

Duquesne University

## Duquesne Scholarship Collection

---

Electronic Theses and Dissertations

---

Fall 2015

### Housing-Related Migration in the Marcellus Shale Region of Pennsylvania

Annette M. Mackay

Follow this and additional works at: <https://dsc.duq.edu/etd>

---

#### Recommended Citation

Mackay, A. (2015). Housing-Related Migration in the Marcellus Shale Region of Pennsylvania (Master's thesis, Duquesne University). Retrieved from <https://dsc.duq.edu/etd/849>

This Immediate Access is brought to you for free and open access by Duquesne Scholarship Collection. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of Duquesne Scholarship Collection.

HOUSING-RELATED MIGRATION IN THE MARCELLUS SHALE REGION OF  
PENNSYLVANIA

A Thesis

Submitted to the Graduate Center for Social and Public Policy

McAnulty College and Graduate School of Liberal Arts

Duquesne University

In partial fulfillment of the requirement for  
the degree of Master of Public Policy

By

Annette M. Mackay

December 2015



HOUSING-RELATED MIGRATION IN THE MARCELLUS SHALE REGION OF  
PENNSYLVANIA

By

Annette M. Mackay

Approved November 19, 2015

---

Michael D. Irwin, Ph.D.  
Associate Professor and Chair, Department of  
Sociology

---

Lenore Resick, Ph.D., CRNP, FNP-  
BC, FAANP, FAAN  
Professor Emerita, School of Nursing

---

James Swindall, Ph.D.  
Dean, McAnulty College and Graduate  
School of Liberal Arts

---

Michael D. Irwin, Ph.D.  
Director, Graduate Center for Social and  
Public Policy

## ABSTRACT

# HOUSING-RELATED MIGRATION IN THE MARCELLUS SHALE REGION OF PENNSYLVANIA

By

Annette M. Mackay

December 2015

Thesis supervised by Michael D. Irwin, Ph.D.

Since 2008, hydraulic fracturing of natural gas, or “fracking,” has brought economic and environmental changes to localities in the Marcellus Shale region in Pennsylvania. In some rural counties, the sudden influx of activity associated with gas extraction created boomtowns, whereas urban areas saw an economic revival after years of stagnation that followed the collapse of the steel industry. To what degree does in-migration from the natural gas industry account for changes observed in daily living in these areas? Dimensions of social disruption have implications for population mobility, however the nature of mobility, community, and place attachment provide explanations why people may stay in place. This research examines social disruption from in-migration into the Marcellus region and its attendant effects on housing security as a primary motive for mobility. Using a mixed-methods approach, geomobility and

migration data from public records a weak association between movers and housing availability.

Observations from key informants contextualize the empirical results by showing regional differences in perceptions about the social effects of the natural gas industry in their area.

Problems associated with housing security are associated more with the availability of water and sewage infrastructure than with changes occurring with natural gas development.

Recommendations for public policy will advise and prepare communities to adapt to current and future conditions inherent in the energy production industry.

## ACKNOWLEDGEMENTS

I am grateful for the guidance and support of Dr. Michael Irwin and Dr. Lenore Resick. This thesis is dedicated to my husband, Dr. William J. Mackay, and daughter, Caroline M. Mackay, in appreciation of their loving support. This research was graciously supported by the Dr. Michael P. Weber Endowed Research Grant.

## TABLE OF CONTENTS

	Page
ABSTRACT.....	iv
ACKNOWLEDGEMENTS .....	vi
Housing-Related Mobility and Migration in the Marcellus Shale Region in Pennsylvania.....	1
Marcellus Shale Development .....	3
Economic Impact of Natural Gas Extraction .....	6
Local Perceptions of Natural Gas Extraction.....	9
Municipal Agency to Control Boomtown Effects .....	10
Boomtown Stress on Community Life and Well-Being .....	12
Unpredictability of the Natural Gas Market .....	13
Housing Market, Social Disruption, and Policy Implications .....	15
Consequences of Housing Insecurity .....	18
Purpose of Research.....	18
Literature Review.....	20
In-migration and Social Disruption .....	20
Nature of Mobility .....	22
Nature of Community .....	24
Nature of Attachment.....	27
Operational Framework and Hypotheses.....	29

Research Design and Methodology .....	34
Operational Definitions.....	34
Methodology .....	38
Population and Sample .....	40
Data Collection .....	41
Data Analysis .....	41
Limitations .....	43
Results and Discussion .....	45
Demographics of the Marcellus Region .....	45
Quantitative Analysis: Natural Gas Activity and Mobility, Migration, and Housing .....	47
Marcellus and Non-Marcellus Region. ....	47
Within-Marcellus analysis: Metropolitan and non-metropolitan comparisons. ....	50
Within-Marcellus analysis: Effects by activity in regional tiers.....	53
Qualitative Analysis: Local Perceptions of Social Change in the Marcellus Region .....	60
Identification of study areas.....	60
Field observations.. ....	62
Key informant demographics and data analysis. ....	66
Major themes across the Marcellus region. ....	67
Major themes in Marcellus Tiers. ....	72

Discussion .....	79
Research Expectations and Empirical Results .....	79
Contextualization with Qualitative Results .....	81
Conclusion and Policy Recommendations.....	84
Further Research .....	86
References .....	87
Appendix A .....	95
Appendix B .....	99
Appendix C .....	100
Appendix D .....	104
Appendix E .....	132
Appendix F.....	133

## **Housing-Related Mobility and Migration in the Marcellus Shale Region in Pennsylvania**

The purpose of this research is to analyze patterns of mobility and migration in areas of Pennsylvania affected by Marcellus Shale drilling. This study also seeks to gain an understanding of social change in response to the expansion of the natural gas extraction industry. Research in mobility and migration has implications for public policy, as population movement is both a factor and a consequent of social disruption.

The investigative rationale comes from the literature on population migration and social disruption, which explores the effect of economic and social change on the choice of residential location. It offers a description of who is likely to move and what the motivating conditions may be. This area of study also analyzes the characteristics of communities that foster place attachment as well as the conditions that lead to severing social and economic ties to one location and re-establishing them elsewhere.

Except for circumstances where movement results from loss of a dwelling or coercion, most people choose to remain in place. Census data substantiates this assertion by reporting that 88.3% of the American population maintained the same residence for at least one year from 2012 to 2013 (Ihrke, 2014, p.1). Theoretical explanations posit that life phases, interpersonal bonds, and civic engagement attach people to places (Irwin, Blanchard, & Tolbert, 2004). Years of residential stability and homeownership indicate residential satisfaction, which lessens the desire to move (Speare, 1974, p. 183). Long-term residents are an indicator of social stability.

However, circumstances will occur that motivate a portion of the population to break place attachments and move in any given year. Ihrke (2014, p.1) found that between 2012 and 2013, that percentage of movers in the U.S. population was 11.7%. Some reasons are pragmatic; better living conditions elsewhere draw populations away from their homes to new locations.

Other reasons suggest that personal or social change, either sudden or gradual, weakens place attachment (Ihrke, 2014; Smith, Krannich, & Hunter, 2001). Residential mobility refers to a change of address where movers remain in close proximity to their original home. Migration is long distance relocation, usually crossing geographic or legislative boundaries (Smith, Tayman & Swanson, 2001, p. 99). Migration is indicative of a more severe separation of place attachment.

Communities in the Marcellus shale region of Pennsylvania have characteristics that foster place attachment whether they are in small rural locations or larger metropolitan places. Nonetheless, people within the region find it preferable or necessary to move. To what degree does social disruption from natural gas extraction sever attachments to place? Refining the question more specifically, is the cost and availability of housing affected by natural gas development and if so, is it a significant motivator in the decision to move?

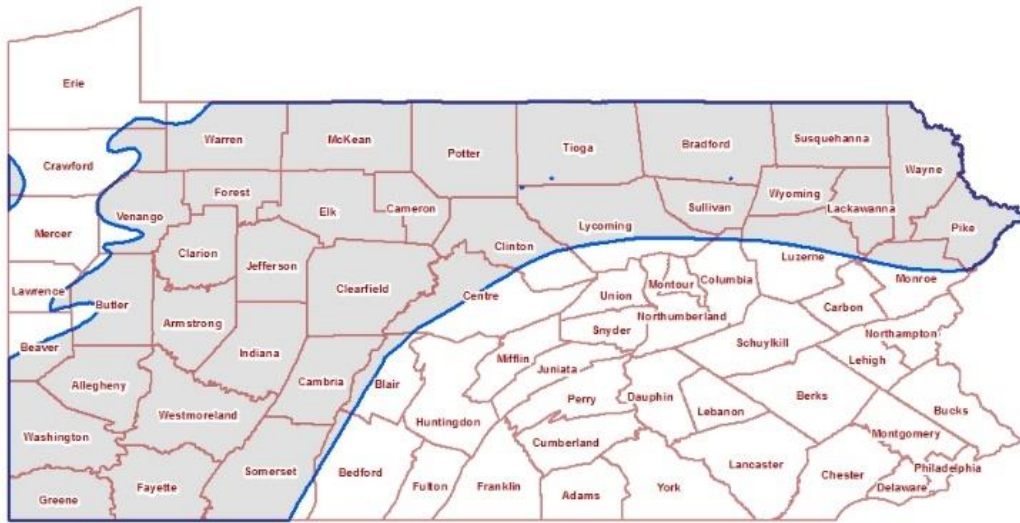
Understanding why people move is relevant to public policy insofar as decision makers need to anticipate population placement in order to provide public services that ensure social stability. Not only housing, but education, healthcare, public safety, and public works are policy areas that respond to the volume of the population. From a functionalist perspective, disruption in these institutions affects processes that create hospitable living environments. This study will examine population movement in the Pennsylvania Marcellus region from the theoretical perspectives explaining migration and non-migration to assess its impact on social disruption, especially as it concerns safe and affordable housing.

## **Marcellus Shale Development**

Marcellus shale is a natural gas-bearing geologic formation situated approximately one mile beneath the surface of southern New York, the western two-thirds of Pennsylvania, and parts of Ohio, Maryland, and West Virginia. In Pennsylvania, Marcellus exists as a crescent-shaped formation extending from Warren to Pike County along the northern border, and extends to the southwestern corner at the Pennsylvania, Ohio, and West Virginia border. This area is traditionally rich in natural resources. Oil and timber are dominant in northern counties, while coal veins allowed for the development of iron and steel manufacturing. Other types of shale are present in the area that makes Pennsylvania a lucrative location for energy exploration and extraction.

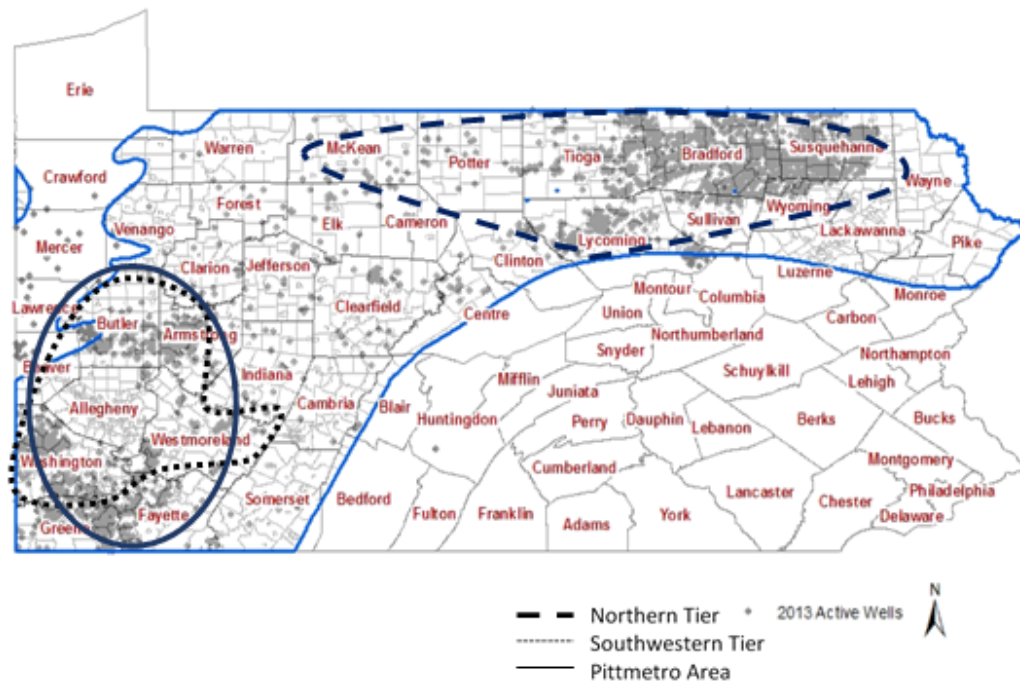
Access to the natural gas embedded in rock had been unavailable until the early 2000s when advances in hydraulic fracturing (“fracking”) and horizontal drilling allowed for cost effective extraction. This type of drilling is “unconventional” because it involves the removal of gas or oil from rock or sand rather than from a naturally formed pocket. The fracking process uses high-pressure injection of water and lubricants to create fissures in the shale, allowing gas to pass through the rock and into a well bore. Vertical and horizontal drilling allows for gas extraction throughout the entire shale play, or field of commercial energy extraction (Bureau of Labor Statistics, 2014). Extraction by fracking can occur under surface structures, such as buildings, parks, and farms. Extraction can also occur closer to urban areas that typically have prohibited energy development because of the density of surface structures.

Figure 1 shows the Marcellus area situated in Pennsylvania. In all, 36 counties in Pennsylvania have active fracking sites. They are Allegheny, Armstrong, Beaver, Bedford, Blair, Bradford, Butler, Cambria, Cameron, Centre, Clarion, Clearfield, Clinton, Columbia, Elk,



*Figure 1.* Marcellus shale region in Pennsylvania (shaded). County boundaries

Fayette, Forest, Greene, Huntingdon, Indiana, Jefferson, Lawrence, Lycoming, McKean, Mercer, Monroe, Potter, Somerset, Sullivan, Susquehanna, Tioga, Venango, Warren, Washington, Westmoreland, and Wyoming (Pennsylvania Department of Environmental Protection [PA DEP], 2015). McLaughlin, DeLessio-Parson and Rhubart (2014, p. 4) further describe the division of Marcellus into tiers according to concentration of extraction activity. The Northern Tier of the Marcellus region contains Bradford, Clinton, Columbia, Lycoming, McKean, Potter, Sullivan, Susquehanna, Tioga, Union, and Wyoming counties. The Southwestern Tier contains Allegheny, Beaver, Fayette, Greene, Washington, and Westmoreland counties. For this study, I designate the remaining counties of Armstrong, Bedford, Blair, Butler, Cambria, Cameron, Centre, Clarion, Clearfield, Elk, Forest, Huntingdon, Indiana, Jefferson, Lawrence, and Venango as the Central region. The majority of the Marcellus region has a rural designation based on population density. Only Allegheny and surrounding counties have an urban designation due to proximity and to Pittsburgh and population density. In fact, the counties in the Pittsburgh



*Figure 2. Regions within the Marcellus shale area in Pennsylvania based on gas drilling activity, 2013*

Metropolitan statistical area closely align with the Southwestern Tier. This allows a natural urban to rural comparison of data presented later in this report. Figure 2 shows the tiers within the Marcellus region.

Looking within natural gas as an energy source, there are two types with their own uses in the energy market (Ratner & Tiemann, 2014). “Dry” natural gas is mostly methane (Ebinger & Avasarala, 2013, p.4), used in heating, cooling, and vehicle fuel (U.S. Energy Development Corporation, 2013). “Wet” gas contains condensates, or natural gas liquids (NGLs), which are isolated from the methane and sold for other energy uses. Wet gas contains butane, used in torches and lighter fluid; propane, used in home heating and cooking; and ethanes, which have utility in the petrochemical industry (U.S. Energy Development Corporation, 2013; Ebinger & Avasarala, 2013, p. 5). The location of wet and dry gas follows a division that bisects the Marcellus crescent, where dry gas is located primarily on the Northeastern side containing

Bradford, Susquehanna, and Lycoming counties. Wet gas is predominately located in Washington, Butler, and Green counties (U.S. Energy Information Center, 2013). Because of its added marketability, wet gas is more valuable than dry gas, however, both respond to the market demand for their respective commodities.

The total quantity of energy contained in Marcellus is substantial. Estimates predict that the Pennsylvania can service domestic consumption for 20 years (Brasier et al., 2014, p.7). As a result, exploration, drilling, and production have been significant. There were 8,486 unconventional wells drilled in Pennsylvania as of January 1, 2015 (PA DEP, 2015). According to the U.S. Department of Energy, Pennsylvania provided 3.23 trillion cubic feet, or 13.3% of the national gas supply in 2013, which was second only to Texas (U.S. Energy Information Center, 2015). The top producing counties in the Northern Tier are Bradford, Susquehanna, and Lycoming; the top producers in the Southwestern tier are Washington and Greene counties (McLaughlin, et al, 2014, p.5). Figure 2 above shows the location of well pads in each tier of the Pennsylvania Marcellus region.

### **Economic Impact of Natural Gas Extraction**

The economic potential of natural gas extraction offers considerable promise to rejuvenate the Pennsylvania economy, which has suffered in the aftermath of the deindustrialization of the steel industry. The discovery of the Marcellus shale play and the advancement in extraction technology has the potential to reverse decades of decline. However, because of the nature of the commodities market, there is no guarantee of sustained economic performance. Local economies are therefore subject to cycles of growth and contraction, which can affect population mobility and social disruption in affected areas.

Since the 2008 recession, employment across all labor sectors has been in decline except for the oil and natural gas industry (Bureau of Labor Statistics, 2014). The natural gas industry added 15,114 jobs from 2007 to 2012, representing a 259.3% increase (Bureau of Labor Statistics, 2014). Since that time, the Pennsylvania Department of Labor and Industry reported that employment in core oil and gas occupations rose by 15,331 jobs from the second quarter of 2010 to the second quarter of 2014, for a total employment figure of 31,180 (Pennsylvania Department of Labor & Industry, 2015). Moreover, “while the state’s average annual pay increased by \$5,158 (11.9 percent), to \$48,397 in 2012, wages in Pennsylvania’s oil and natural gas industry rose by \$22,104 (36.3 percent), to \$82,974 in 2012” (Bureau of Labor Statistics, 2014).

Despite the overall benefit to Pennsylvania, the economic impact of Marcellus is inconsistent statewide. Counties within the Marcellus region have rural and urban economies. The type of prevailing industry in a county before drilling occurs has an impact on overall employment and income gains. For example, Brasier et al. (2014, pp. 25-31) reported that Bradford and Lycoming counties saw job growth and higher taxable income rates largely because of a pre-existing stagnant agricultural and coal mining base, whereas the effects in Washington and Greene counties were conditioned by the economic climate in Pittsburgh. Income and employment were already higher there than in other counties in the study region. Informants in Washington and Greene counties reported lower income gains associated with fracking because of the greater economic and social diversity. People receiving income from the gas industry may actually live in other counties, and those places would have seen gains related to income generated by natural gas development.

Economic inconsistency is also a condition of the fluctuating market price of natural gas. Just like oil and other commodities, supply and demand moderate the level of production, which in turn affects hiring and spending. When the price is high, companies invest in exploration, drilling, and production. This includes increased hiring and local spending by both the workers and the industry. Eventually the market for gas will taper off as the supply of gas satisfies the market. When this happens, companies cut back production, resulting in layoffs and reduced spending until the market improves (Christopherson & Righthor, 2012, p. 2). The net effect in communities is recurring cycles of increased economic activity followed by periods of loss.

Yet the natural gas industry in Pennsylvania is at a mid-point in overall development. A panel discussion conducted by legal experts and representatives from the Pennsylvania Department of Environmental Protection and the Pennsylvania Department of Community and Economic Development discussed land use and zoning in the Marcellus region. Part of the discussion described the production cycle of natural gas. According to Geraghty, Smith, and McGrail (2015), following the drilling phase comes distribution through pipelines. The potential to reach new customers expands with the pipeline, especially in areas that have not had access to natural gas as an energy source. Communities previously not affected by drilling will become involved in the market through pipeline construction, where the same principle applies. Local economies will grow with the construction of the pipeline, and then may contract once operations are in place and the labor needs change. Sustained municipal revenue will come from taxes and impact fees on gas production, but again, the overall benefit remains attached to the market price for gas.

## **Local Perceptions of Natural Gas Extraction**

Likewise, the social response to the rapid deployment of the natural gas extraction industry varies within the Marcellus region. Urban areas like Allegheny County and surrounding counties have an existing history with manufacturing, and the infrastructure to support mass transportation already exists. According to Brasier et al. (2011, p. 53) familiarity with manufacturing and industrialization makes changes that occur with natural gas extraction less noticeable. Residents in Allegheny, Washington, Beaver, Fayette, and Westmoreland are less likely to perceive physical changes resulting from fracking as unusual because evidence of industrialization is already a fixture in the landscape. Existing highways accommodate transportation of oversized loads, heavy equipment, and hazardous liquids. Seeing trucks hauling these things are not out of the ordinary. Large industrial-looking structures situated on fracking sites are more congruent in areas with existing warehouses, excavation sites, cell phone towers, and commercial buildings.

The manufacturing heritage of the Pittsburgh area and the pre-existing experience with natural resource extraction also minimizes negative perceptions of economic impacts (Brasier et al., 2011, p. 39). Greater familiarity with industrial expansion and contraction preconditions places like Washington County to the cyclic effects on employment associated with the gas industry. A broad range of occupations and educational opportunities does not tie residents to a specific occupation or industry in the Southern counties. The diversity of the area also dilutes the immediate effect of income disparity as people of different socioeconomic statuses come together in heterogeneous areas, like shopping malls and downtowns.

However, counties like Bradford, Tioga, Lycoming, and Sullivan are more homogeneous. According to Jacquet (2014, p. 8327), lack of congruity can make residents more likely to

perceive social changes as disruptive, or magnify the importance of changes to their overall residential satisfaction. The small populations, lack of interstate highways or major state roads, and recent inexperience with the cyclic nature of the natural resource extraction industry makes them more reactive to changes brought on by rapid industrialization. Brasier et al. (2011, pp. 44-52) found that people who make their living from tourism, hunting, fishing, and camping have concerns that fracking will harm their industry. In addition, respondents reported that they believed that revenue from leasing and royalties created unequal wealth opportunities where some receive windfalls while others bear the burden of inflation, increased crime, overcrowding, and other attendant social problems associated with rapid economic development.

### **Municipal Agency to Control Boomtown Effects**

The sudden activity from gas extraction created boomtowns in small municipalities all throughout the region. Boomtowns are communities where a sudden influx of population and cash, usually from natural resource exploitation, changes the overall social and economic structure in communities (Christopherson & Rightor, 2012, p.2; England & Albrecht, 1984, p, 231). While there are legislative tools that municipalities can use to manage rapidly changing economic and social effects, the ability to self-govern is constrained in Pennsylvania when it comes to natural resources. The limitations on community control come directly from the authority of the state government. This has put an appreciable amount of stress on municipal planning in the communities in the Marcellus region.

Under most conditions, boroughs, townships, cities, and other legislative areas are able to accommodate economic and social change within their jurisdiction through the regulatory process in local government. Municipalities employ land use, zoning, and code enforcement policies to plan for efficient and effective community development. These regulations and

policies minimize social and economic externalities that can come from sudden growth. For example, building codes and zoning ordinances can restrict types of commercial development in residential areas, or near schools and hospitals. Communities may also decide to resist development entirely if the risks compromise other civic values, such as destruction of natural areas.

Yet a municipal government is not a sovereign entity having full autonomy in decision-making. Local government must act within the authority delegated by state, as they are entities of the larger governing body. According to legal scholar and environmental policy advisor Ubringer (2015), the state has the power to mandate, amend, or disallow municipal authority in regulatory matters. For example, local governments must comply with minimum state environmental standards rather than impose limits that may be preferable to their interests.

Act 13 is an amendment to Commonwealth Statute 58 that gives gas companies the advantage to extract natural gas or perform other operations pursuant to the gas industry in communities where there geologic evaluations determine marketable shale plays (Kelsey, Metcalf, & Saldedo, 2012, p.2). Associated operations include pipeline, compressor stations, and waste disposal facilities. The language in the preemption provisions of Act 13 states that local ordinances cannot impose conditions or limitations on oil and gas operations. Operations include well development from seismic exploration through pad construction and site restoration; water and fluid storage areas; pipelines, compressor stations and processing plants; and waste management facilities (Ubringer, 2015).

Because of this ruling, municipalities cannot ban gas development outright regardless of their concern for the overall economic and social impacts that extraction may impose, although there is some recourse to protect communities from negative impacts. The only situation that can

supersede the codification of Act 13 is a threat to clean air and water, or harm to property and public space. In the 2014 Commonwealth Court ruling in *Robinson Township v. the Commonwealth of Pennsylvania*, the state has a fiduciary obligation to guard the public trust against pollution or other harmful effects (Ubinger, 2015). The court ruled that the state could not preempt the placement of structures, referred to as a setback waiver, to protect water sources, public spaces, etc. However, local governments have no authority to regulate the operation of oil and gas facilities. This gives municipalities some ability to work with the Pennsylvania Public Utilities Commission and the Department of Environmental Protection in order to make best practice decisions in the community interest. However, according to legal experts and municipal government authorities, the oil and gas companies can challenge setback conditions in court, which can be costly and time consuming for municipalities given stringent budgets and limited legal expertise (Hockenberry, Ball, Cohen, Puko, & Trant, 2015).

### **Boomtown Stress on Community Life and Well-Being**

With municipalities constrained in their ability to restrict or control natural gas development, boomtown changes are likely to continue as long as oil and gas companies find profitable shale plays. Previously cohesive communities may experience conflict due to shifting power and disenfranchisement. Communities may also find it difficult to develop effective planning proposals because of uncertainty and unpredictability within the gas industry.

