BRENT SPENCE BRIDGE CORRIDOR
Moving the Economy,
Creating Jobs

BRENT SPENCE BRIDGE PROJECT

EMPLOYMENT AND POPULATION FORECASTS

FEBRUARY 2014

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

KENTUCKY
TRANSPORTATION
CABINET

EXECUTIVE SUMMARY

This report develops population and employment forecasts for the 11 counties that comprise the Brent Spence Bridge corridor (see Exhibits 2.1 and 2.2). The Brent Spence Bridge is a major commuting artery and is an important link for the local, regional, and national economies. The bridge carries Interstates I-71 and I-75 across the Ohio River and provides an interstate connection between downtown Cincinnati, Ohio (Hamilton County) and Covington, Kentucky (Kenton County). The forecast area covers parts of three states (Ohio, Kentucky and Indiana) and parts of two Metropolitan Statistical Areas (MSAs) – the Cincinnati-Middletown MSA (eight counties) and the Dayton, OH MSA (three counties).

County-level forecasting models that capture the interplay between population and employment at the level of an individual county were developed. The population and employment projections are based on econometric models that use prior trends in population density and employment across counties over the 1980-2012 period to forecast population and employment over the next 40-years. To help maximize precision the models were estimated using annual county-level data from 1980-2012 from 41 metropolitan statistical areas (MSA) from across the country, including the 20 MSAs that are larger than Cincinnati in terms of population and the 20 MSAs that are smaller.[1] This resulted in data from 326 individual counties over 33 years. Including such a large number of counties allowed us to ensure that we had data from counties across the population and employment spectrums.

Overall this report forecasted that the forecast area's population will increase by approximately 410,000 individuals or 0.3% per annum over the next 40 years (see Exhibit 5.1). This is slightly below the forecast area's annual growth rate over the 1980-2012 period. The forecast area's employment is forecasted to increase by approximately 195,000 over the same time period (see Exhibit 5.4). This represents annual employment growth of 0.4% per annum.

The population projections developed in these analyses are broadly consistent at the metropolitan area level with those produced by the respective states. The econometric model projections exceed state population projections by a modest 5.3 percent in 2040. At the individual county level, there are more significant differences between the econometric and State projections, because the econometric approach adopted in this analysis builds off past trends and incorporates information from the growth patterns from other similarly sized metropolitan areas, the econometric framework provides a viable alternative to the population projections developed by each of the respective states. Importantly, the econometric approach can be used to project long-term employment growth, providing a consistent framework for projecting both population and employment. Both of which are necessary for the traffic and revenue forecasting process.

The forecast developed in this study assumes that the Brent Spence Bridge continues to operate at its current capacity. While we feel that the additional capacity that is being added as part of this project will likely have a positive economic impact on the region, the employment and population projected for the region is not likely to increase significantly as a result of the project. However, if the proposed project were not to go forward as planned and there is a significant decrease in the level –of-service of the bridge, the failure to replace the bridge is likely to have a large negative impact on future population and employment growth for the region.

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[1] See Appendix 2 for a complete list of the MSAs included in the regression model.

TABLE OF EXHIBITS

1. INTRODUCTION

This report develops population and employment forecasts for the 11 counties that comprise the Brent Spence Bridge corridor (see Exhibits 2.1 and 2.2). The Brent Spence Bridge is a major commuting artery and is an important link for the local, regional and national economies. The bridge carries Interstates I-71 and 1-75 across the Ohio River and provides an interstate connection between downtown Cincinnati, Ohio (Hamilton County) and Covington, Kentucky (Kenton County).   For purposes of our analysis, the forecast area covers parts of three states (Ohio, Kentucky and Indiana) and parts of two Metropolitan Statistical Areas (MSAs) – the Cincinnati-Middletown MSA (eight counties) and the Dayton, OH MSA (three counties).

This report provides methodologically consistent estimates of population and employment through 2040 for the 11 counties in the Ohio-Kentucky-Indiana forecast area. The population and employment projections developed in this project are based on econometric models that use prior trends in population density and employment across counties in 42 metropolitan areas. Although the projections are based on econometric models, there are a number of other methods that are used to generate long term projections. The projections developed in this analysis are presented in the context of other projections that have been made for county level population and employment.

One of the most common, well accepted approaches to projecting population in a metropolitan area is to examine the age structure of the population and project natural population change resulting from the expected pattern of births and deaths. Population change resulting from migration and immigration, which is typically projected based on econometric models, is added to the estimates of natural growth. In 2013, each state included in the forecast area, Ohio, Kentucky, Indiana, developed population projections for all of the counties in the forecast area based on this approach.

It should be noted that while the births-deaths-migration approach is a well-excepted approach, like all long-term forecasting methods, it is subject to substantial uncertainty. For example, the population projections developed in 2013 differed significantly from those developed 10 years earlier for the metropolitan area as a whole, and in some cases dramatically from the both the projections and the realization at the county level. For example the projection for population in Hamilton County was for a decline of 788,000 by 2015, but by 2012, the county had declined to only 802,000. The new projections for Hamilton County are dramatically more optimistic, with projected population in 2040 of 786,090, nearly 79,000 greater than projected based on forecasts produced in 2003.

In addition to the econometric approach taken in this project or the births-deaths-migration approach, there have been a number of other approaches used to determine county level projections. Some are based on models that attempt to explain the relative share of the nation's population in counties and metropolitan areas as a function of area characteristics and policies (see Linneman and Siaz (2006) for example). Others are based on structural models of population and employment growth (see Mills and Lubuele (1995)). Finally there are commercial forecasting services such as ProximityOne[2] whose projections are publicly available as well as those such as Woods and Poole which are available for a fee that are based on proprietary models.

Underscoring the uncertainty associated with long-term population projection, there are significant differences in county-level population projections and significant differences in projections in metropolitan area totals as well. Moreover, some of the older projections can be evaluated with respect to actual

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[2] http://proximityone.com/demographics2060.htm

outcomes. While the projections are at one level "reasonable" there are often large differences between the realized population changes and the earlier projected changes.

The population projections developed in this analyses are broadly consistent at the metropolitan area level with those produced by the respective states. The econometric model projections exceed the state's population projections by a modest 5.3 percent in 2040. At the individual county level there are more significant differences between the econometric and State projections.   This is because the econometric approach adopted in this analysis builds off past trends and incorporates information from the growth patterns from other similarly sized metropolitan areas; the econometric framework provides a viable alternative to the population projections developed by each of the respective states. Importantly, the econometric approach can be used to project long-term employment growth, providing a consistent framework for projecting both population and employment.

The literature on long term employment forecasting at the county level is less well developed. Aside from proprietary forecasts of long-term employment growth, which are typically based on the sharing out of macro forecasts to the smaller geographical areas, the research on this issue is relatively limited. The population and employment forecast model developed by Mills and Lubuele (1995) is a notable exception. This approach is similar, though not identical to the econometric approach to population and employment projections developed in this project.

In theory, employment changes in a metropolitan area should depend on the current distribution of industries, the expected future growth of those industries and the relative competitiveness, now and in the future of the metropolitan area in each of the industries. Projection of future employment growth by industries at the national level is itself a challenge and evaluating the current and future competitiveness of a region for each industry is an even greater challenge. Moreover, the distribution of employment at the county level within a metropolitan area on the same basis magnifies the challenge further. Such an analysis, if feasible, would be a massive undertaking.

Rather than a detailed, bottom up industry level approach, this analysis applied a similar econometric methodology to that used to project county level population. Specifically, information from past employment trends in counties in the Cincinnati and other metropolitan areas to develop employment projections were used for this forecast area. While there is only one publicly available projection for employment at the county level (from the MPO, developed based on 2003 population projections), the employment projections generated in our framework give reasonable estimates of the projected employment to population ratios for individual counties and the metropolitan area as a whole. In addition the projections appear reasonable relative to the structure of the metropolitan economy.

The remainder of this report provides an overview of the metropolitan economy, details on the methodology and data used, presentation of the projections, and evaluation of the internal consistency of the projection, a comparison with other projections, an assessment of the risks associated with the projections.

2. THE CINCINNATI REGION

The Cincinnati-Middletown Metropolitan Statistical Area (MSA) covers 4,400 square miles and includes 15 counties from Indiana (three counties), Kentucky (seven counties), and Ohio (five counties). The principal city, Cincinnati, is in Hamilton County, Ohio, which sits in the southwest corner of Ohio, bordering Kentucky to the south (separated by the Ohio River) and Indiana to the west. The Brent Spence Bridge is one of the primary crossings between Ohio and Kentucky.

The Forecast Area contains fewer counties than the MSA overall, including three that are part of the Dayton, OH MSA. Exhibits 2.1 and 2.2 illustrate the difference between the forecast area and the MSA. Our discussion of the local economy will focus on the Cincinnati MSA.

Exhibit 2-1: Counties in MSA and Forecast Area

Cincinnati, OH-KY-IN	Project Area
Ohio	Ohio
Brown County	Butler County
Butler County	Clermont County
Clermont County	Greene County (Dayton MSA)
Hamilton County	Hamilton County
Warren County	Miami County (Dayton MSA)
	Montgomery County (Dayton MSA)
Kentucky	Warren County
Boone County	
Bracken County	Kentucky
Campbell County	Boone County
Gallatin County	Campbell County
Grant County	Kenton County
Kenton County	
Pendleton County	Indiana
	Dearborn County
Indiana	
Dearborn County	
Ohio County	
Union County	

Exhibit 2-2: Map of Forecast Area
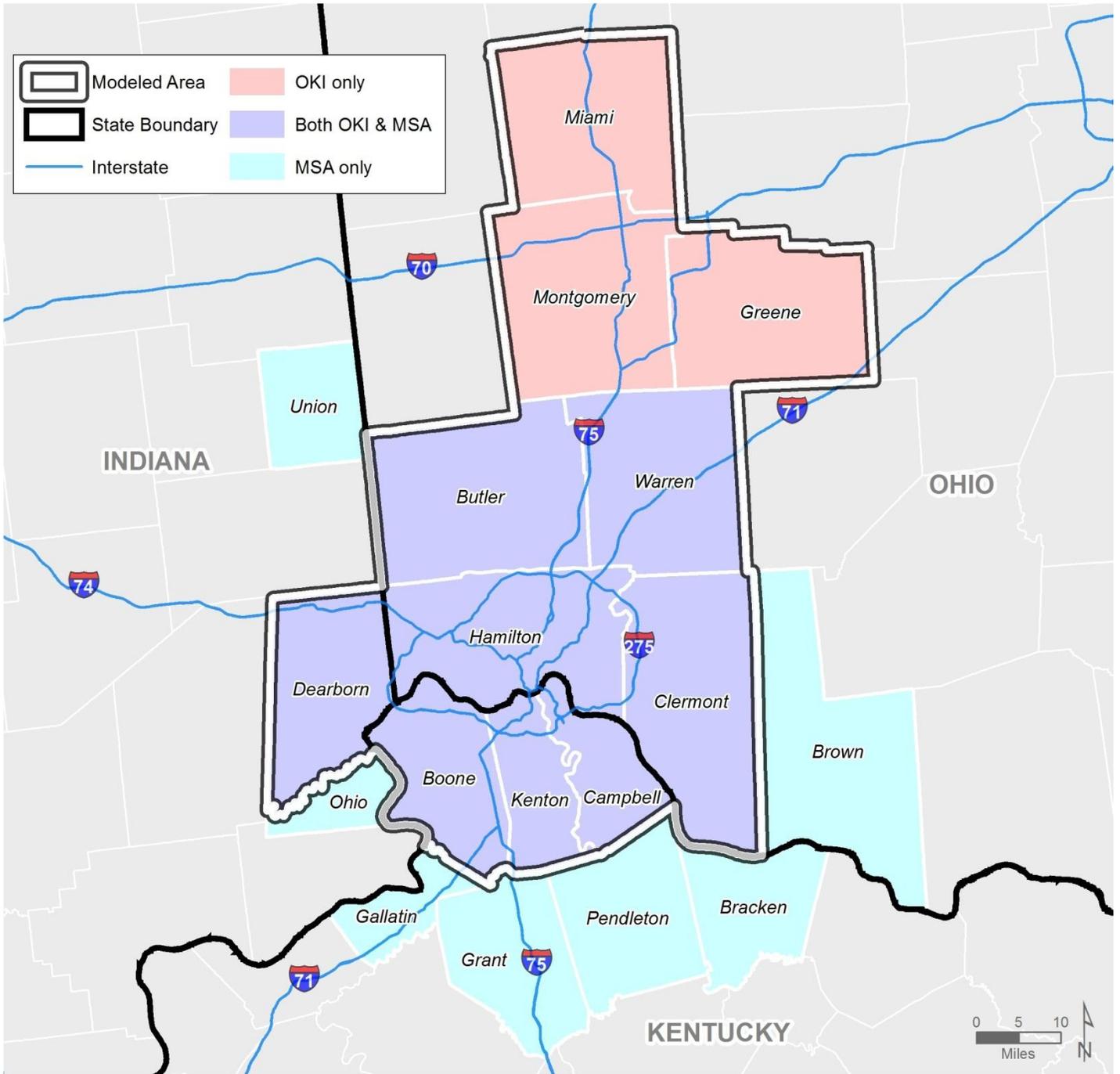
Source: ESI (2014)

2.1 MACRO-ECONOMIC OVERVIEW

The Nation has been recovering from what has been acknowledged as the most serve recession since the 1930s and the forecast area is no exception. The analysis begins by providing an overview of the key macro-economic trends in the region over the last twenty years. This will allow the current economic development to be placed in the context of larger historical trends. For the purposes of this analysis the focus is on the economy of the Cincinnati MSA.

While national employment grew by 25% over the 1990-2010 periods, employment in the Cincinnati MSA grew by less than 17% over the same time period (see Exhibit 2.3). Total non-farm employment in the MSA has increased from 864,900 in 1990 to 1,010,600 in 2013. While the employment for the MSA is up relative to 1990, it is still down from its peak in 2007 of 1,047,200 jobs. The Great Recession basically erased ten years of job growth in the MSA; in 2013 the MSA had fewer jobs in 2013 than it had in 2003. While both the national employment and employment in Cincinnati have begun to recover, it appears that the national employment is recovering at a faster pace than Cincinnati. Since 2010, national employment has increased by 5% while employment in the Cincinnati MSA has increased by only 3%.

Exhibit 2-3: Comparison of National and Regional Employment Growth
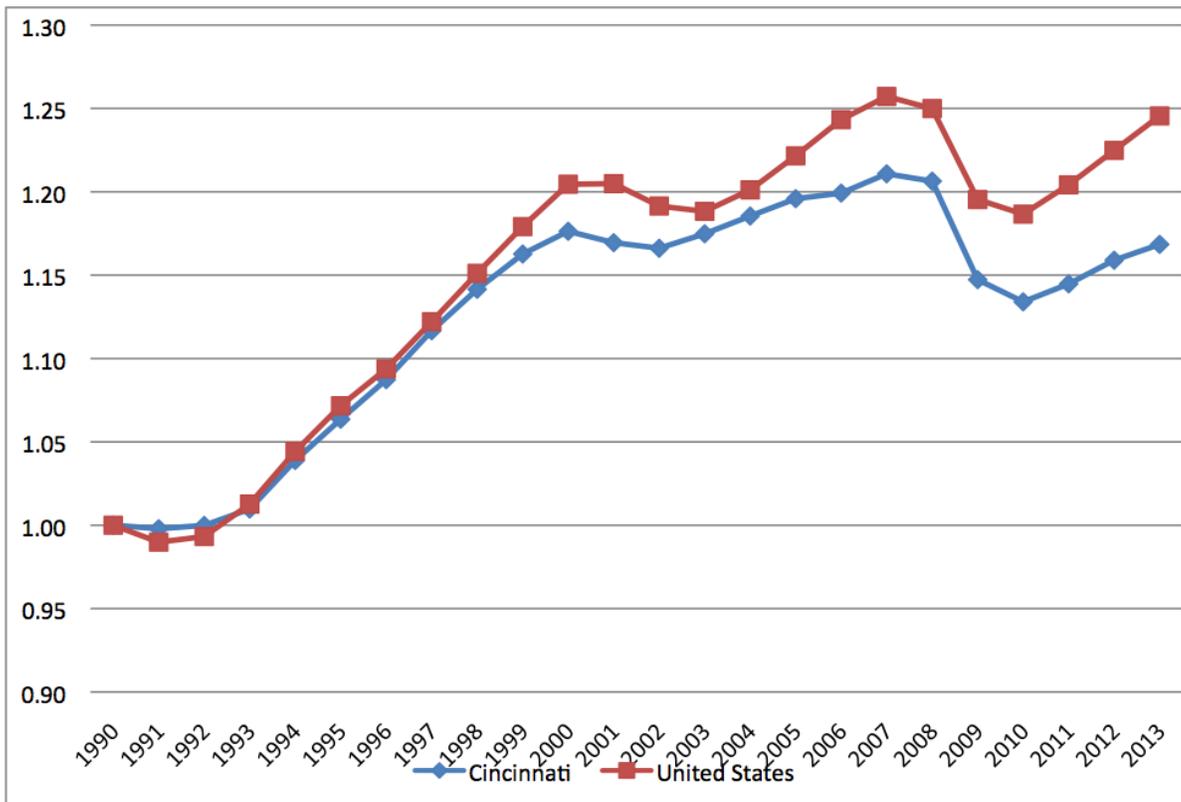
Source: BLS(2014)

Over the 2007-2012 period the annual GDP growth rate of the Cincinnati MSA has increased 11.9% which is on par with the US economy which increased 11.8% over the same period (see Exhibit 2.4). It also appears that the Cincinnati MSA has been able to weather the Great Recession better than the US economy as the MSA'a annual growth in recent years has been outpacing that of the nation.

