Social Science

Oil and gas development and small business lending in U.S. nonmetropolitan counties

Michael C. Lotspeich II, Charles M. Tolbert II and F. Carson Mencken
Center for Community Research and Development, Department of Sociology, Baylor University, Waco, TX, USA

ABSTRACT

How does the presence or absence of small business loans affect the emergence and development of rural businesses in traditionally underserved areas? Further, how has capital-intensive oil and gas development contributed to these lending patterns? In our ongoing work, we have established that locally oriented businesses such as small manufacturing establishments and retail outlets are associated with many beneficial local outcomes and promote nonmetropolitan community resilience. Using a longitudinal dataset based on annual public disclosures, we employ data on lending in more than 3,000 United States counties to build analytical visualizations. We provide relevant documentation through spatial statistics for future research on small business lending in underserved nonmetropolitan communities.

ARTICLE HISTORY

Received 23 June 2018
Revised 23 January 2019
Accepted 23 January 2019

KEYWORDS

Community Reinvestment Act; rural banking; small businesses; resource extraction; credit-constrained; underserved communities; oil and gas development

1. Introduction

Traditional commercial bank lending has declined in rural America since 1992 (Mencken & Tolbert, 2016). Between 1996 and 2015, the percentage of small business loans that went to nonmetropolitan counties declined from 19 percent to 9.8 percent. These figures are not an artifact of increased lending in metropolitan counties; the number of nonmetropolitan small business loans originating from small banks declined from 200,000 in 1997 to less than 10,000 in 2008 (Federal Financial Institutions Examination Council, 2018). This is important because nonmetropolitan banks and businesses have traditionally formed symbiotic relationships. Without lending, nonmetropolitan banks will suffer; without borrowers, nonmetropolitan banks will suffer. Without banks and small businesses, rural communities suffer (see Blanchard, Tolbert, & Mencken, 2012; Irwin, Tolbert, & Lyson, 1999; Tolbert, Irwin, Lyson, & Nucci, 2002; Tolbert, Lyson, & Irwin, 1998).

Explanation for this decline is varied, but one common theme that has emerged in the literature is the pattern of mergers and acquisitions in the financial sector since the 1980s (see DeYoung, Glennon, Nigro, & Spong, 2012; Dudley, 1996; Flora, Flora, & Gasteyer, 2015; Gilbert & Wheelock, 2013). Nonmetropolitan community banks have been absorbed into regional and national banks. In 1976, local community banks comprised 80% of all banks in nonmetropolitan counties. By 2010, only 1 in 5 nonmetropolitan banks were locally owned (Tolbert, Mencken, Riggs, & Li, 2014). Research on this topic finds that locally owned banks and other financial institutions are more important for the economic vitality of nonmetropolitan communities, more so than in metropolitan settings (DeYoung et al., 2012; Gilbert & Wheelock, 2013; Mencken & Tolbert, 2016). Reasons include

1. Nonmetropolitan communities have fewer banks and less competition for lower interest rates;
2. Regional and national banks may not see a significant return on investment to lend in smaller communities;
3. Businesses in nonmetropolitan economies, which are typically small, may lack the physical capital, or objective credit worthiness, necessary to secure collateral-based loans; and
4. Nonmetropolitan community banks have relied upon soft-data lending, such as the social capital and community reputation of the borrower in making loan decisions.

We propose that one industry, oil and gas production, has been exempt from this decline in nonmetropolitan lending. Domestic oil and gas development in the United States increased significantly during the first two decades of the twenty-first Century. During the 1990s, domestic natural gas production increased by 7%. Between 2000 and 2012, domestic natural gas production increased 33.3%. This increased production

© 2019 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group on behalf of Journal of Maps
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

CONTACT Michael C. Lotspeich II michael_lotspeich_II@baylor.edu Center for Community Research and Development, Department of Sociology, Baylor University, One Bear Place #97326, Waco, TX, USA
has been driven in large part by the emergence of unconventional natural gas exploration, also known as ‘fracking’ (Gold, 2015; Kinchy et al., 2014). Fracking has brought income growth to rural communities in many regions (Anderson & Theodori, 2009; Kinchy et al., 2014; Tunstall 2015).

