



APPLYING GEOGRAPHIC MODELS TO EXAMINE THE IMPACT OF GROSS DOMESTIC PRODUCT AS A PROXY FOR ECONOMIC WELL-BEING

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Abstract

This paper considers whether gross domestic product (GDP) adequately measures economic well-being, or whether other measures of economic well-being should be used instead of or in addition to GDP. Increasing GDP/capita has long been the goal for local communities, regions, and states. Usually, GDP is treated either explicitly or implicitly as a measure of economic prosperity. But economic prosperity might not correspond to economic well-being if the prosperity is unevenly distributed or if the benefits are experienced outside the local area. This paper introduces a two-pronged approach to evaluating the relationship between regional economic development and regional economic well-being. First, we identify geographical patterns of economic development and consider measures of economic well-being for the same geographical areas. Second, we consider spatial analyses that cluster index values in relation to cultural and geographic features at national, region, and state levels. Regression residuals and local R^2 patterns confirm the complexity at which economic well-being factors vary over space. The paper concludes that policy making based on economic well-being must incorporate a comprehensive definition of economic well-being that attends to local and regional interactions; economic well-being cannot be adequately defined by any single variable, such as GDP. Recommendations for future studies are included.

Keywords: Economic well-being, GDP, Geospatial, Econometrics.

INTRODUCTION

The traditional view of economic development measures economic growth and job creation (Flammang, 1979; Botev et al., 2019). The underlying logic is static in time and space and typically ignores within- and between-market differences as well as other determinants of economic and community well-being, like quality of life

measures, publicly shared services, and other community assets (Harangozo et al., 2018).

The Problem

Contemporary research on economic development emphasizes job creation within a locality (Rather, 2020; Jakobsen, 2017). However, resources in one geographic market can, and arguably will, provide opportunities for entrepreneurs, job seekers, and families in other markets and do not necessarily have to be recreated as these assets are dynamic and can be enjoyed regionally. Important examples of resources that can impact job creation within or across regions include resources from institutions and organizations with the ability to respond with technical assistance and capital to entrepreneurs and small business owners, the ability to assist displaced workers and employers with job placement and job fulfillment, or assistance with post-incident coordination and information dissemination during times of crises. Similarly, community resources are often enjoyed by non-residents and are a source of competitive advantage, not because of their proximity to local market demands, but as an attraction to neighboring communities - within or outside the immediate region (Chen et al., 2021).

The presence of resource fluidity, such as knowledge sharing, industrial cluster formations across communities, labor force mobility, and extensive and integrated supply chains of production, highlight the apparent shortcomings of assuming a 1:1 ratio of economic growth to job creation (Yang, 2019). The error, for decision making purposes, becomes clear for economic development professionals when assessing the dynamic nature of labor supply, consumer demand, and natural cross-regional trade that takes place in most, if not all, economic development districts in the United States.

Visualization Models

Mapping regional industrial capacity not only facilitates quicker and more agile development but also helps economic developers to visualize regional patterns and multilevel differences and similarities. Being able to visualize *what* is produced and *where* reveals opportunities to respond to unanticipated needs through public/private strategic arrangements (McGlashan, 2019). The recent COVID-19 crisis demonstrated how public and private entities might struggle to identify potential producers of medical equipment, transportation channels, and other logistics solutions. Visualization models and mapping of dynamic assets in spatial- and relationship-based formats can support faster, better decision-making.

The within and between differences of regional economic development may be local or industry-specific, or a part of a larger regional pattern, which can be discovered by examining similarities and differences among the different levels of analyses such as Census regions, counties, organizational markets, MSAs, etc. (Markham & McKee, 1991). This multi-level approach would clearly be valuable to smaller, private



economic actors that need to monitor needs and opportunities that are regional by nature (Das & Bing-Sheng, 1999). For example, many entrepreneurs cannot easily align organizational strategies with industry changes. It is simply too costly for these organizations to access frequently changing data and make sense of variables that act differently within and between markets.

However, these visualization models could help the public sector, too. In particular, public entities operating at a regional or state-level could achieve improved process congruence if each lower-level entity were better equipped to adjust production systems in a timely and efficient manner, by relying on macro-information that was collected through models that encompass regional and state-level data.

The full value of this approach, however, cannot be captured in metrics that emphasize optimizing economic efficiency in support of increased gross domestic product (GDP), because raising GDP may not be the ultimate goal for local communities, regions, and even states. Therefore, this project introduces a two-pronged approach to supporting regional economic development in a dynamic, highly integrated, and complex economy: 1) the conceptualization of economic development as an activity sensitive to the location of resources in proximity to one another, and (2) supporting decision-making by identifying geographical patterns within and between economic activity that may affect economic well-being.

LITERATURE REVIEW/THEORY

Economic Growth

Economic growth is defined as an increase in the production of economic goods and services, from one period to another. It can be measured in nominal or real terms (i.e., adjusted for inflation). Traditionally, aggregate economic growth is represented by gross national product (GNP) or gross domestic product (GDP), although alternative metrics can be used (Fagerberg et al., 2010). Economic growth is modeled as a function of physical capital, human capital, labor force, and technology. The model assumes that increasing the quantity or quality of the working age population, combined with improved technology and methods of production, will lead to increased economic output.

Economic growth is measured by increases in aggregate production in an economy. It is assumed that aggregate gains in production correlate with increased average marginal productivity, which in turn leads to an increase in incomes, higher consumption, and ultimately a higher material quality of life or standard of living. The post-war era in the 1950s and 1960s were examples of rapid increases in aggregate production in the United States with corresponding income growth, although followed by stagnant and more uncertain growth cycles over the subsequent five

decades. Similarly, the neoliberal expansion in China following market liberalizations by the central government led to even higher growth rates in the late 1980s, 1990s, and early 2000s as the economy embraced modern supply chains, heavy capital investments in production systems, and global trade (McNally, 2011).

China's experience demonstrates some of the challenges associated with rapid economic expansion and unequal geographic developments, but the contemporary American economy also exhibits wealth inequalities and geographic distributions that are also quite staggering. Economists have focused extensively on income and wealth inequalities following the 2008 financial crisis. However, these examinations are often done in the aggregate, and few economists have paid significant attention to the underlying regional challenges from a geographic standpoint. Urbanization and the gradual transition from rural and primary and secondary industries to service-based economies have complicated the study of regional development and have also made it even more important to understand how policies aimed at augmenting economic development for the sake of growth alone can be detrimental for communities and larger regions (Harvey, 2018).

Drivers of Regional Economic Growth

The contribution of innovation to regional growth has been widely identified and documented through studies on innovation, competitiveness, and economic growth (Ewers, 2019). Advanced economic activities tend to possess a high market value, resulting in a competitive advantage at least during the first stage of the diffusion process. As a result, these advanced economic activities provide new, and at times unique, opportunities for the development of firms, and the expansion of market shares, profitability, and employment growth (Wang & Tan, 2021). Regions characterized by a high level of technological innovation typically show a greater acceleration of economic growth than regions with slower innovation patterns. These high innovation regions also attract investments at a higher rate.

Technology diffusion is a complex process, involving changes in the behavior of economic agents. Many studies emphasize the great importance of the technology diffusion process for market development. Therefore, societal expected return on new technology without the diffusion process remains insignificant and limited to product-specific production within the individual firm. Nonetheless, there are few examples in rural communities of programs that are specifically designed to foster technology diffusion (Ghezzi et al., 2013).

Regional economic competitiveness is directly and strongly dependent on the spatial diffusion of innovation processes. Innovations occur somewhere in space and time, and until the new technology is fully diffused, innovations, creations and/or adaptations are marked by regional spatial variations. For example, potential solutions to industry-specific challenges often remain hidden on college campuses



and in laboratories not frequented by those who would benefit most from the academic progress being made.