Exhibit 2-4: Comparison of Real GDP Change 2007-2012
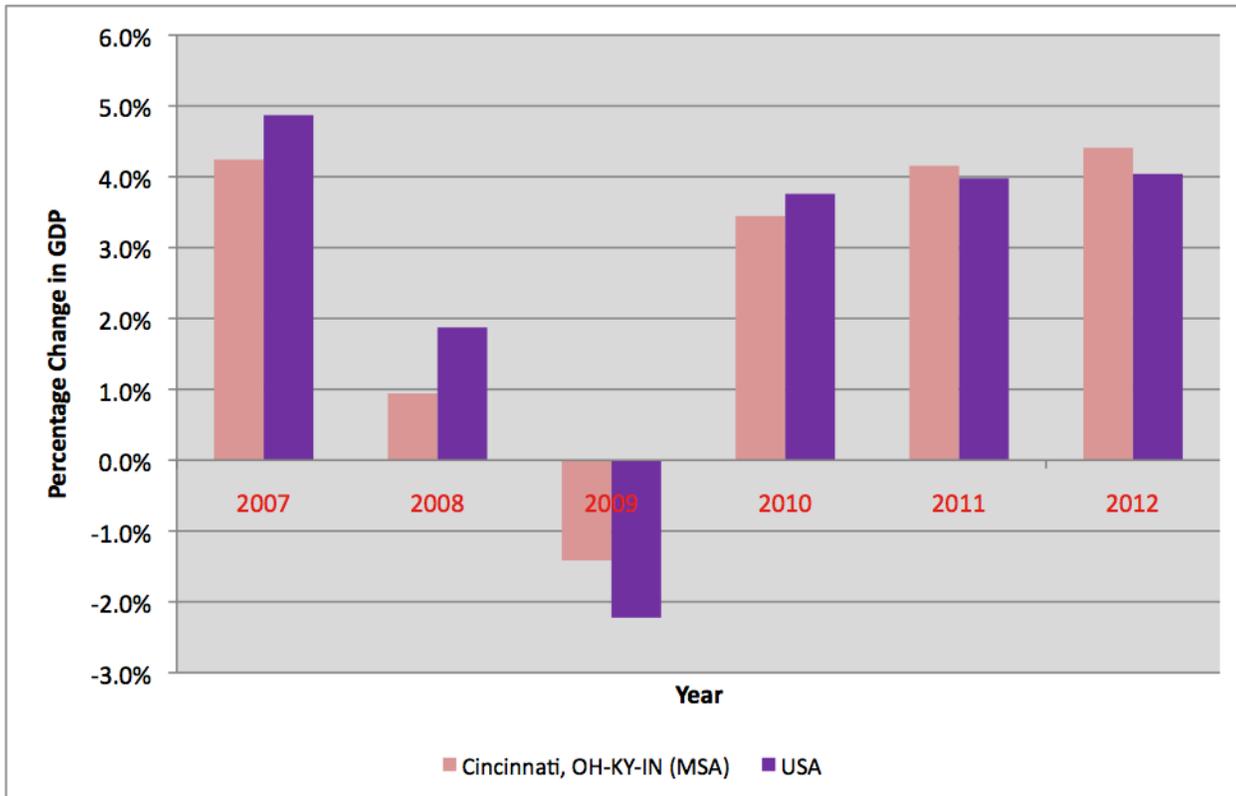
Source: US BEA (2014)

Up until a few years before the start of the Great recession, the Cincinnati MSA has traditionally enjoyed an unemployment rate that is below the national average (see Exhibit 2.5). Both the national unemployment and unemployment in Cincinnati peaked in 2010 at around 9.7% nationally and 9.6% locally. Since that time the unemployment rate has been dropping both regionally and nationally and the unemployment rate in Cincinnati has dropped back to its traditional position of being lower than the national rate.

2.2 THE CINCINNATI ECONOMY

The city of Cincinnati was known in the early 19th century as the country's main hog packing district and has since had a strong manufacturing base. The city was the first inland city founded after the American Revolution, booming from the development of commercial activity on the Ohio River, which served as a main commercial route connecting the north and south prior to the development of railroads. Since then, Cincinnati's economy has diversified, but manufacturing and distribution remain major drivers of the regional economy. The ten largest employers in the Cincinnati area listed in Exhibit 2.6. Notably, four of the ten are in the health industry, and only one is in manufacturing.

Exhibit 2-5: Unemployment Rate
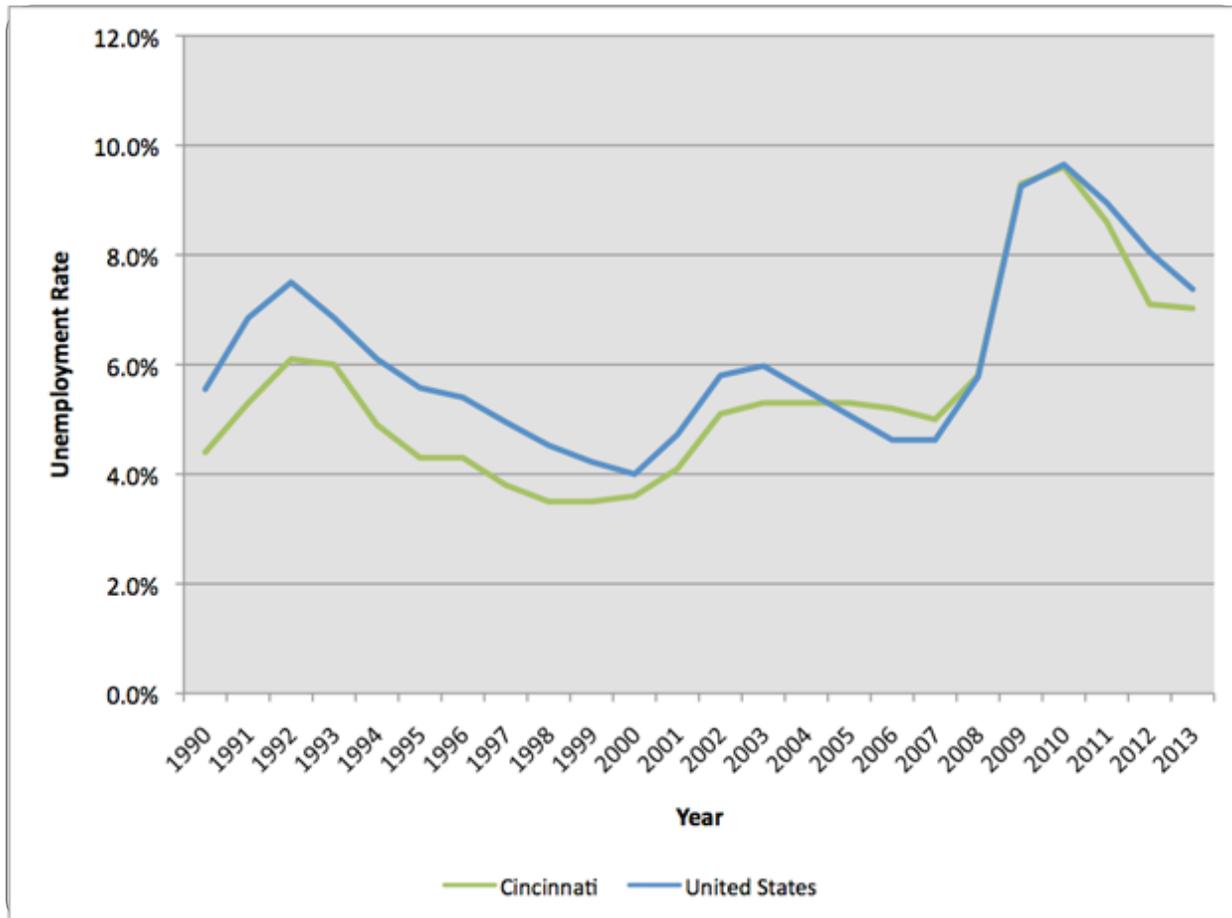
Source: BLS(2014)

Exhibit 2-6: Top Employers in the Cincinnati MSA

Rank	Company	Industry	Employees
1	Kroger Company	Retail	17,000
2	University of Cincinnati	Education	15,162
3	The Procter & Gamble Company	Consumer Goods	14,000
4	Cincinnati Children's Hospital Medical Center	Health	12,057
5	TriHealth Inc	Heath	9,898
6	Mercy Health Partners	Health	8,550
7	Archdiocese of Cincinnati	Religious	8,000
8	GE Aviation	Manufacturing	7,300
9	Wal-Mart Stores	Retail	6,932
10	St. Elizabeth Healthcare	Health	6,839

Source: Business Courier book of Lists, accessed via City of Cincinnati Office of Trade and Development

Exhibit 2-7: Cincinnati MSA Employment by Industry
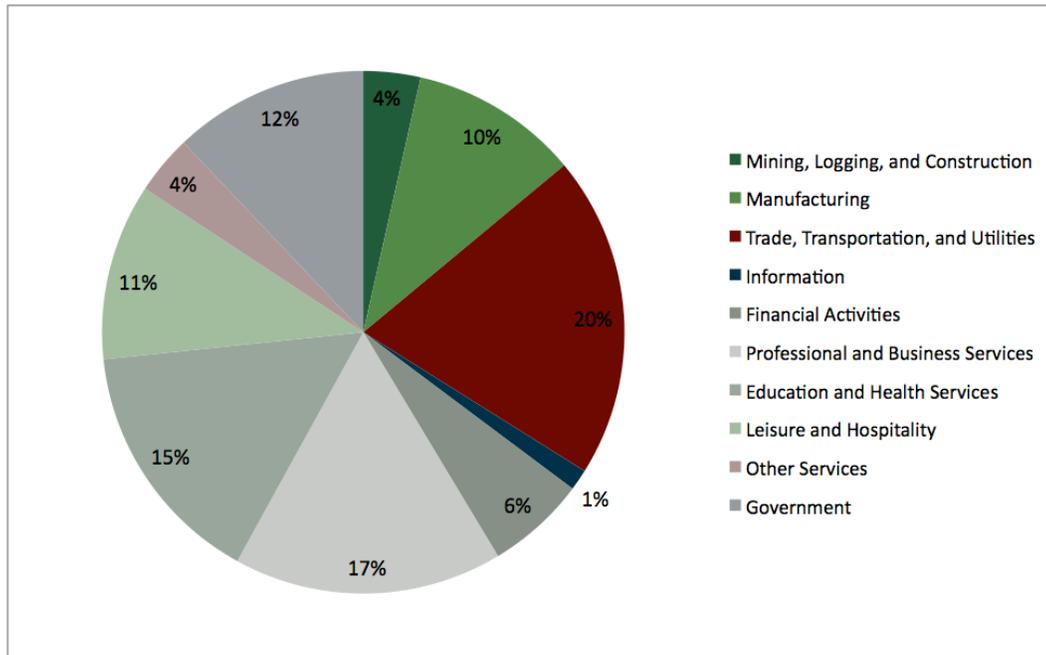
Source: BLS(2014)

Downtown Cincinnati serves as the central hub of the city's business activity. The area is home to the headquarters of 10 companies on last year's Fortune 500 list. Kroger was the highest ranked company on the 2013 Fortune 500 list at 23rd. The subsequent rankings are as follows:

- Procter & Gamble: 28th
- Macy's: 109th
- Ashland Inc.: 321st
- Fifth Third Bancorp: 361st
- Omnicare: 416th
- General Cable Corp.: 425th
- AK Steel: 430th
- Western & Southern Financial Group: 471st
- American Financial Group: 485th

Although this is only 10 out of 500 companies, Cincinnati has more Fortune 500 companies per capita than Los Angeles, New York or Chicago.

Currently the largest employment sector in the Cincinnati MSA is Trade Transportation, and Utilities followed by Professional and Business Services and Education and Health Services (see Exhibit 2.7). In recent years, the region has be diversifying away from a manufacturing into a more service-based economy. This transition is evident when one looks at an industry-level employment growth index. Since 1990, the number of the jobs in the Manufacturing Sector has been steadily declining, while employment in the Professional and Business Services, Education and Health Services, and Financial Activities has been increasing (see Exhibit 2.8). Other sectors that have experienced a decrease include Mining, Logging, and Construction and Information. Since 1990, employment in Professional and Business Services has increased over 75%, 57% in Education and Health Services, 42% in Leisure and Hospitality, and 28% in Financial Activities, while employment has decreased 32% in manufacturing, 27% in Information, and 9% in Mining, Logging, and Construction.

Exhibit 2-8: Cincinnati MSA Industry Employment Index
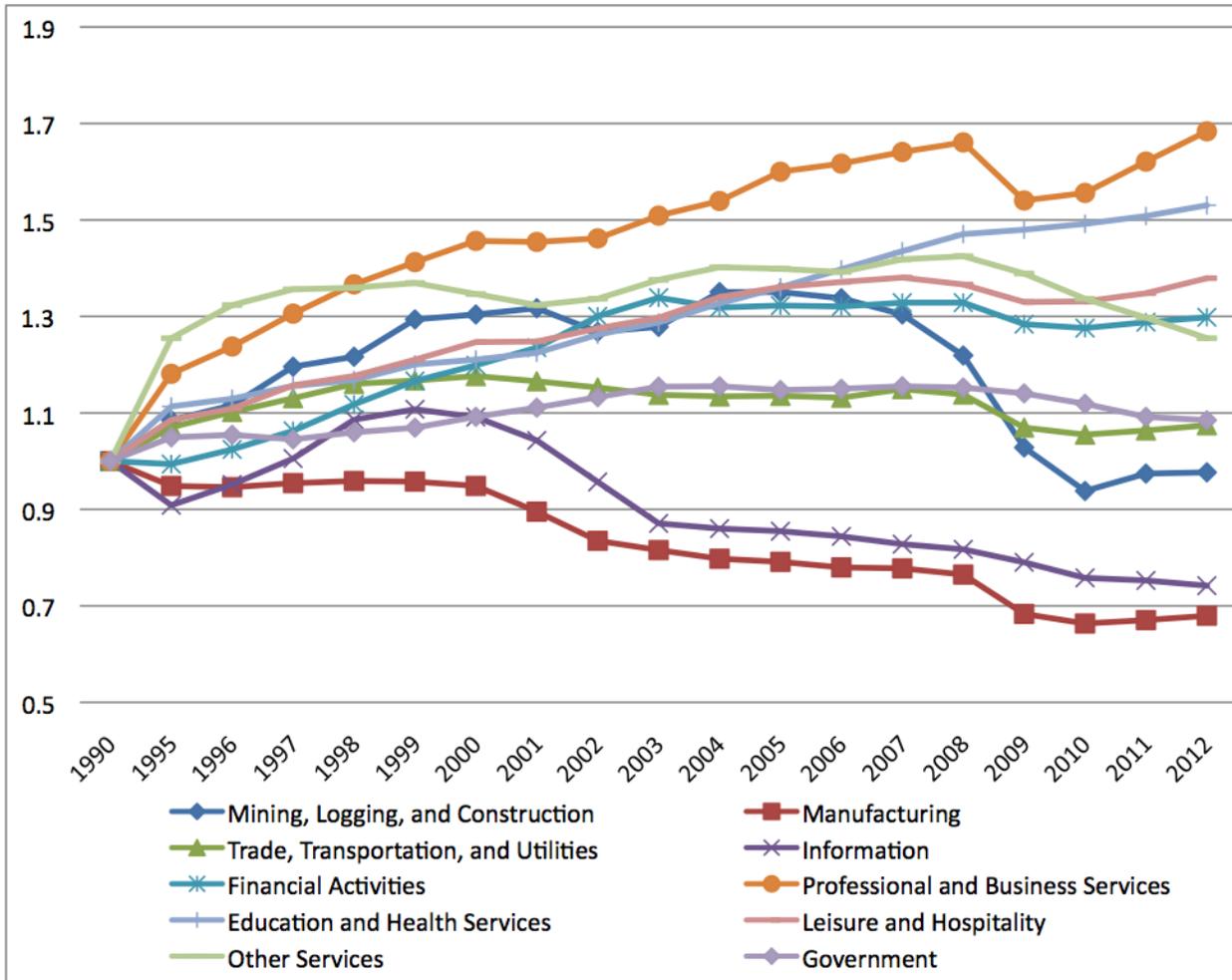
LOCATION QUOTIENT

A location quotient (LQ) is an indicator of industry concentration within a metropolitan area, expressed as the ratio of the proportion of the industry locally within the total local economy to the proportion of the industry nationally within the total national economy. It can help reveal what makes a particular region "unique" in comparison to the national average. Therefore, an LQ greater than one indicates that the industry is a bigger piece of the local economy than it is of the national economy, with the implication being that that industry is producing more goods and services than are being consumed locally, and must

therefore be exporting them outside the region. Hence, those industries are considered "base" in that by exporting goods and services outside the region, they bring in revenue from the outside, which forms the base of the local economy. Conversely, an LQ less than one indicates that the industry is smaller piece of the local economy than it is of the national economy, and must therefore be importing those goods and services from outside the region. These industries rely indirectly on the base industries for their vitality.

The location quotients presented in Exhibit 2.9 suggest that the Cincinnati MSA is becoming a center for Professional and Business Services and Financial activities, with both of these sectors having location quotients that are well above unity. This indicates a higher concentration of employment finance and business service employment than the national average. The importance of both of these sectors has been steadily increasing over the last twenty years. The region's manufacturing location quotient is well above unity and has been increasing steadily overtime.

The US Bureau of Labor Statistics[3] forecasts that the occupations and industries related to healthcare and social assistance sectors are expected to add the most new jobs between 2012 and 2022. Employment in the healthcare and social assistance sector is expected to increase at a Compound Annual Growth Rate (CAGR) of 2.6 percent over the 2012-2022 period. This fact combined with region's LQ for those sectors at around one, coupled with the increasing employment in the region, should help the region capitalize on the projected growth for the healthcare sector. Other sectors that are forecasted to have CAGR above 1 percent include Financial Activities, Professional and Business Services, and Educational Services. These sectors will be important for the growth of the region's economy in the future due to the fact that the LQ above 1 means that they help to bring money into the region. The BLS also projects that nationwide employment in the manufacturing sector will continue to decline over the next ten years, this coupled with the fact the LQ for manufacturing has been increasing, and is above unity, may indicate trouble for the regional economy in the future.

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[3] BLS (2013). "Employment Projections 2012-2022 New Release." US Bureau of Labor Statistics. December 19, 2013. http://www.bls.gov/news.release/ecopro.htm

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SHIFT SHARE

Shift share is a tool for analyzing changes in a region's economy in the context of changes in the national economy. The total change in jobs is separated out into three pieces:

1. National effect: the change in jobs associated with the overall health of the national economy
2. Industry shift: the change in jobs associated with the health of that industry national
3. Regional shift: the change in jobs associated with the health of that industry locally

The three components can move in different directions, but their sum is equal to the total change in jobs observed in the region's economy. The most important indicator for a local economy is the regional shift; a positive value indicates that the local industry is outperforming the national industry, which can be true even there is a net decrease in jobs. A negative value indicates the local industry is lagging the national industry, which can be true even when there is a net increase in jobs.

