Industrial Diversity, Growth, and Volatility in the Seven States of the Tenth District

By Alison Felix

State and local officials have long sought to diversify the mix of industries in their regions, hoping to reduce short-term volatility in their communities' economic growth rates and potentially boost overall long-term growth. Economic theory predicts that, just as diversifying an investment portfolio can help reduce risk, the diversification of industries in a given region can help reduce volatility in growth rates. The theory is that regions specializing heavily in only one or two industries will be tied closely to the fate of those industries, a condition that may lead to large swings in employment growth and wage growth. If instead employment is spread across many industries, then when one industry stumbles, others may still fuel the region's overall economic performance and mitigate volatility in its growth rates.

While theory suggests diversity reduces volatility, views are mixed on how industrial diversity affects long-term growth. According to one view, even if diversity does offer the benefit of reduced volatility, it might be detrimental to a region's growth prospects over time. Communities with diverse industries may be unable to achieve as much growth as more specialized communities because the latter can benefit

*Alison Felix is an assistant vice president and Denver branch executive with the Federal Reserve Bank of Kansas City. Adam Pope, an assistant economist with the bank, helped prepare this article. This article is on the bank's website at **www.KansasCityFed.org.***

from knowledge spillovers among firms within the same industry. A contrary view is that economic growth is maximized when numerous, *differing* industries are in proximity, allowing the cross-pollination of knowledge and skills among them.

A close examination of the evidence can help policymakers determine whether industrial diversity poses a tradeoff, providing increased stability but at the cost of slower growth, or whether it can offer the best of both worlds: increased stability and faster growth. The case of the seven-state region examined here—the Tenth District of the U.S. Federal Reserve System—sheds light on this policy debate. The analysis shows that counties with greater industrial diversity did see greater economic stability. However, differences in industrial diversity had no significant impact on overall growth, neither increasing nor restraining the growth rates for employment or wages.

Section I sets out a method for measuring industrial diversity, describes the Tenth District's industrial mix, and shows how it has shifted over time. Sections II and III, respectively, estimate the impact of industrial diversity on volatility and growth, in each case also examining the results after controlling for the effects of two key industries in the region: agriculture and energy. Section IV summarizes the two conclusions that emerge from the analysis. First, industrial diversification can benefit a community by promoting stability, without adversely affecting economic growth. Greater stability is an important benefit in and of itself, helping individuals and local governments plan for the future and avoid the disruptions inherent in volatile conditions. Second, diversification is not a driver of growth. Officials who want to promote growth may need to apply other approaches to the task.

I.   EXAMINING INDUSTRIAL DIVERSITY: THE CASE OF THE TENTH DISTRICT

This section describes the landscape of industrial diversity across the Tenth District, first introducing a measure of diversity that reflects how workers in a given area—in this case, in each county of the Tenth District—are distributed among different industries.[1] The measure varies considerably across the nearly 500 counties of the District, revealing widely differing levels of industrial diversification. Some counties specialize heavily in the energy and agricultural sectors, while

others feature varying degrees of specialization and diversification among other industries.
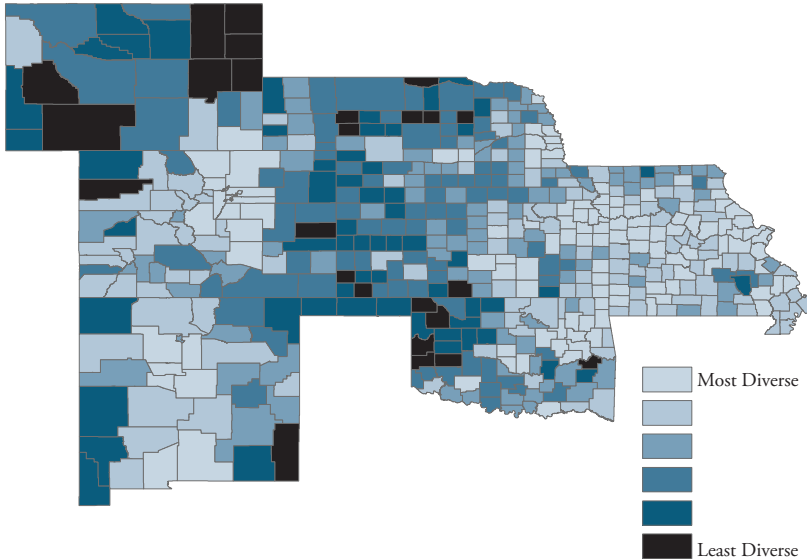
Measuring industrial diversity

Researchers use a variety of methods to measure industrial diversity. They have calculated diversity at different geographic levels, ranging from states and metropolitan areas to commuter areas and counties.[2] This study uses the "national diversity index," which measures a given county's level of industrial diversity by comparing its mix of industries with that of the entire country, making use of the fact that the United States has a highly diversified economy.

The national diversity index ranks a county as "more diverse" when the distribution of its shares of employment across industry categories is similar to that of the United States at large and "less diverse" when it is less similar. The distribution of industries across the highly diversified U.S. economy is thus used as a standard for comparison.