For example, owners of large parcels have the most incentive to allow fracking on their land. Their “voice” has more influence than that of smaller landholders or the municipal government (Kelsey et al., 2012, p. 11). When the owners of the mineral rights agree to leases, they in effect create policy for the other residents. This can be divisive in formerly cooperative agrarian communities where people have a history of weathering the good and bad times as a

group. Studies of resident perceptions of the gas industry impacts show that some residents will welcome the economic opportunity and encourage development, while others express dissatisfaction (Brasier et al., 2011, p.34; Kelsey et al., 2012, p.2). Those who cannot participate in the development process believe they will experience the inconvenience and cost of remediation without enjoying much of the gains. Resentment can divide communities and weaken social attachments between people and places. In his review of community risks from shale development, Jacquet (2014, p. 8324-8325) summarized from the literature that unequal distribution of benefits and risks is a contributing factor to lower community cohesion. People polarize along issues affecting the community, such as environmental risk and economic opportunity, which inflames conflict. The diminished capacity of local government to exercise leadership by limiting or banning natural gas development ties their hands in acting as mediator to resolve community conflicts.

On the other hand, residents of Southwestern Pennsylvania may experience less friction from widening social inequality. Many residents in this area do not own the mineral rights to their property. Generations ago in the early days of Pennsylvania oil and coal industries, the government disaggregated mining rights from property deeds (Kelsey et al., 2012, p.3). The mineral right holders today may be the local government or a non-resident private entity. In any case, the decision to lease property in this region for gas extraction is less likely to create social divisions within the community because the proximal recipients of revenue are not friends, family, or neighbors.

### **Unpredictability of the Natural Gas Market**

The boom imposes a variety of stressors for community planning because of economic volatility and the unpredictability of where gas companies will decide to situate their operations.

As Christopherson and Rightor (2012, p.6) note, the direct impact of shale play extraction is local, unpredictable, and responsive to the risky market for natural gas and its components. The host community withstands the first impact of drilling from heavy traffic, road damage, increased crime, demand for social services and demand on public services (Herzenberg, Polson, & Price, 2014, p.16; Ward, Polson, & Price, 2014, p.2). Yet community officials are uncertain as to the permanence of these changes because production fluctuates with the price of gas. Drilling increases when the price of gas is high then tapers off when the excess supply lowers market prices (Ebinger & Avasarala, 2013, p.11); Jacquet, 2014, p.8322). Further, the market price for wet or dry gas moderates production. When dry gas is less valuable, such as in the summer months or when supply outstrips demand, operators shift production to wet gas (Ratner & Tiemann, 2014, p.5). Operators hire and lay off workers at different sites accordingly. Because of economic volatility, the boom-bust cycle can occur multiple times in a community, where the gains and losses recur in unpredictable patterns (Christopherson & Rightor, 2012, p.8). In addition, if a site does not produce as predicted, or if better prospects exist elsewhere, operators can pull out, taking their workers and the economic benefits to the community with them (Christopherson & Rightor, 2012, p.6).

Even in locations where gas production is consistent, local governments cannot easily devise comprehensive plans for community development because of the Act 13 restrictions. For example, municipal planners are cautious about revising industrial zoning boundaries near residential areas because of the potentially negative effect on property values (Geraghty et al., 2015). Reduced property values lead to tax adjustments, which lower municipal revenue. In addition, communities have reported that deals with business and residential developers are constrained by the possibility that a well pad may go in adjacent to a planned residential

subdivision or shopping center, thus reducing market potential of the development even before construction is complete (Geraghty et al., 2015). These uncertainties make it difficult for host communities to anticipate tax revenue in order to budget for immediate and future needs.

### **Housing Market, Social Disruption, and Policy Implications**

The focus of this research concerns the impact of natural gas development on the rental housing market. The projects in the Marcellus extraction fields are time-limited, meaning that unlike industries with a permanent presence, like manufacturing, gas workers will come and go as needed. The length of time that drilling crews remain in an area can vary from a weeks to years, depending on the number of wells planned for a geographic area (Williamson & Kolb, 2011, pp. 7-8). The preference for workers at this phase of gas development is for rental housing, which includes hotels, and campsites in addition to apartments and single-family homes (Williamson & Kolb, 2011, p. 11-12).

However, in areas where the gas companies establish regional headquarters, worker deployments are considerably longer. Considering that Pennsylvania shale can produce gas for at least 20 years, these assignments are likely to be permanent. In this case, workers may look for long-term rental housing before moving in to the homeowner market (Williamson & Kolb, 2011, p.8).

Regardless of the duration of work deployments, the influx of gas workers increases competition and cost for rental housing (Christopherson & Rightor, 2012; Herzenberg et al., 2014; Jacquet, 2014; Komadina, McNally, & Young, 2014; Williamson & Kolb, 2011). Rural counties like Bradford and Lycoming have reported rent increases of at least 50%, “with many communities experiencing a doubling or even tripling of rents” (Williamson & Kolb, 2011, p. 10). Some property owners target gas workers for higher, short-term rent, while keeping rates

lower for long-term rentals that usually go to local residents. Yet others see an opportunity to capitalize on the market knowing that rents may return to pre-boom rates once the initial wave of workers move on. These property owners indiscriminately raise rent across the board (Williamson & Kolb, 2011, p. 7, 10).

Federal programs designed to help with housing insecurity lag in their response to help low- and moderate-income renters cope with housing inflation. The U.S. Department of Housing and Urban Development (HUD), the United States Department of Agriculture, and the Internal Revenue administer programs that provide direct payment to renters, or fund rental assistance programs administered by the states. These programs receive set-amount funding in the federal budget from which states receive an allocation. Although there are standards for emergency exception payments, they are insufficient to meet growing demand. When the fair market rent in a geographic area increases, the utilization rate measuring the number of vouchers goes down. Evidence from a study on gas exploration and affordable housing shows two emerging trends. Komadina et al. (2014, p.4-5) found that from 2009-2013, market rents inflated the costs per voucher while the number of recipients decreased. Additionally, the lowest utilization rates occurred in rural areas of oil and gas affected states.

Housing stock is another contributor to upward pressure on housing insecurity. McLaughlin et al. (2014) found that despite growing demand, affordable housing inventory has not changed appreciably in response to Marcellus activity in Green, Bradford, Lycoming, and Washington counties. The authors attribute the impact of housing to the size of the available stock prior to gas exploration, and to stakeholder's caution about investing in infrastructure during a "boom-bust" climate. The concern about over-developing housing is valid when one considers community problems that may arise from vacant properties after the boom subsides.

Property owners and developers are disinclined to expand into affordable housing market while the inventory is low, and others see an opportunity to shift from the subsidized housing market to the regular rental market (McLaughlin et al., 2014, p.24). In reports on affordable housing in rural counties affected by natural gas development, some owners who previously rented to Section 8 families changed the status of their housing units in order to attract tenants who could afford higher rental rates (Ward et al., 2014, p.18; Komadina et al., 2014, p. 3). This further reduces the number of units that qualify for federal and state housing assistance programs. However, Pennsylvania has taken action to alleviate the pressure on affordable housing through the impact fees imposed by Act 13. A portion of fees fund projects creating more affordable housing in a variety of programs ranging from cash assistance to new construction of affordable units (Komadina et al., 2014, p.6).

At the micro level, the consequences of housing security can be serious for families with children. Housing instability has impacts on providing social services. In Bradford, lack of existing affordable housing created placement problems for social service workers trying to find residences for low-income and homeless families (Brasier et al., 2011, p.47). Housing authority workers there reported that most of the vacancies were taken by field workers, and other available properties were either too expensive to qualify for subsidy programs, or in unsuitable repair. In some areas, this has had implication on family cohesion. Herzenberg et al. (2014, p. 1, 14), reported that the number of Greene county children placed in foster care for housing-related reasons doubled in the year after drilling began from 15% to 30%, and has remained at that level since. People squeezed out of their homes have few options but to move or enter into homelessness.

## **Consequences of Housing Insecurity**

A body of research has established that moving is disruptive to the home life, especially when the circumstances preconditioning the decision to move are negative. Examples of such factors are divorce, illness, family member incarceration, loss of income, and natural disaster (Cohen & Wardrip, 2011). Dimensions of family instability include increased household stress, reduced family cohesion, difficulty in forming social attachments, reduced academic achievement in children, and lower rates of educational persistence (Brennan, 2011; Cohen & Wardrip, 2011). Low-income families forced to relocate may not be in a financial position to maintain or improve the quality of their home. In addition to emotional stress, they face potential health and safety risks from living in sub-standard housing. They also risk homelessness if affordable options are unavailable (McLaughlin, 2014, p. 24).

Student mobility affects the education system as well. Schafft, Kotok, and Biddle (2014, pp. 10-14) found that curricular adjustments may become necessary to accommodate new students with different levels of skills and proficiencies. This has particular relevance to school ratings and funding in accordance with the Pennsylvania System of School Assessment (PSSA) mandate. For example, Rhodes (2005, p. 9) found an association between increased mobility of low-income children and lower school ratings according to the No Child Left Behind (NCLB) guidelines. Factors that bear on school performance indicators, such as enrollment, tax base, and assessment rating affect resource allocation which in turn has direct implications for curriculum content and faculty and staff composition (Brennan, 2011; Rhodes, 2005; Schafft, et al., 2014).

## **Purpose of Research**

In the Marcellus region, reports from housing administrators and social service agencies indicate that gas development contributes to the mobility and migration stream where people

relocate in search of housing (McLaughlin et al., 2014; Ward et al., 2014). The focus of this study is to examine mobility and migration patterns in Pennsylvania counties affected by the development and expansion of the natural gas industry. The main purpose is to identify a relationship between natural gas development and population movement. Because the natural gas industry creates high-paying jobs, it is likely that population movement will occur as people within the state travel in search of work. In addition, because unconventional gas extraction is a new technology in Pennsylvania, a trained workforce will likely come from another state to establish operations. It is also likely that the development of a new industry will create social and economic change that may displace current residents, or create new opportunities for people to act on a desire to move. Therefore, if natural gas development is a stimulus for population movement, does it follow a mobility model (intra-county or short inter-county move), a migration model (long distance inter-county or inter-state), or both? The study will also ask if a relationship exists between drilling, population movement, and housing. The research will investigate two main hypotheses:

1. Areas with more gas drilling activity will have greater population mobility than less active areas.
2. Lower income households, renters, and working age population (18-65) will be more mobile.

Interviews with key informants will provide local perceptions of how fracking and migration relate at the community level. Again, the expectation is that indicators of social disruption will be more evident in areas with more mobility and gas extraction activity. An examination of the literature on mobility and community will provide the theoretical basis for the study rationale described in the research design section of this thesis.

## **Literature Review**

Demographic inquiries examine reasons for non-migration as well as migration. According to Lee (1966), inertia resists change, which argues for staying in place as the natural state in human behavior. Census data supports this assertion. The percentage of people in the United States who moved within the past year from 2012 to 2013 was 11.7% compared to 88.3% non-movers (Ihrke, 2014, p. 1). Thus, in any set of circumstances affecting the community environment, there will be more who remain in place rather than move. This holds true for Pennsylvania as well, where 42.1% of residents who moved to their home between 2000 and 2009 still resided at that location in 2013 (U. S. Census Bureau, 2013c). Aside from events that remove individual agency from the decision to relocate, like natural disasters, incarceration, or eviction, mobility is a choice. However, Lu (1999, pp. 481-483) maintains that intervening circumstances condition choices that people make. Again, studies by the Census Bureau report that those who move cite housing, family, and employment as intervening circumstances prompting their decision (Ihrke, 2014, pp. 5-7). A review of the migration and social disruption literature provides details on the factors that increase residential satisfaction or diminish it, thereby prompting people to decide to move.

### **In-migration and Social Disruption**

In-migration can be disruptive in several ways. The presence of new people and their customs, tastes, and habits draws attention from in-place residents who must adapt to unfamiliar people and settings in their communities. The newcomers must adjust to new surroundings and people as well, while reconciling feelings of loneliness, boredom, or isolation. Evidence from Marcellus shale impact studies reveal increases in 911 calls for accidents and crimes, notably DUIs, theft, and serious crime (Herzenberg et al., 2014, p. 18; Ward et al., 2014, p. 2). Early

research in the study of boomtowns suggested that rapid social change caused by the presence of new people weakened preexisting interpersonal bonds and diminished the community capacity to provide for physical and psychosocial needs (England & Albrecht, 1984; Smith et al., 2001). However, criticisms of methodology and bias led researchers to revisit prior assumptions (Smith et al., 2001, p. 429). Later works looked at the totality of social integration on a number of dimensions, such as trusting neighbors, borrowing items, and helping with tasks, and found that booms do not adversely affect all areas of social function (Smith et al., 2001, p. 446).

While social disruption affects some factors, other dimensions of community cohesion remain in place. Some, such as the importance of belonging to churches and civic groups, may be protective against long-term social change (Irwin, Tolbert, & Lyson, 1997; Smith et al., 2001). According to Portes (2010, p. 31), migration makes superficial changes to visible social life, but of itself does not change the pre-existing social structures of the receiving community. Thus, in-migrants will have proximal impacts on traffic, crime, public health, housing, etc., but the dominant social structure of the community will moderate the long-term implications through assimilation.

Public policy should take into consideration the social contexts associated with the decision to move or migrate. While policy cannot account for personal preferences in the desire to move, it can respond to changing social structures and adapt accordingly to meet the residential needs of individuals and families. Understanding the nature of mobility, the nature of community, and the nature of attachment provides information about why people choose to move or stay in place. Public policy then can respond to the motivation for staying by providing support for factors that strengthen social cohesion. In addition, knowing why people move as

well as who is likely to move can prepare the receiving communities so that they can accommodate the needs of new residents.

### **Nature of Mobility**

As stated previously, unless mobility is the outcome of factors beyond one's control, moving will be the result of a free or constrained choice. Mobility starts with the desire to move, but other factors predict the likelihood that desire will turn to action (Lee, Oropesa, & Kanan, 1994; Mateyka, 2015; Speare, 1974). Key determinants for acting on the desire to move are life stage and residential satisfaction (Lee et al., 1994, p. 263-264). Others are desirable circumstances at destination locations. Factors that make people happy or unhappy with their location can push or pull people into the decision to move or migrate (Speare, 1974; Dorigo & Tobler, 1983).

Life stage and tenure (owning or renting) are interconnected. Both are associated with conditions that affect the decision to move. Younger people (35 and younger) beginning careers and family are more likely to rent than those aged 36 and older (Mateyka, 2015, p.6). They are freer to respond to the desire to move that may arise from wanting a better home, chasing employment, or family-related reasons (Lu, 1999; Mateyka, 2015). Renters, too, are less committed to their residence because they have no financial or emotional equity in their home. It is also easier to escape financial commitments at the renewal of a lease period than it is to sell a home in order to fulfill a mortgage. For example, Lu (1999, p. 478) reported that 60.7% of renters actually moved after expressing interest in doing so, compared to 24.4% of homeowners.

Homeownership, duration of residence, and housing condition are indicators of residential satisfaction (Speare, 1974, pp. 183-186). People who like where they are living generally do not consider moving. Homeowners and older people are also more likely to have

stayed in place longer, which reinforces attachment to houses and neighborhoods (Lee et al., 1994, p. 264).

The aforementioned conditions reflect pragmatism in the decision to relocate, which describe philosophical explanations of why people make the decisions that they do. Neoclassical and economic rational choice theories argue for utilitarian reasons for migration. Ihrke (2014, p. 1) reported that in the 2013 U.S. Census Bureau Current Population survey, 48% of movers said that housing was the primary reason for moving, 30.3% claimed family reasons, and 19.4% said the reason that they moved was for employment. These explanations suggest that mobility fulfills an unmet need found in the existing location. When people consider their options, they find that the reasonable course of action is to move. Push-pull theory explains mobility and migration as a means to achieving happiness. Here, negative circumstances in the source community and/or desirable attributes in the destination community motivate migration (Dorigo & Tobler, 1983).

Boomtown communities in the Marcellus region model neoclassical theories. The potential for high paying jobs attracts in-migration from those seeking employment; offering a migration “pull.” High labor demand and capital investment attracts migration flows. Because drilling is a specialized industry, the first wave of newcomers is usually people associated with the oil and gas companies who establish extractions sites and administration (Vachon, 2014). Not only do industry-specific populations move into town, but also individuals in other service industries and entrepreneur will relocate as well in order to capitalize on their particular market (Brasier et al., 2011; Vachon, 2014). Presence of the newcomers is not permanent. Once wells are established, workers move on to the next project, following labor opportunities elsewhere (Vachon, 2014). The pushes and pulls associated with natural gas extraction predict migration and mobility because of environmental, social, and economic impacts. “Push” factors in

Marcellus communities are scarcity of social resources like housing. Demand becomes competitive with an influx of workers, and people may need to leave because of a lack of available housing or increased costs. There is also strain on public infrastructure like high volume traffic or road construction, which makes communities more dangerous or inconvenient to navigate. Environmental issues like air and water pollution can make a community undesirable for residential living because of health concerns. Sudden wealth from leases and royalties makes the pull factors from desirable external locations possible, providing opportunity to migrate that did not previously exist (McLaughlin et al., 2014).

However, rational choice theories are insufficient at explaining why the majority of people remain in place despite sudden social change. They fail to consider overarching priorities that may moderate proximal reasons to move. For example, residents may tolerate inconveniences like economic inflation or heavy traffic knowing that it is short-term, especially when other desirable or necessary factors are unchanged. Families may not want to uproot their children, for example, despite rent increases and road congestion. Additionally, relocation requires capital and effort. People may not invest in a long-term move if they believe that the current unfavorable environment is temporary and will return to pre-boom economic and social stasis once the activity subsides (Gallin, p. 17-18). The desire for stability and familiarity supersedes the impulse to respond to immediate, transitory conditions.

### **Nature of Community**

“Community” is both a location where interactions occur, and a perception of belonging to a place (Manzo & Perkins, 2006, p. 347). Forrest and Kearns (2001) describe a typology of a neighborhood. First, it is a place of residence, where “friendships and casual acquaintance which, according the available research, appears to remain as an important dimension of our everyday

lives” (p. 2141). Second, it is context in the form of labeling according to prevailing social norms. An example would be an upscale area known as “snobby.” Third, neighborhood is a commodity when a purposefully planned context emphasizes safety or lifestyle, and is directed to those seeking certain qualities from there area of residence. (Forrest & Kearns, 2001). The prevailing characteristic is that community is the location where social interaction happens, and social interaction creates community cohesion. From these interactions, people develop trust, share common values, offer mutual support, and feel connected to place and people (Forrest & Kearns, 2001; Smith et al., 2001; Irwin et al., 2004). In this context, however, neighborhood is a source of social capital that explains why people remain in place, rather than move. Places within small, identified geographic boundaries, like a neighborhood, bring people together where they can form cooperative networks, sharing knowledge and resources that foster well-being. Examples of these places are private homes or public spaces that are unique to a community.

Neighborhoods are not the sole loci of interaction. Places with social organizations and institutions offer additional opportunities to create social ties. Examples are churches, small businesses, clubs, coffee shops, and other spaces where people can gather and communicate. The presumption is that group interactions facilitate social bonds that strengthen community cohesion. These ties connect one’s identity with the place where they live. “Community” as a perception of belonging is a powerful adhesive that keeps people in place.

Civic engagement theory describes how social capital occurs within the framework of social structures and organizations. Through coming together according to shared interests or needs, people meet each other and interact, developing the social networks that enhance well-being. In civic engagement theory, social institutions groups provide structure that bind residents in place despite rational arguments say to leave (Irwin et al., 2004; Irwin et al., 1997). People

become familiar with each other from frequency of interactions and through shared experiences. Indicators of civil society, such as churches, clubs, and community development organizations are local. These organizations situate civic engagement in place. Presence of these organizations associate civility with socioeconomic well-being, which in turn enhances residential desirability. Places with more local institutions, particularly small businesses, have greater levels of civic engagement than areas predominated by a national or global workforce (Irwin et al., 2004; Tolbert, Lyson, & Irwin, 1998).

Civic values may also explain higher rates of non-migration in areas adjacent to urban centers where national and global economic structures weaken local cohesion. Urbanization is associated with migration in part because of lower civic engagement (Irwin et al., 1997; Putnam, 2001). However, Irwin et al. (1997) found that the nonmetropolitan counties located close to cities have lower migration rates compared to those that were more distant. The proximity to the city may offer greater opportunity for civic engagement, sustained employment, and shared interests, which may keep people attached to adjacent areas.

Evidence from the offshore oil industry shows that communities with strong civic engagement and local entrepreneurship preserve social ties, and that despite boomtown growth, resist the non-regional influence of corporate presence on cohesion (Brown, Bankston, & Forsyth, 2013). Communities with civic groups, churches, and small businesses have higher levels of civic engagement because of tight social networks between people and place (Irwin et al., 2004; Tolbert et al., 1998). Social disruption and the attendant negative effects of boomtowns, such as crime, are lower in communities scoring high on civic engagement indicators (Lee, 2008). In a study of three energy-induced boomtowns, England and Albrecht(1984) report that previously homogenous communities do not experience disruption in

informal ties, but rather they increase through forming new role relationships. The overall implication from these studies is that strong communities contain intangible benefits that resist migration.

### **Nature of Attachment**

People attach significance to place because that is where relationships occur. Churches, schools, parks, restaurants, entertainment, and recreational areas are examples of public places where people gather to share interests and form emotional bonds. Such structures also create mental bookmarks of past social experiences that reinforce attachment to people and places. For example, a public swimming pool evokes memories of happy times spent in the presence of others. The pool situates the event in time and space. Places like these are where people find personal satisfaction, which according to Speare (1974), is a factor that operates against the desire to move.

Because places have such a strong connection with social interaction and emotional fulfillment, they create a structural framework for keeping society intact. While social ties are created by people, geography increases their likelihood of occurring. Jobs and homeownership, for example, tie people to a location. Both imply a commitment to remaining in place for long periods, if not permanently, which increases the chance of creating social ties as well as enhances their intensity. The strength of emotional attachment overpowers rational arguments to relocate for personal needs. Irwin et al. (2004) found integration in a community through work or family lessens the likelihood of migration. Dahl and Sorenson (2010, pp. 653-654) found that emotional attachment to people countervails the rational argument to seek financial gain through migration. Hidalgo and Hernandez (2001, pp 279-280) found that attachment to a particular neighborhood is weaker than measures of social attachment to groups of people. These

studies suggest that if people move, then it is likely that the move will be short distance in order to maintain social capital.

Civic engagement theories incorporate a physical component requiring actual presence to create social cohesion. However, is physical residency necessary for place attachment, and if not, how does this affect the decision to migrate? Barcus and Brunn (2010) found in their study of Appalachian communities that emotional attachment factors into decisions to migrate, but is not a primary reason. They theorize that the sense of community and civic attachment remains despite migration because of “place elasticity,” or the ability to use technology to maintain social interactions and bonds from a distance (pp. 284). Transportation, communication technology, and social media create a postmodern sense of place that substitute for physical presence. Thus, civic engagement may not condition the appeal of migration to destinations with attractive characteristics. In the Marcellus region, people may be more responsive to economic, social, and environmental disruption, both positive and negative, and choose relocation because it does not involve the sacrifice of community for place.

To summarize, geographic locations have characteristics that facilitate residential satisfaction and desirability. These include proximity to resources (i.e. jobs, schools, healthcare) as well as places for socialization or emotional fulfillment. Remaining in a location is dependent on how well a geographic location continues to meet those needs. The potential for high-paying jobs in the Marcellus region is an attraction for mobility and migration. Communities within the shale play vary from rural agrarian to urban cosmopolitan, offering a variety of characteristics that may affect the desire to move. Because Marcellus activity is inconsistent throughout the shale play, regional differences may account for patterns of mobility and migration. A closer

examination of drilling activity in different geographies is in order to explore relationships between natural gas activity and social change.

### **Operational Framework and Hypotheses**

The focus of this study is to examine migration patterns in 36 Pennsylvania counties and 1548 municipalities experiencing hydraulic fracturing of natural gas. There are two major clusters of drilling activity that divide the region into three tiers. Each tier has unique characteristics that may bear on the ability to move or the desirability to attract movers and migrants. The Northern Tier located along the New York-Pennsylvania border, is a rural and natural resource-rich area. Bradford County, located within the Northern Tier, is the site of the earliest unconventional wells and still has the most in operation (Brasier et al., 2014). The Southwestern Tier is predominately urban as it encompasses the Pittsburgh Metropolitan Statistical Area. Like the Northern Tier, this area has a long history of natural resource extraction and industrialization, and as such has a high concentration of wells. The Central Tier has low population density like the Northern Tier, but the drilling activity is diffuse and lower in volume. The research questions seek to determine how these areas differ with respect to population movement and social disruption relative to gas extraction activity.

Energy resource development brings new opportunities for high-paying employment that stimulates in-migration and creates boomtowns (Brasier et al., 2014; England & Albrecht, 1984; Vachon, 2014). Inward population movement can be a source of social disruption where for social and economic reasons some of the original population may relocate. Social disruption is defined as change to existing social processes, In this study, change comes from a new industrial development. Indicators of social disruption are population movement, changes in income inequality, and changes in social behavior resulting from natural gas activity.

Before exploring hypotheses that explain population movement, it is necessary to understand the meaning of community in order to determine the geographic level of measurement appropriate for the study. As discussed in Forrest and Kearns (2001) and Irwin (2007), social definitions or concepts situate a “community” to a place, which can conform to territorial boundaries. For example, zoning or community covenants moderate the quality of life through restrictions on development or social activities within a specified area. The area then develops a qualitative assessment that attaches to formal boundaries, such as neighborhood designations or larger place types like towns. The choice of a study geography must therefore capture the concept of a community within measurable boundaries.

As stated previously, the most common reasons for moving are family obligations, employment, and housing (Ihrke, 2014, p. 10). These conditions are highly localized, rather than being county or state level characteristics. Conditions that exist in local spaces are more likely to influence both the decision to move and the choice of a landing destination. Using data from higher-level geographies would mask the local impact of factors such as housing where the direct effects occur at smaller geographies. County, metropolitan, or statewide housing statistics do not reveal the proximal conditions that instigate the desire to move.