Exhibit 2-9: Cincinnati MSA Location Quotient Analysis

Industry	1990	1995	2000	2005	2010
Mining, Logging, and Construction	0.81	0.91	0.89	0.85	0.77
Manufacturing	1.11	1.09	1.11	1.12	1.19
Trade, Transportation, and Utilities	1.04	1.06	1.08	1.05	1.05
Information	0.88	0.76	0.72	0.67	0.69
Financial Activities	0.94	0.91	0.98	1.03	1.08
Professional and Business Services	1.11	1.12	1.08	1.17	1.18
Education and Health Services	1.14	1.06	1.03	1.00	1.00
Leisure and Hospitality	1.05	1.02	1.05	1.06	1.04
Other Services	0.91	1.07	1.03	1.03	1.02
Government	0.79	0.79	0.78	0.78	0.76

Source: BLS(2014) and ESI (2014)

Exhibit 2-10: Cincinnati MSA Shift Share Analysis 2002 to 2012 (thousands of jobs)

Sector	2002	National	Industry	Region	Total Change	2012
Mining, Logging, and Construction	49.2	+1.2	-6.7	-5.9	-11.3	37.9
Manufacturing	130.0	+3.3	-31.7	+4.3	-24.2	105.8
Trade, Transportation, and Utilities	213.7	+5.4	-5.2	-14.7	-14.5	199.2
Information	17.8	+0.4	-4.2	-0.2	-4.0	13.8
Financial Activities	64.1	+1.6	-3.0	+1.3	-0.1	64.0
Professional and Business Services	139.6	+3.5	+13.6	+4.1	+21.2	160.8
Education and Health Services	124.7	+3.1	+28.6	-5.2	+26.5	151.2
Leisure and Hospitality	98.2	+2.5	+11.9	-6.4	+8.0	106.2
Other Services	40.9	+1.0	-0.5	-3.0	-2.5	38.4
Government	130.6	+3.3	-0.8	-8.0	-5.5	125.1
Total Nonfarm	**1,008.6**	**+25.4**	**+1.9**	**-33.7**	**-6.4**	**1,002.4**

Source: BLS(2014) and ESI (2014)

Data for the shift share analysis is drawn from the Bureau of Labor Statistics Current Employment Statistics (CES), which are able to provide fuller industry detail over time, without the confidentially censoring found in other sources. The CES data also includes government jobs, which are not included in the CBP data presented above.

2.3 CINCINNATI COMPARED TO ITS PEERS

One way to understand the Cincinnati MSA economy better is to compare it to other similar MSAs. For the purposes of our analysis, we choose Dayton, OH; Cleveland, OH; Columbus, OH, Indianapolis, IN; and Pittsburgh, PA. These comparators were chosen due to their size, geographic location and economic similarity to Cincinnati.

As Illustrated in Exhibits 2.11 and 2.12, the Cincinnati Region is in the middle of the pack when it come population growth over the last 20 years. Since 1990, the population of Cincinnati has increased at CAGR of approximately 0.7%, compared to Columbus, OH and Indianapolis, IN which have increased at an annual rate of 1.3% and 1.4%, respectively, and Cleveland, OH and Pittsburgh, PA, which have decreased at an annual rate of -0.1% and -0.2%, respectively.

Exhibit 2-11: MSA Population

Population	1990	2000	2005	2010	2012	CAGR
Cincinnati, OH	1,836,971	1,999,554	2,054,879	2,116,811	2,128,603	0.7%
Dayton, OH	804,489	805,938	804,766	799,980	800,972	0.0%
Cleveland, OH	2,103,367	2,147,532	2,111,699	2,076,016	2,063,535	-0.1%
Columbus, OH	1,467,387	1,682,068	1,791,126	1,906,295	1,944,002	1.3%
Indianapolis, IN	1,430,017	1,663,995	1,772,959	1,892,368	1,928,982	1.4%
Pittsburgh, PA	2,468,674	2,428,303	2,374,483	2,356,827	2,360,733	-0.2%

Source: US Census Bureau(2014)

Exhibit 2-12: Population Growth Index
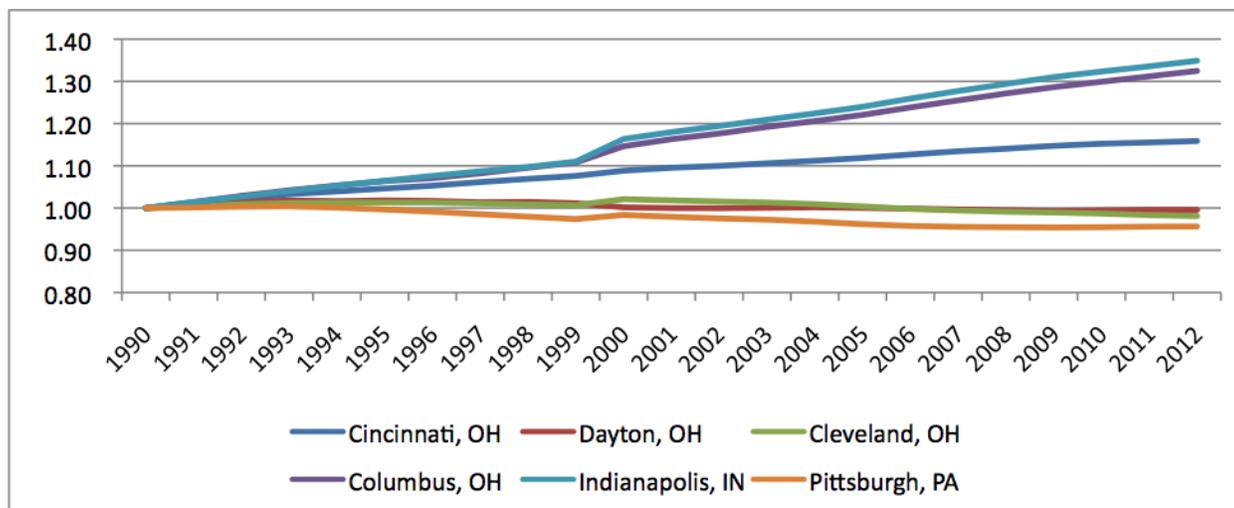
Source: US Census Bureau (2014)

Compared to its peers, Cincinnati had the second highest growth in employment over the 1990-2012 period (Exhibit 2.13 and Exhibit 2.14). All of the cities have yet to fully recover from the Great Recession and several have yet to recover from the recession in the early 2000s. Employment in Cincinnati, Columbus, and Indianapolis is still below their peak employment levels, which occurred in 2007, while the others are still below their peak employment levels, which occurred in 2000 or 2001. In addition, the employment levels in Dayton and Cleveland are below their 1990 levels.

Exhibit 2-13: MSA Employment

Population	1990	2000	2005	2010	2012	CAGR
Cincinnati, OH	829,321	992,249	999,816	943,777	959,570	0.7%
Dayton, OH	387,901	409,228	386,006	343,868	349,894	-0.5%
Cleveland, OH	1,017,433	1,112,303	1,046,711	957,593	979,570	-0.2%
Columbus, OH	716,386	899,202	907,816	878,945	916,300	1.1%
Indianapolis, IN	712,932	876,334	882,782	865,764	903,656	1.1%
Pittsburgh, PA	1,001,119	1,100,266	1,082,429	1,069,751	1,097,436	0.4%

Source: BLS (2014)

Exhibit 2-14: Employment Growth Index
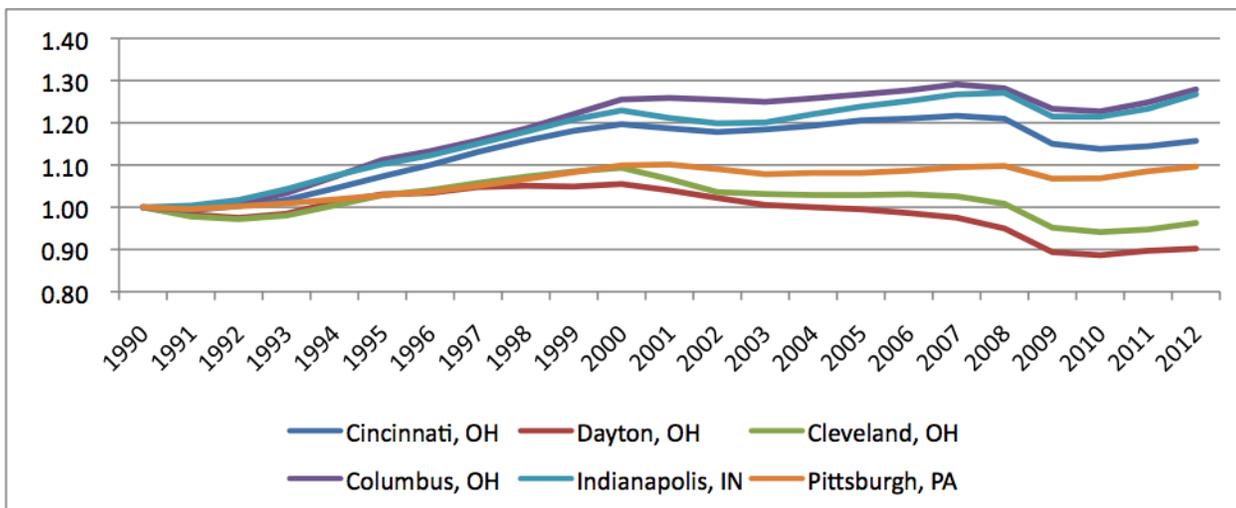
Source: BLS (2014)

As Exhibit 2.15 illustrates, in terms of GDP, the impact of the Great Recession in Cincinnati was more severe than the US economy as a whole, but it did fare better than some of its peers. Between 2007 and 2008, Cincinnati's GDP contracted 1.3% compared to a contraction of 0.3% for the US – compared to its peer only Pittsburgh fared better over the same time period and the hardest hit region was Dayton. Between 2008 and 2009 Cincinnati's GDP contracted 4.1% compared to a contraction of 2.8% for the US – compared to its peer the only cities to fare worse than Cincinnati where Dayton and Cleveland. However since 2009 the recovery in Cincinnati has kept pace with nation and with many of its top-performing peers.

Exhibit 2-15: Comparison of Real GDP Change 2007-2012
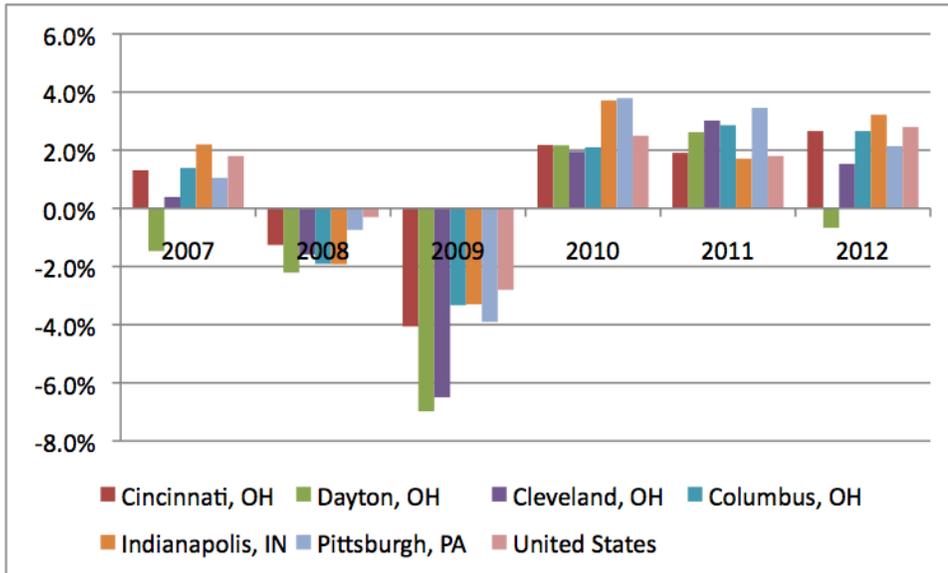
Source: BEA (2014)

While the Cincinnati MSA has begun to recover from the Great Recessions, it appears that the recovery in Dayton is lagging behind that of the Cincinnati's MSA and the nation as a whole. Since the Dayton MSA is included in the forecast area for the Brent Spence Bridge, this slowed recovery in the northern portion of the forecast area may have an impact on both the number of passenger and freight trips across the bridge.

3. HISTORICAL TRENDS IN KEY VARIABLES

3.1   POPULATION TRENDS[4]

Employment in the forecast area counties is shown in Exhibits 3.1 and 3.2. Hamilton County, Ohio, which contains the City of Cincinnati, is the most heavily populated, followed by Montgomery County, Ohio, which contains the City of Dayton. These two counties are also the only two counties to have less population in 2012 as compared to 1980. A look at growth rates of these counties reveals that in general population growth over the more recent 2000-2012 period has been slower than over the entire 1980-2013 period. It also shows that growth has been strongest in the suburban counties as compared to the more urban counties.

As shown in Exhibit 3.4 the suburban counties have enjoyed a tremendous growth in population density, while the more urban counties of Hamilton and Montgomery counties have experienced a decrease in their population density over the 1980 to 2012 timeframe. While all of the suburban counties have experienced increases in their population density, some have increased faster than others – with Boone County, Kentucky and Warren County, Ohio being two in particular. The population density of both of these counties has more than doubled over the 1980 to 2012 time period, with the population density of Boone County increasing from 186 individuals per square mile in 1980 to 501 individuals in 2012 and in Warren County the population density increased from 247 to 541.

3.2   EMPLOYMENT TRENDS

Employment in the Forecast Area counties is shown in Exhibits 3.5 and 3.6. Hamilton County leads the region in terms of employment and is by far the region's major center for employment and commercial activity, having more than doubled the jobs of the next largest employment center, Montgomery County. While almost all of the counties have experienced employment growth since 1980, all counties, save Campbell County, Kentucky are below their peak employment levels.

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[4] Please see Appendix 1 for annual data for each county.

Exhibit 3-1: Population by county 1980-2012

Year	Ohio							Kentucky			Indiana	Forecast Area Total
	Hamil.	Clermt.	Warren	Butler	Mont.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
1980	462,039	22,434	20,224	79,268	276,278	20,224	33,243	20,080	31,836	16,601	8,978	991,205
1985	476,618	27,829	23,489	81,563	289,031	23,489	32,805	24,002	35,935	17,075	8,338	1,040,174
1990	537,074	36,278	34,499	90,528	313,460	34,499	36,949	38,361	46,247	21,211	9,547	1,198,653
1995	544,205	41,707	45,222	104,434	312,842	45,222	42,926	51,947	50,541	23,332	10,739	1,273,117
2000	566,965	49,109	59,404	126,189	303,352	59,404	44,772	69,011	58,248	26,255	14,065	1,376,774
2005	538,866	52,970	69,532	136,387	280,583	69,532	41,106	75,202	61,643	27,910	14,718	1,368,449
2010	483,074	51,697	73,884	137,975	239,472	73,884	37,467	70,620	63,467	27,219	14,292	1,273,051
2012	490,070	53,331	75,680	138,754	243,104	75,680	38,981	75,653	61,454	28,597	14,298	1,295,602
Diff 80-12	28,031	30,897	55,456	59,486	(33,174)	55,456	5,738	55,573	29,618	11,996	5,320	304,397
% Increase 80-12	6.1%	137.7%	274.2%	75.0%	-12.0%	274.2%	17.3%	276.8%	93.0%	72.3%	59.3%	30.7%
CAGR 80-12	0.2%	2.7%	4.2%	1.8%	-0.4%	4.2%	0.5%	4.2%	2.1%	1.7%	1.5%	**0.8%**
CAGR 00-12	-1.2%	0.7%	2.0%	0.8%	-1.8%	2.0%	-1.1%	0.8%	0.4%	0.7%	0.1%	**-0.5%**

Source: US Census Bureau (2014) and ESI (2014)

Exhibit 3-2: Population by County 1980-2010
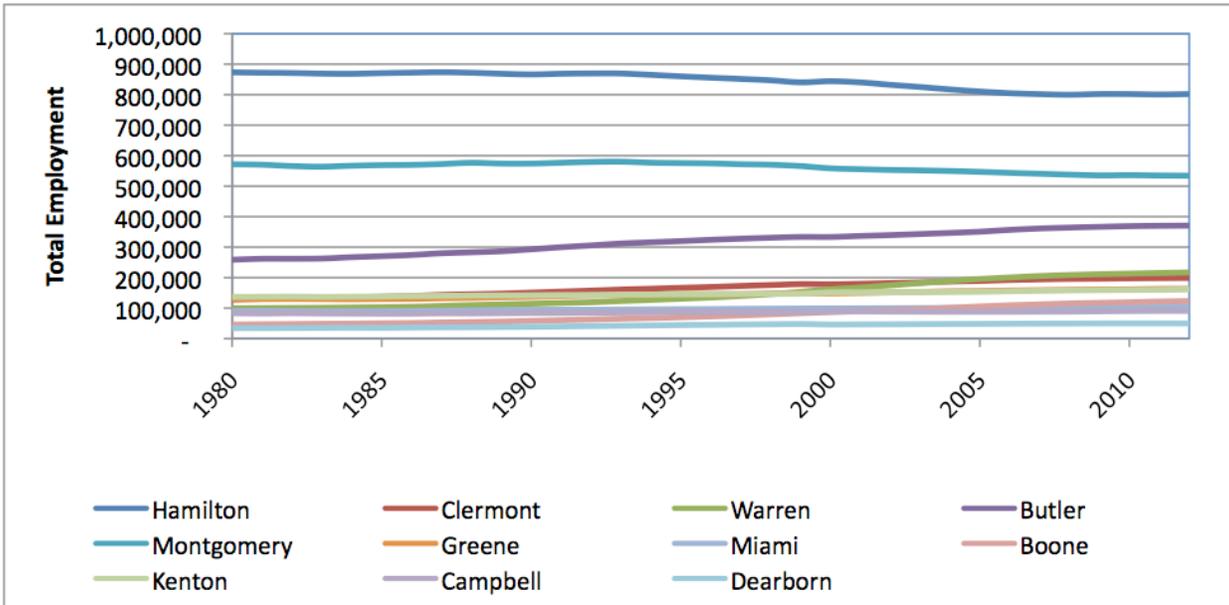
Source: US Census Bureau (2014) and ESI (2014)

Exhibit 3-3: Population as Percent of MSA Population[5]

	Ohio							Kentucky			Indiana
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.
1980	50.2%	7.4%	5.7%	14.9%	N/A	N/A	N/A	2.6%	7.9%	4.8%	2.0%
1985	49.2%	7.8%	5.8%	15.3%	N/A	N/A	N/A	2.8%	7.8%	4.6%	2.0%
1990	47.2%	8.2%	6.2%	15.9%	N/A	N/A	N/A	3.2%	7.7%	4.6%	2.1%
1995	44.8%	8.7%	6.8%	16.6%	N/A	N/A	N/A	3.6%	7.6%	4.5%	2.3%
2000	42.2%	8.9%	8.1%	16.7%	N/A	N/A	N/A	4.4%	7.6%	4.4%	2.3%
2005	39.4%	9.2%	9.5%	17.1%	N/A	N/A	N/A	5.1%	7.5%	4.3%	2.4%
2010	37.9%	9.3%	10.1%	17.4%	N/A	N/A	N/A	5.6%	7.6%	4.3%	2.4%
2012	37.7%	9.4%	10.2%	17.4%	N/A	N/A	N/A	5.8%	7.6%	4.3%	2.3%

Source: US Census Bureau (2014)and ESI (2014)

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[5] Please see Appendix 1 for annual population and employment estimates for the Cincinnati MSA.