Our focus in this research is the impact of the industry on lending patterns in the nonmetropolitan United States. Unlike many small retail and service-based businesses, oil and gas development is capital-intensive. The equipment involved is very expensive, very extensive, and not particularly mobile (Theodori, 2009). In many locales, local vendors lease and maintain oil field production equipment. A new well, according to Theodori (2009), can utilize up to 350 transportation vehicles to move almost 2,000 pieces of equipment (see also Rahm, Fields, & Farmer, 2015). The valuable equipment can be used as collateral in loans, a previous road-block to rural nonfarm lending. Moreover, the potential profits from oil and natural gas production may allow local bank officers to perceive less risk.

In addition, oil and gas development can create downstream business development and growth. The businesses that support the personnel who work in oil and gas, even as temporary laborers from other places, are affected by increased production. These support businesses in small towns need capital to expand to keep up with demand. Thus, an interest in the symbiotic relationship between nonmetropolitan communities, small business lending patterns, and fracking is warranted.

In this article, we utilize Community Reinvestment Act (CRA) data on small business lending to examine the spatial relationship between growth in oil and gas development and small business lending between 1996 and 2015. Our primary interest is on nonmetropolitan counties. We offer this in three maps:

1. Map 1 – Percentage change, expressed as a choropleth map, in financial lending originating for nonmetropolitan counties
2. Map 2 – Spatial clustering of nonmetropolitan financial lending, change from 1996 to 2015, using Univariate Local Moran’s I
3. Map 3 – Bivariate regression, MLE spatial lag model between small business loan origination and change in oil and gas production

2. Data

Our analysis began with Community Reinvestment Act (CRA) data. We retrieved yearly county files from 1996 to 2015 representing the CRA Aggregate report data on origination of small business loans to small businesses with gross annual revenues under one million (Federal Financial Institutions Examination Council, 2017).

Second, we obtained county-level demographic and geographic data from the U.S. Bureau of the Census, population estimates for each county and metropolitan/non-metropolitan county classification (2015). From the U.S. Department of Agriculture’s Economic Research Service, we used the 2015 County Typology Codes and 2000–2011 county-level oil and natural gas production dataset (2015). The County Typology Codes classify all U.S. counties according to six mutually exclusive categories of economic dependence and six overlapping categories of policy-relevant themes. The county-level oil and natural gas production dataset compiles extraction statistics for gross withdrawals.

Nonmetropolitan counties are micropolitan and outside-core based statistical areas. These delineations are determined by the U.S. Office of Management and Budget (OMB) for use solely in Federal statistical activities (2015).

Because the political definition of county and county-equivalents varies over time and space, these data products required extensive recoding, splitting, and other forms of cleaning to generate a longitudinal data set with harmonized spatial units. Alfred Nucci and colleague’s work in this area was used as a template (see Irwin, Blanchard, Tolbert, Nucci, & Lyson, 2004).

Finally, the 2015 TIGER/Line® shapefile produced by the U.S. Bureau of the Census was used for spatial statistics and plotting of the descriptive indices (2015). The use of longitudinal recodes required internal modification to the shapefile provided by the U.S. Bureau of the Census.

3. Methods

To create a clearer picture of the relationship between small business lending and oil and gas development in nonmetropolitan communities, we used our longitudinal dataset and spatial statistics to quantify change in lending over a twenty-year period (1996–2015).

To do this, we first calculated a change-in-lending index for each county. This index represented the amount of small business loans originating from the county, per 1000 residents measured at the previous decennial Census. Because of data constraints, two versions of this index were prepared:

1. Change in amount of lending to businesses under $1 million, per 1000 residents, for the years 1996–2015.
2. Change in amount of lending to businesses under $1 million, per 1000 residents, from 2000 to 2011.