The Census Bureau system of nested geographic divisions identifies places by population density and legal boundaries (Irwin, 2007). The ideal geography for this study is the block unit because it would capture all moves within identified places. This is especially useful to study the effect of the housing market, which is highly localized and variable even within municipalities. However, because of confidentiality issues, public data is limited in the smallest geographies. This prohibits an analysis of migration at the lowest level of data collection given the time and resource constraints of this research. The smallest census geography that presents migration

flows is the Minor Civil Division (MCD). MCDs are census-designated places governed by a legislative authority (U. S. Census Bureau, 2013a). The place designations are boroughs, cities, and townships. Analyzing MCDs is useful to this study because they maintain the properties of a social district (Irwin, 2007), where the social organization and cohesion impart an identity to the place designation. People are aware of the social qualities of adjacent or nearby boroughs, cities, and townships. The reputation of these areas may influence population movement as people have knowledge of or opinions regarding the living conditions in other areas. Therefore, it is reasonable to attach the concept of a community to the MCD.

The main assumptions in this study are that drilling activity stimulates population movement due to changing social and economic conditions, and as such, people who are most vulnerable to economic disenfranchisement will be the most mobile. The U. S. Census Bureau and the PA DEP provide data that forms the foundation of quantitative analyses of population movement within the Marcellus region based on volume of gas extraction activity. Further analysis refines who is most likely to move and how far most of the moves occur.

The first research hypothesis states that high-paying jobs in the natural gas industry will initiate population movement. The expectation is that the number of wells will be an indicator of economic opportunity and subsequently serve as a draw for in-migration (Lee, 1966; Vachon, 2014). As a precipitant of social disruption, as in-migration increases, so will the percentage of movers based on residential satisfaction theory (Speare, 1974). The null hypothesis states that there is no relationship between drilling activity and population movement. The independent variable is the degree of drilling activity, operationalized here in terms of the volume of activity in various geographic divisions in the Marcellus region. First is a comparison of population movement between the Marcellus and non-Marcellus areas in Pennsylvania. Second is a

comparison of movement in the higher drilling area of the rural non-metropolitan Marcellus region versus movement in the less drilled urban Pittsburgh Metropolitan area. Third is a comparison of population movement according to the three tiers in the Marcellus region, which differ by geography and volume of gas activity. The dependent variables are the percentages of in-movers, out-movers, and non-movers in a regional division of the Marcellus area determined by the number of in-movers, out-movers, and non-movers divided the aggregate populations of the Marcellus areas.

How do the characteristics of places affect whether residents stay or leave, and how far they move? Based on the findings of Irwin et al. (1997), Tolbert et al. (1998), and Irwin et al. (2004), areas with high social cohesion will keep people in place. Low population density in rural towns may have greater cohesion because these areas are more homogenous and conducive to high levels of civic engagement and social capital (Forrest & Kearns, 2001; Irwin et al., 1997). The expectation is that municipalities in rural counties will have more stability evidenced by higher percentages of non-movers or short-distance movers. The null hypothesis is that there is no relationship between population density and population movement. The independent variables are the Pittsburgh Metropolitan region, the non-metropolitan region, and the Norther, Central and Southwestern Tiers. The dependent variables are percentages of in-, out-, and non-movers. A related hypothesis is that movers will relocate close to the MCD of origin in order to maintain social ties, jobs, and civic activities (Ihrke, 2014; Irwin et al., 1997). Here the dependent variable is distance from MCD of origin evidenced by movers within the same county, within the same state, or to a different state or abroad. Looking at social and economic diversity as a mechanism that keeps population in place (Irwin et al., 1997), MCDs in the Southwestern Tier containing the Pittsburgh Metropolitan Statistical area will have more non-movers or short distance movers than

the Central and Northern Tiers. The null hypothesis is that there is no relationship between distance to Pittsburgh and the percentage of non-movers and short distance movers.

The second hypothesis tests who is more likely to move and why. People tend to move more often because of characteristics of their stage of life and socioeconomic status. These are working aged people (18-64), children (aged 1 to 17), and low-income households (Ihrke, 2014; Mateyka, 2015). The expectation is that the mobility of these groups is associated with the natural gas activity in or near their municipality. Because of their vulnerability and considering place attachment theories, the presumption is that movers in these categories will be greater than non-movers, and that the moves are more likely to be short distances (Ihrke, 2014; Irwin et al., 2004; Tolbert et al., 1998). The independent variables are age and poverty status categorized by Pittsburgh Metropolitan region, the non-metropolitan region, and the Northern, Central and Southwestern Tiers. The dependent variables are percentage of in-movers, out-movers, non-movers, movers within county, within state, and interstate.

As stated previously, homeowners stand to achieve economic windfalls from leasing and royalties, and are more likely to keep their property. (Kelsey et al., 2012). Renters are susceptible to price gouging from skyrocketing rents, and therefore may find themselves in the migration stream in order to chase affordable housing. (Kelsey et al., 2012; McLaughlin et al., 2014). The expectations here are that in areas with more gas extraction activity, mobility is higher with renters rather than homeowners. The independent variables are renters, homeowners, and geographic region (i.e. Pittsburgh Metropolitan Region, non-metro region, Northern, Southwestern, and Central Tiers). The dependent variables are non-movers, movers within county, within state, and interstate. The null hypothesis is there is no association between household tenure and mobility.

Finally, previous research indicates that pre-existing housing inventory was a factor in managing the demand as workers in the gas industry relocated to Pennsylvania (McLaughlin et al., 2014). The expectation is that regions with more housing units will have more mobility, and that moves will most likely be short distances. In addition, areas with affordable rental housing will have higher mobility than those with units that are more expensive. The independent variables are total housing units, percentage of units built after 2010, percentage of units according to the Gross Rent as a Percentage of Income (GRAPI) measure, renters, and owners, Pittsburgh Metropolitan Region, non-metro region, Northern, Southwestern, and Central Tiers. The dependent variables are non-movers, movers within county, within state, and interstate. The null hypothesis is there is no association between housing stock and mobility.

From a qualitative perspective, the expectation is that residents will report changes in the quality of life in their communities with increased natural gas activity. These changes affect the local economy, interpersonal relations, demand on social and public services, and the operation of institutions such as education, government, and law enforcement. Prior familiarity with the natural resources industry may moderate local perceptions of change. Here the expectation is that there will be regional differences in how residents describe the effect of the expanding natural gas industry on dimensions of social disruption.

## **Research Design and Methodology**

### **Operational Definitions**

Table 1 summarizes the estimated population, number of municipalities, and distribution of gas wells in the Pennsylvania Marcellus region. This is an aggregate of the information for population and wells taken from the 2013 ACS and the PA DEP. Table 3 in Appendix D contains a full description of county populations and wells by county.

Table 1

*Distribution of Unconventional Natural Gas Wells in Pennsylvania, 2013*

Region or County	Population	Municipalities	Wells	% Wells
Pennsylvania	12,597,683	2,577	6,525	100
Marcellus	4,980,729	1,585	6,525	100
Non-Marcellus	7,616,954	992	-	-
Pittsburgh Metropolitan	2,336,778	120	1,871	28.7
Non-Metropolitan	2,643,951	249	4,653	71.3
Central Tier	2,144,216	82	373	5.7
Northern Tier	506,352	149	3,658	56.1
Southwestern Tier	2,374,723	138	2,493	38.2

*Note.* Adapted from U.S. Census Bureau, 2013 American Community Survey 5-Year Estimates, Table S0701, generated by Annette Mackay, using American FactFinder, <http://factfinder2.census.gov>, (30 September, 2015), and Pennsylvania Department of Environmental Protection Oil and Gas Reports, generated by Annette Mackay using SPUD Data Reports, [http://www.portal.state.pa.us/portal/server.pt/community/oil\\_and\\_gas\\_reports/20297](http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297)

Gas wells are unconventional horizontal or vertical wells drilled using hydraulic fracturing methods. This definition includes compressors, pipelines, earth-moving equipment, fracking ponds, drilling towers, diesel fumes, trucks, and roadways, which all can contribute to community disruption (Brasier et al., 2011; Goldberg, 2013). Well pads may contain multiple wells, which increases not only the economic value of the pad, but also the amount of activity involved in production that could be potentially disruptive to the community

Population is the number of people in a geographic area. The decennial census is an actual count of the population. The ACS is a sample of the population, which replaced the census long form used until 2005 (U. S Census, 2014). The long form captured detailed information about social characteristics, such as mobility, housing, income, etc. Therefore, population values in ACS data tables reflect estimates based on a complex sampling procedure. Although weighted and corrected, the ACS provides a reasonably accurate depiction of very large geographies. The

weighting system is applied to both person samples and housing units. It compensates for variability in sampling rates, bringing the sample characteristics into agreement with the full population (U.S. Census, 2014, ch. 11.1). The Census Bureau conducts the ACS throughout the year via mailed response forms, phone interviews, and personal visits. In 2013, the survey selected 3.5 million households based on known addresses for housing units and group quarters. Group quarters are residential living facilities, including dormitories, nursing homes, homeless shelters, and prisons. The response rate for the 2013 ACS was 89.9% (U.S. Census, 2014).

Percentages of people moving in, moving out, or not moving operationalize the definition of population movement. The percentage of in-migrants or in-movers is the number of people 1 year or older who moved into an MCD 1 year ago divided by the population and multiplied by 100. The percentage of out-migrants or out-movers is the number of people 1 year or older who moved away from MCD 1 year ago divided by the population and multiplied by 100. Non-movers is the percentage of people 1 year or older who stayed in place divided by the population and multiplied by 100. Population size refers to the number of people 1 year or older in an MCD. The total population divided by the total area of an MCD measures population density. Distance is the number of miles between MCDs and counties within the study boundaries.

The observations of key informants will identify dimensions of social disruption and change according to their perspective as professionals in the community. In addition, the information will provide a qualitative assessment of how disruption and change has affected the quality of life. Have the changes helped, hurt, or had no effect community well-being? Identifying the meaning of empirical or perceived change will provide insight to the significance of population migration and economic boom in these communities.

Indicators of social change in the education system include change in student attendance, including transfers, truancy, excused, and unexcused absenteeism. Changes in student needs at school as an indicator of disruption are special needs educational programs, reliance on the school lunch program. Changes in student behavior include participation in sports and social events; concerns about student housing, concerns about family stress, and concerns about student violence.

Indicators of social change at the economic level includes change in the volume of rental turnover, change in cost of rent, change in real estate values, and a change in clientele. It also includes new business starts, new clients or customers, change in business volume, and more activity at public places. Changes in housing include a shift in tenure (renter to owner, or vice versa), availability of rental housing, and availability of affordable housing.

Indicators of social change at the service and assistance level include change in need for mental health services, such as marriage counseling, crisis pregnancy counseling, substance abuse counseling. It also includes change in health care, such as emergency room utilization, treatment for sexually transmitted diseases, and treatment for accidents. Other social services are, foster care, food assistance, housing assistance, changes in client type (family, single, elderly, special needs), homelessness, interest in advocacy organizations, and use of shelters for homelessness or intimate partner violence. It also refers to the ability to meet the demand for those services. Finally, court issues such as change in divorce filings and change in mandated custody agreements are further indicators of disruption in the social service system.

Indicators of social change from the perspective of law enforcement includes change in the volume of issues involving people, such as intimate partner violence, public disturbances, robbery, assault, sexual assault, drug trafficking, prostitution, and drug use. It also includes

issues involving traffic and vehicles, such as driving under the influence of alcohol and drugs, distracted driving, accidents, moving and non-moving traffic violations. Other changes relate to property, such as vandalism, and burglary.

## **Methodology**

The study used a mixed-methods research approach to investigate social change in response to population movement and changing economic conditions from the expansion of the natural gas extraction industry in Pennsylvania. Analysis of secondary data from public use records identified mobility and migration patterns within the Marcellus region. Areas with more mobility were for qualitative investigation on how the gas industry affected daily life in the community and surrounding area.

The quantitative phase used public records from the 2013 American Community Survey 5-year estimate to analyze geomobility and migration patterns. Historical oil and gas data from the PA DEP situated gas-drilling activity to municipalities during the same period as the ACS survey. Using ArcGis (ArcGis v. 10.3), maps of well locations, geomobility, and migration data provided a graphic representation of population movement relative to drilling activity and geographic region. This approach expands on previous research using county-level aggregates to characterize mobility and social change in the Marcellus area (Brasier et al., 2014; Kelsey et al., 2012; McLaughlin et al., 2014; Schafft, Glenna, Green, & Borlu, 2014). Tests of statistical significance determined the characteristics of mobility that occurred between 2009 and 2013. From there, municipalities with high mobility became targets for the qualitative phase of the study.

The source data for migration flows came from the Census Bureau 2008-2012 American Community Survey County MCD-to-County MCD Migration Flows. This survey asked participants not only if they moved within the past year, but also recorded the location of their previous address (U.S. Census Bureau, 2015). This data set classified migration by occupation, which allowed for multiple analyses of general population movement and mobility as well as targeted mobility according to occupation. Appendix B contains a list of all of the public records used in this study.

Because the census data is several years old, additional information from key informants was necessary to validate the statistical observations related to fracking and population mobility. The purpose of this phase of the study was to ground-truth the quantitative information with the perceptions from available personnel. Because the market for natural gas and natural gas liquids fluctuates, the migration estimates and other demographic characteristics may have changed from the last year of the census surveys to the present. However, information from the quantitative analysis directed the choice of municipalities from which to gather qualitative information from key informants.

People who live and work in municipalities impacted by natural gas extraction can explain best what the industry has brought to the community in terms of quality of life. The study limited qualitative observations to professionals living or working in the selected municipalities. Informants were school administrators, realtors, social service personnel, municipal government and law enforcement personnel.

Perceptions of social change, migration, and concerns for community well-being came from analysis of semi-structured interviews using a protocol approved by the Duquesne University Institutional Review Board, found in Appendix C. A pilot test conducted in June,

2015 with informants outside the study area validated the interview protocol. Identification of potential study informants came from information gathered from fieldwork and from identification of key professionals from organizational websites. Interviews took place either in person or over the phone. TranscribeMe! <sup>TM</sup> was the professional service used to transcribe voice recordings to text. Content analysis identified common themes and concepts that indicated the qualitative effect of fracking on everyday life in the selected municipality and surrounding area. To improve reliability, both the researcher and a co-investigator analyzed the content of the transcripts.

### **Population and Sample**

The population for the quantitative phase of the study was people living in the Marcellus Shale region of Pennsylvania for at least one year according to census data. The geographies were counties, boroughs, cities, and townships. Cluster analysis determined the regional effect (Pittsburgh Metropolitan and rural; Northern, Southwestern and Central) on migration and mobility. Other demographic characteristics such as age, poverty status, housing tenure, and housing stock were independent variables in the migration analysis. The units of analysis for this part of the study were census tables and drilling data.

Non-probabilistic and purposive sampling identified key informants whose expertise provided qualitative information about observed changes in their community since fracking activity began. These informants were school administrators, social service workers, realtors, law enforcement, and local government personnel. The study only solicited information from adults working in a professional capacity. Fieldwork in the targeted municipalities also provided leads that identified additional informants whose perspective on community change was relevant to the study.

The total number of interview requests was not pre-determined. Interviews of informants occurred during August and September 2015. Based on previous research of qualitative methods determining a minimum number of interviews needed for information saturation (Guest, Bunce, & Johnson, 2006), the objective was set at interviewing at least 12 informants. In all, 18 individual informants consented to participate in the study. Their observations, plus field notes, comprised the body of qualitative data.

### **Data Collection**

The U. S. Census Bureau provided data tables for population, housing characteristics, mobility, and migration as described previously and shown in Appendix B. These were used for statistical analyses and for mapping mobility patterns. The PA DEP provided files with the location of unconventional gas wells (PA DEP, 2015). Data used to create maps of Pennsylvania counties and subdivisions came from the U. S. Census Bureau Topologically Integrated Geographic Encoding and Referencing [TIGER/line] shapefiles. These digital database files recreate geographic features using geographic information software. (TIGER/Line, 2014).

Semi-structured interview guides provided conversation starters to gather information about the previously described dimensions of social disruption. Leading questions designed according to the expertise of the informant allowed for collection of specific information as previously described. Appendix A contains the IRB-approved leading questions used in the interviews.

### **Data Analysis**

Quantitative analysis examined the demographic characteristics of the Pennsylvania population before the natural gas industry expanded using data from the 2000 and 2010 decennial censuses. The decennial census is an actual count, rather than an estimate of

population characteristics. Standard methods of determining population change informed the analysis of demographic composition between 2000 and 2010 (Smith, Tayman & Swanson, 2001).

Analysis of population change along different independent variables indicated the effect of mobility. The study tested hypotheses by using appropriate tests of significance, which included independent samples T-test and one-way ANOVA using Statistical Package for the Social Sciences (SPSS) (IBM, 2012, v. 21.0). As stated previously, there is an expectation that changes in these variables are associated with increases in dimensions of migration, including population change, percentage of movers, and the distance between origin and destination communities.

Qualitative interviews captured dimensions of social change as it related to people's perception of well-being. The method of content analysis as described in Gray (2014) identified patterns in the responses of key informants arranged according to the indicators of social disruption. Indicators of social disruption were population movement, changes in income inequality, and changes in social behavior. Major themes were identified in the first analysis of the qualitative data that reflect changes in the community since the development of the natural gas industry in the area, as well as the importance of those changes to the quality of life. In the second analysis of the qualitative data, coding was done for common concepts that emerged from the interviews. The operational definitions of social disruption described previously guided the identification of the codes, but the actual concepts emerged from the data. In the final analysis, coding was done according to the expertise of the informant, the geographic region, and the qualitative assessment of impacts on residential life in the community.

## **Limitations**

The study had limitations. The smallest geography for migration and mobility analysis was the municipal level. This geography did not track response to intra-municipal conditions. The study also reflects the limitations of the American Community Survey. Unlike the decennial census, the ACS uses a sampling methodology rather than an actual count of households (U.S. Census Bureau, 2014). Therefore, sampling error, response rate, data processing operations, and methodological modifications affects the accuracy of the ACS. While the ACS samples people living within group units, such as military bases, it does not include people living at campsites or temporary work housing sites. Many gas workers live in man-camps while deployed at a well site. They would only be included in ACS estimates as residents at their permanent address. Meanwhile, the workers are actually living elsewhere most of the time. Good section.

Another limitation is the time specificity of information at small geographies. The ACS has 1-, 3-, and 5-year data products. Only the 5-year estimates provide data for small geographies such as places and block groups. These estimates are averages of population characteristics over the five-year period. In a fluctuating situation such as short-term economic booms, population and income may peak and fall within a year or two. The 5-year average may not have the sensitivity to report these changes. Further, since the survey asks questions that may reveal the identity of a respondent, information must be aggregated to levels that protect individual respondent identity (Smith, Tayman, & Swanson, 2001). In the data used for this study, the disaggregation of origins is less specific and the margin of error can be high. This gives greater importance to substantiating the quantitative data with qualitative information from key informants.

Generalizability is a limitation of qualitative research as well (Gray, 2014). Because it is not possible to obtain information from key informants in all 360 municipalities in the study area, the observations gathered in this study reflect highly localized conditions from an individual perspective. The observations may be dependent on that person's position in the community. This is both a strength and a weakness of using key informants. The informant provides meaning and detail to understanding migration and the factors leading to the decision to move. However, these are the perceptions of a few individuals and do not necessarily represent community views. In addition, identical findings may not occur in demographically similar areas because of unknown intervening variables. A condition that may be important to informants in one community might not have the same significance in a different area, all other factors being similar.

Time and resources were another limitation in obtaining qualitative data. As the map in Figure 2 on page 5 illustrates, the Marcellus region is expansive, and it was not possible to conduct in-person interviews in every municipality selected for investigation within the time allotted for this phase of the research. The study used a combination of in-person and telephone interviews to gather qualitative data. Therefore, interpretation of social cues during the data analysis may have been inconsistent because the context was different. In addition, the interviews were conducted by the primary researcher alone, which prohibited confirmation of validity and reliability that would have come from the participation of a co-researcher.

Finally, natural gas extraction is a controversial topic. Informants may choose to give socially desirable rather than authentic comments in order to diffuse emotional reactions. Individuals whose livelihood depends on the performance of the gas industry may also censure their remarks in consideration of their professional position or standing within the community.

## Results and Discussion

### Demographics of the Marcellus Region

The research questions address overall population change in Pennsylvania that comes primarily from labor migration, with the assumption that working-aged adults and children under 18 are more likely than those out of the workforce are to move. In addition, areas experiencing economic change along with labor migration will have more population movement associated with the cost and availability of housing, with renters more likely to move than homeowners.

Table 2

#### *Age Structure of the U.S. and Pennsylvania*

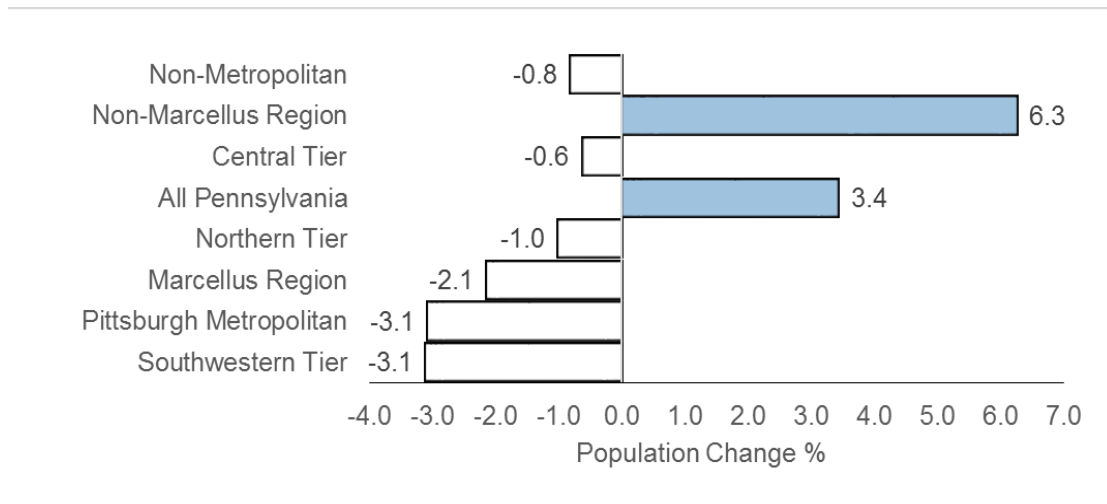
##### Percentage of Total Population

	United States			Pennsylvania		
	2000	2010	Change	2000	2010	Change
0 to 4	6.8	6.5	-0.3	5.9	5.7	-0.2
5 to 9	7.3	6.6	-0.7	6.7	5.9	-0.8
10 to 14	7.3	6.7	-0.6	7.0	6.2	-0.8
15 to 19	7.2	7.1	-0.1	6.9	7.1	0.2
20 to 24	6.8	7.0	0.2	6.1	6.9	0.8
25 to 29	6.8	6.8	0.0	6.0	6.2	0.2
30 to 34	7.3	6.5	-0.8	6.7	5.7	-1.0
35 to 39	8.0	6.5	-1.5	7.7	6.0	-1.7
40 to 44	8.0	6.8	-1.2	8.1	6.7	-1.4
45 to 49	7.2	7.3	0.2	7.4	7.5	0.1
50 to 54	6.3	7.2	0.9	6.5	7.8	1.3
55 to 59	4.8	6.4	1.6	5.0	6.9	1.9
60 to 64	3.8	5.5	1.6	4.2	5.9	1.7
65 to 69	3.4	4.0	0.7	3.9	4.4	0.4
70 to 74	3.1	3.0	-0.1	4.0	3.4	-0.6
75 to 79	2.6	2.4	-0.3	3.4	2.9	-0.6
80 to 84	1.8	1.9	0.1	2.4	2.5	0.1
85 and over	1.5	1.8	0.3	1.9	2.4	0.5

*Note.* Adapted from U.S. Census Bureau, Decennial Census, 2000 SF 100% Data , Table DP-1, and 2010 SF 100% Data, Table DP-1, generated by Annette Mackay, using American FactFinder, <http://factfinder2.census.gov>, (30 September, 2015)

To begin this analysis, it is relevant to look at the population distribution across age categories in order to establish a baseline demographic profile in the years prior to the build-up of natural gas extraction activity. Table 2 compares the percentages of the total population by five-year age categories for the United States and Pennsylvania using the 2000 and 2010 decennial censuses. Both the United States and Pennsylvania had declining birthrates from 2000 to 2010. As a percentage of the total population, Pennsylvania has fewer births than the country as a whole. However, in Pennsylvania, the population cohorts from 15 to 19 year olds to 25 to 29 year olds increased between 2000 and 2010, whereas in the national population those cohorts showed decline. This suggests that the working age population is increasing, which may be an effect of labor opportunities associated with the natural gas industry. However, other factors may contribute to this observation as well, such as education or international migration.

Yet in the years prior to the expansion of the natural gas industry, the Marcellus region was in population decline. Tables 3 and 4 in Appendix D show population change by county, which is illustrated by Figure 3. The overall population in Pennsylvania grew by 3.4% between 2000 and 2010. Most of the counties with population increases were in the Non-Marcellus area in the eastern half of the state. This area grew by 6.3%, largely from the gains in counties around the Philadelphia area. The Marcellus region as a whole lost 2.1% of its population, driven by declines in the Pittsburgh Metropolitan area and the Southwestern Tier. This area has suffered declines from deindustrialization of the steel industry during the 1970s and 1980s, as well as the manufacturing shift to offshore labor markets in the 1990s. Of the 28 counties having population losses, 25 were counties in the Marcellus area.



*Figure 3. Population change from 2000-2010 in Marcellus regions. Adapted from U.S. Census Bureau, Decennial Census, 2000 SF 100% Data , Table DP-1, and 2010 SF 100% Data, Table DP-1, generated by Annette Mackay, using American FactFinder, <http://factfinder2.census.gov>, (30 September, 2015)*

### **Quantitative Analysis: Natural Gas Activity and Mobility, Migration, and Housing**

The following sections describe the statistical analyses used to characterize mobility, migration, and housing in sections of the Marcellus region based on geographic location and volume of natural gas extraction activity. Analysis using appropriate tests of statistical significance for area, region, and tier as described in Table 1 informed the regional characterization of mobility and migration in the Marcellus region.