Exhibit 3-4: Population Density by County 1980-2012

	Ohio							Kentucky			Indiana	Overall Density
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
1980	2,151	284	247	566	1,238	313	222	186	855	551	112	635
1985	2,145	304	256	592	1,232	313	221	204	863	541	117	641
1990	2,135	334	285	641	1,243	331	229	236	887	555	128	661
1995	2,119	369	326	700	1,247	354	237	284	906	575	145	684
2000	2,080	394	403	729	1,210	358	243	354	946	586	152	698
2005	1,996	419	487	767	1,185	377	250	428	960	582	159	711
2010	1,976	437	531	807	1,161	390	252	484	998	598	164	725
2012	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729
Dif 80-12	(175)	156	294	245	(81)	82	31	314	154	50	51	94

Source: US Census Bureau (2014) and ESI (2014)

Exhibit 3-5: Employment by County 1980-2012

	Ohio							Kentucky			Indiana	Forecast
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	Area Total
1980	462,039	22,434	20,224	79,268	276,278	20,224	33,243	20,080	31,836	16,601	8,978	**991,205**
1985	476,618	27,829	23,489	81,563	289,031	23,489	32,805	24,002	35,935	17,075	8,338	**1,040,174**
1990	537,074	36,278	34,499	90,528	313,460	34,499	36,949	38,361	46,247	21,211	9,547	**1,198,653**
1995	544,205	41,707	45,222	104,434	312,842	45,222	42,926	51,947	50,541	23,332	10,739	**1,273,117**
2000	566,965	49,109	59,404	126,189	303,352	59,404	44,772	69,011	58,248	26,255	14,065	**1,376,774**
2005	538,866	52,970	69,532	136,387	280,583	69,532	41,106	75,202	61,643	27,910	14,718	**1,368,449**
2010	483,074	51,697	73,884	137,975	239,472	73,884	37,467	70,620	63,467	27,219	14,292	**1,273,051**
2012	490,070	53,331	75,680	138,754	243,104	75,680	38,981	75,653	61,454	28,597	14,298	**1,295,602**
Diff 80-12	28,031	30,897	55,456	59,486	(33,174)	55,456	5,738	55,573	29,618	11,996	5,320	**304,397**
% increase 80-12	6.1%	137.7%	274.2%	75.0%	-12.0%	274.2%	17.3%	276.8%	93.0%	72.3%	59.3%	**30.7%**
CAGR 80-12	0.2%	2.7%	4.2%	1.8%	-0.4%	4.2%	0.5%	4.2%	2.1%	1.7%	1.5%	**0.8%**
CAGR 00-12	-1.2%	0.7%	2.0%	0.8%	-1.8%	2.0%	-1.1%	0.8%	0.4%	0.7%	0.1%	**-0.5%**

Source: BLS(2014) and ESI (2014)

While Hamilton County is the commercial and economic center of the region, its importance has been decreasing over time. The percent of total MSA employment found in Hamilton County has decreased from a high of 68.6% in 1980 to 51.1% in 2012, while the percent of total MSA employment has been in increasing in the suburban counties, especially in Warren, Butler, and Clermont counties in Ohio and Boone County in Kentucky over the same time period.

Exhibit 3-6: Total Employment by County 1980-2012
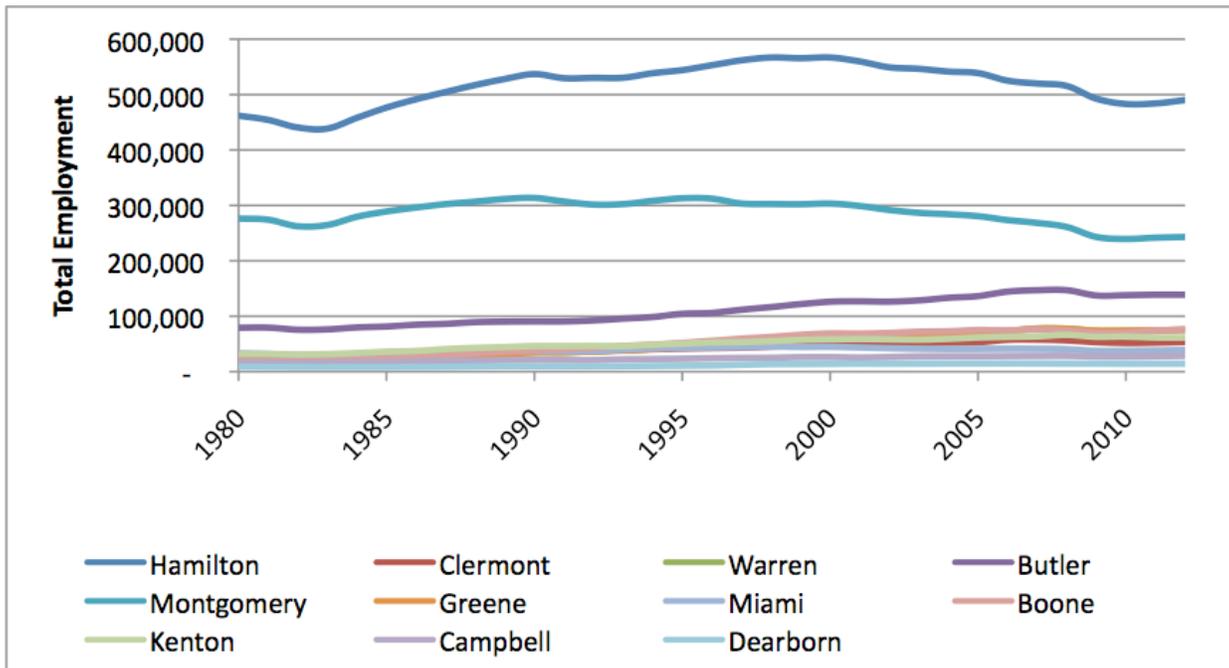
Source: BLS(2014) and ESI (2014)

Exhibit 3-7: Percent of MSA Employment

	Ohio							Kentucky			Indiana
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.
1980	68.6%	3.3%	3.0%	11.8%	N/A	N/A	N/A	3.0%	4.7%	2.5%	1.3%
1985	67.4%	3.9%	3.3%	11.5%	N/A	N/A	N/A	3.4%	5.1%	2.4%	1.2%
1990	64.8%	4.4%	4.2%	10.9%	N/A	N/A	N/A	4.6%	5.6%	2.6%	1.2%
1995	61.2%	4.7%	5.1%	11.7%	N/A	N/A	N/A	5.8%	5.7%	2.6%	1.2%
2000	57.1%	4.9%	6.0%	12.7%	N/A	N/A	N/A	7.0%	5.9%	2.6%	1.4%
2005	53.9%	5.3%	7.0%	13.6%	N/A	N/A	N/A	7.5%	6.2%	2.8%	1.5%
2010	51.2%	5.5%	7.8%	14.6%	N/A	N/A	N/A	7.5%	6.7%	2.9%	1.5%
2012	51.1%	5.6%	7.9%	14.5%	N/A	N/A	N/A	7.9%	6.4%	3.0%	1.5%

Source: BLS (2014) and ESI (2014)

4. FORECAST METHODOLOGY

County-level forecasting models were developed to capture the interplay between population and employment at the individual county-level. The basic conceptual notions behind the models is widely used and accepted in the urban and regional analysis literature – an increase in population should stimulate employment and an increase in employment should stimulate population. The models that were developed are based on the regional labor market models developed by Mills and Lubuele (1995) and others.

The specification of the models is intended to capture regional growth dynamics while taking advantage of econometric modeling techniques to control for unmeasured local factors. The models are defined as follows:

$$PopDen_{it} = \beta_1 PopDen_{it-1} + \beta_2 PopDen_{i,t-1}^2 + \beta_3 Emp_{it-1} + \alpha_i + \varepsilon_{it}$$

$$Emp_{it} = \gamma_1 Emp_{i,t-1} + \gamma_2 Emp_{i,t-1}^2 + \gamma_3 Pop_{i,t-1} + \eta_i + \mu_{it}$$

Where: $PopDen_{it}$ is the population density in county i at time t;

Emp_{it} is the employment in county i at time t;

Pop_{it} is the population in county I at time t;

α_1, η_i are county specific fixed effects; and

$\varepsilon_{it}, \mu_{it}$ are random error terms.

Population density at location i at time t ($PopDen_{it}$) is a function of both the population density and the population density squared at the same location in the previous period (t-1) as well as employment in the

previous period. Each county is modeled with a county specific fixed-effect (α_i, η_i) to measure the impacts specific to each county that are unchanging through time. Similar to population, employment was modeled as a function of employment and employment squared at the same location in the previous period as well as the population in the previous period. County-specific fixed effects were included as well.

If only the lagged values of the independent variables in each model are used, the resulting forecasts would essentially be an extrapolation of the previous trend; however, including the squared terms as well helps to introduce exogenous factors into the model and removes the determinacy found in trend extrapolation models. Moreover, the county-specific fixed effects control for the substantial difference in population density and employment across counties.

The model population density was chosen as opposed to population to capture the impact of increasing development costs and land prices as counties exhaust their supply of land, In other words, counties may see diminished rates of population growth as land becomes scarcer. Including the squared population density allows relationships between variables that are non-linear. Thus when population density is relatively modest, population may increase rapidly but that may diminish as density becomes high and land

becomes scarcer (and more expensive). Employment was not modeled in terms of density because the impact of increasing density on employment is theoretically ambiguous. While development costs increases with density which should adversely affect employment, there is also substantial literature that agglomeration economies associated with employment density increases productivity and hence employment.

The model was estimated using a fixed-effects panel data model using three stage least squares. Panel data has the advantage of being able to capture both variations over units, e.g counties, as well as variation over time. Fixed effects allow the control for various factors that are specific to an individual location but are fixed over time and that cannot be easily controlled for in the modeling. For example, one county may be characterized by very rugged terrain that is difficult to develop while another county might have no such obstacles; it would be expected that these counties have different population and employment density levels and these differences are captured by the use of fixed effects which are represented by the location specific constant terms, α_i, η_i.

It was also investigated whether there were differences in growth rates, both population and employment for counties that had a principal city and those counties that did not have a principal city. This was done by including a dummy variable that indicates whether or not the county included a principal city and then interacting the dummy variable with the key variables in the regression model. For both employment and population the interactions terms were not statistically significant at any meaningful level of confidence; this indicates that there are not differences in the growth rates for counties that have a principal city versus those that do not have a principal city.

To help maximize precision, the model was estimated using annual county-level data from 1980-2012 from 41 MSAs, the 20 MSAs that are larger than Cincinnati in terms of population and the 20 MSAs that are smaller.[6] This resulted in inclusion of data from 326 individual counties and 10,049 observations. Including such a large number of counties ensured that data from counties all across the population and employment spectrum was used.

The results of the models are presented in Appendix 4. The signs on the coefficients have the expected signs and are statistically significant. The r-squared of the population model is 0.9998 and for the employment model it is 0.993. This indicates that the models are able to explain over 99 percent of the variation in population and employment.

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[6] See Appendix 2 for a complete list of MSAs included in the regression model.

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5. COUNTY LEVEL FORECASTS

5.1 FORECAST RESULTS[7]

POPULATION

Exhibits 5.1 and 5.2 present the population forecasts for key years. Overall, the forecast shows that the forecast area's population will increase by approximately 410,000 individuals or 0.3% per annum over the next 40 years. Exhibit 5.3 summarizes the forecasted population density for each county in the forecast area.

Exhibit 5-1: Population Forecasts 2012-2052

	Ohio							Kentucky			Indiana	Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012	802,038	199,085	217,241	370,589	534,325	163,587	103,060	123,316	161,711	90,908	49,831	2,815,692
2015	800,040	205,670	228,082	380,086	530,100	168,260	103,566	130,041	164,185	92,204	51,320	2,853,553
2020	798,295	216,203	245,422	394,214	525,249	175,501	104,469	141,106	168,128	94,188	53,614	2,916,388
2030	798,004	235,152	276,626	416,964	520,424	187,948	106,291	161,866	175,100	97,531	57,558	3,033,464
2040	799,302	250,916	302,559	433,810	518,725	197,864	107,931	179,832	180,725	100,143	60,752	3,132,559
2050	800,828	263,556	323,268	446,190	518,251	205,595	109,304	194,576	185,091	102,154	63,316	3,212,129
2052	801,115	265,737	326,829	448,235	518,225	206,913	109,546	197,142	185,829	102,495	63,763	3,225,830
Diff. 12-52	(924)	66,652	109,588	77,646	(16,100)	43,326	6,486	73,826	24,118	11,587	13,932	410,138
% Incr. 12-52	-0.1%	33.5%	50.4%	21.0%	-3.0%	26.5%	6.3%	59.9%	14.9%	12.7%	28.0%	14.6%
CAGR 12-52	0.0%	0.7%	1.0%	0.5%	-0.1%	0.6%	0.2%	1.2%	0.3%	0.3%	0.6%	0.3%

Source: ESI (2014)

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[7] Please see Appendix 3 for annual forecasts for each variable.

Exhibit 5-2: Population Forecasts 2012-2052
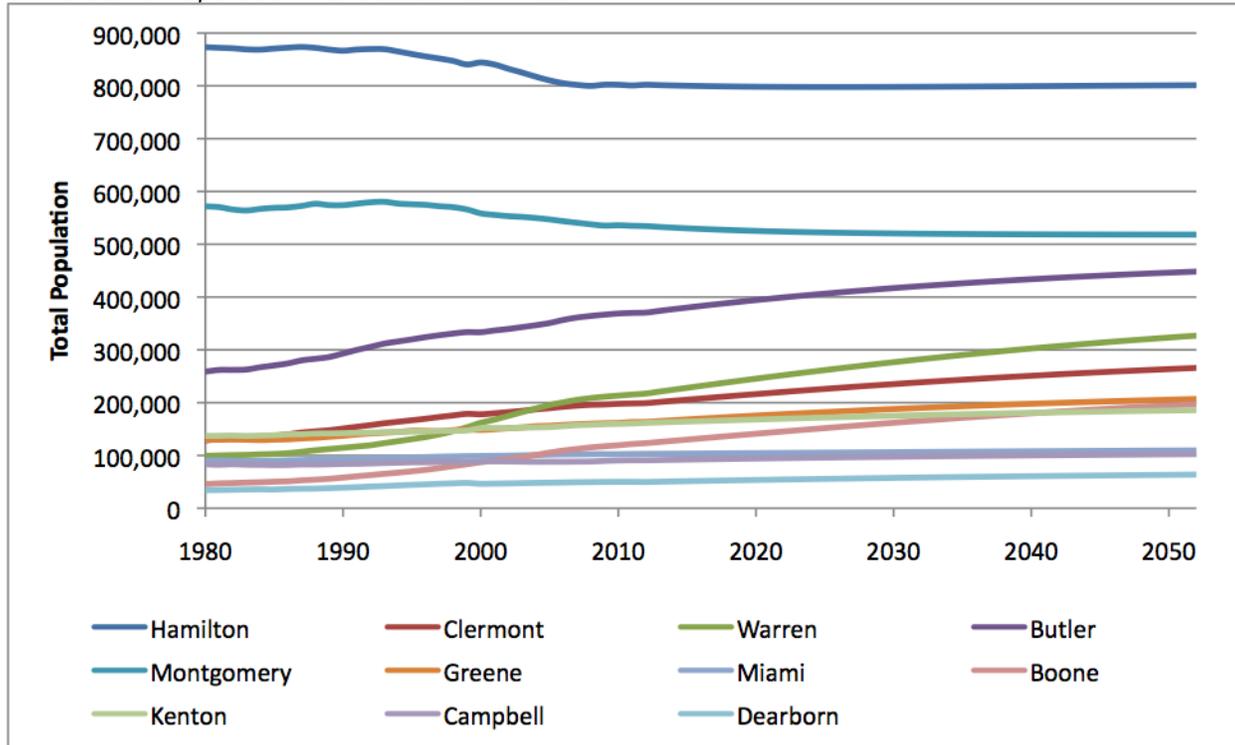
Source: ESI(2014)

Exhibit 5-3: Forecasted Population Density 2012-2052

	Ohio							Kentucky			Indiana	Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729
2015	1,971	455	568	832	1,148	406	254	528	1,025	609	168	739
2020	1,967	478	612	863	1,138	423	257	573	1,049	622	176	755
2030	1,966	520	689	912	1,127	453	261	657	1,093	645	189	785
2040	1,969	555	754	949	1,124	477	265	730	1,128	662	199	811
2050	1,973	583	806	976	1,123	496	269	790	1,155	675	208	832
2052	1,974	588	814	981	1,122	499	269	800	1,160	677	209	835

Source: ESI (2014)

EMPLOYMENT

Exhibits 5.4 and 5.5 present the population forecasts for key years. Overall, the forecast shows that the forecast area will add approximately 196,600 jobs over the next 40 years. This is equivalent to annual growth rate of 0.4% per annum.

Exhibit 5-4: Employment Forecasts 2012-2052

	Ohio							Kentucky			Indiana	Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012	490,070	53,331	75,680	138,754	243,104	75,680	38,981	75,653	61,454	28,597	14,298	1,295,602
2015	495,687	55,591	79,652	140,725	247,010	69,540	39,619	81,236	63,072	29,023	14,553	1,315,708
2020	502,687	58,960	85,706	143,799	251,815	72,144	40,503	89,773	65,387	29,654	14,965	1,355,394
2030	510,968	64,414	95,824	149,078	257,276	76,430	41,780	104,035	68,893	30,673	15,717	1,415,088
2040	515,131	68,496	103,623	153,218	259,790	79,701	42,628	114,972	71,327	31,437	16,360	1,456,683
2050	517,344	71,545	109,539	156,364	260,973	82,180	43,214	123,219	73,040	32,009	16,893	1,486,318
2052	517,651	72,055	110,532	156,891	261,122	82,597	43,308	124,599	73,317	32,105	16,988	1,491,165
Dif 12-52	27,581	18,724	34,852	18,137	18,018	6,917	4,327	48,946	11,863	3,508	2,690	195,563
% Increa 12-52	5.6%	35.1%	46.1%	13.1%	7.4%	9.1%	11.1%	64.7%	19.3%	12.3%	18.8%	15.1%
CAGR 12-52	0.1%	0.8%	1.0%	0.3%	0.2%	0.2%	0.3%	1.3%	0.4%	0.3%	0.4%	0.4%

Source: ESI (2014)

EMPLOYMENT TO POPULATION RATIO

One way to check if forecasts of population and employment are reasonable is to compare historical and forecast ratios of employment / population. For most geographic areas the ratio tends to be fairly stable over long periods of time. Exhibits 5.6 and 5.7 summarize the forecasted employment/population ratios for the 2012-2052 timeframe.