The most powerful paradigm for technological progress remains Schumpeter's model of evolutionary process, and the interpretations and extensions of the model. According to this model, ideas, innovations, and technologies compete for resources in an environment characterized by economic scarcity. Ultimately, the technology most suited to the times and the conditions is expected to triumph, though the process may be long, time-consuming, and somewhat inefficient. The Schumpeterian evolutionary models imply that as technology ages, more and more firms gain the opportunity to learn and use it as they observe other firms and adapt.

However, most firms do not possess skills, capital, or capacity to innovate at the scale necessary unless they operate in a field where innovation is a core competency (e.g., information technology, software development, design innovation, etc.). Unlike with Silicon Valley-style innovation, most manufacturers and service providers in rural areas of the U.S. cannot host their own R&D operations and instead need the expertise acquired from a dedicated research entity and/or thorough inter-sector collaboration (Harfst et al., 2017). Public sector officials and industry leaders often emphasize the important role of information and knowledge in the process of technological change and the diffusion of innovation as critically important for regions to advance economically. Obviously, advanced means of communication can support disseminating knowledge over space, yet, in regional economies, the dissemination does not occur automatically – the element of space may have to be overcome as a necessary component in the process of regional development and economic growth.

The precise nature of the process by which innovation procedures diffuse through an economy, from region to region, and from one economy to another - and through which one firm learns from another - is very important, because it is a crucial determinant of competitive advantages for our regions and local communities.

The business milieu of a community or region, upon which sustainable development depends (Bergvall-Kåreborn et al., 2009), may be characterized by five general attributes: (1) basic location factors (e.g., labor, land, infrastructure, capital), (2) quality of life, (3) existing organizational structures, (4) business and finance regulations, and (5) support around environmental initiatives (Löfsten & Lindelöf, 2003).

Some of these elements are fixed and cannot be altered, improved, or replaced. However, each of the five categories include elements that may be flexible or susceptible to improvement. The innovative milieu should therefore be perceived as an opportunity to enhance the innovative capability of firms and local economies to provide real-world experiences for entrepreneurs and possibly students enrolled in

higher education. From an industry standpoint, it would be a cost-reducing agent or factor that diminishes uncertainty and increases production efficiencies.

Challenges/Opportunities with Regional Economic Development

Focusing on economic growth alone is not sufficient to enhance quality of life and standards of living across and within regions because regional economic competitiveness also depends greatly on the quality of supporting institutions (Nelson, 2008). There is a strong correlation between the quality of regional institutions and its overall competitiveness. Unlike the ability to tax, plan, legislate and enforce laws, the regional economic success of a city depends upon stakeholders' willingness to support effective and strong institutions.

Moreover, a narrow focus on economic growth may appear myopic or short-sighted if the growth proves unsustainable, and external economic factors rapidly undo the benefits of that growth. Many small and mid-sized cities and towns across the U.S. are struggling because their economies were built largely on a single economic sector that has changed significantly in recent years. For example, if jobs might have been heavily concentrated in industries like agriculture, food processing, or related manufacturing, but technology and market forces have significantly automated or otherwise transformed these sectors, then the regions may no longer require a large workforce - or at least not the same type of workforce. And the new jobs may require different skills (Drozдов, 2015). And not only technology shifts, but other kinds of changing circumstances, such as those caused by resource depletion, globalization, or shifts in consumer preferences, can shake the economic foundations of communities, leaving people without jobs and cities without a healthy tax base.

Alternatives to traditional economic development efforts are beginning to emerge in the United States. Rather than simply seeking to attract major employers to replace lost jobs, some cities have tried a different method to anticipate and overcome some of these challenges with "smart growth" economic development, which is a strategy that builds upon existing assets, takes incremental actions to strengthen communities, and builds long-term value to attract a range of investments (Edwards & Haines, 2007).

The three core components of such smart growth strategies are (1) supporting businesses, (2) supporting workers, and (3) supporting quality of life.

Supporting Businesses

Attracting new businesses and supporting and expanding existing businesses contribute to economic development in several key ways, including (1) helping businesses create jobs, (2) encouraging entrepreneurship, (3) enhancing fiscal sustainability by expanding and diversifying the tax base, and (4) improving quality of life with new services and amenities (Perley et al., 2017).



The strategy of supporting businesses for smart growth focuses on understanding the current composition and location of businesses, jobs, and potential emerging entrepreneurs in the community (Artmann et al., 2019). This information can help reveal how well businesses serve local residents and contribute to quality of life, and which industries have the most potential to drive sustainable economic growth in the future.

Targeting key economic sectors for growth allows regional actors to direct their economic development efforts in a strategic manner, which helps communities use their limited resources wisely (Bibri, 2019). This part of the smart growth economic development strategy considers not only the businesses and industries with the greatest growth potential, but also where these businesses are located and how their location helps the community meet its economic, environmental, and other goals.

Supporting Workers

Workforce development is important to ensuring that residents can successfully compete for employment opportunities and that all residents have the opportunity to benefit from economic prosperity. The availability of a workforce with a wide range of skills and education levels can help local businesses grow and attract new businesses.

Quality of Life

By offering residents opportunities to learn skills for a wide range of jobs, workforce development efforts might also reduce the need for residents to commute long distances to find appropriate employment, thereby improving quality of life and reducing pollution from vehicles. This smart growth economic development component focuses on how well the skills and education of the local workforce align with the needs of existing and growing industries and provides insight into what the community could do to help workers better match businesses' needs (Aliakbari et al., 2019).

Economic Growth vs. Economic Well-Being

As Harvey (2007) suggests, economic development is not the same as growth. Development greatly depends on social relations, communal structures, and relations to nature, and does not necessarily align with the needs of invested capital. Similarly, the strengths of local and regional institutions, matter a great deal when it comes to a region's development and the region's ability to adapt to economic changes.

Impacts and responses to global influences also matter. Whereas some regions are more closely tied to global trade through industry clusters focused on exports, other

regions produce more for local consumption. Different regions will therefore develop in different ways due to their history, culture, location, and political-economic conditions. Outside developments can be supportive or complementary to local production, while others might be deleterious or even antagonistic (Harvey, 2007).

Economic development should be viewed as more multifaceted than simply stimulating growth and job creation. Ultimately, the objective of economic development should be the economic well-being of the affected communities. Economic well-being means that people have their most basic survival needs met as well as additional resources necessary to prosper (Dynan & Sheiner, 2018). Economic well-being is already recognized as an important construct by the federal government in the United States and is increasingly viewed as critical for a society's health and prosperity, and a way to ensure that economic decision-making also accounts for environmental sustainability (Chrysopoulou, 2020).

Whereas growth viewed in isolation often benefits investors from outside the region – especially in regions where local entrepreneurship plays a minor role in the industrial portfolio – per capita personal income in the region is a better measure of successful development. Specifically, growth in wages and salaries is a crucial indicator of economic well-being, because a high personal income from any source could be due to passive income, such as transfer payments, rents, capital gain, interest, and dividends.

Income equality is also frequently used as an indicator of sound economic development and is typically associated with lower social and economic problems (Wilkinson & Pickett, 2020; Stiglitz, 2017). Similarly, poverty and unemployment rates are other considerations not captured by the traditional measures of growth and job creation. Dependence on income sources other than those tied to work also reflect a region's ability to support economic well-being. Finally, net migration patterns reflect the attractiveness of regions.

METHODOLOGY

Our spatial analysis and visualization involved the following stages: Data acquisition (hypothesis generation), exploratory regressions, ordinary least squares (OLS), geographically weighted regressions (GWR), and data visualization and initial analysis. At each stage we refined variable selection from the input categories of Innovation 2.0 including Human Capital & Knowledge Creation, Business Dynamics, Business Profile, and Social Capital (Slaper et al., 2016). Exploratory regressions provided different lenses through which to view the data. OLS and GWR tools in GIS allowed us to generate geospatial and visualization products to this paper. All geospatial-statistical analyses used the geographic information system (GIS) software ArcGIS Pro 2.8.2 by Esri Inc.