For purposes of this study, employment is divided among 15 industries: agriculture and forestry, energy, construction, manufacturing, transportation, information and utilities, wholesale trade, retail trade, finance, business services, entertainment, health care, education, other services, and public administration. The national diversity index is computed according to the formula below, in which the industrial diversity in county j is calculated by measuring, for each industry i, the difference between its employment share in the county and its employment share in the United States as a whole.[3]

$$Diversity_j = \sum_{i=1}^{15} \frac{\left\{\left[\left(\frac{emp_{ij}}{emp_j}\right)-\left(\frac{emp_i^{US}}{emp^{US}}\right)\right]^2\right\}^{1/2}}{\left(\frac{emp_i^{US}}{emp^{US}}\right)}$$

Lower values of the national diversity index indicate that the employment mix in a given county is very similar to the diverse employment mix across the United States, meaning that county is ranked as relatively diverse. The most diverse counties have low index values, and highly specialized counties have high index values.

Map 1

INDUSTRIAL DIVERSITY BY COUNTY IN THE TENTH DISTRICT, 2006-1010

Most Diverse

Least Diverse

Source: Diversity index calculations based on U.S. Census Bureau data from the Bureau's "American Community Survey," using a five-year sample from 2006 to 2010.

The landscape of industrial diversity

Across the seven states of the Tenth District, many counties stand out in the extent to which their industry mix differs from that of the nation as a whole. The variation in industrial diversity across counties is shown in Map 1.[4] Lighter shades of blue indicate that a county's mix of industries is more diverse, while darker shades indicate it is less diverse. Some counties have diverse employment mixes that closely mirror the diverse distribution of industries across the nation. Many, however, have high concentrations in one or two industries. For example, Oklahoma and Wyoming specialize in the energy sector; Wichita specializes in aerospace manufacturing; and parts of Kansas and Nebraska specialize in agriculture.

Some of the Tenth District counties that specialize in agriculture and in the energy sector (in this case, predominantly mining) have especially large concentrations of employment in those sectors. For example, three counties have more than 50 percent of their workforce

employed in agriculture and three other counties have more than 20 percent of their workforce employed in energy.[5] Such concentrations account for the low levels of industrial diversity in those areas.

But there are also counties in the District that have high concentrations in other industries when compared with the nation as a whole, including construction, manufacturing, service industries (including finance, as well as the joint category, professional and business services), transportation, entertainment and leisure, and education. The high concentration of these industries in some parts of the Tenth District is described in Box 1, which shows examples of specific counties specializing in each industry.

In contrast, highly populated, metropolitan areas generally are more diverse than rural areas and have an industrial mix that looks more like that of the nation as a whole. For example, counties in the metropolitan areas surrounding Albuquerque, Denver, Fort Collins, Kansas City, Oklahoma City, Tulsa, and Omaha are much more diverse than other parts of the District.

How industrial diversity has changed over time

The industrial mix of employment across the United States changed significantly from 1980 to 2010, as it also did in the Tenth District.[6] Nationwide, the shares of employment in agriculture, energy and manufacturing declined, while employment in service industries such as healthcare, leisure and entertainment, and professional and business services increased. Similar trends occurred in Tenth District states, where the expansion of some industries and the contraction of others had varying effects on industrial diversity. Many counties in the Tenth District grew even less diverse in their mix of industries than the nation at large.

Employment in agriculture and energy, as shares of total employment, declined almost as steeply in the Tenth District as they did in the United States as a whole. Both industries' shares of total U.S. employment declined by half or more from 1980 to 2010. Agriculture, for example, saw its share of national employment fall from 3.0 percent to 1.4 percent. In the Tenth District, on average across counties, the share of employment in agriculture fell by slightly less than half, from 15 percent to 8.5 percent.

BOX 1
INDUSTRIAL DIVERSITY ACROSS THE
COUNTIES OF THE TENTH DISTRICT

Across the seven states of the Tenth District, many counties have high concentrations of employment in particular industrial sectors, ranging from agriculture and energy to the education, entertainment, and leisure industries.

Agriculture and Energy

Employment in the agriculture industry made up more than 20 percent of total employment in 44 counties in District states, primarily located in Nebraska and Kansas, during the 2006-2010 period. (There are currently 510 counties in Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Wyoming.) In the United States overall, only 1.4 percent of all employment was in the agriculture industry during the same period. Twenty one counties in District states had more than 10 percent of employment in the energy sector—specifically, in mining—whereas, in the nation as a whole, only 0.5 percent of total employment was in the mining industry.

- In the three least diverse counties, Wheeler, Arthur and Blaine—all located in Nebraska—employment in agriculture was greater than 50 percent of total employment.

- Most mining-intensive counties are located in Wyoming and Oklahoma, but Colorado, New Mexico and Kansas also have several counties with high mining employment.

Construction and Manufacturing

Construction employment made up 7.1 percent of employment in the United States but in 21 counties of the Tenth District, particularly in Colorado, the share was more than double that during the 2006-2010 period. Manufacturing is another industry in which many counties in the District specialize. Thirty-three counties in District states had more than 20 percent of their workforce employed in manufacturing, compared with just 11 percent in the nation as a whole.

- Most of the counties with high concentrations of employment in manufacturing industries are located in Nebraska, Kansas and Missouri.

Finance, Professional and Business Services, and Transportation

In services industries, several counties around Denver, Kansas City and Omaha have a high concentration of workers in the finance industry. Several counties in the Denver metropolitan area also have large concentrations of workers in professional and business services. Although transportation employment made up only 4 percent of total employment nationally, in the

2006-2010 period, four Nebraska counties had transportation employment shares more than three times higher.