Exhibit 5-5: Employment Forecasts 2012-2052
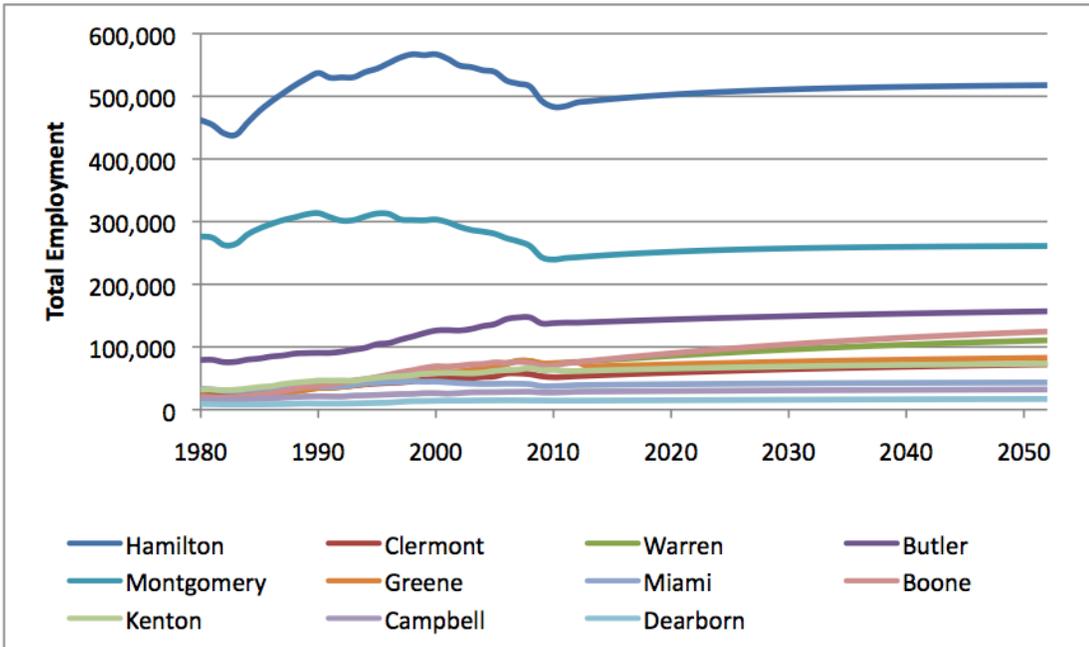
Source: ESI (2014)

Exhibit 5-6: Employment/Population Ratios[8]

	Ohio							Kentucky		Indiana		Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012	0.61	0.27	0.35	0.37	0.45	0.46	0.38	0.61	0.38	0.31	0.29	0.46
2015	0.62	0.27	0.34	0.37	0.46	0.41	0.38	0.62	0.38	0.32	0.28	0.46
2020	0.64	0.27	0.34	0.36	0.48	0.41	0.39	0.61	0.39	0.32	0.27	0.46
2030	0.65	0.26	0.32	0.35	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2040	0.66	0.26	0.31	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.25	0.47
2050	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46
2052	0.67	0.25	0.30	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46

Source: ESI (2014)

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[8] Please see Table A4-5 for historic employment / population ratio data.

Exhibit 5-7: Employment/Population Ratios 1980-2052
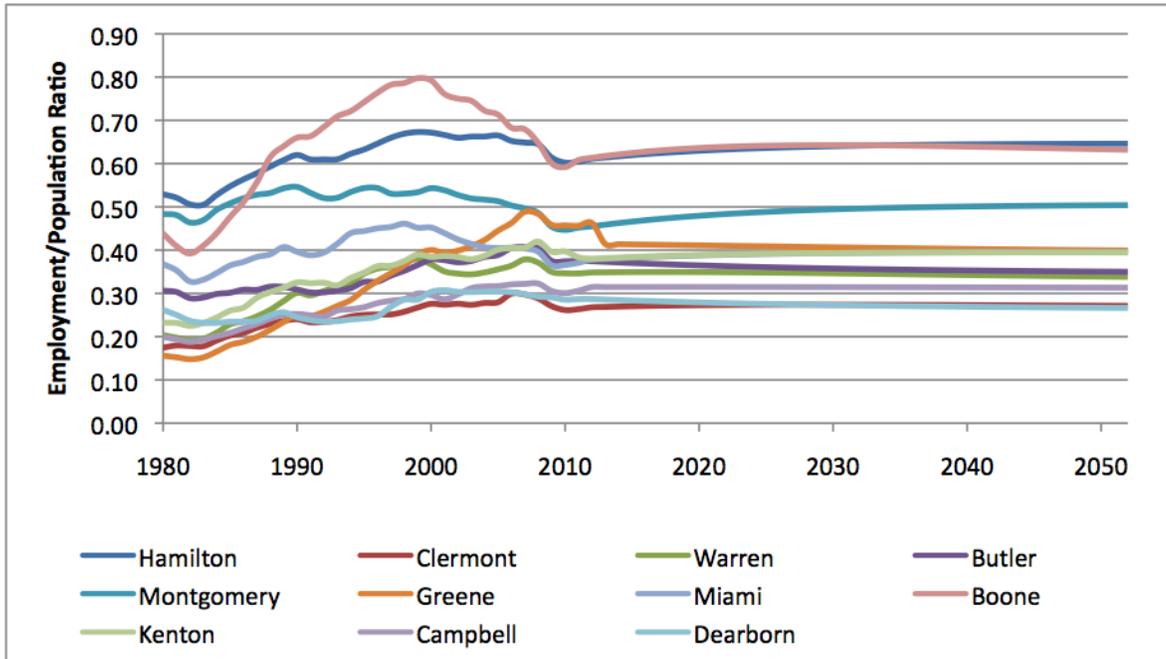
Source: ESI (2014)

5.2 COMPARISON TO OTHER FORECASTS

There are a number of sources that produce annual county-level population forecasts for the forecast area. In this section the population forecasts are compared to these other sources.

FORECASTS USED IN THE 2040 TRANSPORTATION PLANS

The forecast area is comprised of two Metropolitan Planning Organizations (MPO); the Ohio Kentucky Indiana (OKI) Regional Council of Governments, which includes Butler, Clermont, Hamilton and Warren counties in Ohio, Boone, Campbell, and Kenton counties in Kentucky, and Dearborn County Indiana and the Miami Valley Regional Planning Commission (MVRPC), which includes Montgomery, Greene, and Miami counties in Ohio. Both MPOs include county-level population and employment forecasts developed by the respective state agencies in their respective 2040 Regional Transportation Plans.[9] These forecasts are based on forecasts that were produced by the respective state agencies and not by the MPOs themselves.

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[9] Please see the respective transportation plans for the additional details on the forecast methodology used to develop each forecast. OKI: http://www.oki.org/?page_id=1937 and MVRPC: http://docs.mvrpc.org/lrtp/2012/FinalReportwith11x17maps.pdf .

The OKI population projections are based on population projections prepared by each of the respective states and the year that the projections were produced varies by state. The projections for the Ohio counties in the OKI region were produced in 2003 and 2011, the Kentucky forecasts were produced in 2009, and the forecasts for Indiana are from 2007. The population forecasts for the MVRPC were produced in 2013.

OKI's 2040 transportation plan includes population and employment forecasts for 2015, 2020, 2030, and 2040 while the MVRPC plan only includes forecasts for 2040. Exhibits 5.8 and 5.9 compare the developed 2040 population and population density estimates to the forecasts used by the respective MPOs. Compared to the forecasts used by the MPO in developing their 2040 long-range plans, it is projected that there will be approximately 73,200 fewer individuals across the forecast area.

Exhibit 5.10 compares the developed 2040 employment forecasts to the employment forecasts used in the 2040 Transportation Plans. In aggregate, it is forecasted that there will be nearly 230,000 fewer jobs with fewer jobs forecasted across each county in the forecast area. Exhibit 5.11 compares the employment / population ratio implied by both the developed forecast and the forecasts used in the 2040 Plans to the maximum and average employment / population ratio over the 1980-2012 period.

Exhibit 5-8: Comparison to MPO Population Projections - 2040

Population	Ohio							Kentucky			Indiana	Forecast Area Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
Our Forecast	799,302	250,916	302,559	433,810	518,725	197,864	107,931	179,832	180,725	100,143	60,752	3,132,559
MPO Forecast	707,538	262,279	406,133	468,950	518,788	191,945	109,494	217,141	182,969	84,236	56,251	3,205,724
Difference	91,764	(11,363)	(103,574)	(35,140)	(63)	5,919	(1,563)	(37,309)	(2,244)	15,907	4,501	(73,165)

Source: OKI (2013), MVRPC (2013), ESI (2014)

Exhibit 5-9: Comparison of MPO Population Density Estimates - 2040

	Ohio							Kentucky			Indiana	Overall Density
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012 Pop Density	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729
Our Forecast	1,969	555	754	949	1,124	477	265	730	1,128	662	199	811
MPO Forecast	1,743	580	1,012	1,026	1,124	463	269	881	1,142	557	184	830
12-40 Change Ours	-7	115	213	138	-34	83	12	229	119	61	36	82
12-40 Change MPO	-233	140	471	215	-34	68	16	381	133	-44	21	101

Source: OKI (2013), MVRPC (2013), ESI (2014)

In all cases, the employment / population ratio implied by the forecasts used by the MPO significantly exceeds the long-term average for each county and in many cases it also exceeds the maximum value found over the 1980-2012 period. It appears that the forecasted employment population ratio is more in line with the long-term average of each county.

Exhibit 5-10: Comparison to MPO Employment Forecasts – 2040

Employment	Ohio							Kentucky			Indiana	Forecast Area Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
Our Forecast	515,131	68,496	103,623	153,218	259,790	79,701	42,628	114,972	71,327	31,437	16,360	1,456,683
MPO Forecast	603,006	74,611	112,258	190,809	301,688	104,877	57,068	105,190	85,619	35,471	15,901	1,686,498
Difference	(87,875)	(6,115)	(8,635)	(37,591)	(41,898)	(25,176)	(14,440)	9,782	(14,292)	(4,034)	459	(229,815)

Source: OKI (2013), MVRPC (2013), ESI (2014)

Exhibit 5-11: Comparison to the MPO Employment/Population Ratio Estimates - 2040

	Ohio							Kentucky			Indiana	Overall Ratio
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Camp.	Dearb.	
08-12 Average	0.61	0.24	0.31	0.34	0.51	0.32	0.40	0.64	0.34	0.27	0.27	0.46
80-12 Max	0.67	0.30	0.38	0.41	0.55	0.49	0.46	0.80	0.42	0.32	0.31	0.51
Our Forecast	0.66	0.26	0.31	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.25	0.46
MPO Forecast	0.85	0.28	0.28	0.41	0.58	0.55	0.52	0.48	0.47	0.42	0.28	0.53

Source: OKI (2013), MVRPC (2013), ESI (2014)

STATE FORECASTS

In 2013 the states Ohio[10], Kentucky[11], and Indiana[12] produced updated county-level population forecasts for 2015, 2020, 2030, and 2040. The projections are based on extrapolations of past and current demographic trends into the future. Each state's population model is based on a cohort-component projection model where future population is a function of present population and the three components of demographic change: births, deaths, and migrations.

Exhibit 4.12 compares the state's population projections for 2040 to the developed population projections. It is projected that there will be approximately 157,000 additional residents across the forecast area by 2040 compared to states. It is also projected that there will be significantly more people in Hamilton, Warren, Montgomery, and Greene counties compared to the state forecast, and significantly less in Boone County. Section 5.3 below suggests some potential reasons for these differences. There are also differences between the models in terms of population density (see Exhibit 5.13).

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[10] http://development.ohio.gov/files/research/P6090.pdf

[11] http://ksdc.louisville.edu/images/DemographicData/Projections/hmk2011_total%20pop.xls

[12] http://www.stats.indiana.edu/pop_proj/

Exhibit 5-12: Comparison to 2013-vintage State Population Forecasts – 2040

Population	Ohio							Kentucky			Indiana	Forecast Area Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Camp.	Dearb.	
Our Forecast	799,302	250,916	302,559	433,810	518,725	197,864	107,931	179,832	180,725	100,143	60,752	3,132,559
State Forecast	786,090	216,190	239,060	430,360	489,390	163,300	103,990	224,687	177,963	88,012	56,369	2,975,411
Difference	13,212	34,726	63,499	3,450	29,335	34,564	3,941	(44,855)	2,762	12,131	4,383	157,148

Source: ESI (2014)

Exhibit 5-13: Comparison to 2013-vintage State Population Density Estimates – 2040

	Ohio							Kentucky			Indiana	Overall Density
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012 Pop Density	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729
Our Forecast	1,969	555	754	949	1,124	477	265	730	1,128	662	199	811
State Forecast	1,937	478	596	942	1,060	394	255	912	1,111	582	185	770
12-40 Change Ours	-7	115	213	138	-34	83	12	229	119	61	36	82
12-40 Change State	-39	38	54	131	-97	-1	2	411	101	-19	21	41

Source: ESI (2014)

LINNEMAN AND SAIZ (2006) FORECASTS

Linnemand and Saiz (2006) developed an econometric-based model to forecast population growth using widely available demographic and economic data. Their model uses the change in share of county's population as a percentage of total US population over the 1980-2000 period as the independent variable. This specification recognizes that in very small counties, growth rates can be very high, while the actual number moving into a county could be small.

The analysis used a regression model to estimate the change in the share of population over the 1980-2000 period as a function of a number of county characteristics in 1980. The results where then used with data from 2000, combined with population forecasts from the US Census, to estimate county-level population in 2020.

Exhibit 5.14 compares the developed forecast population in 2020 to the results of Linneman and Saiz (2006). It is projected that there will be approximately 264,000 fewer residents than Linneman and Saiz in 2020. Exhibit 5.15 compares the developed population density estimates to the population densities implied by the Limmeman results.

Exhibit 5-14: Comparison to Population Forecasts for Linneman and Saiz (2006) - 2020 [13]

	Ohio							Kentucky			Indiana	Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
Our Forecast	798,295	216,203	245,422		525,249	175,501	104,469	141,106	168,128	94,188	53,614	2,522,174
Linneman Forecast	857,350	238,890	266,608		577,804	173,540	125,631	168,470	186,134	111,449	80,582	2,786,458
Difference	(59,055)	(22,687)	(21,186)		(52,555)	1,961	(21,162)	(27,364)	(18,006)	(17,261)	(26,968)	(264,284)

Source: Linnemand and Saiz (2006) and ESI (2014)

COMMERCIAL FORECASTS

PromximityOne[14] is one source of commercial available county-level population projections.[15] The estimates are developed using models that knit together a mix of historical birth, death, migration, economic and other data to arrive at population estimates for each county. Exhibits 5.16 and 5.17 compare the developed 2030 population and population density estimates to the forecasts produced by ProximityOne. ProximityOne is projecting that nearly 148,000 more individuals will be living in the forecast area in 2030 than the developed model. There are differences between the developed estimates and ProximityOne's estimates across counties. Compared to ProximityOne's estimates, the developed model tends to have less people in urban counties (Hamilton, Montgomery, and Kenton) and slightly more people in the suburban counties.

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[13] The Linneman paper did not produce population estimates for Butler County, Ohio. For comparison purposes the forecast area total excludes Butler County from both forecasts.

[14] http://proximityone.com/demographics2060.htm

[15] Other sources of commercially available population projections include Moody's Analytics, Woods and Poole, and others.

Exhibit 5-15: Comparison to Population Density Estimates based on Linneman and Siaz (2006) – 2020

	Ohio							Kentucky			Indiana
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.
2012 Pop Density	1,976	440	541		1,157	394	253	501	1,009	601	163
Our Forecast	1,967	478	612		1,138	423	257	573	1,049	622	176
MPO Forecast	2,112	528	664		1,252	418	309	684	1,162	737	264
12-20 Change Ours	-9	38	70		-20	29	3	72	40	22	12
12-20 Change MPO	136	88	123		94	24	55	183	152	136	101

Source: Linnemand and Saiz (2006) and ESI (2014)

Exhibit 5-16: Comparison to Population Forecasts Produced by ProximityOne – 2030

	Ohio							Kentucky			Indiana	Total
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
Our Forecast	798,004	235,152	276,626	416,964	520,424	187,948	106,291	161,866	175,100	97,531	57,558	3,033,464
Proximity-One	911,991	221,668	254,702	421,963	587,491	174,733	109,000	161,047	186,738	99,800	52,302	3,181,435
Difference	(113,987)	13,484	21,924	(4,999)	(67,067)	13,215	(2,709)	819	(11,638)	(2,269)	5,256	(147,971)

Source: ProximityOne.com (2014) and ESI (2014)

Exhibit 5-17: Comparison to Population Density Estimates based on ProximityOne Forecasts – 2030

	Ohio							Kentucky			Indiana	Overall Density
	Hamilt.	Clermt.	Warren	Butler	Montg.	Greene	Miami	Boone	Kenton	Campb.	Dearb.	
2012 Pop Density	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729
Our Forecast	1,966	520	689	912	1,127	453	261	657	1,093	645	189	785
ProximityOne	2,247	490	635	923	1,273	421	268	654	1,165	660	171	824
12-30 Change Ours	-10	80	148	101	-30	59	8	156	84	44	25	56
12-30 Change ProximityOne	271	50	93	112	115	27	15	153	156	59	8	95

Source: ProximityOne.com (2014) and ESI (2014)

NOTABLE VARIATIONS ACROSS COUNTIES

For most of the counties in the study our 2040 population forecasts compare relatively closely to the forecasts that are currently being used by each of the MPOs for transportation planning purposes (2040 Plan).   Exceptions to this are discussed below.

The population projections developed by the state of Ohio show a continued decentralization of the urban counties of Hamilton (Cincinnati) and Montgomery (Dayton), while the developed model shows the population of Cincinnati stabilizing at approximately its current level and significant slowdown in the decentralization of Montgomery County. The developed projections are consistent with the recent trend of repopulation of urban areas.

In Warren County Ohio, it is forecasted that there will be approximately 103,000 less people compare to the forecasts used in 2040 Plan (302,559 versus 406,133). There are several reasons for the differences in the forecasted population. First, the forecast used in the 2040 Plan implies an almost doubling of the population density of Warren County from 541 people per square mile in 2012 to over 1,012 people per square mile in 2040 (see Exhibit 4.8). If this occurs, Warren County will have the same population density as Montgomery County, Ohio (which is home to Dayton) and Kenton County, Kentucky (which is home to Covington). Such an increase in density implied by the MPO forecasts is too great and is unlikely happen.[16] The density implied by the forecasted results is more likely to happen.

