Economic Impacts of Marcellus Shale in Bradford County:

Employment and Income in 2010

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Economic Impacts of Marcellus Shale in Bradford County: Employment and Income in 2010

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I. Introduction

There has been much interest about the economic development potential of Marcellus Shale in Pennsylvania. Travel through counties where drilling is occurring, and anecdotes from residents and local businesses clearly demonstrate that gas development is having a major impact on local employment and income. Other anecdotes and experience suggest that natural gas development is also having major non-monetary impacts, such as significant increases in truck and other traffic, new roads, well pads and pipelines cutting through forest and farmland, and conflict in communities about its potential health, social, and environmental implications.

Most of the academic focus on the potential economic impacts of Marcellus Shale development has been at the state level, which considers the economic impacts that are occurring throughout the Commonwealth as a result of drilling activity in the Marcellus region. For example, Kelsey, Shields, Ladlee, and Ward (2011) estimated that Marcellus Shale development created around 23,000 jobs in Pennsylvania in 2009, and they estimated that the total employment impact in 2010 was around 44,000 jobs if per-well employment impacts remain relatively consistent.

How much of the economic benefit of gas drilling actually stays local is important to know, because the communities where drilling is occurring are most directly bearing the costs of that development. For residents living in those communities, the impacts statewide are less relevant than what is occurring within their community itself. Gas development does create some social, environmental and economic challenges for host communities, in part due to the influx of new workers, increase in truck and other traffic, increasing demands for services, and large use of water and other natural resources. Identifying local impacts is critical to understanding the implications of natural gas development for communities where drilling is occurring.

Due to the regional nature of the work and the high specialization of the businesses, equipment, and tasks involved in gas development, it is clear that many of the economic benefits of Marcellus Shale development are occurring outside of the counties where drilling is being done. Many of the firms doing the work are regional, national, or international companies, with little formal footprint in the individual counties with drilling, and they are bringing in specialized equipment and supplies that are not directly available from local county-based businesses. For example, the companies are not leasing drilling rigs from local businesses, purchasing drilling and gathering line pipe from county hardware stores, or buying fracing sand from local quarries. All these are being leased or purchased outside of the county. Some of these companies are creating regional offices or facilities within the Marcellus region, such as in Washington and Lycoming Counties, which will support drilling activities in the nearby counties. These offices help keep more of the dollars within those regions, but they do not necessarily help keep dollars within the individual counties where the drilling is happening.

Even though many of the industry dollars are not being spent in the specific counties where drilling is occurring, it also is very obvious from anecdotes, surveys, and secondary data that the amount of dollars being spent in these communities is significant, and it is having major local economic impacts. Some supplies and services are being purchased locally, such as aggregate used for road and well pad

construction, local construction and trucking services, motel rooms and other housing, food service, and other materials and services that are not overly specialized or unique to the industry. For example, one-third of the businesses in Bradford County report that their sales have increased due to Marcellus activity (Kelsey, Shields, Ladlee, and Ward, 2011). Local infrastructure investment is being spurred by Marcellus activity, such as rail, roads, and hotels, and local nonprofits informally are reporting major local charitable giving by gas companies. The local economic development impacts of gas development cannot and should not be slighted and must be understood more completely.

This study examines the county-level economic impact of Marcellus Shale activity in Bradford County in 2010, using several data sources and tools to estimate the county-level job and income effects. The data includes publicly available industry reports on spending, U.S. Bureau of Labor Statistics employment data, GIS analysis of land ownership, results from a survey of landowners about how they spent leasing and royalty income, and use of the economic impact tool IMPLAN to estimate multiplier effects.

II. Bradford County

Bradford County leads Pennsylvania in the number of Marcellus Shale wells, with a total of 513 wells drilled between 2008 and 2010 (including 386 in 2010) (DEP). It is a rural county, with a population of 62,622 in 2010 (U.S. Census of Population), and labor force of 33,759 (BLS). In 2009, there were a total of 1,341 businesses located within the county (County Business Patterns). About 24 percent of the county's labor force worked outside the county (U.S. Census 2000).

Bradford County has led the five county area in drilling permits, with roughly 46 percent of all permits issued. A total of 1,757 drilling permits were issued in Bradford County (see Table 1) to ten exploration and production companies, with the most permits issued to Chesapeake Energy (941) followed closely by Talisman USA (610).

Table 1. Marcellus Drilling Permits Issued

County	2006	2007	2008	2009	2010	2011*	Grand Total
Bradford	1	2	52	431	830	441	1757

*as of September 2011

The county has experienced the most wells drilled, with 821 wells spudded (started) between January 1, 2006 and September 30, 2011 (see Table 2) by a combination of 14 different energy companies. Talisman USA has drilled the most wells in Bradford County with 415 (Fortuna [38] and Talisman [377] combined) wells followed closely by Chesapeake Energy with 320 wells.