- Los Alamos County, New Mexico, stood apart from the nation with more than 50 percent of its employees in the professional and business services category, due to the presence of Los Alamos National Laboratory.

Education; and Entertainment and Leisure

Education employment is high in many counties in the District, several of which feature major universities. The entertainment and leisure industry is also important in many counties of the Tenth District. Many mountain counties in Colorado, Wyoming, and New Mexico rely heavily on this industry as does Taney County, Missouri (home of Branson).

- Counties with more than 25 percent of their workers in the field of education included Albany County, Wyoming, home of the University of Wyoming; Riley County, Kansas, home of Kansas State University; and Payne County, Oklahoma, home of Oklahoma State University.

Map 2 shows the change in the diversity index for counties of the Tenth District from 1980 to 2010, based on a comparison of each county's national diversity index value in 1980 with its value in 2010. Lighter shades of blue indicate that a county's mix of industries became more diverse, while darker shades indicate it became less diverse. Overall, the counties' diversity index values in 1980 were highly correlated with changes in those values over time. In particular, counties that were not very diverse in 1980 tended to become even less diverse by the end of the period, due largely to their increasing reliance on the agriculture and energy sectors.

But there were also exceptions. For example, some counties that started in 1980 with a large share of employment in the energy industry actually grew more diverse by 2010 as their concentration of employment in energy declined. And although manufacturing activity declined as a share of total employment nationwide—and also declined from 13.1 percent to 9.9 percent on average in the Tenth District—manufacturing actually rose in some Tenth District counties.

Box 2 provides more detail on some of the counties of the Tenth District that saw the greatest changes in industrial diversity over the 30-year period.

BOX 2
CHANGES IN INDUSTRIAL DIVERSITY
ACROSS TENTH DISTRICT COUNTIES

The landscape of industrial diversity across the seven states of the Tenth District changed significantly from 1980 to 2010, with the industrial mix growing much less diverse in some counties and much more diverse in others.

Agriculture

From 1980 through 2010, the share of employment in agriculture decreased in many counties across the seven states of the Tenth District. In particular, many counties in Nebraska saw large declines in agriculture employment. For instance, agriculture's share of employment fell from 70 percent to 26 percent in McPherson County, 41 percent to 12 percent in Gosper County, and 60 percent to 33 percent in Hayes County just to name a few.

In some cases, community leaders actively attempted to diversify their communities. For example, one of the key missions of the Box Butte Development Corporation, which was formed in 1986, is to diversify the economy of Box Butte County, Nebraska away from agriculture and the railroad. In addition, the stated emphasis of the Nebraska Department of Economic Development "is growing and diversifying the state's 'economic base,' bringing new dollars to the state."

Energy

The share of employment in the energy sector also fell. Averaging across all counties in the Tenth District states, employment in the energy sector (mainly mining) fell from about 3.7 percent to 2.0 percent in the last three decades. Over the same time period, the share of employment in energy fell by about half in the United States. from just over 1.0 percent to 0.5 percent.

Many counties in the Tenth District saw steep declines in the energy sector. For example, the share of mining employment fell from over 20 percent in 1980 to less than 2.0 percent in 2010, in Lake County, Colorado; San Juan County, Colorado; Mineral County, Colorado; Valencia County, New Mexico; and Chaffee County, Colorado. In Lake County, Colorado the decline was due to the closing of the Climax Mine in 1987 which forced the county to diversify (Raabe). (Climax Mine recently reopened but with far fewer workers than in the early 1980s (*Summit Daily*).)

Manufacturing

Manufacturing rose in some counties and fell in others. For example, manufacturing's share of employment increased from 14 percent to 28 percent in Ford County, Kansas and from 20 percent to 36 percent in Colfax County, Nebraska. Over the same period, however, the employment share in manufacturing fell by over 20 percentage points in Shannon County, Missouri; Christian County, Missouri; Hidalgo County, New Mexico; and McCurtain County, Oklahoma.

Map 2
CHANGES IN INDUSTRIAL DIVERSITY BY COUNTY IN THE TENTH DISTRICT, 1980-2010
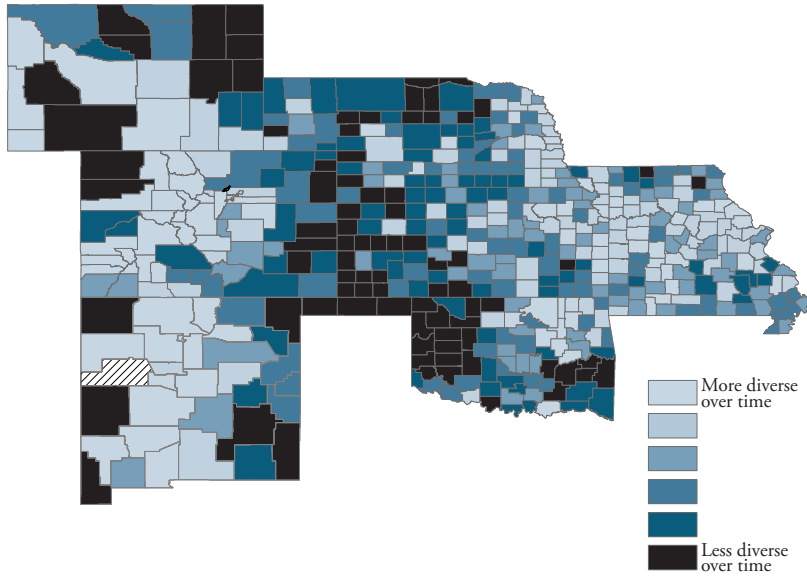
Source: U.S. Census Bureau data from 1980 and from the Bureau's "American Community Survey," using a five-year sample from 2006 to 2010.