Second, the forecasts used in the 2040 Plan were produced by the Ohio Development Services Agency in 2003. More recent forecasts produced by Ohio Development Services Agency have much lower results for

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[16] This was further support through an examination of aerial photographs of Warren County. The existing development in the county appears to mainly consist of suburban subdivision development with a few areas of higher density. Given the current development patterns, it seems unlikely that the county will experience that large increase in population density as implied by the MPO forecasts.

Warren County in 2040 (239,060 (state) versus 406,133 (2040 Plan))[17]. Third, the average annual increase in population implied by the forecasts used in the 2040 Plan is higher than the average annual growth over the 1980-2012 period. The forecasted average annual growth rate for Warren County, while lower than the rate over the 1980-2012, is the highest in the forecast area, save for Boone County in Kentucky.

The other county where the developed population forecasts differ from the forecasts in the 2040 plan is Boone County, Kentucky where the developed forecast is approximately 37,300 less people than forecasts used in the 2040 Plan (179,832 versus 217,141). There are several reasons for the differences in the forecast. First, similar to Warren County the forecast used in the 2040 Plan implies a significant increase in population density that does not seem to be achievable. There is anecdotal evidence to support the notion that residents of the County do not want additional development.[18] Second the average annual growth rate implied by the forecast used in the 2040 Plan is significantly higher than the historic rate over the 1980-2012 period (2.0% versus 0.8%). The forecasted annual population growth rate for Boone County is the second highest in the forecast area. Given the large difference in historic versus forecasted growth rates and the anecdotal evidence against additional development; the forecasts for Boone County seem more accurate.

The developed forecast is for significantly less employment both in the forecast area as a whole as well as across most of the individual counties. As was discussed earlier, one way to check the reasonableness of employment forecasts is to look at the ratio of total employment to total population with the expectation that the long term the average employment/population ratio should not change drastically. Over the 1980-2012 period, the aggregate employment/population ratio of the entire forecast area was 0.46 while the employment/population ratio implied by the population and employment forecasts used in the 2040 Plan is 0.53. In fact, the employment/population ratio implied by the 2040 plan forecasts is even greater than the maximum actual employment/population ratio for any county in the forecast area over the 1980-2012 period. The 2040 Plan forecast thus represents a significant increase in the employment/population ratio of the forecast area.

At the individual county-level, the employment/population ratios implied by the values included in the 2040 Plan are higher than the long term average in nine out of the ten counties included in the forecast area and it is higher than the maximum value in six of the counties (see Exhibit 4.11).

Given the large increase in the employment/population ratio used in the 2040 Plan, it is thought that the employment growth used in 2040 Plan is overestimating potential employment growth. Especially when it is considered that Ohio's and Cincinnati's population is getting older - the US Census Bureau projects[19] that the

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[17] In their 2040 Regional Transportation Plan the OKI MPO does not mention making any adjustments to the population forecasts form the Ohio Development Services Agency.

[18] For example please see: "Kroger Eyes Northern Kentucky Land for Rezoning, Residents say keep looking." http://www.wcpo.com/news/local-news/boone-county/union/kroger-eyes-northern-kentucky-land-for-rezoning-residents-say-keep-looking

[19] http://development.ohio.gov/files/research/P7001.pdf

Ohio's old-age dependency ratio[20] will increase from 23 to 38 and the median age will increase to 40.2 between 2000 and 2030.   As the population of the forecast area ages and the number of working-age individuals decreases relative to the number of retirement-age individuals, that the employment/population ratio should decreases, not increase.

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[20] The ratio of the number of people over 65 to the number of people between 20 and 64.

6. CONCLUSIONS AND FORECAST RISKS

This report developed a county-level forecasting model that captures the interplay between population and employment at the level of an individual county. The population and employment projections are based on econometric models that use prior trends in population density and employment across counties over the 1980-2012 period to forecast population and employment over the next 40-years.

Overall it is forecasted that the forecast area's population will increase by approximately 410,000 individuals or 0.3% per annum over the next 40 years (see Exhibit 5.1). This is slightly below the forecast area's annual growth rate over the 1980-2012 period. The forecast area's employment is forecasted to increase by approximately 195,000 over the same time period (see Exhibit 5.4). This represents annual employment growth of 0.4% per annum.

The population projections developed in these analyses are broadly consistent at the metropolitan area level with those produced by the respective states and used by the respective MPOs. The econometric model projections exceed state population projections by a modest 5.3 percent in 2040. At the individual county level, there are more significant differences between the econometric and State projections.

The forecast developed in this study assumes that the Brent Spence Bridge continues to operate at its current capacity. While we feel that the additional capacity that is being added as part of this project will likely have a positive economic impact on the region, the employment and population projected for the region is not likely to increase significantly as a result of the project. However, if the proposed project were not to go forward as planned and there is a significant decrease in the level –of-service of the bridge, the failure to replace the bridge is likely to have a large negative impact on future population and employment growth for the region.

APPENDIX 1: ANNUAL HISTORIC POPULATION AND EMPLOYMENT DATA 1980-2012

Table A1-1: Total Population 1980-2012   *SOURCE: US CENSUS BUREAU (2013)*

	Ohio							Kentucky			Indiana	
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	Study Area Total
1980	873,204	128,483	99,276	258,787	571,697	129,769	90,381	45,842	137,058	83,317	34,291	2,452,105
1981	872,014	130,938	99,953	261,926	570,260	129,725	90,844	47,070	137,184	82,441	34,594	2,456,950
1982	871,027	132,719	100,581	262,015	565,803	130,099	90,265	47,769	137,627	83,347	35,000	2,456,252
1983	869,026	134,129	101,084	262,757	563,911	129,763	89,692	48,635	136,936	82,438	35,450	2,453,821
1984	868,534	135,550	102,088	267,077	566,943	129,138	89,732	49,322	137,568	82,210	35,843	2,464,006
1985	870,575	137,393	102,828	270,444	568,935	129,898	90,014	50,347	138,245	81,801	35,552	2,476,032
1986	872,226	139,924	104,298	274,324	569,689	130,523	90,837	51,078	139,780	81,997	36,485	2,491,161
1987	873,550	143,332	106,987	280,021	572,546	132,249	91,386	52,855	140,309	82,914	37,025	2,513,174
1988	871,861	145,624	109,842	283,064	576,663	133,439	92,538	54,199	141,516	82,797	37,333	2,528,877
1989	868,633	147,784	112,219	286,469	574,060	135,427	92,871	55,892	141,724	83,321	38,109	2,536,509
1990	866,466	150,971	114,525	292,964	574,003	137,195	93,291	58,121	142,146	84,038	39,034	2,552,754
1991	868,684	154,294	116,953	299,802	576,791	139,705	94,016	60,570	142,867	84,260	39,973	2,577,915
1992	869,632	157,519	119,345	305,680	579,435	141,609	94,732	62,882	143,089	84,871	41,152	2,599,946
1993	869,356	160,928	123,379	311,861	580,299	143,039	95,601	65,303	144,274	85,664	42,102	2,621,805
1994	865,034	163,759	127,010	315,858	576,978	144,492	96,158	67,532	144,575	86,192	43,225	2,630,812
1995	860,198	166,655	130,902	319,851	575,712	146,698	96,636	69,991	145,192	86,968	44,348	2,643,151
1996	855,704	169,522	134,862	324,033	574,575	146,517	96,970	72,830	145,139	87,089	45,262	2,652,503
1997	851,670	172,827	139,997	327,697	571,954	145,983	97,719	76,117	146,143	87,517	46,378	2,664,002
1998	847,202	175,786	146,027	330,892	570,141	147,942	98,208	79,761	146,731	87,301	47,169	2,677,160
1999	840,443	178,749	153,292	333,486	565,866	149,149	98,721	83,356	147,221	87,203	48,011	2,685,497
2000	844,124	177,960	161,716	333,368	558,522	148,401	99,015	87,108	151,658	88,687	46,349	2,696,908
2001	840,335	179,845	167,851	336,679	555,536	149,643	99,300	90,277	151,974	88,843	46,726	2,707,009
2002	832,390	182,143	174,833	339,514	553,170	151,537	99,579	93,323	151,777	88,596	47,052	2,713,914
2003	825,139	184,446	181,976	343,022	551,742	153,064	100,120	96,680	152,591	88,259	47,631	2,724,670
2004	817,306	187,281	188,904	346,655	549,713	155,442	100,775	100,822	153,138	87,982	48,135	2,736,153
2005	810,352	189,486	195,499	350,732	546,979	156,223	101,564	105,456	153,769	88,047	48,421	2,746,528
2006	804,913	192,209	200,630	356,691	543,620	157,850	102,028	109,295	155,557	88,036	48,879	2,759,709
2007	801,815	194,346	205,258	361,192	540,667	159,055	102,130	112,308	157,240	88,302	49,348	2,771,661
2008	799,840	195,891	208,640	364,179	537,664	160,115	102,430	115,262	158,258	88,548	49,643	2,780,470
2009	802,149	196,512	211,231	366,633	535,294	161,075	102,526	117,461	159,239	89,664	49,931	2,791,715
2010	802,034	197,759	213,269	368,814	535,905	161,625	102,450	119,306	159,880	90,522	50,079	2,801,643
2011	800,688	198,466	215,348	369,932	534,941	163,279	102,820	121,683	160,540	90,953	50,036	2,808,686
2012	802,038	199,085	217,241	370,589	534,325	163,587	103,060	123,316	161,711	90,908	49,831	2,815,692
CAGR 80-12	-0.3%	1.4%	2.5%	1.1%	-0.2%	0.7%	0.4%	3.1%	0.5%	0.3%	1.2%	0.4%
CAGR 00-12	-0.4%	0.9%	2.5%	0.9%	-0.4%	0.8%	0.3%	2.9%	0.5%	0.2%	0.6%	0.4%
CAGR 07-12	0.0%	0.5%	1.1%	0.5%	-0.2%	0.6%	0.2%	1.9%	0.6%	0.6%	0.2%	0.3%

BRENT SPENCE BRIDGE CORRIDOR
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Table A1-2: Population as a Percent of MSA Population   *SOURCE: US CENSUS BUREAU (2013) AND ESI (2014)*

| | Ohio | | | | | | | Kentucky | | | Indiania | Aggregate |
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	% of MSA
1980	50.2%	7.4%	5.7%	14.9%	N/A	N/A	N/A	2.6%	7.9%	4.8%	2.0%	95.4%
1981	49.9%	7.5%	5.7%	15.0%	N/A	N/A	N/A	2.7%	7.9%	4.7%	2.0%	95.4%
1982	49.7%	7.6%	5.7%	15.0%	N/A	N/A	N/A	2.7%	7.9%	4.8%	2.0%	95.4%
1983	49.6%	7.7%	5.8%	15.0%	N/A	N/A	N/A	2.8%	7.8%	4.7%	2.0%	95.4%
1984	49.4%	7.7%	5.8%	15.2%	N/A	N/A	N/A	2.8%	7.8%	4.7%	2.0%	95.4%
1985	49.2%	7.8%	5.8%	15.3%	N/A	N/A	N/A	2.8%	7.8%	4.6%	2.0%	95.3%
1986	48.9%	7.8%	5.9%	15.4%	N/A	N/A	N/A	2.9%	7.8%	4.6%	2.0%	95.4%
1987	48.5%	8.0%	5.9%	15.6%	N/A	N/A	N/A	2.9%	7.8%	4.6%	2.1%	95.4%
1988	48.1%	8.0%	6.1%	15.6%	N/A	N/A	N/A	3.0%	7.8%	4.6%	2.1%	95.3%
1989	47.7%	8.1%	6.2%	15.7%	N/A	N/A	N/A	3.1%	7.8%	4.6%	2.1%	95.2%
1990	47.2%	8.2%	6.2%	15.9%	N/A	N/A	N/A	3.2%	7.7%	4.6%	2.1%	95.2%
1991	46.8%	8.3%	6.3%	16.1%	N/A	N/A	N/A	3.3%	7.7%	4.5%	2.2%	95.1%
1992	46.4%	8.4%	6.4%	16.3%	N/A	N/A	N/A	3.4%	7.6%	4.5%	2.2%	95.1%
1993	45.8%	8.5%	6.5%	16.4%	N/A	N/A	N/A	3.4%	7.6%	4.5%	2.2%	95.0%
1994	45.3%	8.6%	6.7%	16.5%	N/A	N/A	N/A	3.5%	7.6%	4.5%	2.3%	95.0%
1995	44.8%	8.7%	6.8%	16.6%	N/A	N/A	N/A	3.6%	7.6%	4.5%	2.3%	94.9%
1996	44.2%	8.8%	7.0%	16.8%	N/A	N/A	N/A	3.8%	7.5%	4.5%	2.3%	94.8%
1997	43.7%	8.9%	7.2%	16.8%	N/A	N/A	N/A	3.9%	7.5%	4.5%	2.4%	94.8%
1998	43.1%	9.0%	7.4%	16.8%	N/A	N/A	N/A	4.1%	7.5%	4.4%	2.4%	94.7%
1999	42.5%	9.0%	7.8%	16.9%	N/A	N/A	N/A	4.2%	7.4%	4.4%	2.4%	94.7%
2000	42.2%	8.9%	8.1%	16.7%	N/A	N/A	N/A	4.4%	7.6%	4.4%	2.3%	94.6%
2001	41.8%	8.9%	8.3%	16.7%	N/A	N/A	N/A	4.5%	7.6%	4.4%	2.3%	94.5%
2002	41.2%	9.0%	8.7%	16.8%	N/A	N/A	N/A	4.6%	7.5%	4.4%	2.3%	94.5%
2003	40.6%	9.1%	9.0%	16.9%	N/A	N/A	N/A	4.8%	7.5%	4.3%	2.3%	94.5%
2004	40.0%	9.2%	9.2%	17.0%	N/A	N/A	N/A	4.9%	7.5%	4.3%	2.4%	94.5%
2005	39.4%	9.2%	9.5%	17.1%	N/A	N/A	N/A	5.1%	7.5%	4.3%	2.4%	94.5%
2006	38.9%	9.3%	9.7%	17.2%	N/A	N/A	N/A	5.3%	7.5%	4.3%	2.4%	94.5%
2007	38.5%	9.3%	9.8%	17.3%	N/A	N/A	N/A	5.4%	7.5%	4.2%	2.4%	94.5%
2008	38.2%	9.4%	10.0%	17.4%	N/A	N/A	N/A	5.5%	7.6%	4.2%	2.4%	94.5%
2009	38.1%	9.3%	10.0%	17.4%	N/A	N/A	N/A	5.6%	7.6%	4.3%	2.4%	94.6%
2010	37.9%	9.3%	10.1%	17.4%	N/A	N/A	N/A	5.6%	7.6%	4.3%	2.4%	94.6%
2011	37.7%	9.4%	10.1%	17.4%	N/A	N/A	N/A	5.7%	7.6%	4.3%	2.4%	94.6%
2012	37.7%	9.4%	10.2%	17.4%	N/A	N/A	N/A	5.8%	7.6%	4.3%	2.3%	94.6%

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Table A1-3 Population Density by County 1980-2012 *SOURCE: US CENSUS BUREAU (2013) AND ESI (2014)*

	Ohio							Kentucky			Indiania	Overall Density
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	
1980	2,151	284	247	566	1,238	313	222	186	855	551	112	635
1981	2,148	290	249	573	1,235	313	223	191	856	545	113	636
1982	2,146	294	251	573	1,226	314	222	194	859	551	115	636
1983	2,141	297	252	575	1,221	313	220	197	855	545	116	635
1984	2,140	300	254	584	1,228	311	220	200	858	543	118	638
1985	2,145	304	256	592	1,232	313	221	204	863	541	117	641
1986	2,149	309	260	600	1,234	315	223	207	872	542	120	645
1987	2,152	317	267	613	1,240	319	225	215	876	548	121	651
1988	2,148	322	274	619	1,249	322	227	220	883	547	122	655
1989	2,140	327	280	627	1,243	326	228	227	884	551	125	657
1990	2,135	334	285	641	1,243	331	229	236	887	555	128	661
1991	2,140	341	291	656	1,249	337	231	246	892	557	131	667
1992	2,142	348	297	669	1,255	341	233	255	893	561	135	673
1993	2,142	356	307	682	1,257	345	235	265	900	566	138	679
1994	2,131	362	316	691	1,250	348	236	274	902	570	142	681
1995	2,119	369	326	700	1,247	354	237	284	906	575	145	684
1996	2,108	375	336	709	1,245	353	238	296	906	576	148	687
1997	2,098	382	349	717	1,239	352	240	309	912	578	152	690
1998	2,087	389	364	724	1,235	357	241	324	916	577	155	693
1999	2,071	395	382	730	1,226	359	243	338	919	576	157	695
2000	2,080	394	403	729	1,210	358	243	354	946	586	152	698
2001	2,070	398	418	737	1,203	361	244	366	948	587	153	701
2002	2,051	403	436	743	1,198	365	245	379	947	586	154	703
2003	2,033	408	453	751	1,195	369	246	392	952	583	156	705
2004	2,014	414	471	758	1,191	375	248	409	956	581	158	708
2005	1,996	419	487	767	1,185	377	250	428	960	582	159	711
2006	1,983	425	500	780	1,177	380	251	444	971	582	160	714
2007	1,975	430	511	790	1,171	383	251	456	981	584	162	718
2008	1,970	433	520	797	1,165	386	252	468	988	585	163	720
2009	1,976	435	526	802	1,159	388	252	477	994	593	164	723
2010	1,976	437	531	807	1,161	390	252	484	998	598	164	725
2011	1,973	439	537	809	1,159	394	253	494	1,002	601	164	727
2012	1,976	440	541	811	1,157	394	253	501	1,009	601	163	729

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Table A1-4: Total Employment by County 1980-2012   *SOURCE: BLS (2013)*

