ECONOMIC STRUCTURE IN APPALACHIA'S URBAN REGIONS: SUPPLEMENT 1

Clustering and Diversification Strategies

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Chapter 1. Albertville, AL

Study Area Overview

The Albertville, AL study region occupies 566 square-miles and had a 2018 population of 96,109. The employed share of the regional labor force during the 2014-2018 period averaged 95.4%. The Animal Slaughtering and Processing industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Elementary and Secondary Schools. These three industries account for a combined 32.72% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.94, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Albertville, AL can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 820 followed by Animal Slaughtering and Processing and Other Fabricated Metal Product Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.16, 55.39, and 10.54.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	820	98	1.16
20	Animal Slaughtering and Processing	738	536	55.39
61	Other Fabricated Metal Product Manufacturing	348	353	10.54
133	Management of Companies and Enterprises	342	336	0.66
140	Services to Buildings and Dwellings	303	257	0.75
42	Plastics Product Manufacturing	290	313	4.61
89	Medical Equipment and Supplies Manufacturing	258	257	3.72
153	Hospitals	252	48	1.16
151	Home Health Care Services	249	219	0.81
146	Offices of Physicians	166	72	0.90

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Albertville, AL, the cluster with the largest CLQ in 2018 is Agribusiness, Food Processing and Technology with a CLQ of 7.15, followed by Transportation Equipment and Primary and Fabricated Metal Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Albertville, AL cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
1	Agribusiness, Food Processing and Technology	6.49	7.15	6,987
4	Biomedical/Biotechnical (Life Sciences)	0.84	1.03	3,953
5	Business and Financial Services	0.67	0.55	3,950
3	Arts, Entertainment, Recreation and Visitor Industries	0.78	0.90	3,753
9	Education and Knowledge Creation	1.98	2.01	2,459
16	Transportation and Logistics	1.04	0.85	2,322
8	Defense and Security	0.23	0.27	1,423
17	Transportation Equipment	3.80	5.11	1,414
15	Primary and Fabricated Metal Products	2.60	2.75	1,093
6	Chemicals and Chemical-Based Products	1.03	2.34	853
11	Forest and Wood Products	1.99	1.92	687
10	Energy (Fossil and Renewable)	1.19	1.08	290
12	Information Technology and Telecommunications	1.39	1.06	269
13	Machinery	1.16	0.93	241
14	Mining, Glass and Ceramics	0.88	0.57	93
2	Apparel and Textiles	3.92	1.01	92
7	Computer, Electronic, and Electrical Products	0.71	0.05	16

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Albertville, AL

2. CADS Analysis

The 2018 CADS analysis of the economy of Albertville, AL identifies 2 anchor industries in 2 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Animal Slaughtering and Processing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
1	Agribusiness, Food Processing and Technology	20	Animal Slaughtering and Processing	5,971	6,709
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	340	630

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
20	Animal Slaughtering and Processing	55.39	536	3.38	12.36	0.43	0.47
42	Plastics Product Manufacturing	4.61	313	-6.65	85.29	0.89	0.05

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were

reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 20

Animal Slaughtering and Processing

Industry #	Industry Name	Employment
1	Crop Production	-1,029
2	Animal Production	-6,619
4	Fishing, Hunting and Trapping	-68
5	Support Activities for Agriculture and Forestry	-233
15	Animal Food Manufacturing	-190
99	Truck Transportation	-399
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-76
103	Couriers and Messengers	-111
128	Computer Systems Design and Related Services	-63
133	Management of Companies and Enterprises	-87
137	Business Support Services	-81

Table 6. Phase 2 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-1,036	-8
2	Animal Production	-6,619	-0
4	Fishing, Hunting and Trapping	-68	-0
5	Support Activities for Agriculture and Forestry	-234	-1
15	Animal Food Manufacturing	-190	-0
99	Truck Transportation	-413	-13
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-81	-5
103	Couriers and Messengers	-114	-3
128	Computer Systems Design and Related Services	-68	-5
133	Management of Companies and Enterprises	-105	-18
137	Business Support Services	-86	-5

Chapter 2. Alexander City, AL

Study Area Overview

The Alexander City, AL study region occupies 1,368 square-miles and had a 2018 population of 51,212. The employed share of the regional labor force during the 2014-2018 period averaged 94.36%. The Motor Vehicle Parts Manufacturing industry was the region's largest employer in 2018, followed by Employment Services and Government and Unclassified. These three industries account for a combined 25.19% of the region's economy. The region's 2018 coefficient of specialization (COS) is 41.73, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Alexander City, AL can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Motor Vehicle Parts Manufacturing, whose employment grew by 1,127 followed by Employment Services and Hospitals. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 24.95, 3.64, and 1.97.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
81	Motor Vehicle Parts Manufacturing	1,127	1,151	24.95
136	Employment Services	759	756	3.64
153	Hospitals	252	134	1.97
42	Plastics Product Manufacturing	162	165	3.94
31	Pulp, Paper, and Paperboard Mills	142	142	16.63
133	Management of Companies and Enterprises	102	65	0.99
55	Architectural and Structural Metals Manufacturing	78	78	2.61
167	Food Services and Drinking Places	74	-191	0.89
181	Government and Unclassified	56	16	0.56
86	Household and Institutional Furniture and Kitchen Cabinet Manufacturing, Excluding Wood TV, Radio and Sewing Machine Cabinet Manufacturing	54	139	12.32

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Alexander City, AL, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 12.97, followed by Apparel and Textiles and Forest and Wood Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Alexander City, AL cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

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Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
5	Business and Financial Services	0.59	0.82	2,266
4	Biomedical/Biotechnical (Life Sciences)	1.59	1.48	2,210
17	Transportation Equipment	1.49	12.97	1,391
3	Arts, Entertainment, Recreation and Visitor Industries	0.79	0.84	1,358
9	Education and Knowledge Creation	2.51	2.37	1,124
8	Defense and Security	0.43	0.52	1,088
11	Forest and Wood Products	4.51	6.44	893
16	Transportation and Logistics	0.81	0.37	386
6	Chemicals and Chemical-Based Products	0.86	1.77	250
2	Apparel and Textiles	27.37	6.93	244
15	Primary and Fabricated Metal Products	1.91	0.91	140
1	Agribusiness, Food Processing and Technology	0.56	0.37	140
7	Computer, Electronic, and Electrical Products	0.16	0.79	102
10	Energy (Fossil and Renewable)	0.54	0.66	69
12	Information Technology and Telecommunications	0.92	0.53	52
14	Mining, Glass and Ceramics	1.18	0.17	10
13	Machinery	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Alexander City, AL
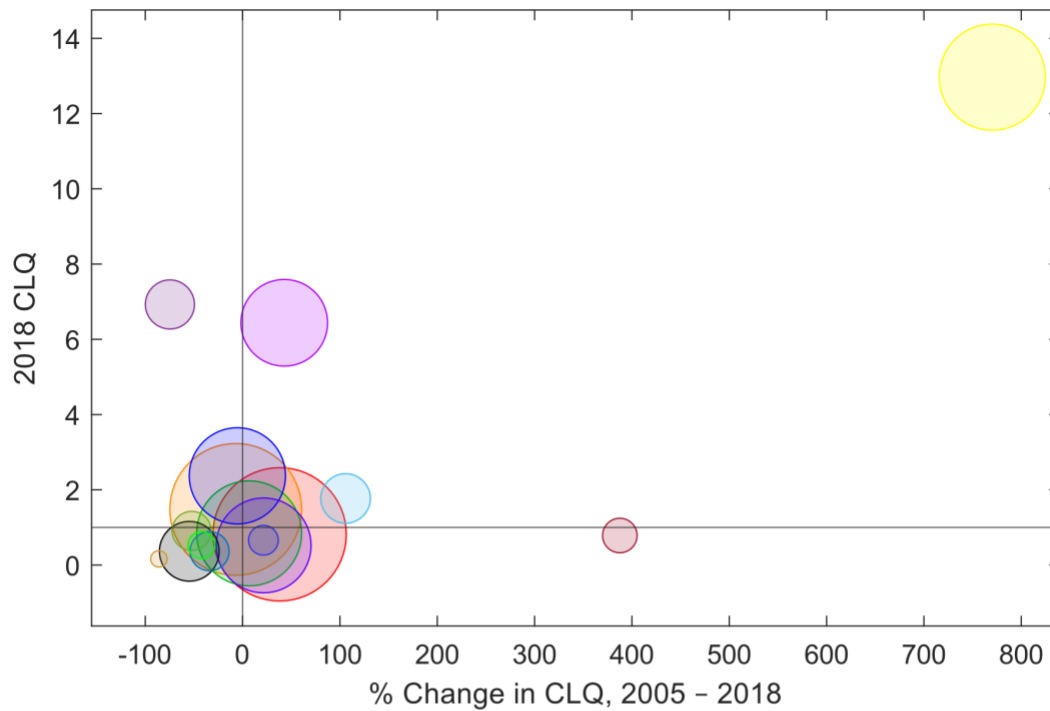
Bubble Size as the Employment for Each Cluster

- Business and Financial Services (2,266)
- Biomedical/Biotechnical (Life Sciences) (2,210)
- Transportation Equipment (1,391)
- Arts, Entertainment, Recreation and Visitor Industries (1,358)
- Education and Knowledge Creation (1,124)
- Defense and Security (1,088)
- Forest and Wood Products (893)
- Transportation and Logistics (386)
- Chemicals and Chemical-Based Products (250)
- Apparel and Textiles (244)
- Primary and Fabricated Metal Products (140)
- Agribusiness, Food Processing and Technology (140)
- Computer, Electronic, and Electrical Products (102)
- Energy (Fossil and Renewable) (69)
- Information Technology and Telecommunications (52)
- Mining, Glass and Ceramics (10)
- Machinery (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Alexander City, AL identifies 2 anchor industries in 2 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Parts Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	209	1,336
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	47	209

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	24.95	1,151	-11.56	539.93	0.45	0.36
42	Plastics Product Manufacturing	3.94	165	-6.65	344.49	0.65	0.04

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were

reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

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Table 5. Phase 1 Deficits for Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
48	Iron and Steel Mills and Ferroalloy Manufacturing	-58
51	Nonferrous Metal (except Aluminum) Production and Processing	-39
52	Foundries	-133
53	Forging and Stamping	-60
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-146
60	Coating, Engraving, Heat Treating, and Allied Activities	-43
61	Other Fabricated Metal Product Manufacturing	-38
72	Semiconductor and Other Electronic Component Manufacturing	-79
91	Wholesale Trade	-130
104	Warehousing and Storage	-114

Table 6. Phase 2 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-59	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-40	-0
52	Foundries	-133	-0
53	Forging and Stamping	-60	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-147	-1
60	Coating, Engraving, Heat Treating, and Allied Activities	-43	-1
61	Other Fabricated Metal Product Manufacturing	-38	-0
72	Semiconductor and Other Electronic Component Manufacturing	-80	-1
91	Wholesale Trade	-136	-6
104	Warehousing and Storage	-118	-4

Chapter 3. Altoona, PA

Study Area Overview

The Altoona, PA study region occupies 526 square-miles and had a 2018 population of 122,492. The employed share of the regional labor force during the 2014-2018 period averaged 96.1%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by All Other Retail and Hospitals. These three industries account for a combined 20.57% of the region's economy. The region's 2018 coefficient of specialization (COS) is 32.08, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Altoona, PA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Other Food Manufacturing, whose employment grew by 847 followed by Business Support Services and Individual and Family Services. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 11.62, 2.45, and 1.57.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
23	Other Food Manufacturing	847	804	11.62
137	Business Support Services	695	678	2.45
155	Individual and Family Services	689	-91	1.57
146	Offices of Physicians	618	341	1.82
133	Management of Companies and Enterprises	482	287	1.21
151	Home Health Care Services	370	118	1.22
104	Warehousing and Storage	280	-228	2.07
154	Nursing and Residential Care Facilities	277	-254	2.69
35	Basic Chemical Manufacturing	272	272	4.96
149	Outpatient Care Centers	272	234	0.88

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Altoona, PA, the cluster with the largest CLQ in 2018 is Forest and Wood Products with a CLQ of 3.38, followed by Mining, Glass and Ceramics and Apparel and Textiles. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Altoona, PA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.74	1.80	10,903
5	Business and Financial Services	0.65	0.62	7,017
3	Arts, Entertainment, Recreation and Visitor Industries	0.96	0.89	5,802
16	Transportation and Logistics	1.61	1.18	5,052
9	Education and Knowledge Creation	2.59	2.20	4,233
1	Agribusiness, Food Processing and Technology	0.64	1.31	2,018
11	Forest and Wood Products	2.87	3.38	1,905
8	Defense and Security	0.23	0.21	1,751
6	Chemicals and Chemical-Based Products	0.90	1.24	709
14	Mining, Glass and Ceramics	2.90	2.59	664
15	Primary and Fabricated Metal Products	0.90	0.87	543
13	Machinery	1.02	1.12	458
7	Computer, Electronic, and Electrical Products	1.03	0.79	419
2	Apparel and Textiles	1.62	2.55	364
12	Information Technology and Telecommunications	0.83	0.91	361
17	Transportation Equipment	0.70	0.58	255
10	Energy (Fossil and Renewable)	0.61	0.51	216

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Altoona, PA
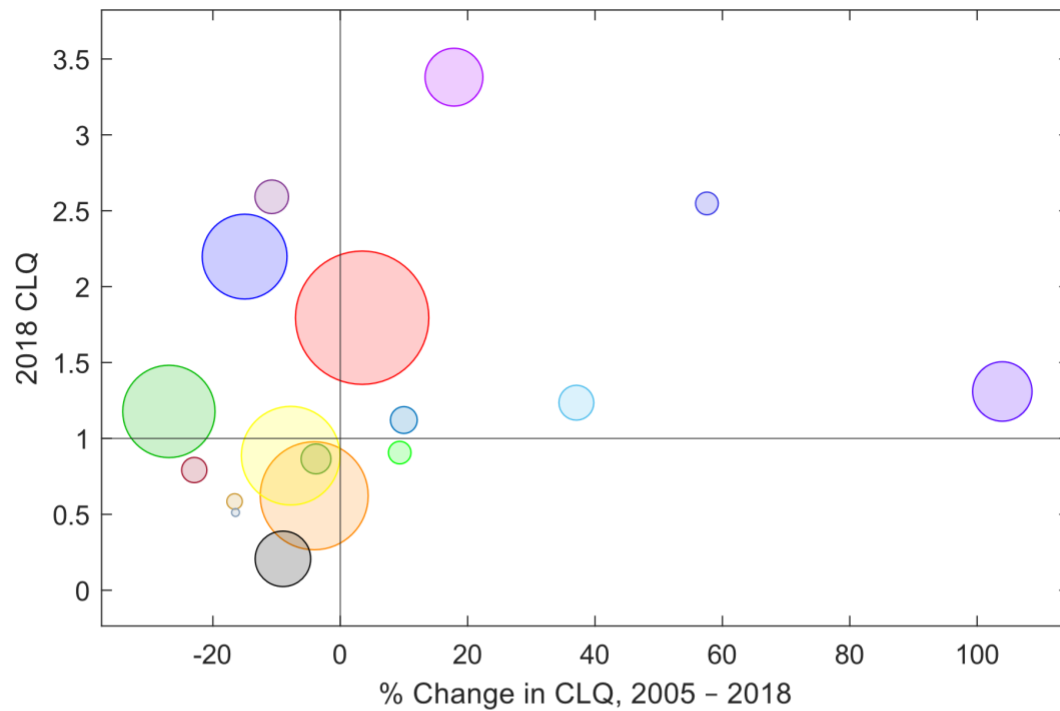
Bubble Size as the Employment for Each Cluster

- Biomedical/Biotechnical (Life Sciences) (10,903)
- Business and Financial Services (7,017)
- Arts, Entertainment, Recreation and Visitor Industries (5,802)
- Transportation and Logistics (5,052)
- Education and Knowledge Creation (4,233)
- Agribusiness, Food Processing and Technology (2,018)
- Forest and Wood Products (1,905)
- Defense and Security (1,751)
- Chemicals and Chemical-Based Products (709)
- Mining, Glass and Ceramics (664)
- Primary and Fabricated Metal Products (543)
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2. CADS Analysis

The 2018 CADS analysis of the economy of Altoona, PA identifies 4 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Other Food Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
1	Agribusiness, Food Processing and Technology	23	Other Food Manufacturing	102	949
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	1,138	1,756
5	Business and Financial Services	137	Business Support Services	149	844
4	Biomedical/Biotechnical (Life Sciences)	151	Home Health Care Services	317	687

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
23	Other Food Manufacturing	11.62	804	41.93	830.39	0.65	0.07
146	Offices of Physicians	1.82	341	24.38	54.31	0.90	0.04
137	Business Support Services	2.45	678	11.43	466.65	0.91	0.01
151	Home Health Care Services	1.22	118	79.39	116.43	0.89	0.00

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 23

Other Food Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-560
5	Support Activities for Agriculture and Forestry	-46
16	Grain and Oilseed Milling	-28
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-10
97	Rail Transportation	-12
127	Specialized Design Services	-5
134	Office Administrative Services	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-562	-2
5	Support Activities for Agriculture and Forestry	-47	-0
16	Grain and Oilseed Milling	-28	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-10	-0
97	Rail Transportation	-12	-1
127	Specialized Design Services	-10	-5
134	Office Administrative Services	-8	-12

Table 7. Phase 3 Deficits Adding Anchor Industry 137

Business Support Services

Industry #	Industry Name	Employment	Added to Deficit

1	Crop Production	-563	-1
5	Support Activities for Agriculture and Forestry	-47	-0
16	Grain and Oilseed Milling	-28	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-10	-0
97	Rail Transportation	-12	-0
127	Specialized Design Services	-11	-1
134	Office Administrative Services	-14	-7

Table 8. Phase 4 Deficits Adding Anchor Industry 151

Home Health Care Services

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-563	-0
5	Support Activities for Agriculture and Forestry	-47	-0
16	Grain and Oilseed Milling	-28	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-10	-0
97	Rail Transportation	-13	-0
127	Specialized Design Services	-11	-0
134	Office Administrative Services	-16	-2

Chapter 4. Anderson, SC

Study Area Overview

The Anderson, SC study region occupies 715 square-miles and had a 2018 population of 200,482. The employed share of the regional labor force during the 2014-2018 period averaged 95.4%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 23.58% of the region's economy. The region's 2018 coefficient of specialization (COS) is 37.08, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Anderson, SC can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Converted Paper Product Manufacturing, whose employment grew by 847 followed by Agriculture, Construction, and Mining Machinery Manufacturing and Individual and Family Services. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 8.59, 7.76, and 0.85.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
32	Converted Paper Product Manufacturing	847	870	8.59
62	Agriculture, Construction, and Mining Machinery Manufacturing	691	691	7.76
155	Individual and Family Services	689	480	0.85
167	Food Services and Drinking Places	688	-1,075	1.33
104	Warehousing and Storage	677	396	2.13
43	Rubber Product Manufacturing	519	634	20.84
143	Elementary and Secondary Schools	519	-663	10.21
91	Wholesale Trade	429	421	0.83
144	Junior Colleges, Colleges, Universities, and Professional Schools	399	202	1.62
95	All Other Retail	370	494	1.30

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Anderson, SC, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 12.89, followed by Transportation Equipment and Chemicals and Chemical-Based Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Anderson, SC cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.49	1.31	8,984
3	Arts, Entertainment, Recreation and Visitor Industries	1.18	1.07	7,880
5	Business and Financial Services	0.52	0.50	6,289
9	Education and Knowledge Creation	2.86	2.82	6,110
16	Transportation and Logistics	0.77	0.81	3,915
17	Transportation Equipment	5.58	6.17	3,032
6	Chemicals and Chemical-Based Products	3.27	4.18	2,698
8	Defense and Security	0.27	0.27	2,534
2	Apparel and Textiles	11.64	12.89	2,076
7	Computer, Electronic, and Electrical Products	2.73	3.05	1,817
11	Forest and Wood Products	0.49	2.54	1,610
13	Machinery	2.18	2.63	1,211
15	Primary and Fabricated Metal Products	1.30	1.66	1,175
1	Agribusiness, Food Processing and Technology	0.34	0.29	505
14	Mining, Glass and Ceramics	2.13	1.74	502
10	Energy (Fossil and Renewable)	0.59	0.59	282
12	Information Technology and Telecommunications	0.11	0.49	221

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Anderson, SC
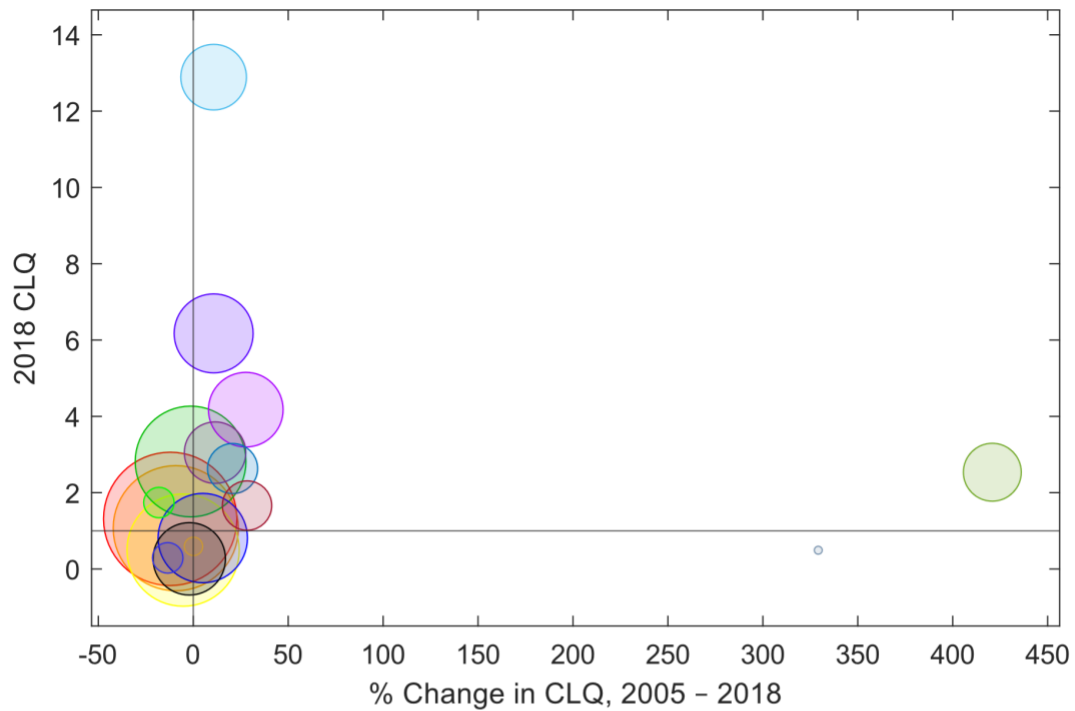
	Bubble Size as the Employment for Each Cluster
○	Biomedical/Biotechnical (Life Sciences) (8,984)
○	Arts, Entertainment, Recreation and Visitor Industries (7,880)
○	Business and Financial Services (6,289)
○	Education and Knowledge Creation (6,110)
○	Transportation and Logistics (3,915)
○	Transportation Equipment (3,032)
○	Chemicals and Chemical-Based Products (2,698)
○	Defense and Security (2,534)
○	Apparel and Textiles (2,076)
○	Computer, Electronic, and Electrical Products (1,817)
○	Forest and Wood Products (1,610)
○	Machinery (1,211)
○	Primary and Fabricated Metal Products (1,175)
○	Agribusiness, Food Processing and Technology (505)
○	Mining, Glass and Ceramics (502)
○	Energy (Fossil and Renewable) (282)
○	Information Technology and Telecommunications (221)

2. CADS Analysis

The 2018 CADS analysis of the economy of Anderson, SC identifies 6 anchor industries in 5 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Parts Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	2,724	3,021
7	Computer, Electronic, and Electrical Products	76	Household Appliance Manufacturing	1,352	1,563
6	Chemicals and Chemical-Based Products	43	Rubber Product Manufacturing	666	1,185
11	Forest and Wood Products	32	Converted Paper Product Manufacturing	108	955
13	Machinery	62	Agriculture, Construction, and Mining Machinery Manufacturing	2	693
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	928	1,136

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	12.33	612	-11.56	10.91	0.66	0.22
76	Household Appliance Manufacturing	59.94	549	-25.03	15.58	0.74	0.07
43	Rubber Product Manufacturing	20.84	634	-17.19	78.00	0.87	0.06
32	Converted Paper Product Manufacturing	8.59	870	-21.07	784.26	0.69	0.05

| 62 | Agriculture, Construction, and Mining Machinery Manufacturing | 7.76 | 691 | 4.70 | 37,090.99 | 0.75 | 0.05 |
| 42 | Plastics Product Manufacturing | 4.68 | 269 | -6.65 | 22.32 | 0.89 | 0.06 |

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
27	Apparel, Leather and Allied Product Manufacturing	-77
31	Pulp, Paper, and Paperboard Mills	-10
48	Iron and Steel Mills and Ferroalloy Manufacturing	-132
51	Nonferrous Metal (except Aluminum) Production and Processing	-89
52	Foundries	-301
53	Forging and Stamping	-72
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-107
60	Coating, Engraving, Heat Treating, and Allied Activities	-70
72	Semiconductor and Other Electronic Component Manufacturing	-242
78	Other Electrical Equipment and Component Manufacturing	-50
133	Management of Companies and Enterprises	-80

Table 6. Phase 2 Deficits Adding Anchor Industry 76

Household Appliance Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-78	-1
31	Pulp, Paper, and Paperboard Mills	-14	-4

48	Iron and Steel Mills and Ferroalloy Manufacturing	-166	-34
51	Nonferrous Metal (except Aluminum) Production and Processing	-115	-26
52	Foundries	-324	-23
53	Forging and Stamping	-123	-52
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-177	-70
60	Coating, Engraving, Heat Treating, and Allied Activities	-88	-18
72	Semiconductor and Other Electronic Component Manufacturing	-287	-45
78	Other Electrical Equipment and Component Manufacturing	-77	-27
133	Management of Companies and Enterprises	-137	-57

Table 7. Phase 3 Deficits Adding Anchor Industry 43

Rubber Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-81	-3
31	Pulp, Paper, and Paperboard Mills	-16	-2
48	Iron and Steel Mills and Ferroalloy Manufacturing	-174	-8
51	Nonferrous Metal (except Aluminum) Production and Processing	-119	-4
52	Foundries	-326	-2
53	Forging and Stamping	-133	-10
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-215	-38
60	Coating, Engraving, Heat Treating, and Allied Activities	-104	-16
72	Semiconductor and Other Electronic Component Manufacturing	-311	-24
78	Other Electrical Equipment and Component Manufacturing	-79	-1
133	Management of Companies and Enterprises	-181	-44