Note: No data is available for the area marked by diagonal stripes–Broomfield County, Colorado, and Cibola County, New Mexico–because these counties did not exist in 1980.

II.   THE IMPACT ON ECONOMIC VOLATILITY

Many researchers have examined the impact of industrial diversity on economic volatility, and most have found an inverse effect, meaning that more diverse counties are typically less volatile.[7] These findings are corroborated by the analysis here, which shows that from 1980 to 2007, more industrially diverse counties experienced less economic volatility. This result holds even after controlling for the effects of several other county characteristics and for the impact of the agriculture and energy industries.

The effects of industrial diversity and other county characteristics

The volatility of the more industrially diverse counties of the Tenth District can be compared with the volatility of the less industrially diverse counties by calculating volatility measures for each county.
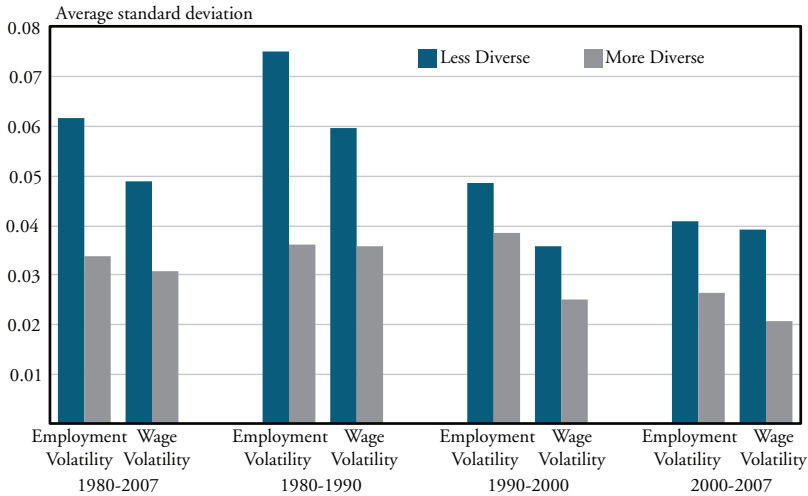
Two key indicators of economic activity are employment growth and wage growth, and the standard deviation over time in these variables provides a measure of their volatility. The data show that more diverse counties on average experienced less volatility from 1980 to 2007 in both employment growth and wage growth (Chart 1).[8] Over the entire 1980-2007 period as well as in each decade, the average volatility of employment growth and of wage growth among the most diverse counties (the top 25 percent, ranked by diversity) was much lower than the average volatility among the least diverse counties (the bottom 25 percent, ranked by diversity).[9] Slight differences emerge from decade to decade. Volatility was highest in the 1980s, as was the difference in volatility between high- and low-diversity counties. The 1990s saw the least pronounced difference between high- and low-diversity counties.

Although Chart 1 suggests an apparent correlation between high diversity and greater stability, the simple comparison of high-diversity counties with low-diversity counties does not control for other factors that may contribute to the apparent correlation. Past research has shown that population size, density, per capita income, and education levels can affect economic volatility.[10] Regression analysis that controls for these other factors, however, shows that industrial diversity still had a significant, positive impact on economic stability across the 1980-2007 period (Appendix, Table 1). Within individual decades, the impact was statistically significant in the 1980s and 2000s but not in the 1990s. The strongest effect was in the 1980s—consistent with Chart 1, which shows diversity having its largest effect in the 1980s and its least effect in the 1990s.

The county population characteristics considered in the regression analysis were also found to affect economic volatility in the Tenth District. The regression results indicate that counties with larger populations tended to have less volatility. This finding could stem from highly populated counties' having more employers in each industry, helping these counties avoid sharp losses in overall employment when any one company falters. The regression results also show that both population density (residents per square mile) and per capita income were correlated with greater volatility in employment growth but had no correlation with volatility in wage growth. In contrast, education (measured by the share of a county's residents who were college-educated) was correlated with more volatility in wage growth but not in employment growth.

Chart 1
THE EFFECT OF INDUSTRIAL DIVERSITY ON EMPLOYMENT AND WAGE GROWTH VOLATILITY

Average standard deviation

Legend: ■ Less Diverse   ■ More Diverse

	Employment Volatility	Wage Volatility
1980-2007		
1980-1990		
1990-2000		
2000-2007		

Note: Blue bars represent the 125 least diverse counties, gray bars the 125 most diverse, in each case indicating the average volatility (average standard deviation) in the growth rates that they experienced. The sample consisted of 499 counties.

This finding might be due to the greater likelihood that college-educated workers receive compensation in the form of bonuses and stock options based on their employers' performance. Such income is frequently more volatile than hourly wages.