The geographic data central to the analysis was acquired as prepackaged spreadsheets delivered by StatsAmerica.org, Innovation Index 2.0 (Slaper et al., 2016). The single file included populated fields for a selection of variables used by the EDA to produce the rankings, medians, and index values per county for the full United States. Because the geospatial components of the analysis relied on topology, the data only covers the 3,080 counties of the contiguous United States. Distribution patterns of variables within groupings, called neighborhoods, the relationships between neighborhoods, and correlations between adjacent features are limited to adjacent counties. Each county and its neighbors were analyzed as neighborhoods with weight given to connectivity and variation over distance.

Upon completion of the national-level analysis, which considered geographical relationships without regard to whether adjacent counties were in different states, we looked for patterns within a state. The visualization of clustered features is more useful when restricted to the state or sub-regional level because regional experts and officials can examine the results relative to their area of focus and specialization. For this paper, the state of Minnesota was selected because of the authors' familiarity and expertise.

Regression Analysis

GDP per worker is often used by policy makers and market analysts to convey trends in economic well-being. Although GDP does not closely correspond to the economic well-being index used in this paper, which comprises numerous measures (Slaper et al., 2016), GDP per worker along with other known influential variables were initially assessed using exploratory regressions. Each variable was tested for its viability and significance using an OLS regression model and spatial autocorrelation (Jang et al., 2021). As expected, several different variables could potentially explain the observed patterns. A review of each individual coefficient of determination (R^2) and corrected Akaike information criterion (AICc) ranked GDP per worker as a first choice, with variables related to education attainment ranking a close second. Thus, GDP per worker was not the sole categorical influencer of economic well-being, which warranted further analysis.

County-level spatial data incorporating the two variables were then processed through global OLS linear regression and GWR. The two models were run in parallel as seen in Figure 1. While traditional OLS offers a sufficient means of regression with a regression coefficient fixed over the entire sample area, GWR considers sample variation over space (Ali et al., 2007). We found that the OLS and GWR regression models generated significant differences in the spatial econometric analysis.

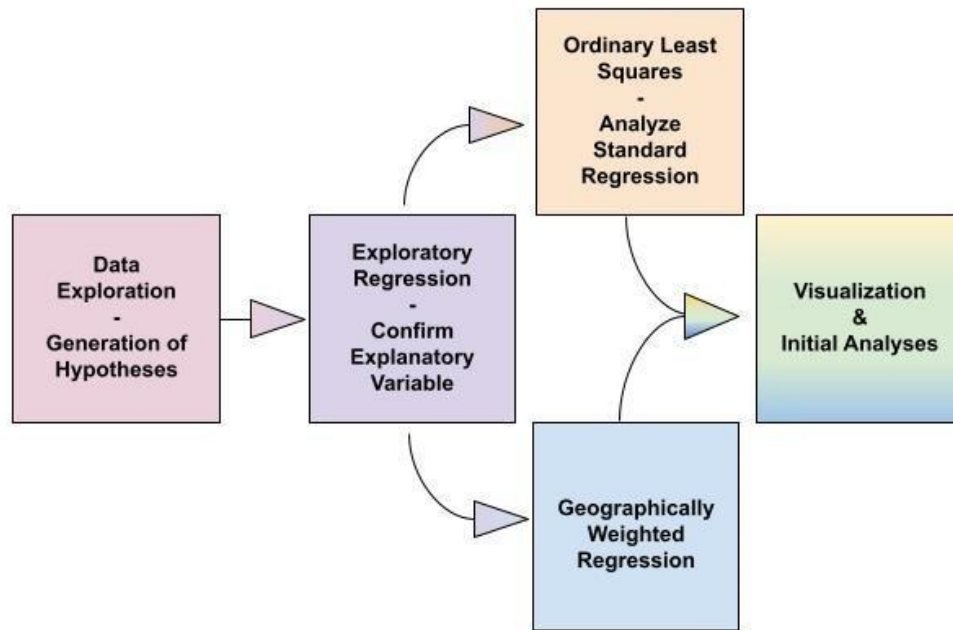


FIG 1. FLOW CHART OF PAPER ANALYSES

RESULTS

OLS and GWR Results

The OLS map depicted in Figure 2 reveals significant non-random clustering of county results. The significance measure for the spatial autocorrelation is shown in Figure 3. The significant clustering at the national level could result from a variety of factors and other explanatory variables that appear to cross multiple states and regions. When compared per county to the Economic Well-Being index (Figure 4) and the GDP per worker index (Figure 5), the OLS regression produced clustering closely related to the original index values of the dependent variable.

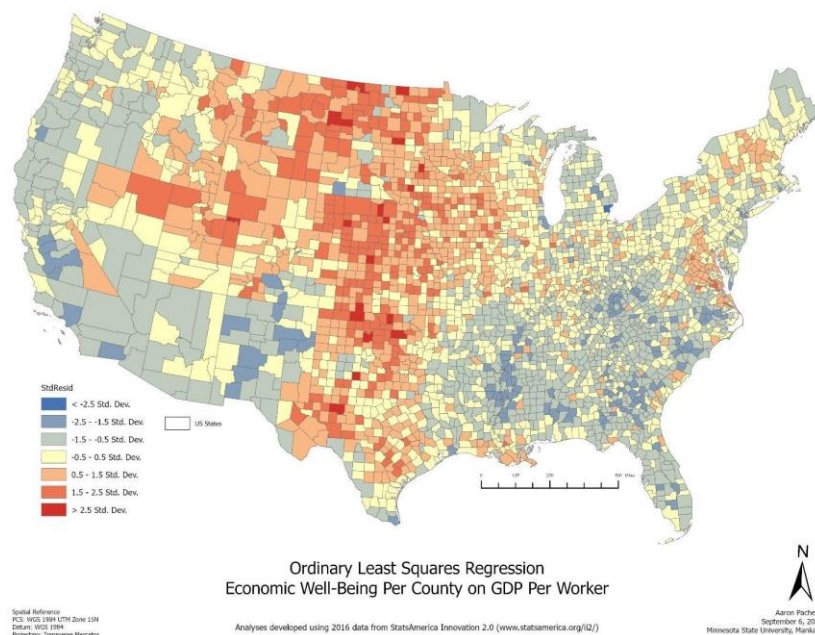
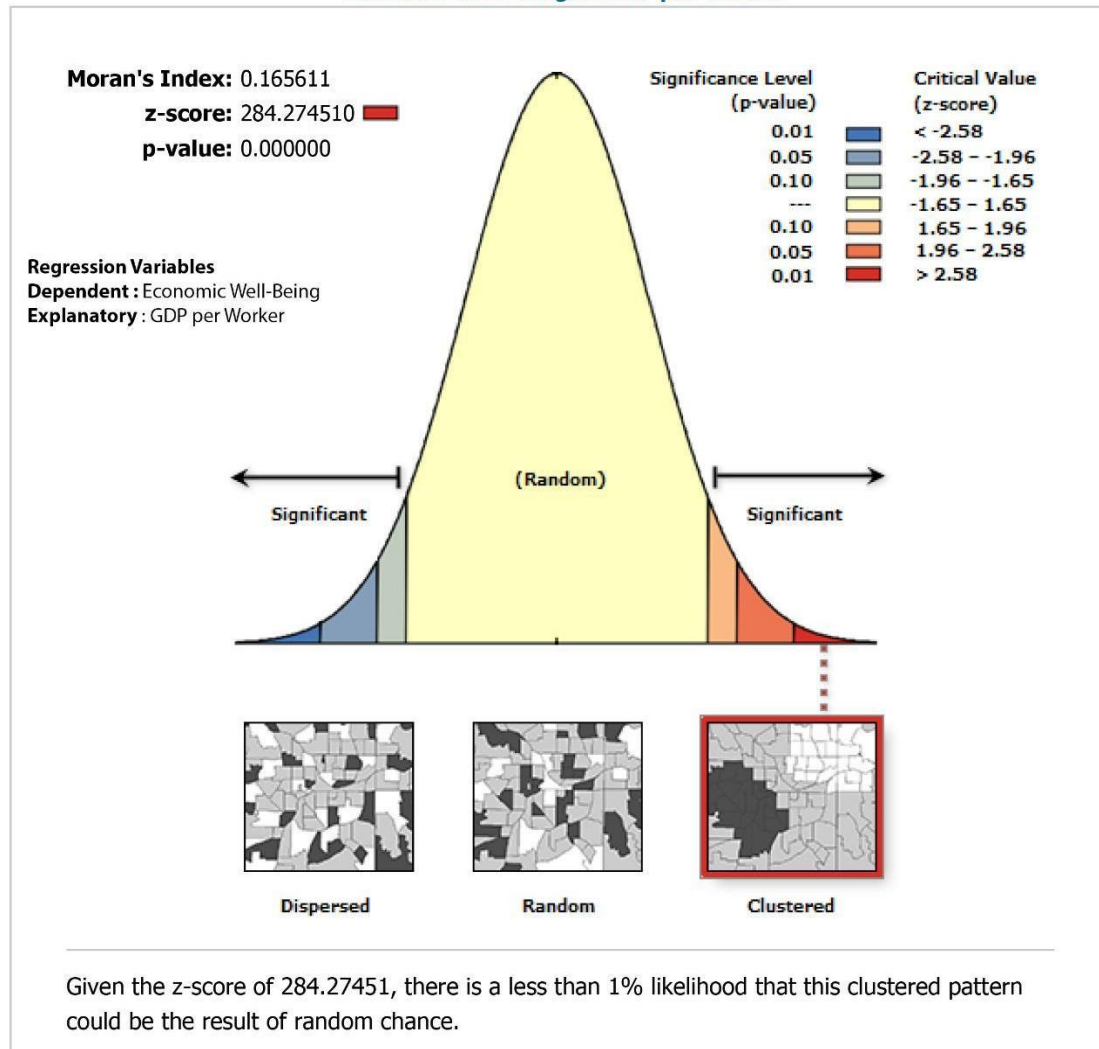