	Ohio							Kentucky			Indiana	Study Area
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	Total
1980	462,039	22,434	20,224	79,268	276,278	20,224	33,243	20,080	31,836	16,601	8,978	991,205
1981	454,339	23,511	19,755	79,417	274,238	19,755	32,082	19,264	31,768	15,968	8,656	978,753
1982	440,631	23,676	19,244	75,723	262,394	19,244	29,562	18,737	30,983	15,654	8,284	944,132
1983	438,668	23,857	19,724	76,336	264,608	19,724	29,750	19,958	31,694	15,917	8,230	948,466
1984	458,139	25,898	21,371	79,783	279,558	21,371	31,155	21,678	33,631	16,533	8,311	997,428
1985	476,618	27,829	23,489	81,563	289,031	23,489	32,805	24,002	35,935	17,075	8,338	1,040,174
1986	491,588	29,227	24,572	84,662	296,179	24,572	33,869	26,119	37,353	17,984	8,570	1,074,695
1987	504,742	31,620	26,428	86,348	302,365	26,428	35,117	29,433	40,693	18,997	8,770	1,110,941
1988	517,276	33,433	28,796	89,343	306,805	28,796	36,123	33,340	42,879	20,008	9,307	1,146,106
1989	528,256	34,954	31,691	90,202	311,636	31,691	37,803	35,784	44,411	20,881	9,770	1,177,079
1990	537,074	36,278	34,499	90,528	313,460	34,499	36,949	38,361	46,247	21,211	9,547	1,198,653
1991	529,635	35,975	34,568	90,581	307,035	34,568	36,492	40,171	46,229	21,002	9,521	1,185,777
1992	530,164	36,904	36,467	92,452	301,517	36,467	37,364	43,074	46,419	20,922	9,654	1,191,404
1993	530,420	38,331	38,773	95,636	302,357	38,773	39,659	46,312	46,005	22,314	9,931	1,208,511
1994	538,675	40,390	41,142	98,644	308,234	41,142	42,232	48,703	48,515	22,710	10,358	1,240,745
1995	544,205	41,707	45,222	104,434	312,842	45,222	42,926	51,947	50,541	23,332	10,739	1,273,117
1996	553,076	42,602	48,207	106,056	312,198	48,207	43,668	55,639	52,678	24,177	11,190	1,297,698
1997	561,910	43,423	50,607	111,761	303,468	50,607	44,329	59,540	53,188	24,770	12,475	1,316,078
1998	566,952	45,290	54,021	116,563	302,516	54,021	45,292	62,724	55,003	25,041	13,462	1,340,885
1999	565,627	47,783	58,195	121,906	302,122	58,195	44,599	66,472	57,346	26,138	13,722	1,362,105
2000	566,965	49,109	59,404	126,189	303,352	59,404	44,772	69,011	58,248	26,255	14,065	1,376,774
2001	559,852	49,234	58,884	126,863	298,982	58,884	43,603	68,684	58,728	25,448	14,365	1,363,527
2002	549,221	50,298	60,447	126,287	291,774	60,447	42,291	70,008	58,290	26,371	14,283	1,349,717
2003	546,562	50,446	62,605	128,615	286,655	62,605	41,494	72,051	57,844	27,548	14,445	1,350,870
2004	541,576	52,059	65,834	133,269	284,026	65,834	41,015	72,824	59,242	27,808	14,631	1,358,118
2005	538,866	52,970	69,532	136,387	280,583	69,532	41,106	75,202	61,643	27,910	14,718	1,368,449
2006	525,147	57,557	73,055	144,391	273,529	73,055	41,376	74,627	62,947	28,238	14,787	1,368,709
2007	520,046	57,813	77,717	147,056	268,440	77,717	41,244	76,276	63,787	28,444	14,718	1,373,258
2008	515,631	56,460	77,406	147,072	261,088	77,406	40,558	74,640	66,393	28,567	14,514	1,359,735
2009	492,605	53,139	73,818	137,461	243,059	73,818	37,424	70,522	63,082	27,388	14,518	1,286,834
2010	483,074	51,697	73,884	137,975	239,472	73,884	37,467	70,620	63,467	27,219	14,292	1,273,051
2011	484,110	52,309	74,536	138,752	241,766	74,536	38,123	74,011	61,556	27,859	14,351	1,281,909
2012	490,070	53,331	75,680	138,754	243,104	75,680	38,981	75,653	61,454	28,597	14,298	1,295,602
CAGR 80-12	0.2%	2.7%	4.2%	1.8%	-0.4%	4.2%	0.5%	4.2%	2.1%	1.7%	1.5%	0.8%
CAGR 00-12	-1.2%	0.7%	2.0%	0.8%	-1.8%	2.0%	-1.1%	0.8%	0.4%	0.7%	0.1%	-0.5%
CAGR 07-12	-1.2%	-1.6%	-0.5%	-1.2%	-2.0%	-0.5%	-1.1%	-0.2%	-0.7%	0.1%	-0.6%	-1.2%

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Table A1-5 Employment as a Percent of Total MSA Employment *SOURCE: BLS (2013)AND ESI (2014)*

| | Ohio | | | | | | | Kentucky | | | Indiana | Aggregate % |
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	of MSA
1980	68.6%	3.3%	3.0%	11.8%	N/A	N/A	N/A	3.0%	4.7%	2.5%	1.3%	98.2%
1981	68.3%	3.5%	3.0%	11.9%	N/A	N/A	N/A	2.9%	4.8%	2.4%	1.3%	98.1%
1982	68.4%	3.7%	3.0%	11.8%	N/A	N/A	N/A	2.9%	4.8%	2.4%	1.3%	98.3%
1983	67.9%	3.7%	3.1%	11.8%	N/A	N/A	N/A	3.1%	4.9%	2.5%	1.3%	98.2%
1984	67.6%	3.8%	3.2%	11.8%	N/A	N/A	N/A	3.2%	5.0%	2.4%	1.2%	98.2%
1985	67.4%	3.9%	3.3%	11.5%	N/A	N/A	N/A	3.4%	5.1%	2.4%	1.2%	98.2%
1986	67.1%	4.0%	3.4%	11.5%	N/A	N/A	N/A	3.6%	5.1%	2.5%	1.2%	98.2%
1987	66.3%	4.2%	3.5%	11.3%	N/A	N/A	N/A	3.9%	5.3%	2.5%	1.2%	98.2%
1988	65.5%	4.2%	3.6%	11.3%	N/A	N/A	N/A	4.2%	5.4%	2.5%	1.2%	98.1%
1989	65.1%	4.3%	3.9%	11.1%	N/A	N/A	N/A	4.4%	5.5%	2.6%	1.2%	98.2%
1990	64.8%	4.4%	4.2%	10.9%	N/A	N/A	N/A	4.6%	5.6%	2.6%	1.2%	98.1%
1991	64.3%	4.4%	4.2%	11.0%	N/A	N/A	N/A	4.9%	5.6%	2.6%	1.2%	98.1%
1992	63.7%	4.4%	4.4%	11.1%	N/A	N/A	N/A	5.2%	5.6%	2.5%	1.2%	98.1%
1993	63.5%	4.6%	4.6%	11.5%	N/A	N/A	N/A	5.5%	5.5%	2.7%	1.2%	99.1%
1994	62.2%	4.7%	4.7%	11.4%	N/A	N/A	N/A	5.6%	5.6%	2.6%	1.2%	98.0%
1995	61.2%	4.7%	5.1%	11.7%	N/A	N/A	N/A	5.8%	5.7%	2.6%	1.2%	98.0%
1996	60.6%	4.7%	5.3%	11.6%	N/A	N/A	N/A	6.1%	5.8%	2.7%	1.2%	98.0%
1997	59.9%	4.6%	5.4%	11.9%	N/A	N/A	N/A	6.3%	5.7%	2.6%	1.3%	97.8%
1998	59.1%	4.7%	5.6%	12.1%	N/A	N/A	N/A	6.5%	5.7%	2.6%	1.4%	97.8%
1999	57.8%	4.9%	5.9%	12.4%	N/A	N/A	N/A	6.8%	5.9%	2.7%	1.4%	97.7%
2000	57.1%	4.9%	6.0%	12.7%	N/A	N/A	N/A	7.0%	5.9%	2.6%	1.4%	97.7%
2001	56.9%	5.0%	6.0%	12.9%	N/A	N/A	N/A	7.0%	6.0%	2.6%	1.5%	97.8%
2002	56.2%	5.1%	6.2%	12.9%	N/A	N/A	N/A	7.2%	6.0%	2.7%	1.5%	97.8%
2003	55.7%	5.1%	6.4%	13.1%	N/A	N/A	N/A	7.3%	5.9%	2.8%	1.5%	97.8%
2004	54.7%	5.3%	6.7%	13.5%	N/A	N/A	N/A	7.4%	6.0%	2.8%	1.5%	97.8%
2005	53.9%	5.3%	7.0%	13.6%	N/A	N/A	N/A	7.5%	6.2%	2.8%	1.5%	97.7%
2006	52.3%	5.7%	7.3%	14.4%	N/A	N/A	N/A	7.4%	6.3%	2.8%	1.5%	97.7%
2007	51.6%	5.7%	7.7%	14.6%	N/A	N/A	N/A	7.6%	6.3%	2.8%	1.5%	97.7%
2008	51.4%	5.6%	7.7%	14.7%	N/A	N/A	N/A	7.4%	6.6%	2.8%	1.4%	97.8%
2009	51.6%	5.6%	7.7%	14.4%	N/A	N/A	N/A	7.4%	6.6%	2.9%	1.5%	97.8%
2010	51.2%	5.5%	7.8%	14.6%	N/A	N/A	N/A	7.5%	6.7%	2.9%	1.5%	97.7%
2011	51.0%	5.5%	7.9%	14.6%	N/A	N/A	N/A	7.8%	6.5%	2.9%	1.5%	97.7%
2012	51.1%	5.6%	7.9%	14.5%	N/A	N/A	N/A	7.9%	6.4%	3.0%	1.5%	97.7%

Table A1-6 Cincinnati MSA Employment and Population

SOURCE: US CENSUS BUREAU (2013), BLS (2013), AND ESI (2014)

	Total Population	Total Employment
1980	1,741,029	673,756
1981	1,747,031	664,987
1982	1,751,052	643,987
1983	1,751,730	645,957
1984	1,759,676	677,602
1985	1,769,618	707,472
1986	1,782,790	733,112
1987	1,800,487	760,803
1988	1,811,516	789,193
1989	1,820,832	810,903
1990	1,836,971	829,321
1991	1,857,562	823,267
1992	1,876,213	831,852
1993	1,896,957	834,825
1994	1,909,454	866,233
1995	1,922,043	889,892
1996	1,934,342	912,224
1997	1,949,997	937,913
1998	1,964,010	960,006
1999	1,976,770	979,378
2000	1,999,554	992,249
2001	2,012,228	984,158
2002	2,020,396	977,068
2003	2,031,529	981,927
2004	2,042,753	989,347
2005	2,054,879	999,816
2006	2,069,960	1,003,439
2007	2,084,042	1,008,799
2008	2,095,040	1,003,113
2009	2,107,649	953,816
2010	2,116,811	943,777
2011	2,122,330	949,104
2012	2,128,603	959,570

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APPENDIX 2: LIST OF MSAS INCLUDED IN REGRESSION MODELS

Table A2-1: List of MSAs Included in the Regression Models

SOURCE: US CENSUS BUREAU (2013)

Rank	Metropolitan Statistical Area	2012 Population
9	Atlanta-Sandy Springs-Roswell, GA	5,457,831
10	Boston-Cambridge-Newton, MA-NH	4,640,802
11	San Francisco-Oakland-Fremont, CA	4,455,560
12	Riverside-San Bernardino-Ontario, CA	4,350,096
13	Phoenix-Mesa-Scottsdale, AZ M	4,329,534
14	Detroit-Warren-Dearborn, MI	4,292,060
15	Seattle-Tacoma-Bellevue, WA	3,552,157
16	Minneapolis-St. Paul-Bloomington, MN-WI	3,422,264
17	San Diego-Carlsbad, CA M	3,177,063
18	Tampa-St. Petersburg-Clearwater, FL	2,842,878
19	St. Louis, MO-IL	2,795,794
20	Baltimore-Columbia-Towson, MD	2,753,149
21	Denver-Aurora-Lakewood, CO	2,645,209
22	Pittsburgh, PA	2,360,733
23	Charlotte-Concord-Gastonia, NC-SC	2,296,569
24	Portland-Vancouver-Hillsboro, OR-WA	2,289,800
25	San Antonio-New Braunfels, TX	2,234,003
26	Orlando-Kissimmee-Sanford, FL	2,223,674
27	Sacramento–Roseville–Arden-Arcade, CA	2,196,482
28	Cincinnati, OH-KY-IN	2,128,603
29	Cleveland-Elyria, OH	2,063,535
30	Kansas City, MO-KS	2,038,724
31	Las Vegas-Henderson-Paradise, NV	2,000,759
32	Columbus, OH	1,944,002
33	Indianapolis-Carmel-Anderson, IN	1,928,982
34	San Jose-Sunnyvale-Santa Clara, CA	1,894,388
35	Austin-Round Rock, TX	1,834,303
36	Nashville-Davidson–Murfreesboro–Franklin, TN	1,726,693
37	Virginia Beach-Norfolk-Newport News, VA-NC	1,699,925
38	Providence-Warwick, RI-MA	1,601,374
39	Milwaukee-Waukesha-West Allis, WI	1,566,981
40	Jacksonville, FL	1,377,850
41	Memphis, TN-MS-AR	1,341,690
42	Oklahoma City, OK	1,296,565
43	Louisville/Jefferson County, KY-IN	1,251,351
44	Richmond, VA	1,231,980
45	New Orleans-Metairie, LA	1,227,096
46	Hartford-West Hartford-East Hartford, CT	1,214,400
47	Raleigh, NC	1,188,564
48	Birmingham-Hoover, AL	1,136,650

APPENDIX 3: REGRESSION RESULTS

Table A3-1: Population Model Regression Results

Dependent Variable: Log(Population Density)				
Variable	Coefficient	Std Error	T-Stat	P-value
Constant	-0.104 ***	0.0168	-6.23	0.000
Log(Population Density) - Lag	0.980 ***	0.0049	201.16	0.000
Log(Population Density Squared) - Lag	-0.002 ***	0.0004	-4.53	0.000
Log(Employment) - Lag	0.020 ***	0.0014	13.71	0.000
Observations	10364			
R-Squared	0.9998			
RMSE	0.0215			
***significant at 95% confidence level				

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Table A3-2: Employment Model Regression Results

Dependent Variable: Log(Employment)				
Variable	Coefficient	Std Error	T-Stat	P-value
Constant	0.113	0.0614	1.04	0.066
Log(Employment) – Lag	0.988 ***	0.0093	106.08	0.000
Log(Employment Squared) – Lag	-0.002 ***	0.0005	-4.32	0.000
Log(Population) – Lag	0.025 ***	0.0047	5.28	0.000
Observations	10364			
R-Squared	0.9993			
RMSE	0.046			
***significant at 95% confidence level				

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APPENDIX 4: ANNUAL COUNTY POPULATION AND EMPLOYMENT FORECASTS

Table A4-1: Total Population Forecasts 2013-2052 *SOURCE: US CENSUS BUREAU (2013)*

	Ohio							Kentucky			Indiana	Total
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	
2013	801,272	201,298	220,886	373,845	532,782	165,172	103,224	125,559	162,543	91,349	50,337	2,828,267
2014	800,609	203,494	224,500	377,010	531,378	166,730	103,393	127,802	163,368	91,781	50,833	2,840,897
2015	800,040	205,670	228,082	380,086	530,100	168,260	103,566	130,041	164,185	92,204	51,320	2,853,553
2016	799,554	207,824	231,628	383,077	528,937	169,763	103,742	132,274	164,994	92,619	51,797	2,866,209
2017	799,145	209,956	235,138	385,982	527,880	171,239	103,921	134,499	165,793	93,024	52,265	2,878,841
2018	798,803	212,064	238,608	388,806	526,918	172,688	104,102	136,714	166,582	93,421	52,723	2,891,428
2019	798,522	214,146	242,036	391,549	526,043	174,108	104,285	138,917	167,361	93,808	53,173	2,903,949
2020	798,295	216,203	245,422	394,214	525,249	175,501	104,469	141,106	168,128	94,188	53,614	2,916,388
2021	798,118	218,232	248,763	396,803	524,527	176,867	104,653	143,279	168,883	94,559	54,045	2,928,729
2022	797,984	220,233	252,058	399,316	523,872	178,206	104,838	145,434	169,626	94,921	54,469	2,940,957
2023	797,890	222,205	255,305	401,758	523,277	179,517	105,023	147,570	170,357	95,275	54,883	2,953,060
2024	797,830	224,147	258,504	404,128	522,738	180,801	105,207	149,685	171,074	95,621	55,290	2,965,026
2025	797,800	226,060	261,653	406,430	522,250	182,058	105,391	151,778	171,779	95,959	55,688	2,976,845
2026	797,798	227,941	264,752	408,664	521,807	183,288	105,574	153,847	172,470	96,289	56,077	2,988,509
2027	797,821	229,791	267,799	410,833	521,407	184,492	105,755	155,892	173,148	96,611	56,459	3,000,009
2028	797,864	231,610	270,795	412,938	521,045	185,670	105,936	157,910	173,813	96,925	56,833	3,011,339
2029	797,926	233,397	273,737	414,981	520,719	186,822	106,114	159,902	174,463	97,232	57,200	3,022,492
2030	798,004	235,152	276,626	416,964	520,424	187,948	106,291	161,866	175,100	97,531	57,558	3,033,464
2031	798,097	236,874	279,462	418,888	520,159	189,048	106,465	163,801	175,724	97,823	57,909	3,044,250
2032	798,202	238,564	282,244	420,754	519,920	190,123	106,638	165,707	176,333	98,108	58,253	3,054,846
2033	798,317	240,221	284,972	422,566	519,706	191,174	106,808	167,583	176,929	98,386	58,589	3,065,250
2034	798,441	241,846	287,646	424,323	519,513	192,200	106,976	169,428	177,511	98,656	58,919	3,075,460
2035	798,572	243,438	290,266	426,027	519,341	193,202	107,142	171,242	178,080	98,921	59,241	3,085,472
2036	798,710	244,998	292,832	427,680	519,187	194,181	107,305	173,024	178,636	99,178	59,557	3,095,287
2037	798,853	246,526	295,344	429,284	519,050	195,135	107,465	174,775	179,178	99,429	59,865	3,104,904
2038	799,000	248,021	297,803	430,839	518,928	196,067	107,623	176,493	179,707	99,673	60,167	3,114,321
2039	799,150	249,484	300,208	432,347	518,820	196,977	107,778	178,179	180,222	99,911	60,463	3,123,539
2040	799,302	250,916	302,559	433,810	518,725	197,864	107,931	179,832	180,725	100,143	60,752	3,132,559
2041	799,456	252,316	304,859	435,228	518,641	198,729	108,081	181,453	181,216	100,369	61,035	3,141,382
2042	799,611	253,685	307,106	436,603	518,567	199,572	108,228	183,041	181,694	100,589	61,312	3,150,007
2043	799,767	255,023	309,301	437,936	518,503	200,395	108,372	184,596	182,159	100,804	61,582	3,158,437
2044	799,922	256,331	311,445	439,228	518,447	201,197	108,513	186,118	182,613	101,012	61,847	3,166,673
2045	800,076	257,608	313,539	440,481	518,399	201,978	108,652	187,608	183,054	101,216	62,106	3,174,717
2046	800,230	258,856	315,582	441,695	518,358	202,740	108,788	189,066	183,484	101,413	62,359	3,182,570
2047	800,382	260,074	317,576	442,872	518,323	203,482	108,921	190,491	183,902	101,606	62,606	3,190,236
2048	800,533	261,263	319,521	444,013	518,294	204,205	109,051	191,884	184,309	101,794	62,848	3,197,716
2049	800,682	262,423	321,418	445,119	518,270	204,909	109,179	193,246	184,705	101,976	63,085	3,205,013
2050	800,828	263,556	323,268	446,190	518,251	205,595	109,304	194,576	185,091	102,154	63,316	3,212,129
2051	800,973	264,660	325,072	447,229	518,236	206,263	109,426	195,874	185,465	102,326	63,542	3,219,067
2052	801,115	265,737	326,829	448,235	518,225	206,913	109,546	197,142	185,829	102,495	63,763	3,225,830

