition, there has been little effort to date to bring these different datasets together to provide a comprehensive understanding (and monitoring) of activities.

Of greater concern is that some important data currently are not being collected or aggregated, which means there are significant things we do not know, much less have a means of knowing. This includes how much leasing has occurred, and thus what percentage of land area potentially could be affected by drilling; who the workers are and how many are Pennsylvania residents versus from out-of-state; baseline environmental monitoring of groundwater quality, forest ecosystem diversity, air quality, and other natural resources potentially being affected by development; baseline monitoring of social and community impacts, such as effects on renters and low income residents, family well-being, housing affordability and access, and social services; and monitoring of human and animal health near active sites.

Most importantly for the economic development impacts, information about who actually owns the mineral rights is not being comprehensively collected, and thus no one knows where leasing and royalty dollars are going. Neither the Commonwealth nor county governments track mineral right ownership, unlike ownership of surface rights, which counties compile into comprehensive records. The result is that in places where surface and mineral rights have been severed, no one knows where leasing and royalty dollars are going, both by type of recipient (e.g. private household, public sector, or business) and by location (e.g. living within the community, living elsewhere in Pennsylvania, or living outside of the Commonwealth). Ownership of such rights is important to know from economic development and equity perspectives because it affects how much of the economic benefit stays within the community where drilling activities are occurring (and thus to what extent the people living with the inconveniences are receiving positive benefits from that activity).

VI. Conclusions

Our study of the economic impact of Marcellus Shale indicates that it had major impact within Pennsylvania during 2009. As with prior studies of Marcellus Shale in Pennsylvania, we relied upon the standard Input-Output economic model IMPLAN to estimate the direct, indirect, and induced effects across the economy and found that Marcellus Shale-related activity accounted for approximately 24,000 new jobs and $3 billion of economic output in Pennsylvania during 2009.

These estimates are smaller than prior economic studies of Marcellus, primarily because we were able to account for how leasing and royalty income are being used. Our survey of landowners and the GIS analysis of landownership patterns allowed us to estimate how many leasing and royalty dollars are going directly to Pennsylvania residents, the Commonwealth, and to non-resident property owners and how those dollars are actually being spent. Our results confirm that where leasing and royalty dollars are going has significant effect on the overall economic impacts of Marcellus Shale development, so it is vital to pay close attention to such payments to have an accurate view on the distribution of economic benefits and costs from Marcellus Shale development. Because only about half of land in a typical Marcellus county is owned by residents of that county, it would suggest that a major portion of the economic benefits immediately leave the communities being impacted by drilling.

In addition, we accounted for how many Marcellus workers are non-Pennsylvanian, and thus how much payroll is not going to Pennsylvania households. Such workers do spend some of their income in Pennsylvania, but they tend to spend it differently than do residents, which affects the overall economic impacts.

Our study included a survey of local businesses, which confirmed the IMPLAN results that positive economic impacts are occurring broadly across the economy in the communities where drilling is very actively occurring. About one-third of all the businesses in Bradford County, for example, reported that their sales had increased due to natural gas development and only 3 percent reported sales had declined.

We also surveyed Pennsylvania local governments in the Marcellus Shale region to identify whether they are experiencing new tax revenues, new service demands, or new costs as a result of the early stages of Marcellus Shale development. A number of local governments reported that these had increased, but there was little pattern to their responses in relation to the amount of drilling activity occurring within their jurisdiction. Only 18 percent of the governments experiencing Marcellus development activity said their tax revenues had increased, which indicates that most local governments with Marcellus activity are not seeing more tax revenue as a result. In comparison, 26 percent of the local governments indicated that their costs had increased, particularly related to road expenses. This confirms that considering both revenues and costs is critical for having a complete understanding of the impacts of Marcellus Shale.

We did not attempt to quantify the costs of Marcellus Shale development, such as effects on the environment and health. We hope that future economic studies can consider such costs as better

information becomes available about the incidence and extent of such impacts. In addition, we did not address the distribution of benefits and costs, even though the equity of how these are distributed underlies much of the current policy debate about Marcellus Shale. The long run implications of Marcellus Shale development are still unknown. Jobs and income in the short run are important, but many would argue that other factors are equally (if not more) important, such as clean water, healthy forests and other ecosystems, clean air, and good public health. In addition to affecting quality of life, these are important resources for the future of Pennsylvania communities, including future economic opportunities, social and physical infrastructure, well-functioning local government and institutions, and community well-being. We believe our results must be viewed as a preliminary, short-run view of the economic impacts of Marcellus Shale, and be placed in a broader context of these other important concerns.