Table 2. Marcellus Wells Drilled							
County	**2006**	**2007**	**2008**	**2009**	**2010**	**2011***	**Grand Total**
Bradford	3	2	14	113	386	303	821
*as of September 2011							

Several previous economic studies provide insights on the range of economic impacts occurring in the county. State sales tax collections within Bradford County increased 21.3 percent between 2007 and 2010, compared to a statewide county level decrease of 3.8 percent (unpublished county-level analysis from Costanzo and Kelsey, 2011), which suggests significant increases in local retail sales activity. Sales tax collections on motor vehicles increased 14.5 percent between 2008 and 2010 (Pennsylvania Tax Compendium, 2011). Realty transfer tax collections in the county during this same period dropped by 6.4 percent, which is much lower than the state average decrease of 22.1 percent, suggesting that either the quantity or value of real estate sales declined less in the county than in most other locations of the Commonwealth (unpublished county-level analysis from Costanzo and Kelsey, 2011).

Changes in Personal Income Tax collections are somewhat mixed; total Personal Income Tax collections in the county increased 6.6 percent between 2007 and 2009, according to Pennsylvania Department of Revenue data, compared to a statewide average county level decrease of 5.5 percent during the same time period. Most of the increase in Personal Income Tax collections was due to leasing income rather than employment. Total compensation (e.g. wages and salaries) only increased 2.8 percent in Bradford County between these years, while the number of tax returns filed from the county reporting wage or salary income decreased slightly (0.3 percent), which suggests there was little increase in total employment by residents within the county. Royalty income, in contrast, increased by 611 percent during this same time period (Kelsey, 2012).

III. Methodology

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 a major tool of analysis, modifying the information with results from several surveys that were conducted as part of a statewide economic impact study (Kelsey, Shields, Ladlee, and Ward, 2011). 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, 2011; Kelsey, Shields, Ladlee, and Ward, 2011; 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).

IMPLAN provides information on three types of impacts. **Direct** impacts are those attributed to the activity itself, for example construction jobs supported by money spent refurbishing farm structures. **Indirect** impacts are jobs created in support of the directly impacted sector, for example jobs at a

lumberyard providing building materials for the farm structure. **Induced** impacts are jobs created by direct and indirect workers spending their own earnings locally.

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, or leasing and royalty dollars going to non-resident property owners, have less local impact than money spent at local businesses. Economists call this spending of dollars outside the area being studied 'leakage,' and it has significant impacts on the economic impacts of change. The smaller the geographic area, generally the larger the amount of leakage will occur because more purchases tend to be from outside the study area.

As discussed previously, much of the gas industry spending related to Bradford County is occurring in nearby counties, or even out of state. Where workers live similarly affects leakage of dollars from the community, because paychecks going to workers living outside the county tend to be spent outside the county. This is especially an issue for natural gas development because of the regional nature of the work, with employees often traveling long distances to work sites. The limited availability of housing in some counties, which makes it difficult for workers to find housing within the county where they're working, contributes to this loss of income from the county economy.

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 county. If the mineral right owners live elsewhere in Pennsylvania, those dollars will create an economic impact in the owners' county and at the state level, but they do little economically for the county where drilling is occurring. Leasing and royalty payments to owners who live outside of Pennsylvania 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 these large 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 size and composition of the local county economy similarly affect how many dollars circulate within the local economy. If the local economy is small, local residents and businesses are more likely to make purchases outside of the county because some of what they want or need is not available locally, reducing local economic impacts of change because those dollars quickly leave the community.

A. Company Spending and Payroll

Published spending information, as collected and reported by Considine, Watson, and Blumsack (2011), indicates that natural gas companies spent $11.48 billion in Pennsylvania during 2010. Considering exploration, upstream, and midstream spending (e.g. everything but leasing and royalty payments), this was $6.23 million per well. Much of this spending was in services, supplies, and equipment, rather than people; estimates are that only about 13 full-time equivalent jobs are created per well during this drilling phase (Brundage, et al, 2011). The reported industry spending includes expenditures on road repairs, charitable giving, and other activities of the companies within Pennsylvania.

We attempted to gather data from the major natural gas companies about their spending patterns to identify how many dollars are going locally, but none ultimately provided such information for use in this study. We similarly were unable to obtain information about the percentage of workers in the county who actually live in the county and thus how many industry payroll dollars go into the local economy.