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Table A4-2: Population Density Forecasts 2012-2052   *SOURCE: ESI (2014)*

| | Ohio | | | | | | | Kentucky | | | Indiana | Total |
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	
2013	1,974	445	550	818	1,154	398	254	510	1,014	604	165	732
2014	1,972	450	559	825	1,151	402	254	519	1,019	607	167	735
2015	1,971	455	568	832	1,148	406	254	528	1,025	609	168	739
2016	1,970	460	577	838	1,146	409	255	537	1,030	612	170	742
2017	1,969	464	586	844	1,143	413	255	546	1,035	615	171	745
2018	1,968	469	595	851	1,141	416	256	555	1,040	617	173	749
2019	1,967	474	603	857	1,139	420	256	564	1,044	620	174	752
2020	1,967	478	612	863	1,138	423	257	573	1,049	622	176	755
2021	1,966	483	620	868	1,136	426	257	582	1,054	625	177	758
2022	1,966	487	628	874	1,135	430	258	590	1,059	627	179	761
2023	1,966	491	636	879	1,133	433	258	599	1,063	630	180	764
2024	1,966	496	644	884	1,132	436	258	608	1,068	632	181	768
2025	1,965	500	652	889	1,131	439	259	616	1,072	634	183	771
2026	1,965	504	660	894	1,130	442	259	624	1,076	636	184	774
2027	1,966	508	667	899	1,129	445	260	633	1,080	639	185	777
2028	1,966	512	675	903	1,129	448	260	641	1,085	641	186	780
2029	1,966	516	682	908	1,128	450	261	649	1,089	643	188	782
2030	1,966	520	689	912	1,127	453	261	657	1,093	645	189	785
2031	1,966	524	696	916	1,127	456	262	665	1,097	647	190	788
2032	1,966	528	703	921	1,126	458	262	673	1,100	648	191	791
2033	1,967	531	710	925	1,126	461	262	680	1,104	650	192	794
2034	1,967	535	717	928	1,125	463	263	688	1,108	652	193	796
2035	1,967	538	723	932	1,125	466	263	695	1,111	654	194	799
2036	1,968	542	730	936	1,125	468	264	702	1,115	655	195	801
2037	1,968	545	736	939	1,124	470	264	709	1,118	657	196	804
2038	1,968	549	742	943	1,124	473	264	716	1,121	659	197	806
2039	1,969	552	748	946	1,124	475	265	723	1,125	660	198	809
2040	1,969	555	754	949	1,124	477	265	730	1,128	662	199	811
2041	1,970	558	760	952	1,123	479	266	737	1,131	663	200	813
2042	1,970	561	765	955	1,123	481	266	743	1,134	665	201	815
2043	1,970	564	771	958	1,123	483	266	749	1,137	666	202	818
2044	1,971	567	776	961	1,123	485	267	755	1,140	668	203	820
2045	1,971	570	781	964	1,123	487	267	762	1,142	669	204	822
2046	1,971	573	786	966	1,123	489	267	767	1,145	670	204	824
2047	1,972	575	791	969	1,123	490	268	773	1,148	672	205	826
2048	1,972	578	796	971	1,123	492	268	779	1,150	673	206	828
2049	1,973	580	801	974	1,123	494	268	784	1,153	674	207	830
2050	1,973	583	806	976	1,123	496	269	790	1,155	675	208	832
2051	1,973	585	810	978	1,123	497	269	795	1,157	676	208	833
2052	1,974	588	814	981	1,122	499	269	800	1,160	677	209	835

Table A4-3: Total Employment Forecasts 2012-2052   *SOURCE: ESI (2014)*

	Ohio							Kentucky			Indiana	Total
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	
2013	492,081	54,105	77,033	139,421	244,506	68,401	39,204	77,552	62,014	28,743	14,384	1,297,443
2014	493,951	54,858	78,357	140,078	245,806	68,978	39,416	79,413	62,553	28,885	14,469	1,306,763
2015	495,687	55,591	79,652	140,725	247,010	69,540	39,619	81,236	63,072	29,023	14,553	1,315,708
2016	497,300	56,303	80,919	141,361	248,125	70,088	39,812	83,021	63,571	29,156	14,637	1,324,295
2017	498,798	56,996	82,158	141,987	249,158	70,622	39,997	84,767	64,052	29,286	14,720	1,332,541
2018	500,191	57,669	83,368	142,603	250,113	71,143	40,173	86,474	64,514	29,412	14,803	1,340,463
2019	501,484	58,324	84,551	143,206	250,997	71,650	40,342	88,143	64,959	29,535	14,884	1,348,076
2020	502,687	58,960	85,706	143,799	251,815	72,144	40,503	89,773	65,387	29,654	14,965	1,355,394
2021	503,806	59,579	86,834	144,380	252,571	72,626	40,657	91,365	65,800	29,770	15,045	1,362,432
2022	504,846	60,180	87,936	144,949	253,271	73,095	40,804	92,919	66,197	29,882	15,123	1,369,202
2023	505,814	60,764	89,010	145,507	253,919	73,551	40,945	94,435	66,580	29,991	15,201	1,375,717
2024	506,715	61,332	90,059	146,052	254,517	73,996	41,080	95,914	66,948	30,098	15,278	1,381,989
2025	507,554	61,883	91,082	146,586	255,071	74,429	41,209	97,357	67,303	30,201	15,354	1,388,029
2026	508,336	62,419	92,079	147,108	255,583	74,851	41,333	98,763	67,645	30,301	15,429	1,393,846
2027	509,064	62,940	93,051	147,618	256,057	75,262	41,452	100,133	67,974	30,398	15,502	1,399,452
2028	509,743	63,445	93,999	148,117	256,495	75,662	41,566	101,468	68,292	30,493	15,575	1,404,855
2029	510,377	63,937	94,923	148,603	256,901	76,051	41,675	102,769	68,598	30,584	15,647	1,410,064
2030	510,968	64,414	95,824	149,078	257,276	76,430	41,780	104,035	68,893	30,673	15,717	1,415,088
2031	511,520	64,878	96,701	149,542	257,623	76,798	41,880	105,268	69,178	30,760	15,786	1,419,934
2032	512,035	65,328	97,555	149,994	257,944	77,157	41,977	106,469	69,452	30,844	15,855	1,424,610
2033	512,517	65,766	98,387	150,435	258,241	77,507	42,070	107,637	69,717	30,926	15,922	1,429,124
2034	512,968	66,190	99,197	150,865	258,517	77,846	42,159	108,774	69,972	31,006	15,988	1,433,481
2035	513,390	66,603	99,986	151,283	258,771	78,177	42,245	109,880	70,218	31,083	16,052	1,437,689
2036	513,785	67,004	100,753	151,691	259,007	78,499	42,327	110,956	70,456	31,158	16,116	1,441,753
2037	514,154	67,394	101,500	152,088	259,226	78,812	42,407	112,002	70,686	31,231	16,179	1,445,679
2038	514,501	67,772	102,227	152,475	259,429	79,117	42,483	113,020	70,907	31,301	16,240	1,449,473
2039	514,826	68,139	102,935	152,851	259,616	79,413	42,557	114,010	71,121	31,370	16,301	1,453,139
2040	515,131	68,496	103,623	153,218	259,790	79,701	42,628	114,972	71,327	31,437	16,360	1,456,683
2041	515,418	68,843	104,292	153,574	259,952	79,981	42,696	115,907	71,526	31,502	16,418	1,460,109
2042	515,687	69,179	104,943	153,920	260,102	80,254	42,762	116,816	71,718	31,565	16,475	1,463,422
2043	515,940	69,506	105,576	154,257	260,240	80,519	42,826	117,699	71,904	31,626	16,531	1,466,626
2044	516,178	69,824	106,191	154,585	260,369	80,777	42,887	118,558	72,084	31,686	16,586	1,469,725
2045	516,402	70,132	106,790	154,903	260,489	81,027	42,946	119,392	72,257	31,744	16,640	1,472,722
2046	516,613	70,431	107,371	155,212	260,600	81,271	43,004	120,202	72,424	31,800	16,693	1,475,623
2047	516,812	70,722	107,937	155,513	260,704	81,508	43,059	120,990	72,586	31,854	16,744	1,478,429
2048	517,000	71,004	108,486	155,805	260,800	81,738	43,112	121,754	72,742	31,907	16,795	1,481,145
2049	517,177	71,279	109,020	156,089	260,889	81,962	43,164	122,497	72,894	31,959	16,845	1,483,774
2050	517,344	71,545	109,539	156,364	260,973	82,180	43,214	123,219	73,040	32,009	16,893	1,486,318
2051	517,502	71,803	110,043	156,631	261,050	82,391	43,262	123,919	73,181	32,058	16,941	1,488,781
2052	517,651	72,055	110,532	156,891	261,122	82,597	43,308	124,599	73,317	32,105	16,988	1,491,165

Table A4-4: Employment / Population Ratio Forecasts 2012-2052 *SOURCE: ESI (2014)*

| | Ohio | | | | | | | Kentucky | | | Indiana | Total |
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	
2013	0.61	0.27	0.35	0.37	0.46	0.41	0.38	0.61	0.38	0.31	0.29	0.46
2014	0.62	0.27	0.35	0.37	0.46	0.41	0.38	0.62	0.38	0.32	0.28	0.46
2015	0.62	0.27	0.34	0.37	0.46	0.41	0.38	0.62	0.38	0.32	0.28	0.46
2016	0.62	0.27	0.34	0.37	0.47	0.41	0.39	0.62	0.39	0.32	0.28	0.46
2017	0.63	0.27	0.34	0.37	0.47	0.41	0.39	0.62	0.39	0.32	0.28	0.46
2018	0.63	0.27	0.34	0.37	0.47	0.41	0.39	0.62	0.39	0.32	0.28	0.46
2019	0.63	0.27	0.34	0.36	0.47	0.41	0.39	0.62	0.39	0.32	0.27	0.46
2020	0.64	0.27	0.34	0.36	0.48	0.41	0.39	0.61	0.39	0.32	0.27	0.46
2021	0.64	0.27	0.34	0.36	0.48	0.41	0.39	0.61	0.39	0.32	0.27	0.47
2022	0.64	0.26	0.33	0.36	0.48	0.41	0.39	0.61	0.39	0.32	0.27	0.47
2023	0.64	0.26	0.33	0.36	0.48	0.40	0.39	0.61	0.39	0.32	0.27	0.47
2024	0.64	0.26	0.33	0.36	0.48	0.40	0.39	0.61	0.39	0.32	0.27	0.47
2025	0.65	0.26	0.33	0.36	0.49	0.40	0.39	0.61	0.39	0.32	0.27	0.47
2026	0.65	0.26	0.33	0.36	0.49	0.40	0.39	0.61	0.39	0.31	0.27	0.47
2027	0.65	0.26	0.33	0.36	0.49	0.40	0.39	0.61	0.39	0.31	0.26	0.47
2028	0.65	0.26	0.33	0.36	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2029	0.65	0.26	0.33	0.35	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2030	0.65	0.26	0.32	0.35	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2031	0.65	0.26	0.32	0.35	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2032	0.65	0.26	0.32	0.35	0.49	0.40	0.40	0.60	0.39	0.31	0.26	0.47
2033	0.66	0.26	0.32	0.35	0.49	0.39	0.40	0.60	0.39	0.31	0.26	0.47
2034	0.66	0.26	0.32	0.35	0.50	0.39	0.40	0.60	0.39	0.31	0.26	0.47
2035	0.66	0.26	0.32	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.26	0.47
2036	0.66	0.26	0.32	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.26	0.47
2037	0.66	0.26	0.32	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.26	0.47
2038	0.66	0.26	0.32	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.25	0.47
2039	0.66	0.26	0.31	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.25	0.47
2040	0.66	0.26	0.31	0.35	0.50	0.39	0.40	0.59	0.39	0.31	0.25	0.47
2041	0.66	0.25	0.31	0.35	0.50	0.39	0.40	0.58	0.39	0.31	0.25	0.46
2042	0.66	0.25	0.31	0.35	0.50	0.39	0.40	0.58	0.39	0.31	0.25	0.46
2043	0.66	0.25	0.31	0.35	0.50	0.39	0.40	0.58	0.39	0.31	0.25	0.46
2044	0.66	0.25	0.31	0.35	0.50	0.39	0.40	0.58	0.39	0.31	0.25	0.46
2045	0.66	0.25	0.31	0.34	0.50	0.38	0.40	0.58	0.39	0.31	0.25	0.46
2046	0.66	0.25	0.31	0.34	0.50	0.38	0.40	0.58	0.39	0.31	0.25	0.46
2047	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.58	0.39	0.31	0.25	0.46
2048	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46
2049	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46
2050	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46
2051	0.67	0.25	0.31	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46
2052	0.67	0.25	0.30	0.34	0.50	0.38	0.40	0.57	0.39	0.31	0.25	0.46

Table A4-5: Employment / Population Ratio Historic Data 1980-2012   *SOURCE: ESI (2014)*

| | Ohio | | | | | | | Kentucky | | | Indiana | Study Area |
	Hamilton	Clermont	Warren	Butler	Montgomery	Greene	Miami	Boone	Kenton	Campbell	Dearborn	Total
1980	0.53	0.17	0.20	0.31	0.48	0.16	0.37	0.44	0.23	0.20	0.26	0.40
1981	0.52	0.18	0.20	0.30	0.48	0.15	0.35	0.41	0.23	0.19	0.25	0.40
1982	0.51	0.18	0.19	0.29	0.46	0.15	0.33	0.39	0.23	0.19	0.24	0.38
1983	0.50	0.18	0.20	0.29	0.47	0.15	0.33	0.41	0.23	0.19	0.23	0.39
1984	0.53	0.19	0.21	0.30	0.49	0.17	0.35	0.44	0.24	0.20	0.23	0.40
1985	0.55	0.20	0.23	0.30	0.51	0.18	0.36	0.48	0.26	0.21	0.23	0.42
1986	0.56	0.21	0.24	0.31	0.52	0.19	0.37	0.51	0.27	0.22	0.23	0.43
1987	0.58	0.22	0.25	0.31	0.53	0.20	0.38	0.56	0.29	0.23	0.24	0.44
1988	0.59	0.23	0.26	0.32	0.53	0.22	0.39	0.62	0.30	0.24	0.25	0.45
1989	0.61	0.24	0.28	0.31	0.54	0.23	0.41	0.64	0.31	0.25	0.26	0.46
1990	0.62	0.24	0.30	0.31	0.55	0.25	0.40	0.66	0.33	0.25	0.24	0.47
1991	0.61	0.23	0.30	0.30	0.53	0.25	0.39	0.66	0.32	0.25	0.24	0.46
1992	0.61	0.23	0.31	0.30	0.52	0.26	0.39	0.68	0.32	0.25	0.23	0.46
1993	0.61	0.24	0.31	0.31	0.52	0.27	0.41	0.71	0.32	0.26	0.24	0.46
1994	0.62	0.25	0.32	0.31	0.53	0.28	0.44	0.72	0.34	0.26	0.24	0.47
1995	0.63	0.25	0.35	0.33	0.54	0.31	0.44	0.74	0.35	0.27	0.24	0.48
1996	0.65	0.25	0.36	0.33	0.54	0.33	0.45	0.76	0.36	0.28	0.25	0.49
1997	0.66	0.25	0.36	0.34	0.53	0.35	0.45	0.78	0.36	0.28	0.27	0.49
1998	0.67	0.26	0.37	0.35	0.53	0.37	0.46	0.79	0.37	0.29	0.29	0.50
1999	0.67	0.27	0.38	0.37	0.53	0.39	0.45	0.80	0.39	0.30	0.29	0.51
2000	0.67	0.28	0.37	0.38	0.54	0.40	0.45	0.79	0.38	0.30	0.30	0.51
2001	0.67	0.27	0.35	0.38	0.54	0.39	0.44	0.76	0.39	0.29	0.31	0.50
2002	0.66	0.28	0.35	0.37	0.53	0.40	0.42	0.75	0.38	0.30	0.30	0.50
2003	0.66	0.27	0.34	0.37	0.52	0.41	0.41	0.75	0.38	0.31	0.30	0.50
2004	0.66	0.28	0.35	0.38	0.52	0.42	0.41	0.72	0.39	0.32	0.30	0.50
2005	0.66	0.28	0.36	0.39	0.51	0.45	0.40	0.71	0.40	0.32	0.30	0.50
2006	0.65	0.30	0.36	0.40	0.50	0.46	0.41	0.68	0.40	0.32	0.30	0.50
2007	0.65	0.30	0.38	0.41	0.50	0.49	0.40	0.68	0.41	0.32	0.30	0.50
2008	0.64	0.29	0.37	0.40	0.49	0.48	0.40	0.65	0.42	0.32	0.29	0.49
2009	0.61	0.27	0.35	0.37	0.45	0.46	0.37	0.60	0.40	0.31	0.29	0.46
2010	0.60	0.26	0.35	0.37	0.45	0.46	0.37	0.59	0.40	0.30	0.29	0.45
2011	0.60	0.26	0.35	0.38	0.45	0.46	0.37	0.61	0.38	0.31	0.29	0.46
2012	0.61	0.27	0.35	0.37	0.45	0.46	0.38	0.61	0.38	0.31	0.29	0.46
80-12 Average	0.61	0.24	0.31	0.34	0.51	0.32	0.40	0.64	0.34	0.27	0.27	0.46
maximum	0.67	0.30	0.38	0.41	0.55	0.49	0.46	0.80	0.42	0.32	0.31	0.51