Table 8. Phase 4 Deficits Adding Anchor Industry 32

Converted Paper Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-83	-2
31	Pulp, Paper, and Paperboard Mills	-118	-101
48	Iron and Steel Mills and Ferroalloy Manufacturing	-176	-2
51	Nonferrous Metal (except Aluminum) Production and Processing	-121	-2
52	Foundries	-327	-1
53	Forging and Stamping	-137	-4
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-248	-33
60	Coating, Engraving, Heat Treating, and Allied Activities	-124	-20
72	Semiconductor and Other Electronic Component Manufacturing	-326	-15
78	Other Electrical Equipment and Component Manufacturing	-80	-1
133	Management of Companies and Enterprises	-224	-43

Table 9. Phase 5 Deficits Adding Anchor Industry 62

Agriculture, Construction, and Mining Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-84	-1
31	Pulp, Paper, and Paperboard Mills	-119	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-201	-25
51	Nonferrous Metal (except Aluminum) Production and Processing	-134	-13
52	Foundries	-347	-20
53	Forging and Stamping	-159	-23

59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-285	-37
60	Coating, Engraving, Heat Treating, and Allied Activities	-135	-11
72	Semiconductor and Other Electronic Component Manufacturing	-360	-34
78	Other Electrical Equipment and Component Manufacturing	-87	-7
133	Management of Companies and Enterprises	-280	-56

Table 10. Phase 6 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-84	-1
31	Pulp, Paper, and Paperboard Mills	-120	-2
48	Iron and Steel Mills and Ferroalloy Manufacturing	-202	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-135	-1
52	Foundries	-348	-1
53	Forging and Stamping	-160	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-295	-10
60	Coating, Engraving, Heat Treating, and Allied Activities	-141	-6
72	Semiconductor and Other Electronic Component Manufacturing	-370	-9
78	Other Electrical Equipment and Component Manufacturing	-88	-1
133	Management of Companies and Enterprises	-303	-24

Chapter 5. Anniston-Oxford, AL

Study Area Overview

The Anniston-Oxford, AL study region occupies 606 square-miles and had a 2018 population of 114,277. The employed share of the regional labor force during the 2014-2018 period averaged 92.2%. The Government and Unclassified industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and All Other Retail. These three industries account for a combined 28.04% of the region's economy. The region's 2018 coefficient of specialization (COS) is 29, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Anniston-Oxford, AL can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Plastics Product Manufacturing, whose employment grew by 379 followed by Junior Colleges, Colleges, Universities, and Professional Schools and Other Transportation Equipment Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 2.44, 2.15, and 40.13.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
42	Plastics Product Manufacturing	379	380	2.44
144	Junior Colleges, Colleges, Universities, and Professional Schools	313	125	2.15
85	Other Transportation Equipment Manufacturing	310	323	40.13
95	All Other Retail	244	317	1.14
141	Other Support Services	188	186	2.05
149	Outpatient Care Centers	167	94	0.93
136	Employment Services	167	155	1.72
29	Veneer, Plywood, and Engineered Wood Product Manufacturing	119	138	7.80
155	Individual and Family Services	114	-243	0.66
52	Foundries	107	341	29.44

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Anniston-Oxford, AL, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 6.43, followed by Primary and Fabricated Metal Products and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Anniston-Oxford, AL cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.27	1.27	5,851
8	Defense and Security	0.92	0.88	5,649
3	Arts, Entertainment, Recreation and Visitor Industries	1.05	1.05	5,226
5	Business and Financial Services	0.58	0.57	4,923
9	Education and Knowledge Creation	2.91	2.89	4,230
16	Transportation and Logistics	1.16	0.81	2,642
17	Transportation Equipment	4.29	6.43	2,133
15	Primary and Fabricated Metal Products	3.84	4.42	2,114
11	Forest and Wood Products	1.40	1.72	740
6	Chemicals and Chemical-Based Products	0.38	1.53	667
1	Agribusiness, Food Processing and Technology	0.34	0.34	397
14	Mining, Glass and Ceramics	1.05	1.53	299
10	Energy (Fossil and Renewable)	0.88	0.83	267
12	Information Technology and Telecommunications	1.03	0.81	246
2	Apparel and Textiles	4.69	0.72	78
13	Machinery	0.20	0.10	30
7	Computer, Electronic, and Electrical Products	0.14	0.07	29

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Anniston-Oxford, AL
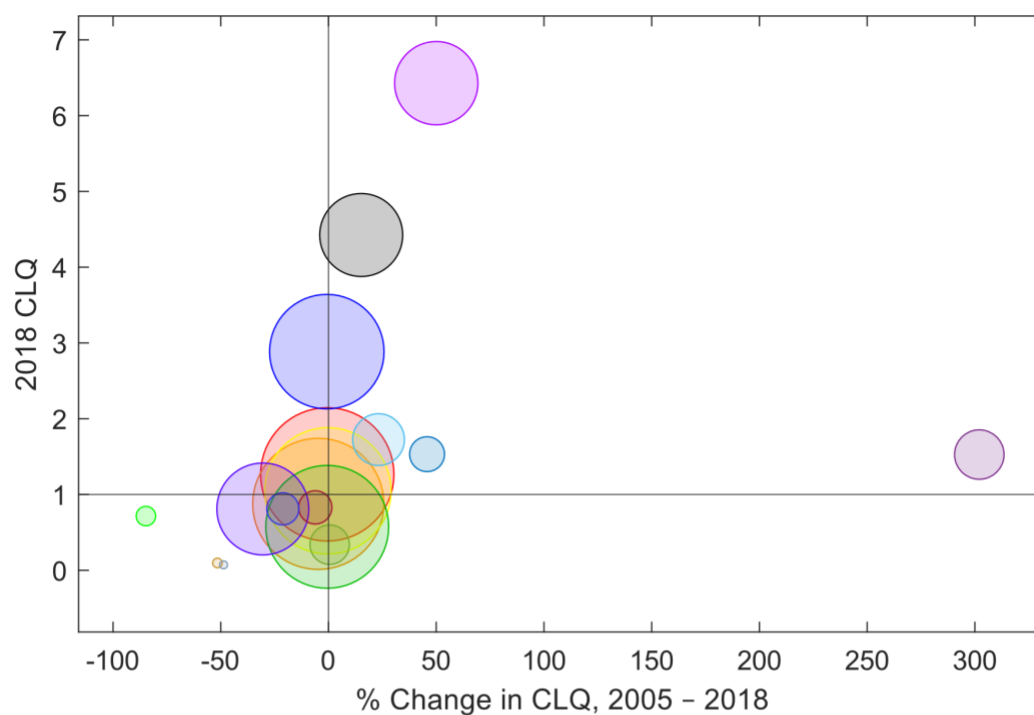
Bubble Size as the Employment for Each Cluster

- ○ Biomedical/Biotechnical (Life Sciences) (5,851)
- ○ Defense and Security (5,649)
- ○ Arts, Entertainment, Recreation and Visitor Industries (5,226)
- ○ Business and Financial Services (4,923)
- ○ Education and Knowledge Creation (4,230)
- ○ Transportation and Logistics (2,642)
- ○ Transportation Equipment (2,133)
- ○ Primary and Fabricated Metal Products (2,114)
- ○ Forest and Wood Products (740)
- ○ Chemicals and Chemical-Based Products (667)
- ○ Agribusiness, Food Processing and Technology (397)
- ○ Mining, Glass and Ceramics (299)
- ○ Energy (Fossil and Renewable) (267)
- ○ Information Technology and Telecommunications (246)
- ○ Apparel and Textiles (78)
- ○ Machinery (30)
- ○ Computer, Electronic, and Electrical Products (29)

2. CADS Analysis

The 2018 CADS analysis of the economy of Anniston-Oxford, AL identifies 4 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Foundries, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
15	Primary and Fabricated Metal Products	52	Foundries	868	975
17	Transportation Equipment	80	Motor Vehicle Body and Trailer Manufacturing	498	564
5	Business and Financial Services	136	Employment Services	1,583	1,750
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	788	1,101

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
52	Foundries	29.44	341	-26.93	12.35	0.66	0.05
80	Motor Vehicle Body and Trailer Manufacturing	12.36	83	-3.45	13.12	0.76	0.04
136	Employment Services	1.72	155	0.78	10.55	0.92	0.03
144	Junior Colleges, Colleges, Universities, and Professional Schools	2.15	125	23.90	39.69	0.89	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 52

Foundries

Industry #	Industry Name	Employment
48	Iron and Steel Mills and Ferroalloy Manufacturing	-10
49	Steel Product Manufacturing From Purchased Steel	-6
50	Alumina and Aluminum Production and Processing	-31
51	Nonferrous Metal (except Aluminum) Production and Processing	-36
66	Metalworking Machinery Manufacturing	-25
72	Semiconductor and Other Electronic Component Manufacturing	N/A
78	Other Electrical Equipment and Component Manufacturing	-4
97	Rail Transportation	-8
104	Warehousing and Storage	-25
133	Management of Companies and Enterprises	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 80

Motor Vehicle Body and Trailer Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-19	-9
49	Steel Product Manufacturing From Purchased Steel	-12	-6
50	Alumina and Aluminum Production and Processing	-46	-15
51	Nonferrous Metal (except Aluminum) Production and Processing	-41	-5
66	Metalworking Machinery Manufacturing	-27	-2
72	Semiconductor and Other Electronic Component Manufacturing	-9	-14
78	Other Electrical Equipment and Component Manufacturing	-10	-6
97	Rail Transportation	-11	-3

| 104 | Warehousing and Storage | -50 | -26 |
| 133 | Management of Companies and Enterprises | N/A | -29 |

Table 7. Phase 3 Deficits Adding Anchor Industry 136

Employment Services

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-19	-0
49	Steel Product Manufacturing From Purchased Steel	-12	-0
50	Alumina and Aluminum Production and Processing	-46	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-42	-0
66	Metalworking Machinery Manufacturing	-28	-0
72	Semiconductor and Other Electronic Component Manufacturing	-10	-1
78	Other Electrical Equipment and Component Manufacturing	-11	-0
97	Rail Transportation	-11	-0
104	Warehousing and Storage	-54	-3
133	Management of Companies and Enterprises	-14	-37

Table 8. Phase 4 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-19	-0
49	Steel Product Manufacturing From Purchased Steel	-12	-0
50	Alumina and Aluminum Production and Processing	-46	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-42	-0
66	Metalworking Machinery Manufacturing	-28	-0
72	Semiconductor and Other Electronic Component Manufacturing	-11	-1
78	Other Electrical Equipment and Component Manufacturing	-11	-0
97	Rail Transportation	-12	-0
104	Warehousing and Storage	-56	-2
133	Management of Companies and Enterprises	-24	-10

Chapter 6. Asheville, NC

Study Area Overview

The Asheville, NC study region occupies 2,034 square-miles and had a 2018 population of 459,585. The employed share of the regional labor force during the 2014-2018 period averaged 96.66%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Hospitals and All Other Retail. These three industries account for a combined 23.57% of the region's economy. The region's 2018 coefficient of specialization (COS) is 28.21, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Asheville, NC can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 5,956 followed by Hospitals and Food and Beverage Stores. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.39, 2.11, and 1.85.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	5,956	1,716	1.39
153	Hospitals	3,600	1,902	2.11
93	Food and Beverage Stores	2,594	2,293	1.85
24	Beverage Manufacturing	1,223	1,042	4.87
95	All Other Retail	1,146	1,494	1.25
162	Museums, Historical Sites, and Similar Institutions	1,030	650	10.11
148	Offices of Other Health Practitioners	969	524	1.32
140	Services to Buildings and Dwellings	826	300	0.89
149	Outpatient Care Centers	783	97	1.34
146	Offices of Physicians	743	-394	1.70

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Asheville, NC, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 2.86, followed by Computer, Electronic, and Electrical Products and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Asheville, NC cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.80	1.70	34,064
3	Arts, Entertainment, Recreation and Visitor Industries	1.31	1.39	30,142
5	Business and Financial Services	0.67	0.66	24,445
9	Education and Knowledge Creation	2.70	2.23	14,171
8	Defense and Security	0.35	0.36	10,067
16	Transportation and Logistics	0.84	0.64	9,058
7	Computer, Electronic, and Electrical Products	1.89	2.48	4,343
1	Agribusiness, Food Processing and Technology	0.57	0.76	3,868
6	Chemicals and Chemical-Based Products	1.57	1.99	3,771
11	Forest and Wood Products	1.31	1.32	2,461
17	Transportation Equipment	1.38	1.44	2,070
13	Machinery	2.08	1.10	1,489
2	Apparel and Textiles	3.07	2.86	1,353
15	Primary and Fabricated Metal Products	0.63	0.62	1,289
14	Mining, Glass and Ceramics	1.05	1.01	851
12	Information Technology and Telecommunications	0.47	0.50	661
10	Energy (Fossil and Renewable)	0.48	0.46	636

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Asheville, NC
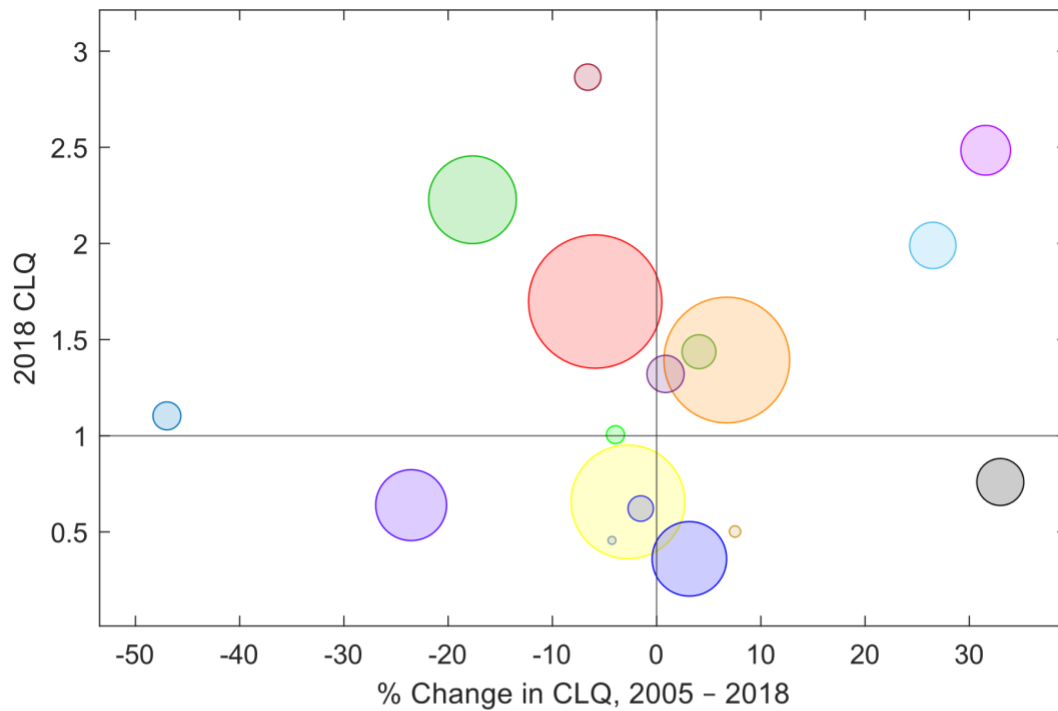
Bubble Size as the Employment for Each Cluster
⬤ Biomedical/Biotechnical (Life Sciences) (34,064)
⬤ Arts, Entertainment, Recreation and Visitor Industries (30,142)
⬤ Business and Financial Services (24,445)
⬤ Education and Knowledge Creation (14,171)
⬤ Defense and Security (10,067)
⬤ Transportation and Logistics (9,058)
⬤ Computer, Electronic, and Electrical Products (4,343)
⬤ Agribusiness, Food Processing and Technology (3,868)
⬤ Chemicals and Chemical-Based Products (3,771)
⬤ Forest and Wood Products (2,461)
⬤ Transportation Equipment (2,070)
⬤ Machinery (1,489)
⬤ Apparel and Textiles (1,353)
⬤ Primary and Fabricated Metal Products (1,289)
⬤ Mining, Glass and Ceramics (851)
⬤ Information Technology and Telecommunications (661)
⬤ Energy (Fossil and Renewable) (636)

2. CADS Analysis

The 2018 CADS analysis of the economy of Asheville, NC identifies 6 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Hospitals, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	9,390	12,990
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	14,210	20,166
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	1,880	2,324
7	Computer, Electronic, and Electrical Products	77	Electrical Equipment Manufacturing	1,931	2,442
3	Arts, Entertainment, Recreation and Visitor Industries	166	Accommodation	3,788	4,432
3	Arts, Entertainment, Recreation and Visitor Industries	162	Museums, Historical Sites, and Similar Institutions	1,079	2,109

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
153	Hospitals	2.11	1,902	18.09	38.34	0.92	0.11
167	Food Services and Drinking Places	1.39	1,716	29.84	41.91	0.96	0.07
42	Plastics Product Manufacturing	3.26	568	-6.65	23.57	0.96	0.05

77	Electrical Equipment Manufacturing	14.45	647	-7.05	26.46	0.78	0.04
166	Accommodation	1.80	249	10.44	17.00	0.97	0.03
162	Museums, Historical Sites, and Similar Institutions	10.11	650	35.20	95.41	0.98	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment
2	Animal Production	N/A
4	Fishing, Hunting and Trapping	-7
8	Metal Ore Mining	-1
21	Seafood Product Preparation and Packaging	N/A
39	Paint, Coating, and Adhesive Manufacturing	-3
48	Iron and Steel Mills and Ferroalloy Manufacturing	-3
50	Alumina and Aluminum Production and Processing	-2
51	Nonferrous Metal (except Aluminum) Production and Processing	-5
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-7
72	Semiconductor and Other Electronic Component Manufacturing	N/A
97	Rail Transportation	-6
109	Cable and Other Subscription Programming	-3
117	Insurance Carriers	-261
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-68	-102
4	Fishing, Hunting and Trapping	-49	-42
8	Metal Ore Mining	-2	-1
21	Seafood Product Preparation and Packaging	-14	-18
39	Paint, Coating, and Adhesive Manufacturing	-4	-2
48	Iron and Steel Mills and Ferroalloy Manufacturing	-6	-3
50	Alumina and Aluminum Production and Processing	-7	-5
51	Nonferrous Metal (except Aluminum) Production and Processing	-8	-3
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-12	-4
72	Semiconductor and Other Electronic Component Manufacturing	N/A	-12
97	Rail Transportation	-13	-7
109	Cable and Other Subscription Programming	-6	-4
117	Insurance Carriers	-290	-29
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	N/A	-32

Table 7. Phase 3 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-70	-2
4	Fishing, Hunting and Trapping	-49	-0
8	Metal Ore Mining	-5	-2
21	Seafood Product Preparation and Packaging	-14	-0
39	Paint, Coating, and Adhesive Manufacturing	-10	-6
48	Iron and Steel Mills and Ferroalloy Manufacturing	-10	-4
50	Alumina and Aluminum Production and Processing	-10	-3
51	Nonferrous Metal (except Aluminum) Production and Processing	-13	-5
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-17	-5
72	Semiconductor and Other Electronic Component Manufacturing	N/A	-38
97	Rail Transportation	-33	-20
109	Cable and Other Subscription Programming	-7	-1
117	Insurance Carriers	-299	-9
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	N/A	-15

Table 8. Phase 4 Deficits Adding Anchor Industry 77

Electrical Equipment Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-71	-1
4	Fishing, Hunting and Trapping	-49	-0
8	Metal Ore Mining	-18	-13

21	Seafood Product Preparation and Packaging	-14	-0
39	Paint, Coating, and Adhesive Manufacturing	-16	-6
48	Iron and Steel Mills and Ferroalloy Manufacturing	-40	-29
50	Alumina and Aluminum Production and Processing	-23	-13
51	Nonferrous Metal (except Aluminum) Production and Processing	-100	-87
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-19	-2
72	Semiconductor and Other Electronic Component Manufacturing	-36	-78
97	Rail Transportation	-39	-6
109	Cable and Other Subscription Programming	-8	-1
117	Insurance Carriers	-309	-10
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-6	-8

Table 9. Phase 5 Deficits Adding Anchor Industry 166

Accommodation

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-85	-14
4	Fishing, Hunting and Trapping	-56	-7
8	Metal Ore Mining	-18	-0
21	Seafood Product Preparation and Packaging	-17	-3
39	Paint, Coating, and Adhesive Manufacturing	-17	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-41	-1
50	Alumina and Aluminum Production and Processing	-24	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-101	-1
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-22	-3
72	Semiconductor and Other Electronic Component Manufacturing	-40	-4
97	Rail Transportation	-41	-2
109	Cable and Other Subscription Programming	-10	-3
117	Insurance Carriers	-321	-12
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-16	-10

Table 10. Phase 6 Deficits Adding Anchor Industry 162

Museums, Historical Sites, and Similar Institutions

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-86	-1
4	Fishing, Hunting and Trapping	-56	-0
8	Metal Ore Mining	-18	-0
21	Seafood Product Preparation and Packaging	-17	-0
39	Paint, Coating, and Adhesive Manufacturing	-17	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-41	-0
50	Alumina and Aluminum Production and Processing	-24	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-101	-0
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-23	-1
72	Semiconductor and Other Electronic Component Manufacturing	-42	-2

97	Rail Transportation	-42	-0
109	Cable and Other Subscription Programming	-11	-1
117	Insurance Carriers	-339	-18
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-19	-3

Chapter 7. Ashtabula, OH

Study Area Overview

The Ashtabula, OH study region occupies 702 square-miles and had a 2018 population of 97,493. The employed share of the regional labor force during the 2014-2018 period averaged 94.3%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Hospitals. These three industries account for a combined 21.62% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.44, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Ashtabula, OH can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Accounting, Tax Preparation, Bookkeeping, and Payroll Services, whose employment grew by 477 followed by Hospitals and Converted Paper Product Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 2.6, 1.87, and 9.56.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
125	Accounting, Tax Preparation, Bookkeeping, and Payroll Services	477	464	2.60
153	Hospitals	411	153	1.87
32	Converted Paper Product Manufacturing	256	307	9.56
135	Facilities Support Services	228	204	10.41
156	Community and Vocational Rehabilitation Services	189	190	3.15
149	Outpatient Care Centers	156	27	1.63
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	149	149	8.15
176	Religious Organizations	139	137	0.63
35	Basic Chemical Manufacturing	127	122	26.21
24	Beverage Manufacturing	117	99	2.93

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Ashtabula, OH, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 8.8, followed by Machinery and Primary and Fabricated Metal Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Ashtabula, OH cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.57	1.52	4,859
3	Arts, Entertainment, Recreation and Visitor Industries	1.05	0.99	3,435
5	Business and Financial Services	0.38	0.46	2,738
9	Education and Knowledge Creation	3.45	2.67	2,709
6	Chemicals and Chemical-Based Products	8.88	8.80	2,664
16	Transportation and Logistics	0.66	0.65	1,466
8	Defense and Security	0.24	0.27	1,192
15	Primary and Fabricated Metal Products	2.56	3.59	1,187
11	Forest and Wood Products	2.96	3.52	1,046
13	Machinery	2.73	3.81	821
17	Transportation Equipment	4.34	3.31	761
7	Computer, Electronic, and Electrical Products	0.68	1.38	385
1	Agribusiness, Food Processing and Technology	0.14	0.43	346
14	Mining, Glass and Ceramics	0.64	1.13	153
10	Energy (Fossil and Renewable)	1.07	0.58	130
12	Information Technology and Telecommunications	0.51	0.58	121
2	Apparel and Textiles	0.93	1.40	106

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Ashtabula, OH
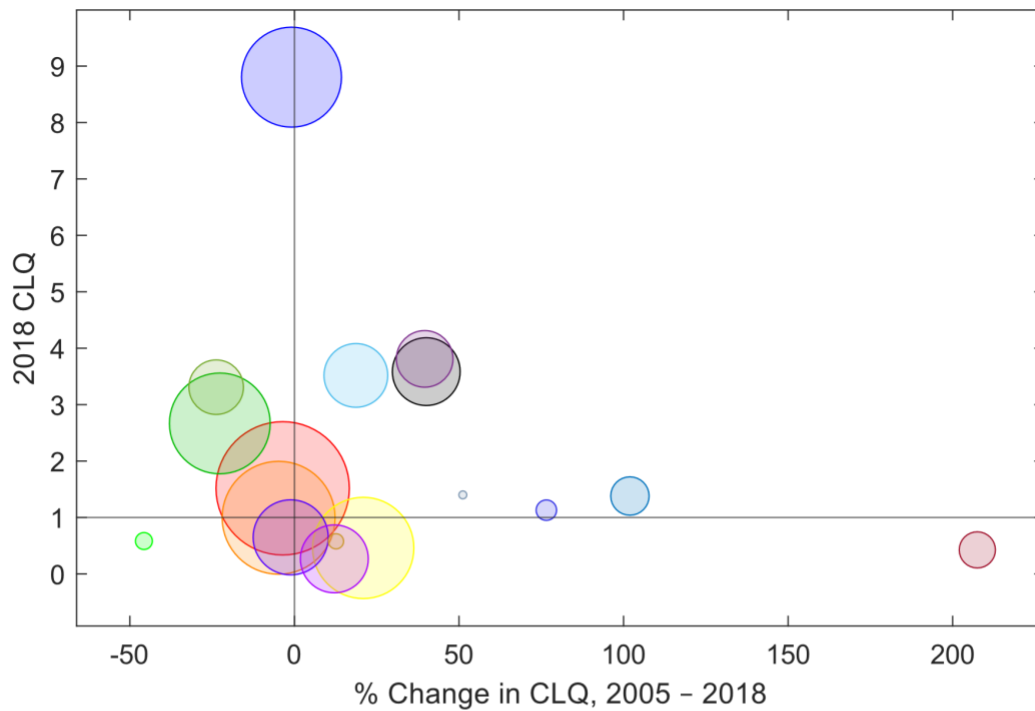
Bubble Size as the Employment for Each Cluster

- ○ Biomedical/Biotechnical (Life Sciences) (4,859)
- ○ Arts, Entertainment, Recreation and Visitor Industries (3,435)
- ○ Business and Financial Services (2,738)
- ○ Education and Knowledge Creation (2,709)
- ○ Chemicals and Chemical-Based Products (2,664)
- ○ Transportation and Logistics (1,466)
- ○ Defense and Security (1,192)
- ○ Primary and Fabricated Metal Products (1,187)
- ○ Forest and Wood Products (1,046)
- ○ Machinery (821)
- ○ Transportation Equipment (761)
- ○ Computer, Electronic, and Electrical Products (385)
- ○ Agribusiness, Food Processing and Technology (346)
- ○ Mining, Glass and Ceramics (153)
- ○ Energy (Fossil and Renewable) (130)
- ○ Information Technology and Telecommunications (121)
- ○ Apparel and Textiles (106)