FIG 2. OLS REGRESSION FOR CONTIGUOUS UNITED STATES

Spatial Autocorrelation Report

Ordinary Least Squares Regression
Economic Well-Being on GDP per Worker



Global Moran's I Summary

Moran's Index:	0.165611
Expected Index:	-0.000325
Variance:	0.000000
z-score:	284.274510
p-value:	0.000000

FIG 3. SPATIAL AUTOCORRELATION OF OLS REGRESSION

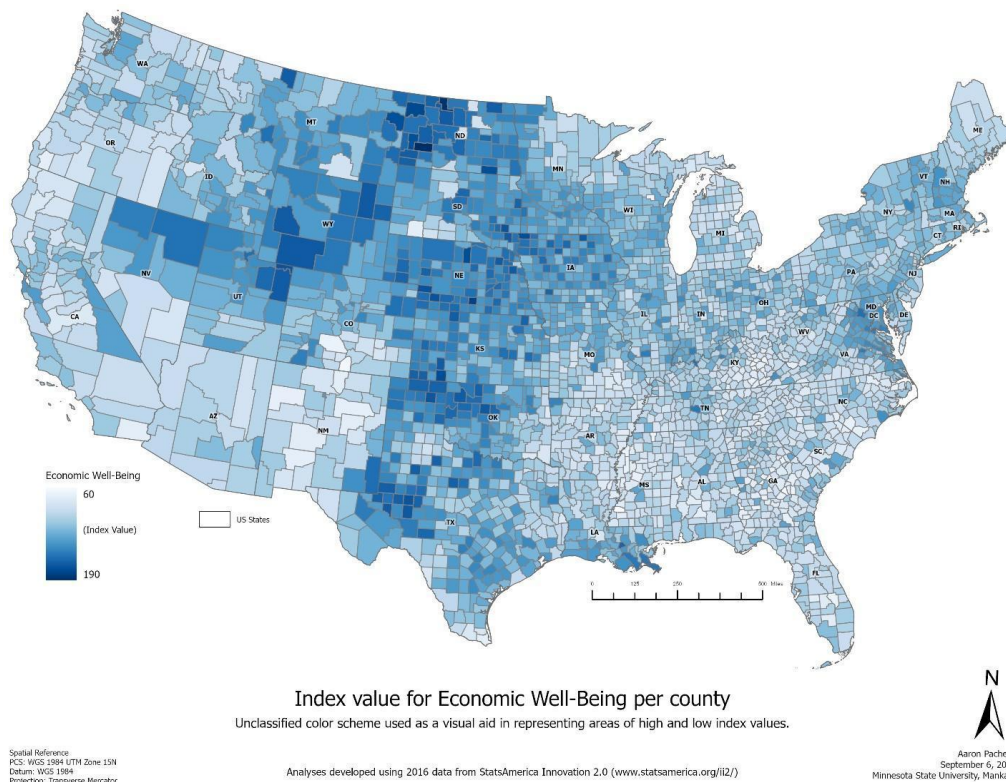


FIG 4. ECONOMIC WELL-BEING PER COUNTY

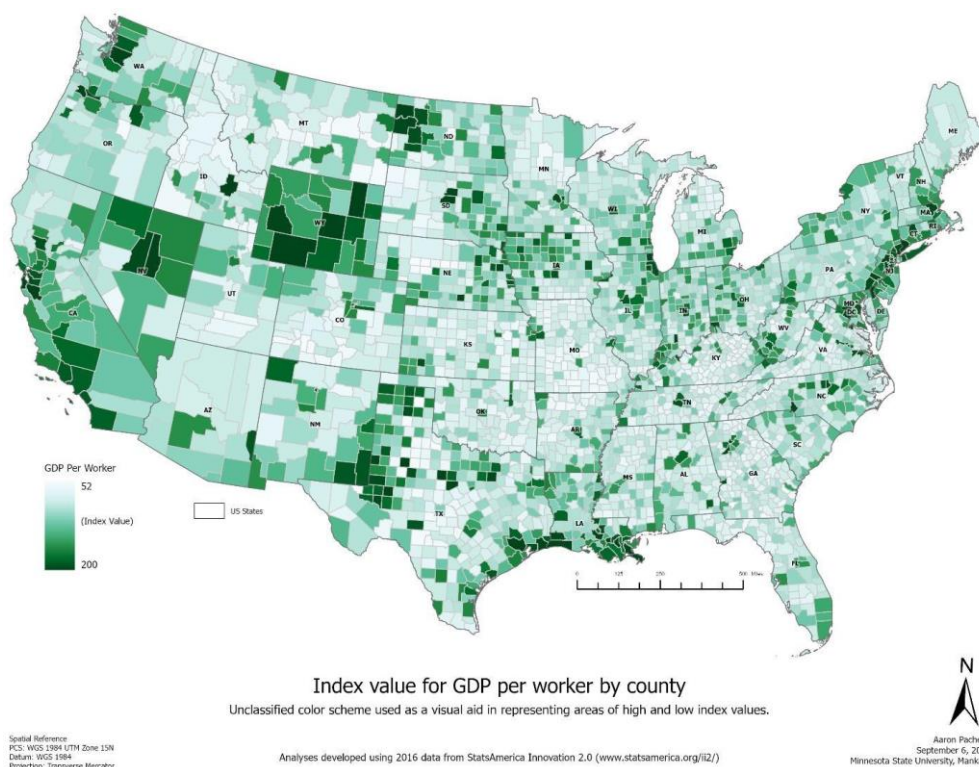
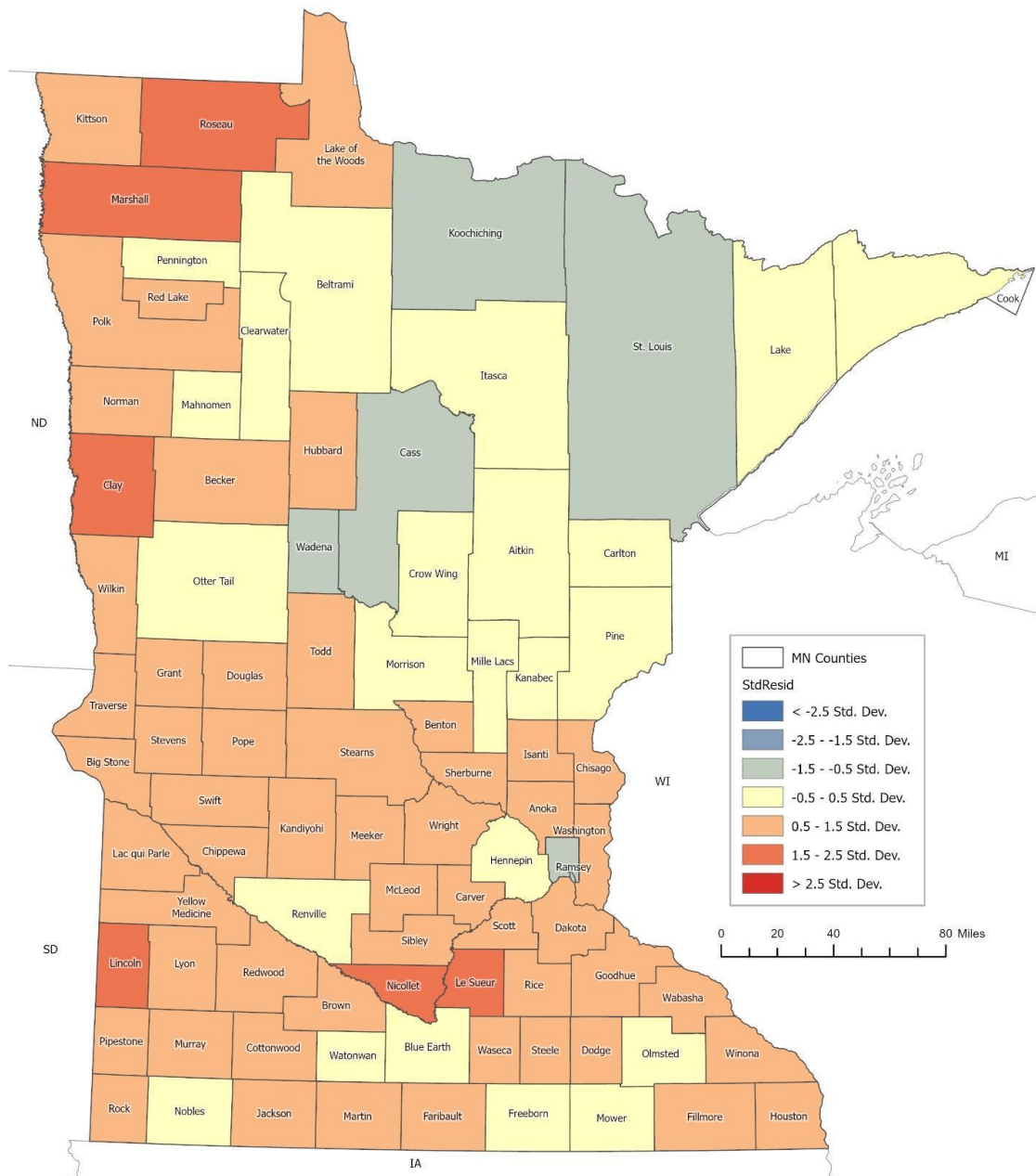


FIG 5. GDP PER WORKER PER COUNTY

The clustering of effects is not surprising. Production requires geographic concentration of money, means of production, and local labor force availability.



Proximity to each of these increases the competitiveness of regional industry, which is reflected by the clusters. The effect is magnified when the production clusters are also close to consumer markets and/or the production of other export goods. Figure 2 shows widespread clustering at the national level. At the state level (Figure 6), clusters define economic regions that can guide state policy making.



Ordinary Least Squares Regression
Economic Well-Being Per County on GDP Per Worker
(Performed for contiguous U.S. and cropped to state-level post-regression)

Spatial Reference
PCS: WGS 1984 UTM Zone 15N
Datum: WGS 1984
Projection: Transverse Mercator

Analyses developed using 2016 data from StatsAmerica Innovation 2.0 (www.statsamerica.org/ii2/)

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FIG 6. OLS RESULTS LIMITED TO MINNESOTA

A key element in GWR over OLS is the introduction of weight matrices for neighborhoods of grouped features (Ali et al., 2007). The resulting map and distribution of residuals in Figure 7 could be mistaken for a random pattern, but because both clustering and dispersion can be statistically significant, the resulting spatial autocorrelation (Figure 8) reveals a geographical pattern with less than one percent chance of randomness.