Because the amount of gas development dollars can be so large relative to the actual size of the local economy in many rural counties with drilling activity, assumptions about industry spending and payroll would significantly affect the study results and could too easily lead to implausible findings. For example, gas industry spending (excluding leases and royalties) to drill the 386 wells in Bradford County during 2010 likely was around $2.4 billion, given average per well expenditures. This is larger than the size of Bradford County's total economy in 2009, which was $1.8 billion, as measured by total person income (U.S. Bureau of Economic Analysis). Gas development has had significant economic effects in Bradford County, but it has not more than doubled the size of the county's economy. Clearly, much of the industry spending has not been within the counties where drilling is occurring.

Rather than make questionable assumptions about how much industry spending actually occurs locally and how many of the workers in the county actually live there, we use U.S. Bureau of Labor Statistics (BLS) direct observations of how employment has changed in the county between 2001 and 2010 and compared this to statewide employment trends. These actual employment changes in the county reflect the influence of industry spending. Such a direct observation approach foregoes the ability to identify direct, indirect, and induced employment changes, but it does provide a clear picture of the overall employment changes in the county.

B. Leasing and Royalty Income

Not all leasing and royalty dollars are immediately spent in the local economy, since some of the dollars go to non-county residents (and thus immediately leave the county), 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. We used GIS analysis of land ownership patterns and survey results about the use of lease and royalty dollars (Kelsey, Shields, Ladlee, and Ward, 2011) to estimate how many leasing and royalty dollars went to Bradford County households and how households spent those funds. Each of these will be explained in turn.

1. GIS Analysis of Ownership

We could find no publicly available documentation that tracks ownership of mineral rights, other than on a deed-by-deed basis. All county governments do 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. We used this data in GIS format to calculate the percentage of land owned by people living within the county.

Land ownership provides a good proxy for mineral right ownership, except in places where the mineral or gas rights have been severed. Fortunately for this study, severed mineral rights are relatively uncommon in Bradford County, so the GIS analysis should relatively accurately reflect mineral right ownership.

2. Amount of Leasing and Royalty Dollars

Available data on leasing and royalty income is only available from industry at the state level, rather than at the county level. To estimate the amount of leasing income in Bradford County in 2010, we calculated each county's share of the Marcellus play's total land area in Pennsylvania and assumed that each county received that same proportion of total leasing income. In other words, if a county was 6 percent of Pennsylvania's Marcellus area, we assumed that mineral right owners in that county received 6 percent of all the leasing dollars paid statewide in 2010. This likely overestimates the actual leasing dollars going to Bradford County in that year, because much of the leasing activity in that county occurred several years earlier.

Royalties going to the county were estimated using industry reports of total royalties paid in 2010 (Considine, Watson and Blumsack, 2011), divided by the total number of active Marcellus wells in Pennsylvania. The data suggest that royalties paid in 2010 averaged $148,561 per well. The average includes some Marcellus wells that have been drilled but as yet are not hooked into pipelines and thus are not yet producing income.

3. Local Use of Leasing and Royalty Dollars

To estimate how local mineral right owners are spending their leasing and royalty income, we used results from a survey of 1,000 landowners located within one thousand feet of active Marcellus wells in Pennsylvania's Bradford and Tioga Counties, as reported in Kelsey, et al (2011). That survey had a response rate of 50.1 percent. Four hundred and twelve of the respondents had leased their land for natural gas drilling (rather than a prior owner having done so).

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 1), rather than being immediately spent. About 66 percent of all the royalty dollars were similarly saved for the future. Other common uses of the dollars 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).

Table 3. Mineral Right Owners' Use of Leasing Dollars, Bradford & Tioga Counties		
Sectors	**Total Spent**	**Percent**
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
		Source: Kelsey, Shields, Ladlee, Ward, 2011

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, 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 repairs, 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. Savings generate a minor amount of new economic activity for the financial firms handling the funds. In

our analysis, we assumed that savings would generate service fees of 1.5 percent, generating new activity within the financial services sector.

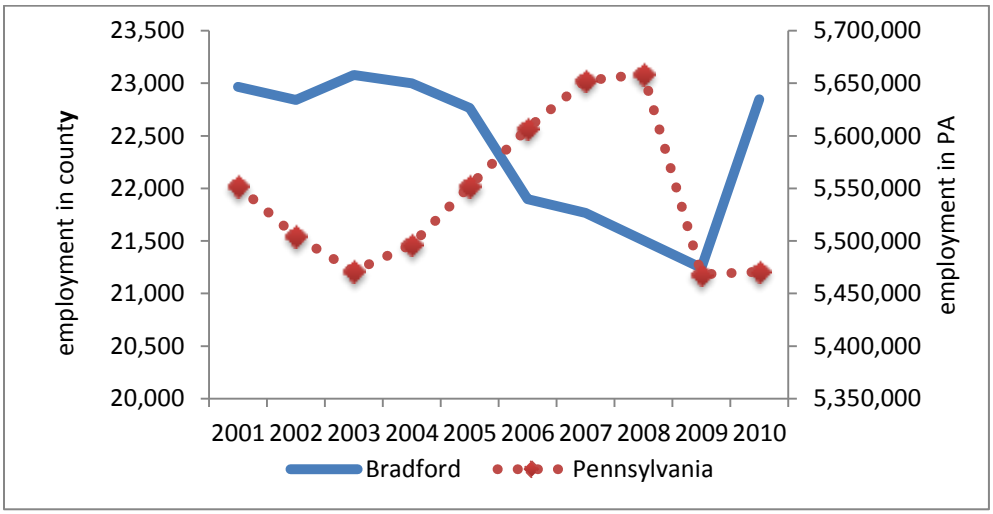
Forty-two respondents completed the question about the percentage of royalty income they spent in the year they received those dollars, but only 10 completed all the detailed questions about where they actually spent those 34 percent of royalty dollars. Due to this relatively small number of responses, 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.