2. CADS Analysis

The 2018 CADS analysis of the economy of Ashtabula, OH identifies 5 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Basic Chemical Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	35	Basic Chemical Manufacturing	632	759
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	1,429	1,840
11	Forest and Wood Products	32	Converted Paper Product Manufacturing	242	498
6	Chemicals and Chemical-Based Products	43	Rubber Product Manufacturing	489	447
13	Machinery	66	Metalworking Machinery Manufacturing	534	577

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
35	Basic Chemical Manufacturing	26.21	122	0.73	20.09	0.64	0.28
153	Hospitals	1.87	153	18.09	28.76	0.74	0.07
32	Converted Paper Product Manufacturing	9.56	307	-21.07	105.76	0.66	0.05
43	Rubber Product Manufacturing	16.78	42	-17.19	-8.59	0.82	0.04

| 66 | Metalworking Machinery Manufacturing | 16.31 | 103 | -11.28 | 8.05 | 0.83 | 0.02 |

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 35

Basic Chemical Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-226
3	Forestry and Logging	-10
6	Oil and Gas Extraction	-18
26	Textile Mills and Textile Product Mills	-6
31	Pulp, Paper, and Paperboard Mills	-4
34	Petroleum and Coal Products Manufacturing	-17
41	Other Chemical Product and Preparation Manufacturing	-18
72	Semiconductor and Other Electronic Component Manufacturing	-36
89	Medical Equipment and Supplies Manufacturing	-1
97	Rail Transportation	-33
117	Insurance Carriers	-8
126	Architectural, Engineering, and Related Services	-23
129	Management, Scientific, and Technical Consulting Services	-23
133	Management of Companies and Enterprises	-70
137	Business Support Services	-17
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-20

Table 6. Phase 2 Deficits Adding Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-229	-3
3	Forestry and Logging	-11	-1
6	Oil and Gas Extraction	-19	-1
26	Textile Mills and Textile Product Mills	-9	-2
31	Pulp, Paper, and Paperboard Mills	-5	-1
34	Petroleum and Coal Products Manufacturing	-17	-1
41	Other Chemical Product and Preparation Manufacturing	-19	-1
72	Semiconductor and Other Electronic Component Manufacturing	-39	-3
89	Medical Equipment and Supplies Manufacturing	-23	-22
97	Rail Transportation	-33	-1
117	Insurance Carriers	-65	-57
126	Architectural, Engineering, and Related Services	-31	-8
129	Management, Scientific, and Technical Consulting Services	-81	-58
133	Management of Companies and Enterprises	-99	-29
137	Business Support Services	-33	-16
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-29	-9

Table 7. Phase 3 Deficits Adding Anchor Industry 32

Converted Paper Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-239	-9
3	Forestry and Logging	-29	-18
6	Oil and Gas Extraction	-20	-1
26	Textile Mills and Textile Product Mills	-31	-22
31	Pulp, Paper, and Paperboard Mills	-62	-57
34	Petroleum and Coal Products Manufacturing	-18	-1
41	Other Chemical Product and Preparation Manufacturing	-23	-5
72	Semiconductor and Other Electronic Component Manufacturing	-48	-9
89	Medical Equipment and Supplies Manufacturing	-23	-0
97	Rail Transportation	-40	-6
117	Insurance Carriers	-68	-2
126	Architectural, Engineering, and Related Services	-44	-13
129	Management, Scientific, and Technical Consulting Services	-90	-9
133	Management of Companies and Enterprises	-122	-23
137	Business Support Services	-40	-7
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-33	-5

Table 8. Phase 4 Deficits Adding Anchor Industry 43

Rubber Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-248	-9

3	Forestry and Logging	-51	-22
6	Oil and Gas Extraction	-20	-1
26	Textile Mills and Textile Product Mills	-66	-35
31	Pulp, Paper, and Paperboard Mills	-63	-0
34	Petroleum and Coal Products Manufacturing	-19	-1
41	Other Chemical Product and Preparation Manufacturing	-24	-1
72	Semiconductor and Other Electronic Component Manufacturing	-57	-9
89	Medical Equipment and Supplies Manufacturing	-23	-0
97	Rail Transportation	-41	-2
117	Insurance Carriers	-70	-2
126	Architectural, Engineering, and Related Services	-51	-7
129	Management, Scientific, and Technical Consulting Services	-96	-6
133	Management of Companies and Enterprises	-138	-16
137	Business Support Services	-44	-5
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-36	-2

Table 9. Phase 5 Deficits Adding Anchor Industry 66

Metalworking Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-248	-0
3	Forestry and Logging	-51	-0
6	Oil and Gas Extraction	-21	-0
26	Textile Mills and Textile Product Mills	-66	-0
31	Pulp, Paper, and Paperboard Mills	-63	-0
34	Petroleum and Coal Products Manufacturing	-19	-0
41	Other Chemical Product and Preparation Manufacturing	-25	-1
72	Semiconductor and Other Electronic Component Manufacturing	-66	-8
89	Medical Equipment and Supplies Manufacturing	-23	-0
97	Rail Transportation	-42	-1
117	Insurance Carriers	-71	-1
126	Architectural, Engineering, and Related Services	-55	-3
129	Management, Scientific, and Technical Consulting Services	-101	-6
133	Management of Companies and Enterprises	-172	-33
137	Business Support Services	-47	-3
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-37	-1

Chapter 8. Athens, OH

Study Area Overview

The Athens, OH study region occupies 504 square-miles and had a 2018 population of 65,818. The employed share of the regional labor force during the 2014-2018 period averaged 94.4%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 28.75% of the region's economy. The region's 2018 coefficient of specialization (COS) is 36.48, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Athens, OH can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Individual and Family Services, whose employment grew by 431 followed by Food Services and Drinking Places and Offices of Physicians. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 2.45, 2.03, and 1.67.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
155	Individual and Family Services	431	187	2.45
167	Food Services and Drinking Places	338	-343	2.03
146	Offices of Physicians	191	122	1.67
133	Management of Companies and Enterprises	181	169	0.85
145	Other Educational Services	173	165	1.78
93	Food and Beverage Stores	171	143	1.73
149	Outpatient Care Centers	155	23	2.94
137	Business Support Services	152	151	1.56
38	Pharmaceutical and Medicine Manufacturing	148	148	4.65
154	Nursing and Residential Care Facilities	145	-15	2.92

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Athens, OH, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.93, followed by Biomedical/Biotechnical (Life Sciences) and Arts, Entertainment, Recreation and Visitor Industries. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Athens, OH cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.
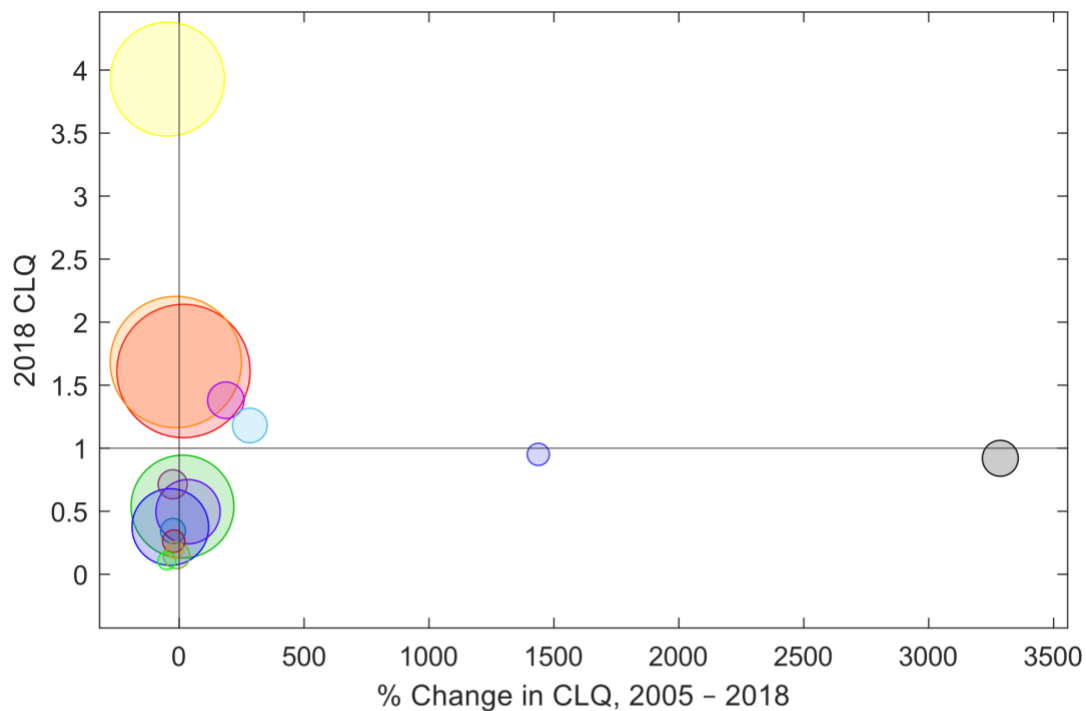
Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
3	Arts, Entertainment, Recreation and Visitor Industries	1.37	1.61	3,109
4	Biomedical/Biotechnical (Life Sciences)	1.94	1.68	3,011
9	Education and Knowledge Creation	7.38	3.93	2,228
5	Business and Financial Services	0.47	0.54	1,783
8	Defense and Security	0.58	0.37	934
16	Transportation and Logistics	0.37	0.50	627
12	Information Technology and Telecommunications	0.48	1.38	162
6	Chemicals and Chemical-Based Products	0.03	0.92	155
13	Machinery	0.31	1.18	142
10	Energy (Fossil and Renewable)	0.97	0.71	89
1	Agribusiness, Food Processing and Technology	0.17	0.15	68
11	Forest and Wood Products	0.46	0.34	57
7	Computer, Electronic, and Electrical Products	0.34	0.26	41
2	Apparel and Textiles	0.06	0.95	40
15	Primary and Fabricated Metal Products	0.21	0.11	20
14	Mining, Glass and Ceramics	0.23	0.19	15
17	Transportation Equipment	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Athens, OH

2. CADS Analysis

The 2018 CADS analysis of the economy of Athens, OH identifies 3 anchor industries in 2 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Offices of Physicians, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	285	476
4	Biomedical/Biotechnical (Life Sciences)	149	Outpatient Care Centers	156	311
9	Education and Knowledge Creation	145	Other Educational Services	17	190

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
146	Offices of Physicians	1.67	122	24.38	67.17	0.82	0.05
149	Outpatient Care Centers	2.94	23	84.40	99.36	0.88	0.02
145	Other Educational Services	1.78	165	44.75	1,021.35	0.87	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can

be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment
129	Management, Scientific, and Technical Consulting Services	-6
150	Medical and Diagnostic Laboratories	-7

Table 6. Phase 2 Deficits Adding Anchor Industry 149

Outpatient Care Centers

Industry #	Industry Name	Employment	Added to Deficit
129	Management, Scientific, and Technical Consulting Services	-10	-4
150	Medical and Diagnostic Laboratories	-14	-7

Table 7. Phase 3 Deficits Adding Anchor Industry 145

Other Educational Services

Industry #	Industry Name	Employment	Added to Deficit
129	Management, Scientific, and Technical Consulting Services	-12	-1
150	Medical and Diagnostic Laboratories	-14	-0

Chapter 9. Athens, TN

Study Area Overview

The Athens, TN study region occupies 430 square-miles and had a 2018 population of 53,285. The employed share of the regional labor force during the 2014-2018 period averaged 94.2%. The Motor Vehicle Parts Manufacturing industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Elementary and Secondary Schools. These three industries account for a combined 26.49% of the region's economy. The region's 2018 coefficient of specialization (COS) is 42.48, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Athens, TN can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Motor Vehicle Parts Manufacturing, whose employment grew by 697 followed by Foundries and Employment Services. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 33.95, 43.2, and 1.44.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
81	Motor Vehicle Parts Manufacturing	697	880	33.95
52	Foundries	466	497	43.20
136	Employment Services	450	449	1.44
19	Dairy Product Manufacturing	285	285	16.83
167	Food Services and Drinking Places	250	-86	1.02
93	Food and Beverage Stores	219	201	1.38
91	Wholesale Trade	210	209	0.79
76	Household Appliance Manufacturing	176	176	24.67
143	Elementary and Secondary Schools	163	-116	9.12
155	Individual and Family Services	132	101	0.57

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Athens, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 19.41, followed by Primary and Fabricated Metal Products and Mining, Glass and Ceramics. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Athens, TN cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.
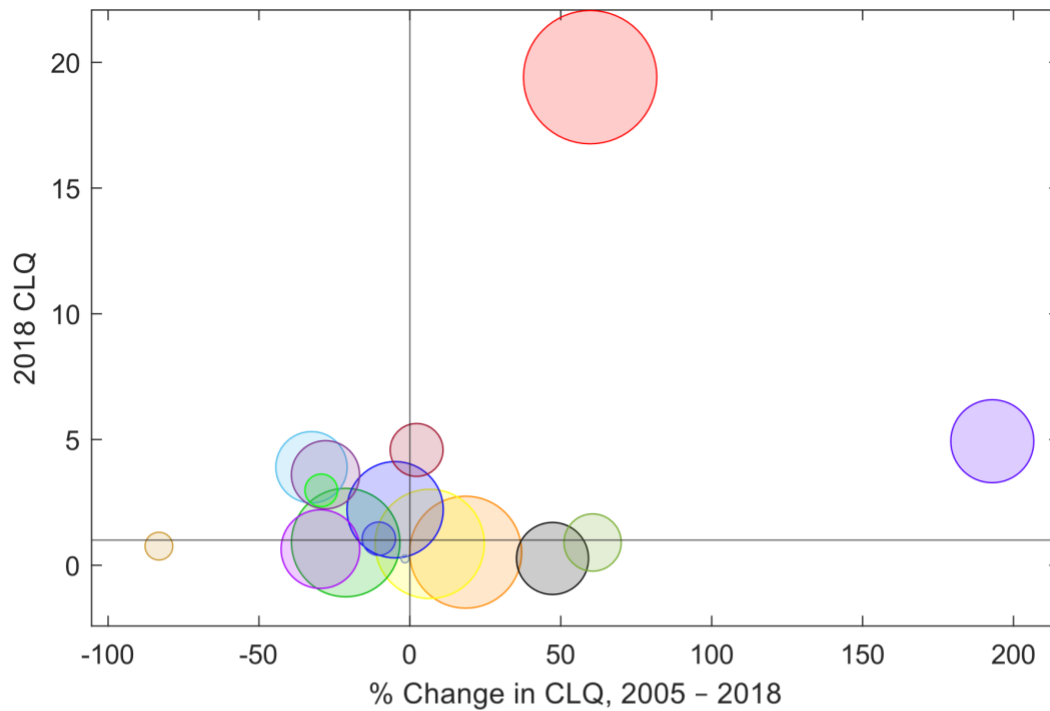
Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
17	Transportation Equipment	12.15	19.41	2,615
5	Business and Financial Services	0.44	0.52	1,810
3	Arts, Entertainment, Recreation and Visitor Industries	0.80	0.85	1,717
4	Biomedical/Biotechnical (Life Sciences)	1.15	0.90	1,692
9	Education and Knowledge Creation	2.32	2.21	1,314
15	Primary and Fabricated Metal Products	1.68	4.93	957
16	Transportation and Logistics	0.91	0.64	853
8	Defense and Security	0.18	0.27	706
6	Chemicals and Chemical-Based Products	5.78	3.90	691
11	Forest and Wood Products	5.00	3.60	627
1	Agribusiness, Food Processing and Technology	0.56	0.90	431
7	Computer, Electronic, and Electrical Products	0.00	2.36	386
14	Mining, Glass and Ceramics	4.49	4.59	363
10	Energy (Fossil and Renewable)	1.18	1.06	138
2	Apparel and Textiles	4.22	2.98	132
13	Machinery	4.51	0.76	96
12	Information Technology and Telecommunications	0.26	0.25	31

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Athens, TN

2. CADS Analysis

The 2018 CADS analysis of the economy of Athens, TN identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Parts Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	1,586	2,283

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	33.95	880	-11.56	43.96	0.51	0.40

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
48	Iron and Steel Mills and Ferroalloy Manufacturing	-100
51	Nonferrous Metal (except Aluminum) Production and Processing	-67
53	Forging and Stamping	-103
55	Architectural and Structural Metals Manufacturing	-65
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-201
61	Other Fabricated Metal Product Manufacturing	-76
72	Semiconductor and Other Electronic Component Manufacturing	-201
99	Truck Transportation	-82
104	Warehousing and Storage	-80
133	Management of Companies and Enterprises	-219

Chapter 10. Beckley, WV

Study Area Overview

The Beckley, WV study region occupies 605 square-miles and had a 2018 population of 74,254. The employed share of the regional labor force during the 2014-2018 period averaged 93.7%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Hospitals and All Other Retail. These three industries account for a combined 23.25% of the region's economy. The region's 2018 coefficient of specialization (COS) is 34, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Beckley, WV can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 631 followed by Individual and Family Services and Offices of Physicians. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.29, 2.07, and 2.66.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	631	-88	1.29
155	Individual and Family Services	597	152	2.07
146	Offices of Physicians	523	313	2.66
154	Nursing and Residential Care Facilities	478	368	1.67
151	Home Health Care Services	449	338	1.94
139	Investigation and Security Services	349	307	2.70
134	Office Administrative Services	248	214	3.15
92	Motor Vehicle and Parts Dealers	212	180	2.33
7	Coal Mining	184	605	161.07
140	Services to Buildings and Dwellings	180	104	0.90

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Beckley, WV, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 8.07, followed by Education and Knowledge Creation and Biomedical/Biotechnical (Life Sciences). The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Beckley, WV cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.66	1.91	6,245
3	Arts, Entertainment, Recreation and Visitor Industries	1.16	1.18	4,170
5	Business and Financial Services	0.63	0.59	3,600
8	Defense and Security	0.41	0.50	2,266
9	Education and Knowledge Creation	3.13	2.07	2,146
16	Transportation and Logistics	1.02	0.80	1,847
10	Energy (Fossil and Renewable)	8.07	8.07	1,838
15	Primary and Fabricated Metal Products	0.57	0.53	179
13	Machinery	0.43	0.58	128
12	Information Technology and Telecommunications	1.06	0.57	123
1	Agribusiness, Food Processing and Technology	0.20	0.12	98
7	Computer, Electronic, and Electrical Products	0.39	0.30	87
11	Forest and Wood Products	0.61	0.29	87
6	Chemicals and Chemical-Based Products	0.19	0.24	74
17	Transportation Equipment	0.26	0.30	70
14	Mining, Glass and Ceramics	0.33	0.22	30
2	Apparel and Textiles	0.01	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Beckley, WV

2. CADS Analysis

The 2018 CADS analysis of the economy of Beckley, WV identifies 5 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Coal Mining, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
10	Energy (Fossil and Renewable)	7	Coal Mining	1,482	1,666
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	862	1,385
4	Biomedical/Biotechnical (Life Sciences)	154	Nursing and Residential Care Facilities	627	1,105
3	Arts, Entertainment, Recreation and Visitor Industries	166	Accommodation	467	544
4	Biomedical/Biotechnical (Life Sciences)	151	Home Health Care Services	140	589

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
7	Coal Mining	161.07	605	-28.42	12.42	0.66	0.34
146	Offices of Physicians	2.66	313	24.38	60.67	0.78	0.06
154	Nursing and Residential Care Facilities	1.67	368	17.58	76.20	0.82	0.02
166	Accommodation	1.35	28	10.44	16.49	0.82	0.02
151	Home Health Care Services	1.94	338	79.39	320.71	0.77	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 7

Coal Mining

Industry #	Industry Name	Employment
9	Nonmetallic Mineral Mining and Quarrying	-39
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-25
41	Other Chemical Product and Preparation Manufacturing	-27
43	Rubber Product Manufacturing	-46
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	-14
61	Other Fabricated Metal Product Manufacturing	-14
72	Semiconductor and Other Electronic Component Manufacturing	-19
97	Rail Transportation	-51
104	Warehousing and Storage	-12
117	Insurance Carriers	-15
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-16
128	Computer Systems Design and Related Services	-11
131	Advertising and Related Services	-11

Table 6. Phase 2 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
9	Nonmetallic Mineral Mining and Quarrying	-40	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-25	-0
41	Other Chemical Product and Preparation Manufacturing	-27	-1
43	Rubber Product Manufacturing	-46	-0
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	-15	-0

61	Other Fabricated Metal Product Manufacturing	-15	-1
72	Semiconductor and Other Electronic Component Manufacturing	-20	-2
97	Rail Transportation	-52	-0
104	Warehousing and Storage	-16	-5
117	Insurance Carriers	-22	-7
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-17	-1
128	Computer Systems Design and Related Services	-25	-14
131	Advertising and Related Services	-15	-4

Table 7. Phase 3 Deficits Adding Anchor Industry 154

Nursing and Residential Care Facilities

Industry #	Industry Name	Employment	Added to Deficit
9	Nonmetallic Mineral Mining and Quarrying	-40	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-25	-0
41	Other Chemical Product and Preparation Manufacturing	-27	-0
43	Rubber Product Manufacturing	-46	-0
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	-15	-0
61	Other Fabricated Metal Product Manufacturing	-15	-0
72	Semiconductor and Other Electronic Component Manufacturing	-21	-1
97	Rail Transportation	-52	-0
104	Warehousing and Storage	-18	-2
117	Insurance Carriers	-24	-2
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-17	-0
128	Computer Systems Design and Related Services	-29	-4
131	Advertising and Related Services	-16	-1

Table 8. Phase 4 Deficits Adding Anchor Industry 166

Accommodation

Industry #	Industry Name	Employment	Added to Deficit
9	Nonmetallic Mineral Mining and Quarrying	-40	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-25	-0
41	Other Chemical Product and Preparation Manufacturing	-27	-0
43	Rubber Product Manufacturing	-46	-0
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	-15	-0
61	Other Fabricated Metal Product Manufacturing	-16	-1
72	Semiconductor and Other Electronic Component Manufacturing	-22	-1
97	Rail Transportation	-52	-0
104	Warehousing and Storage	-21	-3
117	Insurance Carriers	-26	-1
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-17	-0
128	Computer Systems Design and Related Services	-32	-3
131	Advertising and Related Services	-19	-3

Table 9. Phase 5 Deficits Adding Anchor Industry 151

Home Health Care Services

Industry #	Industry Name	Employment	Added to Deficit
9	Nonmetallic Mineral Mining and Quarrying	-40	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-25	-0
41	Other Chemical Product and Preparation Manufacturing	-28	-0

43	Rubber Product Manufacturing	-47	-0
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	-15	-0
61	Other Fabricated Metal Product Manufacturing	-16	-0
72	Semiconductor and Other Electronic Component Manufacturing	-22	-0
97	Rail Transportation	-52	-0
104	Warehousing and Storage	-22	-1
117	Insurance Carriers	-26	-0
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-18	-0
128	Computer Systems Design and Related Services	-33	-1
131	Advertising and Related Services	-20	-0

Chapter 11. Binghamton, NY

Study Area Overview

The Binghamton, NY study region occupies 1,225 square-miles and had a 2018 population of 240,219. The employed share of the regional labor force during the 2014-2018 period averaged 94.94%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Government and Unclassified. These three industries account for a combined 22.82% of the region's economy. The region's 2018 coefficient of specialization (COS) is 29.08, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Binghamton, NY can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Hospitals, whose employment grew by 1,586 followed by Food Services and Drinking Places and Junior Colleges, Colleges, Universities, and Professional Schools. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 2.02, 1.13, and 3.39.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
153	Hospitals	1,586	710	2.02
167	Food Services and Drinking Places	1,170	-998	1.13
144	Junior Colleges, Colleges, Universities, and Professional Schools	1,142	485	3.39
177	Grantmaking and Giving Services and Social Advocacy Organizations	827	782	3.77
166	Accommodation	509	415	1.11
76	Household Appliance Manufacturing	409	423	11.84
119	Real Estate and Owner-Occupied Dwellings	370	312	0.68
104	Warehousing and Storage	277	-8	0.85
133	Management of Companies and Enterprises	213	-47	0.65
140	Services to Buildings and Dwellings	211	-87	0.83

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Binghamton, NY, the cluster with the largest CLQ in 2018 is Computer, Electronic, and Electrical Products with a CLQ of 6.97, followed by Education and Knowledge Creation and Biomedical/Biotechnical (Life Sciences). The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Binghamton, NY cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.38	1.44	14,906
9	Education and Knowledge Creation	3.93	3.92	12,874
5	Business and Financial Services	0.70	0.61	11,750
3	Arts, Entertainment, Recreation and Visitor Industries	0.90	0.99	11,073
8	Defense and Security	0.52	0.48	6,928
16	Transportation and Logistics	0.90	0.90	6,549
7	Computer, Electronic, and Electrical Products	8.33	6.97	6,289
15	Primary and Fabricated Metal Products	0.71	1.08	1,151
1	Agribusiness, Food Processing and Technology	0.54	0.40	1,057
12	Information Technology and Telecommunications	1.09	1.31	892
11	Forest and Wood Products	0.55	0.77	743
10	Energy (Fossil and Renewable)	1.28	0.92	663
6	Chemicals and Chemical-Based Products	0.60	0.63	618
13	Machinery	1.05	0.75	523
14	Mining, Glass and Ceramics	1.63	1.16	505
2	Apparel and Textiles	0.47	0.36	87
17	Transportation Equipment	0.04	0.01	10

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Binghamton, NY

2. CADS Analysis

The 2018 CADS analysis of the economy of Binghamton, NY identifies 3 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Hospitals, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	4,845	6,431
7	Computer, Electronic, and Electrical Products	72	Semiconductor and Other Electronic Component Manufacturing	3,155	3,233
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	2,747	3,888

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
153	Hospitals	2.02	710	18.09	32.74	0.90	0.10
72	Semiconductor and Other Electronic Component Manufacturing	14.06	638	-17.77	2.47	0.82	0.07
144	Junior Colleges, Colleges, Universities, and Professional Schools	3.39	485	23.90	41.56	0.95	0.04

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has

been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment
35	Basic Chemical Manufacturing	-10
38	Pharmaceutical and Medicine Manufacturing	-51
51	Nonferrous Metal (except Aluminum) Production and Processing	-2
135	Facilities Support Services	-17

Table 6. Phase 2 Deficits Adding Anchor Industry 72

Semiconductor and Other Electronic Component Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
35	Basic Chemical Manufacturing	-15	-6
38	Pharmaceutical and Medicine Manufacturing	-51	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-38	-36
135	Facilities Support Services	-20	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
35	Basic Chemical Manufacturing	-16	-1
38	Pharmaceutical and Medicine Manufacturing	-51	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-39	-0
135	Facilities Support Services	-21	-1