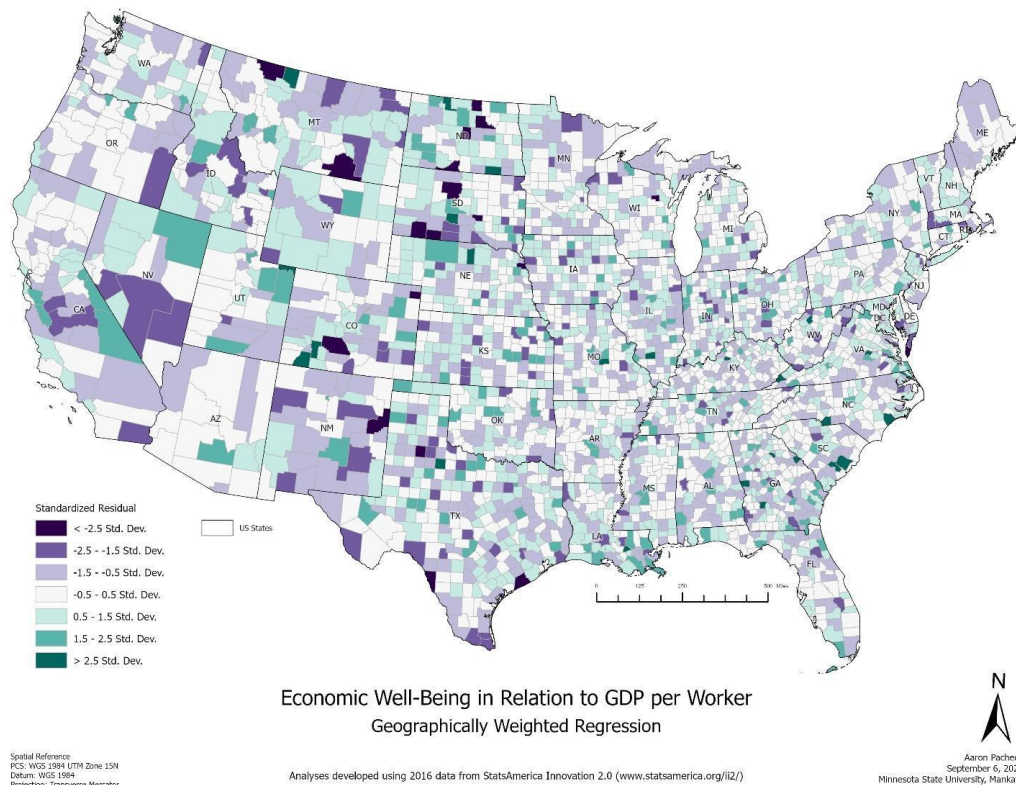
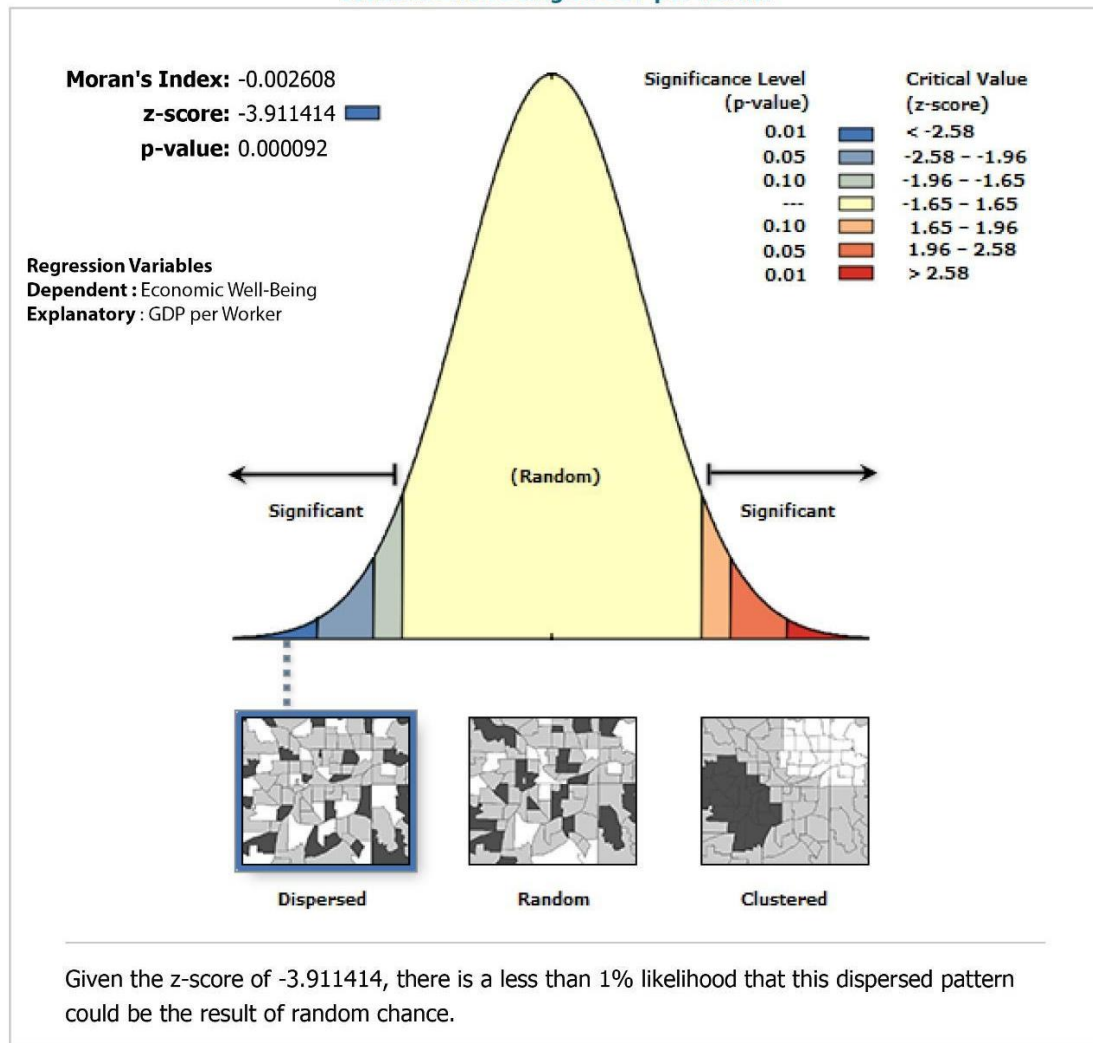


FIG 7. GWR RESULTS FOR CONTIGUOUS UNITED STATES

Dispersed patterns on a small map scale (e.g., lower 48 states) are less effective at displaying significant clustering information. When examining the same data on a larger map scale (e.g., state-level) seen in Figure 9, the significance of the information becomes