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VIII. Appendices

Appendix 1. Marcellus Natural Gas Industry Spending Results

Output					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$1,200,667,093	$428,097,138	$517,027,001	$2,145,791,233
1	11 Ag, Forestry, Fish & Hunting	$4,706,562	$1,401,464	$1,158,103	$7,266,129
20	21 Mining	$474,430,258	$17,521,225	$1,043,333	$492,994,816
33	22 Utilities	$5,675,796	$12,752,545	$12,038,327	$30,466,668
34	23 Construction	$378,171,901	$6,242,481	$2,149,609	$386,563,992
41	31-33 Manufacturing	$9,013,135	$60,938,528	$34,427,891	$104,379,554
319	42 Wholesale Trade	$194,407,911	$34,324,793	$25,103,738	$253,836,441
320	44-45 Retail trade	$9,303,714	$13,850,988	$46,663,562	$69,818,264
332	48-49 Transportation & Warehousing	$37,593,267	$28,914,245	$13,871,566	$80,379,079
341	51 Information	$425,882	$20,771,076	$18,586,472	$39,783,430
354	52 Finance & insurance	$572,142	$33,375,849	$66,491,790	$100,439,781
360	53 Real estate & rental	$842,046	$54,479,472	$89,572,925	$144,894,443
367	54 Professional- scientific & tech services	$70,525,649	$76,160,148	$24,394,990	$171,080,787
381	55 Management of companies	$0	$24,259,451	$5,698,687	$29,958,138
382	56 Administrative & waste services	$9,794,052	$19,843,289	$12,200,535	$41,837,876
391	61 Educational services	$1,309,237	$284,576	$12,227,617	$13,821,430
394	62 Health & social services	$1,303,644	$39,703	$92,871,967	$94,215,314
402	71 Arts- entertainment & recreation	$579,029	$1,631,571	$7,829,442	$10,040,043
411	72 Accommodation& food services	$717,045	$5,488,889	$24,271,390	$30,477,325
414	81 Other services	$1,295,823	$8,021,215	$17,554,423	$26,871,460
427	92 Government & non NAICs	$0	$7,795,630	$8,870,635	$16,666,266
Value added					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$626,335,174	$250,664,416	$316,891,277	$1,193,890,867
1	11 Ag, Forestry, Fish & Hunting	$1,553,659	$462,630	$382,295	$2,398,584
20	21 Mining	$226,303,866	$8,400,164	$500,203	$235,204,232
33	22 Utilities	$3,279,844	$7,401,126	$6,986,619	$17,667,588
34	23 Construction	$176,414,670	$3,009,539	$1,036,340	$180,460,548
41	31-33 Manufacturing	$2,541,090	$17,125,363	$9,675,162	$29,341,616
319	42 Wholesale Trade	$131,192,812	$22,589,089	$16,520,728	$170,302,629
320	44-45 Retail trade	$7,917,929	$11,680,779	$39,352,191	$58,950,899
332	48-49 Transportation & Warehousing	$19,737,700	$15,476,604	$7,424,878	$42,639,182
341	51 Information	$225,655	$11,058,350	$9,895,285	$21,179,290
354	52 Finance & insurance	$326,404	$19,276,801	$38,403,488	$58,006,693
360	53 Real estate & rental	$593,583	$38,147,930	$62,721,270	$101,462,784
367	54 Professional- scientific & tech services	$47,235,368	$52,500,219	$16,816,437	$116,552,023
381	55 Management of companies	$0	$15,970,647	$3,751,598	$19,722,245

382	56 Administrative & waste services	$6,084,957	$12,568,111	$7,727,433	$26,380,501
391	61 Educational services	$767,889	$171,855	$7,384,237	$8,323,981
394	62 Health & social services	$737,597	$23,031	$53,872,749	$54,633,377
402	71 Arts- entertainment & recreation	$339,804	$981,029	$4,707,677	$6,028,510
411	72 Accommodation& food services	$361,707	$2,810,475	$12,427,675	$15,599,858
414	81 Other services	$720,642	$4,545,952	$9,948,811	$15,215,405
427	92 Government & non NAICs	$0	$6,464,724	$7,356,199	$13,820,923
Labor Income					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$398,405,378	$146,829,148	$184,097,066	$729,331,592
1	11 Ag, Forestry, Fish & Hunting	$1,243,058	$370,143	$305,868	$1,919,069
20	21 Mining	$102,756,963	$3,814,231	$227,125	$106,798,319
33	22 Utilities	$950,784	$2,145,490	$2,025,330	$5,121,603
34	23 Construction	$150,200,762	$2,562,344	$882,347	$153,645,453
41	31-33 Manufacturing	$1,396,083	$9,408,729	$5,315,565	$16,120,378
319	42 Wholesale Trade	$76,418,158	$13,157,859	$9,623,115	$99,199,132
320	44-45 Retail trade	$4,764,601	$7,028,890	$23,680,119	$35,473,611
332	48-49 Transportation & Warehousing	$14,570,645	$11,425,045	$5,481,148	$31,476,839
341	51 Information	$114,213	$5,597,050	$5,008,379	$10,719,642
354	52 Finance & insurance	$164,397	$9,709,010	$19,342,413	$29,215,820
360	53 Real estate & rental	$46,330	$2,977,484	$4,895,457	$7,919,270
367	54 Professional- scientific & tech services	$38,495,755	$42,786,489	$13,705,015	$94,987,259
381	55 Management of companies	$0	$13,107,316	$3,078,985	$16,186,301
382	56 Administrative & waste services	$4,741,450	$9,793,179	$6,021,281	$20,555,910
391	61 Educational services	$728,465	$163,032	$7,005,119	$7,896,615
394	62 Health & social services	$681,535	$21,280	$49,778,051	$50,480,866
402	71 Arts- entertainment & recreation	$232,351	$670,808	$3,219,014	$4,122,172
411	72 Accommodation& food services	$253,111	$1,966,678	$8,696,480	$10,916,269
414	81 Other services	$646,719	$4,079,632	$8,928,271	$13,654,622
427	92 Government & non NAICs	$0	$6,044,460	$6,877,981	$12,922,441
Employment					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	6,741.40	2,630.80	4,253.70	13,625.90
1	11 Ag, Forestry, Fish & Hunting	69.6	20.5	16.9	107.1
20	21 Mining	1,614.50	60.5	3.6	1,678.60
33	22 Utilities	6.8	15.6	14.7	37.1
34	23 Construction	2,861.80	49.3	17	2,928.00
41	31-33 Manufacturing	19.9	135.6	76.6	232.1
319	42 Wholesale Trade	988.1	171.7	125.6	1,285.40
320	44-45 Retail trade	164.6	245.1	825.6	1,235.30
332	48-49 Transportation & Warehousing	282.8	223.8	107.4	614
341	51 Information	1.4	70.5	63.1	135.1
354	52 Finance & insurance	2.4	140.7	280.2	423.2
360	53 Real estate & rental	2.6	169.3	278.4	450.3
367	54 Professional- scientific & tech services	512.3	574.6	184.1	1,271.00