Controlling for the effects of the agriculture and energy industries

In the Tenth District, where the agriculture and energy industries make up a large share of employment in many counties, an accurate evaluation of the impact of industrial diversity requires controlling for the effects of these two industries. Because the geographic concentration of the agriculture and energy industries is highly correlated with low industrial diversity, their effects could obscure the broader, general impact of diversity among other industries in the region.

However, a regression analysis that controls for counties' shares of employment in agriculture and energy still indicates that less diverse counties saw greater volatility in growth rates for both employment and wages across the 1980-2007 period (Appendix, Table 2). The

results confirm that industrial diversity had its strongest restraining impact on volatility in the 1980s. The impact of industrial diversity on employment growth volatility was statistically significant in the 1980s and 2000s but not in the 1990s. Diversity had a significant restraining effect on the volatility of wage growth rates in all three decades.

Thus, over the past 30 years, even after accounting for the impact on volatility of the agriculture and energy industries in each county, industrial diversity had a significant, inverse effect on employment growth volatility in the 1980s and 2000s and on wage growth volatility in every decade.

The regression results also show that, after controlling for the impact of industrial diversity, the agriculture and energy industries themselves tended to reduce economic volatility. The share of employment in agriculture in a given county had a significant restraining effect on volatility in employment growth across the 1980-2007 period as a whole, though its effect on wage growth across the period did not prove statistically significant. Considering each decade individually, the data show that agriculture was associated with less volatility in employment growth in the 1980s and 2000s and less volatility in wage growth in all three decades. Although the energy industry's impact on volatility across the entire 1980-2007 period was not statistically significant, it did have effects within individual decades: energy restrained volatility in employment growth in the 1980s and 2000s and in wage growth in the 1990s and 2000s.

III. THE IMPACT ON ECONOMIC GROWTH

Researchers have offered opposing theories on whether industrial diversity increases or decreases long-term economic growth, and empirical studies of the subject have produced mixed results: some suggest a positive effect while others suggest no effect.[11] A preliminary look at the Tenth District appears, at first, to suggest a possible relationship between greater industrial diversity and faster employment and wage growth. Counties with greater industrial diversity did, on average, see higher employment and wage growth than those with less industrial diversity. This result holds even after controlling for a variety of additional county characteristics, such as population density and educational attainment.

The pattern does not hold, however, after controlling for the effect of the agriculture and energy industries. This section illustrates the importance of taking those two key industries' impact into account in any

evaluation of the Tenth District's industrial mix. After controlling for the effects of the agriculture and energy industries, the analysis shows that industrial diversity did not affect counties' employment and wage growth.

The effects of industrial diversity and other county characteristics

A simple comparison of economic growth rates among the Tenth District's most diverse and least diverse counties—without controlling for other factors that drive growth—may give the impression of a causal relationship between diversity and growth. Using annual growth rates in employment and wages for each county, Chart 2 compares the average performance of the 125 most diverse counties with that of the 125 least diverse counties. It shows that, over the 1980-2007 period as a whole, employment growth and wage growth were slower in the less diverse counties.

An examination of each decade, individually, shows that employment grew slower in the less diverse counties in every decade. Wages also grew slower in two of the three decades: the 1980s and 1990s. In the 2000s, however, wages grew faster in the less diverse counties. This finding could reflect the impact of the agriculture and energy sectors, which are highly concentrated in the District's least diverse counties. Wages grew faster in the 2000s in these sectors than in many other industries.

However, the association between diversity and growth suggested by Chart 2 does not take into account other factors that may cause growth rates to vary among counties. Regression analysis can be used to determine whether the pattern shown in Chart 2 continues to hold after controlling for population, population density, per capita income, education levels and state-level effects (Appendix, Table 3). The results show that, in the 1980-2007 period as a whole, these population characteristics were themselves significant drivers of growth. Population density and higher education levels supported employment growth and wage growth. Overall population size had the opposite effect, however, with larger populations correlating with slower growth in wages and employment. Per capita income did not have a significant effect on growth.

The regression analysis shows that, after controlling for a range of county population characteristics that affect growth, an association between industrial diversity and growth rates remains evident: employment and wages grew faster from1980 to 2007 in counties with greater

Chart 2

THE EFFECT OF INDUSTRIAL DIVERSITY ON EMPLOYMENT AND WAGE GROWTH
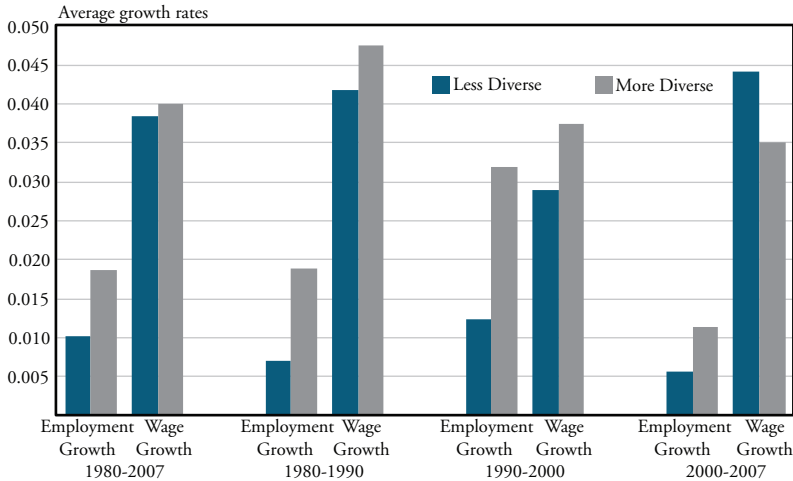
Average growth rates