clearer. The residuals of the Minnesota counties demonstrate geographic relationships between features such as the Minneapolis-Twin Falls center versus the surrounding suburbs or between agricultural and mining regions to the north and south.

Spatial Autocorrelation Report

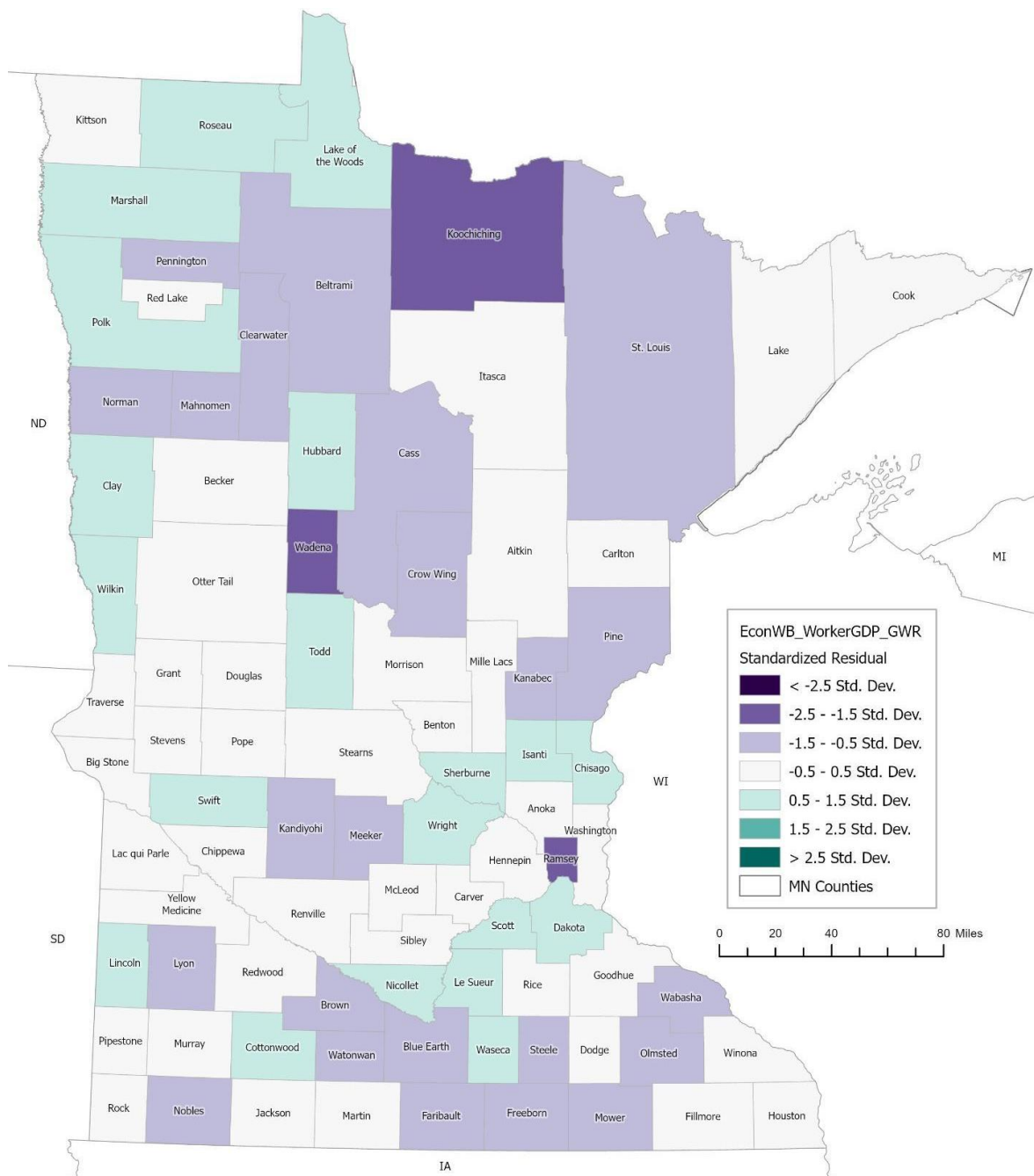
Geographically Weighted Regression
Economic Well-Being on GDP per Worker