381	55 Management of companies	0	110	25.8	135.9
382	56 Administrative & waste services	144.3	300.8	184.9	630
391	61 Educational services	17.4	3.9	168.9	190.2
394	62 Health & social services	13.1	0.4	965.6	979.1
402	71 Arts- entertainment & recreation	9.5	27.8	133.5	170.8
411	72 Accommodation& food services	11.9	93.3	412.5	517.7
414	81 Other services	18.2	115.9	253.7	387.9
427	92 Government & non NAICs	0	101.5	115.5	217.1

Appendix 2. Marcellus Natural Gas Industry Payroll Impacts: Scenario 1

Scenario 1: If 50 Percent of Non-Resident Worker Income Leaves Pennsylvania

Output					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$86,952,840	$86,952,840
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$200,818	$200,818
20	21 Mining	$0	$0	$182,838	$182,838
33	22 Utilities	$0	$0	$2,156,805	$2,156,805
34	23 Construction	$0	$0	$362,199	$362,199
41	31-33 Manufacturing	$0	$0	$5,925,582	$5,925,582
319	42 Wholesale Trade	$0	$0	$4,452,032	$4,452,032
320	44-45 Retail trade	$0	$0	$6,732,106	$6,732,106
332	48-49 Transportation & Warehousing	$0	$0	$2,264,402	$2,264,402
341	51 Information	$0	$0	$3,161,565	$3,161,565
354	52 Finance & insurance	$0	$0	$10,928,098	$10,928,098
360	53 Real estate & rental	$0	$0	$15,020,759	$15,020,759
367	54 Professional- scientific & tech services	$0	$0	$4,166,232	$4,166,232
381	55 Management of companies	$0	$0	$975,913	$975,913
382	56 Administrative & waste services	$0	$0	$2,055,236	$2,055,236
391	61 Educational services	$0	$0	$1,943,453	$1,943,453
394	62 Health & social services	$0	$0	$16,603,941	$16,603,941
402	71 Arts- entertainment & recreation	$0	$0	$1,288,409	$1,288,409
411	72 Accommodation& food services	$0	$0	$4,002,456	$4,002,456
414	81 Other services	$0	$0	$3,014,620	$3,014,620
427	92 Government & non NAICs	$0	$0	$1,515,374	$1,515,374
Value added					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$52,988,161	$52,988,161
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$66,291	$66,291
20	21 Mining	$0	$0	$87,658	$87,658
33	22 Utilities	$0	$0	$1,251,733	$1,251,733
34	23 Construction	$0	$0	$174,619	$174,619
41	31-33 Manufacturing	$0	$0	$1,665,248	$1,665,248
319	42 Wholesale Trade	$0	$0	$2,929,875	$2,929,875
320	44-45 Retail trade	$0	$0	$5,677,302	$5,677,302
332	48-49 Transportation & Warehousing	$0	$0	$1,212,041	$1,212,041
341	51 Information	$0	$0	$1,683,191	$1,683,191
354	52 Finance & insurance	$0	$0	$6,311,713	$6,311,713
360	53 Real estate & rental	$0	$0	$10,517,922	$10,517,922
367	54 Professional- scientific & tech services	$0	$0	$2,871,949	$2,871,949
381	55 Management of companies	$0	$0	$642,470	$642,470
382	56 Administrative & waste services	$0	$0	$1,301,722	$1,301,722