IV. Results

1. Select Employment and Labor Market Trends in Bradford County

Growth in Marcellus activity has resulted in significant job gains in the county. According to the US Bureau of Labor Statistics (BLS), Bradford County had 22,846 total jobs in the fourth quarter of 2010. This is up more than 1,600 positions from 12 months earlier (7.5 percent), bringing the county back near its 2004 employment levels. This trend contrasts strongly with overall employment trends in Pennsylvania (see Figure 1). The increase in county employment included more than 500 mining jobs, construction (299 jobs), and transportation.

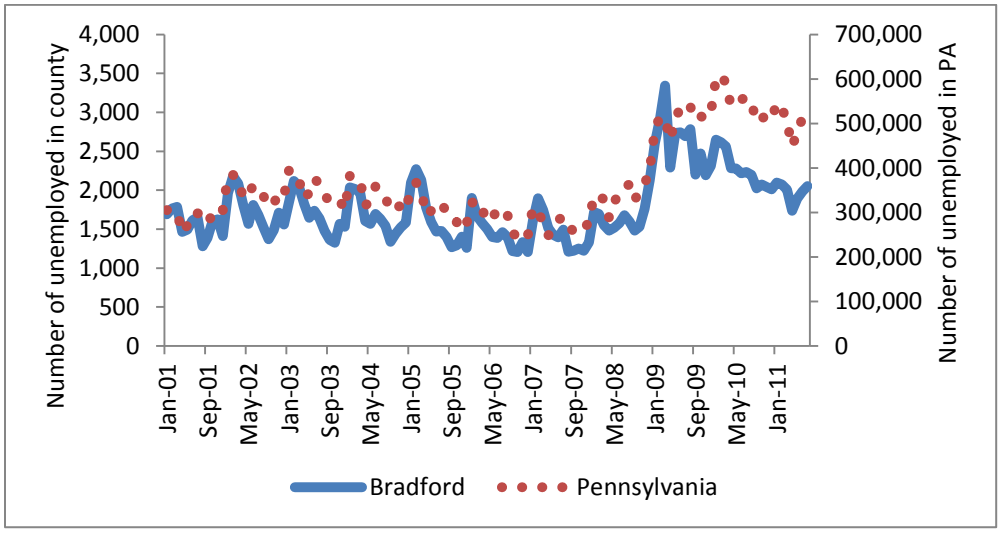
Figure 1: Total County Employment: 2001-2010



Source: Bureau of Labor Statistics/QCEW

With this job growth, the local unemployment situation is improving. According to the BLS, about 2,000 people were unemployed in Bradford County in July 2011. This is down about 640 from 2 years earlier, and nearly 1,300 lower than its peak in March 2009 (see Figure 2).

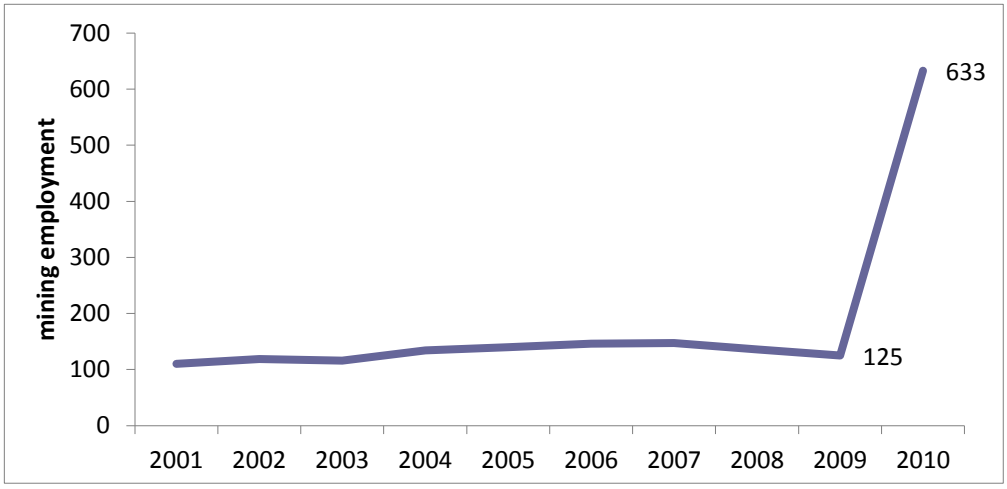
Figure 2. Number of County Unemployed: 2001-2010