Both indices are built using three-year rolling averages, encompassing the first three and last three years of available data. The first change index was used for Map 1 and Map 2, employing the full scope of data available from the FFIEC. The second change index was used to create a bivariate, maximum likelihood estimation spatial lag mode. This index is
temporarily bounded by the length of the matching county-level oil and gas development data series. We completed exploratory spatial data analysis (see Anselin, 1998). For all maps, metropolitan counties were omitted since we are interested in loan originations from nonmetropolitan counties alone. Graphical output emphasizes nonmetropolitan areas.

Map 1 is a descriptive choropleth map that represents change in the origination of nonmetropolitan financial lending over a twenty-year period. This is a thematic map that visualizes variability in lending across geographic boundaries. Seven bins were provided: three representing a decrease in the origination of small business lending, one representing very little change, and three representing an increase. The color green signifies growth in origination of lending, whereas the color red indicates a decline in origin of lending.

For the next two maps, our spatial statistics required the creation of weights. While many of America’s 3114 counties and county equivalents are similar in size, others in the continental states range from 20,057 square miles (San Bernardino County, California) to 2 square miles (a county equivalent Independent City of Falls Church, Virginia). This would prevent the use of weights based on the Euclidean Distance. Instead we used a queen contiguity weight matrix for the second and third maps. Even though our analysis was limited to the contiguous United States, two counties (San Juan County, Washington and Nantucket County, Massachusetts) exist entirely in bodies of water and queen contiguity identifies them as statistical islands. We exclude them from the analysis.

In Map 2 we explore local indicators of spatial association (Anselin, 1995) using the Univariate Local Moran’s I test. Mapped clusters are significant at \( p < .001 \) with 999 permutations, representing the degree of spatial autocorrelation for each county, along with identifying local spatial cluster patterns and spatial outliers as a concentration of high values or low values (Harries, 2006).

In Map 3, we introduce an additional variable – along with the second change in lending index – in a bivariate, maximum likelihood estimation spatial lag model. We did so to call attention to a potential predictor of change – the growth of unconventional oil and natural gas development in the Great Plains and upper Appalachia. This binary variable was based upon change in the dollar value of oil production and change in the dollar value of natural gas production more than $20 million dollars. From 2000 to 2011, onshore gross withdrawals of natural gas increased by 47 percent and gross withdrawals of oil increased by 11 percent; nonmetropolitan communities accounted for almost all this growth (U.S. Department of Agriculture, 2014).

4. Results

Map 1 – Percentage change, expressed as a choropleth map, in financial lending originating for nonmetropolitan counties. Map 1 visualizes percentage change in amount of lending, per 1000 people, in each county or county-equivalent from 1996–1998 to 2013–2015. Green signifies growth in the origination of lending, whereas the color red indicates a decline in the origin of lending. We make two observations from Map 1. First, there is a large growth of lending in the upper Midwest and Western United States. This is contrasted by a decline in lending throughout the Eastern United States, especially in the belt of southern states.

Map 1 stands in contrast to past literature which says traditional commercial bank lending has been on the decline (see Mencken & Tolbert, 2016). Rather, there are forces at play in some nonmetropolitan communities – specifically the upper Midwest and Western United States. One potential explanation is an increase in oil and gas development, which is capital-intensive and requires significant financial capital. To localize and investigate the clustering of these forces, we moved onto the second map.

Map 2 – Spatial clustering of nonmetropolitan financial lending, change from 1996 to 2015, using Univariate Local Moran’s I. Using local indicators of spatial association (LISA), or Univariate Local Moran’s I, we ascertained the degree of spatial autocorrelation in small business loan for each county. As well, we identified local spatial cluster patterns and spatial outliers as a concentration of high values or low values. These high or low values are considered statistically significant at the 95 percent confidence level. Red county or county-equivalents are considered to have a statistically significant high origination of lending surrounded by other counties or county-equivalents with high origination of lending. Blue county or county-equivalents have a significantly low loan origination and are surrounded by other counties or county-equivalents with low origination. Following industry standard (see Anselin, 1995), deep blue and red counties represent spatial clusters and have a statistically significant positive global spatial autocorrelation. The pale blue and red counties are spatial outliers and have a statistically significant negative global spatial autocorrelation. Gray counties or county-equivalents are not statistically significant.