391	61 Educational services	$0	$0	$1,173,648	$1,173,648
394	62 Health & social services	$0	$0	$9,631,539	$9,631,539
402	71 Arts- entertainment & recreation	$0	$0	$774,693	$774,693
411	72 Accommodation& food services	$0	$0	$2,049,377	$2,049,377
414	81 Other services	$0	$0	$1,708,509	$1,708,509
427	92 Government & non NAICs	$0	$0	$1,256,663	$1,256,663
Labor income					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$30,955,834	$30,955,834
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$53,038	$53,038
20	21 Mining	$0	$0	$39,802	$39,802
33	22 Utilities	$0	$0	$362,861	$362,861
34	23 Construction	$0	$0	$148,672	$148,672
41	31-33 Manufacturing	$0	$0	$914,892	$914,892
319	42 Wholesale Trade	$0	$0	$1,706,615	$1,706,615
320	44-45 Retail trade	$0	$0	$3,416,307	$3,416,307
332	48-49 Transportation & Warehousing	$0	$0	$894,746	$894,746
341	51 Information	$0	$0	$851,927	$851,927
354	52 Finance & insurance	$0	$0	$3,178,976	$3,178,976
360	53 Real estate & rental	$0	$0	$820,934	$820,934
367	54 Professional- scientific & tech services	$0	$0	$2,340,574	$2,340,574
381	55 Management of companies	$0	$0	$527,283	$527,283
382	56 Administrative & waste services	$0	$0	$1,014,313	$1,014,313
391	61 Educational services	$0	$0	$1,113,391	$1,113,391
394	62 Health & social services	$0	$0	$8,899,476	$8,899,476
402	71 Arts- entertainment & recreation	$0	$0	$529,719	$529,719
411	72 Accommodation& food services	$0	$0	$1,434,087	$1,434,087
414	81 Other services	$0	$0	$1,533,252	$1,533,252
427	92 Government & non NAICs	$0	$0	$1,174,968	$1,174,968
Employment					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	0	0	704.4	704.4
1	11 Ag, Forestry, Fish & Hunting	0	0	2.9	2.9
20	21 Mining	0	0	0.6	0.6
33	22 Utilities	0	0	2.6	2.6
34	23 Construction	0	0	2.9	2.9
41	31-33 Manufacturing	0	0	13.2	13.2
319	42 Wholesale Trade	0	0	22.3	22.3
320	44-45 Retail trade	0	0	119.1	119.1
332	48-49 Transportation & Warehousing	0	0	17.5	17.5
341	51 Information	0	0	10.7	10.7
354	52 Finance & insurance	0	0	46.1	46.1
360	53 Real estate & rental	0	0	46.7	46.7
367	54 Professional- scientific & tech services	0	0	31.4	31.4

381	55 Management of companies	0	0	4.4	4.4
382	56 Administrative & waste services	0	0	31.2	31.2
391	61 Educational services	0	0	26.8	26.8
394	62 Health & social services	0	0	172.6	172.6
402	71 Arts- entertainment & recreation	0	0	22	22
411	72 Accommodation& food services	0	0	68	68
414	81 Other services	0	0	43.6	43.6
427	92 Government & non NAICs	0	0	19.7	19.7

Appendix 3. Marcellus Natural Gas Industry Payroll Impacts: Scenario 2

Scenario 2: If 25 Percent of Non-Resident Worker Income Leaves Pennsylvania

Output					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$97,772,457	$97,772,457
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$225,661	$225,661
20	21 Mining	$0	$0	$203,541	$203,541
33	22 Utilities	$0	$0	$2,378,908	$2,378,908
34	23 Construction	$0	$0	$403,551	$403,551
41	31-33 Manufacturing	$0	$0	$6,653,629	$6,653,629
319	42 Wholesale Trade	$0	$0	$5,282,446	$5,282,446
320	44-45 Retail trade	$0	$0	$7,970,945	$7,970,945
332	48-49 Transportation & Warehousing	$0	$0	$2,573,400	$2,573,400
341	51 Information	$0	$0	$3,555,716	$3,555,716
354	52 Finance & insurance	$0	$0	$12,384,450	$12,384,450
360	53 Real estate & rental	$0	$0	$16,654,562	$16,654,562
367	54 Professional- scientific & tech services	$0	$0	$4,680,622	$4,680,622
381	55 Management of companies	$0	$0	$1,098,486	$1,098,486
382	56 Administrative & waste services	$0	$0	$2,299,910	$2,299,910
391	61 Educational services	$0	$0	$2,099,477	$2,099,477
394	62 Health & social services	$0	$0	$18,238,675	$18,238,675
402	71 Arts- entertainment & recreation	$0	$0	$1,442,831	$1,442,831
411	72 Accommodation& food services	$0	$0	$4,537,129	$4,537,129
414	81 Other services	$0	$0	$3,394,428	$3,394,428
427	92 Government & non NAICs	$0	$0	$1,694,089	$1,694,089
Value added					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$59,674,181	$59,674,181
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$74,492	$74,492
20	21 Mining	$0	$0	$97,583	$97,583
33	22 Utilities	$0	$0	$1,380,634	$1,380,634
34	23 Construction	$0	$0	$194,554	$194,554
41	31-33 Manufacturing	$0	$0	$1,869,848	$1,869,848
319	42 Wholesale Trade	$0	$0	$3,476,369	$3,476,369
320	44-45 Retail trade	$0	$0	$6,722,036	$6,722,036
332	48-49 Transportation & Warehousing	$0	$0	$1,377,435	$1,377,435
341	51 Information	$0	$0	$1,893,034	$1,893,034
354	52 Finance & insurance	$0	$0	$7,152,854	$7,152,854
360	53 Real estate & rental	$0	$0	$11,661,954	$11,661,954
367	54 Professional- scientific & tech services	$0	$0	$3,226,539	$3,226,539
381	55 Management of companies	$0	$0	$723,163	$723,163
382	56 Administrative & waste services	$0	$0	$1,456,690	$1,456,690
391	61 Educational services	$0	$0	$1,267,871	$1,267,871
394	62 Health & social services	$0	$0	$10,579,808	$10,579,808