Note: Blue bars represent the 125 least diverse counties, gray bars the 125 most diverse, in each case indicating the average growth rates achieved for annual employment growth and for annual wage growth. The sample consisted of 499 counties.

industrial diversity. However, considering each decade individually, the regression results reveal that the correlation of industrial diversity and growth rates switched from a positive correlation in the 1980s and 1990s to a negative one in the 2000s. Thus, the data from the 1980s and 1990s could support the view that diverse industries in close proximity can benefit from cross-industry knowledge spillovers, helping boost growth. But the data from the 2000s suggest the opposite, supporting the contrary view that more industrially specialized areas have a comparative advantage.

Another possible explanation, however, is that the agriculture and energy industries, which contracted in the 1980s and 1990s but outperformed other industries in the 2000s, had a substantial impact on county growth that masks the true effect of industrial diversity. These two industries make up a large share of total employment in some counties of the Tenth District. Because the agriculture and energy industries' presence in counties tended to correspond with low index values for industrial diversity, the industries' effects on county growth data may conceal the impact on growth of diversity among other industries.

Controlling for the effects of the agriculture and energy industries

A regression analysis that controls for the effects of the agriculture and energy industries can separate these industries' impact from the impact on growth of diversity among other industries. The regression analysis shown in the Appendix, Table 4, controls for the impact of variables such as population density and educational attainment as well as for the impact of the agriculture and energy industries.

The results show that over the 1980-2007 period as a whole, after controlling for the share of employment in agriculture and energy in any given county, industrial diversity did not have a statistically significant effect on employment growth or wage growth. In each of the three decades considered individually, the impact of industrial diversity on wage growth was statistically insignificant after controlling for the shares of county employment in agriculture and energy. Although diversity appears to have had some effect on employment growth in the 1990s, it did not have such an effect in the 1980s, the 2000s, or the 1980-2007 period as a whole.

The regression results also show that, over the 1980-2007 period as a whole, employment grew more slowly in counties specializing in agriculture and energy. This correlation is more evident in the 1980s than in the other two decades, an unsurprising finding given that both industries contracted sharply in that decade.

IV. CONCLUSION

The case of industrial diversity and its impact in the Tenth District may have implications for government and business leaders in any region who seek to promote stability and growth. Over nearly three decades, across the District's nearly 500 counties, both employment growth and wage growth were more stable in the more industrially diverse counties. The pattern remained evident even after controlling for a variety of county population characteristics and for the effects of two key industries, agriculture and energy. This finding suggests that diversifying the industrial mix in a region can provide benefit to communities in the form of increased stability.

Higher levels of industrial diversity did not, however, have any statistically significant effect on long-run growth in employment or

wages after controlling for the share of employment in each county in agriculture and energy. This finding suggests that industrial diversification does not necessarily cause a trade-off, boosting stability for a community at the cost of slower growth. On the contrary, economic development policies aimed at industrial diversification may be able to increase stability in growth rates, to a community's benefit, without reducing long-term growth. Given that industrial diversity does not appear to affect growth, officials seeking to boost growth rates may need to focus on efforts beyond diversification.

APPENDIX: REGRESSION ANALYSIS

Table 1

THE IMPACT OF INDUSTRIAL DIVERSITY ON THE VOLATILITY OF EMPLOYMENT GROWTH AND WAGE GROWTH

	All Years (1980 - 2007)		1980 - 1990		1990 - 2000		2000 - 2007	
	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth
Industrial Diversity index	0.0013 ***	0.0010 ***	0.0034 ***	0.0014***	-0.0005	0.0004	0.0003*	0.0006***
Ln (Population)	-0.0344 ***	-0.0079 ***	-0.0142 ***	-0.0110***	-0.0406***	-0.0049	-0.0187***	-0.0083***
Ln (Density)	0.0231 ***	0.0030	0.0121 ***	0.0064***	0.0231***	-0.0009	0.0110***	0.0032*
Share College Educated	0.0367	0.0406*	0.0322	0.0252	0.0213	0.0262	0.0478**	0.0412**
Ln (Per Capita Income)	0.0219*	0.0084	-0.0096	0.0106	0.0427*	0.0135	-0.0007	0.0051
Constant	0.0843	0.0104	0.1800**	0.0153	-0.0466	-0.0563	0.1695*	0.0317
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	499	499	499	499	499	499	499	499

*Statistically signifigant within a margin of error of 10 percent.
**Margin of error of 5 percent.
***Margin of error of 1 percent.

Sources: Employment and wage data are from the "Quarterly Census of Employment and Wages" of the U.S. Bureau of Labor Statistics. Data used to calculate counties' industrial diversity measures and population characteristics are from the U.S. Census, using 1980 data for the 1980-2007 and 1980-1990 columns; 1990 data for the 1990-2000 column; and 2000 data for the 2000-2007 column.