Source: Bureau of Labor Statistics/LAUS

Natural gas sector jobs are categorized as 'Mining' in Federal industrial classifications, so gas sector employment changes are reported in the mining sector. According to the BLS, Bradford County's mining employment totaled 633 in 2010, up more than 500 jobs from the previous year. Preliminary estimates indicate the average annual pay for these jobs in 2010 was nearly $70,000.

Figure 3. Total County Mining Employment: 2001-2010

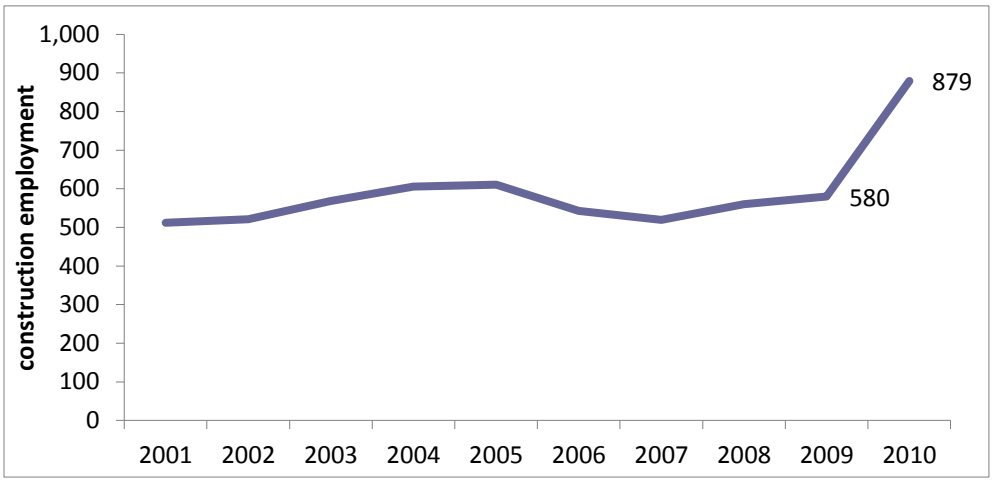


Source: Bureau of Labor Statistics/QCEW

According to Considine et al, 2011, construction is one of the largest ancillary economic activities for Marcellus activity. Between 2009 and 2010, the industry added nearly 300 jobs in Bradford County (see Figure 4). It is not possible to separate construction activity due directly or indirectly to Marcellus from

other activity; however, for the 9 years prior to 2009, county construction employment only averaged about 550 jobs per year.

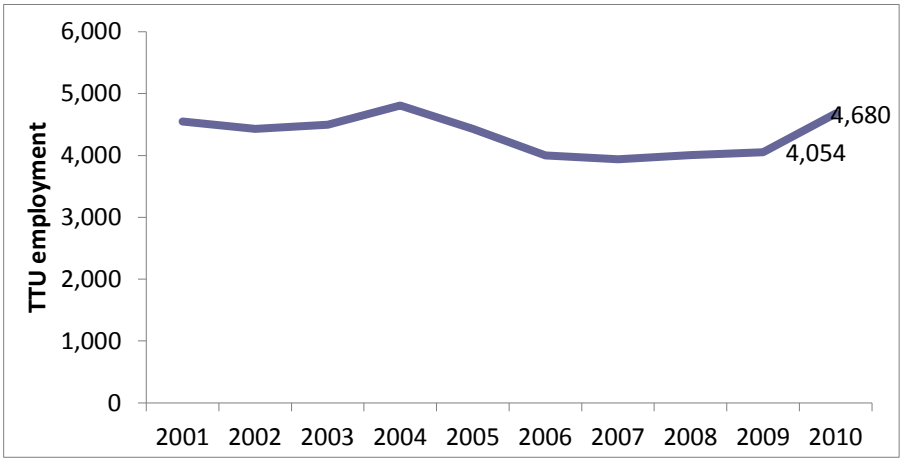
Figure 4. Total County Construction Employment: 2001-2010



Source: Bureau of Labor Statistics/QCEW

The trade, transportation, and utility (TTU) sector is another closely aligned set of industries. Trade captures both retail and wholesale activities, with gains in this aspect closely aligned with increases in household income and wealth. Transportation and utility employment captures, among other things, the impacts of water hauling and other transport. According to BLS data between 2009 and 2010, Bradford County employment in the trade, transportation, and utility sector increased by 626 jobs.