Again, we see a high level of loan origination in the Upper Midwest and Western United States. This is accompanied by a low level of loan origination in the Eastern and Southern United States. To attempt to contextualize this map, we assembled Table 1 with LISA clustering, the amount changes in lending, and 2015 U.S. Department of Agriculture County Typology codes.
Comparing the High-High counties to Low-Low counties, we find that counties with a positive percentage change in lending origination have an economy structured around resource extraction or commodity production (with population loss). Counties with a negative percentage change in lending origination have an economy structured around manufacturing or recreation. In drawing this distinction, we can still assert that the percentage of total small business loans originating in nonmetropolitan communities is declining but can infer that an industry which has been exempt from this lending decline is oil and natural gas production. Oil and gas development, instead, brings a growth in income to the nonmetropolitan United States (Tunstall, 2015). This leads us to directly investigate the relationship between resource extraction and lending origination, in Map 3.

Map 3 – Bivariate regression, MLE spatial lag model between small business loan origination and change in oil and gas production. In our final map, we estimated a maximum likelihood estimation spatial lag model between small business lending (IV) and a binary variable for local growth of $20 million or more in oil and gas development (DV). This decision was statistically motivated as spatial dependence can arise from unobservable latent variables, such as the origination of loans to small businesses that span counties. Both variables were built from two time periods, 2001–2003 and 2009–2011. The level of lag predicted by CRA lending, then, is presented in this visualization.

We found that Map 3 confirmed our earlier assumptions, showing a bivariate relationship between small-business lending and oil and gas development. Counties which are darker are more likely to have their production predicted by level of origination of small business lending. Table 2 seeks to further contextualize this relationship by quantifying the counties with highest lag predicted.

It is important to note, in reviewing Table 2, that our dataset measures loan origination to only small businesses. This is likely to explain the discrepancy between the change in small business lending, against oil/natural gas production growth. However, oil and natural gas production can create downstream business development and growth that may be demonstrated in these figures. Wise County, Texas, for instance, has experienced a notable increase in unconventional natural gas exploration that has created increased demand for infrastructure and logistic services (Rahm et al., 2015; Theodori, 2009).

5. Conclusions

These maps make multiple contributions to the literature. First, the development of an innovative longitudinal dataset created in-house from public disclosure flat files, we employ data on lending in more than 3,000 U.S. counties. We furnish relevant documentation for future research to further the knowledge in the rural social sciences on small business lending in underserved nonmetropolitan communities. Second, we answer the question of why, despite significant declines in nonmetropolitan small business lending, oil and gas counties had small business lending, on average, 150 times higher than the nonmetropolitan average. Finally, this research creates visualizations that will create a better picture of where small-businesses are more likely to be fully capitalized, in a format that is legible to a lay audience.

Software/data availability

Several research software packages were used in the development of our maps. The yearly aggregate reports downloaded from the Federal Financial Institutions

Table 2. County or county-equivalents predicted by MLE spatial lag model.

| Change in SB Lending | Oil/Gas Growth (by) | Lag Predicted | Lag Residual |
|----------------------|---------------------|---------------|--------------|
| Lipscomb, Texas      | 1.59                | 538,316,009   | 0.355392     | 1.220704     |
| Hemphill, Texas      | 1.68                | 858,023,003   | 0.350336     | 1.220834     |
| McMullen, Texas      | 0.28                | 59,832,036    | 0.342788     | 0.196080     |
| La Salle, Texas      | 0.05                | 38,557,539    | 0.339605     | 0.193628     |
| Ellis, Oklahoma      | 0.24                | 11,370,302    | 0.388285     | 0.163165     |
| Wise, Texas          | 0.36                | 124,587,072   | 0.335546     | 0.083752     |
| Williams,            | 1.45                | 54,311,611    | 0.320077     | 0.663118     |
| North Dakota         | 0.57                | 655,368,126   | 0.330705     | 0.186824     |
| Mountrail,           | 0.20                | 30,803,701    | 0.326539     | 0.390502     |
| North Dakota         | 0.61                | 59,981,650    | 0.325509     | 0.197183     |

Table 1. Relationship between change in origination of small business lending and local economic structural indicators.