Note: This table presents estimated OLS coefficients for regressions in which the dependent variable is either the standard deviation of employment growth or the standard deviation of wage growth. Annual growth rates are used, over the years indicated in each column. Values of the index used here for industrial diversity (the "national diversity index" described in Section I) are inversely related to industrial diversity; lower values of the index indicate greater diversity. Dummy variables for each state were used in the regression to control for "state fixed effects": any factors that differ by state and affect employment or wage growth.

Table 2

THE IMPACT OF EMPLOYMENT SHARES IN AGRICULTURE AND MINING ON THE VOLATILITY OF EMPLOYMENT GROWTH AND WAGE GROWTH

	All Years (1980 - 2007)		1980 - 1990		1990 - 2000		2000 - 2007	
	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth	Standard Deviation of Employment Growth	Standard Deviation of Wage Growth
Industrial Diversity index	0.0022*	0.0018 ***	0.0054***	0.0017***	-0.0027	0.0025**	0.0035***	0.0024***
Ln (Population)	-0.0360***	-0.0078***	-0.0153***	-0.0119***	-0.0432***	-0.0032	-0.0174***	-0.0076***
Ln (Density)	0.0208 ***	0.0022	0.0090***	0.0053***	0.0228***	-0.0014	0.0091***	0.0021
Share College Educated	0.0151	0.0252	-0.0097	0.0169	0.0556	-0.0057	0.0299	0.0309*
Ln (Per Capita Income)	0.0213	0.0095	-0.0083	0.0100	0.0376*	0.0179	0.0004	0.0057
Ag. Employment Share	-0.1014**	-0.0434	-0.1513***	-0.0455*	0.0441	-0.0739*	-0.2318***	-0.1324**
Energy Employment Share	-0.0782	-0.0797	-0.1895**	-0.0241	0.3850	-0.3630**	-0.8261***	-0.4736**
Constant	0.1274	0.0038	0.2048	0.0406	0.0367	-0.1155	0.1547	0.0228
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	499	499	499	499	499	499	499	499

*Statistically signifigant within a margin of error of 10 percent.
**Margin of error of 5 percent.
***Margin of error of 1 percent.

Sources: Employment and wage data are from the "Quarterly Census of Employment and Wages" of the U.S. Bureau of Labor Statistics. Data used to calculate counties' industrial diversity measures, population characteristics measures, population characteristics, agriculture employment shares and energy employment shares are from the U.S. Census, using 1980 data for the 1980-2007 and 1980-1990 columns; 1990 data for the 1990-2000 column; and 2000 data for the 2000-2007 column.

Note: This table presents estimated OLS coefficients for regressions in which the dependent variable is either the standard deviation of employment growth or the standard deviation of wage growth. Annual growth rates are used, over the years indicated in each column. Values of the index used here for industrial diversity (the "national diversity index" described in Section I) are inversely related to industrial diversity: lower values of the index indicate greater diversity. Dummy variables for each state were used in the regression to control for "state fixed effects"; any factors that differ by state and affect employment or wage growth.

Table 3

THE IMPACT OF INDUSTRIAL DIVERSITY ON EMPLOYMENT GROWTH AND WAGE GROWTH

	All Years (1980 - 2007)		1980 - 1990		1990 - 2000		2000 - 2007	
	Employment Growth	Wage Growth	Employment Growth	Wage Growth	Employment Growth	Wage Growth	Employment Growth	Wage Growth
Industrial Diversity index	-0.0007***	-0.0002***	-0.0008***	-0.0003***	-0.0014***	-0.0005***	0.0002**	0.0004***
Ln (Population)	-0.0049***	-0.0020***	-0.0016	-0.0031***	-0.0099***	-0.0022**	-0.0014	-0.0003
Ln (Density)	0.0028**	0.0014***	-0.0007	0.0026***	0.0049**	0.0013	0.0027**	0.0003
Share College Educated	0.0728***	0.0225***	0.1043***	0.0225**	0.0281	0.0171*	0.0144	0.0160*
Ln (Per Capita Income)	0.0033	-0.0010	-0.0109	-0.0048	0.0316***	0.0058	0.0115**	0.0037
Constant	0.0187	0.0637***	0.1172**	0.1086***	-0.1872**	0.0039	-0.1080**	-0.0036
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	499	499	499	499	499	499	499	499

*Statistically signifigant within a margin of error of 10 percent.
**Margin of error of 5 percent.
***Margin of error of 1 percent.

Sources: Employment and wage data are from the "Quarterly Census of Employment and Wages" of the U.S. Bureau of Labor Statistics. Data used to calculate counties' industrial diversity measures and population characteristics are from the U.S. Census, using 1980 data for the 1980-2007 and 1980-1990 columns; 1990 data for the 1990-2000 column; and 2000 data for the 2000-2007 column.

Note: This table presents estimated OLS coefficients for regressions in which the dependent variable is either employment growth or wage growth. Annual growth rates are used, over the years indicated in each column. Values of the index used here for industrial diversity (the "national diversity index" described in Section 1) are inversely related to industrial diversity; lower values of the index indicate greater diversity. Dummy variables for each state were used in the regression to control for "state fixed effects"; any factors that differ by state and affect employment or wage growth.