Chapter 12. Birmingham-Hoover, AL

Study Area Overview

The Birmingham-Hoover, AL study region occupies 5,280 square-miles and had a 2018 population of 1,151,801. The employed share of the regional labor force during the 2014-2018 period averaged 94.8%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Hospitals and All Other Retail. These three industries account for a combined 20.49% of the region's economy. The region's 2018 coefficient of specialization (COS) is 23.38, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Birmingham-Hoover, AL can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 7,890 followed by Junior Colleges, Colleges, Universities, and Professional Schools and Motor Vehicle Parts Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.13, 2.01, and 2.09.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	7,890	-2,352	1.13
144	Junior Colleges, Colleges, Universities, and Professional Schools	5,047	3,513	2.01
81	Motor Vehicle Parts Manufacturing	2,783	2,909	2.09
146	Offices of Physicians	2,218	7	1.38
155	Individual and Family Services	2,190	96	0.54
149	Outpatient Care Centers	2,010	-1,244	1.92
153	Hospitals	1,838	-3,654	2.03
154	Nursing and Residential Care Facilities	1,761	160	1.05
104	Warehousing and Storage	1,595	666	0.75
118	Agencies, Brokerages, and Other Insurance Related Activities	1,491	646	1.33

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Birmingham-Hoover, AL, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 2.73, followed by Education and Knowledge Creation and Primary and Fabricated Metal Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Birmingham-Hoover, AL cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
5	Business and Financial Services	1.06	1.03	98,580
4	Biomedical/Biotechnical (Life Sciences)	1.42	1.42	73,365
3	Arts, Entertainment, Recreation and Visitor Industries	0.92	0.99	55,243
16	Transportation and Logistics	1.23	1.08	39,455
9	Education and Knowledge Creation	2.50	2.39	39,145
8	Defense and Security	0.38	0.40	28,800
15	Primary and Fabricated Metal Products	2.36	2.10	11,166
10	Energy (Fossil and Renewable)	2.66	2.73	9,771
1	Agribusiness, Food Processing and Technology	0.51	0.47	6,158
17	Transportation Equipment	0.45	1.28	4,729
11	Forest and Wood Products	0.82	0.85	4,068
12	Information Technology and Telecommunications	1.91	1.11	3,768
14	Mining, Glass and Ceramics	1.38	1.65	3,593
13	Machinery	0.65	0.82	2,836
6	Chemicals and Chemical-Based Products	0.46	0.56	2,730
7	Computer, Electronic, and Electrical Products	0.22	0.36	1,603
2	Apparel and Textiles	0.48	0.34	416

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Birmingham-Hoover, AL
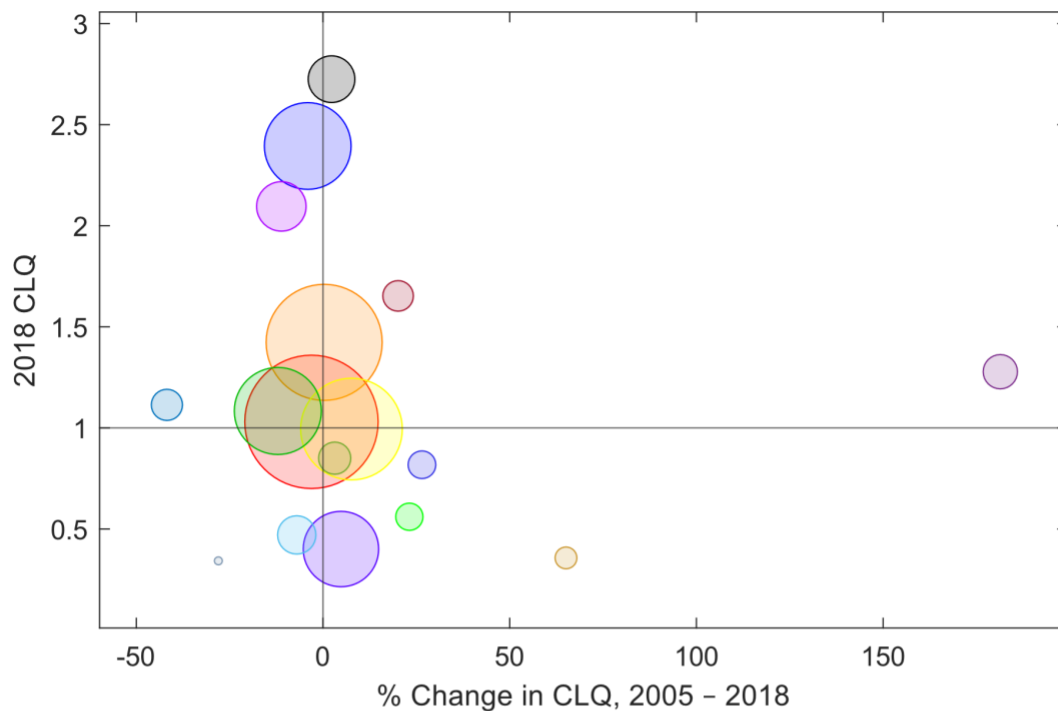
Bubble Size as the Employment for Each Cluster
Business and Financial Services (98,580)
Biomedical/Biotechnical (Life Sciences) (73,365)
Arts, Entertainment, Recreation and Visitor Industries (55,243)
Transportation and Logistics (39,455)
Education and Knowledge Creation (39,145)
Defense and Security (28,800)
Primary and Fabricated Metal Products (11,166)
Energy (Fossil and Renewable) (9,771)
Agribusiness, Food Processing and Technology (6,158)
Transportation Equipment (4,729)
Forest and Wood Products (4,068)
Information Technology and Telecommunications (3,768)
Mining, Glass and Ceramics (3,593)
Machinery (2,836)
Chemicals and Chemical-Based Products (2,730)
Computer, Electronic, and Electrical Products (1,603)
Apparel and Textiles (416)

2. CADS Analysis

The 2018 CADS analysis of the economy of Birmingham-Hoover, AL identifies 7 anchor industries in 6 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Electric Power Generation, Transmission and Distribution, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
10	Energy (Fossil and Renewable)	11	Electric Power Generation, Transmission and Distribution	6,119	6,191
5	Business and Financial Services	115	Monetary Authorities, Credit Intermediation, and Related Activities	16,315	17,257
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	9,068	11,286
16	Transportation and Logistics	99	Truck Transportation	6,469	7,316
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	6,419	11,467
5	Business and Financial Services	118	Agencies, Brokerages, and Other Insurance Related Activities	3,713	5,204
8	Defense and Security	139	Investigation and Security Services	3,954	5,382

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
11	Electric Power Generation, Transmission and Distribution	5.14	223	-2.47	1.17	0.88	0.09

115	Monetary Authorities, Credit Intermediation, and Related Activities	2.08	2,316	-8.42	5.77	0.98	0.08
146	Offices of Physicians	1.38	7	24.38	24.46	0.99	0.03
99	Truck Transportation	1.40	770	1.19	13.09	0.97	0.03
144	Junior Colleges, Colleges, Universities, and Professional Schools	2.01	3,513	23.90	78.63	0.99	0.02
118	Agencies, Brokerages, and Other Insurance Related Activities	1.33	646	22.75	40.16	0.99	0.02
139	Investigation and Security Services	1.80	414	25.66	36.13	0.98	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 11

Electric Power Generation, Transmission and Distribution

Industry #	Industry Name	Employment
4	Fishing, Hunting and Trapping	-3
6	Oil and Gas Extraction	-128
31	Pulp, Paper, and Paperboard Mills	-9
70	Communications Equipment Manufacturing	-1
72	Semiconductor and Other Electronic Component Manufacturing	-5
97	Rail Transportation	-139
109	Cable and Other Subscription Programming	-5
114	Other Information Services	N/A
161	Independent Artists, Writers, and Performers	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 115

Monetary Authorities, Credit Intermediation, and Related Activities

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-5	-3
6	Oil and Gas Extraction	-140	-12
31	Pulp, Paper, and Paperboard Mills	-23	-14
70	Communications Equipment Manufacturing	-11	-10
72	Semiconductor and Other Electronic Component Manufacturing	-32	-26
97	Rail Transportation	-146	-6
109	Cable and Other Subscription Programming	-20	-15
114	Other Information Services	N/A	-81
161	Independent Artists, Writers, and Performers	-33	-66

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-7	-2
6	Oil and Gas Extraction	-143	-2
31	Pulp, Paper, and Paperboard Mills	-27	-3
70	Communications Equipment Manufacturing	-18	-7
72	Semiconductor and Other Electronic Component Manufacturing	-44	-13
97	Rail Transportation	-149	-4
109	Cable and Other Subscription Programming	-22	-2
114	Other Information Services	N/A	-17
161	Independent Artists, Writers, and Performers	-47	-14

Table 8. Phase 4 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-7	-1
6	Oil and Gas Extraction	-160	-17
31	Pulp, Paper, and Paperboard Mills	-31	-4
70	Communications Equipment Manufacturing	-21	-3
72	Semiconductor and Other Electronic Component Manufacturing	-59	-15
97	Rail Transportation	-185	-35
109	Cable and Other Subscription Programming	-24	-2
114	Other Information Services	-1	-10
161	Independent Artists, Writers, and Performers	-58	-11

Table 9. Phase 5 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-13	-6
6	Oil and Gas Extraction	-162	-2
31	Pulp, Paper, and Paperboard Mills	-32	-2
70	Communications Equipment Manufacturing	-23	-2
72	Semiconductor and Other Electronic Component Manufacturing	-66	-7
97	Rail Transportation	-187	-2
109	Cable and Other Subscription Programming	-24	-1

| 114 | Other Information Services | -12 | -11 |
| 161 | Independent Artists, Writers, and Performers | -63 | -5 |

Table 10. Phase 6 Deficits Adding Anchor Industry 118

Agencies, Brokerages, and Other Insurance Related Activities

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-14	-0
6	Oil and Gas Extraction	-162	-0
31	Pulp, Paper, and Paperboard Mills	-33	-1
70	Communications Equipment Manufacturing	-23	-1
72	Semiconductor and Other Electronic Component Manufacturing	-68	-2
97	Rail Transportation	-187	-0
109	Cable and Other Subscription Programming	-25	-1
114	Other Information Services	-16	-3
161	Independent Artists, Writers, and Performers	-66	-2

Table 11. Phase 7 Deficits Adding Anchor Industry 139

Investigation and Security Services

Industry #	Industry Name	Employment	Added to Deficit
4	Fishing, Hunting and Trapping	-14	-0
6	Oil and Gas Extraction	-163	-0
31	Pulp, Paper, and Paperboard Mills	-34	-1
70	Communications Equipment Manufacturing	-27	-4
72	Semiconductor and Other Electronic Component Manufacturing	-75	-8
97	Rail Transportation	-188	-1
109	Cable and Other Subscription Programming	-26	-1
114	Other Information Services	-23	-7
161	Independent Artists, Writers, and Performers	-69	-3

Chapter 13. Blacksburg-Christiansburg-Radford, VA

Study Area Overview

The Blacksburg-Christiansburg-Radford, VA study region occupies 1,073 square-miles and had a 2018 population of 168,234. The employed share of the regional labor force during the 2014-2018 period averaged 96.01%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by All Other Retail and Elementary and Secondary Schools. These three industries account for a combined 21.65% of the region's economy. The region's 2018 coefficient of specialization (COS) is 33.72, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Blacksburg-Christiansburg-Radford, VA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 955 followed by Electrical Equipment Manufacturing and Plastics Product Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.42, 31.05, and 2.67.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	955	-566	1.42
77	Electrical Equipment Manufacturing	680	741	31.05
42	Plastics Product Manufacturing	494	499	2.67
128	Computer Systems Design and Related Services	458	172	1.11
136	Employment Services	402	398	0.74
181	Government and Unclassified	310	236	0.29
154	Nursing and Residential Care Facilities	277	81	1.17
41	Other Chemical Product and Preparation Manufacturing	246	382	30.40
66	Metalworking Machinery Manufacturing	218	220	3.59
119	Real Estate and Owner-Occupied Dwellings	213	151	1.03

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Blacksburg-Christiansburg-Radford, VA, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 9.33, followed by Chemicals and Chemical-Based Products and Computer, Electronic, and Electrical Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Blacksburg-Christiansburg-Radford, VA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
3	Arts, Entertainment, Recreation and Visitor Industries	1.07	1.25	7,951
5	Business and Financial Services	0.58	0.68	7,495
4	Biomedical/Biotechnical (Life Sciences)	0.85	0.89	5,227
9	Education and Knowledge Creation	4.70	2.76	5,167
17	Transportation Equipment	7.79	9.33	3,952
16	Transportation and Logistics	0.63	0.58	2,405
8	Defense and Security	0.21	0.28	2,323
6	Chemicals and Chemical-Based Products	2.70	4.00	2,227
7	Computer, Electronic, and Electrical Products	2.43	3.81	1,961
11	Forest and Wood Products	3.18	2.30	1,260
14	Mining, Glass and Ceramics	2.87	3.63	904
1	Agribusiness, Food Processing and Technology	0.33	0.36	546
13	Machinery	0.60	1.26	502
15	Primary and Fabricated Metal Products	0.91	0.66	400
12	Information Technology and Telecommunications	0.67	0.45	173
2	Apparel and Textiles	1.89	1.24	172
10	Energy (Fossil and Renewable)	0.84	0.39	160

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Blacksburg-Christiansburg-Radford, VA
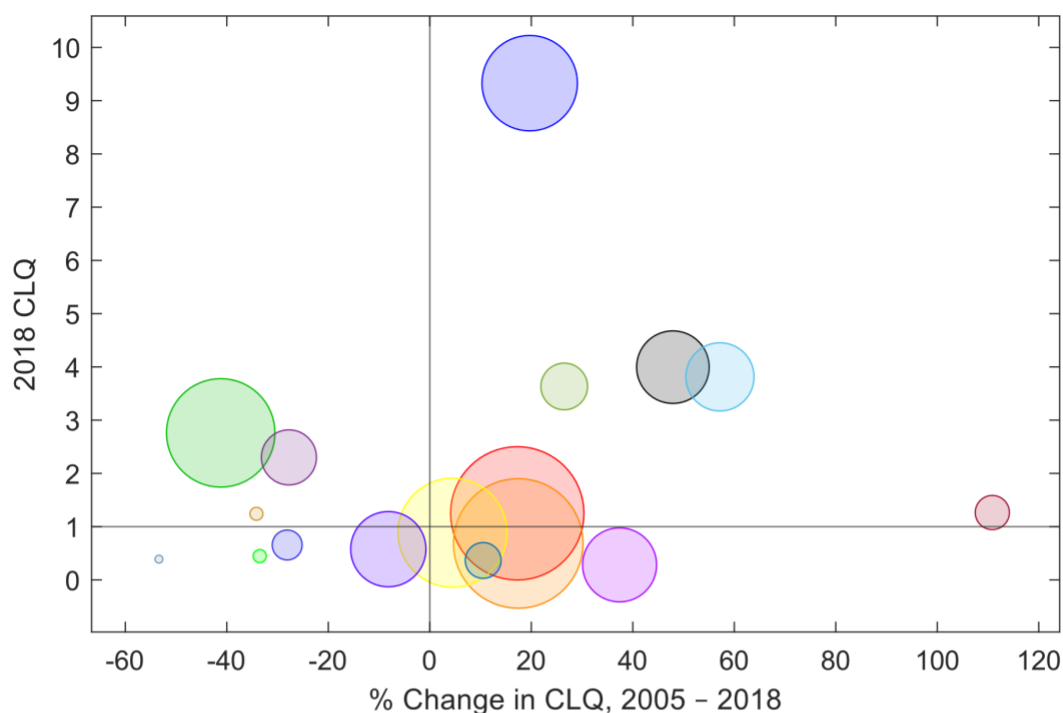
Bubble Size as the Employment for Each Cluster

- Arts, Entertainment, Recreation and Visitor Industries (7,951)
- Business and Financial Services (7,495)
- Biomedical/Biotechnical (Life Sciences) (5,227)
- Education and Knowledge Creation (5,167)
- Transportation Equipment (3,952)
- Transportation and Logistics (2,405)
- Defense and Security (2,323)
- Chemicals and Chemical-Based Products (2,227)
- Computer, Electronic, and Electrical Products (1,961)
- Forest and Wood Products (1,260)
- Mining, Glass and Ceramics (904)
- Agribusiness, Food Processing and Technology (546)
- Machinery (502)
- Primary and Fabricated Metal Products (400)
- Information Technology and Telecommunications (173)
- Apparel and Textiles (172)
- Energy (Fossil and Renewable) (160)

2. CADS Analysis

The 2018 CADS analysis of the economy of Blacksburg-Christiansburg-Radford, VA identifies 4 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Other Chemical Product and Preparation Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	41	Other Chemical Product and Preparation Manufacturing	661	907
7	Computer, Electronic, and Electrical Products	77	Electrical Equipment Manufacturing	864	1,544
14	Mining, Glass and Ceramics	46	Cement and Concrete Product Manufacturing	704	709
5	Business and Financial Services	126	Architectural, Engineering, and Related Services	696	774

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
41	Other Chemical Product and Preparation Manufacturing	30.40	382	-20.49	37.25	0.81	0.07
77	Electrical Equipment Manufacturing	31.05	741	-7.05	78.68	0.70	0.05
46	Cement and Concrete Product Manufacturing	10.24	135	-18.50	0.67	0.84	0.02

126	Architectural, Engineering, and Related Services	1.41	12	9.37	11.06	0.91	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 41

Other Chemical Product and Preparation Manufacturing

Industry #	Industry Name	Employment
6	Oil and Gas Extraction	-7
8	Metal Ore Mining	-3
31	Pulp, Paper, and Paperboard Mills	-11
39	Paint, Coating, and Adhesive Manufacturing	-15
45	Glass and Glass Product Manufacturing	-8
48	Iron and Steel Mills and Ferroalloy Manufacturing	-3
49	Steel Product Manufacturing From Purchased Steel	N/A
51	Nonferrous Metal (except Aluminum) Production and Processing	-4
56	Boiler, Tank, and Shipping Container Manufacturing	-7
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	N/A
60	Coating, Engraving, Heat Treating, and Allied Activities	N/A
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	-35
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-1
97	Rail Transportation	-14

Table 6. Phase 2 Deficits Adding Anchor Industry 77

Electrical Equipment Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-9	-2
8	Metal Ore Mining	-11	-8
31	Pulp, Paper, and Paperboard Mills	-13	-3
39	Paint, Coating, and Adhesive Manufacturing	-19	-4
45	Glass and Glass Product Manufacturing	-10	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-22	-19
49	Steel Product Manufacturing From Purchased Steel	-11	-14
51	Nonferrous Metal (except Aluminum) Production and Processing	-59	-55
56	Boiler, Tank, and Shipping Container Manufacturing	-10	-3
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-32	-80
60	Coating, Engraving, Heat Treating, and Allied Activities	-14	-20
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	-36	-2
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-17	-16
97	Rail Transportation	-18	-4

Table 7. Phase 3 Deficits Adding Anchor Industry 46

Cement and Concrete Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-10	-1
8	Metal Ore Mining	-12	-1
31	Pulp, Paper, and Paperboard Mills	-14	-1
39	Paint, Coating, and Adhesive Manufacturing	-21	-2
45	Glass and Glass Product Manufacturing	-14	-4
48	Iron and Steel Mills and Ferroalloy Manufacturing	-24	-2
49	Steel Product Manufacturing From Purchased Steel	-14	-4
51	Nonferrous Metal (except Aluminum) Production and Processing	-61	-1
56	Boiler, Tank, and Shipping Container Manufacturing	-11	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-42	-10
60	Coating, Engraving, Heat Treating, and Allied Activities	-21	-7
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	-37	-0
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-17	-0
97	Rail Transportation	-27	-9

Table 8. Phase 4 Deficits Adding Anchor Industry 126

Architectural, Engineering, and Related Services

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-11	-0
8	Metal Ore Mining	-12	-0
31	Pulp, Paper, and Paperboard Mills	-15	-0
39	Paint, Coating, and Adhesive Manufacturing	-22	-0
45	Glass and Glass Product Manufacturing	-14	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-25	-1
49	Steel Product Manufacturing From Purchased Steel	-15	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-62	-1

56	Boiler, Tank, and Shipping Container Manufacturing	-11	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-43	-1
60	Coating, Engraving, Heat Treating, and Allied Activities	-22	-1
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	-37	-1
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-17	-0
97	Rail Transportation	-27	-0

Chapter 14. Bloomsburg-Berwick, PA

Study Area Overview

The Bloomsburg-Berwick, PA study region occupies 613 square-miles and had a 2018 population of 83,696. The employed share of the regional labor force during the 2014-2018 period averaged 96.38%. The Hospitals industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Management of Companies and Enterprises. These three industries account for a combined 29.03% of the region's economy. The region's 2018 coefficient of specialization (COS) is 44.96, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Bloomsburg-Berwick, PA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Hospitals, whose employment grew by 1,156 followed by Outpatient Care Centers and Insurance Carriers. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 4.86, 8.37, and 3.01.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
153	Hospitals	1,156	227	4.86
149	Outpatient Care Centers	1,098	266	8.37
117	Insurance Carriers	915	899	3.01
133	Management of Companies and Enterprises	825	183	4.46
167	Food Services and Drinking Places	425	-280	0.92
151	Home Health Care Services	376	266	1.32
144	Junior Colleges, Colleges, Universities, and Professional Schools	247	40	2.39
99	Truck Transportation	196	192	1.19
26	Textile Mills and Textile Product Mills	172	685	23.50
104	Warehousing and Storage	164	-224	2.11

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Bloomsburg-Berwick, PA, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 14.63, followed by Biomedical/Biotechnical (Life Sciences) and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Bloomsburg-Berwick, PA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	2.34	2.64	11,097
5	Business and Financial Services	0.70	0.76	5,932
3	Arts, Entertainment, Recreation and Visitor Industries	0.84	0.83	3,768
9	Education and Knowledge Creation	2.82	2.31	3,089
16	Transportation and Logistics	0.59	0.66	1,958
1	Agribusiness, Food Processing and Technology	2.24	1.36	1,457
2	Apparel and Textiles	7.40	14.63	1,450
8	Defense and Security	0.16	0.17	986
15	Primary and Fabricated Metal Products	2.23	2.27	985
17	Transportation Equipment	1.86	2.22	670
6	Chemicals and Chemical-Based Products	0.84	1.34	534
13	Machinery	0.82	1.06	299
10	Energy (Fossil and Renewable)	1.27	0.64	187
14	Mining, Glass and Ceramics	0.56	0.91	162
11	Forest and Wood Products	1.58	0.28	108
7	Computer, Electronic, and Electrical Products	0.07	0.14	52
12	Information Technology and Telecommunications	0.55	0.16	44

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Bloomsburg-Berwick, PA
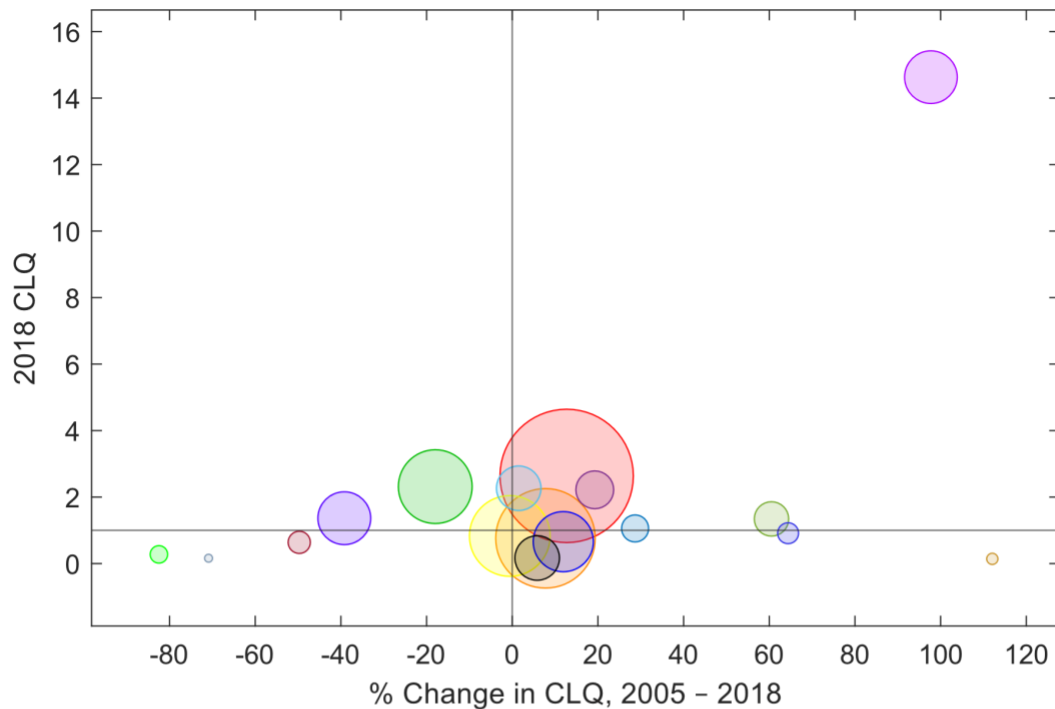
Bubble Size as the Employment for Each Cluster

- ○ Biomedical/Biotechnical (Life Sciences) (11,097)
- ○ Business and Financial Services (5,932)
- ○ Arts, Entertainment, Recreation and Visitor Industries (3,768)
- ○ Education and Knowledge Creation (3,089)
- ○ Transportation and Logistics (1,958)
- ○ Agribusiness, Food Processing and Technology (1,457)
- ○ Apparel and Textiles (1,450)
- ○ Defense and Security (986)
- ○ Primary and Fabricated Metal Products (985)
- ○ Transportation Equipment (670)
- ○ Chemicals and Chemical-Based Products (534)
- ○ Machinery (299)
- ○ Energy (Fossil and Renewable) (187)
- ○ Mining, Glass and Ceramics (162)
- ○ Forest and Wood Products (108)
- ○ Computer, Electronic, and Electrical Products (52)
- ○ Information Technology and Telecommunications (44)

2. CADS Analysis

The 2018 CADS analysis of the economy of Bloomsburg-Berwick, PA identifies 5 anchor industries in 5 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Hospitals, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	5,132	6,288
2	Apparel and Textiles	26	Textile Mills and Textile Product Mills	1,241	1,413
17	Transportation Equipment	80	Motor Vehicle Body and Trailer Manufacturing	408	526
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	867	1,114
15	Primary and Fabricated Metal Products	55	Architectural and Structural Metals Manufacturing	463	497

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
153	Hospitals	4.86	227	18.09	22.52	0.73	0.23
26	Textile Mills and Textile Product Mills	23.50	685	-41.39	13.85	0.75	0.08
80	Motor Vehicle Body and Trailer Manufacturing	12.66	132	-3.45	28.93	0.69	0.04
144	Junior Colleges, Colleges, Universities, and Professional Schools	2.39	40	23.90	28.52	0.90	0.03

| 55 | Architectural and Structural Metals Manufacturing | 4.99 | 41 | -1.47 | 7.45 | 0.62 | 0.03 |