| LISA                | Amt. change | Economy      | Employment | Population | Poverty |
|---------------------|-------------|--------------|------------|------------|---------|
| McKenzie, North Dakota | High-High | Mining       | Average    | Maintenance/growth | Average |
| Richland, Montana    | High-High  | Mining       | Average    | Maintenance/growth | Average |
| Pierce, North Dakota | High-High  | Farming      | Average    | Loss       | Average |
| Clay, Nebraska       | High-High  | Farming      | Average    | Loss       | Average |
| Custer, Montana      | High-High  | Non specialized | Average  | Maintenance/growth | Average |
| Chase, Nebraska      | High-High  | Farming      | Average    | Loss       | Average |
| Itawamba, Mississippi | Low-Low    | Manufacturing | Average    | Maintenance/growth | Average |
| Leelanau, Mississippi | Low-Low    | Recreation   | Average    | Maintenance/growth | Average |
| Grenada, Mississippi | Low-Low    | Manufacturing | Average    | Maintenance/growth | Average |
| Grand Traverse, Michigan | Low-Low | Recreation   | Average    | Maintenance/growth | Average |
| Vilas, Wisconsin     | Low-Low    | Recreation   | Average    | Maintenance/growth | Average |
| Oneida, Wisconsin    | Low-Low    | Recreation   | Average    | Maintenance/growth | Average |
Examination Council (FFIEC), oil and natural gas production statistics from the United States Department of Agriculture, and bicentennial population counts from 1990, 2000, and 2010 from the U.S. Bureau of the Census were cleaned and consolidated into a longitudinal dataset using SAS 9.4. SAS 9.4 was also used to create index/average scores and preliminary descriptive statistics. The initial descriptive map was created using ESRI ArcGIS 10.5 by joining a TIGER/Line® shapefile with the in-house dataset. From here, spatial statistics – local indicators of spatial association and the maximum likelihood estimation lag model – were processed with GeoDa 1.12 (Anselin & Rey, 2014). Finally, all figures were edited and laid out using ESRI ArcGIS 10.5.

Acknowledgments

A previous version of this project was presented as a poster at the 80th Rural Sociological Society Annual Meeting – ‘Rural People in a Volatile World: Disruptive Agents and Adaptive Strategies’; Columbus, Ohio.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Agriculture and Food Research Initiative of the National Institute of Food and Agriculture (NIFA), an agency of the U.S. Department of Agriculture (USDA), under grant #2011-67023-30072. This work was supported by the Agriculture and Food Research Initiative of the National Institute of Food and Agriculture (USDA), under grant #2011-67023-30072.

ORCID

Michael C. Lotspeich II http://orcid.org/0000-0001-5537-3654
Charles M. Tolbert II http://orcid.org/0000-0001-7063-8542