402	71 Arts- entertainment & recreation	$0	$0	$867,544	$867,544
411	72 Accommodation& food services	$0	$0	$2,323,145	$2,323,145
414	81 Other services	$0	$0	$1,923,761	$1,923,761
427	92 Government & non NAICs	$0	$0	$1,404,867	$1,404,867
Labor income					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$34,850,239	$34,850,239
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$59,600	$59,600
20	21 Mining	$0	$0	$44,309	$44,309
33	22 Utilities	$0	$0	$400,228	$400,228
34	23 Construction	$0	$0	$165,645	$165,645
41	31-33 Manufacturing	$0	$0	$1,027,301	$1,027,301
319	42 Wholesale Trade	$0	$0	$2,024,941	$2,024,941
320	44-45 Retail trade	$0	$0	$4,044,975	$4,044,975
332	48-49 Transportation & Warehousing	$0	$0	$1,016,842	$1,016,842
341	51 Information	$0	$0	$958,136	$958,136
354	52 Finance & insurance	$0	$0	$3,602,627	$3,602,627
360	53 Real estate & rental	$0	$0	$910,227	$910,227
367	54 Professional- scientific & tech services	$0	$0	$2,629,556	$2,629,556
381	55 Management of companies	$0	$0	$593,509	$593,509
382	56 Administrative & waste services	$0	$0	$1,135,065	$1,135,065
391	61 Educational services	$0	$0	$1,202,776	$1,202,776
394	62 Health & social services	$0	$0	$9,775,670	$9,775,670
402	71 Arts- entertainment & recreation	$0	$0	$593,209	$593,209
411	72 Accommodation& food services	$0	$0	$1,625,661	$1,625,661
414	81 Other services	$0	$0	$1,726,424	$1,726,424
427	92 Government & non NAICs	$0	$0	$1,313,538	$1,313,538
Employment					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	0	0	794.9	794.9
1	11 Ag, Forestry, Fish & Hunting	0	0	3.3	3.3
20	21 Mining	0	0	0.7	0.7
33	22 Utilities	0	0	2.9	2.9
34	23 Construction	0	0	3.2	3.2
41	31-33 Manufacturing	0	0	14.8	14.8
319	42 Wholesale Trade	0	0	26.4	26.4
320	44-45 Retail trade	0	0	141	141
332	48-49 Transportation & Warehousing	0	0	19.9	19.9
341	51 Information	0	0	12.1	12.1
354	52 Finance & insurance	0	0	52.2	52.2
360	53 Real estate & rental	0	0	51.8	51.8
367	54 Professional- scientific & tech services	0	0	35.3	35.3
381	55 Management of companies	0	0	5	5
382	56 Administrative & waste services	0	0	34.9	34.9

391	61 Educational services	0	0	29	29
394	62 Health & social services	0	0	189.6	189.6
402	71 Arts- entertainment & recreation	0	0	24.6	24.6
411	72 Accommodation & food services	0	0	77.1	77.1
414	81 Other services	0	0	49.1	49.1
427	92 Government & non NAICs	0	0	22.1	22.1