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	N/A
38	Pharmaceutical and Medicine Manufacturing	-49
72	Semiconductor and Other Electronic Component Manufacturing	-10
89	Medical Equipment and Supplies Manufacturing	-75
103	Couriers and Messengers	-30
118	Agencies, Brokerages, and Other Insurance Related Activities	-36
129	Management, Scientific, and Technical Consulting Services	-162
134	Office Administrative Services	-63
136	Employment Services	-456
139	Investigation and Security Services	-58
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-29
174	Drycleaning and Laundry Services	-33

Table 6. Phase 2 Deficits Adding Anchor Industry 26

Textile Mills and Textile Product Mills

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-46	-46
38	Pharmaceutical and Medicine Manufacturing	-50	-0
72	Semiconductor and Other Electronic Component Manufacturing	-33	-23
89	Medical Equipment and Supplies Manufacturing	-75	-0
103	Couriers and Messengers	-38	-8
118	Agencies, Brokerages, and Other Insurance Related Activities	-50	-14
129	Management, Scientific, and Technical Consulting Services	-177	-15
134	Office Administrative Services	-67	-3
136	Employment Services	-490	-35
139	Investigation and Security Services	-66	-9
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-35	-5
174	Drycleaning and Laundry Services	-35	-2

Table 7. Phase 3 Deficits Adding Anchor Industry 80

Motor Vehicle Body and Trailer Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-48	-3
38	Pharmaceutical and Medicine Manufacturing	-50	-0
72	Semiconductor and Other Electronic Component Manufacturing	-46	-13
89	Medical Equipment and Supplies Manufacturing	-75	-0
103	Couriers and Messengers	-43	-4
118	Agencies, Brokerages, and Other Insurance Related Activities	-57	-7
129	Management, Scientific, and Technical Consulting Services	-185	-9
134	Office Administrative Services	-69	-2
136	Employment Services	-509	-19
139	Investigation and Security Services	-71	-5
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-37	-2
174	Drycleaning and Laundry Services	-36	-1

Table 8. Phase 4 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-48	-0
38	Pharmaceutical and Medicine Manufacturing	-50	-0
72	Semiconductor and Other Electronic Component Manufacturing	-47	-1
89	Medical Equipment and Supplies Manufacturing	-75	-0
103	Couriers and Messengers	-44	-1
118	Agencies, Brokerages, and Other Insurance Related Activities	-59	-2
129	Management, Scientific, and Technical Consulting Services	-188	-2
134	Office Administrative Services	-70	-1
136	Employment Services	-518	-9

139	Investigation and Security Services	-73	-2
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-38	-1
174	Drycleaning and Laundry Services	-36	-1

Table 9. Phase 5 Deficits Adding Anchor Industry 55

Architectural and Structural Metals Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-49	-1
38	Pharmaceutical and Medicine Manufacturing	-50	-0
72	Semiconductor and Other Electronic Component Manufacturing	-54	-7
89	Medical Equipment and Supplies Manufacturing	-76	-0
103	Couriers and Messengers	-46	-3
118	Agencies, Brokerages, and Other Insurance Related Activities	-61	-2
129	Management, Scientific, and Technical Consulting Services	-193	-5
134	Office Administrative Services	-71	-1
136	Employment Services	-540	-22
139	Investigation and Security Services	-83	-10
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-39	-2
174	Drycleaning and Laundry Services	-37	-0

Chapter 15. Bluefield, WV-VA

Study Area Overview

The Bluefield, WV-VA study region occupies 938 square-miles and had a 2018 population of 99,986. The employed share of the regional labor force during the 2014-2018 period averaged 94.8%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 22.62% of the region's economy. The region's 2018 coefficient of specialization (COS) is 33.45, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Bluefield, WV-VA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Government and Unclassified, whose employment grew by 427 followed by Coal Mining and Outpatient Care Centers. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 0.39, 51.52, and 2.74.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
181	Government and Unclassified	427	375	0.39
7	Coal Mining	337	403	51.52
149	Outpatient Care Centers	307	86	2.74
155	Individual and Family Services	249	-124	1.15
133	Management of Companies and Enterprises	178	93	0.85
157	Child Day Care Services	165	162	0.97
162	Museums, Historical Sites, and Similar Institutions	161	156	4.75
62	Agriculture, Construction, and Mining Machinery Manufacturing	144	123	13.16
151	Home Health Care Services	106	-155	1.34
140	Services to Buildings and Dwellings	106	69	0.44

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Bluefield, WV-VA, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 3.86, followed by Education and Knowledge Creation and Machinery. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Bluefield, WV-VA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechical (Life Sciences)	1.76	1.63	5,732
3	Arts, Entertainment, Recreation and Visitor Industries	1.04	1.05	3,975
9	Education and Knowledge Creation	3.51	3.47	3,859
5	Business and Financial Services	0.57	0.54	3,516
8	Defense and Security	0.26	0.38	1,856
16	Transportation and Logistics	1.07	0.69	1,719
10	Energy (Fossil and Renewable)	2.25	3.86	941
13	Machinery	1.65	2.99	704
15	Primary and Fabricated Metal Products	1.58	1.34	485
11	Forest and Wood Products	0.92	1.08	350
7	Computer, Electronic, and Electrical Products	0.89	0.59	179
14	Mining, Glass and Ceramics	1.47	1.08	159
12	Information Technology and Telecommunications	0.67	0.66	152
6	Chemicals and Chemical-Based Products	0.65	0.21	70
17	Transportation Equipment	0.11	0.27	69
1	Agribusiness, Food Processing and Technology	0.57	0.08	68
2	Apparel and Textiles	0.70	0.74	61

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Bluefield, WV-VA
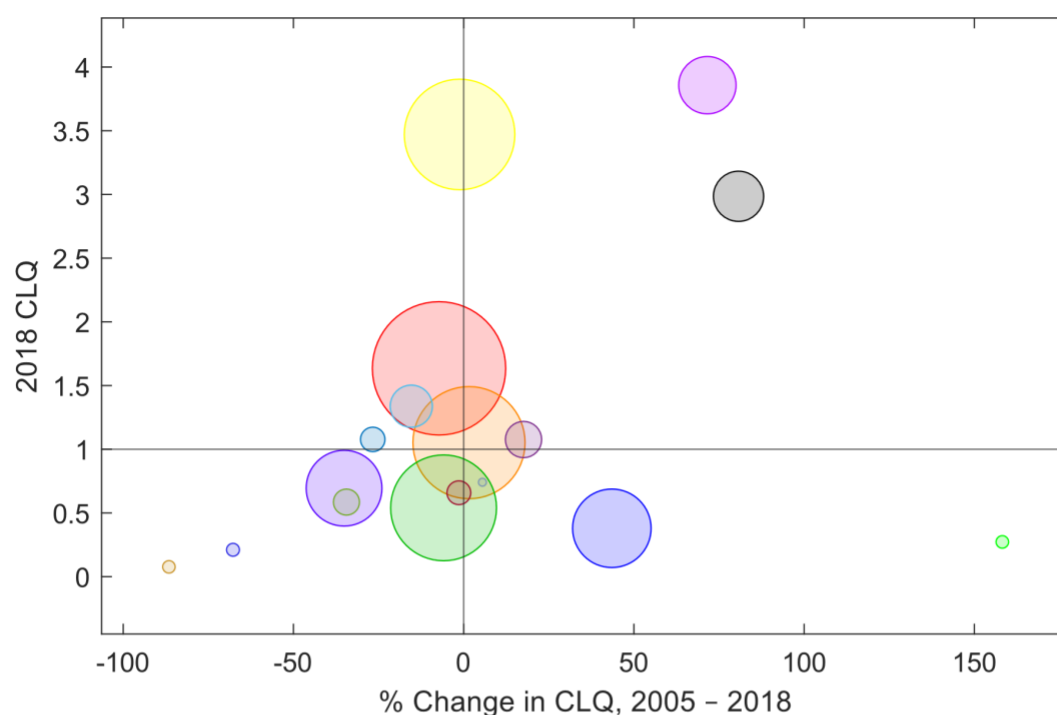
Bubble Size as the Employment for Each Cluster

- ⬤ Biomedical/Biotechnical (Life Sciences) (5,732)
- ⬤ Arts, Entertainment, Recreation and Visitor Industries (3,975)
- ⬤ Education and Knowledge Creation (3,859)
- ⬤ Business and Financial Services (3,516)
- ⬤ Defense and Security (1,856)
- ⬤ Transportation and Logistics (1,719)
- ⬤ Energy (Fossil and Renewable) (941)
- ⬤ Machinery (704)
- ⬤ Primary and Fabricated Metal Products (485)
- ⬤ Forest and Wood Products (350)
- ⬤ Computer, Electronic, and Electrical Products (179)
- ⬤ Mining, Glass and Ceramics (159)
- ⬤ Information Technology and Telecommunications (152)
- ⬤ Chemicals and Chemical-Based Products (70)
- ⬤ Transportation Equipment (69)
- ⬤ Agribusiness, Food Processing and Technology (68)
- ⬤ Apparel and Textiles (61)

2. CADS Analysis

The 2018 CADS analysis of the economy of Bluefield, WV-VA identifies 3 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Coal Mining, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
10	Energy (Fossil and Renewable)	7	Coal Mining	234	571
13	Machinery	62	Agriculture, Construction, and Mining Machinery Manufacturing	458	602
4	Biomedical/Biotechnical (Life Sciences)	149	Outpatient Care Centers	262	569

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
7	Coal Mining	51.52	403	-28.42	143.97	0.81	0.12
62	Agriculture, Construction, and Mining Machinery Manufacturing	13.16	123	4.70	31.52	0.64	0.09
149	Outpatient Care Centers	2.74	86	84.40	117.27	0.91	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column

reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 7

Coal Mining

Industry #	Industry Name	Employment
42	Plastics Product Manufacturing	-7
43	Rubber Product Manufacturing	-10
48	Iron and Steel Mills and Ferroalloy Manufacturing	-3
49	Steel Product Manufacturing From Purchased Steel	-2
52	Foundries	N/A
53	Forging and Stamping	-2
61	Other Fabricated Metal Product Manufacturing	N/A
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	N/A
81	Motor Vehicle Parts Manufacturing	N/A
97	Rail Transportation	-18

Table 6. Phase 2 Deficits Adding Anchor Industry 62

Agriculture, Construction, and Mining Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
42	Plastics Product Manufacturing	-25	-18
43	Rubber Product Manufacturing	-31	-21
48	Iron and Steel Mills and Ferroalloy Manufacturing	-26	-22
49	Steel Product Manufacturing From Purchased Steel	-15	-13
52	Foundries	-19	-22
53	Forging and Stamping	-23	-21
61	Other Fabricated Metal Product Manufacturing	-15	-28
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-25	-30
81	Motor Vehicle Parts Manufacturing	-29	-58
97	Rail Transportation	-21	-4

Table 7. Phase 3 Deficits Adding Anchor Industry 149

Outpatient Care Centers

Industry #	Industry Name	Employment	Added to Deficit
42	Plastics Product Manufacturing	-26	-1
43	Rubber Product Manufacturing	-31	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-26	-0
49	Steel Product Manufacturing From Purchased Steel	-16	-0
52	Foundries	-19	-0
53	Forging and Stamping	-24	-0
61	Other Fabricated Metal Product Manufacturing	-15	-0
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-25	-0
81	Motor Vehicle Parts Manufacturing	-30	-0
97	Rail Transportation	-22	-0

Chapter 16. Boone, NC

Study Area Overview

The Boone, NC study region occupies 313 square-miles and had a 2018 population of 55,945. The employed share of the regional labor force during the 2014-2018 period averaged 97.4%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by All Other Retail and Junior Colleges, Colleges, Universities, and Professional Schools. These three industries account for a combined 33.87% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.02, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Boone, NC can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 885 followed by Junior Colleges, Colleges, Universities, and Professional Schools and Community and Vocational Rehabilitation Services. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 2.19, 7.01, and 12.05.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	885	78	2.19
144	Junior Colleges, Colleges, Universities, and Professional Schools	468	159	7.01
156	Community and Vocational Rehabilitation Services	381	386	12.05
141	Other Support Services	313	311	6.82
119	Real Estate and Owner-Occupied Dwellings	287	263	1.76
133	Management of Companies and Enterprises	187	152	0.89
151	Home Health Care Services	173	110	1.20
93	Food and Beverage Stores	157	118	1.71
95	All Other Retail	112	172	1.84
140	Services to Buildings and Dwellings	104	55	0.79

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Boone, NC, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.67, followed by Arts, Entertainment, Recreation and Visitor Industries and Biomedical/Biotechnical (Life Sciences). The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Boone, NC cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
3	Arts, Entertainment, Recreation and Visitor Industries	1.97	2.16	5,287
5	Business and Financial Services	0.50	0.63	2,661
9	Education and Knowledge Creation	3.90	3.67	2,641
4	Biomedical/Biotechnical (Life Sciences)	1.22	1.02	2,325
8	Defense and Security	0.26	0.28	885
16	Transportation and Logistics	1.23	0.51	812
1	Agribusiness, Food Processing and Technology	0.43	0.48	277
11	Forest and Wood Products	0.80	0.79	166
12	Information Technology and Telecommunications	0.54	0.67	100
6	Chemicals and Chemical-Based Products	0.03	0.23	49
14	Mining, Glass and Ceramics	0.88	0.48	46
2	Apparel and Textiles	0.90	0.80	43
10	Energy (Fossil and Renewable)	1.48	0.21	34
15	Primary and Fabricated Metal Products	0.17	0.09	20
13	Machinery	0.00	0.09	14
7	Computer, Electronic, and Electrical Products	0.92	0.00	0
17	Transportation Equipment	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Boone, NC
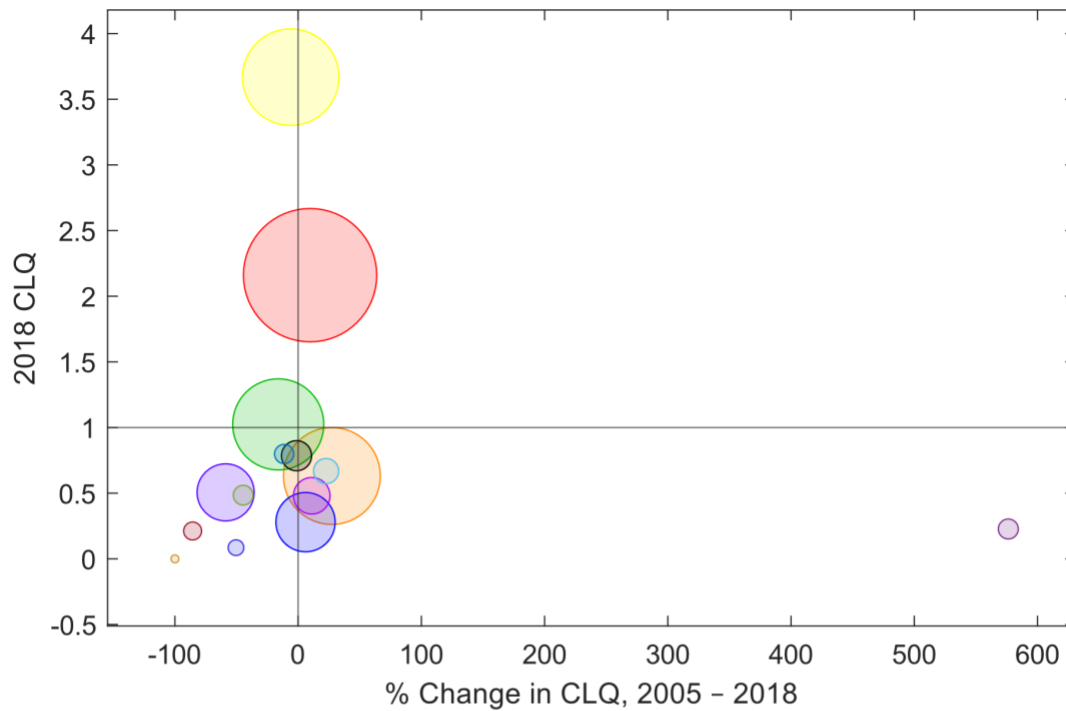
	Bubble Size as the Employment for Each Cluster
○	Arts, Entertainment, Recreation and Visitor Industries (5,287)
○	Business and Financial Services (2,661)
○	Education and Knowledge Creation (2,641)
○	Biomedical/Biotechnical (Life Sciences) (2,325)
○	Defense and Security (885)
○	Transportation and Logistics (812)
○	Agribusiness, Food Processing and Technology (277)
○	Forest and Wood Products (166)
○	Information Technology and Telecommunications (100)
○	Chemicals and Chemical-Based Products (49)
○	Mining, Glass and Ceramics (46)
○	Apparel and Textiles (43)
○	Energy (Fossil and Renewable) (34)
○	Primary and Fabricated Metal Products (20)
○	Machinery (14)
○	Computer, Electronic, and Electrical Products (0)
○	Transportation Equipment (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Boone, NC identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Real Estate and Owner-Occupied Dwellings, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
5	Business and Financial Services	119	Real Estate and Owner-Occupied Dwellings	222	509

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
119	Real Estate and Owner-Occupied Dwellings	1.76	263	11.04	129.79	0.77	0.29

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 119

Real Estate and Owner-Occupied Dwellings

Industry #	Industry Name	Employment
117	Insurance Carriers	-30
126	Architectural, Engineering, and Related Services	-17
136	Employment Services	-50
139	Investigation and Security Services	-15

Chapter 17. Bradford, PA

Study Area Overview

The Bradford, PA study region occupies 979 square-miles and had a 2018 population of 40,968. The employed share of the regional labor force during the 2014-2018 period averaged 94.2%. The Elementary and Secondary Schools industry was the region's largest employer in 2018, followed by Nursing and Residential Care Facilities and Government and Unclassified. These three industries account for a combined 20.31% of the region's economy. The region's 2018 coefficient of specialization (COS) is 40.41, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Bradford, PA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Electrical Equipment Manufacturing, whose employment grew by 406 followed by Elementary and Secondary Schools and Management of Companies and Enterprises. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 36.1, 11.01, and 1.02.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
77	Electrical Equipment Manufacturing	406	411	36.10
143	Elementary and Secondary Schools	209	-62	11.01
133	Management of Companies and Enterprises	196	184	1.02
151	Home Health Care Services	151	66	1.76
140	Services to Buildings and Dwellings	151	113	1.14
144	Junior Colleges, Colleges, Universities, and Professional Schools	74	22	1.68
20	Animal Slaughtering and Processing	53	52	1.40
163	Amusement Parks and Arcades	52	52	2.56
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	47	47	5.16
168	Automotive Repair and Maintenance	45	45	1.02

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Bradford, PA, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 9.91, followed by Primary and Fabricated Metal Products and Forest and Wood Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Bradford, PA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.55	1.49	2,354
9	Education and Knowledge Creation	2.36	2.97	1,490
5	Business and Financial Services	0.34	0.41	1,215
3	Arts, Entertainment, Recreation and Visitor Industries	0.72	0.71	1,213
10	Energy (Fossil and Renewable)	9.26	9.91	1,089
8	Defense and Security	0.35	0.42	929
15	Primary and Fabricated Metal Products	3.95	5.43	887
16	Transportation and Logistics	1.01	0.65	727
11	Forest and Wood Products	7.39	3.95	578
7	Computer, Electronic, and Electrical Products	0.84	3.49	480
14	Mining, Glass and Ceramics	5.94	3.67	245
1	Agribusiness, Food Processing and Technology	0.38	0.51	205
6	Chemicals and Chemical-Based Products	0.54	1.12	167
12	Information Technology and Telecommunications	0.39	0.35	36
13	Machinery	0.19	0.25	27
2	Apparel and Textiles	0.60	0.00	0
17	Transportation Equipment	0.50	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Bradford, PA
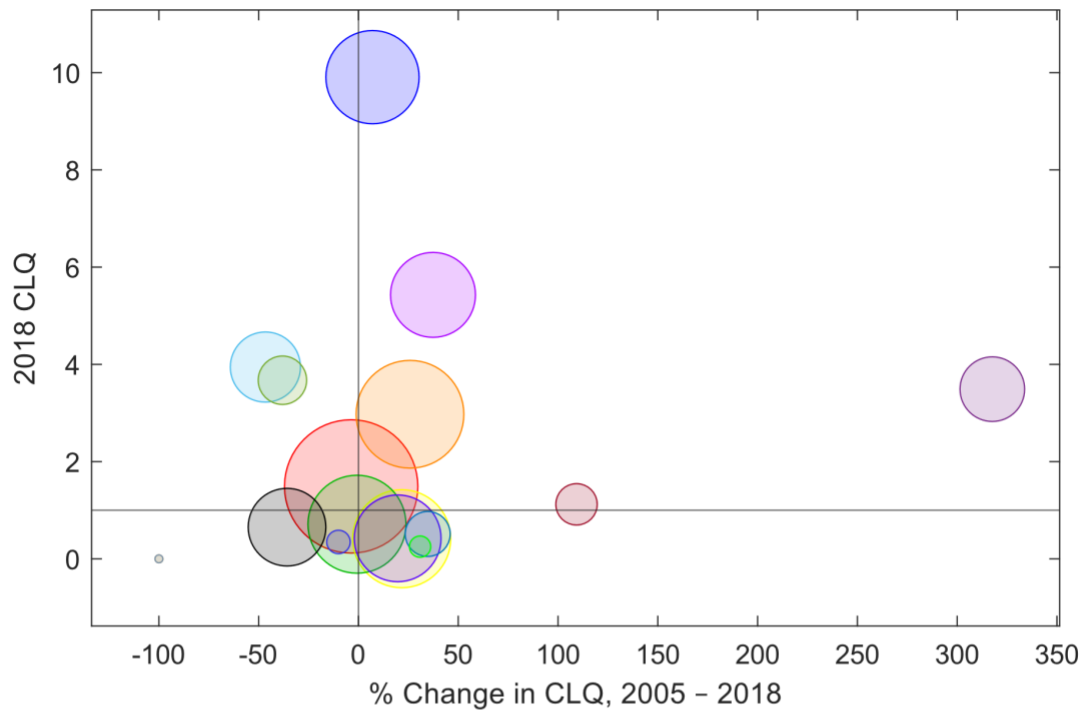
Bubble Size as the Employment for Each Cluster

- ○ Biomedical/Biotechnical (Life Sciences) (2,354)
- ○ Education and Knowledge Creation (1,490)
- ○ Business and Financial Services (1,215)
- ○ Arts, Entertainment, Recreation and Visitor Industries (1,213)
- ○ Energy (Fossil and Renewable) (1,089)
- ○ Defense and Security (929)
- ○ Primary and Fabricated Metal Products (887)
- ○ Transportation and Logistics (727)
- ○ Forest and Wood Products (578)
- ○ Computer, Electronic, and Electrical Products (480)
- ○ Mining, Glass and Ceramics (245)
- ○ Agribusiness, Food Processing and Technology (205)
- ○ Chemicals and Chemical-Based Products (167)
- ○ Information Technology and Telecommunications (36)
- ○ Machinery (27)
- ○ Apparel and Textiles (0)
- ○ Transportation Equipment (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Bradford, PA identifies 5 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Electrical Equipment Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
7	Computer, Electronic, and Electrical Products	77	Electrical Equipment Manufacturing	74	480
15	Primary and Fabricated Metal Products	54	Cutlery and Handtool Manufacturing	359	361
15	Primary and Fabricated Metal Products	56	Boiler, Tank, and Shipping Container Manufacturing	153	172
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	220	294
4	Biomedical/Biotechnical (Life Sciences)	151	Home Health Care Services	107	258

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
77	Electrical Equipment Manufacturing	36.10	411	-7.05	546.05	0.58	0.05
54	Cutlery and Handtool Manufacturing	99.67	125	-34.13	0.61	0.61	0.04
56	Boiler, Tank, and Shipping Container Manufacturing	19.82	17	0.77	12.03	0.51	0.03

144	Junior Colleges, Colleges, Universities, and Professional Schools	1.68	22	23.90	33.78	0.86	0.01
151	Home Health Care Services	1.76	66	79.39	141.12	0.84	0.00

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 77

Electrical Equipment Manufacturing

Industry #	Industry Name	Employment
48	Iron and Steel Mills and Ferroalloy Manufacturing	-6
49	Steel Product Manufacturing From Purchased Steel	-4
50	Alumina and Aluminum Production and Processing	-3
51	Nonferrous Metal (except Aluminum) Production and Processing	-17
52	Foundries	-3
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-11
72	Semiconductor and Other Electronic Component Manufacturing	-16
104	Warehousing and Storage	-24
139	Investigation and Security Services	-2

Table 6. Phase 2 Deficits Adding Anchor Industry 54

Cutlery and Handtool Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-15	-9
49	Steel Product Manufacturing From Purchased Steel	-10	-5
50	Alumina and Aluminum Production and Processing	-9	-6
51	Nonferrous Metal (except Aluminum) Production and Processing	-21	-3

52	Foundries	-10	-6
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-26	-16
72	Semiconductor and Other Electronic Component Manufacturing	-22	-6
104	Warehousing and Storage	-54	-31
139	Investigation and Security Services	-7	-5

Table 7. Phase 3 Deficits Adding Anchor Industry 56

Boiler, Tank, and Shipping Container Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-23	-8
49	Steel Product Manufacturing From Purchased Steel	-15	-5
50	Alumina and Aluminum Production and Processing	-36	-27
51	Nonferrous Metal (except Aluminum) Production and Processing	-26	-5
52	Foundries	-11	-2
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-35	-9
72	Semiconductor and Other Electronic Component Manufacturing	-28	-7
104	Warehousing and Storage	-71	-17
139	Investigation and Security Services	-10	-3

Table 8. Phase 4 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-23	-0
49	Steel Product Manufacturing From Purchased Steel	-15	-0
50	Alumina and Aluminum Production and Processing	-36	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-26	-0
52	Foundries	-11	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-36	-0
72	Semiconductor and Other Electronic Component Manufacturing	-29	-0
104	Warehousing and Storage	-72	-1
139	Investigation and Security Services	-10	-0

Table 9. Phase 5 Deficits Adding Anchor Industry 151

Home Health Care Services

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-23	-0
49	Steel Product Manufacturing From Purchased Steel	-15	-0
50	Alumina and Aluminum Production and Processing	-36	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-26	-0
52	Foundries	-11	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-36	-0
72	Semiconductor and Other Electronic Component Manufacturing	-29	-0
104	Warehousing and Storage	-72	-0
139	Investigation and Security Services	-11	-1