References

Anderson, B., & Theodori, G. (2009). Local leader perceptions of energy development in the Barnett Shale. Southern Rural Sociology, 24(1), 113–129.
Anselin, L. (1995). Local indicators of spatial association—LISA. Geographical Analysis, 27(2), 93–115.
Anselin, L. (1998). Exploratory spatial data analysis in a geocomputational environment. In P. A. Longley, S. M. Brooks, R. McDonnell, & B. MacMillan (Eds.), Geocomputation: A primer (pp. 77–94). New York City, NY: Wiley.
Anselin, L., & Rey, S. J. (2014). Modern spatial econometrics in practice: A Guide to GeoDa, GeoDaSpace, and PySAL. Chicago, IL: GeoDa Press LLC.
Blanchard, T., Tolbert, C. M., & Mencken, F. C. (2012). The health and wealth of U.S. counties: How the small business environment impacts alternative measures of development. Cambridge Journal of Regions, Economy, and Society, 5, 149–162.
DeYoung, R., Glennon, D., Nigro, P., & Spong, K. (2012). Small business lending and social capital: Are rural relationships different? University of Minnesota workshop on Small Business Lending.
Dudley, K. M. (1996). The problem of community in rural America. The Journal of Community and Culture, 18, 47–57.
Federal Financial Institutions Examination Council (FFIEC). (2017). Community Reinvestment Act aggregate & disclosure flat files [Data file and code book]. Washington, DC. Retrieved from https://www.ffiec.gov/cra/craflatfiles.htm.
Federal Financial Institutions Examination Council. (2018, June 25). Agencies release list of distressed or underserved nonmetropolitan middle-income geographies [Press release]. Retrieved from https://www.ffiec.gov/press/pr062518.htm
Flora, C. B., Flora, J. L., & Gasteyer, S. P. (2015). Rural communities: Legacy and change (5th ed.). Boulder, CO: Westview Press.
Gilbert, R. A., & Wheelock, D. C. (2013). Big banks in small places: Are community banks being driven out of rural markets? Federal Reserve Bank of St. Louis Review, 95(3), 199–218.
Gold, R. (2015). The boom: How fracking ignited the American energy revolution and changed the world. New York, NY: Simon and Schuster.
Harries, K. (2006). Extreme spatial variations in crime density in Baltimore County, MD. GeoForum; Journal of Physical, Human, and Regional Geosciences, 37(3), 404–416.
Irwin, M., Blanchard, T., Tolbert, C. M., Nucci, A., & Lyson, T. (2004). Why people stay: The impact of community context on nonmigration in the USA. Population, 59(5), 567–591.
Irwin, M., Tolbert, C. M., & Lyson, T. (1999). There is no place like home: Migration and civic engagement. Environment and Planning A, 31(12), 2223–2238.
Kinchy, A., Perry, S., Rhubart, D., Stedman, R., Brasier, K., & Jacquet, J. (2014). New natural gas development and rural communities: Key issues and research priorities. In C. Bailey, L. Jensen, & E. Ransom (Eds.), Rural America in a globalizing world (pp. 260–278). Morgantown, WV: West Virginia University Press.
Mencken, F. C., & Tolbert, C. M. (2016). Restructuring of the financial industry and implications for sources of start-up capital for new businesses in nonmetropolitan counties. Journal of Rural Social Sciences, 31(1), 71.
Rahm, D., Fields, B., & Farmer, J. L. (2015). Transportation impacts of fracking in the Eagle Ford shale development in rural south Texas: Perceptions of local government officials. Journal of Rural and Community Development, 10, 78–99.
Theodori, G. (2009). Paradoxical perceptions of problems associated with unconventional natural gas development. Southern Rural Sociology, 24(3), 97–117.
Tolbert, C. M., Irwin, M., Lyson, T., & Nucci, A. (2002). Civic community in small-town America: How civic welfare is influenced by local capitalism and civic engagement. Rural Sociology, 67, 90–113.
Tolbert, C. M., Lyson, T., & Irwin, M. (1998). Local capitalism, civic engagement, and socioeconomic well-being. Social Forces, 77, 401–427.
Tolbert, C. M., Mencken, F. C., Riggs, L., & Li, J. (2014). Traditional and alternative financial institutions in rural America: 1976–2007. Rural Sociology, 79, 355–379.
Tunstall, T. (2015). Recent economic and community impact of unconventional oil and gas exploration and
production on south Texas counties in the Eagle Ford Shale area. *The Journal of Regional Analysis & Policy, 45* (1), 82–92.

U.S. Bureau of the Census. (2015). *2015 TIGER/Line shapefile* [Machine-readable data file], Washington, DC. Retrieved from [https://www.census.gov/geo/maps-data/data/tiger-line.html](https://www.census.gov/geo/maps-data/data/tiger-line.html)

U.S. Department of Agriculture. (2014). *County-level onshore oil and natural gas production in the lower 48 states, 2000-11* [Data file and code book], Washington, DC. Retrieved from [https://www.ers.usda.gov/data-products/county-level-oil-and-gas-production-in-the-us](https://www.ers.usda.gov/data-products/county-level-oil-and-gas-production-in-the-us)

U.S. Office of Management and Budget. (2015). Revised delineations of metropolitan statistical areas, micropolitan statistical areas, and combined statistical areas, and guidance on uses of the delineations of these areas (Bulletin No. 15-01). Washington, DC: Executive Office of the President.