Appendix 4. Royalty Payments to Private Mineral Right Owners

Scenario 1: If 7.7 Percent of Mineral Rights are Owned Out-of-State

Output					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$15,691,609	$15,691,609
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$35,264	$35,264
20	21 Mining	$0	$0	$31,994	$31,994
33	22 Utilities	$0	$0	$374,205	$374,205
34	23 Construction	$0	$0	$65,348	$65,348
41	31-33 Manufacturing	$0	$0	$1,043,014	$1,043,014
319	42 Wholesale Trade	$0	$0	$867,268	$867,268
320	44-45 Retail trade	$0	$0	$1,256,269	$1,256,269
332	48-49 Transportation & Warehousing	$0	$0	$407,857	$407,857
341	51 Information	$0	$0	$570,032	$570,032
354	52 Finance & insurance	$0	$0	$1,998,997	$1,998,997
360	53 Real estate & rental	$0	$0	$2,723,444	$2,723,444
367	54 Professional- scientific & tech services	$0	$0	$745,767	$745,767
381	55 Management of companies	$0	$0	$175,910	$175,910
382	56 Administrative & waste services	$0	$0	$368,143	$368,143
391	61 Educational services	$0	$0	$352,288	$352,288
394	62 Health & social services	$0	$0	$2,909,503	$2,909,503
402	71 Arts- entertainment & recreation	$0	$0	$229,570	$229,570
411	72 Accommodation & food services	$0	$0	$738,610	$738,610
414	81 Other services	$0	$0	$529,298	$529,298
427	92 Government & non NAICs	$0	$0	$268,827	$268,827
Value Added					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$9,585,000	$9,585,000
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$11,641	$11,641
20	21 Mining	$0	$0	$15,339	$15,339
33	22 Utilities	$0	$0	$217,176	$217,176
34	23 Construction	$0	$0	$31,504	$31,504
41	31-33 Manufacturing	$0	$0	$293,115	$293,115
319	42 Wholesale Trade	$0	$0	$570,748	$570,748
320	44-45 Retail trade	$0	$0	$1,059,433	$1,059,433
332	48-49 Transportation & Warehousing	$0	$0	$218,309	$218,309
341	51 Information	$0	$0	$303,480	$303,480
354	52 Finance & insurance	$0	$0	$1,154,556	$1,154,556
360	53 Real estate & rental	$0	$0	$1,907,026	$1,907,026
367	54 Professional- scientific & tech services	$0	$0	$514,087	$514,087
381	55 Management of companies	$0	$0	$115,806	$115,806

382	56 Administrative & waste services	$0	$0	$233,170	$233,170
391	61 Educational services	$0	$0	$212,746	$212,746
394	62 Health & social services	$0	$0	$1,687,731	$1,687,731
402	71 Arts- entertainment & recreation	$0	$0	$138,036	$138,036
411	72 Accommodation & food services	$0	$0	$378,190	$378,190
414	81 Other services	$0	$0	$299,975	$299,975
427	92 Government & non NAICs	$0	$0	$222,932	$222,932
Labor Income					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$5,575,826	$5,575,826
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$9,314	$9,314
20	21 Mining	$0	$0	$6,965	$6,965
33	22 Utilities	$0	$0	$62,956	$62,956
34	23 Construction	$0	$0	$26,823	$26,823
41	31-33 Manufacturing	$0	$0	$161,038	$161,038
319	42 Wholesale Trade	$0	$0	$332,453	$332,453
320	44-45 Retail trade	$0	$0	$637,512	$637,512
332	48-49 Transportation & Warehousing	$0	$0	$161,159	$161,159
341	51 Information	$0	$0	$153,603	$153,603
354	52 Finance & insurance	$0	$0	$581,507	$581,507
360	53 Real estate & rental	$0	$0	$148,845	$148,845
367	54 Professional- scientific & tech services	$0	$0	$418,969	$418,969
381	55 Management of companies	$0	$0	$95,044	$95,044
382	56 Administrative & waste services	$0	$0	$181,688	$181,688
391	61 Educational services	$0	$0	$201,823	$201,823
394	62 Health & social services	$0	$0	$1,559,452	$1,559,452
402	71 Arts- entertainment & recreation	$0	$0	$94,386	$94,386
411	72 Accommodation & food services	$0	$0	$264,645	$264,645
414	81 Other services	$0	$0	$269,204	$269,204
427	92 Government & non NAICs	$0	$0	$208,439	$208,439
Employment					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	0	0	127.2	127.2
1	11 Ag, Forestry, Fish & Hunting	0	0	0.5	0.5
20	21 Mining	0	0	0.1	0.1
33	22 Utilities	0	0	0.5	0.5
34	23 Construction	0	0	0.5	0.5
41	31-33 Manufacturing	0	0	2.3	2.3
319	42 Wholesale Trade	0	0	4.3	4.3
320	44-45 Retail trade	0	0	22.2	22.2
332	48-49 Transportation & Warehousing	0	0	3.2	3.2
341	51 Information	0	0	1.9	1.9

354	52 Finance & insurance	0	0	8.4	8.4
360	53 Real estate & rental	0	0	8.5	8.5
367	54 Professional- scientific & tech services	0	0	5.6	5.6
381	55 Management of companies	0	0	0.8	0.8
382	56 Administrative & waste services	0	0	5.6	5.6
391	61 Educational services	0	0	4.9	4.9
394	62 Health & social services	0	0	30.3	30.3
402	71 Arts- entertainment & recreation	0	0	3.9	3.9
411	72 Accommodation & food services	0	0	12.6	12.6
414	81 Other services	0	0	7.7	7.7
427	92 Government & non NAICs	0	0	3.5	3.5