Global Moran's I Summary

Moran's Index:	-0.002608
Expected Index:	-0.000325
Variance:	0.000000
z-score:	-3.911414
p-value:	0.000092

FIG 8. SPATIAL AUTOCORRELATION OF GWR



Economic Well-Being in Relation to GDP per Worker
Geographically Weighted Regression

Spatial Reference
PCS: WGS 1984 UTM Zone 15N
Datum: WGS 1984
Projection: Transverse Mercator

Analyses developed using 2016 data from StatsAmerica Innovation 2.0 (www.statsamerica.org/ii2/)

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FIG 9. GWR RESULTS LIMITED TO MINNESOTA

The health care and social services sectors are the leading employers in Minnesota and both sectors are expected to continue growing. Among traded clusters, medical device manufacturing and marketing are the two strongest clusters in the state. Construction is also trending upwards and exhibits high earning potentials for the foreseeable future. The Minnesota population is getting older and more diverse. Rural counties are experiencing high net outmigration, or, in some cases, only maintaining



population through an influx of non-white workers filling essential labor positions. Minnesota is experiencing increasing wealth inequalities, not only between individuals, but also geographically. As a state, Minnesota is doing well, but the great majority of counties are well below the national average when it comes to economic output and personal earnings. Human capital and knowledge creation, historically a Minnesota competitive advantage, appear to be at risk as innovation and technology diffusion now lag national and global trends (The innovation index, 2021). Access to capital for entrepreneurial ventures is also in decline, especially in rural areas.

The R^2 produced in the GWR visualization process helps assess how well GDP per worker describes economic well-being. Patterns emerge at national (Figure 10) and state levels (Figure 11), with darker areas representing the stronger correlation between GDP per worker and economic well-being, the lighter areas, showing a weaker correlation. These economic patterns would reasonably be expected to develop geographically, due to clustering of industrial activity, and geographic similarities within and between regions with shared history, culture, location, and political-economic conditions. It is reasonable to assume that relationships between economic growth and economic well-being form patterns throughout an economy and is not *accidental* or random. Because GDP variation is likely the result, not the cause, of the observed clustering, other measures should be explored to identify potential drivers of economic well-being.

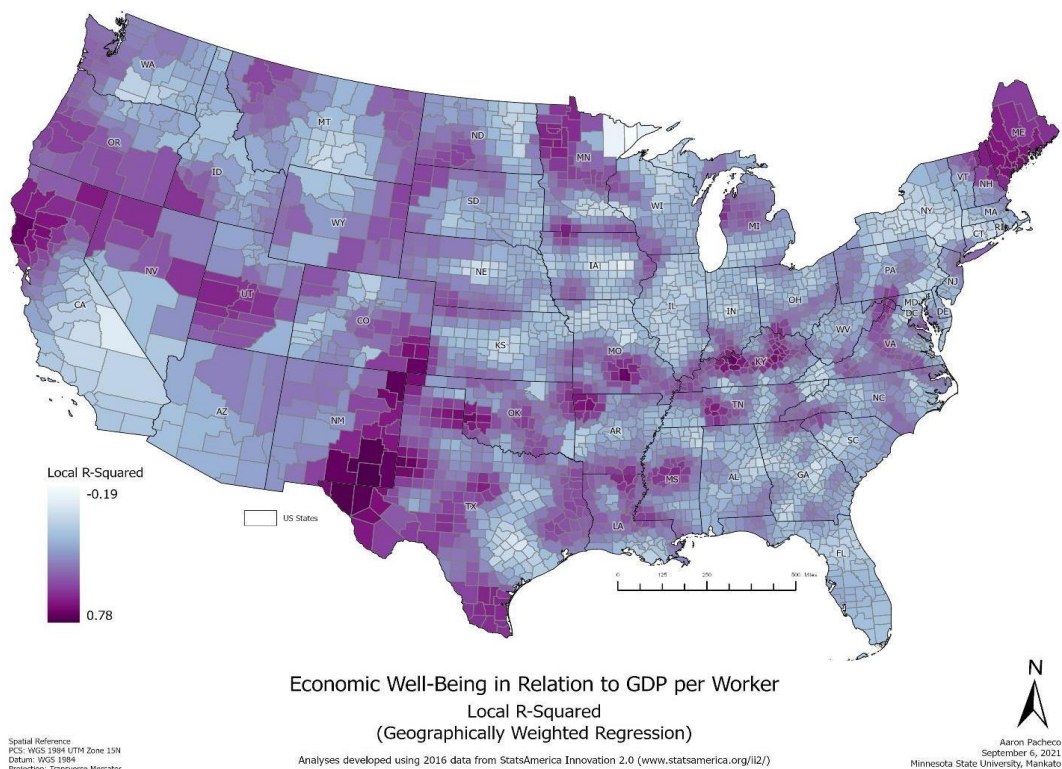
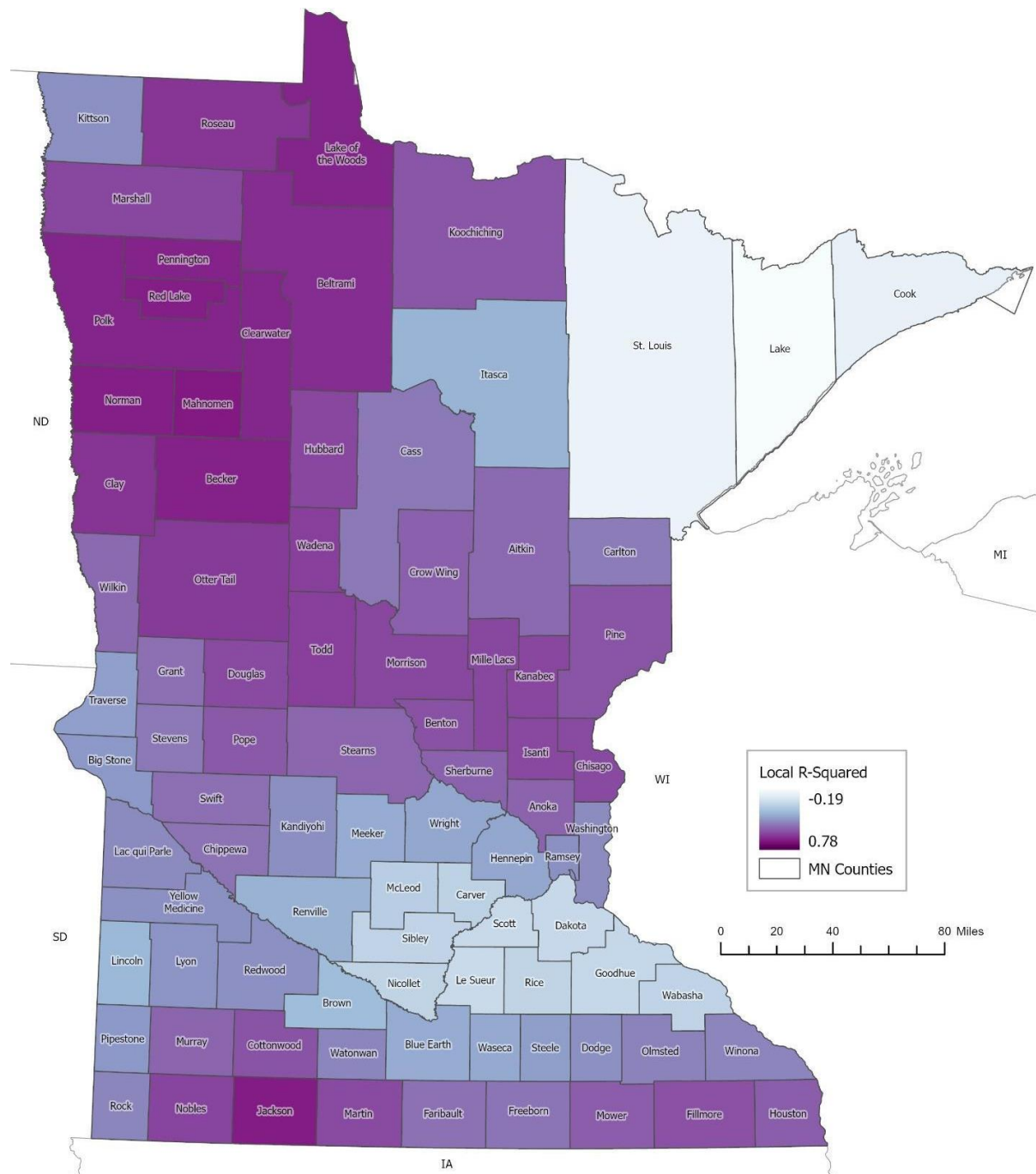