Figure 5. Total County Trade, Transportation and Utility (TTU) Employment: 2001-2010

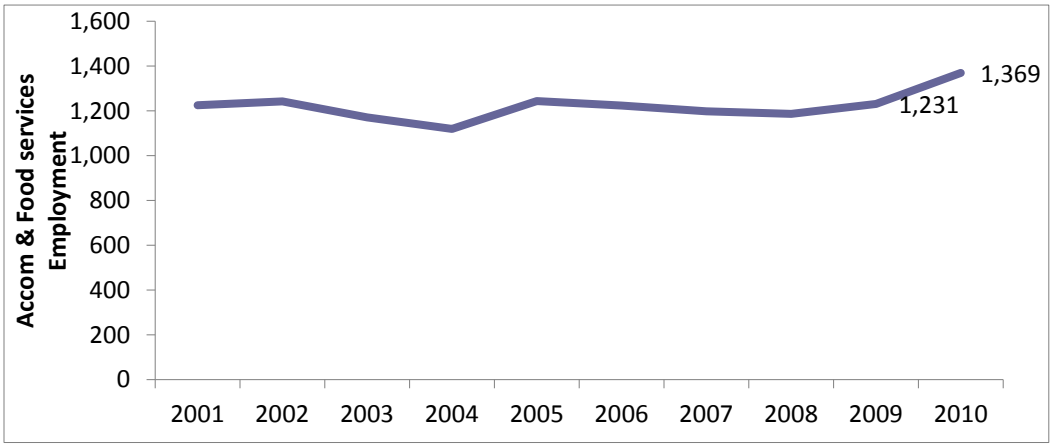


Source: Bureau of Labor Statistics/QCEW

Employment growth affects the need for worker housing and food service. Discussions with local entrepreneurs and leaders indicated that many gas-related workers are living in motels and that some

restaurants are experiencing significant increases in business. The BLS data report that Bradford County saw 138 additional jobs in the accommodation and food service sector between 2009 and 2010 (see Figure 6).

Figure 6. Total County Accommodations and Food Service Employment: 2001-2010



Source: Bureau of Labor Statistics/QCEW

2. Economic Impacts of Additional Household Income from Leasing and Royalties

Leasing Impacts

Based on industry spending patterns and land development patterns, we estimated that Bradford County landowners received $128.5 million in leasing income in 2010. According to our analysis of land ownership records, we estimate 60 percent of this leasing income ($77.1 million) went to mineral rights owners current living in the county, with the remainder going to owners living outside of the county. Not all of this money is spent locally. Based on the results of the landowner survey that indicated landowners are saving 55 percent of the leasing dollars they receive, and the amount going to state and federal taxes, we estimated that about $17.9 million of leasing income was spent by Bradford County residents in 2010. To model the economic impacts of this spending, we used the survey responses to break this spending down across 10 economic categories in the county and entered these as increases in final demand in the appropriate IMPLAN sectors.

Overall, we estimated that leasing income in 2010 generated $16.8 million in output, either directly or through multiplier impacts, which supported $6.2 million in labor income and about 180 jobs in Bradford County (see Table 4). This economic impact is lower than the new income being spent by residents, which is unusual compared to most economic impacts. The results reflect that the economy in Bradford County is relatively small, which means residents spend much of their income outside the community. It also occurs because the leasing spending is atypical, with a large share going to motor vehicles. Typically a large proportion of the sale price of such goods goes to cover the wholesale cost the retailer paid to a supplier outside the county, so those dollars immediately leave the community rather than being re-

spent. For example, if a consumer buys a new car for $30,000 from a local dealer, most of this purchase price goes directly to the auto manufacturer.

Table 4. Economic Impacts in Bradford County of Leasing Income

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	133.4	$4,644,742.7	$6,340,019.4	$12,336,747.5
Indirect Effect	19.8	$667,978.6	$917,302.3	$1,704,789.1
Induced Effect	26.4	$969,521.6	$1,635,368.0	$2,779,658.1
Total Effect	179.6	$6,282,242.9	$8,892,689.7	$16,821,194.6

Royalty Impacts

We used a similar method to estimate the local economic impact of royalty payments to mineral right owners living in Bradford County, adjusted for savings. To estimate the impacts, we used IMPLAN's median household income category with $11.6 million in 2010.

Overall, we estimated that this local spending of royalty income supports $6.5 million in county output, $2.5 million in labor income, and about 66 jobs (see Table 5).