Appendix 5. Payments to Private Mineral Right Owners

Scenario 2: If 15.4 Percent of Mineral Rights are Owned Out-of-State

Output					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$14,088,728	$14,088,728
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$31,662	$31,662
20	21 Mining	$0	$0	$28,726	$28,726
33	22 Utilities	$0	$0	$335,981	$335,981
34	23 Construction	$0	$0	$58,672	$58,672
41	31-33 Manufacturing	$0	$0	$936,471	$936,471
319	42 Wholesale Trade	$0	$0	$778,677	$778,677
320	44-45 Retail trade	$0	$0	$1,127,942	$1,127,942
332	48-49 Transportation & Warehousing	$0	$0	$366,195	$366,195
341	51 Information	$0	$0	$511,804	$511,804
354	52 Finance & insurance	$0	$0	$1,794,802	$1,794,802
360	53 Real estate & rental	$0	$0	$2,445,247	$2,445,247
367	54 Professional- scientific & tech services	$0	$0	$669,588	$669,588
381	55 Management of companies	$0	$0	$157,941	$157,941
382	56 Administrative & waste services	$0	$0	$330,537	$330,537
391	61 Educational services	$0	$0	$316,302	$316,302
394	62 Health & social services	$0	$0	$2,612,300	$2,612,300
402	71 Arts- entertainment & recreation	$0	$0	$206,120	$206,120
411	72 Accommodation & food services	$0	$0	$663,162	$663,162
414	81 Other services	$0	$0	$475,231	$475,231
427	92 Government & non NAICs	$0	$0	$241,367	$241,367
Value Added					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$8,605,902	$8,605,902
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$10,452	$10,452
20	21 Mining	$0	$0	$13,772	$13,772
33	22 Utilities	$0	$0	$194,991	$194,991
34	23 Construction	$0	$0	$28,286	$28,286
41	31-33 Manufacturing	$0	$0	$263,174	$263,174
319	42 Wholesale Trade	$0	$0	$512,446	$512,446
320	44-45 Retail trade	$0	$0	$951,213	$951,213
332	48-49 Transportation & Warehousing	$0	$0	$196,009	$196,009
341	51 Information	$0	$0	$272,480	$272,480
354	52 Finance & insurance	$0	$0	$1,036,619	$1,036,619
360	53 Real estate & rental	$0	$0	$1,712,225	$1,712,225
367	54 Professional- scientific & tech services	$0	$0	$461,574	$461,574
381	55 Management of companies	$0	$0	$103,977	$103,977

382	56 Administrative & waste services	$0	$0	$209,352	$209,352
391	61 Educational services	$0	$0	$191,014	$191,014
394	62 Health & social services	$0	$0	$1,515,331	$1,515,331
402	71 Arts- entertainment & recreation	$0	$0	$123,935	$123,935
411	72 Accommodation & food services	$0	$0	$339,559	$339,559
414	81 Other services	$0	$0	$269,333	$269,333
427	92 Government & non NAICs	$0	$0	$200,159	$200,159
Labor Income					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	$0	$0	$5,006,261	$5,006,261
1	11 Ag, Forestry, Fish & Hunting	$0	$0	$8,362	$8,362
20	21 Mining	$0	$0	$6,253	$6,253
33	22 Utilities	$0	$0	$56,525	$56,525
34	23 Construction	$0	$0	$24,083	$24,083
41	31-33 Manufacturing	$0	$0	$144,588	$144,588
319	42 Wholesale Trade	$0	$0	$298,494	$298,494
320	44-45 Retail trade	$0	$0	$572,391	$572,391
332	48-49 Transportation & Warehousing	$0	$0	$144,697	$144,697
341	51 Information	$0	$0	$137,912	$137,912
354	52 Finance & insurance	$0	$0	$522,107	$522,107
360	53 Real estate & rental	$0	$0	$133,641	$133,641
367	54 Professional- scientific & tech services	$0	$0	$376,172	$376,172
381	55 Management of companies	$0	$0	$85,335	$85,335
382	56 Administrative & waste services	$0	$0	$163,129	$163,129
391	61 Educational services	$0	$0	$181,207	$181,207
394	62 Health & social services	$0	$0	$1,400,156	$1,400,156
402	71 Arts- entertainment & recreation	$0	$0	$84,744	$84,744
411	72 Accommodation & food services	$0	$0	$237,612	$237,612
414	81 Other services	$0	$0	$241,705	$241,705
427	92 Government & non NAICs	$0	$0	$187,147	$187,147
Employment					
Sector	**Description**	**Direct**	**Indirect**	**Induced**	**Total**
0	Total	0	0	114.2	114.2
1	11 Ag, Forestry, Fish & Hunting	0	0	0.5	0.5
20	21 Mining	0	0	0.1	0.1
33	22 Utilities	0	0	0.4	0.4
34	23 Construction	0	0	0.5	0.5
41	31-33 Manufacturing	0	0	2.1	2.1
319	42 Wholesale Trade	0	0	3.9	3.9
320	44-45 Retail trade	0	0	20	20
332	48-49 Transportation & Warehousing	0	0	2.8	2.8
341	51 Information	0	0	1.7	1.7