FIG 10. LOCAL R-SQUARED RESULTS LIMITED TO CONTIGUOUS UNITED STATES



Economic Well-Being in Relation to GDP per Worker Local R-Squared (Geographically Weighted Regression)

Spatial Reference
PCS: WGS 1984 UTM Zone 15N
Datum: WGS 1984
Projection: Transverse Mercator

Analyses developed using 2016 data from StatsAmerica Innovation 2.0 (www.statsamerica.org/ii2/)

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FIG 11. LOCAL R-SQUARED RESULTS LIMITED TO MINNESOTA

DISCUSSION

To support economic development, market analyses often consider the systematic changes in economic geography and sectoral composition over time. Economies often become more competitive by shifting activities both to higher value-add activities *within* existing industries and also to higher value-add industries (Christian, 2019).



However, increasing specialization in ways that are not complementary – i.e., that lack opportunities for mutually beneficial interactions – can undermine overall prosperity growth or economic well-being if aggregate economic growth, or GDP per worker, is the core outcome of interest.

Cluster Identification

Results from this study suggest that identifying clusters, defined as regional concentrations of economic activities in related industries connected through local linkages and spillovers, can be an important tool for guiding economic development efforts. Cluster identification reveals the interplay between location, value chains, and regional specialization patterns. Clusters can be identified in several dimensions:

First, the clusters are groups of related industries and the economies of scope that the relationships make possible. As the findings reveal, clusters are not simply a concentration of economic activity in a narrow industry, driven by economies of scale. They are crucially defined by the notion of related variety, where dynamism emerges from the combination of capabilities and activities that are complementary, not identical, or merely diverse, throughout regions (Lu et al., 2018).

Second, clusters are shaped by geographical proximity. On one hand, they reflect the specific nature and density of local connections, for example, in a deep local skill pool, in knowledge spillovers, and in deep collaborations among local partners. On the other hand, they take into account non-local relationships that stretch longer distances, such as global value chains and knowledge networks (Bathelt & Glückler, 2018). Cluster frameworks suggest that local and global connections play complementary but different roles. Local clusters can be the sources of unique competitive advantages, providing access to a specific set of local circumstances and partners. Global linkages add capabilities that are missing locally – no location provides everything - but can be copied by economic entities from other locations.

Third, clusters appear to be driven by the interplay of collaboration and competition among related activities within a given location. Clusters provide some benefits merely from the co-location of related activities – for example knowledge spillovers and deeper and more specialized input markets. However, the dynamic power of co-location is significantly enhanced if the co-located entities start to engage with each other directly (Yström & Aspenberg, 2017). This can happen through collaboration, for example in joint research or training efforts. However, it can also happen in the intense local competition among rival

firms, forcing them to adopt more differentiated strategies as well as enhancing productivity and innovation.

Fourth, the dynamics that can emerge in regional clusters are driven by the critical mass that geographically linked actors achieve in a set of related industries. If the related activities are few and the entities locally present are small, the number of actual linkages may be small as well. As the number of participants grows, the possible interactions increase geometrically. This drives a regionally dependent growth path, where clusters start showing significantly higher performance and growth once they move beyond a certain size (Götz & Jankowska, 2017). Clusters emerge naturally as the benefits of co-location affect the growth of firms differently across locations and enhance specific locations' attractiveness for firms that are moving. The process of cluster emergence is shaped both by the decisions firms make about their investments and ways of competing and by the decisions governments and other institutions make about relevant qualities of the cluster-specific business environment (Isaksen, 2016).

Fifth, clusters may experience economic growth without corresponding improvements in economic well-being. Indeed, the economic benefits intrinsic to clusters themselves, such as interdependence of geographically co-located complementary resources, offer new ways to increase economic growth even while overall economic well-being within the cluster is diminished when considering other measures. This may occur when high resource dependence, specialization within related sectors, and high degrees of traded (i.e., exported) clusters increase productivity even as the workforce is shrinking (e.g., due to out-migration), transfer payments increase (e.g., age-related benefits), and labor participation declines (Biermann & Harsch, 2017). Accordingly, regionally important clusters should be monitored not only for economic growth but also for economic well-being to detect threats to economic resilience that could lead to measured growth unaccompanied by the benefits of growth, or short-term growth followed by long-term decline.

Economic Well-Being and Growth

These results indicate that economic well-being is a key determinant of economic growth and not the other way around. In other words, ensuring economic stability, job opportunities, and prosperity is a critical component for areas and regions seeking growth, while growth in itself does not generate well-being. It is quite plausible that a regional economy produces enough wealth to sustain high levels of well-being, but if there are no mechanisms in place to facilitate local ownership of capital and revenues, earnings from growth may not be reinvested locally.

It is also possible that economic growth, contrary to neo-classical dogmas, leads to inefficiencies as regional workers perform more work than is required to produce their own consumption, i.e., a situation where the wage is below the average product of



labor. If so, one fails to fulfill the notions of *competitive markets* which would require a wage that is less than the value of the marginal product of labor. In labor intensive sectors of a regional economy, it is therefore quite plausible that there is a distribution problem, which is typically overlooked by neo-classical theories of economic development.

LIMITATIONS, FUTURE RESEARCH, AND PRACTICAL IMPLICATIONS

Regional economic well-being would be better measured by considering multiple states, and not only Minnesota. This would have allowed for an analysis of differences and similarities between states and within-state regions, while also examining between state specific differences. Economic well-being itself would be better measured by considering additional indicators such as quality of life, disposable income, etc. Although it might have been premature to develop additional measures before it was clear if these economic clustering relationships existed, or what within-state differences looked like, additional articulation of well-being measures and the comparison of clustering effects in multiple states is now warranted.

Additionally, the study was limited to single-year observations. Future studies should assess findings utilizing longitudinal data to assess the impact of long-term trends, economic disruptions, etc. Future research should also pay attention to how economic modeling assesses growth and how job creation is viewed as a tool to stimulate growth, particularly in rural segments of the economy. We know little about why a sole focus on economic growth is more detrimental in some regions than in others.

Future research is also needed to fully understand the benefits and risks of using economic growth to measure the success of economic development strategies designed to achieve resilient communities and improve quality of life for residents. Finally, future research should also examine the predictive differences among variables at different levels of analyses. Traditional economic development models have assumed that the same variables will impact models in consistent manners in very different geographic markets. If economic development efforts were to be translated to sources of competitive advantage, as suggested by the literature, taking multilevel implications into consideration should greatly benefit our understanding of these advantages.

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