**Marcellus and Non-Marcellus Region.** An independent samples t-test was conducted to compare differences in mobility, migration, and housing using data in the Marcellus and Non-Marcellus regions. Tables 6-10 show these results. The ACS survey asks respondents about their mobility or migration in the past year, and averages the responses over the five years in the survey period. The data analyzed in this study categorizes the population by age, poverty, and

tenure of occupancy (owner or renter). Data on housing availability, construction, are averaged estimates as well.

Table 6 shows that there was no significant difference between in-migrants, out-migrants, non-migrants, net migration, and gross migration between the two regions. The expectation that there would be an effect on migration in the Marcellus region due to the impact of natural gas activity on the labor market was not supported by a statistical difference between the Marcellus and the rest of Pennsylvania. There were similar results comparing within-city, -county, and – state movers in the general population, as well as homeowners or renters who moved.

Within the population, Table 7 shows that the Marcellus region had statistically higher percentages of children aged 1 to 17 ( $M=7.4$ ,  $SD=8.4$ ,  $t(2455)= 2.132$ ,  $p = .033$ ) who moved within the same county in the past year. Since this age group does not move or migrate alone, the assumption is that mobility of households with children within Marcellus counties is also higher than for the rest of the state. More overall movers occurs in Marcellus for ages 18 to 34 ( $M=55.8$ ,  $SD=131.5$ ,  $t(1985)= 4.869$ ,  $p = .000$ ), indicating mobility of young adults as they age out of dependency or enter into the education or labor migration streams. Some of the people in this age category presumably co-migrate with the children under age 18 as they are of reproductive age. Those aged 18 to 34 will most likely move for the first time, either for education, work, or to establish independent residence from their household of origin. However, because the mobility is higher in Marcellus suggests that labor and educational opportunities, or economic changes, create conditions to move. Yet drawing migrants from a different state in the 18 to 34 age category was higher in the Non-Marcellus region ( $M=3.2$ ,  $SD=4.0$ ,  $t(2180)=-2.827$ ,  $p = .004$ ). Explanations for more migrants outside of Marcellus may reflect the social economic characteristics of the Philadelphia Metropolitan Statistical Area and the eastern coast influences

of New York and New Jersey. This explanation may also account for higher in-state mobility for people in the Non-Marcellus region aged 35 to 64 ( $M=1.7$ ,  $SD=2.1$ ,  $t(2536)=-2.016$ ,  $p=.044$ ). Senior citizens aged 65 and over had more mobility and migration in the Non-Marcellus region while Marcellus had significantly more nonmovers ( $M=93.2$ ,  $SD=8.5$ ,  $t(2561)=3.638$ ,  $p=.000$ ) in this age category. A possible reason for older people to remain in place in Marcellus may come from the desire to maintain homeownership because of its increased value from natural gas.

Looking at the mobility of people in the Marcellus/Non-Marcellus region according to poverty status, Table 8 shows that the percentage of the population in every poverty category is higher in the Marcellus region. This area was especially hard-hit during the deindustrialization of the American economy, and lost a considerable number of manufacturing jobs. Most of the economic recovery occurred in the eastern part of the state as illustrated by population growth in the Non-Marcellus region. Among those who moved in the past year according to poverty status, there were more movers within state and from another state in the Non-Marcellus region for those in households below 100% poverty. This would include some migration from the Marcellus to the Non-Marcellus region possibly for jobs or other factors like safety net programs that are relevant to the needs of this group. Mobility and migration for households 150% of poverty and above for within county, within state, and from another state were higher in the Non-Marcellus region as well.

These macro area differences suggest several possibilities. First, despite the contribution that natural gas activity had in the labor market, it was not a pull factor for mobility and migration among working aged or low-income populations. Second, economic gains from high paying natural gas jobs did not improve the percentage of people living in poverty in the Marcellus region. This implies that natural gas was not a powerful influence in turning around an

economically distressed region, and that factors existing in other parts of Pennsylvania compete with the economic contributions of natural gas.

With the Non-Marcellus region having almost double the population as the Marcellus, the expectation is that the former region would have more housing, which the results in Table 9 in Appendix D show. Total units ( $M=3257.0$ ,  $SD=21439.2$ ,  $t(1058)=-2.615$ ,  $p=.009$ ), total occupied units ( $M=89.5$ ,  $SD=10.4$ ,  $t(2561)=-11.53$ ,  $p=.000$ ), owner occupied ( $M=68.4$ ,  $SD=14.4$ ,  $t(2389)=-6.25$ ,  $p=.000$ ) or renter occupied ( $M=21.2$ ,  $SD=12.3$ ,  $t(2573)=-4.85$ ,  $p=.000$ ), were higher in the Non-Marcellus region. The data set did not subdivide the total units by owner or rental housing, but it did offer an indicator affordable rental housing. Using the Gross Rent As a Percentage of Income (GRAPI) index as a measure, where rental units less than 15% of income are the most affordable, and rental units costing more than 35% of income are considered less affordable, independent samples t-test showed regional differences in the Marcellus and Non-Marcellus areas. These results are in Table 10. The Non-Marcellus area had statistically more units from 25% to 29% ( $M=11.7$ ,  $SD=9.4$ ,  $t(2358)=-3.128$ ,  $p=.001$ ), and 35% and above ( $M=36.3$ ,  $SD=15.9$ ,  $t(2354)=-2.90$ ,  $p=.004$ ) than the Marcellus region. In contrast, the Marcellus region had more affordable housing units at <15% of income ( $M=19.9$ ,  $SD=16.8$ ,  $t(2406)=4.84$ ,  $p=.000$ ). The importance of this finding is relevant because the Marcellus region had statistically higher percentages of households in each poverty category tracked by the census. The expectation is that there would be more affordable housing where income is lower. These findings support the overall conclusion that the Marcellus region more economically distressed despite reported gains in specific sectors of the economy.

**Within-Marcellus analysis: Metropolitan and non-metropolitan comparisons.** Using the Pittsburgh Metropolitan Statistical Area (hereafter Pittmetro) as an urban indicator, an

independent samples t-test was conducted to compare the differences in natural gas activity, migration, mobility, housing, and poverty characteristics with the rural Non-Metropolitan (hereafter Nonmetro) area in the Marcellus region. Looking at the study variables in smaller geographies will contextualize the effects of natural gas development at more local levels in order to gauge community impacts. Results of these analyses are shown Tables 11 through 15. According to the data in Table 1 on p. 35, the 2013 population estimates for the two regions showed that the nonmetro area had more people (2,643,951) than the Pittsburgh Metro region (2,336,778). On a percentage basis, the nonmetro region had 53% of the Marcellus population and 6% more than the Pittmetro region. Natural gas activity varied as well. The Nonmetro region had 71.4% of the wells largely due to the volume of drilling in the Northern Tier. The Pittmetro region had 28.7% in comparison. Considering the relative closeness in population, the Nonmetro region had substantially more wells than the Pittmetro area.

Yet despite the expectation that migration would follow the volume of natural gas activity, Table 11 shows that the Pittmetro area had a higher percentage of in-migrants ( $M=8.6$ ,  $SD=6.6$ ,  $t(156)=2.7$ ,  $p=.007$ ) than the Nonmetro area ( $M=7.8$ ,  $SD=5.6$ ,  $t(1556)=2.7$ ,  $p=.007$ ). The percentage gross migration was higher in the Pittmetro area ( $M=18.2$ ,  $SD=17.0$ ,  $t(1556)=2.9$ ,  $p=.004$ ), indicating that the area had statistically more people moving in and out than in the Nonmetro area. Comparatively, the Pittsburgh area had more percentage movers overall ( $M=10.0$ ,  $SD=6.0$ ,  $t(1568)=2.91$ ,  $p=.004$ ), and particularly within the same county ( $M=6.5$ ,  $SD=4.5$ ,  $t(1568)=5.13$ ,  $p=.000$ ). Other factors present in the Pittmetro area, for example corporate headquarters, institutions of higher education, and industry, may offer greater variability in employment than natural gas alone.

Table 12 shows that each age group had statistically higher percentages of movers within the same county in the Pittmetro area. There was no difference between the two areas for the percentage of working aged people 18 to 35 and 35 to 64 moving within state or from another state, suggesting that work and educational opportunities are competitive across urban and rural lines. That is, the higher volume of natural gas drilling in the Northern Tier may offer opportunities for mobility and migration that compete with the social and economic diversity of the Pittsburgh area. The higher percentages of in-migrants and within county movers across age groups suggest that the Pittmetro region is a draw for new people because of its diversity in social and economic opportunity. Regional corporate offices for the gas companies are located in downtown Pittsburgh and the surrounding area. Incoming managers and executives may initially settle in one location, and then move to another once they find a neighborhood suitable to their preferences. In any case, these results substantiate the expectation that the majority of moves will be short distances, especially in urban areas.

Low-income households are also likely to be short distance movers as the results in Table 13 show. There is no difference between the Pittmetro and Nonmetro regions for the percentage of households at the lowest poverty categories up to 149% of the poverty level. However, mobility within county is statistically higher in the Pittmetro region for the percentage of households below 100% Poverty ( $M=12.3$ ,  $SD=12.9$ ,  $t(1555)=2.46$ ,  $p=.014$ ) and 100% to 149% Poverty ( $M=9.4$ ,  $SD=12.9$ ,  $t(733)=3.61$ ,  $p=.000$ ). The Pittmetro region had a higher percentage of households between 150% and 184% Poverty ( $M=7.6$ ,  $SD=4.4$ ,  $t(1079)=4.40$ ,  $p=.000$ ) and between 185% and 199% Poverty ( $M=3.4$ ,  $SD=3.1$ ,  $t(1142)=3.06$ ,  $p=.002$ ). The Nonmetro region had a higher percentage of households at 200% Poverty and Above ( $M=68.9$ ,  $SD=12.9$ ,  $t(91568)=3.11$ ,  $p=.03$ ). However, mobility and migration at these levels was not significantly

different. While there is a regional difference in the population of households at or above the poverty level, it does not seem to affect mobility or migration between urban and rural areas. These results did not confirm the expectation that mobility and migration would be higher across the board in urban areas.

The results for housing characteristics shown in Table 14 substantiated the expectation of higher mobility in urban areas. Although there was a higher percentage of housing units in the Nonmetro area ( $M=2394.8$ ,  $SD=7694.3$ ,  $t(481)=-3.629$ ,  $p=.000$ ) as opposed to the Pittmetro area ( $M=1076.7$ ,  $SD=1885.1$ ,  $t(481)=-3.629$ ,  $p=.000$ ), the high standard deviations suggest that housing availability is quite variable between municipalities. Both owners ( $M=3.2$ ,  $SD=2.6$ ,  $t(1566)=2.88$ ,  $p=.004$ ) and renters ( $M=15.3$ ,  $SD=11.7$ ,  $t(953)=1.97$ ,  $p=.048$ ) had higher within-county mobility in the Pittsburgh Metro area. The non-metro area had more homeowners, while the metro area had more renters, suggesting that there are more rental units in the Pittsburgh Metro area. This is also consistent with higher percentages of the population in poverty, where homeownership is less likely. However, this assumption is unverified because the data set did not contain an estimate of the number of rental and non-rental units. In addition, the independent samples t-tests comparing the availability of rental units according to the GRAPI index shown in Table 15 did not show a statistical difference between the two areas, therefore the results did not substantiate the assumption that the Pittmetro area will have more affordable housing given the poverty characteristics.

**Within-Marcellus analysis: Effects by activity in regional tiers.** One-way ANOVA comparisons were conducted on the Northern, Central, and Southwestern Tiers to further analyze the effects of varying volumes of natural gas extraction activity on mobility, migration, and housing. The research expectations were that well-paying jobs in the natural gas industry would

draw movers and migrants, and that areas with more activity would have greater percentages of people who relocate than area with less activity would. As a reminder of the data presented in Table 1 on p. 35, the demographic information from 2013 shows that the Northern Tier had the highest percentage of wells (56.1%), but the lowest population (506,352). The Central and Southwestern Tiers were closer in population (2,144,216 and 2,374,723, respectively), but had differing percentages of active wells. The Central Tier had the fewest wells at 5.7%. The Southwestern Tier had the highest population and 38.2% of the active wells. As they had similar county geographies, the well activity in the Pittmetro area and Southern Tier are also comparable to each other. Tables 16 through 23 in Appendix D show the results of the one-way ANOVA and post hoc analyses.

Table 16 shows the one-way ANOVA for mobility and migration. The varying N values for each of the tiers reflect incomplete reporting in the ACS data. The variables having significant mean differences were percent in-migrants, gross-migration, non-movers, movers, and movers from a different state. Either variables were significant with the F statistic or Welch's F. Table 16 shows mobility differences among the three tiers. The Central (N=745, M=83.9, SD=12.1) and Northern (N=329, M=54.3, SD=11.3) had higher percentages of non-movers than the Southwestern Tier (N=848, M=81.9, SD=16.9). The mean difference between the Central and Southwestern Tiers (1.97) was significant at  $p=.036$ , and the mean difference between the Northern and Southwestern Tiers (2.42) was significant at  $p=.035$ . However, the Southwestern Tier had a higher percentage of movers (N=486, M=1.1, SD=6.1) compared to the Central Tier (N=752, M=8.9, SD=6.5). The mean difference (1.09) was significant at  $p=.008$ . Similar to the results for in-migration, the percentage of movers from a different state was higher

in the Southwestern Tier (N=486, M=8.8, SD=5.4) than in the Central Tier (N=752, M=5.9, SD=5.6), with the mean difference (.91) significant at  $p=.013$ .

Table 17 shows the results of the multiple comparisons post hoc tests. For percentage of in-migrants, the mean difference (.854) between the Southern Tier (N=484, M=8.6, SD=6.6) and the Central Tier (N=745, M=7.7, SD=5.7), was significant at  $p=.035$ . There was no significant mean difference between the Northern Tier (N=329, M=8.0, SD=5.2) and the Central or Southwestern Tiers. Gross migration was significantly higher in the Southwestern Tier (N=484, M=18.1, SD=16.9) compared to the Central (N=745, M=16.1, SD=12.1) and Northern (N=329, M=15.7, SD=11.3) Tiers. The mean difference between the Southwestern and Central Tiers (1.97) was significant at  $p=.035$ , while the difference between the Southwestern and Northern Tiers (2.42) was significant at  $p=.036$ .

These results indicated that the level of gas activity in the relatively homogeneous Northern Tier was enough of a draw for in-migration to achieve similarity with the diverse population and economy of the Southwestern Tier. Similar results for movers from a different state supported this assumption. While the Central Tier had less mobility and migration than the Southwestern Tier, similarity with the Northern Tier in these variables suggested that other factors besides natural gas influence population movement in Northern and Central Pennsylvania. For example, Pennsylvania has many colleges and universities, including Penn State University, in those geographies. The predominance of small rural communities and their characteristic social cohesiveness may explain the higher percentages of non-movers in the Northern and Central Tiers. Another possibility is the housing inventory may limit mobility because there are fewer options in making the decision to move. Because there was no statistical difference in short or medium distance movers, that is, within county and within state mobility,

the implication is that natural gas did not create strong labor migration. If it did, the expectation was that the Northern and Southwestern Tiers would have had more mobility in the within-state variables.

The 2013 ACS geomobility data did not separate households by the presence of children under age 18. People in this age category do not generally move independently of others in older age groups. Therefore, statistical variation in the mobility of children reported in Tables 18 and 19 reflect the actions of those aged 18 and above.

The research expectations were that people aged 18 to 34 and 35 to 64 would have higher mobility and migration because of life course situations such as receiving higher education, entering the labor market, or establishing independent residence. People aged 65 and over who are out of the workforce will not experience labor migration, but may move to a retirement location. Therefore, the expectations were that varying gas activity would draw labor migration of 18 to 64 year olds to the Southwestern and Northern Tiers more than the Central Tier, and that there would not be an apparent association with natural gas activity and movement of senior citizens.

Tables 18 and 19 show one-way ANOVA and multiple comparison results for the migration and mobility by age. Whereas the percentages of movers in the general population were statistically similar in the Northern and Southwestern Tiers, movers in the 18 to 34 year age group were higher in the Northern Tier ( $N=323$ ,  $M=62.5$ ,  $SD=140$ ) than in the Southwestern Tier ( $N=484$ ,  $M=39.7$ ,  $SD=49$ ). The mean difference between the two was significant (22.9,  $p=.041$ ). The mean difference (22.8,  $p=.041$ ) between the Southwestern Tier ( $N=484$ ,  $M=60.3$ ,  $SD=49$ ) and the Northern Tier ( $N=323$ ,  $M=37.5$ ,  $SD=140$ ) was statistically significant, indicating that a higher percentage of this age group stayed in place in the Southwestern Tier. Unlike the

overall population, there was a difference in the percentage of movers within the same county for all age groups under age 65. For 18 to 34 year olds, the significant mean difference (1.63,  $p=.004$ ) occurred only between the Southwestern Tier ( $N=484$ ,  $M=12.1$ ,  $SD=0$ ) and the Central Tier ( $N=742$ ,  $M=10.5$ ,  $SD=9$ ). For 35 to 64 year olds, a higher percentage of within county moves occurred in the Southwestern Tier ( $N=481$ ,  $M=4.4$ ,  $SD=4$ ) compared to the Northern ( $N=328$ ,  $M=3.5$ ,  $SD=4$ ) and Central ( $N=747$ ,  $M=3.3$ ,  $SD=3$ ) Tiers. The mean differences between the Southwestern and Northern Tiers was .952,  $p=.000$ , and the Southwestern and Central Tiers was 1.2,  $p=.000$ .

The higher mobility of 18 to 34 year olds in the Northern Tier compared to the Central Tier may reflect moves for education or labor, especially because the majority occurred at the smallest distance measured in the survey: movers within the same county. More non-movers in this age group and tier may be due to diversity in the region where people do not have to relocate in order to achieve personal goals. Yet the overall significance values suggest that the overall differences are not very strong, suggesting more similarity among the tiers rather than diversity. Higher significance between the mean differences for the 35 to 64 year old age group indicates the strength of the Southwestern Tier to offer diversity in labor opportunities. Because there are fewer wells in this tier compared to the Northern region, gas activity alone may not be the overriding factor to move. Other conditions may exist that do not have a direct association with the gas industry, but influence mobility.

An example of a condition that influences population mobility is poverty. The research assumptions were that areas with higher populations of people in poverty would also see more short distance mobility. Tables 20 and 21 show the results of one-way ANOVA to determine the poverty characteristics of the three Marcellus tiers.

Data from the ACS separates households by 6 levels of poverty. There was no significant difference in the population of households at poverty intervals up to 124% of poverty in each of the three tiers. The Central and Northern Tiers had higher percentages of household in the intermediate to upper intervals between 125% and 200% or above poverty. However, with respect to movement, there is more within county mobility in the Southwestern Tier for intervals from below 100% poverty to 150% or above. None of the other distances had significant mobility for any of the poverty intervals, supporting the assumption that the poor cannot afford long distance moves. For those below 100% poverty, the Southwestern Tier (N=485, M=12.4, SD=13.1) had a higher percentage of movers than the Central (N=745, M=10.6, SD=13.3) or Northern tiers (N=327, M=10.1, SD=13.3). The mean differences between the Southwestern and Central tiers (1.8,  $p=.048$ ), and Southwestern and Northern tiers (2.4,  $p=.033$ ) indicated that the mobility in urban Southwestern area was distinct from the rural tiers. Similarly, the Southwestern Tier (N=485, M=4.1, SD=8.1) had a higher percentage of movers than the Central (N=745, M=4.0, SD=7.2) or Northern tiers (N=327, M=3.8, SD=7.2) in the 100% to 149% poverty category. Again, mean differences between the Southwestern and Central tiers (1.8,  $p=.033$ ), and Southwestern and Northern tiers (3.2,  $p=.000$ ) show urban and rural distinctions. For households at 150% poverty or above, within county mobility was higher only between the Southwestern (N=485 M=4.6, 3.4) and Central tiers (N=752, M=3.8, SD=3.1).

With respect to poverty and migration, the Southwestern Tier did not have a significantly higher percentage of people below poverty or at poverty, but had more short distance mobility. Because the means were similar in the Northern and Central tiers, the implication is that factors other than gas activity may have encouraged mobility in the Southwestern Tier, be it greater availability of services or other factors that stimulate movement. Otherwise, there would have

been similarity between the Southwestern and Northern tiers. The next analysis looks at housing as a motivation for mobility.

Tables 22 and 23 show the results of one-way ANOVA for housing characteristics among the three Marcellus tiers. The Northern Tier had lower percentage occupied housing ( $N=333$ ,  $M=74.8$ ,  $SD=22.4$ ) than either the Central ( $N=753$ ,  $M=83.2$ ,  $SD=16.9$ ) or Southwestern tiers ( $N=486$ ,  $M=88.9$ ,  $SD=7.8$ ), which indicates less housing availability. The mean differences between the Central and Northern tiers ( $8.4$ ,  $p=.000$ ) and the Southwestern and Northern tiers ( $14.2$ ,  $p=.000$ ) were significant. However, the Northern Tier also had more vacant housing ( $N=333$ ,  $M=24.9$ ,  $SD=22.1$ ) than the Central ( $N=753$ ,  $M=16.7$ ,  $SD=17.7$ ) or Southwestern tiers ( $N=486$ ,  $M=11.1$ ,  $SD=7.8$ ). The mean differences between the Northern and Central tiers ( $8.3$ ,  $p=.000$ ) and the Northern and Southwestern tiers ( $13.9$ ,  $p=.000$ ) were significant. There were other differences in the housing tenure (renting or owning) among the three tiers. Although the Gross Rent As a Percentage of Income index did not reveal differences in affordable rental housing, the overall percentage of renter occupied housing was higher in the Southwestern Tier ( $N=486$ ,  $M=22.9$ ,  $SD=12.9$ ) than in the Central ( $N=753$ ,  $M=17.3$ ,  $SD=11.4$ ) and Northern tiers ( $N=33$ ,  $M=15.9$ ,  $SD=11.3$ ). The mean differences between the Southwestern and Central tiers ( $4.9$ ,  $p=.000$ ) and the Southwestern and Northern tiers ( $4.6$ ,  $p=.000$ ) was significant. With respect to owner occupied housing, the Northern Tier ( $N=333$ ,  $M=58.9$ ,  $SD=18.6$ ) again had a lower percentage of occupied units than the Central ( $N=753$ ,  $M=65.9$ ,  $SD=16.9$ ) and Southwestern tiers ( $N=486$ ,  $M=66.0$ ,  $SD=15.7$ ). The mean differences between the Central and Northern tiers ( $7.0$ ,  $p=.000$ ) and the Southwestern and Northern tiers ( $7.1$ ,  $p=.000$ ) was significant. Yet the mean differences between the Central and Southwestern tiers were not significant. Finally, the only tenure characteristic with significant mobility was the percentage of homeowners who moved

within the same county. The Southwestern Tier (N=485, M=3.2, SD=2.6) had a higher percentage of within county movers than the Central Tier (N=751, M=1.2, SD=2.0). The mean differences between the two (5.06  $p=.002$ ) was significant.

Occupancy was clearly higher for owners and renters in the Southwestern Tier compared to the Northern and Central tiers, while the non-urban areas had more vacancies. The Northern Tier had a much smaller population, so it makes sense that there would be fewer occupied units. However, the higher percentage of vacant housing indicates more population loss in this area. There were more renters in Southwestern Tier but more homeowners in the Northern and Central Tiers, suggesting a difference in the inventory in the types of housing may direct people in the rural areas toward homeownership, while people in the urban area have more housing options. Although the data showed that as expected, more renters moved than homeowners did, the results did not correspond to a regional influence on the decision to move. Therefore, there was no clear association between mobility, housing tenure, and regions with more or less gas activity.

### **Qualitative Analysis: Local Perceptions of Social Change in the Marcellus Region**

Because the 5-year census data are now two to seven years old, observations from key informants offered a description of how natural gas development affected social dimensions in their community since the 2013 ACS. The research questions asked what changes occurred since the expansion of the industry, and how especially did population change affect housing in the. Descriptions of social change from professionals living and working in Marcellus communities provided current information about the experience of natural gas to those most directly affected by its impacts.

**Identification of study areas.** In order to identify key informants to gather local perception of social change after natural gas expansion, there needed to be a rationale for

selecting a geographic area for informant recruitment. Using shapefiles from the U.S Census Bureau for Pennsylvania counties and subdivisions (TIGER/Line, 2014), and well location data from the PA DEP historical archive for those active in 2013 (PA DEP 2015), a basic map was constructed using ArcGIS v. 10.3. The approximate boundaries for the Northern and Southwestern Tiers, as well as the Pittmetro region were added in order to contextualize the counties and municipalities relative to the geographies used in the quantitative and qualitative analyses. Since the quantitative analysis showed more statistically significant mobility for within county movers across various variables, data from the 2008-2012 American Community Survey County MCD-to-County MCD Migration Flows was joined to the ArcGIS basic map by matching Federal Information Processing Standard (FIPS) codes. The percentage of the population moving within the same county subdivision, or MCD was converted to a Z-score in order to provide a distribution based on the mean percentage of movers within the Marcellus area. Figure 4 shows the resulting map.

This graphic representation showed differences in the percentage of movers within the same county according to individual municipality. Using a scale that divided the z-scores into 4 categories, variations in mobility emerged in relation to clusters of wells. Note that each visible well symbol may actually represent multiple well pads that the mapping program condensed under a single symbol according to the scale of the map. Communities in Washington, Greene, Fayette, Tioga, Bradford, and Lycoming show an association between wells and variation in mobility.