Chapter 18. Brevard, NC

Study Area Overview

The Brevard, NC study region occupies 379 square-miles and had a 2018 population of 34,215. The employed share of the regional labor force during the 2014-2018 period averaged 95.3%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Government and Unclassified and Elementary and Secondary Schools. These three industries account for a combined 25.79% of the region's economy. The region's 2018 coefficient of specialization (COS) is 34.84, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Brevard, NC can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Other Food Manufacturing, whose employment grew by 118 followed by Semiconductor and Other Electronic Component Manufacturing and Elementary and Secondary Schools. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 9.32, 6.05, and 11.58.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
23	Other Food Manufacturing	118	118	9.32
72	Semiconductor and Other Electronic Component Manufacturing	112	115	6.05
143	Elementary and Secondary Schools	100	-79	11.58
93	Food and Beverage Stores	89	68	2.25
154	Nursing and Residential Care Facilities	88	22	2.43
145	Other Educational Services	82	69	1.97
129	Management, Scientific, and Technical Consulting Services	73	70	0.81
38	Pharmaceutical and Medicine Manufacturing	60	59	6.55
181	Government and Unclassified	59	32	0.61
24	Beverage Manufacturing	46	46	3.10

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Brevard, NC, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.84, followed by Computer, Electronic, and Electrical Products and Chemicals and Chemical-Based Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Brevard, NC cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
3	Arts, Entertainment, Recreation and Visitor Industries	1.60	1.44	1,459
4	Biomedical/Biotechnical (Life Sciences)	1.31	1.24	1,171
9	Education and Knowledge Creation	3.21	3.84	1,144
5	Business and Financial Services	0.39	0.48	835
8	Defense and Security	0.50	0.58	756
16	Transportation and Logistics	0.59	0.42	280
1	Agribusiness, Food Processing and Technology	0.53	1.06	253
6	Chemicals and Chemical-Based Products	0.76	1.52	135
7	Computer, Electronic, and Electrical Products	0.54	1.54	127
11	Forest and Wood Products	0.50	1.21	106
12	Information Technology and Telecommunications	0.93	1.32	82
15	Primary and Fabricated Metal Products	1.68	0.37	36
13	Machinery	0.00	0.51	32
14	Mining, Glass and Ceramics	1.30	0.80	32
17	Transportation Equipment	0.00	0.18	12
2	Apparel and Textiles	0.00	0.52	11
10	Energy (Fossil and Renewable)	0.29	0.16	10

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Brevard, NC
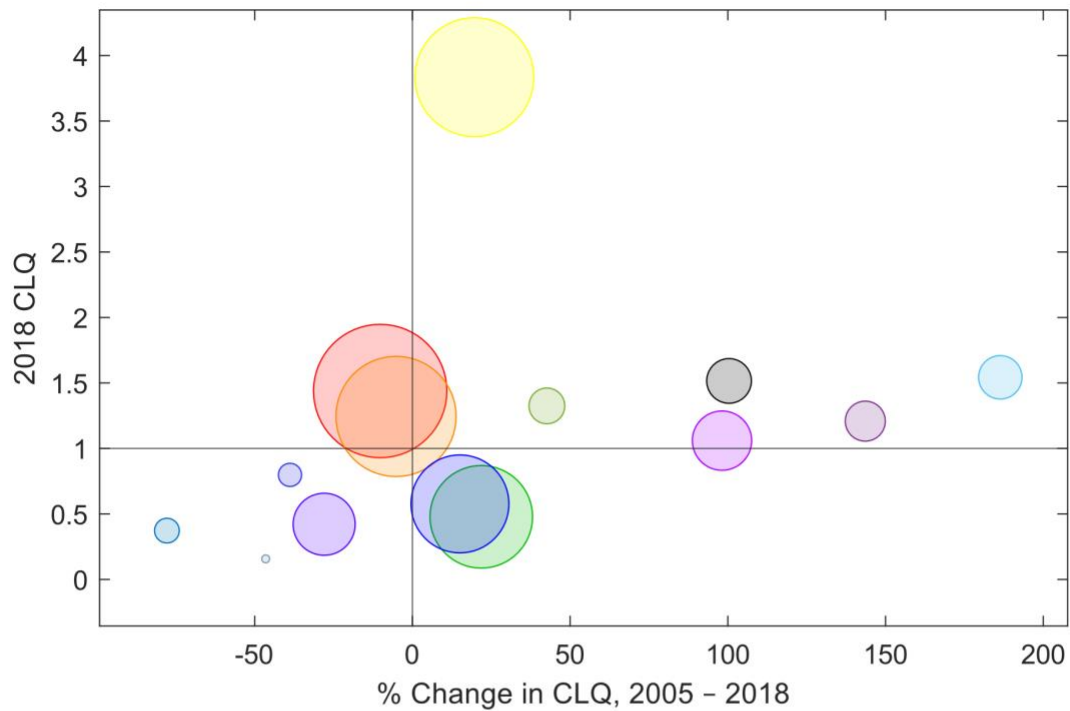
Bubble Size as the Employment for Each Cluster

- Arts, Entertainment, Recreation and Visitor Industries (1,459)
- Biomedical/Biotechnical (Life Sciences) (1,171)
- Education and Knowledge Creation (1,144)
- Business and Financial Services (835)
- Defense and Security (756)
- Transportation and Logistics (280)
- Agribusiness, Food Processing and Technology (253)
- Chemicals and Chemical-Based Products (135)
- Computer, Electronic, and Electrical Products (127)
- Forest and Wood Products (106)
- Information Technology and Telecommunications (82)
- Primary and Fabricated Metal Products (36)
- Machinery (32)
- Mining, Glass and Ceramics (32)
- Transportation Equipment (12)
- Apparel and Textiles (11)
- Energy (Fossil and Renewable) (10)

2. CADS Analysis

The 2018 CADS analysis of the economy of Brevard, NC identifies 2 anchor industries in 2 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Pharmaceutical and Medicine Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	38	Pharmaceutical and Medicine Manufacturing	50	110
9	Education and Knowledge Creation	145	Other Educational Services	29	111

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
38	Pharmaceutical and Medicine Manufacturing	6.55	59	2.37	120.94	0.62	0.07
145	Other Educational Services	1.97	69	44.75	286.13	0.80	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were

reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 38

Pharmaceutical and Medicine Manufacturing

Industry #	Industry Name	Employment
133	Management of Companies and Enterprises	-19

Table 6. Phase 2 Deficits Adding Anchor Industry 145

Other Educational Services

Industry #	Industry Name	Employment	Added to Deficit
133	Management of Companies and Enterprises	-20	-1

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Chapter 19. Calhoun, GA

Study Area Overview

The Calhoun, GA study region occupies 356 square-miles and had a 2018 population of 57,685. The employed share of the regional labor force during the 2014-2018 period averaged 96.5%. The Textile Mills and Textile Product Mills industry was the region's largest employer in 2018, followed by Employment Services and Food Services and Drinking Places. These three industries account for a combined 39.61% of the region's economy. The region's 2018 coefficient of specialization (COS) is 48.38, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Calhoun, GA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Hospitals, whose employment grew by 423 followed by Wholesale Trade and Government and Unclassified. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.23, 1.57, and 0.28.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
153	Hospitals	423	338	1.23
91	Wholesale Trade	323	318	1.57
181	Government and Unclassified	232	208	0.28
42	Plastics Product Manufacturing	150	193	9.51
104	Warehousing and Storage	114	-26	1.71
118	Agencies, Brokerages, and Other Insurance Related Activities	112	94	1.07
22	Bakeries and Tortilla Manufacturing	107	105	2.53
136	Employment Services	103	91	3.06
154	Nursing and Residential Care Facilities	102	56	0.76
44	Clay Product and Refractory Manufacturing	101	119	24.60

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Calhoun, GA, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 109.31, followed by Chemicals and Chemical-Based Products and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Calhoun, GA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
2	Apparel and Textiles	59.59	109.31	6,059
5	Business and Financial Services	0.65	0.63	2,740
16	Transportation and Logistics	1.06	1.18	1,961
4	Biomedical/Biotechnical (Life Sciences)	0.61	0.77	1,803
9	Education and Knowledge Creation	2.59	2.28	1,699
3	Arts, Entertainment, Recreation and Visitor Industries	0.63	0.62	1,573
6	Chemicals and Chemical-Based Products	4.19	6.38	1,419
8	Defense and Security	0.18	0.26	867
1	Agribusiness, Food Processing and Technology	0.24	0.74	445
11	Forest and Wood Products	0.41	1.24	270
14	Mining, Glass and Ceramics	1.24	1.78	177
15	Primary and Fabricated Metal Products	0.10	0.26	63
12	Information Technology and Telecommunications	0.23	0.35	55
13	Machinery	1.16	0.20	31
10	Energy (Fossil and Renewable)	0.10	0.01	1
7	Computer, Electronic, and Electrical Products	0.00	0.00	0
17	Transportation Equipment	0.30	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Calhoun, GA

2. CADS Analysis

The 2018 CADS analysis of the economy of Calhoun, GA identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Textile Mills and Textile Product Mills, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
2	Apparel and Textiles	26	Textile Mills and Textile Product Mills	6,887	6,059

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
26	Textile Mills and Textile Product Mills	180.20	2,023	-41.39	-12.02	0.54	0.50

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 26

Textile Mills and Textile Product Mills

Industry #	Industry Name	Employment
1	Crop Production	-241
2	Animal Production	-67
27	Apparel, Leather and Allied Product Manufacturing	-143
35	Basic Chemical Manufacturing	-51
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-120
72	Semiconductor and Other Electronic Component Manufacturing	-101
104	Warehousing and Storage	-67
126	Architectural, Engineering, and Related Services	-54
129	Management, Scientific, and Technical Consulting Services	-53
133	Management of Companies and Enterprises	-218

Chapter 20. Cambridge, OH

Study Area Overview

The Cambridge, OH study region occupies 522 square-miles and had a 2018 population of 39,022. The employed share of the regional labor force during the 2014-2018 period averaged 95.2%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Nursing and Residential Care Facilities and Hospitals. These three industries account for a combined 19.16% of the region's economy. The region's 2018 coefficient of specialization (COS) is 40.67, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Cambridge, OH can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Support Activities for Mining, whose employment grew by 444 followed by Individual and Family Services and Motor Vehicle Parts Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 15.17, 2.36, and 5.35.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
10	Support Activities for Mining	444	410	15.17
155	Individual and Family Services	357	134	2.36
81	Motor Vehicle Parts Manufacturing	306	306	5.35
43	Rubber Product Manufacturing	247	282	33.97
14	Construction	237	250	0.88
145	Other Educational Services	218	200	2.70
167	Food Services and Drinking Places	166	-166	1.11
154	Nursing and Residential Care Facilities	153	31	2.63
78	Other Electrical Equipment and Component Manufacturing	142	142	10.10
99	Truck Transportation	135	132	2.46

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Cambridge, OH, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 7.03, followed by Energy (Fossil and Renewable) and Machinery. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Cambridge, OH cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.98	1.63	2,595
3	Arts, Entertainment, Recreation and Visitor Industries	1.06	1.03	1,775
5	Business and Financial Services	0.53	0.36	1,063
6	Chemicals and Chemical-Based Products	5.99	7.03	1,060
9	Education and Knowledge Creation	2.63	2.08	1,053
16	Transportation and Logistics	1.02	0.93	1,045
8	Defense and Security	0.29	0.32	720
10	Energy (Fossil and Renewable)	1.26	5.25	583
15	Primary and Fabricated Metal Products	2.46	3.04	501
13	Machinery	5.46	4.20	450
17	Transportation Equipment	0.00	2.67	306
1	Agribusiness, Food Processing and Technology	0.41	0.45	184
7	Computer, Electronic, and Electrical Products	0.20	1.08	150
11	Forest and Wood Products	0.20	0.71	106
14	Mining, Glass and Ceramics	4.19	1.41	95
12	Information Technology and Telecommunications	0.28	0.25	26
2	Apparel and Textiles	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Cambridge, OH

2. CADS Analysis

The 2018 CADS analysis of the economy of Cambridge, OH identifies 5 anchor industries in 5 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Rubber Product Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	43	Rubber Product Manufacturing	204	451
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	0	306
10	Energy (Fossil and Renewable)	10	Support Activities for Mining	65	509
16	Transportation and Logistics	99	Truck Transportation	264	399
15	Primary and Fabricated Metal Products	55	Architectural and Structural Metals Manufacturing	162	208

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
43	Rubber Product Manufacturing	33.97	282	-17.19	121.20	0.75	0.08
81	Motor Vehicle Parts Manufacturing	5.35	306	-11.56	N/A	0.65	0.08
10	Support Activities for Mining	15.17	410	52.54	683.08	0.79	0.08
99	Truck Transportation	2.46	132	1.19	51.14	0.83	0.04
55	Architectural and Structural Metals Manufacturing	5.51	48	-1.47	28.40	0.77	0.03

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 43

Rubber Product Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-15
3	Forestry and Logging	-18
26	Textile Mills and Textile Product Mills	-36
27	Apparel, Leather and Allied Product Manufacturing	-1
52	Foundries	-1
53	Forging and Stamping	-4
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-5
60	Coating, Engraving, Heat Treating, and Allied Activities	-7
72	Semiconductor and Other Electronic Component Manufacturing	-11
104	Warehousing and Storage	N/A
129	Management, Scientific, and Technical Consulting Services	N/A
133	Management of Companies and Enterprises	-13

Table 6. Phase 2 Deficits Adding Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-18	-2
3	Forestry and Logging	-19	-1
26	Textile Mills and Textile Product Mills	-41	-5
27	Apparel, Leather and Allied Product Manufacturing	-12	-11
52	Foundries	-31	-30
53	Forging and Stamping	-18	-14

59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-47	-42
60	Coating, Engraving, Heat Treating, and Allied Activities	-17	-10
72	Semiconductor and Other Electronic Component Manufacturing	-37	-26
104	Warehousing and Storage	-10	-25
129	Management, Scientific, and Technical Consulting Services	-7	-10
133	Management of Companies and Enterprises	-43	-29

Table 7. Phase 3 Deficits Adding Anchor Industry 10

Support Activities for Mining

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-20	-2
3	Forestry and Logging	-20	-0
26	Textile Mills and Textile Product Mills	-42	-1
27	Apparel, Leather and Allied Product Manufacturing	-12	-0
52	Foundries	-32	-1
53	Forging and Stamping	-19	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-51	-4
60	Coating, Engraving, Heat Treating, and Allied Activities	-19	-2
72	Semiconductor and Other Electronic Component Manufacturing	-40	-3
104	Warehousing and Storage	-16	-6
129	Management, Scientific, and Technical Consulting Services	-19	-12
133	Management of Companies and Enterprises	-62	-19

Table 8. Phase 4 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-20	-0
3	Forestry and Logging	-20	-0
26	Textile Mills and Textile Product Mills	-42	-0
27	Apparel, Leather and Allied Product Manufacturing	-13	-0
52	Foundries	-32	-0
53	Forging and Stamping	-19	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-52	-1
60	Coating, Engraving, Heat Treating, and Allied Activities	-19	-1
72	Semiconductor and Other Electronic Component Manufacturing	-40	-0
104	Warehousing and Storage	-33	-17
129	Management, Scientific, and Technical Consulting Services	-23	-4
133	Management of Companies and Enterprises	-70	-8

Table 9. Phase 5 Deficits Adding Anchor Industry 55

Architectural and Structural Metals Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-20	-0
3	Forestry and Logging	-20	-0
26	Textile Mills and Textile Product Mills	-42	-0
27	Apparel, Leather and Allied Product Manufacturing	-13	-0
52	Foundries	-33	-1
53	Forging and Stamping	-20	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-60	-8

60	Coating, Engraving, Heat Treating, and Allied Activities	-21	-2
72	Semiconductor and Other Electronic Component Manufacturing	-43	-3
104	Warehousing and Storage	-42	-9
129	Management, Scientific, and Technical Consulting Services	-25	-2
133	Management of Companies and Enterprises	-75	-5

Chapter 21. Cedartown, GA

Study Area Overview

The Cedartown, GA study region occupies 310 square-miles and had a 2018 population of 42,470. The employed share of the regional labor force during the 2014-2018 period averaged 94.7%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Rubber Product Manufacturing and Elementary and Secondary Schools. These three industries account for a combined 27.48% of the region's economy. The region's 2018 coefficient of specialization (COS) is 50.82, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Cedartown, GA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Rubber Product Manufacturing, whose employment grew by 427 followed by Food Services and Drinking Places and Nursing and Residential Care Facilities. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 107.66, 1.3, and 2.39.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
43	Rubber Product Manufacturing	427	533	107.66
167	Food Services and Drinking Places	304	67	1.30
154	Nursing and Residential Care Facilities	242	186	2.39
94	General Merchandise Stores	213	199	2.28
87	Office Furniture (Including Fixtures) Manufacturing	183	286	101.09
153	Hospitals	155	133	0.78
26	Textile Mills and Textile Product Mills	146	146	8.78
81	Motor Vehicle Parts Manufacturing	146	146	3.50
142	Waste Management and Remediation Services	137	129	5.33
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	68	68	7.28

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Cedartown, GA, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 11.46, followed by Forest and Wood Products and Apparel and Textiles. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Cedartown, GA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
6	Chemicals and Chemical-Based Products	5.91	11.46	1,263
3	Arts, Entertainment, Recreation and Visitor Industries	0.72	0.93	1,173
4	Biomedical/Biotechnical (Life Sciences)	0.58	0.90	1,054
9	Education and Knowledge Creation	2.93	2.64	977
11	Forest and Wood Products	4.72	8.42	912
8	Defense and Security	0.49	0.45	739
5	Business and Financial Services	0.45	0.30	658
1	Agribusiness, Food Processing and Technology	3.08	2.21	654
16	Transportation and Logistics	0.85	0.70	576
13	Machinery	0.77	1.89	148
2	Apparel and Textiles	0.00	5.32	146
17	Transportation Equipment	3.41	1.75	146
15	Primary and Fabricated Metal Products	0.44	1.02	123
14	Mining, Glass and Ceramics	0.42	1.09	53
10	Energy (Fossil and Renewable)	2.42	0.60	49
12	Information Technology and Telecommunications	4.54	0.52	40
7	Computer, Electronic, and Electrical Products	0.40	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Cedartown, GA
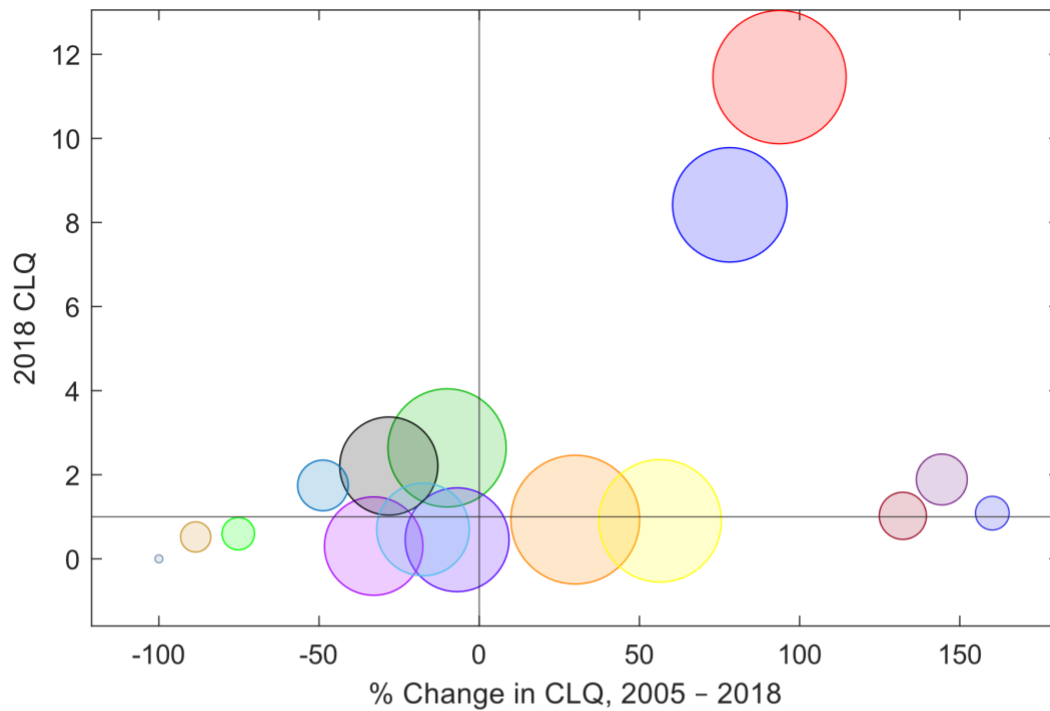
Bubble Size as the Employment for Each Cluster

- Chemicals and Chemical-Based Products (1,263)
- Arts, Entertainment, Recreation and Visitor Industries (1,173)
- Biomedical/Biotechnical (Life Sciences) (1,054)
- Education and Knowledge Creation (977)
- Forest and Wood Products (912)
- Defense and Security (739)
- Business and Financial Services (658)
- Agribusiness, Food Processing and Technology (654)
- Transportation and Logistics (576)
- Machinery (148)
- Apparel and Textiles (146)
- Transportation Equipment (146)
- Primary and Fabricated Metal Products (123)
- Mining, Glass and Ceramics (53)
- Energy (Fossil and Renewable) (49)
- Information Technology and Telecommunications (40)
- Computer, Electronic, and Electrical Products (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Cedartown, GA identifies 3 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Rubber Product Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	43	Rubber Product Manufacturing	618	1,045
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	0	146
2	Apparel and Textiles	26	Textile Mills and Textile Product Mills	0	146

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
43	Rubber Product Manufacturing	107.66	533	-17.19	69.08	0.61	0.26
81	Motor Vehicle Parts Manufacturing	3.50	146	-11.56	N/A	0.50	0.05
26	Textile Mills and Textile Product Mills	8.78	146	-41.39	N/A	0.62	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has

been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 43

Rubber Product Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-23
3	Forestry and Logging	-54
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-33
53	Forging and Stamping	-10
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-20
60	Coating, Engraving, Heat Treating, and Allied Activities	-17
72	Semiconductor and Other Electronic Component Manufacturing	-25
126	Architectural, Engineering, and Related Services	-17
129	Management, Scientific, and Technical Consulting Services	-16
133	Management of Companies and Enterprises	-45
139	Investigation and Security Services	-10

Table 6. Phase 2 Deficits Adding Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-24	-1
3	Forestry and Logging	-54	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-35	-2
53	Forging and Stamping	-16	-6
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-39	-19
60	Coating, Engraving, Heat Treating, and Allied Activities	-21	-4
72	Semiconductor and Other Electronic Component Manufacturing	-36	-12

126	Architectural, Engineering, and Related Services	-20	-4
129	Management, Scientific, and Technical Consulting Services	-20	-5
133	Management of Companies and Enterprises	-58	-13
139	Investigation and Security Services	-13	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 26

Textile Mills and Textile Product Mills

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-23	2
3	Forestry and Logging	-54	0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-34	1
53	Forging and Stamping	-16	0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-39	0
60	Coating, Engraving, Heat Treating, and Allied Activities	-21	0
72	Semiconductor and Other Electronic Component Manufacturing	-36	0
126	Architectural, Engineering, and Related Services	-20	0
129	Management, Scientific, and Technical Consulting Services	-20	0
133	Management of Companies and Enterprises	-57	1
139	Investigation and Security Services	-12	0

Chapter 22. Charleston, WV

Study Area Overview

The Charleston, WV study region occupies 2,529 square-miles and had a 2018 population of 288,318. The employed share of the regional labor force during the 2014-2018 period averaged 95.01%. The Government and Unclassified industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Hospitals. These three industries account for a combined 24.34% of the region's economy. The region's 2018 coefficient of specialization (COS) is 21.52, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Charleston, WV can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Motor Vehicle Parts Manufacturing, whose employment grew by 1,466 followed by Employment Services and Hospitals. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 5.21, 1.03, and 2.2.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
81	Motor Vehicle Parts Manufacturing	1,466	1,582	5.21
136	Employment Services	1,372	1,359	1.03
153	Hospitals	1,023	-412	2.20
133	Management of Companies and Enterprises	1,003	737	0.94
148	Offices of Other Health Practitioners	531	142	1.38
128	Computer Systems Design and Related Services	515	331	0.44
166	Accommodation	342	216	0.96
152	Other Ambulatory Health Care Services	340	242	2.03
144	Junior Colleges, Colleges, Universities, and Professional Schools	315	-6	1.13
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	268	180	3.46

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Charleston, WV, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 4.12, followed by Transportation Equipment and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Charleston, WV cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
5	Business and Financial Services	0.75	0.86	21,029
4	Biomedical/Biotechnical (Life Sciences)	1.37	1.49	19,730
8	Defense and Security	0.67	0.77	14,109
3	Arts, Entertainment, Recreation and Visitor Industries	0.95	0.94	13,464
9	Education and Knowledge Creation	2.36	2.32	9,721
16	Transportation and Logistics	1.32	0.90	8,422
10	Energy (Fossil and Renewable)	8.31	4.12	3,788
17	Transportation Equipment	0.84	2.62	2,490
6	Chemicals and Chemical-Based Products	1.65	1.24	1,543
12	Information Technology and Telecommunications	1.47	1.26	1,094
15	Primary and Fabricated Metal Products	0.30	0.52	708
1	Agribusiness, Food Processing and Technology	0.17	0.13	420
11	Forest and Wood Products	0.21	0.22	265
14	Mining, Glass and Ceramics	0.81	0.35	192
7	Computer, Electronic, and Electrical Products	0.13	0.16	180
13	Machinery	0.16	0.13	114
2	Apparel and Textiles	0.18	0.14	43