Table 5. Economic Impacts in Bradford County of Royalty Income

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	-	-	-	-
Indirect Effect	-	-	-	-
Induced Effect	65.6	$2,467,757.52	$3,866,207.65	$6,525,317.65
Total Effect	65.6	$2,467,757.52	$3,866,207.65	$6,525,317.65

V. Discussion

U.S. Bureau of Labor Statistics numbers require some care in interpretation. They are actual employment changes that have occurred in the county during the years of drilling activity, which shows clearly how total employment has changed. Their numbers include employment changes associated with both industry and mineral right owner spending, so the IMPLAN-based estimates in this analysis are already included in those figures. How many of the jobs in the county are directly or indirectly related to Marcellus Shale activity is not directly apparent from these numbers because it is unclear what would have occurred in the county in the absence of Marcellus development. For example, there may have been some layoffs in non-gas related firms in the sector between 2009 and 2010, so the gas development could have helped prevent major employment losses in the sector.

We did not try to quantify the costs of Marcellus Shale development, such as effects on the environment and health. In addition, we did not address the distribution of benefits and costs between individuals, even though the equity of how these are distributed underlies much of the current policy debate about Marcellus Shale.

The composition of the economic impacts will change as the play matures. Leasing income currently is relatively high compared to royalty income, since the play is relatively young. As leasing activity slows and more wells come on-line, the amount of leasing income will substantially decline, and royalty income should significantly increase.

Local Economic Impacts and Leakage

These county-level employment numbers may be lower than some would expect (only a **7.5** percent net increase in employment), given the relatively large amount of money the industry reports spending to develop wells and related infrastructure in the county and the amount of activity that is visible within the county. Local employment gains are smaller than the 13 full time-equivalent jobs per well estimated in prior studies (Brundage et al, 2011), suggesting many of the jobs and much of the income associated with drilling in the county are being created elsewhere, outside the county. This is not surprising due to the rural nature of the county and the relatively small size of its economy, which typically means a larger share of economic activity occurs with businesses, jobs, and workers from outside the county. There thus is less ability to capture economic benefits than in larger economies. This leakage is exacerbated by the spatial nature of natural gas development, with activities shifting frequently from well pad to well pad across the entire region and the supporting infrastructure (and jobs) spread across the region rather than being solely based in the county.

One surprising result was that the economic impacts resulting from lease and royalty dollars going to county residents were not larger, given the amount of these dollars. The relatively large proportion of such spending going to motor vehicles and other retail purchases, combined with the small, rural nature of the county economy, means that much of the dollars going to local mineral right owners end up being spent outside the county. The county and its economy may simply be too small to capture a large proportion of the economic impacts of Marcellus Shale development.

Local Activity Doesn't Necessarily Mean Local Economic Impact

The spatial nature of development and the industry mean that local drilling and gas-related activity may not necessarily have a strong connection to the county's economy, other than through the lease and royalty payments to resident mineral right owners. To the extent that the workers live outside the county, the companies are not based in the county, and a majority of the equipment and materials were not purchased or produced within the county, drilling and pipeline construction activity in Bradford County may have little direct contribution to the local county economy. For example, a truck driver living in Williamsport and working for a company based there may be driving into and out of Bradford County to deliver materials and thus be very visible on the roads, but their individual direct connection to the local economy may solely be buying lunches and other incidental purchases if they stop at a local store. Similarly, drilling activity on parcels where non-residents own the mineral rights has less local economic impact because those leasing and royalty dollars immediately leave the community. Visible activity and anecdotes do not necessarily mean local economic impacts are occurring.

The actual observed employment and income effects in the county, compared to the amount that industry reports they spend per well, suggest that a significant proportion of such expenditures occur outside of the county where a well is drilled. This would include purchasing services, supplies, and materials from companies based outside the county, hiring workers who live outside the county, and using materials and supplies that were manufactured outside the county. Yet the dollars being expended are large enough, even with the leakage, that a significant amount of spending clearly does occur within the county itself and is having a positive job and income impact.

Economic Development implications

Even though it was not directly analyzed within this study, it is absolutely critical to keep in mind that the direct economic impacts from Marcellus Shale development will be transitory because this is a nonrenewable natural resource. When the gas is gone, the direct economic impacts likewise will be gone. In addition, the majority of the employment impacts will occur during the drilling phase of gas development, not during the production phase (see Brundage et al, 2011). The same phenomenon will occur with royalty income due to the shape of Marcellus Shale well production curves (Kelsey, 2011, unpublished analysis). Bradford County residents and businesses thus need to view natural gas development as a temporary boost to their local economy and be actively working to ensure that the development is tailored in ways that it leaves their community better off long term. This includes maintaining the local quality of life, ensuring current infrastructure investments have long-term usefulness (and are paid off before the boom slows), encouraging the creation of local businesses that broaden the economy so it is less dependent in the long run upon gas development, and protecting the water, air, and forest ecosystems that future generations will depend upon.