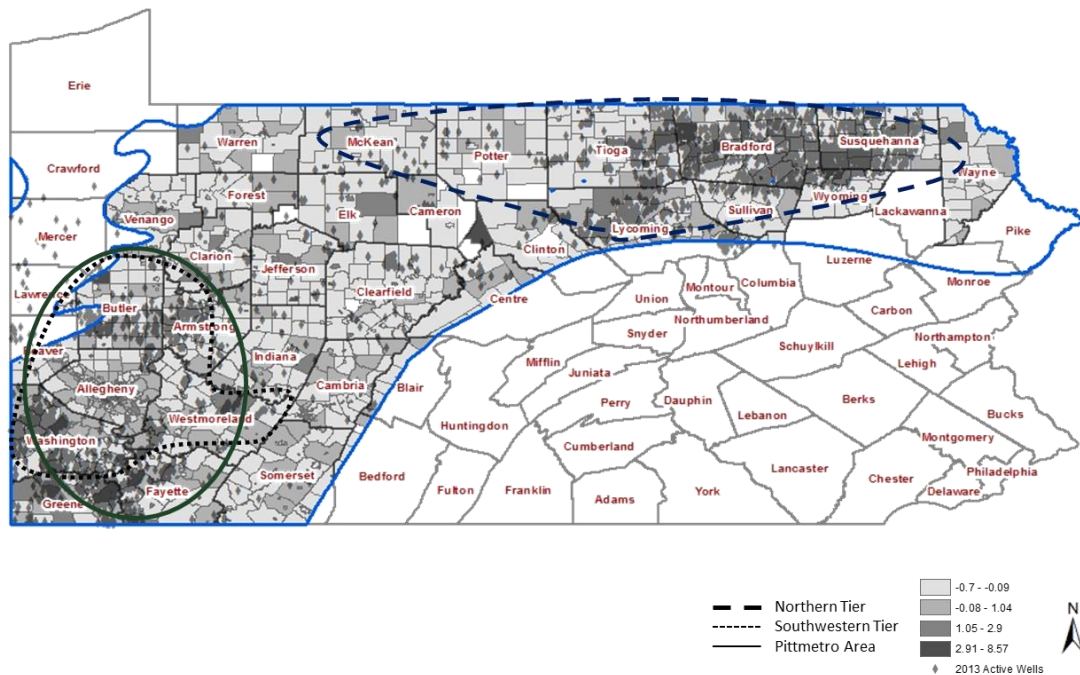


Figure 4. Percentage of movers within the same county by municipality.

However, some areas have more mobility but fewer wells, or a concentration of wells but less mobility. This suggests that other factors besides natural gas drilling may affect why people move to a community. For example, Pennsylvania has a variety of institutional or group quarter facilities, such as long-term care facilities, prisons, and universities that have mobile populations.

**Field observations.** Field research began on August 4, 2015 with phone calls to realtors, social service agencies, local government offices, and school district administrative offices in order to solicit participants for interviews. Based on the information from the map in Figure 6, and considering time and distance constraints, data collection focused on the following counties and municipalities shown in Table 24.

Table 24

*Counties and Municipalities Selected for Field Research*

<b>Northern Tier</b>		<b>Southwestern Tier</b>	
Bradford County	Athens Borough Towanda Township	Washington County	Robinson Township McDonald Borough Canonsburg Borough Rostraver Township
McKean County	Bradford City	Westmoreland County	
Susquehanna County	Bridgewater Township Montrose Township		

In addition to the areas listed above, information about Cameron County in the Central Tier came from a realtor in McKean County, whose business covered three counties, including Potter County in the Northern Tier. While Cameron County was not initially targeted, the information received was useful in describing the Central Tier experience during the natural gas expansion.

Specific contacts came from internet searches of realty agencies, local governments, school district websites, and social service agencies. Because these were cold call conversations, there was a variety of reactions to the request for an interview. Each person who answered the phone received a description of the research study according to an approved script shown in Appendix E. The script concluded with a question asking if they would be interested in participating in an interview. The reactions of individuals described their attitudes toward participating in a study as well as their feelings about the research subject. Because natural gas drilling is a contested topic, people may have had a range of feelings or concerns that tempered their willingness to participate in the study. Moreover, as mentioned previously as a study limitation, people whose livelihood or community standing is attached to the gas industry may or may not have wanted their thoughts about the gas industry recorded.

For example, some of the realtors in McKean, Washington, and Bradford County did not wish to appear uncooperative, yet they were evasive about committing to an interview. Several felt that the project was irrelevant because the majority of activity was over. Others did not want to invest time in a conversation that was not beneficial to their immediate business concerns. They mentioned business commitments that left little time for an in-person or phone interview. Some county-level human services directors in Bradford, Westmoreland, and Washington counties were also evasive. They either did not accept calls or return emails and voicemail messages. One receptionist in a Bradford County housing authority office said, “I don’t know who would want to talk to you,” which suggests that the topic was a sensitive one in that particular office. A school administrator in Bradford County asked to see the interview questions in advance prior to committing to participation, but did not respond to a follow up request for an interview. This type of response may have indicated a passive rejection of the opportunity to participate in the project. No one received more than one follow-up email or voicemail message.

Yet others were enthusiastic about participating in the study. Several informants in local government, social services, and law enforcement expressed appreciation for the interest in the social effects of natural gas because so much attention had focused on environmental and regulatory aspects of natural gas drilling. They seemed to want to talk about the impacts of natural gas because they hoped that more information and research could lead to policy changes that addressed the externalities placed on communities. A borough manager in Washington County said was thankful for “taking an interest in the area because no one seems to be looking at the social impacts.”

In-person field observations showed that Washington and McKean counties might be similar in respect to the landscape and external indicators of social change. The area just 15

miles outside of Allegheny County is very rural, even parts of towns adjacent to Interstate 79 where there is usually commercial development. A field visit to Washington County on August 11, 2015 indicated a stable business environment because nothing looked like recent changes to existing structures. Most of the storefronts looked like they had been in place for years judging by the older-looking signage and dull paint on the exteriors. There was no indication of new business either by the presence of new construction or contemporary upgrades to existing buildings. However, a car dealership in McDonald Borough looked recently renovated, and because it exclusively sold Buicks, the implication is that there is a market for high-end vehicles in the surrounding area. Many of the vehicles that were on the road or parked in driveways were late model cars or trucks. Houses were sparse and old, but there was new construction closer to Canonsburg Borough in Washington County as well as in Fayette County. There were no obvious signs of poverty, such as abandoned structures, junked vehicles, or vacant storefronts along the major roads. The same was true for the Northern Tier, where a field visit to McKean County on August 20, 2015 showed no obvious changes or improvements to the landscape along Route 6, which was the major east-west access road. Business appeared established, and the structures looked in good repair.

In McDonald Borough, the town center exhibited noontime activity judging from the filled parking spaces and people walking on the street. The same was true for Bradford City in McKean County. Both communities had flowerpots and flags on the streets, which indicated investment from the municipal government or business council on civic beautification. Although the visits took place in the early afternoon, there were few vehicles with out of state plates parked near restaurants. This suggested that the gas workers ate somewhere else, at least on that day. In summary, the field observations of communities in the Marcellus region did not show

expected indicators of in-migration, such as new businesses or out of state plates on cars. They did show indications that there was some prosperity based on the condition of the businesses, a significant number of late model cars, and patronage of local businesses.

**Key informant demographics and data analysis.** In addition to information obtained from conversations that occurred through fieldwork, interviews conducted with 18 key informants provided descriptions of the effect of natural gas on community life since 2013. There were 9 women and 9 men. Six women were from the Northern Tier, 2 from the Southwestern Tier, and 1 from the Central Tier. Three men were from the Northern Tier, 5 from the Southwestern Tier, and 1 from the Central Tier. Table 25 shows the breakdown of key informants by professional categories. Each interview lasted from approximately 18 to 30 minutes, whether in-person or by phone. Appendix A shows the list of questions designed according to the professional expertise of the key informant, and approved by the Duquesne University Institutional Review Board. Interviews were audio recorded and transcribed with a professional online transcription service.

Table 25

*Professions of Key Informants by Location*

Profession	Total	Northern Tier	Southwestern Tier	Central Tier
Social Services	3	1	2	0
Law/Government	5	2	2	1
Real Estate	4	2	1	1
School Administrator	3	2	1	0
Other*		1		

\*Newspaper Reporter

**Major themes across the Marcellus region.** A first pass through the data identified major themes in the description of the effects of natural gas throughout the Marcellus region. The conversations were limited to perceptions of changes in daily living in response to the presence of new people, the activity accompanying a new industry, economic changes, and the implications on housing cost and availability. The themes fell into three qualitative categories: positive, negative, and undetermined effects.

Many of the informants talked about the economic windfall to established businesses, but none specifically mentioned that new retailers or service industries started from the increase in economic activity. The first benefits from new income went to small businesses, retailers, and property owners. A realtor from Bradford County described the effects as “booming” when drilling was at the peak. Bars, restaurants, small and large retailers saw more transactions both from gas workers and residents. Property owners filled rental vacancies at higher rates than those seen in recent years. In particular, informants mentioned the significance of natural gas to family farms. Leases and royalties saved struggling farms from bankruptcy. A Washington County informant referred to the added income as “an influx of prosperity to famers who had farmed out their lands for generations and were finding it hard to make ends meet...And what is fantastic is they’re still farming.” Informants spoke about people investing in their business by upgrading equipment and fixing up their buildings, yet retaining their traditions. Some of the words like “pride,” “roots,” and “having it a little bit better,” indicated money did not change the integrity of the community, but improved it. The income changed, but not the culture or personal values that distinguished the character of the community.

There were public benefits from the increased economy as well. Local government workers and school administrators said that natural gas has allowed them to make needed

improvements without raising taxes. These changes help the public at large. Some of the benefits came directly from the gas companies. A local government official in Washington County described how the existing roads and bridges in his municipality were widened and strengthened in order to carry the heavy equipment vehicles needed for drilling. This saved \$1.26 million in the operating budget. In Westmoreland County, impact fees and taxes provided a significant portion of the annual budget, allowing them to keep pace with expenditures. In the Northern Tier, an informant described a charitable endowment made to one of the hospitals, as well as donations to the arts by one of the gas companies. Increased business revenue, especially from hotel taxes, is helping a school district in Washington County build new elementary school buildings and expand the high school without instituting a bond initiative or raising taxes.

A final positive theme found throughout the data that natural gas created jobs. As told by informants in Washington, McKean, and Bradford Counties, the gas companies initially brought trained crews from the West or South when drilling started. Eventually they hired and trained local workers, both for work in the field and in administration. This provided opportunities for men, women, and high school students to get high paying jobs after years of losses. For example, a Washington County informant said that he knew of people in the health services field who doubled their salary by taking a job with the gas companies. In Susquehanna County, a school superintendent said that trade schools offering welding certificates saw an increase in enrollment because of the job demand. Informants in Washington County and elsewhere described that students have choices besides going to college and incurring heavy debt in order to acquire marketable skills.

On the negative side, a striking comment made by informants in both the Northern and Southern Tiers was that they were unprepared for what was to come with natural gas expansion

in their area. A McKean County realtor said, “no one told us what to expect when the drilling started.” In Rostraver Township, Westmoreland County, the township planner said that revisions were necessary for emergency management protocols after an incident occurred at a well that threatened public safety. This informant referred to the incident as “a learning process for elected officials... I think we were all so unprepared for when this started happening compared to today.” A similar occurrence in Washington County implied that communities experienced a learning curve in accommodating the presence of area gas drilling.

A related issue with the perception of being unprepared for changes was apparent with the way that communities responded to the impermanence of the economic boom. All of the positive economic effects came from the activity of the gas industry, and when it subsided, businesses felt the loss. No secondary industries or services developed from natural gas that could have added independent economic support. This condition was more apparent in the Northern Tier where natural gas drilling occurred first, however, informants in the entire area noted these effects. Speaking about the economy, a Bradford County realtor said, “It’s come down quite a bit.” Real estate transactions in the owner and rental markets have slowed in response to changes in labor needs that respond to the market demand for gas. Informants in Bradford, McKean, Susquehanna, and Westmoreland Counties said that gas companies were laying off workers because the price is low. In some areas, this was a long-term decision. In McKean County, two companies relocated their operations back to West Virginia, transferring their out of state workers back home and leaving their Pennsylvania workers behind. The downturn eventually affected all economic sectors. A social service agency volunteer in Bradford County talked about how people who had nice paying jobs now work at minimum wage. Although the layoffs in the Southwestern Tier were not as severe at the time of the

interviews, informants noticed that the activity was not as high as it had been recently. In Westmoreland County, plans for hotel construction have “come to a halt after the big shift that was made towards ... the beginning of this year,” according to a township supervisor from Rostraver Township.

Another key problem from the boom and bust cycle of natural gas was the effect on the cost of rental housing. The overall problem began with rent inflation, and then expanded into other social dimensions. In Washington County, rents increased as rental vacancies decreased, but new construction of multi-family units stabilized prices. However, in the Northern Tier rental costs skyrocketed and remain high even now during a period of economic contraction. As a Susquehanna County non-profit housing developer explained, the housing crisis had a “ripple effect through the system.” First, prior to the buildup of the natural gas industry it was difficult to prove the need for affordable housing beyond sustaining existing units due to wear and tear. Second, some rental property owners who suddenly made triple the revenue rented preferentially to gas workers. This displaced families who could not afford hyper-inflated rents. Informants from McKean and Bradford counties corroborated this observation. They noted that homelessness and doubling up increased with gas activity, and remain a problem even as the peak has passed. Third, the economic crunch caused by housing put a strain on other social services, such as food banks and other assistance agencies. Informants in Bradford County talked about the ongoing need to find clothing, blankets, and other necessities for the growing number of poor individuals and families.

Yet, even though the high level of gas activity has subsided, rents remain high. According to a school superintendent in Bradford County, pipeline construction, condensing stations, and gas-powered plants are beginning to pick up. These jobs pay salaries high enough to

afford inflated rent. Property owners can afford to hold vacancies for the time being in the hope of getting above market prices. This is not helpful for many residents who are not part of the gas industry. As explained by an informant in Susquehanna County, "...you pay a rent of \$800 to \$900 a month, which is more than the norm; it's still a pretty good hit on salaries that haven't increased anywhere near that increase."

While the development of the natural gas industry brought positive and negative changes to communities, other changes were qualitatively indeterminate. One example is the actual presence of new people from out of state. Observations from informants suggested that the gas employees working in the fields did not engage much with the local residents. Law enforcement officials in Washington and Westmoreland counties did not report an increase in problems such as public disturbances, gambling, or prostitution. Several of the informants referred to out of state license plates rather than the people as indicators of newcomers to the community. Another informant said, "There wasn't anybody that wasn't happy to see them coming in and spending money," suggesting the workers had little significance beyond providing an economic boost. This may have been because work schedules limited opportunities to engage within the community aside from eating meals in restaurants.

Another example of a change that was neither a benefit nor a problem was the level of civic engagement. While informants from local government were glad to see higher attendance at meetings, it usually meant that people came to complain about something related to natural gas. Some residents brought up important issues related to water contamination or traffic hazards, which government officials needed to know in order to work effectively with the Department of Environmental Protection and the gas companies. Yet public meetings often became contentious as residents had strong opinions about natural gas extraction in their community.

**Major themes in Marcellus Tiers.** A second reading of the data categorized the descriptions of community change by tier. Sorting the interviews according to Northern, Southwestern, and Central Tier revealed a pattern in the assessment of change among the three tiers. The research expectations were that communities with more gas extraction activity would also experience correspondingly more social disruption from the presence of newcomers. The differences would come from the way in which communities adapted to a new industry and its effects on the social structure and economy. The findings show that the pre-existing municipal framework had more influence on how informants qualified the changes that happened in their communities because of natural gas.

The Central Tier had the least amount of natural gas activity (5.7%) and consequently, the qualitative effects on community disruption were minimal. However, as one informant described, there was an anticipation of population and economic change that never materialized. The anticipation was that "... there was going to be an influx of people here (Cameron County), and that just did not happen." Drilling occurred later in the Central Tier, and the expectation was that once it began, the communities would have similar experiences as those reported in boroughs and townships in Northern counties. To prepare for these changes, investors bought properties expecting to use them as rentals. However, the gas workers did not stay in those communities. Nor did the Central Tier see increases in business activity, heavy traffic, or multitudes of new people as other tiers reported. There also was no impact on housing because the inventory was sufficient to provide for community needs. While they heard of stories of crowding and price gouging in other areas, nothing like that happened in areas with less gas activity. In short, in low volume areas, the natural gas industry neither caused social disruption, nor offered much in the way of community benefits because of the low volume of activity.

However, the Northern and Southwestern Tiers had different experiences even though each area had characteristics that predicted similar responses to natural gas. Although the Northern Tier had more well activity, (71.3%), the empirical analysis showed that area had less migration and mobility than the Southwestern Tier. The assumption that population movement indicated social disruption suggested that the Northern Tier communities adapted to newcomers and economic changes that occurred with natural gas. The Southwestern Tier, which had about 28% of the gas drilling, had more population movement. The implication here was that drilling might have been more disruptive to community life in the boroughs and towns. Informants in both areas said that the changes from natural gas in their communities were substantial. In addition, each felt that they were unprepared at first to accommodate the variety of situations that occurred with the development of a new industry. They mainly referred to community relations, relations with the gas companies and DEP, environmental contamination, and safety at the well sites, as these conditions were experiences associated with a new industry. However, the second reading of the qualitative data showed that qualitative assessment of social change was not the same along dimensions.

The informants from the Southwestern Tier had an overall positive attitude toward natural gas development. While there was friction between municipalities over the distribution of impact fees and other regulatory issues, these were not serious problems, at least from the perspective of those in local government. Informants described the natural gas industry as a “blessing,” “godsend,” and using other words that expressed appreciation for the improvements that occurred in recent years. They spoke about the importance of direct and indirect benefits to municipal budgets through increased revenue either from taxes and impact fees, or by the gas companies’ assumption of road upgrades and repair costs. Municipal improvements were now

possible where before these small communities struggled to keep up with the costs of maintaining public works. They also described cooperative relations with the DEP and the gas companies regarding the handling of environmental problems. The perception was that the DEP was a valued advocate in enforcing regulations on the gas companies, and that the gas companies were quick to remediate contamination or other problems. This included relations between the workers and the community through company safety departments. Local government informants also reported that perceptions among the residents were positive overall because of the public benefits personal gains from leases and royalties. However, there were those who objected strongly to natural gas because of health and environmental concerns and the traffic inconvenience. Yet they downplayed these attitudes in favor of portraying a positive assessment of the changes to the quality of life that occurred because of natural gas development in their community.

Informants from the other professional areas in the Southwestern Tier echoed similar affirmative perceptions while minimizing the effect of negative impacts on overall community improvement. For example, an informant at a Washington County social service agency was enthusiastic about the opportunity that good-paying jobs had to reverse the fortunes of people who had been having difficulty making ends meet. However, there were complications like increased traffic and pollution, which this person rationalized as part of the growth process. A school administrator was likewise pleased with the economic benefits to the school system, and the change in the employment outlook for students. They now have options for obtaining employment at a livable wage without needing to leave the area or state. This was more significant to the positive assessment of change than having to adapt to curricular adjustments

was to the negative impact. These included thriving businesses, school improvements, and new opportunities for high-paying jobs.

Another difference between the Northern and Southwestern Tiers was that the latter did not experience a housing shortage, nor was natural gas associated with housing insecurity. Although there are homeless people in this area, informants coupled the proximal causes for homelessness to personal problems such as mental health, substance abuse, or to the economic recession. There were several reasons why, according to informant observations, that natural gas did not contribute to housing insecurity. First, the field workers had temporary assignments. Their housing preference was motels or hotels rather than rental homes or apartments, although some took on short-term rental leases. Property owners did not escalate rent to capitalize on a short-term condition in consideration of long-term consequences of displacing permanent, steady-paying tenants. Second, developers in areas like Canonsburg Borough and Cecil Township in Washington County that experienced an influx of management-level gas employees built more housing to accommodate new residents looking for permanent housing. Housing construction stabilized rents and contributed to overall economic growth.

Like the Southwestern Tier, communities in the North experienced economic gains, which saved struggling businesses and family farms. However, the burst of activity was short-lived, and the responses from informants describe the adjustment from a boom to bust phase. During the buildup, realtors in Bradford and McKean counties reported that people were happy as business picked up and personal wealth increased because of drilling on private property. Like in the Southwestern Tier, they rationalized the complications from traffic or pollution as part of accepting progress and growth. However, Northern Tier informants reported more indicators of social disruption and negative outcomes from natural gas. Words like “distressful,” “sad,” and

“hardship” were used to describe the current conditions while positive-sounding statements like “booming,” “growing,” and “better,” referenced past experiences.

For example, a municipal court clerk described activity in the court system that indicates social stress because of changes imposed by the natural gas industry. Local workers had long, non-traditional work schedules that conflicted with the usual workweek and school calendar. This caused couples to renegotiate custody and visitation agreements, which contributed to family stress. Since the downturn and subsequent loss of income, couples have to return to court to revise child support agreements, which incurs legal fees. Other issues affecting the courts include settling disputes over who gets royalties, which involves complex title searches. While no informant specifically mentioned a significant increase in crime, there were reports of more cases of driving under the influence and breaking and entering.

School administrators talked about how the economic cycle affected the student environment. Representatives from districts in Bradford and Susquehanna reported that enrollment did not increase as predicted, and with subsequent job losses in the gas industry, people are leaving in order to chase employment. Evidence of economic hardship included increased eligibility for safety net programs like food stamps and the federal subsidized school lunch program. In addition, administrators noticed more address changes and record transfers as families moved in search of affordable housing. Because of job losses and lack of other opportunities for viable employment, high school graduates are leaving and not returning. As a result, the long-term outlook for schools in the Northern Tier is lower enrollment, which will eventually affect funding and other financial support for small districts.

The key difference between the Northern and Southwestern Tiers was the response to the need for housing during the buildup of the gas industry. Where housing construction was

booming in the southern corner of Pennsylvania, along the northern border the situation was a crisis. Gas workers were grouping in houses or apartments “maybe five or six guys at a time and they used it kind of just to sleep there and maybe have something to eat,” said a Bradford County realtor. The communities had difficulty finding places not only for the gas workers to live, but also for non-gas related people searching for rental housing. Informants reported that families doubled up or commuted long distances to work or school because they found affordable housing in other areas.

High rents still put pressure on low and moderate-income families, even with the downturn in the gas industry. This had been especially hard on senior citizens and others with fixed incomes who cannot adjust to rental inflation. Moreover, municipalities in the Northern Tier had few multi-family rental buildings or transitional housing for people to stay while they searched for more lodging. Informants in Bradford, McKean, and Susquehanna counties across professions reported knowledge of people and families who were doubling up with friends and relatives, moving frequently to chase affordable housing, or becoming homeless. According to the opinions of the informants, the gas industry effects had no bearing on chasing housing in the Southwestern Tier despite having evidence of more population mobility and migration. The main cause for this disparity between the two tiers was insufficient housing construction in the north.

Why was this the case? Informants in Bradford and Susquehanna counties pointed to structural impediments that limited or prohibited new housing construction in that area which did not exist in Washington or Westmoreland counties. The rural agrarian communities along the Northern Tier have limited municipal water and sewage infrastructure. Right now, these systems are at their carrying capacity to provide fresh, clean water to their service areas. Moreover, the service areas do not extend far into less populated areas. As public services, municipal water and

sewage systems are the responsibility of the local government. These entities do not have the financial resources to expand systems without assistance from larger government or private contributions, even from pooled inter-municipal resources.

Most residents living outside municipal centers like Towanda and Athens in Bradford County have private water and septic systems on their property. However, there were limits to using private systems in constructing new housing. Because the natural gas industry expanded at the same time other macro-economic conditions raised the cost of building construction, the added cost of installing private wells and septic systems, even for single-family units, was “a deal-breaker” for new construction. As described by a state government informant in Bradford County, there was no investor interest in major housing projects. This was partly because prior to the boom there was no substantiated need for additional housing, and therefore, no funds available to expand the existing inventory. Even with cost aside, most of the soil in the northern region is not “perkable,” meaning that it has reduced capacity to support multiple septic units. Health and pollution concerns restrict the number and volume of private and commercial sewage systems. A realtor in Bradford City, McKean County, said that the area could not support any new systems unless others discontinue service. Too many systems can overload the leaching capacity of the soil, which becomes an important consideration when granting building permits. This ultimately complicates zoning and land use decisions. In contrast, the urban and industrial environment of the Southwestern Tier had a better network of utilities even in undeveloped areas. Building cost was less, allowing for the quick construction of subdivisions like Southpointe in Cecil Township, Washington County, and other forms of rental housing in order to provide housing for gas company managers and employees.

## **Discussion**

### **Research Expectations and Empirical Results**

This project undertook an examination of mobility and migration resulting from the expansion of the natural gas industry in the Marcellus shale region of Pennsylvania. Prior research in population movement showed a relationship between social disruption and mobility. The assumptions in this study predicted that with the expansion of the natural gas industry, new people and economic changes would create social disruption, which would then have an effect on population mobility. However, other characteristics of communities explain why people remain in place, even when changes occur in social environments. Several hypotheses tested these theoretical assumptions. Expectations were that mobility and migration would increase with drilling activity; the people most likely to move were the working-age population renters, and the poor; and that areas with more in-migration have more short distance mobility. This study also expected that the characteristics of the urban Southwestern Tier of Marcellus would have more mobility and the rural Northern Tier would have more people who stay in place.

Statistical results from analysis of census data taken through the peak of gas well production supported some of the research hypotheses relating to the special characteristics of places and the likelihood of mobility. Overall, working-age people and children were more mobile than older adults were. This was consistent with the characteristics of labor-mediated mobility. The urban Pittsburgh Metropolitan Statistical Area, which overlapped with most of the Southwestern Tier, had more mobility than the rural nonmetro area containing the Northern and Central Tiers.

However, a closer analysis of the three regions categorized by geography and drilling activity did not show a definitive association with the gas industry and mobility. Comparisons of

aggregate community mobility and migration showed more similarity between regions despite varying levels of gas development. There are several possible explanations for this observation.

First, the management of the natural gas industry workers may not have been conducive to labor migration in Pennsylvania as reported elsewhere (Vachon, 2014). The field workers were single men who traveled from permanent residences for temporary work assignments. Their families as well as their community attachments resided elsewhere. Although some expected longer deployments in the Northern Tier, those in the Central and Southwestern Tier tended to work their shifts, and then return to their homes in the south or west. Census surveys may not have captured their presence in Pennsylvania.