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Charleston, WV
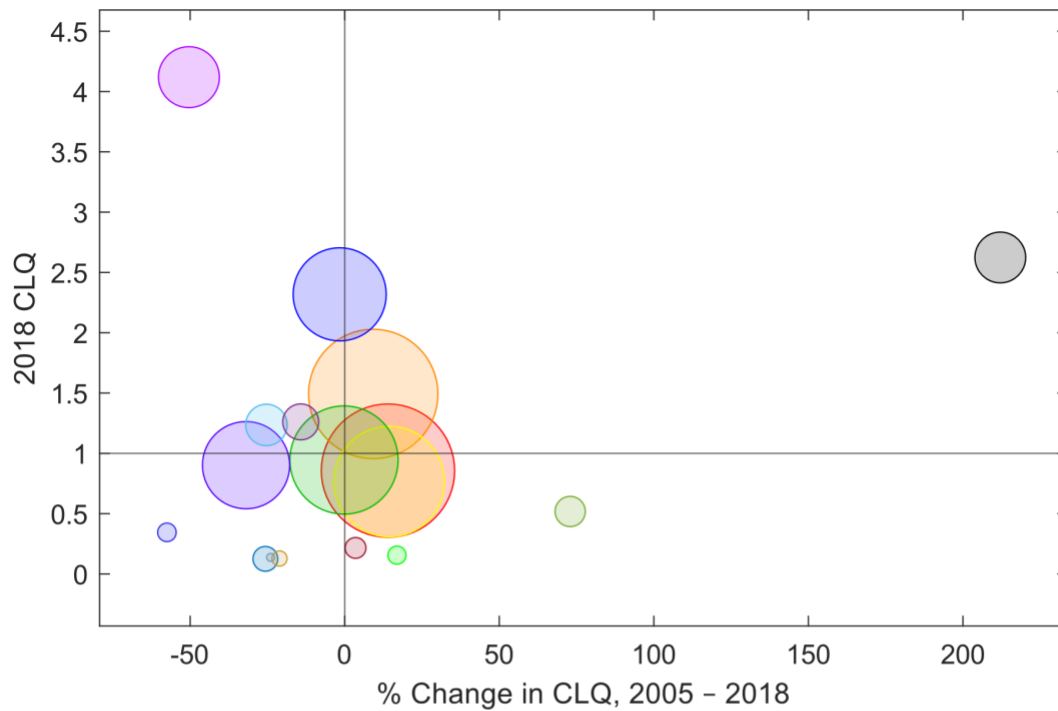
Bubble Size as the Employment for Each Cluster
○ Business and Financial Services (21,029)
○ Biomedical/Biotechnical (Life Sciences) (19,730)
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○ Energy (Fossil and Renewable) (3,788)
○ Transportation Equipment (2,490)
○ Chemicals and Chemical-Based Products (1,543)
○ Information Technology and Telecommunications (1,094)
○ Primary and Fabricated Metal Products (708)
○ Agribusiness, Food Processing and Technology (420)
○ Forest and Wood Products (265)
○ Mining, Glass and Ceramics (192)
○ Computer, Electronic, and Electrical Products (180)
○ Machinery (114)
○ Apparel and Textiles (43)

2. CADS Analysis

The 2018 CADS analysis of the economy of Charleston, WV identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Parts Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	1,000	2,466

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	5.21	1,582	-11.56	146.57	0.62	0.08

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
27	Apparel, Leather and Allied Product Manufacturing	-85
42	Plastics Product Manufacturing	-126
48	Iron and Steel Mills and Ferroalloy Manufacturing	-108
49	Steel Product Manufacturing From Purchased Steel	-65
51	Nonferrous Metal (except Aluminum) Production and Processing	-73
52	Foundries	-245
53	Forging and Stamping	-111
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-61
61	Other Fabricated Metal Product Manufacturing	-64
72	Semiconductor and Other Electronic Component Manufacturing	-217

Chapter 23. Chattanooga, TN-GA

Study Area Overview

The Chattanooga, TN-GA study region occupies 2,088 square-miles and had a 2018 population of 560,793. The employed share of the regional labor force during the 2014-2018 period averaged 95.37%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 20.19% of the region's economy. The region's 2018 coefficient of specialization (COS) is 25.86, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Chattanooga, TN-GA can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 5,380 followed by Elementary and Secondary Schools and Motor Vehicle Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.26, 8.21, and 4.96.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	5,380	-26	1.26
143	Elementary and Secondary Schools	3,050	-111	8.21
79	Motor Vehicle Manufacturing	1,829	1,829	4.96
93	Food and Beverage Stores	1,645	1,471	0.86
140	Services to Buildings and Dwellings	1,601	811	1.11
155	Individual and Family Services	1,526	164	0.73
81	Motor Vehicle Parts Manufacturing	1,328	1,433	2.42
146	Offices of Physicians	1,135	-103	1.51
154	Nursing and Residential Care Facilities	1,124	379	1.03
181	Government and Unclassified	1,115	780	0.29

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Chattanooga, TN-GA, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 5.54, followed by Transportation Equipment and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Chattanooga, TN-GA cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
5	Business and Financial Services	0.93	0.92	44,309
3	Arts, Entertainment, Recreation and Visitor Industries	0.97	1.09	30,301
4	Biomedical/Biotechnical (Life Sciences)	1.05	1.11	28,726
16	Transportation and Logistics	2.37	1.30	23,667
9	Education and Knowledge Creation	1.99	2.33	19,100
8	Defense and Security	0.27	0.31	11,193
1	Agribusiness, Food Processing and Technology	1.13	0.90	5,913
17	Transportation Equipment	0.60	2.75	5,107
15	Primary and Fabricated Metal Products	1.68	1.77	4,716
6	Chemicals and Chemical-Based Products	1.30	1.51	3,682
10	Energy (Fossil and Renewable)	2.08	1.97	3,533
2	Apparel and Textiles	4.43	5.54	3,368
11	Forest and Wood Products	0.77	1.24	2,973
13	Machinery	1.82	1.55	2,701
7	Computer, Electronic, and Electrical Products	0.91	1.01	2,275
14	Mining, Glass and Ceramics	1.26	1.81	1,975
12	Information Technology and Telecommunications	0.34	1.01	1,709

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Chattanooga, TN-GA
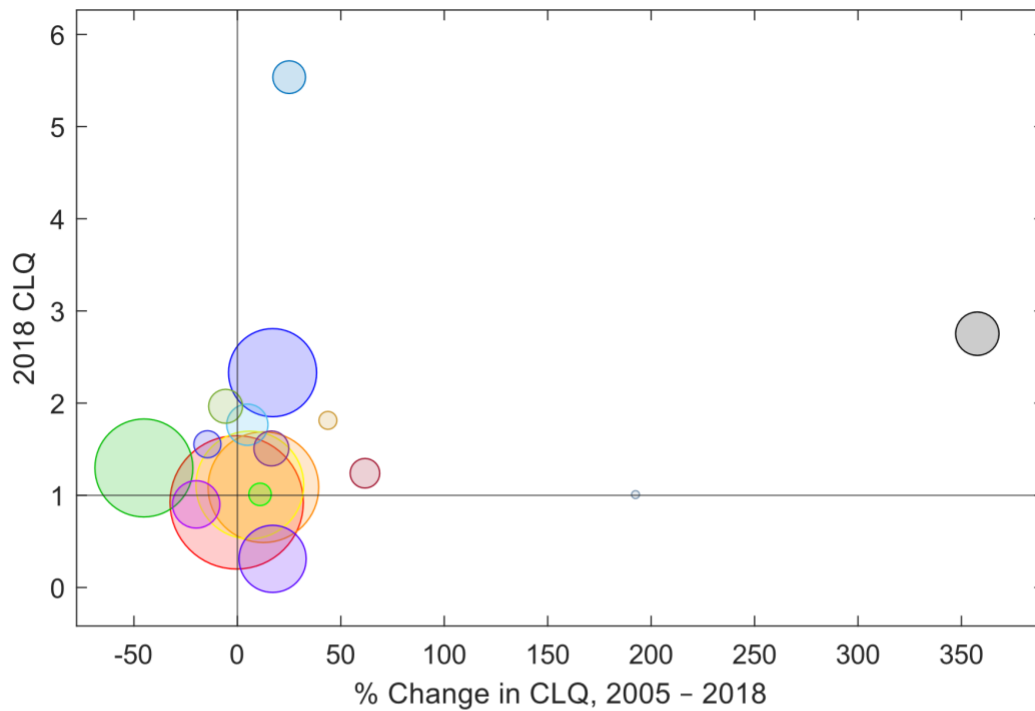
Bubble Size as the Employment for Each Cluster	
⭕	Business and Financial Services (44,309)
⭕	Arts, Entertainment, Recreation and Visitor Industries (30,301)
⭕	Biomedical/Biotechnical (Life Sciences) (28,726)
⭕	Transportation and Logistics (23,667)
⭕	Education and Knowledge Creation (19,100)
⭕	Defense and Security (11,193)
⭕	Agribusiness, Food Processing and Technology (5,913)
⭕	Transportation Equipment (5,107)
⭕	Primary and Fabricated Metal Products (4,716)
⭕	Chemicals and Chemical-Based Products (3,682)
⭕	Energy (Fossil and Renewable) (3,533)
⭕	Apparel and Textiles (3,368)
⭕	Forest and Wood Products (2,973)
⭕	Machinery (2,701)
⭕	Computer, Electronic, and Electrical Products (2,275)
⭕	Mining, Glass and Ceramics (1,975)
⭕	Information Technology and Telecommunications (1,709)

2. CADS Analysis

The 2018 CADS analysis of the economy of Chattanooga, TN-GA identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Junior Colleges, Colleges, Universities, and Professional Schools, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	2,614	3,695

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
144	Junior Colleges, Colleges, Universities, and Professional Schools	1.29	456	23.90	41.34	0.98	0.01

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment

Note: If no industries with deficits greater than 10 employees are identified for a given analysis phase, deficit tables will include only column headings.

Chapter 24. Chillicothe, OH

Study Area Overview

The Chillicothe, OH study region occupies 689 square-miles and had a 2018 population of 76,931. The employed share of the regional labor force during the 2014-2018 period averaged 94%. The Hospitals industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Government and Unclassified. These three industries account for a combined 31.12% of the region's economy. The region's 2018 coefficient of specialization (COS) is 40.45, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Chillicothe, OH can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Hospitals, whose employment grew by 1,407 followed by Motor Vehicle Parts Manufacturing and Food Services and Drinking Places. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 4.13, 8.08, and 1.41.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
153	Hospitals	1,407	967	4.13
81	Motor Vehicle Parts Manufacturing	603	635	8.08
167	Food Services and Drinking Places	555	-199	1.41
79	Motor Vehicle Manufacturing	364	426	44.59
155	Individual and Family Services	325	101	1.18
95	All Other Retail	293	347	1.37
80	Motor Vehicle Body and Trailer Manufacturing	185	185	6.19
136	Employment Services	172	167	1.20
99	Truck Transportation	163	160	1.48
145	Other Educational Services	162	120	1.42

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Chillicothe, OH, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 13.75, followed by Forest and Wood Products and Education and Knowledge Creation. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Chillicothe, OH cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.89	2.03	6,153
3	Arts, Entertainment, Recreation and Visitor Industries	1.15	1.08	3,533
17	Transportation Equipment	7.49	13.75	2,985
9	Education and Knowledge Creation	2.88	2.41	2,311
5	Business and Financial Services	0.45	0.39	2,166
8	Defense and Security	0.55	0.51	2,134
16	Transportation and Logistics	0.79	0.68	1,460
11	Forest and Wood Products	4.75	3.61	1,014
12	Information Technology and Telecommunications	1.23	0.94	187
10	Energy (Fossil and Renewable)	0.83	0.82	172
1	Agribusiness, Food Processing and Technology	0.22	0.21	159
15	Primary and Fabricated Metal Products	0.39	0.41	128
14	Mining, Glass and Ceramics	0.82	0.57	73
13	Machinery	0.10	0.31	64
7	Computer, Electronic, and Electrical Products	0.69	0.14	36
2	Apparel and Textiles	0.01	0.13	9
6	Chemicals and Chemical-Based Products	0.03	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Chillicothe, OH
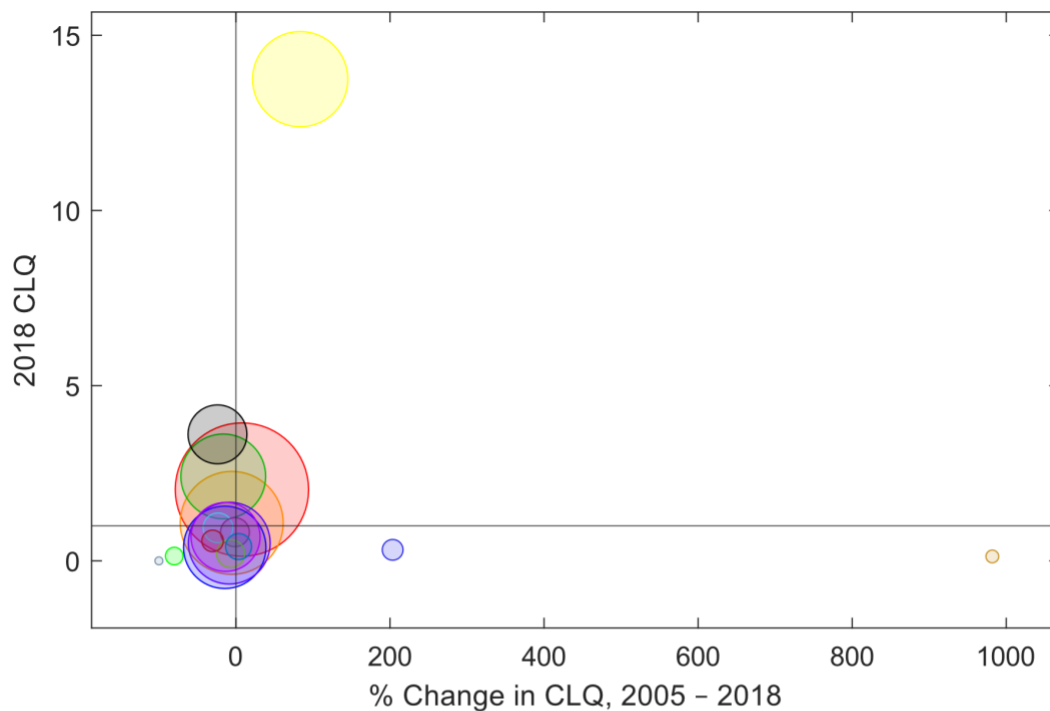
Bubble Size as the Employment for Each Cluster

- Biomedical/Biotechnical (Life Sciences) (6,153)
- Arts, Entertainment, Recreation and Visitor Industries (3,533)
- Transportation Equipment (2,985)
- Education and Knowledge Creation (2,311)
- Business and Financial Services (2,166)
- Defense and Security (2,134)
- Transportation and Logistics (1,460)
- Forest and Wood Products (1,014)
- Information Technology and Telecommunications (187)
- Energy (Fossil and Renewable) (172)
- Agribusiness, Food Processing and Technology (159)
- Primary and Fabricated Metal Products (128)
- Mining, Glass and Ceramics (73)
- Machinery (64)
- Computer, Electronic, and Electrical Products (36)
- Apparel and Textiles (9)
- Chemicals and Chemical-Based Products (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Chillicothe, OH identifies 1 anchor industry in 1 cluster. Identified anchor and its parent cluster are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industry and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	79	Motor Vehicle Manufacturing	1,560	1,924

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
79	Motor Vehicle Manufacturing	44.59	426	-3.98	23.34	0.28	0.57

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The

tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 79

Motor Vehicle Manufacturing

Industry #	Industry Name	Employment
42	Plastics Product Manufacturing	-432
52	Foundries	-360
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-583
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-307
71	Audio and Video Equipment Manufacturing	-383
72	Semiconductor and Other Electronic Component Manufacturing	-459
81	Motor Vehicle Parts Manufacturing	-2,412
91	Wholesale Trade	-1,142
104	Warehousing and Storage	-384
133	Management of Companies and Enterprises	-401

Chapter 25. Clarksburg, WV

Study Area Overview

The Clarksburg, WV study region occupies 909 square-miles and had a 2018 population of 92,822. The employed share of the regional labor force during the 2014-2018 period averaged 94.14%. The Government and Unclassified industry was the region's largest employer in 2018, followed by Hospitals and Construction. These three industries account for a combined 27.74% of the region's economy. The region's 2018 coefficient of specialization (COS) is 28.81, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Clarksburg, WV can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Construction, whose employment grew by 1,442 followed by Hospitals and Architectural, Engineering, and Related Services. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.4, 2.52, and 2.14.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
14	Construction	1,442	1,489	1.40
153	Hospitals	844	384	2.52
126	Architectural, Engineering, and Related Services	538	507	2.14
99	Truck Transportation	520	517	1.79
10	Support Activities for Mining	485	300	9.11
181	Government and Unclassified	442	265	0.88
6	Oil and Gas Extraction	416	395	16.45
133	Management of Companies and Enterprises	364	349	0.66
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	352	309	2.42
151	Home Health Care Services	288	73	1.38

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Clarksburg, WV, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 7.19, followed by Education and Knowledge Creation and Biomedical/Biotechnical (Life Sciences). The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Clarksburg, WV cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.58	1.59	6,930
8	Defense and Security	1.00	0.93	5,661
5	Business and Financial Services	0.55	0.60	4,877
3	Arts, Entertainment, Recreation and Visitor Industries	0.97	0.83	3,927
16	Transportation and Logistics	0.95	1.09	3,363
9	Education and Knowledge Creation	2.81	1.78	2,466
10	Energy (Fossil and Renewable)	4.48	7.19	2,183
6	Chemicals and Chemical-Based Products	0.60	0.69	284
12	Information Technology and Telecommunications	1.17	0.79	227
15	Primary and Fabricated Metal Products	0.49	0.47	213
1	Agribusiness, Food Processing and Technology	0.20	0.17	191
14	Mining, Glass and Ceramics	2.41	0.74	136
7	Computer, Electronic, and Electrical Products	0.34	0.33	125
11	Forest and Wood Products	0.61	0.12	49
13	Machinery	0.16	0.10	30
2	Apparel and Textiles	0.03	0.14	15
17	Transportation Equipment	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Clarksburg, WV

Figure 1: Cluster Bubble Chart of Clarksburg, WV
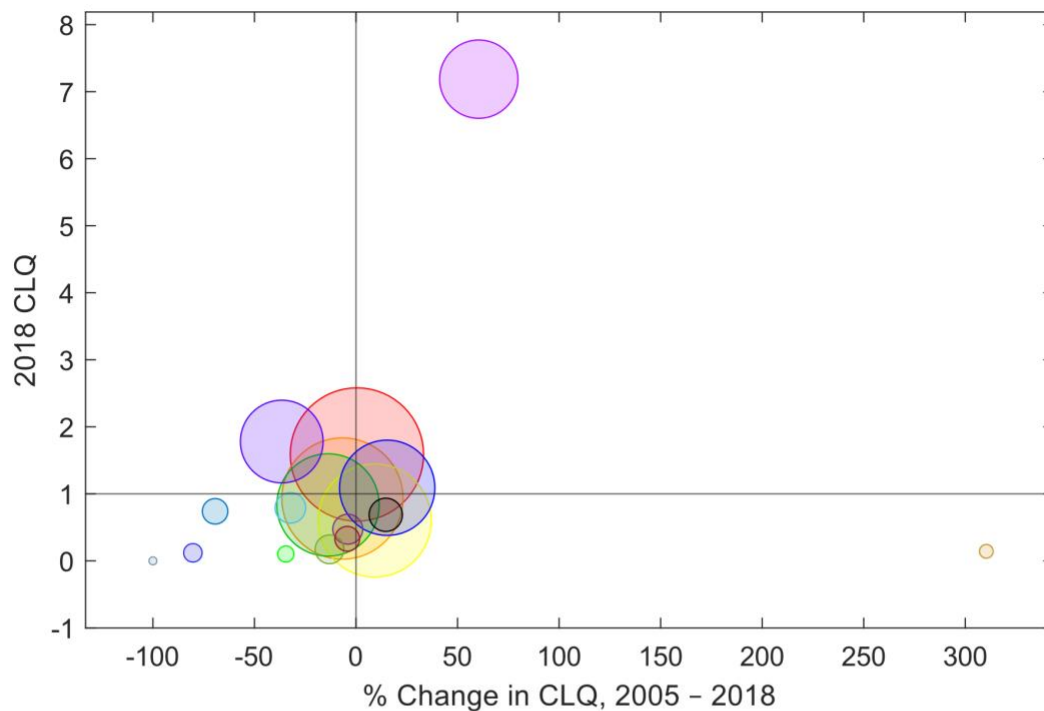
Bubble Size as the Employment for Each Cluster

- Biomedical/Biotechnical (Life Sciences) (6,930)
- Defense and Security (5,661)
- Business and Financial Services (4,877)
- Arts, Entertainment, Recreation and Visitor Industries (3,927)
- Transportation and Logistics (3,363)
- Education and Knowledge Creation (2,466)
- Energy (Fossil and Renewable) (2,183)
- Chemicals and Chemical-Based Products (284)
- Information Technology and Telecommunications (227)
- Primary and Fabricated Metal Products (213)
- Agribusiness, Food Processing and Technology (191)
- Mining, Glass and Ceramics (136)
- Computer, Electronic, and Electrical Products (125)
- Forest and Wood Products (49)
- Machinery (30)
- Apparel and Textiles (15)
- Transportation Equipment (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Clarksburg, WV identifies 3 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Oil and Gas Extraction, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
10	Energy (Fossil and Renewable)	6	Oil and Gas Extraction	196	612
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	2,539	3,383
16	Transportation and Logistics	99	Truck Transportation	275	796

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
6	Oil and Gas Extraction	16.45	395	10.72	212.81	0.70	0.25
153	Hospitals	2.52	384	18.09	33.22	0.74	0.10
99	Truck Transportation	1.79	517	1.19	189.05	0.86	0.03

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were

reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 6

Oil and Gas Extraction

Industry #	Industry Name	Employment
35	Basic Chemical Manufacturing	-22
38	Pharmaceutical and Medicine Manufacturing	-0
41	Other Chemical Product and Preparation Manufacturing	-25
48	Iron and Steel Mills and Ferroalloy Manufacturing	-21
49	Steel Product Manufacturing From Purchased Steel	-29
58	Spring and Wire Product Manufacturing	-17
61	Other Fabricated Metal Product Manufacturing	-60
62	Agriculture, Construction, and Mining Machinery Manufacturing	-34
66	Metalworking Machinery Manufacturing	-57
81	Motor Vehicle Parts Manufacturing	-18
89	Medical Equipment and Supplies Manufacturing	N/A
117	Insurance Carriers	-74
129	Management, Scientific, and Technical Consulting Services	N/A
136	Employment Services	N/A
139	Investigation and Security Services	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment	Added to Deficit
35	Basic Chemical Manufacturing	-27	-5
38	Pharmaceutical and Medicine Manufacturing	-27	-27
41	Other Chemical Product and Preparation Manufacturing	-27	-2
48	Iron and Steel Mills and Ferroalloy Manufacturing	-21	-1
49	Steel Product Manufacturing From Purchased Steel	-29	-1
58	Spring and Wire Product Manufacturing	-18	-0
61	Other Fabricated Metal Product Manufacturing	-63	-2
62	Agriculture, Construction, and Mining Machinery Manufacturing	-34	-0
66	Metalworking Machinery Manufacturing	-57	-1
81	Motor Vehicle Parts Manufacturing	-22	-4

89	Medical Equipment and Supplies Manufacturing	-30	-40
117	Insurance Carriers	-180	-105
129	Management, Scientific, and Technical Consulting Services	-21	-107
136	Employment Services	-113	-255
139	Investigation and Security Services	-29	-35

Table 7. Phase 3 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
35	Basic Chemical Manufacturing	-28	-0
38	Pharmaceutical and Medicine Manufacturing	-27	-0
41	Other Chemical Product and Preparation Manufacturing	-27	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-22	-0
49	Steel Product Manufacturing From Purchased Steel	-30	-0
58	Spring and Wire Product Manufacturing	-18	-0
61	Other Fabricated Metal Product Manufacturing	-63	-1
62	Agriculture, Construction, and Mining Machinery Manufacturing	-34	-0
66	Metalworking Machinery Manufacturing	-58	-0
81	Motor Vehicle Parts Manufacturing	-28	-5
89	Medical Equipment and Supplies Manufacturing	-30	-0
117	Insurance Carriers	-190	-10
129	Management, Scientific, and Technical Consulting Services	-29	-8
136	Employment Services	-178	-65
139	Investigation and Security Services	-36	-7

Chapter 26. Cleveland, TN

Study Area Overview

The Cleveland, TN study region occupies 764 square-miles and had a 2018 population of 123,625. The employed share of the regional labor force during the 2014-2018 period averaged 94.51%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Warehousing and Storage. These three industries account for a combined 21.4% of the region's economy. The region's 2018 coefficient of specialization (COS) is 38.38, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Cleveland, TN can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Warehousing and Storage, whose employment grew by 2,477 followed by Food Services and Drinking Places and Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 8.33, 1.26, and 26.36.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
104	Warehousing and Storage	2,477	2,342	8.33
167	Food Services and Drinking Places	1,406	570	1.26
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	653	658	26.36
137	Business Support Services	637	621	2.96
133	Management of Companies and Enterprises	537	432	1.28
14	Construction	404	442	0.76
143	Elementary and Secondary Schools	372	-303	8.87
47	Lime, Gypsum and Other Nonmetallic Mineral Product Manufacturing	339	339	12.53
93	Food and Beverage Stores	326	293	0.93
146	Offices of Physicians	314	148	1.35

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Cleveland, TN, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 7.45, followed by Computer, Electronic, and Electrical Products and Mining, Glass and Ceramics. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Cleveland, TN cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
5	Business and Financial Services	0.82	0.74	6,325
3	Arts, Entertainment, Recreation and Visitor Industries	0.90	1.04	5,207
16	Transportation and Logistics	0.99	1.57	5,125
9	Education and Knowledge Creation	2.66	2.68	3,931
4	Biomedical/Biotechnical (Life Sciences)	1.27	0.71	3,292
7	Computer, Electronic, and Electrical Products	6.33	6.19	2,493
1	Agribusiness, Food Processing and Technology	1.54	1.61	1,888
6	Chemicals and Chemical-Based Products	2.23	3.37	1,471
11	Forest and Wood Products	3.59	3.39	1,453
8	Defense and Security	0.20	0.22	1,401
2	Apparel and Textiles	6.82	7.45	812
14	Mining, Glass and Ceramics	0.80	3.77	735
15	Primary and Fabricated Metal Products	0.71	0.56	266
10	Energy (Fossil and Renewable)	0.88	0.64	205
13	Machinery	0.23	0.48	149
12	Information Technology and Telecommunications	0.31	0.47	142
17	Transportation Equipment	0.61	0.23	76

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Cleveland, TN

Bubble Size as the Employment for Each Cluster

- Business and Financial Services (6,325)
- Arts, Entertainment, Recreation and Visitor Industries (5,207)
- Transportation and Logistics (5,125)
- Education and Knowledge Creation (3,931)
- Biomedical/Biotechnical (Life Sciences) (3,292)
- Computer, Electronic, and Electrical Products (2,493)
- Agribusiness, Food Processing and Technology (1,888)
- Chemicals and Chemical-Based Products (1,471)
- Forest and Wood Products (1,453)
- Defense and Security (1,401)
- Apparel and Textiles (812)
- Mining, Glass and Ceramics (735)
- Primary and Fabricated Metal Products (266)
- Energy (Fossil and Renewable) (205)
- Machinery (149)
- Information Technology and Telecommunications (142)
- Transportation Equipment (76)

2. CADS Analysis

The 2018 CADS analysis of the economy of Cleveland, TN identifies 7 anchor industries in 6 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
6	Chemicals and Chemical-Based Products	36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	44	696
1	Agribusiness, Food Processing and Technology	17	Sugar and Confectionery Product Manufacturing	588	703
16	Transportation and Logistics	104	Warehousing and Storage	153	2,630
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	2,802	4,207
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	682	996
16	Transportation and Logistics	99	Truck Transportation	601	753
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	838	1,116