The relatively large amount of dollars leaving the community, both through employment and leasing/royalty spending, are an opportunity for economic development. A variety of actions can be taken to increase the amount of dollars that stay and circulate within the local economy. Building more housing would allow a larger share of workers to live within the county (and thus to spend more of their

income there), plus reduce negative impacts on renters (see, for example, Williamson and Kolb, 2011). Efforts must be cautious because overbuilding could leave a surplus of houses once the boom slows. There may be options for creating housing facilities that can be repurposed after the boom for other uses, such as vacation homes. Workforce training for local residents similarly could increase local economic impacts by increasing the share of the workforce who live locally, as would strengthening the ability of locally owned businesses to compete for contracts with the gas companies.

One important finding of this study is the large amount of leakage of leasing and royalty dollars, which is partially due to the relatively small nature of the county's economy. Increasing the scale and scope of the local retail and service sectors would help capture more of these dollars and could have long-term positive impacts within the community if it was done with the long run in mind. Such actions can include participating in Main Street style programs to revitalize downtown shopping districts, organizing and providing technical support to local businesses, and expanding the diversity of retail items and services available locally.

It also is important to recognize that economic activity and Marcellus Shale-related development in surrounding counties can benefit residents of Bradford County. The county's economy is connected to nearby counties and does not stand separately. Many residents commute outside the county for work, local businesses employ nearby county residents, and non-residents patronize those county businesses. The regional nature of the economy means to an extent it is somewhat artificial to focus solely on the impacts within the county itself. Economic development efforts and local officials should recognize the interconnected nature of the local economies and that job creation in one county generally has positive effects on surrounding counties. Rather than each county working on its own economic development activities, there is benefit to communication and collaboration across county lines.

The relatively rapid onset of Marcellus Shale development has caught some local governments and agencies by surprise. It is creating significant opportunities and challenges, but many of these require relatively rapid and comprehensive responses. The Commonwealth should consider whether local development agencies, local government, and others could benefit from increased state assistance to increase their capacity to respond proactively. This would help those counties directly, plus recognize the regional and statewide implications of gas development within those counties.

VI. Conclusions

The Bureau of Labor Statistics and IMPLAN analyses indicate that development of Marcellus Shale is having a significant economic impact in Bradford County. The strong employment growth that has occurred during the ramp up of Marcellus Shale development, in sharp contrast to statewide employment trends, shows that the development is positively affecting employment in the county. The IMPLAN analysis suggests that leasing and royalty income going to county residents similarly is having very positive impacts on the local economy, generating around 246 jobs in 2010, in addition to increasing those residents' income.

Yet the job creation in the county, as identified by the BLS data, appears small compared to the spending that the natural gas companies report and to estimates of the statewide economic impacts. This would suggest that a large proportion of the economic benefit resulting from Marcellus Shale development in Bradford County is occurring outside the county. How the distribution of these benefits across counties compares to the costs and inconveniences of drilling activity is unclear, but is important to consider.

Some may view the BLS employment data as not matching the scale of activity seen within the county. The difference between the actual employment counted by the federal government and local perceptions of employment effects likely is a result of the spatial nature of the development, with many companies and workers being based elsewhere and commuting into the county and many of the supplies being purchased elsewhere. In addition, the small size of the local economy means a larger share of spending by companies, workers, and mineral rights occurs outside the county because needed supplies and services are not available locally. Activity does not necessarily mean a strong connection to the local economy.

These county level results are consistent with prior statewide and national economic impact studies of shale gas development; the main difference with this study is the focus on the economic impacts that occur within the communities with drilling, rather than on the impacts occurring more. A smaller than expected number at the county level does not negate the broader economic impacts which are occurring in neighboring counties, elsewhere in Pennsylvania, and nationally. Prior economic impact studies have been based upon economic estimates or extrapolations, rather than actual observations of employment changes. The results in this study are what the Federal Bureau of Labor Statistics identified as actually occurring within the county.

How long Marcellus Shale development will last in the county, with its associated employment, leasing, and royalty impacts, is unclear. Natural gas development is a non-renewable resource, so by definition drilling will end at some point and so will its local economic impacts in Bradford County. Some have estimated it may take 30 or more years to drill all the planned Marcellus Shale wells in Pennsylvania, but the drilling phase in any single community likely will be shorter, as the crews complete work in one area before moving on to another. The challenge and opportunity for residents, local businesses, and leaders in Bradford County is to find ways of using the current Marcellus-related economic activity to strengthen

the community and local economy, so when the drilling and natural gas production ends, the county and its residents are better off than they were before the gas development began.

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