Second, the ACS survey used in the study was a 5-year average of data collected between 2009 and 2013. During this time, changes occurred in the market for natural gas that had an effect on labor and the economy. Drilling began around 2007 and 2008, depending on the region. According to informants, gas production had begun to reach market saturation by 2013. Companies slowed the pace of drilling, particularly in the dry gas market in the Northern Tier, and subsequently reduced hiring until eventually proceeding to layoffs by 2014 and 2015. The ACS data did not reflect sudden gains or changes that probably occurred during the survey period. If it had, then a clearer picture may have emerged capturing population change and housing availability relative to changes in the gas industry.

Third, analyzing census figures in counties and municipalities where drilling occurred did not take into consideration other factors that may have influenced population change, caused social disruption, or affected housing security. Public census information at the county subdivision level did not identify movers within institutionalized populations, for example. The data also did not distinguish movers responding to other social forces such as the 2008 recession,

factory closings or openings, school district restructuring, or changes in safety net allocations administered at county levels. Moreover, the census data could not reflect confounding social problems bearing on housing security, such as mental health issues, marketable labor skills, or substance abuse.

### **Contextualization with Qualitative Results**

The limitations in the quantitative analysis necessitated gathering information from key informants to contextualize the empirical data to the lived experience in communities affected by the natural gas industry. Time and resources prohibited an exhaustive investigation of population movement and social change in every municipality or county within the Marcellus region. However, mapping the census mobility data identified municipalities with noticeable population change in the near vicinity of gas wells. This allowed for a targeted investigation of community changes occurring because of natural gas activity. The expectation was that these communities would experience direct effects from the natural gas industry, and that professionals in local government, school administration, social services, law enforcement, and real estate could provide information about social change based on their expertise.

These informants provided a description of community changes in response to natural gas drilling. Considering that in-migration is a potential factor of social disruption (England & Albrecht, 1984), the accounts from the study informants indicated that the gas workers did not disturb the existing social structures in Marcellus communities. Informants reported that people noticed the presence of newcomers, but did not give any indication that they were involved with community activities or other behaviors associated with social integration. Professional interactions with the gas workers implied a cordial but reserved relationship. There was no indication that the workers actively engaged with the social life of the community, aside from

those who brought their families and enrolled children in school. As for causing public disruptions or putting a strain on law or emergency services, there were no complaints from the informants regarding disorderly conduct beyond mentioning minor accidents or traffic violations. In fact, some of the realtors and local government informants did not even know where the gas workers stayed. This suggested that the workers kept to themselves.

Social disintegration might have been an outcome of a physically rigorous work environment or a purposeful strategy on the part of the gas industry management to minimize social problems in host communities. Field workers had 12 to 14-hour shift assignments for more than seven consecutive days. This provided little opportunity for social engagement at night or on weekends. Keeping the men busy and segregated diminished opportunities for situations that would threaten the safety of gas workers or impair the relationship between the companies and the local municipality. As an informant in Westmoreland County reported, “the men did not have time or energy to cause trouble.”

Another explanation for the apparent lack of disruption from the gas workers may have more to do with the behavior of the people in the Marcellus communities toward the newcomers rather than the other way around. Many of the informants mentioned the presence of newcomers by a reference to their vehicles rather descriptions of the people. This suggests that the residents may not have tried to integrate the workers into the existing social structure. This may have been because since the workers were temporary the community treated them as transients. Had they stayed longer, the community may have taken more initiative to integrate the newcomers into the normative social structure.

Yet some discernment is necessary when evaluating the qualitative perceptions of the informants in this study. One of the limitations of using professional informants was that their

community standing or employment might depend on their relationship with the gas companies. For example, public officials cannot challenge the activities of the gas companies without risking costly litigation, and realtors do not want to endanger the possibility of future business with potential clients. Therefore, a conflict of interest might cause these informants to minimize the importance of externalities that the gas industries place on communities. The study findings suggest that looking ahead to the future must include an awareness of problems that accompany natural gas development.

Several informants alluded to problems with water and air pollution; however, they framed the comments as reflections of resident concerns rather than actual situations that threaten community well-being. Some of the local government personnel spoke approvingly of the cooperative relationship that they had with the gas industry and state regulatory agencies. A Robinson Township supervisor said, “I know the DEP monitors everything that takes place, and the gas industries themselves actually do a pre-imposed testing of water for everybody within...3,000 feet of an actual well.” However, evidence to the contrary indicates that municipalities have diminished recourse when confronting gas companies over violations and land use. (Brasier, et al, 2011; Christopherson & Rightor, 2012; Hockenberry et al., 2015). Because many conflicts are resolved in court, municipalities often do not want to spend money on court fees if the likelihood is that they will lose. Local government is subsequently constrained in its ability to advocate for the health and safety of the community.

In addition to environmental concerns, conflict of interest between the informants and the industry masked the extent to which the gas industry disadvantages the poor. The drop in the market for natural gas has not resulted in the expected return to pre-boom conditions. According to informants in the Northern Tier, the current downturn is creating a “new normal” where rents

have dropped, but are still at an unaffordable level. The poor are subject to a loss of housing quality, which previous research shows has negative implications for student achievement (Brennan, 2011) as well as poor health and emotional outcomes for children and families (Cohen & Wardrip, 2011). The likelihood that conditions will improve for the poor is negligible. Communities most affected have no ability to alleviate the housing crisis. The water and sewage infrastructure problem, plus the constraints on land use and development imposed by Act 13 complicates efforts to build affordable housing. The poor have few options but to enter the mobility stream, take increasingly inadequate housing, or enter into homelessness.

### **Conclusion and Policy Recommendations**

The research findings show that social disruption associated with population change in the Marcellus shale region was most severe in areas where a pre-existing lack of housing created a crisis when demand for rental units outstripped supply. Several policy areas are appropriate for review in order for strategic planning that will help alleviate the current crisis, and provide preventative action against recurring situations in the future.

Part of the housing problem came from decisions made over 100 years ago when the planning for municipal water and sewage projects only considered the service needs of populations clustered in cities and towns in Northern Pennsylvania. While the system may have been sufficient for the agricultural and timber industries of the 20<sup>th</sup> century, it is inadequate to sustain contemporary economic growth or to respond to changing public demand. Investment in municipal water and sewage infrastructure will provide more options for land use in municipalities that can accommodate social and economic needs as they arise. The advantages include better opportunity to attract business and industry to Pennsylvania as well as humanitarian benefits to public well-being. The research findings suggest that state and national

initiatives for capital infrastructure projects include plans to modernize the public utility system. This paper recommends a feasibility study on the capability of current water and sewage systems to accommodate growth, and research into other alternatives such as combined private and public systems or the creation of inter-municipal joint water authorities that can provide sanitary services in a cost-effective and environmentally sound manner.

The second policy to reconsider is Act 13. This policy restricts land use for social and commercial development because it gives more latitude to gas companies to place structures like wells and pipeline that deter or impair residential or public use. A modification to Act 13 that requires gas companies and municipalities to identify potential social impacts from gas industry development prior to permitting would help municipalities make a case for increased allocations from state and federal safety-net programs, or apply for other types of assistance from programs that help local government meet statutory requirements. This could include grants for emergency vehicles, for example, or funding for housing construction. A related policy recommendation specific to housing is a provision to lift on the cap for vouchers where the actual market rent and the fair market rent differ by a percentage of the median gross income or some other measure. Such a policy change would allow for temporary redistribution of block grant allocations to minimize displacement of low-income families after a sudden increase in rent. As the gas industry transitions from drilling to pipeline, booms can recur in Marcellus communities and appear in others not affected when drilling began. Findings in this study support a careful review of existing policies to see where modifications are necessary to anticipate fluctuating or unpredictable effects of the energy industry.

## **Further Research**

Continued research on the effects of the development of the natural gas industry in the Marcellus region of Pennsylvania is needed to improve and refine the findings presented in this study. Analysis of population change and housing costs within municipalities in the Marcellus region can target specific areas for housing assistance, and identify locations in need of the construction of additional affordable housing. Improvement in the methodology to obtain resident evaluations of social change includes consistent data collection, either by phone or in-person interviews, in order to analyze data within the same social context. In addition, at least two researchers are recommended to conduct interviews to ensure that the semi-structured conversations contain consistent information. Such changes would improve the reliability and rigor of the qualitative findings.

## References

- Barcus, H. R., & Brunn, S. D. (2010). Place elasticity: Exploring a new conceptualization of mobility and place attachment in rural America. *Geografiska Annaler: Series B, Human Geography*, 92(4), 281-295.
- Brasier, K., Davis, L., Glenna, L., Kelsey, T., McLaughlin, D., Schafft, K., . . . Rhubart, D. (2014). The Marcellus Shale Impacts Study: Chronicling social and economic change in North Central and Southwest Pennsylvania. Retrieved from the Center for Rural Pennsylvania website: <http://www.rural.palegislature.us/documents/reports/The-Marcellus-Shale-Impacts-Study.pdf>.
- Brasier, K. J., Filteau, M. R., McLaughlin, D. K., Jacquet, J., Stedman, R. C., Kelsey, T. W., & Goetz, S. J. (2011). Resident's perceptions of community and environmental impacts from development of natural gas in the marcellus shale: a comparison of Pennsylvania and New York cases. *Journal of Rural Sociology*, 26(1), 32-61.
- Brennan, M. (2011, May). The impacts of affordable housing on education: A research summary. *Insights from Housing Policy Research*. Retrieved from National Housing Conference and Center for Housing Policy website: <http://www2.nhc.org/publications/index.html?start=50>.
- Brown, T. C., Bankston, W. B., & Forsyth, C. J. (2013). A service town: An examination of the offshore oil industry, local entrepreneurs, and the civic community thesis. *Sociological Spectrum*, 33(1), 1-15.
- Bureau of Labor Statistics. (2014, February). The Marcellus Shale gas boom in Pennsylvania: employment and wage trends. *Monthly Labor Review*. Retrieved from

<http://www.bls.gov/opub/mlr/2014/article/the-marcellus-shale-gas-boom-in-pennsylvania.htm>

Christopherson, S., & Rightor, N. (2012). How shale gas extraction affects drilling localities: Lessons for regional and city policy makers. *Journal of Town and City Management*, 2(4), 350-368.

Cohen, R., & Wardrip, K. (2011). Should I stay or should I go?: Exploring the effects of housing instability and mobility on children. Retrieved from National Housing Conference and Center for Housing Policy website:  
<http://www2.nhc.org/publications/index.html?start=50>.

Dahl, M. S., & Sorenson, O. (2010). The social attachment to place. *Social Forces*, 89(2), 633-658.

Dorigo, G., & Tobler, W. (1983). Push-pull migration laws. *Annals of the Association of American Geographers*, 73(1), 1-17.

Ebinger, C. K. & Avasarala, G. (2013). Natural gas liquids. *Brookings Natural Gas Task Force Natural gas briefing document 1*. Retrieved from Brookings Institution website:  
<http://www.brookings.edu/research/reports/2013/04/01-natural-gas-liquids-ebinger-avasarala>

England, L., & Albrecht, S. L. (1984). Boomtowns and social disruption. *Rural Sociology*, 49(2), 230-246.

Forrest, R., & Kearns, A. (2001). Social cohesion, social capital, and the neighbourhood. *Urban Studies*, 38(12), 2125-2143.

Gallin, J. H. (2004). Net Migration and State Labor Market Dynamics. *Journal of Labor Economics*, 22(1), 1-21.

- Geraghty, A, Smith, J. & McGrail, P. (2015, June). *Risks and benefits of various municipal responses*. Panel discussion at Managing Marcellus: Land Use, Zoning, & Addressing Impacts of Shale Gas Drilling After Pennsylvania Supreme Court Act 13 Rulings, Local Government Academy and W & J Center for Energy Policy and Management, Washington, PA.
- Gray, D. (2014). Research Design: Qualitative methods. In Jai Seaman (Ed.), *Doing research in the real world* (3<sup>rd</sup> ed., pp.159-189). Los Angeles, CA: Sage Publications.
- Goldberg, S. (2013, December 14). Fracking hell: what it's really like to live next to a shale gas well. *The Guardian*. Retrieved from <http://www.theguardian.com/environment/2013/dec/14/fracking-hell-live-next-shale-gas-well-texas-us>. Accessed May 1, 2015.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, 18(1), 59-82.
- Herzenberg, S., Polson, D., & Price, M. (2014). Measuring the costs and benefits of natural gas development in Greene County, Pennsylvania. Retrieved from the Pennsylvania Budget and Policy Center website: <http://pennbpc.org/shale-drillings-mixed-legacy-new-jobs-and-community-costs>.
- Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of Environmental Psychology*, 21(3), 273-281.
- Hockenberry, S., Ball, D., Cohen, A., Puko, D., & Trant, J. (2015, June). *Municipal planners and an elected official discuss experiences and suggestions for how to deal with related issues*. Panel discussion at Managing Marcellus: Land Use, Zoning & Addressing Impacts of Shale Gas Drilling After Pennsylvania Supreme Court Act 13 Rulings, Local

Government Academy and W & J Center for Energy Policy and Management.  
Washington, PA.

Ihrke, D. (2014). Reason for Moving: 2012-2013. Retrieved from United States Census Bureau website: <http://www.census.gov/content/census/en/library/publications.2014.html/>

Irwin, Michael D. (2007). Territories of Inequality: An Essay on the Measurement and Analysis of Inequality in Grounded Place Settings. In L. Lobao, A. Tickamyer, and G. Hooks (Eds.), *Spaces, places, and inequality: The Sociology of spatial inequality* (pp. 85-109). Albany, NY: SUNY Press.

Irwin, M., Blanchard, T., & Tolbert, C. (2004). Why people stay: The impact of community context on nonmigration in the USA. *Population*, 59(5), 567-591.

Irwin, M. D., Tolbert, C. M., & Lyson, T. A. (1997). How to Build Strong Home Towns. *American Demographics*, 19(2), 43-47.

Jacquet, J. B. (2014). Review of risks to communities from shale energy development. *Environmental Science & Technology*, 48(15), 8321-8333.

Kelsey, T. W., Metcalf, A., & Saldedo, R. (2012). Marcellus Shale: Land Ownership, Local Voice, and the Distribution of Lease and Royalty Dollars. Retrieved from Penn State University Center for Economic and Community Development website: <http://aese.psu.edu/research/centers/cecd/publications>

Komadina, S., McNally, T., & Young, S. (2014). Impact of oil and gas exploration on affordable housing. (Working Paper No. EMAD-2014-02). Retrieved from U.S. Department of Housing and Urban Development website: <http://www.huduser.gov/portal/publications/econdev/workpap1.html>.

- Lee, B., Oropesa, R. S., & Kanan, J. W. (1994). Neighborhood content and residential mobility. *Demography*, 31(2), 249-270.
- Lee, E. S. (1966). A theory of migration. *Demography*, 3(1), 47-57.
- Lee, M. R. (2008). Civic community in the hinterland: Toward a theory of rural social structure and violence. *Criminology*, 46(2), 447-478.
- Lu, M. (1999). Do people move when they say they will? Inconsistencies in individual migration behavior. *Population and Environment*, 20(5), 467-488.
- Manzo, L. C., & Perkins, D. D. (2006). Finding common ground: The importance of place attachment to community participation and planning. *Journal of Planning Literature*, 20(4), 335-350.
- Mateyka, P. (2015). Desire to move and residential mobility: 2011-2011. Retrieved from United States Census Bureau website:  
<https://www.census.gov/library/publications/2015/demo/p70-140.html>
- McLaughlin, D., Rhubart, D., DeLessio-Parson, A., Brasier, K., Babbie, K., & Leach, M. (2014). Population change and marcellus shale development (The Marcellus Impacts Project Report #1). Retrieved from The Center for Rural Pennsylvania website:  
[http://www.rural.palegislature.us/publications\\_reports.html](http://www.rural.palegislature.us/publications_reports.html)
- McLaughlin, D. K., DeLessio-Parson, A., & Rhubart, D. (2014, September). Housing and Marcellus Shale development (The Marcellus Impacts Project Report #5). Retrieved from The Center for Rural Pennsylvania website:  
[http://www.rural.palegislature.us/publications\\_reports.html](http://www.rural.palegislature.us/publications_reports.html)
- Pennsylvania Department of Environmental Protection. (2015). Unconventional wells. Retrieved from

- <https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/DataExports.aspx>. Accessed February 12, 2015.
- Pennsylvania Department of Labor & Industry. (2015). Marcellus shale fast facts. Retrieved from <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=1222103&mode=2>
- Portes, A. (2010). Migration and social change: Some conceptual reflections. *Journal of Ethnic and Migration Studies*, 36(10), 1537-1563.
- Putnam, R. D. (2001). *Bowling alone: The collapse and revival of American community*. New York, NY: Simon and Schuster.
- Ratner, M., & Tiemann, M. (2014). An overview of unconventional oil and natural gas: resources and federal actions (Congressional Research Service Report 43148). Retrieved from the Congressional Research Service website: <https://www.fas.org/sgp/crs/misc/index.html>
- Rhodes, V. L. (2005). Kids on the move: The effects of student mobility on NCLB school accountability ratings. *Perspectives on Urban Education*, 3(3). Retrieved from <http://www.urbanedjournal.org/archive/volume-3-issue-3-spring-2005/kids-move-effects-student-mobility-nclb-school-accountability-r>
- Schafft, K., Kotok, S., & Biddle, C. (2014). Marcellus Shale gas development and impacts on Pennsylvania schools and education (The Marcellus Impacts Project Report #3). Retrieved from The Center for Rural Pennsylvania website: [http://www.rural.palegislature.us/publications\\_reports.html](http://www.rural.palegislature.us/publications_reports.html).
- Schafft, K. A., Glenna, L. L., Green, B., & Borlu, Y. (2014). Local impacts of unconventional gas development within Pennsylvania's Marcellus shale region: Gauging boomtown

- development through the perspectives of educational administrators. *Society & Natural Resources*, 27(4), 389-404.
- Smith, M. D., Krannich, R. S., & Hunter, L. M. (2001). Growth, decline, stability, and disruption: A longitudinal analysis of social well-being in four western rural communities. *Rural Sociology*, 66(3), 425-450.
- Smith, S.K., Tayman, J., & Swanson, D. (2001). *State and Local Population Projections Methodology and Analysis*. New York, NY: Plenum.
- Speare, A. (1974). Residential satisfaction as an intervening variable in residential mobility. *Demography*, 11(2), 173-188.
- U.S. Census Bureau. (2014). TIGER/Line Shapefiles. [machine-readable data files]. Retrieved from <https://www.census.gov/mp/www/geo/tiger.html?cssp=SERP>
- Tolbert, C. M., Lyson, T. A., & Irwin, M. D. (1998). Local capitalism, civic engagement, and socioeconomic well-being. *Social Forces*, 77(2), 401-427.
- Ubringer, J. (2015, June). *Managing shale development from the local perspective: In search of a satisfactory decision-making process*. Presentation at Managing Marcellus: Land Use, Zoning, & Addressing Impacts of Shale Gas Drilling After Pennsylvania Supreme Court Act 13 Rulings, Local Government Academy and W & J Center for Energy Policy and Management, Washington, PA.
- U. S. Census Bureau. (2013a). Geographic Terms and Definitions. Retrieved from <https://www.census.gov/popest/about/geo/terms.html>
- U. S. Census Bureau. (2013b). Selected Housing Characteristics Table DP04. American Community Survey 5-Year Estimate 2009-2013. Retrieved from [http://factfinder.census.gov/faces/nav/jsf/pages/download\\_center.xhtml#](http://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml#)

- U.S. Census Bureau. (2013c). Core Based Statistical Areas [Table]. Retrieved from <http://www.census.gov/population/metro/files/lists/2013/List1.xls>
- U.S. Census Bureau. (2014). American Community Survey Design and Methodology (January 2014). Retrieved from [http://www.census.gov/acs/www/methodology/methodology\\_main/](http://www.census.gov/acs/www/methodology/methodology_main/)
- U. S. Census Bureau. (2015). Migration/Geographic Mobility. County-to-County Migration Flows: 2008-2012 ACS. Retrieved from [https://www.census.gov/hhes/migration/data/acs/county\\_to\\_county\\_mig\\_2008\\_to\\_2012.html](https://www.census.gov/hhes/migration/data/acs/county_to_county_mig_2008_to_2012.html)
- U.S. Energy Information Center. (2013). West Virginia, southwest Pennsylvania form an integrated natural gas production region. Retrieved from <http://www.eia.gov/todayinenergy/detail.cfm?id=12671>
- U.S. Energy Information Center. (2015). Which states consume and produce the most natural gas. Retrieved from <http://www.eia.gov/tools/faqs/faq.cfm?id=46&t=8>
- Vachon, M. C. (2014, May). The impact of local labor market conditions on migration: evidence from the Bakken oil boom. Paper presented at the meeting of the International Association for Energy Economics, Antalya, Turkey. Retrieved from [http://www.iaee.org/iaee2015/submissions/OnlineProceedings/Vachon\\_Migration.pdf](http://www.iaee.org/iaee2015/submissions/OnlineProceedings/Vachon_Migration.pdf)
- Ward, S., Polson, D., & Price, M. (2014). Measuring the costs and benefits of natural gas development in Tioga County, Pennsylvania. Retrieved from the Pennsylvania Budget and Policy Center website: <https://pennbpc.org/sites/pennbpc.org/files/greeneCASESTUDY.pdf>

## **Appendix A**

### **Leading Questions for Key Informants**

#### **School Administrator**

**1. Can you tell me where most of the student body comes from?**

Probes: Are they from local families? Have the families lived in the area very long? Do students have siblings or cousins in the school? Do many students transfer? Has this level changed in past few years? Where do the new students come from?

**2. Tell me about how students get to school.**

Probes: Do they arrive on time? Has tardiness changed in the past few years? Do students say why they are late?

**3. What can you say about student attendance?**

Probes: Has attendance patterns changed in the past few years? Do students say why they are absent or truant?

**4. Tell me about school morale. Are students active in school events?**

Probes: Does the public support school activities? Are their community and recreational activities for students? Is discipline a problem in school? In what way has morale changed in the past few years? Why do you think morale has changed?

**5. What are the challenges facing students today besides going to college?**

Probes: What are the challenges facing the school in providing for student needs?

**6. What are strengths of the school community?**

Probes: Of what are you most proud? Where do you see the school headed in terms of academic progress for students? How supportive is the community of the school? Are students staying in school through graduation?

## Realtors

1. Can you tell me where most of the residents in town come from?

Probes: Are they local families? Where do the new people come from? What kind of housing are they looking for?

2. Which neighborhoods are popular now? What are they like?

Probes: Where do single people live? Where do families live?

3. Tell me about the market. What kind of housing is in demand, meaning rental or purchase?

Probes: Have rents changed in past few years? Has house value changed? Why do you think that is? Do property owners prefer to rent to gas workers or other tenants? Are more people investing in rental housing?

4. Tell me about other businesses. Is there interest in renting commercial or retail space?

Probes: Where is the business interest coming from? Are the people local or not? How is the activity at local businesses? Which businesses are hot or cold?

5. Are people moving away in your opinion?

Probe: Where are they going? Do some come back? Do you know why some of them left or returned?

6. Tell me about the housing inventory.

Probe: Are there enough units for people looking for a place to live? Are there plans to build more housing? What kind of housing do you think should be built and where?

7. Tell me about the oil and gas companies.

Probe: Are they helpful in finding housing for their employees?

## Social Service Personnel

1. Can you tell me where most of the people in the community come from?

Probe: Have they lived here for over a year at least? Do you know why new people arrived in the area?

2. Tell me about the volume of calls about healthcare services, including counseling.

Probe: Is there a type of counseling request that has changed in the past few years, meaning that there are greater or fewer calls? Has the number of children in foster care changed?

3. Can you tell me about housing security?

Probe: Are there enough spaces for homeless people, and has this changed in the past few years? Are there enough affordable housing units for clients who need them? Are there plans to increase the number of affordable housing units?

4. What can you tell me about public health?

Probe: Has requests for STD testing changed in the past few years? Has drug or alcohol abuse changed? How so?

5. Has interest in advocacy groups changed in the past few years?

Probe: Have the groups increased in membership and activity? Which groups are the most active?

6. What do you see as the greatest community strength?

Probe: What kind of outreach do churches, advocacy groups, and social organizations provide? Has the level of outreach changed in recent years?

## Law Enforcement

1. Can you tell me where most of the people in the community come from?

Probe: Have they lived here for over a year at least? Do you know why new people arrived in the area?

2. What can you tell me about vehicle traffic?

Probe: Do you see more trucks? Do you see more out-of-state license plates or fleet vehicles? Where are the vehicles from? Has this changed over the past few years? Have moving violations changed in the past few years? Have non-moving violations changed in the past few years?

3. Tell me about calls from residents. To what kind of calls do officers normally respond?

Probe: Has the type of calls changed in the past few years?

4. Can you talk about change in drug and alcohol offenses?

Probe: What kinds of drugs are trafficked most often? Is the number of dui's changing?

5. What can you say about new people in town?

Probe: Are they mostly families or single men? Do they live in town? Do they spend money in bars and restaurants?

6. Tell me about non-violent crime. Has prostitution and gambling changed in the past few years?

Probe: Tell me about vandalism and vagrancy. Has it changed?

7. What can you tell me about juvenile crime?

Probe: Has it changed in the past few years? How so? What do you think is the cause of juvenile crime?

8. Can you tell me if people left the area?

Probe: Were they families? Do you know where they went? Do you know why they left?

## **Appendix B**

### **Public Records**

B07001. Geographical Mobility In The Past Year By Age For Current Residence In The United States

<http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

B07013. Geographical Mobility In The Past Year By Tenure For Current Residence In The United States

[http://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=table&id=table.en.ACS\\_13\\_5YR\\_B07413#main\\_content](http://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=table&id=table.en.ACS_13_5YR_B07413#main_content)

B07204. Geographical Mobility In The Past Year For Current Residence--State, County And Place Level In The United States

<http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

DP-1. Profile of General Demographic Characteristics: 2000.