354	52 Finance & insurance	0	0	7.6	7.6
360	53 Real estate & rental	0	0	7.6	7.6
367	54 Professional- scientific & tech services	0	0	5.1	5.1
381	55 Management of companies	0	0	0.7	0.7
382	56 Administrative & waste services	0	0	5	5
391	61 Educational services	0	0	4.4	4.4
394	62 Health & social services	0	0	27.2	27.2
402	71 Arts- entertainment & recreation	0	0	3.5	3.5
411	72 Accommodation & food services	0	0	11.3	11.3
414	81 Other services	0	0	6.9	6.9
427	92 Government & non NAICs	0	0	3.1	3.1

Appendix 6. Methodology and Definitions

Methodology

In this analysis, we use an economic impact software program known as IMPLAN (Impact Analysis for Planning). Originally developed by the US Forest Service, IMPLAN is an input-output model that is widely used to quantify how businesses use technology, labor and materials (i.e., inputs) to produce a product (i.e., output). The IMPLAN software and database (www.implan.com) establishes the characteristics of economic activity in terms of more than 450 sectors. In practice, the IMPLAN model is used in every state and hundreds of communities across the nation to catalog economic activity and predict the effect of alternative policies and various economic changes.

Definitions

Multipliers

Input-output models are driven by final consumption (or final demand). Industries respond to meet demands directly or indirectly (by supplying goods and services to industries responding directly). Each industry that produces goods and services generates demand for other goods and services and so on, round by round. These so called *ripple effects* are described by **multipliers**. A multiplier examines how much spin off economic activity is generated by a marginal change in an industry. For example, multipliers can describe how many total jobs in the economy are created when an industry adds one new job. In general, input-output modelers describe three types of multiplier effects when examining the role of an industry in the county economy.

1. The **direct effect** is the contribution of the industry itself. It may represent the total revenue (output), employment, or employee compensation. The value of the direct effect multiplier is always 1.

2. The **indirect effects** are effects of the industry on its suppliers. This multiplier captures the additional activity in businesses that provide inputs to the industry of interest.

3. The **induced effects** capture the impacts of changes in spending from households as income changes due to the direct effect. This effect captures the impact of spending by a) employees of the industry being studied, and b) employees of the input supplying businesses. These effects usually show up in retail and service industries. In the study here, the *secondary effects* are the sum of the indirect and induced effects.

In this study we use the IMPLAN type SAM multipliers. The Type SAM multiplier is obtained according to the following formula:

Type SAM multiplier = (direct effect + indirect effect + induced effect) ÷ direct effect

Input-output analysis is a means of examining the relationships within an economy both between businesses and between businesses and final consumers. It captures all monetary transactions for consumption in a given time period. The resulting mathematical formulae allow one to examine the effects of change in one or several economic activities on an entire economy.

Industry output is a single number in dollar for each industry. The dollars represent the value of an industry's total production. In IMPLAN, the output data are derived from a number of sources including Bureau of Census economic censuses and the Bureau of Labor Statistics employment projections. Another way to think about industry output is as the total revenue generated by an industry.

Employment is total number of wage and salary employees and self-employed jobs in a region. It includes both full-time and part-time workers and is measured in total jobs. The data sets used to derive employment totals in the IMPLAN model are the ES-202 data, County Business Patterns, and the Regional Economic Information System (REIS) data.

While output captures the total dollar value of economic activity, its use as a measure of economic activity can be over counted in that it captures the value of all intermediate stages of the production process as well. For example, the price one pays for a car at the local auto dealership in large part represents economic activity that occurred in the production process. If one were to consider the price one paid for a car as the contribution to the local economy, then one would likely be overstating its impact. This is called double counting. To avoid double counting, economists usually examine economic contributions in terms of **Value Added**. At the local level, value added is equivalent to the concept of Gross Domestic Product in that it examines the unique contribution of an industry to the overall economy. In input-output analysis, value added consists of four components.

1. **Employee compensation** is wage and salary payments as well as benefits including health and life insurance, retirement payment, and any other non-cash compensation. It includes all income to workers paid by employers.

2. **Proprietary income** consists of payments received by self-employed individuals as income. This is income recorded on Federal Tax Form 1040C. This includes income received by private business owners, doctors, lawyers, and so forth. Any income a person receives for payment of *self-employed* work is counted here. Note: labor income is the sum of employee compensation and proprietary income.

3. **Other property type income** consists of payments for interest, rent, royalties, dividends, and profits. This includes payments to individuals in the form of rents received on property, royalties from contracts, and dividends paid by corporations. This also includes corporate profits earned by corporations.

4. **Indirect business taxes** consist primarily of excise and sales taxes paid by individuals to businesses. These taxes occur during the normal operation of these businesses but do not include taxes on income or profit.