Table 4

THE IMPACT OF EMPLOYMENT SHARES IN AGRICULTURE AND MINING ON EMPLOYMENT GROWTH AND WAGE GROWTH

	All Years (1980 - 2007)		1980 - 1990		1990 - 2000		2000 - 2007	
	Employment Growth	Wage Growth	Employment Growth	Wage Growth	Employment Growth	Wage Growth	Employment Growth	Wage Growth
Indu nathan.kauffman@ kc.frb.org strial Diversity index	0.0002	0.0000	0.0006	-0.0002	-0.0018**	0.0000	0.0009	0.0008
Ln (Population)	-0.0052***	-0.0016***	-0.0002	-0.0025**	-0.0113***	-0.0014	-0.0012	-0.0005
Ln (Density)	0.0015	0.0016***	-0.0012	0.0029***	0.0039	0.0015*	0.0007	-0.0002
Share College Educated	0.0537***	0.0202***	0.0803***	0.0220**	0.0356	0.0084	0.0189	0.0167*
Ln (Per Capita Income)	0.0042	-0.0003	-0.0077	-0.0040	0.0301***	0.0072*	0.0189***	0.0028
Ag. Employment Share	-0.0639***	0.0029	-0.0444*	0.0118	-0.0271	-0.0058	-0.1033*	-0.0428
Energy Employment Share	-0.0905**	-0.0198	-0.1444**	-0.0132	0.0786	-0.0971**	-0.1379	-0.0763
Constant	0.0235	0.0505***	0.0764	0.0915***	-0.1487	-0.0203	-0.1663**	0.0112
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	499	499	499	499	499	499	499	499

*Statistically signifigant within a margin of error of 10 percent.
**Margin of error of 5 percent.
***Margin of error of 1 percent.

Sources: Employment and wage data are from the "Quarterly Census of Employment and Wages" of the U.S. Bureau of Labor Statistics. Data used to calculate counties' industrial diversity measures, population characteristics, agriculture employment shares and energy employment shares are from the U.S. Census, using 1980 data for the 1980-2007 and 1980-1990 columns; 1990 data for the 1990-2000 column; and 2000 data for the 2000-2007 column.

Note: This table presents estimated OLS coefficients for regressions in which the dependent variable is either employment growth or wage growth. Annual growth rates are used, over the years indicated in each column. Values of the index used here for industrial diversity (the "national diversity index" described in Section I) are inversely related to industrial diversity: lower values of the index indicate greater diversity. Dummy variables for each state were used in the regression to control for "state fixed effects"; any factors that differ by state and affect employment or wage growth.

ENDNOTES

[1]The Tenth District of the U.S. Federal Reserve System spans seven states including Colorado, Kansas, Nebraska, Oklahoma, Wyoming and parts of Missouri and New Mexico.

[2]Grubesic, Kessler, and Mack provide an overview of several measures of industrial diversity and review some of the past literature that has used these measures.

[3]This equation is similar to the national diversity index presented in Grubesic, Kessler, and Mack.

[4]County-level employment data by industry were obtained from the U.S. Census Bureau's "American Community Survey." The five-year estimate from 2006 to 2010 was used because it has a larger sample size (many counties in the Tenth District have small populations) and is the most reliable estimate available.

[5]Percentages are based on the five-year sample from 2006 to 2010.

[6]Diversity in 1980 was calculated using data from the 1980 U.S. Census. The 2010 diversity measures reflect data from 2006 to 2010. For simplicity, the diversity index calculated using data from 2006 to 2010 is referred to throughout the article as 2010 diversity.

[7]Ke and Malizia; Deller and Wagner; Kort; and Hammond and Thompson all find that industrial diversity reduces economic volatility. Kort notes that other factors, such as population, also matter. Hammond and Thompson estimates that diversity has a larger effect on employment volatility in non-metropolitan regions. They also emphasize the importance of controlling for differences in population characteristics, such as education levels, that can affect employment volatility.

[8]More recent years of data are excluded because they were so sharply affected by the severe recession starting in December, 2007. Employment and wage data are available at the county level from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages, starting in 1975, but there are many missing observations from 1975 to 1977. The analysis in this paper begins in 1978 to maximize the number of counties in the sample. The following counties were not used in the analysis because data was missing in one or more years: Broomfield County, Colorado; Custer County, Colorado; Hinsdale County, Colorado; Hodgeman County, Kansas; Worth County, Missouri; Loup County, Nebraska; McPherson County, Nebraska; Cibola County, New Mexico; Harding County, New Mexico; Roger Mills County, Oklahoma; and Niobrara County, Wyoming. Broomfield County was not established until 2001 and Cibola County was not formed until 1981.

[9]There are 499 counties in the sample. Therefore, 125 counties represent approximately 25 percent of the observations.

[10]Ke and Malizia finds the population size and percentage of adults with a college education are important factors that influence instability. Izraeli and Murphy control for national per capita income, population, and population density among others, in their analysis of the effects of diversity on unemployment and per capita income. Deller and Wagner find that population, per capita income, and the percentage of the population with a college education (among other factors) affect growth and stability.

[11]Glaeser, Kallal, Scheinkman and Shleifer discuss the different economic theories that predict that industrial diversity either increases or decreases economic growth. They find a positive correlation, focusing specifically on growth in employment. Deller and Wagner find a positive correlation between industrial diversity and income growth. However, Attaran finds no significant correlation between diversity and growth in either employment or income.

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