[http://factfinder.census.gov/faces/nav/jsf/pages/download\\_center.xhtml#](http://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml#)

DP-1. Profile of General Population and Housing Characteristics: 2010

[http://factfinder.census.gov/faces/nav/jsf/pages/download\\_center.xhtml#](http://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml#)

DP04. Selected Housing Characteristics

<http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

S0701. Geographic Mobility By Selected Characteristics In The United States

<http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

Pennsylvania Department of Environmental Protection Oil and Gas Reports

[http://www.portal.state.pa.us/portal/server.pt/community/oil\\_and\\_gas\\_reports/20297](http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297)

U.S.Census Bureau County/MCD-to-County/MCD Migration Flows. In-, Out-, Net and Gross Migration

[https://www.census.gov/hhes/migration/data/acs/county\\_to\\_county\\_mig\\_2008\\_to\\_2012.html](https://www.census.gov/hhes/migration/data/acs/county_to_county_mig_2008_to_2012.html)

U. S. Census Bureau County/MCD-to-County/MCD Migration Flows by Employment Status. All Flows

[https://www.census.gov/hhes/migration/data/acs/county\\_to\\_county\\_mig\\_2008\\_to\\_2012.html](https://www.census.gov/hhes/migration/data/acs/county_to_county_mig_2008_to_2012.html)

## Appendix C

### Consent to Participate in a Research Study

Duquesne University IRB  
Protocol #2015-05-11  
Approved: 6-8-2015  
Expiration Date: 6-7-2016



DUQUESNE UNIVERSITY

600 FORBES AVENUE ♦ PITTSBURGH, PA 15282

#### CONSENT TO PARTICIPATE IN A RESEARCH STUDY

**TITLE:** Population Mobility and Migration in the Marcellus Shale Region of Pennsylvania

**INVESTIGATOR:** Annette M. Mackay  
Duquesne University, graduate student  
Center for Social and Public Policy  
[REDACTED]  
mackaya@duq.edu

**ADVISOR: (if applicable)** Michael D. Irwin, Ph.D.  
Associate Professor of Sociology  
Duquesne University Center for Social and Public Policy  
(412) 396-6488  
irwinm@duq.edu

**SOURCE OF SUPPORT:** This study is being performed as partial fulfillment of the requirements for the Master of Arts degree in Social and Public Policy at Duquesne University. This study is supported by a grant from the Dr. Michael P. Weber Endowment.

**PURPOSE:** You are being asked to participate in a research project that seeks to investigate the effect of population change in your area, and if the changes are related to hydraulic fracturing, or “fracking” in or near your area. You are asked to provide your observations on population change that has occurred in the past 7 years, and any changes in social behavior that may accompany population movement.

In order to qualify for participation, you must be currently employed or serving as: an elementary or secondary school

**PARTICIPANT  
PROCEDURES:**

administrator; a licensed realtor, a municipal law enforcement official; or a social service provider or professional. You must be 18 years of age or older.

You will be asked to offer your observations on the effect of population change in your community, and comment if the changes are the result of fracking in your area. The principal investigator will ask some questions in order to guide a conversation, which will be audio recorded. You will be asked if new people have moved into or away from the community, and how and if your work has changed because of population movement. You will also be asked to describe other changes that have occurred since fracking began in your area, and how those changes have affected life in the community.

The interviews will occur at your place of business during normal work hours at a pre-arranged time, unless you wish to meet otherwise. The alternative location and time will be mutually agreeable. The interview will be audio recorded and transcribed by a professional transcription service. There is only one interview, which will last approximately one hour. These are the only requests that will be made of you.

**RISKS AND BENEFITS:**

Participation in the interview incurs no risks greater than those encountered in everyday life. However, the principal investigator is aware that fracking is a controversial issue. There is some risk in expressing opposing opinions to existing policies and procedures. Discussing the effects of fracking may have implications on the participant's personal and professional standing in the community.

While participation is completely confidential, anonymity is not guaranteed. Because the study includes areas with small populations, it is possible that participants can be identified through their position in the community, or through descriptions of events. Efforts will be taken to minimize the chance of identification by deduction or inference.

The benefit to you is the opportunity to describe your observations of changes in your community that have

resulted from fracking. This information will help to inform policy makers of the needs in your community which require attention, as well as any positive outcomes that should inform future policies, laws, ordinances, or strategic planning. As a participant, you may receive the results and analysis of the study for your own information, at your request. This information may be beneficial for your own purposes in your professional endeavors.

**COMPENSATION:**

There is no compensation for participation in this study aside from receiving the study results. Participation in the project will require no monetary cost to you. A self-addressed stamped envelope is provided for return of your response to the investigator.

**CONFIDENTIALITY:**

Your participation in this study and any personal information that you provide will be kept confidential at all times and to every extent possible. No personal information will be shared with anyone other than the principal investigator. All materials related to the study will be maintained by the principal investigator in locked storage. Electronic data will be stored on the principal investigator's personal password-protected computer.

Audio recordings will be collected on the principal investigator's recording device, which will be maintained in locked storage. Audio recordings will be transcribed by a professional service, where a certificate of confidentiality will be provided upon request. The audio recordings will be erased from the recording device at the completion of the study.

Your name will never appear on any survey or research instruments. The only association between you and the study will be the signed consent form. All written and electronic forms and study materials will be kept secure. Your response(s) will only appear in statistical data summaries, unless you give expressed permission to quote you. Any sensitive information will be generalized as much as possible to help protect your anonymity. Any study materials with personal identifying information will be

maintained for three years after the completion of the research and then destroyed. Electronic data will be erased with a certified removal program, while paper data such as field notes and transcripts, will be cross-cut shredded.

**RIGHT TO WITHDRAW:**

You are under no obligation to participate in this study. You are free to withdraw your consent to participate at any time. If you choose to withdraw during the study, any information collected thus far, such as your informed consent form, audio recordings and transcripts, will be destroyed. The final analysis will not contain any information gathered from your interview.

**SUMMARY OF RESULTS:**

A summary of the results of this research will be supplied to you, at no cost, upon request.

**VOLUNTARY CONSENT:**

I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

I understand that should I have any further questions about my participation in this study, I may call Ms. Annette M. Mackay, Principal Investigator, (814) 490-2054, or Dr. Michael D. Irwin, Advisor, (412) 396-6488. Should I have questions regarding protection of human subject issues, I may contact Dr. Linda Goodfellow, Chair of the Duquesne University Institutional Review Board, (412)-396-6326.

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Researcher's Signature

\_\_\_\_\_  
Date

## Appendix D

Table 3

*Demographic Change in Pennsylvania 2000-2010*

	Region	Metro Area	Tier	Population		Absolute Change	Percentage Change
				2000	2010		
Pennsylvania				12,281,054	12,702,379	421,325	3.4
Adams	Non-Marcellus	Nonmetro	None	91,292	101,407	10,115	11.1
Allegheny	Marcellus	Pittmetro	Southwestern	1,281,666	1,223,348	-58,318	-4.6
Armstrong	Marcellus	Pittmetro	Southwestern	72,392	68,941	-3,451	-4.8
Beaver	Marcellus	Pittmetro	Southwestern	181,412	170,539	-10,873	-6.0
Bedford	Marcellus	Nonmetro	Central	49,984	49,762	-222	-0.4
Berks	Non-Marcellus	Nonmetro	None	373,638	411,442	37,804	10.1
Blair	Marcellus	Nonmetro	Central	129,144	127,089	-2,055	-1.6
Bradford	Marcellus	Nonmetro	Northern	62,761	62,622	-139	-0.2
Bucks	Non-Marcellus	Nonmetro	None	597,635	625,249	27,614	4.6
Butler	Marcellus	Pittmetro	Southwestern	174,083	183,862	9,779	5.6
Cambria	Marcellus	Nonmetro	Central	152,598	143,679	-8,919	-5.8
Cameron	Marcellus	Nonmetro	Central	5,974	5,085	-889	-14.9
Carbon	Non-Marcellus	Nonmetro	None	58,802	65,249	6,447	11.0
Centre	Marcellus	Nonmetro	Central	135,758	153,990	18,232	13.4
Chester	Non-Marcellus	Nonmetro	None	433,501	498,886	65,385	15.1
Clarion	Marcellus	Nonmetro	Central	41,765	39,988	-1,777	-4.3
Clearfield	Marcellus	Nonmetro	Central	83,382	81,642	-1,740	-2.1
Clinton	Marcellus	Nonmetro	Northern	37,914	39,238	1,324	3.5
Columbia	Non-Marcellus	Nonmetro	None	64,151	67,295	3,144	4.9
Crawford	Non-Marcellus	Nonmetro	None	90,366	88,765	-1,601	-1.8
Cumberland	Non-Marcellus	Nonmetro	None	213,674	235,406	21,732	10.2
Dauphin	Non-Marcellus	Nonmetro	None	251,798	268,100	16,302	6.5
Delaware	Non-Marcellus	Nonmetro	None	550,864	558,979	8,115	1.5
Elk	Marcellus	Nonmetro	Central	35,112	31,946	-3,166	-9.0
Erie	Non-Marcellus	Nonmetro	None	280,843	280,566	-277	-0.1
Fayette	Marcellus	Pittmetro	Southwestern	148,644	136,606	-12,038	-8.1
Forest	Marcellus	Nonmetro	Central	4,946	7,716	2,770	56.0
Franklin	Non-Marcellus	Nonmetro	None	129,313	149,618	20,305	15.7
Fulton	Non-Marcellus	Nonmetro	None	14,261	14,845	584	4.1
Greene	Marcellus	Nonmetro	Southwestern	40,672	38,686	-1,986	-4.9
Huntingdon	Marcellus	Nonmetro	Central	45,586	45,913	327	0.7
Indiana	Marcellus	Nonmetro	Central	89,605	88,880	-725	-0.8
Jefferson	Marcellus	Nonmetro	Central	45,932	45,200	-732	-1.6
Juniata	Non-Marcellus	Nonmetro	None	22,821	24,636	1,815	8.0
Lackawanna	Non-Marcellus	Nonmetro	None	213,295	214,437	1,142	0.5
Lancaster	Non-Marcellus	Nonmetro	None	470,658	519,445	48,787	10.4

Table 3, continued

*Demographic Change in Pennsylvania 2000-2010*

	Region	Metro Area	Tier	Population		Absolute Change	Percentage Change
				2000	2010		
Lawrence	Marcellus	Nonmetro	Central	94,643	91,108	-3,535	-3.7
Lebanon	Non-Marcellus	Nonmetro	None	120,327	133,568	13,241	11.0
Lehigh	Non-Marcellus	Nonmetro	None	312,090	349,497	37,407	12.0
Luzerne	Non-Marcellus	Nonmetro	None	319,250	320,918	1,668	0.5
Lycoming	Marcellus	Nonmetro	Northern	120,044	116,111	-3,933	-3.3
McKean	Marcellus	Nonmetro	Northern	45,936	43,450	-2,486	-5.4
Mercer	Marcellus	Nonmetro	Central	120,293	116,638	-3,655	-3.0
Mifflin	Non-Marcellus	Nonmetro	None	46,486	46,682	196	0.4
Monroe	Non-Marcellus	Nonmetro	None	138,687	169,842	31,155	22.5
Montgomery	Non-Marcellus	Nonmetro	None	750,097	799,874	49,777	6.6
Montour	Non-Marcellus	Nonmetro	None	18,236	18,267	31	0.2
Northampton	Non-Marcellus	Nonmetro	None	267,066	297,735	30,669	11.5
Northumberland	Non-Marcellus	Nonmetro	None	94,556	94,528	-28	0.0
Perry	Non-Marcellus	Nonmetro	None	43,602	45,969	2,367	5.4
Philadelphia	Non-Marcellus	Nonmetro	None	1,517,550	1,526,006	8,456	0.6
Pike	Non-Marcellus	Nonmetro	None	46,302	57,369	11,067	23.9
Potter	Marcellus	Nonmetro	Northern	18,080	17,457	-623	-3.4
Schuylkill	Non-Marcellus	Nonmetro	None	150,336	148,289	-2,047	-1.4
Snyder	Non-Marcellus	Nonmetro	None	37,546	39,702	2,156	5.7
Somerset	Marcellus	Nonmetro	Central	80,023	77,742	-2,281	-2.9
Sullivan	Marcellus	Nonmetro	Northern	6,556	6,428	-128	-2.0
Susquehanna	Marcellus	Nonmetro	Northern	42,238	43,356	1,118	2.6
Tioga	Marcellus	Nonmetro	Northern	41,373	41,981	608	1.5
Union	Non-Marcellus	Nonmetro	None	41,624	44,947	3,323	8.0
Venango	Marcellus	Nonmetro	Central	57,565	54,984	-2,581	-4.5
Warren	Marcellus	Nonmetro	Central	43,863	41,815	-2,048	-4.7
Washington	Marcellus	Pittmetro	Southwestern	202,897	207,820	4,923	2.4
Wayne	Marcellus	Nonmetro	Central	47,722	52,822	5,100	10.7
Westmoreland	Marcellus	Pittmetro	Southwestern	369,993	365,169	-4,824	-1.3
Wyoming	Marcellus	Nonmetro	Northern	28,080	28,276	196	0.7
York	Non-Marcellus	Nonmetro	None	381,751	434,972	53,221	13.9

*Note.* Adapted from U.S. Census Bureau, Decennial Census, 2000 SF 100% Data , Table DP-1,

and 2010 SF 100% Data, Table DP-1, generated by Annette Mackay, using American

FactFinder, <http://factfinder2.census.gov>, (30 September, 2015)

Table 4

*Percent Population Change by Marcellus Region, 2000-2010*

Region	Counties	Population		Absolute Change	Percent Change
		2000	2010		
All Pennsylvania	67	12,281,054	12,702,379	421325	3.4
Marcellus Region	35	4,138,636	4,049,889	-88747	-2.1
Non-Marcellus Region	32	8,142,418	8,652,490	510072	6.3
Pittsburgh Metro	7	2,431,087	2,356,285	-74802	-3.1
Non-Pittsburgh Metro	60	1,707,549	1,693,604	-13945	-0.8
Central Tier	18	1,263,895	1,255,999	-7896	-0.6
Northern Tier	9	402,982	398,919	-4063	-1.0
Southwestern Tier	8	2,471,759	2,394,971	-76788	-3.1

*Note.* Adapted from U.S. Census Bureau, Decennial Census, 2000 SF 100% Data ,

Table DP-1, and 2010 SF 100% Data, Table DP-1, generated by Annette Mackay,

using American FactFinder, <http://factfinder2.census.gov>, (30 September, 2015)

Table 5

*Distribution of Unconventional Natural Gas Wells in Pennsylvania 2013*

Region or County	Population	Municipalities	Wells	% Wells
Pennsylvania	12597683	2577	6525	100
Marcellus	4980729	1585	6525	100
Pittsburgh Metropolitan	2336778	120	1871	28.7
Non-Metropolitan	2643951	249	4653	71.3
Central Tier	2144216	82	373	5.7
Northern Tier	506352	149	3658	56.1
Southwestern Tier	2374723	138	2493	38.2
Adams	100638	34	-	-
Allegheny	1214616	130	30	0.5
Armstrong	68062	45	179	2.7
Beaver	169049	54	14	0.2
Bedford	49060	38	-	-
Berks	407361	74	-	-
Blair	125720	25	6	0.1
Bradford	61996	36	1016	15.6
Bucks	620166	54	-	-
Butler	182803	57	253	3.9
Cambria	141197	63	3	0.0
Cameron	4957	7	18	0.3
Carbon	64556	23	-	-
Center	153144	35	37	0.6
Chester	497512	73	-	-
Clarion	39306	35	23	0.4
Clearfield	80789	51	105	1.6
Clinton	39080	29	70	1.1
Columbia	66389	34	-	-
Crawford	87257	51	1	0.0
Cumberland	235135	33	-	-
Dauphin	265862	40	-	-
Delaware	553293	49	-	-
Elk	31562	12	45	0.7
Erie	277497	39	-	-

Table 5, continued

*Distribution of Unconventional Natural Gas Wells in Pennsylvania 2013*

Region or County	Population	Municipalities	Wells	% Wells
Fayette	135030	43	232	3.6
Forest	7671	9	10	0.2
Franklin	148867	22	-	-
Fulton	14634	13	-	-
Greene	37945	26	622	9.5
Huntingdon	45431	48	1	0.0
Indiana	87607	38	39	0.6
Jefferson	44492	17	33	0.5
Juniata	24479	17	-	-
Lackawana	212428	40	-	-
Lancaster	516052	60	-	-
Lawrence	89520	27	14	0.2
Lebanon	132534	26	-	-
Lehigh	348265	25	-	-
Luzerne	317581	76	-	-
Lycoming	115398	52	761	11.7
McKean	42810	22	61	0.9
Mercer	115019	48	24	0.4
Mifflin	46260	16	-	-
Monroe	167414	20	-	-
Montgomery	795955	62	-	-
Montour	18143	11	-	-
Northumberland	388848	74	-	-
Perry	45338	30	-	-
Philadelphia	1516924	1	-	-
Pike	56667	13	-	-
Potter	17325	30	45	0.7
Schuylkill	146321	67	-	-
Snyder	39261	21	-	-
Somerset	76731	50	10	0.2
Sullivan	6374	13	58	0.9
Susquehanna	42579	40	840	12.9

Table 5, continued

*Distribution of Unconventional Natural Gas Wells in Pennsylvania 2013*

Region or County	Population	Municipalities	Wells	% Wells
Tioga	41879	39	638	9.8
Union	44562	14	-	-
Venango	54127	31	4	0.1
Warren	41054	27	1	0.0
Washington	206016	66	918	14.1
Wayne	51956	28	-	-
Westmoreland	361202	65	245	3.8
Wyoming	27960	23	169	2.6
York	432017	72	-	-

Note. Adapted from U.S. Census Bureau, 2013 American Community Survey 5-Year Estimates,

Table S0701, generated by Annette Mackay, using American FactFinder,

<http://factfinder2.census.gov>, (30 September, 2015), and Pennsylvania Department of

Environmental Protection Oil and Gas Reports, generated by Annette Mackay using SPUD Data

Reports, [http://www.portal.state.pa.us/portal/server.pt/community/oil\\_and\\_gas\\_reports/20297](http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297)

Table 6

*Independent Samples T-Test for Marcellus and Non-Marcellus Mobility and Migration*

Variable	Marcellus		Non-Marcellus		t (df)	p
	M	SD	M	SD		
Percent						
In-Migrants	8.0	5.9	8.3	4.7	-1.365 (2427)	0.172
Out-Migrants	8.7	11.8	9.1	10.4	-.876 (2555)	0.381
Non-Migrants	-0.8	12.6	-1.1	10.1	1.082 (2555)	0.28
Net Migration	16.6	13.6	17.2	12.5	.489 (2424)	0.625
Gross Migration	83.4	13.6	82.8	12.5	-1.082 (2555)	0.28
Movers	9.2	6.3	9.6	5.5	-1.350 (2570)	0.177
Non-Movers	90.6	6.4	90.2	5.7	1.732 (2570)	0.083
Movers in Same City	1.0	2.3	1.1	2.2	-.648 (2570)	0.517
Movers in Same County	1.0	2.3	1.1	2.2	-.571 (2570)	0.568
Movers in Same State	0.0	0.2	0.0	0.2	-.956 (2570)	0.339
Movers from Different State	8.2	5.5	8.5	4.7	-1.331 (2372)	0.183

\* p&lt;.05

Table 7

*Independent Samples T-Test for Marcellus and Non-Marcellus Mobility by Age*

Variable	Marcellus		Non-Marcellus		t (df)	p
Percent	M	SD	M	SD		
Age 1 to 17						
Movers	10.9	9.7	10.6	8.0	.867 (2684)	0.386
Non-Movers	89.1	9.7	89.4	8.0	-.867 (2384)	0.386
Movers Within Same County	7.4	8.4	6.7	6.4	2.132 (2455)	.033 *
Movers Within Same State	2.2	4.8	2.4	3.9	-.944 (2519)	0.345
Movers From Different State	1.4	3.0	1.5	2.6	-1.243 (2521)	0.214
Age 18 to 34						
Movers	50.8	131.5	33.4	41.3	4.869 (1985)	.000 *
Non-Movers	49.2	131.5	66.6	41.3	-4.869 (1985)	.000 *
Movers Within Same County	11.1	8.7	10.9	7.7	.519 (2295)	0.604
Movers Within Same State	5.3	7.0	5.3	5.3	-.145 (2482)	0.884
Movers From Different State	2.7	4.2	3.2	4.0	-2.827 (2180)	.004 *
Age 35 to 64						
Movers	14.8	87.0	10.9	8.6	1.777 (1599)	0.076
Non-Movers	85.2	87.0	89.1	8.6	-1.777 (1599)	0.076
Movers Within Same County	3.7	3.4	3.9	3.1	-1.669 (2283)	0.095
Movers Within Same State	1.5	2.3	1.7	2.1	-2.016 (2536)	.044 *
Movers From Different State	0.0	0.0	0.0	0.0	.205 (2549)	0.837
Age 65 and Over						
Movers	6.8	8.5	8.1	8.2	-3.638 (2561)	.000 *
Non-Movers	93.2	8.5	91.9	8.2	3.638 (2561)	.000 *
Movers Within Same County	4.3	6.6	5.1	6.2	-3.197 (2561)	.001 *
Movers Within Same State	1.6	4.1	1.6	3.4	-.704 (2561)	0.941
Movers From Different State	1.0	2.6	1.4	3.4	-3.116(1744)	.002 *

\* p&lt;.05

Table 8

*Independent Samples T-Test for Marcellus and Non-Marcellus Mobility by Poverty Status*

Variable	Marcellus		Non-Marcellus		t (df)	p
Percent	M	SD	M	SD		
Below 100 % Poverty						
Movers Within Same County	11.1	13.1	11.0	13.2	.062(2554)	.950
Movers Within Same State	4.0	7.5	4.7	8.2	-2.388(1971)	.017 *
Movers From Different State	2.3	5.6	2.8	6.4	-2.195(1928)	.028 *
100% to 149% Poverty						
Movers Within Same County	7.7	11.5	8.4	11.3	-1.532(2550)	.126
Movers Within Same State	2.6	7.3	2.7	5.8	-.665(2550)	.506
Movers From Different State	1.5	4.9	1.6	4.6	-.7225(2550)	.470 *
150% Poverty and Above						
Movers Within Same County	4.1	3.5	4.4	3.0	-2.15(2371)	.032 *
Movers Within Same State	1.6	2.0	1.8	2.0	-3.473(2569)	.001 *
Movers From Different State	1.0	1.6	1.1	1.4	-1.999(2569)	.047 *
Total Population						
Below 50% Poverty	4.9	4.5	4.1	4.2	4.509(2336)	.000 *
Between 50% and 99% Povert	7.5	5.2	6.1	4.6	7.109(2326)	.000 *
Between 100% and 124% Pov	4.6	3.5	3.9	3.0	5.290(2336)	.000 *
Between 125% and 149% Pov	5.0	3.7	4.3	3.0	5.259(2440)	.000 *
Between 150% and 184% Pov	7.3	4.2	6.6	3.5	4.231(2378)	.000 *
Between 185% and 199% Pov	3.3	2.9	2.9	2.2	4.490(2502)	.000 *
200% Poverty and Above	67.5	12.3	72.1	12.0	-9.468(2570)	.000 *

\* p&lt;.05

Table 9

*Independent Samples T-Test for Marcellus and Non-Marcellus Housing Tenure and Mobility*

Variable	Marcellus		Non-Marcellus		t (df)	p
	M	SD	M	SD		
Total Units	1462.4	4491.1	3257.0	21439.2	-2.615 (1058)	.009 *
Owners	79.7	12.8	78.7	12.7	19.9 (2570)	0.056
Renters	20.3	12.8	21.3	12.7	-1.9.9 (2570)	0.056
Owner Non-Movers	95.3	3.6	95.1	2.8	1.2416 (2481)	0.215
Renter Non-Movers	77.0	15.5	75.9	13.6	1.9 (2320)	0.058
Occupied Housing	83.2	17.4	89.5	10.4	-11.533 (2561)	.000 *
Vacant Housing	16.7	17.2	10.4	10.0	11.744 (2552)	.000 *
Owner Occupied	64.5	17.1	68.4	14.4	-6.258 (2389)	.000 *
Renter Occupied	18.7	12.2	21.1	12.3	-4.856 (2573)	.000 *
Owner Mover Same County	2.9	2.7	2.8	2.3	.706 (2372)	0.48
Renter Mover Same County	14.4	12.7	14.8	10.9	-.912 (2355)	0.362
Owner Mover Same State	1.1	1.8	1.2	1.4	-1.168 (2568)	0.243
Renter Mover Same State	5.2	8.2	5.7	7.8	-1.679 (2559)	0.093

\* p&lt;.05

Table 10

*Independent Samples T-Test for Marcellus and Non-Marcellus  
Gross Rent As a Percentage of Income (GRAPI) Index*

Variable	Marcellus		Non-Marcellus		t (df)	p
Percent	M	SD	M	SD		
GRAPI < 15 %	19.9	16.8	16.9	13.7	4.848 (2406)	.000 *
GRAPI 15 % to 19.9%	14.5	14.2	14.4	10.5	.234 (2496)	0.815
GRAPI 20 % to 24.9%	12.5	12.4	12.9	9.8	-.733 (2432)	0.464
GRAPI 25 % to 29.9%	10.4	11.1	11.7	9.4	-3.188 (2358)	.001 *
GRAPI 30 % to 34.9%	8.3	10.5	7.8	7.3	1.614 (2531)	0.107
GRAPI 35 % and above	34.3	18.6	36.3	15.9	-2.908 (2354)	.004 *
Built Later than 2010	0.4	0.9	0.4	0.8	-1.699 (2262)	0.089

\* p<.05

Table 11

*Independent Samples T-Test for Pittsburgh Metropolitan and Non-Metropolitan  
Mobility and Migration*

Variable (Percent))	Pittsburgh Metro		Non-Metro		t (df)	p
	M	SD	M	SD		
In-Migrants	8.6	6.6	7.8	5.6	2.7 (1556)	.007 *
Out-Migrants	9.6	14.6	8.4	10.4	1.8 (1556)	.065
Net Migration	-1.0	14.9	-0.8	11.5	-0.3 (1556)	.758
Gross Migration	18.2	17.0	16.0	11.9	2.9 (1556)	.004 *
Movers	10.0	6.0	8.9	6.4	2.91 (1568)	.004 *
Non-Movers	89.9	6.1	90.9	6.5	2.826 (1568)	.005 *
Movers in Same City	1.2	2.0	0.9	2.3	1.68 (1568)	.094
Movers in Same County	6.5	4.5	5.3	4.2	5.135 (1568)	.000 *
Movers in Same State	2.4	3.3	2.4	3.4	-.399 (1568)	.000 *
Movers From Different State	8.8	5.4	8.0	5.5	2.342 (1568)	.008 *

\* p < 0.5

Table 12

*Independent Samples T-Test for Pittsburgh Metropolitan and Non-Metropolitan  
Mobility and Migration by Age*

	Pittsburgh Metro		Non-Metro			
Variable	M	SD	M	SD	t (df)	p
Age 1 to 17						
Movers	11.6	9.6	10.6	9.8	1.785 (1532)	.074
Non-Movers	88.4	9.6	89.4	9.8	1.785 (1532)	.074
Movers Within Same County	8.3	8.8	7.0	8.2	2.741 (1531)	.006 *
Movers Within Same State	2.1	4.2	2.3	5.1	-.629 (1527)	.530
Movers From Different State	1.3	2.4	1.4	3.3	-.945 (1134)	.340
Age 18 to 34						
Movers	39.4	49.7	55.6	153.1	3.124 (1483)	.002 *
Non-Movers	60.6	49.7	44.4	153.1	3.124 (1483)	.002 *
Movers Within Same County	12.2	8.3	10.6	8.8	3.387 (1547)	.001 *
Movers Within Same State	5.3	6.0	5.3	7.4	-.188 (1040)	.851
Movers From Different State	2.6	3.2	2.8	4.5	1.042 (1188)	.298
Age 35 to 64						
Movers	12.6	12.9	15.7	103.1	-.643 (1552)	.520
Non-Movers	87.4	12.9	84.3	103.1	0.643 (1552)	.520
Movers Within Same County	4.5	3.5	3.3	3.3	6.030 (1554)	.000 *
Movers Within Same State	1.4	1.7	1.5	2.5	1.276 (1207)	.202
Movers From Different State	0.0	0.0	0.0	0.0	.635 (1549)	.526
Age 65 and Over						
Movers	6.9	7.1	6.8	9.0	.377 (1072)	.706
Non-Movers	93.1	7.1	93.2	9.0	-.377 (1072)	.706
Movers Within Same County	4.8	6.0	4.1	6.8	1.992 (1561)	.047 *
Movers Within Same State	1.4	2.9	1.6	4.4	1.087 (1283)	.277
Movers From Different State	0.7	1.8	1.1	2.9	3.043 (1335)	.002 *

\* p < 0.5

Table 13

*Independent Samples T-Test for Pittsburgh Metropolitan and Non-Metropolitan  
Mobility and Migration by Poverty Characteristics*

	Pittsburgh Metro		Non-Metro		<i>t</i> (df)	<i>p</i>
Variable	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Below 100 % Poverty						
Movers Within Same County	12.3	12.9	10.5	13.1	2.461 (1555)	.014 *
Movers Within Same State	4.2	8.2	3.9	7.1	.766 (1555)	.444
Movers From Different State	2.5	5.9	2.2	5.4	.857 (1555)	.391
100% to 149% Poverty						
Movers Within Same County	9.4	12.9	6.9	10.8	3.617 (733)	.000 *
Movers Within Same State	2.6	7.8	2.5	7.1	.255 (1556)	.799
Movers From Different State	1.6	5.5	1.4	4.7	.609 (1556)	.543
150% Poverty and Above						
Movers Within Same County	4.7	3.4	3.9	3.6	3.922 (1567)	.000 *
Movers Within Same State	1.6	1.9	1.5	2.1	.829 (1567)	.407
Movers From Different State	0.9	1.2	1.0	1.7	-.919 (1230)	.358
Total Population						
Below 50% Poverty	4.7	4.3	5.1	4.9	1.1448 (773)	.148
Between 50% and 99% Poverty	7.6	5.3	7.2	5.0	1.350 (1568)	.177
Between 100% and 124% Poverty	4.7	3.5	4.3	3.3	1.847 (1568)	.061
Between 125% and 149% Poverty	5.1	3.5	4.8	4.2	1.553 (1568)	.121
Between 150% and 184% Poverty	7.6	4.4	6.6	3.5	4.403 (1079)	.000 *
Between 185% and 199% Poverty	3.4	3.1	3.0	2.3	3.060 (1142)	.002 *
200% Poverty and Above	66.9	11.9	68.9	12.9	3.109 (1568)	.003 *

\*  $p < 0.5$

Table 14

*Independent Samples T-Test for Pittsburgh Metropolitan and Non-Metropolitan  
Mobility and Migration by Housing Tenure*

Variable	Pittsburgh Metro		Non-Metro		t (df)	p
	M	SD	M	SD		
Total Units	1076.7	1885.1	2394.8	7694.3	-3.629(481)	.000 *
Owners	76.4	14.6	81.1	11.7	-6.124(716)	.000 *
Renters	23.6	14.6	18.9	11.7	6.124(716)	.000 *
Owner Non-Movers	95.1	3.1	95.3	3.8	-1.249(1015)	.212
Renter Non-Movers	76.2	14.0	77.4	16.1	-1.473(982)	.141
Occupied Housing	89.2	7.7	80.7	19.6	12.404(1567)	.000 *
Vacant Housing	10.8	7.7	19.1	19.3	12.272(1568)	.000 *
Owner Occupied	66.2	15.9	63.8	17.6	2.590(1570)	.010 *
Renter Occupied	23.0	13.1	16.9	11.3	8.724(756)	.000 *
Owner Mover Same County	3.2	2.6	2.7	2.7	2.883(1566)	.004 *
Renter Mover Same County	15.3	11.7	14.0	13.1	1.978(953)	.048 *
Owner Mover Same State	1.1	1.4	1.2	2.0	-.903(1566)	.367
Renter Mover Same State	5.1	6.9	5.2	8.6	-.217(1560)	.828

\*p<.05

Table 15

*Independent Samples T-Test for Pittsburgh Metropolitan and Non-Metropolitan  
Gross Rent As a Percentage of Income (GRAPI) Index*

Variable Percent	Marcellus		Non-Marcellus		t (df)	p
	M	SD	M	SD		
GRAPI < 15 %	18.9	14.0	20.3	17.8	1.578 (1082)	.115
GRAPI 15 % to 19.9%	14.9	13.4	14.3	14.5	.772 (926)	.440
GRAPI 20 % to 24.9%	13.0	10.9	12.3	12.9	1.089 (1012)	.276
GRAPI 25 % to 29.9%	11.0	10.3	10.2	11.4	1.281 (947)	.201
GRAPI 30 % to 34.9%	8.6	9.7	8.2	10.8	.633 (1548)	.527
GRAPI 35 % and above	33.5	16.3	34.6	19.5	1.114 (1016)	.266

\* p < 0.5

Table 16

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities*

Variable (Percent)	Tier	N	M	SD	p
In-Migrants	Central	745	7.7	5.7	.045* <sup>a</sup>
	Northern	329	8.0	5.2	
	Southwestern	484	8.6	6.6	
Out-Migrants	Central	745	8.6	10.1	0.108
	Northern	329	7.8	10.7	
	Southwestern	484	9.6	14.6	
Net Migraton	Central	745	-1.0	10.9	0.432
	Northern	329	0.0	12.4	
	Southwestern	484	-1.1	15.0	
Gross Migration	Central	745	16.1	12.1	.016* <sup>a</sup>
	Northern	329	15.7	11.3	
	Southwestern	484	18.1	16.9	
Non-Movers	Central	745	83.9	12.1	.016* <sup>a</sup>
	Northern	329	84.3	11.3	
	Southwestern	484	81.9	16.9	
Movers	Central	752	8.9	6.5	.011* <sup>a</sup>
	Northern	332	9.1	6.1	
	Southwestern	486	9.9	6.1	
Movers in Same City	Central	752	0.9	2.2	0.355
	Northern	332	1.0	2.6	
	Southwestern	486	1.1	2.0	
Movers in Same County	Central	752	0.9	2.2	0.413
	Northern	332	1.0	2.6	
	Southwestern	486	1.1	2.0	
Movers in Same State	Central	752	0.0	0.0	0.256
	Northern	332	0.0	0.0	
	Southwestern	486	0.0	0.3	
Movers from Different State	Central	752	7.9	5.6	.017* <sup>b</sup>
	Northern	332	8.1	5.3	
	Southwestern	486	8.8	5.4	

\* p&lt;.05

<sup>a</sup> Significant with F statistic<sup>b</sup> Significant with Welch statistic

Table 17

*Multiple Comparisons for Mobility and Migration  
Within Marcellus Municipalities*

Dependent Variable	Region		Mean Difference	p
In-Migrants	Southwestern Central		.854*	.035
Gross Migration	Southwestern Central		1.97*	.036
Gross Migration	Southwestern Northern		2.42*	.035
Non-Movers	Central	Southwestern	1.97	.036
Non-Movers	Northern	Southwestern	2.42*	.035
Movers	Southwestern Central		1.09*	.008
Movers from Different State	Southwestern Central		.91*	.013

\* p<.05

Table 18

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities by Age*

Variable	Tier	N	M	SD	p
1 to 17 Total	Central	753	587.4	1237	.000 * <sup>b</sup>
	Northern	333	274.7	422	
	Southwestern	486	933.1	2426	
1 to 17 % Movers	Central	732	10.2	9	.023 * <sup>a</sup>
	Northern	322	11.6	11	
	Southwestern	480	11.6	10	
1 to 17 % Non-Movers	Central	732	89.8	9	.023 * <sup>a</sup>
	Northern	322	88.4	11	
	Southwestern	480	88.4	10	
1 to 17 % Within Same County	Central	731	6.7	8	.007 * <sup>b</sup>
	Northern	322	7.6	10	
	Southwestern	480	8.2	9	
1 to 17 % Within Same State	Central	729	2.2	5	.307
	Northern	322	2.6	6	
	Southwestern	478	2.0	4	
18 to 34 Total	Central	753	626.4	1774	.000 * <sup>b</sup>
	Northern	333	299.9	796	
	Southwestern	486	1042.0	5062	
18 to 34 % Movers	Central	742	53.0	161	.004 * <sup>b</sup>
	Northern	323	62.5	140	
	Southwestern	484	39.7	49	
18 to 34 % Non-Movers	Central	742	47.0	161	.008 * <sup>b</sup>
	Northern	323	37.5	140	
	Southwestern	484	60.3	49	
18 to 34 % Within Same County	Central	742	10.5	9	.005 * <sup>a</sup>
	Northern	323	10.9	9	
	Southwestern	484	12.1	8	
18 to 34 % Within Same State	Central	741	5.6	8	.221
	Northern	323	4.9	7	
	Southwestern	484	5.1	6	
18 to 34 % from Different State	Central	742	2.6	4	.231
	Northern	323	3.1	5	
	Southwestern	482	2.7	4	

Table 18, continued

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities by Age*

Variable	Tier	N	M	SD	p
35 to 64 Total	Central	753	1171.2	1914	.000* <sup>b</sup>
	Northern	333	568.6	761	
	Southwestern	486	2049.1	5286	
35 to 64 Total % Movers	Central	746	16.4	124	0.757
	Northern	328	14.1	23	
	Southwestern	480	12.7	13	
35 to 64 Total % Non-Movers	Central	746	83.6	124	0.757
	Northern	328	85.9	23	
	Southwestern	480	87.3	13	
35 to 64 % Within Same County	Central	747	3.3	3	.000* <sup>a</sup>
	Northern	328	3.5	4	
	Southwestern	481	4.4	4	
35 to 64 % Within Same State	Central	741	1.6	3	0.516
	Northern	328	1.5	2	
	Southwestern	475	1.4	2	
35 to 64 % from Different State	Central	744	0.6	114	0.62
	Northern	327	0.4	67	
	Southwestern	480	0.8	54	
65 and Above Total	Central	753	462.6	723	.000* <sup>a</sup>
	Northern	333	243.6	333	
	Southwestern	486	862.1	2225	
65 and Above % Movers	Central	749	6.7	9	0.669
	Northern	330	6.6	9	
	Southwestern	484	7.1	8	
65 and Above % Non-Movers	Central	749	93.3	9	0.669
	Northern	330	93.4	9	
	Southwestern	484	92.9	8	

Table 18, continued

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities by Age*

Variable	Tier	N	M	SD	p
65 and Above	Central	749	4	7	0.085
Within Same County	Northern	330	4.1	7	
	Southwest	484	4.8	6	
65 and Above	Central	749	1.6	4	0.776
% Within Same State	Northern	330	1.5	4	
	Southwest	484	1.5	3	
65 and Above	Central	749	1.1	3	0.073
% from Different State	Northern	330	1	3	
	Southwest	484	0.8	2	

\*  $p < .05$

<sup>a</sup> Significant with F statistic

<sup>b</sup> Significant with Welch statistic

Table 19

*Multiple Comparisons for Mobility and Migration Within Marcellus Municipalities by Age*

Variable	Tier		Mean Difference	p
1 to 17 Total	Central	Northern	312.7	.009*
1 to 17 Total	Southwestern	Central	345.7	.001*
1 to 17 Total	Northern	Southwestern	658.4	.000*
1 to 17 % Movers	Southwestern	Central	1.3	.051*
1 to 17 % Non-Movers	Central	Southwestern	658.4	.051*
1 to 17 % Within Same County	Southwestern	Central	1.5	.006*
18 to 34 Total	Southwestern	Northern	74.21	.002*
18 to 34 % Mvers	Northern	Southwestern	22.9	.041*
18 to 34 % Non-Movers	Southwestern	Northern	22.8	.041*
18 to 34 % Within Same County	Southwestern	Central	1.63	.004*
35 to 64 Total	Central	Northern	602.6	.013*
35 to 64 Total	Southwestern	Central	877.9	.000*
35 to 64 Total	Southwestern	Northern	1480.5	.000*
35 to 64 % Within Same County	Central	Southwestern	1.2	.000*
35 to 64 % Within Same County	Southwestern	Northern	0.9	.000*
65 nd Above Total	Northern	Southwestern	618.5	.000*
65 and Above Total	Southwestern	Central	399.5	.000*

\* p&lt;.05

Table 20

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities  
by Poverty Characteristics*

Variable (Percent)	Tier	N	M	SD	p
Below 100 % Poverty	Central	745	10.6	13.3	.019* <sup>a</sup>
Movers Within Same County	Northern	327	10.1	12.4	
	Southwestern	485	12.4	13.1	
Below 100 % Poverty	Central	745	4.0	7.2	.804
Movers Within Same County	Northern	327	3.8	7.2	
	Southwestern	485	4.1	8.1	
Below 100 % Poverty	Central	745	2.2	5.1	0.502
Movers Within Same County	Northern	327	2.4	6.1	
	Southwestern	485	2.5	5.9	
100% ot 149% Poverty	Central	745	7.4	11.5	.000* <sup>b</sup>
Movers Within Same County	Northern	329	6.0	9.1	
	Southwestern	848	9.2	12.8	
100% ot 149% Poverty	Central	745	2.6	7.2	.849
Movers Within Same State	Northern	329	2.4	7.1	
	Southwestern	484	2.5	7.6	
100% ot 149% Poverty	Central	745	1.5	5.0	.502
Movers from Different State	Northern	329	1.2	3.9	
	Southwestern	484	1.6	5.4	
150% or Above Poverty	Central	752	3.8	3.1	.000* <sup>b</sup>
Movers Within Same County	Northern	332	4.2	4.5	
	Southwestern	485	4.6	3.4	
150% or Above Poverty	Central	752	1.5	2.0	.707
Movers Within Same State	Northern	332	1.6	2.2	
	Southwestern	485	1.6	1.8	
150% or Above Poverty	Central	752	0.9	1.5	0.058
Movers from Different State	Northern	332	1.2	2.0	
	Southwestern	485	1.0	1.4	
Below 50% Poverty	Central	752	4.6	4.2	0.163
	Northern	332	4.9	4.6	
	Southwestern	486	5.1	4.9	

Table 20, continued

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities  
by Poverty Characteristics*

Variable (Percent)	Tier	N	M	SD	p
50% and 99% Poverty	Central	752	7.4	5.3	0.349
	Northern	332	7.8	5.1	
	Southwest	486	7.3	5.0	
100% and 124% Poverty	Central	752	4.6	3.5	0.125
	Northern	332	4.9	3.5	
	Southwest	486	4.4	3.4	
125% and 149% Poverty	Central	752	4.9	3.4	.001* <sup>a</sup>
	Northern	332	5.7	3.7	
	Southwest	486	4.9	4.2	
150% and 184% Poverty	Central	752	4.0	4.0	.000* <sup>b</sup>
	Northern	332	5.2	5.2	
	Southwest	486	3.6	3.6	
185% and 199% Poverty	Central	752	2.9	2.9	.036* <sup>b</sup>
	Northern	332	3.5	3.5	
	Southwest	486	2.3	2.3	
200% Poverty and Above	Central	752	12.4	12.4	.000* <sup>b</sup>
	Northern	332	10.5	10.5	
	Southwest	486	12.9	17.9	

\*  $p < .05$

<sup>a</sup> Significant with F Statistic

<sup>b</sup> Significant with Welch statistic

Table 21

*Multiple Comparisons for Mobility and Migration Within Marcellus Municipalities by Poverty Characteristics*

Variable	Tier		Mean Difference	p
Below 100% Poverty-Same County	Southwestern	Central	1.8*	.048
Below 100% Poverty-Same County	Southwestern	Northern	2.3*	.033
100% to 149% Poverty-Same County	Southwestern	Central	1.8*	.033
100% to 149% Poverty-Same County	Southwestern	Northern	3.2*	.000
At or above 150 % Poverty-Same County	Southwestern	Central	.86*	.000
125% and 149% Poverty	Central	Northern	.28*	.001
125% and 149% Poverty	Northern	Southwestern	.89*	.002
150% and 184% Poverty	Northern	Central	.81*	.033
150% and 184% Poverty	Central	Southwestern	.65*	.010
150% and 184% Poverty	Northern	Southwestern	156*	.000
185% and 199% Poverty	Central	Southwestern	.41*	.018
185% and 199% Poverty	Northern	Southwestern	.41*	.186
200% Poverty and Above	Central	Northern	2.7*	.001
200% Poverty and Above	Northern	Southwestern	3.6*	.000

\* p<.05

Table 22

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities  
by Household Characteristics*

Variable (Percent)		N	M	SD	p
Occupied Housing	Central	753	83.2	17.9	.000 * <sup>a</sup>
	Northern	333	74.8	22.4	
	Southwestern	486	88.9	7.8	
Vacant Housing	Central	753	16.7	17.7	.000 * <sup>a</sup>
	Northern	333	24.9	22.1	
	Southwestern	486	11.1	7.8	
Owner Occupied	Central	753	65.9	16.9	.000 * <sup>a</sup>
	Northern	333	58.9	18.6	
	Southwestern	486	66.0	15.7	
Renter Occupied	Central	753	17.3	11.4	.000 * <sup>a</sup>
	Northern	333	15.9	11.3	
	Southwestern	486	22.9	12.9	
Owners	Central	752	81.3	12.0	.000 * <sup>a</sup>
	Northern	332	81.0	11.2	
	Southwestern	486	76.4	14.3	
Renters	Central	752	18.7	12.0	.000 * <sup>a</sup>
	Northern	332	19.0	11.2	
	Southwestern	486	23.6	14.3	
Owner Non-Mover	Central	751	95.5	3.3	.100
	Northern	332	95.0	4.7	
	Southwestern	485	95.2	3.1	
Renter Non-Mover	Central	747	77.5	15.9	.339
	Northern	329	77.0	16.7	
	Southwestern	486	76.2	14.0	
Owner Moved-Same County	Central	751	2.6	2.3	.005 * <sup>a</sup>
	Northern	332	2.9	3.4	
	Southwestern	485	3.2	2.6	
Renter Moved-Same County	Central	747	14.0	12.7	.182
	Northern	329	14.1	14.1	
	Southwestern	486	15.2	11.7	

Table 22, continued

*One-Way ANOVA for Mobility and Migration Within Marcellus Municipalities  
by Household Characteristics*

Variable (Percent)		N	M	SD	p
Owner Moved Same-State	Central	751	1.2	2.0	.177
	Northern	332	1.3	2.0	
	Southwestern	485	1.0	1.3	
Renter Moved Same-State	Central	747	5.4	8.8	.681
	Northern	329	5.0	8.4	
	Southwestern	486	5.0	6.8	
GRAPI < 15%	Central	742	19.5	16.8	.340
	Northern	323	21.2	19.6	
	Southwestern	485	19.5	14.7	
GRAPI 15% to 19.9%	Central	742	14.1	14.2	.427
	Northern	323	15.3	15.5	
	Southwestern	485	14.7	13.2	
GRAPI 20% to 24.9%	Central	742	13.0	13.2	.070
	Northern	323	11.1	12.3	
	Southwestern	485	12.7	10.9	
GRAPI 25% to 29.9%	Central	742	9.9	9.9	.221
	Northern	323	11.0	14.2	
	Southwestern	485	10.8	10.3	
GRAPI 30% to 34.9%	Central	742	8.4	11.2	.602
	Northern	323	7.8	10.2	
	Southwestern	485	8.5	9.6	
GRAPI 35% and above	Central	742	35.0	19.0	.382
	Northern	323	33.4	20.8	
	Southwestern	485	33.8	16.3	

\* p&lt;.05

<sup>a</sup> Significant with Welch statistic

Table 23

*Multiple Comparisons for Mobility and Migration Within Marcellus Municipalities  
by Household Characteristics*

Variable	Tier		Mean Difference	p
Occupied Housing	Central	Northern	8.42*	.000
Occupied Housing	Central	Southwestern	5.7*	.000
Occupied Housing	Northern	Southwestern	14.2*	.000
Vacant Housing	Central	Northern	8.3*	.000
Vacant Housing	Central	Southwestern	5.69*	.000
Vacant Housing	Northern	Southwestern	13.9*	.000
Owner Occupied	Central	Northern	7.0*	.000
Owner Occupied	Northern	Southwestern	7.1*	.000
Renter Occupied	Central	Southwestern	5.1*	.000
Renter Occupied	Northern	Southwestern	7.0*	.000
Owners	Central	Southwestern	4.9*	.000
Owners	Northern	Southwestern	4.6*	.000
Renters	Southwestern	Central	4.9*	.000
Renters	Southwestern	Northern	4.6*	.000
Owner Moved Same County	Southwestern	Central	5.1*	.002

\* p<.05

## Appendix E

Duquesne University IRB  
Protocol #2015-05-11  
Approved: 6-8-2015  
Expiration Date: 6-7-2016

### **Invitation to Participate in a Research Study on Population and Social Change Due to Natural Gas Extraction in the Marcellus Shale Region of Pennsylvania**

Hello (address of key informant):

My name is Annette Mackay, and I am a graduate student at Duquesne University's Center for Social and Public Policy. I am calling you to ask if you would participate in a study that I am conducting on population and social change in (the name of the municipality). I am interested in changes that have occurred in the past 7 years or so that may have a relationship with natural gas drilling in the area. Your position as a (type of informant) qualifies you as an expert to answer questions about changes you have observed in (field of the informant), and what may account for those changes.

I am asking if you would consent to an audio-recorded interview at your convenience. The interview will take approximately one hour. Participation is voluntary, and you may withdraw at any time without penalty. Your comments will remain in strictest confidence and your name will not appear on any reports. However, I cannot guarantee that you will remain anonymous because the information that you provide can connect you with your professional position.

As a participant, you will receive a copy of my final report upon request at no cost to you. You may find the results of the study to be beneficial to your professional interests. Aside from the final report, there is no other compensation to you.

You will receive an informed consent document that describes the purpose of the research study and your rights as provider of information. You will also receive contact information for my advisors and me should you have any questions about participating in this study. I will need your consent in writing prior to the interview.

This study has been approved by Duquesne University Institutional Review Board.

Thank you for taking my call, and for your consideration to become a participant in this study.

## Appendix F



MCANULTY COLLEGE AND GRADUATE SCHOOL OF LIBERAL ARTS  
GRADUATE OFFICE  
COLLEGE HALL 215

600 FORBES AVENUE  
PITTSBURGH, PA 15282  
tel 412.396.5400 fax 412.396.5265

March 19, 2015

Ms. Annette M. Mackay  
Graduate Center for Social and Public Policy

Dear Annette,

Congratulations. I am writing to offer you an award of \$2,469.78 from the Dr. Michael P. Weber Endowed Research Grant to support your thesis project, "Housing-Related Migration among Low-Income Families in the Marcellus Shale Region of Pennsylvania.

Please write to confirm your acceptance of the grant.

Funds are available for expenditures made between July 1, 2015, and June 30, 2016. **Pursuant to the guidelines of the grant, please submit requests for expenditures to me for approval prior to making purchases that you wish to have reimbursed from the grant.** Present evidence of reimbursable expenses to Ms. Julie Dougherty of the dean's office (210 College Hall, gardner@duq.edu, X5597) for reimbursement as soon as possible after the expenses are incurred.

Please submit a report of your progress on the project to my successor as grant administrator by December 15, 2015, and a final report upon completion of the project or by June 30, 2016, whichever is earlier.

I congratulate you on your successful proposal and wish you every success with your project.

Sincerely,

A handwritten signature in blue ink that reads 'G. Evan Stoddard'.

G. Evan Stoddard, Ph.D., Grant Administrator  
Dr. Michael P. Weber Endowed Research Grant

c: Ms. Julie Dougherty  
Dr. Michael Irwin  
Dr. Pat Dunham