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD

36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	26.36	658	-11.32	1,491.92	0.79	0.20
17	Sugar and Confectionery Product Manufacturing	32.03	110	0.89	19.59	0.77	0.07
104	Warehousing and Storage	8.33	2,342	88.22	1,618.95	0.90	0.06
167	Food Services and Drinking Places	1.26	570	29.84	50.17	0.84	0.05
146	Offices of Physicians	1.35	148	24.38	46.04	0.87	0.03
99	Truck Transportation	1.60	145	1.19	25.25	0.81	0.03
144	Junior Colleges, Colleges, Universities, and Professional Schools	2.18	77	23.90	33.11	0.88	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 36

Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	N/A
6	Oil and Gas Extraction	-20
9	Nonmetallic Mineral Mining and Quarrying	-9
12	Natural Gas Distribution	-8
16	Grain and Oilseed Milling	-6
23	Other Food Manufacturing	-0
31	Pulp, Paper, and Paperboard Mills	-7
34	Petroleum and Coal Products Manufacturing	-15
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-15
63	Industrial Machinery Manufacturing	-9

73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-14
97	Rail Transportation	-25
117	Insurance Carriers	-6
129	Management, Scientific, and Technical Consulting Services	N/A
131	Advertising and Related Services	-11
139	Investigation and Security Services	-16

Table 6. Phase 2 Deficits Adding Anchor Industry 17

Sugar and Confectionery Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-66	-163
6	Oil and Gas Extraction	-22	-3
9	Nonmetallic Mineral Mining and Quarrying	-10	-1
12	Natural Gas Distribution	-10	-3
16	Grain and Oilseed Milling	-17	-11
23	Other Food Manufacturing	-18	-17
31	Pulp, Paper, and Paperboard Mills	-17	-9
34	Petroleum and Coal Products Manufacturing	-17	-2
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-25	-10
63	Industrial Machinery Manufacturing	-10	-1
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-15	-1
97	Rail Transportation	-34	-9
117	Insurance Carriers	-14	-7
129	Management, Scientific, and Technical Consulting Services	N/A	-31
131	Advertising and Related Services	-24	-14
139	Investigation and Security Services	-23	-7

Table 7. Phase 3 Deficits Adding Anchor Industry 104

Warehousing and Storage

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-67	-2
6	Oil and Gas Extraction	-23	-1
9	Nonmetallic Mineral Mining and Quarrying	-10	-0
12	Natural Gas Distribution	-11	-1
16	Grain and Oilseed Milling	-17	-0
23	Other Food Manufacturing	-18	-0
31	Pulp, Paper, and Paperboard Mills	-18	-1
34	Petroleum and Coal Products Manufacturing	-18	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-31	-7
63	Industrial Machinery Manufacturing	-10	-0
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-15	-0
97	Rail Transportation	-35	-1
117	Insurance Carriers	-23	-9
129	Management, Scientific, and Technical Consulting Services	N/A	-17
131	Advertising and Related Services	-28	-4
139	Investigation and Security Services	-35	-12

Table 8. Phase 4 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-83	-16
6	Oil and Gas Extraction	-24	-1
9	Nonmetallic Mineral Mining and Quarrying	-11	-0
12	Natural Gas Distribution	-12	-1
16	Grain and Oilseed Milling	-18	-1
23	Other Food Manufacturing	-25	-7
31	Pulp, Paper, and Paperboard Mills	-19	-1
34	Petroleum and Coal Products Manufacturing	-19	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-34	-2
63	Industrial Machinery Manufacturing	-10	-0
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-15	-0
97	Rail Transportation	-36	-1
117	Insurance Carriers	-29	-6
129	Management, Scientific, and Technical Consulting Services	N/A	-16
131	Advertising and Related Services	-41	-12
139	Investigation and Security Services	-43	-8

Table 9. Phase 5 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-84	-1
6	Oil and Gas Extraction	-24	-0
9	Nonmetallic Mineral Mining and Quarrying	-11	-0
12	Natural Gas Distribution	-12	-0
16	Grain and Oilseed Milling	-18	-0
23	Other Food Manufacturing	-25	-0
31	Pulp, Paper, and Paperboard Mills	-19	-0
34	Petroleum and Coal Products Manufacturing	-19	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-34	-1
63	Industrial Machinery Manufacturing	-10	-0
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-20	-4
97	Rail Transportation	-37	-0
117	Insurance Carriers	-34	-5
129	Management, Scientific, and Technical Consulting Services	-14	-25
131	Advertising and Related Services	-43	-3
139	Investigation and Security Services	-51	-8

Table 10. Phase 6 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-84	-0

6	Oil and Gas Extraction	-25	-1
9	Nonmetallic Mineral Mining and Quarrying	-11	-0
12	Natural Gas Distribution	-12	-0
16	Grain and Oilseed Milling	-18	-0
23	Other Food Manufacturing	-25	-0
31	Pulp, Paper, and Paperboard Mills	-19	-0
34	Petroleum and Coal Products Manufacturing	-20	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-36	-2
63	Industrial Machinery Manufacturing	-10	-0
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-20	-0
97	Rail Transportation	-39	-2
117	Insurance Carriers	-41	-7
129	Management, Scientific, and Technical Consulting Services	-19	-5
131	Advertising and Related Services	-45	-2
139	Investigation and Security Services	-56	-5

Table 11. Phase 7 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-87	-3
6	Oil and Gas Extraction	-26	-0
9	Nonmetallic Mineral Mining and Quarrying	-11	-0
12	Natural Gas Distribution	-13	-1
16	Grain and Oilseed Milling	-18	-0
23	Other Food Manufacturing	-26	-1
31	Pulp, Paper, and Paperboard Mills	-20	-0
34	Petroleum and Coal Products Manufacturing	-20	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-36	-0
63	Industrial Machinery Manufacturing	-10	-0
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	-20	-0
97	Rail Transportation	-39	-0
117	Insurance Carriers	-42	-1
129	Management, Scientific, and Technical Consulting Services	-22	-2
131	Advertising and Related Services	-46	-1
139	Investigation and Security Services	-58	-2

Chapter 27. Columbus, MS

Study Area Overview

The Columbus, MS study region occupies 506 square-miles and had a 2018 population of 58,930. The employed share of the regional labor force during the 2014-2018 period averaged 91.8%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by All Other Retail and Government and Unclassified. These three industries account for a combined 22.77% of the region's economy. The region's 2018 coefficient of specialization (COS) is 34.01, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Columbus, MS can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 984 followed by Iron and Steel Mills and Ferroalloy Manufacturing and Motor Vehicle Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.42, 44.94, and 11.05.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	984	481	1.42
48	Iron and Steel Mills and Ferroalloy Manufacturing	594	594	44.94
79	Motor Vehicle Manufacturing	411	411	11.05
82	Aerospace Product and Parts Manufacturing	348	348	4.36
146	Offices of Physicians	318	221	1.72
81	Motor Vehicle Parts Manufacturing	216	216	2.31
144	Junior Colleges, Colleges, Universities, and Professional Schools	211	-28	4.18
155	Individual and Family Services	198	136	0.65
100	Transit and Ground Passenger Transportation	165	125	2.53
52	Foundries	158	166	9.95

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Columbus, MS, the cluster with the largest CLQ in 2018 is Primary and Fabricated Metal Products with a CLQ of 4.32, followed by Transportation Equipment and Apparel and Textiles. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Columbus, MS cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.22	1.25	3,272
3	Arts, Entertainment, Recreation and Visitor Industries	0.92	1.16	3,256
9	Education and Knowledge Creation	3.62	2.98	2,461
5	Business and Financial Services	0.53	0.50	2,439
16	Transportation and Logistics	1.23	1.13	2,078
8	Defense and Security	0.43	0.50	1,830
15	Primary and Fabricated Metal Products	1.01	4.32	1,164
17	Transportation Equipment	0.00	3.68	689
11	Forest and Wood Products	5.28	1.57	380
1	Agribusiness, Food Processing and Technology	0.26	0.41	271
7	Computer, Electronic, and Electrical Products	1.49	1.16	263
10	Energy (Fossil and Renewable)	1.30	1.30	236
2	Apparel and Textiles	3.54	3.22	198
14	Mining, Glass and Ceramics	2.46	1.56	172
12	Information Technology and Telecommunications	0.37	0.78	133
6	Chemicals and Chemical-Based Products	0.72	0.54	132
13	Machinery	0.15	0.53	93

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Columbus, MS
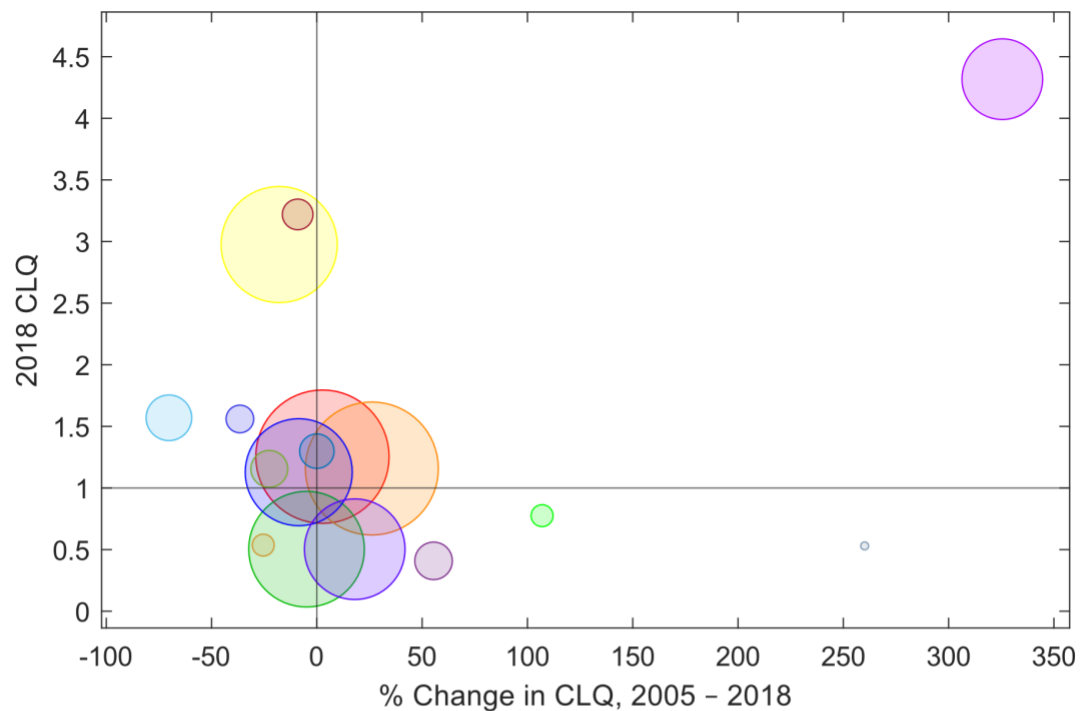
Bubble Size as the Employment for Each Cluster

- Biomedical/Biotechnical (Life Sciences) (3,272)
- Arts, Entertainment, Recreation and Visitor Industries (3,256)
- Education and Knowledge Creation (2,461)
- Business and Financial Services (2,439)
- Transportation and Logistics (2,078)
- Defense and Security (1,830)
- Primary and Fabricated Metal Products (1,164)
- Transportation Equipment (689)
- Forest and Wood Products (380)
- Agribusiness, Food Processing and Technology (271)
- Computer, Electronic, and Electrical Products (263)
- Energy (Fossil and Renewable) (236)
- Apparel and Textiles (198)
- Mining, Glass and Ceramics (172)
- Information Technology and Telecommunications (133)
- Chemicals and Chemical-Based Products (132)
- Machinery (93)

2. CADS Analysis

The 2018 CADS analysis of the economy of Columbus, MS identifies 5 anchor industries in 5 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Motor Vehicle Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
17	Transportation Equipment	79	Motor Vehicle Manufacturing	0	411
15	Primary and Fabricated Metal Products	48	Iron and Steel Mills and Ferroalloy Manufacturing	2	595
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	1,687	2,671
8	Defense and Security	82	Aerospace Product and Parts Manufacturing	0	348
16	Transportation and Logistics	100	Transit and Ground Passenger Transportation	95	260

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
79	Motor Vehicle Manufacturing	11.05	411	-3.98	N/A	0.56	0.21
48	Iron and Steel Mills and Ferroalloy Manufacturing	44.94	594	-14.74	37,740.89	0.68	0.21
167	Food Services and Drinking Places	1.42	481	29.84	58.33	0.85	0.05
82	Aerospace Product and Parts Manufacturing	4.36	348	11.31	N/A	0.75	0.04

| 100 | Transit and Ground Passenger Transportation | 2.53 | 125 | 42.20 | 173.00 | 0.93 | 0.01 |

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 79

Motor Vehicle Manufacturing

Industry #	Industry Name	Employment
8	Metal Ore Mining	-6
26	Textile Mills and Textile Product Mills	-28
42	Plastics Product Manufacturing	-92
51	Nonferrous Metal (except Aluminum) Production and Processing	-27
53	Forging and Stamping	-40
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-66
71	Audio and Video Equipment Manufacturing	-82
72	Semiconductor and Other Electronic Component Manufacturing	-98
81	Motor Vehicle Parts Manufacturing	-486
104	Warehousing and Storage	-78
129	Management, Scientific, and Technical Consulting Services	-19
133	Management of Companies and Enterprises	-86
137	Business Support Services	-20

Table 6. Phase 2 Deficits Adding Anchor Industry 48

Iron and Steel Mills and Ferroalloy Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-54	-47

26	Textile Mills and Textile Product Mills	-33	-5
42	Plastics Product Manufacturing	-112	-20
51	Nonferrous Metal (except Aluminum) Production and Processing	-104	-77
53	Forging and Stamping	-47	-7
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-68	-3
71	Audio and Video Equipment Manufacturing	-82	-0
72	Semiconductor and Other Electronic Component Manufacturing	-125	-27
81	Motor Vehicle Parts Manufacturing	-507	-21
104	Warehousing and Storage	-183	-104
129	Management, Scientific, and Technical Consulting Services	-51	-32
133	Management of Companies and Enterprises	-145	-58
137	Business Support Services	-49	-28

Table 7. Phase 3 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-54	-0
26	Textile Mills and Textile Product Mills	-34	-1
42	Plastics Product Manufacturing	-118	-6
51	Nonferrous Metal (except Aluminum) Production and Processing	-104	-0
53	Forging and Stamping	-48	-0
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-69	-0
71	Audio and Video Equipment Manufacturing	-82	-0
72	Semiconductor and Other Electronic Component Manufacturing	-126	-2
81	Motor Vehicle Parts Manufacturing	-509	-1
104	Warehousing and Storage	-189	-6
129	Management, Scientific, and Technical Consulting Services	-61	-10
133	Management of Companies and Enterprises	-195	-51
137	Business Support Services	-55	-6

Table 8. Phase 4 Deficits Adding Anchor Industry 82

Aerospace Product and Parts Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-54	-0
26	Textile Mills and Textile Product Mills	-35	-1
42	Plastics Product Manufacturing	-122	-4
51	Nonferrous Metal (except Aluminum) Production and Processing	-106	-1
53	Forging and Stamping	-50	-3
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-69	-0
71	Audio and Video Equipment Manufacturing	-82	-0
72	Semiconductor and Other Electronic Component Manufacturing	-146	-19
81	Motor Vehicle Parts Manufacturing	-511	-2
104	Warehousing and Storage	-197	-8
129	Management, Scientific, and Technical Consulting Services	-73	-12
133	Management of Companies and Enterprises	-213	-18
137	Business Support Services	-60	-5

Table 9. Phase 5 Deficits Adding Anchor Industry 100

Transit and Ground Passenger Transportation

Chapter 27. Columbus, MS

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-54	-0
26	Textile Mills and Textile Product Mills	-35	-0
42	Plastics Product Manufacturing	-122	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-106	-0
53	Forging and Stamping	-50	-0
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-69	-0
71	Audio and Video Equipment Manufacturing	-82	-0
72	Semiconductor and Other Electronic Component Manufacturing	-146	-0
81	Motor Vehicle Parts Manufacturing	-511	-0
104	Warehousing and Storage	-198	-1
129	Management, Scientific, and Technical Consulting Services	-75	-2
133	Management of Companies and Enterprises	-215	-2
137	Business Support Services	-61	-1

Chapter 28. Cookeville, TN

Study Area Overview

The Cookeville, TN study region occupies 1,142 square-miles and had a 2018 population of 112,669. The employed share of the regional labor force during the 2014-2018 period averaged 96.24%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 22.49% of the region's economy. The region's 2018 coefficient of specialization (COS) is 32.92, which indicates that it is less specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Cookeville, TN can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Food Services and Drinking Places, whose employment grew by 1,614 followed by Elementary and Secondary Schools and Government and Unclassified. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 1.35, 9.2, and 0.44.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	1,614	792	1.35
143	Elementary and Secondary Schools	1,437	1,068	9.20
181	Government and Unclassified	847	780	0.44
136	Employment Services	746	738	1.77
153	Hospitals	495	133	1.81
155	Individual and Family Services	419	-24	1.25
14	Construction	312	357	0.86
95	All Other Retail	309	382	1.20
146	Offices of Physicians	271	89	1.42
92	Motor Vehicle and Parts Dealers	263	237	1.53

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Cookeville, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 5.76, followed by Education and Knowledge Creation and Machinery. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Cookeville, TN cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.32	1.20	5,407
5	Business and Financial Services	0.54	0.63	5,252
3	Arts, Entertainment, Recreation and Visitor Industries	0.88	1.05	5,104
9	Education and Knowledge Creation	2.47	3.28	4,663
16	Transportation and Logistics	1.26	0.88	2,790
8	Defense and Security	0.29	0.42	2,603
17	Transportation Equipment	7.47	5.76	1,856
1	Agribusiness, Food Processing and Technology	3.03	1.13	1,283
13	Machinery	1.01	2.14	647
11	Forest and Wood Products	2.35	1.53	638
15	Primary and Fabricated Metal Products	1.63	1.35	626
7	Computer, Electronic, and Electrical Products	0.90	1.46	570
6	Chemicals and Chemical-Based Products	0.95	1.03	438
12	Information Technology and Telecommunications	0.93	0.79	233
14	Mining, Glass and Ceramics	1.27	1.16	219
10	Energy (Fossil and Renewable)	0.42	0.18	55
2	Apparel and Textiles	0.30	0.48	51

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Cookeville, TN
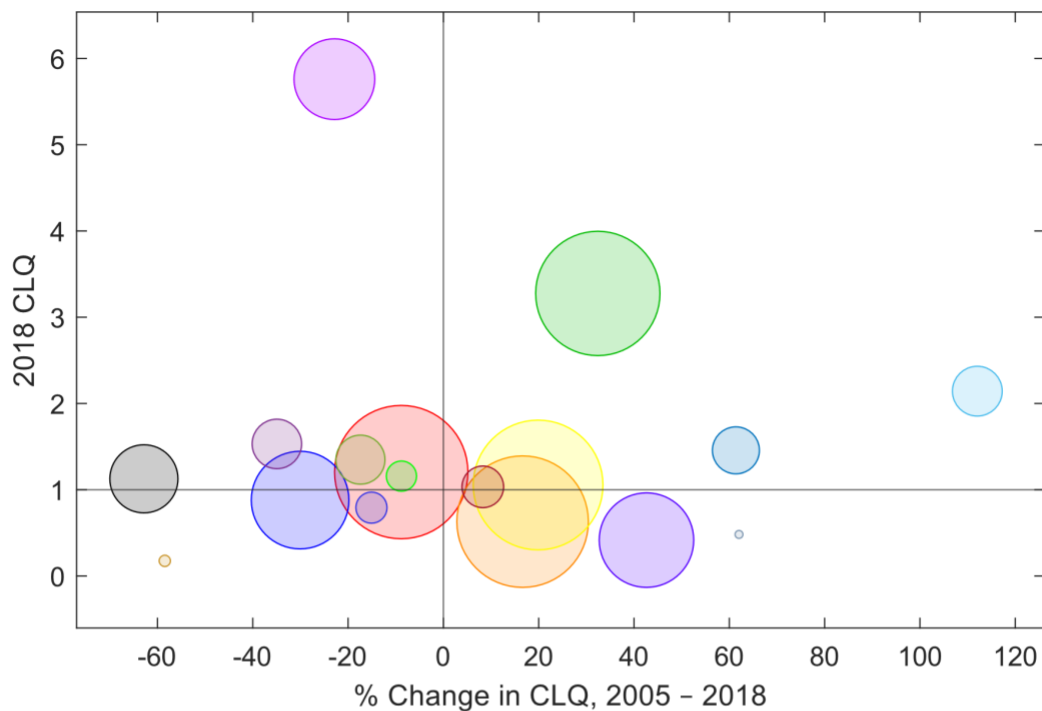
Bubble Size as the Employment for Each Cluster

○	Biomedical/Biotechnical (Life Sciences) (5,407)
○	Business and Financial Services (5,252)
○	Arts, Entertainment, Recreation and Visitor Industries (5,104)
○	Education and Knowledge Creation (4,663)
○	Transportation and Logistics (2,790)
○	Defense and Security (2,603)
○	Transportation Equipment (1,856)
○	Agribusiness, Food Processing and Technology (1,283)
○	Machinery (647)
○	Forest and Wood Products (638)
○	Primary and Fabricated Metal Products (626)
○	Computer, Electronic, and Electrical Products (570)
○	Chemicals and Chemical-Based Products (438)
○	Information Technology and Telecommunications (233)
○	Mining, Glass and Ceramics (219)
○	Energy (Fossil and Renewable) (55)
○	Apparel and Textiles (51)

2. CADS Analysis

The 2018 CADS analysis of the economy of Cookeville, TN identifies 4 anchor industries in 3 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Hospitals, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	1,998	2,492
5	Business and Financial Services	115	Monetary Authorities, Credit Intermediation, and Related Activities	807	1,049
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	2,755	4,369
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	745	1,016

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
153	Hospitals	1.81	133	18.09	24.76	0.73	0.09
115	Monetary Authorities, Credit Intermediation, and Related Activities	1.45	310	-8.42	29.94	0.90	0.06
167	Food Services and Drinking Places	1.35	792	29.84	58.58	0.82	0.06
146	Offices of Physicians	1.42	89	24.38	36.37	0.84	0.04

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment
2	Animal Production	N/A
38	Pharmaceutical and Medicine Manufacturing	-20
89	Medical Equipment and Supplies Manufacturing	-25
117	Insurance Carriers	-75
129	Management, Scientific, and Technical Consulting Services	N/A
133	Management of Companies and Enterprises	N/A
134	Office Administrative Services	-9
139	Investigation and Security Services	N/A
152	Other Ambulatory Health Care Services	-18
161	Independent Artists, Writers, and Performers	-4

Table 6. Phase 2 Deficits Adding Anchor Industry 115

Monetary Authorities, Credit Intermediation, and Related Activities

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	N/A	-1
38	Pharmaceutical and Medicine Manufacturing	-20	-0
89	Medical Equipment and Supplies Manufacturing	-25	-0
117	Insurance Carriers	-78	-3
129	Management, Scientific, and Technical Consulting Services	-25	-61
133	Management of Companies and Enterprises	N/A	-17
134	Office Administrative Services	-15	-6
139	Investigation and Security Services	-13	-22

152	Other Ambulatory Health Care Services	-18	-0
161	Independent Artists, Writers, and Performers	-8	-4

Table 7. Phase 3 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-12	-22
38	Pharmaceutical and Medicine Manufacturing	-20	-0
89	Medical Equipment and Supplies Manufacturing	-25	-0
117	Insurance Carriers	-84	-6
129	Management, Scientific, and Technical Consulting Services	-40	-15
133	Management of Companies and Enterprises	-63	-83
134	Office Administrative Services	-20	-5
139	Investigation and Security Services	-21	-8
152	Other Ambulatory Health Care Services	-18	-0
161	Independent Artists, Writers, and Performers	-11	-3

Table 8. Phase 4 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-12	-0
38	Pharmaceutical and Medicine Manufacturing	-25	-5
89	Medical Equipment and Supplies Manufacturing	-34	-8
117	Insurance Carriers	-89	-5
129	Management, Scientific, and Technical Consulting Services	-65	-25
133	Management of Companies and Enterprises	-89	-26
134	Office Administrative Services	-26	-7
139	Investigation and Security Services	-29	-8
152	Other Ambulatory Health Care Services	-18	-0
161	Independent Artists, Writers, and Performers	-12	-1

Chapter 29. Corbin, KY

Study Area Overview

The Corbin, KY study region occupies 438 square-miles and had a 2018 population of 36,242. The employed share of the regional labor force during the 2014-2018 period averaged 92.4%. The Elementary and Secondary Schools industry was the region's largest employer in 2018, followed by Food Services and Drinking Places and Junior Colleges, Colleges, Universities, and Professional Schools. These three industries account for a combined 30.71% of the region's economy. The region's 2018 coefficient of specialization (COS) is 42.51, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Corbin, KY can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Junior Colleges, Colleges, Universities, and Professional Schools, whose employment grew by 462 followed by Services to Buildings and Dwellings and Rubber Product Manufacturing. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 7.32, 1.36, and 22.29.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
144	Junior Colleges, Colleges, Universities, and Professional Schools	462	335	7.32
140	Services to Buildings and Dwellings	195	174	1.36
43	Rubber Product Manufacturing	163	174	22.29
155	Individual and Family Services	156	122	1.01
167	Food Services and Drinking Places	145	-172	1.36
153	Hospitals	124	-33	2.63
143	Elementary and Secondary Schools	99	-286	17.68
10	Support Activities for Mining	98	93	4.17
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	93	91	6.96
146	Offices of Physicians	91	2	2.34

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Corbin, KY, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 6.56, followed by Chemicals and Chemical-Based Products and Energy (Fossil and Renewable). The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Corbin, KY cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
9	Education and Knowledge Creation	5.27	6.56	2,554
4	Biomedical/Biotechnical (Life Sciences)	1.94	1.71	2,093
3	Arts, Entertainment, Recreation and Visitor Industries	1.06	1.14	1,510
5	Business and Financial Services	0.53	0.42	965
8	Defense and Security	0.33	0.32	551
16	Transportation and Logistics	0.61	0.56	488
6	Chemicals and Chemical-Based Products	1.55	4.04	469
10	Energy (Fossil and Renewable)	1.37	2.82	241
15	Primary and Fabricated Metal Products	0.61	1.88	238
17	Transportation Equipment	1.33	1.27	112
1	Agribusiness, Food Processing and Technology	0.69	0.36	111
13	Machinery	0.35	0.57	47
12	Information Technology and Telecommunications	1.13	0.57	46
2	Apparel and Textiles	2.02	0.86	25
14	Mining, Glass and Ceramics	1.99	0.26	14
7	Computer, Electronic, and Electrical Products	0.99	0.07	7
11	Forest and Wood Products	1.55	0.03	3

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Corbin, KY
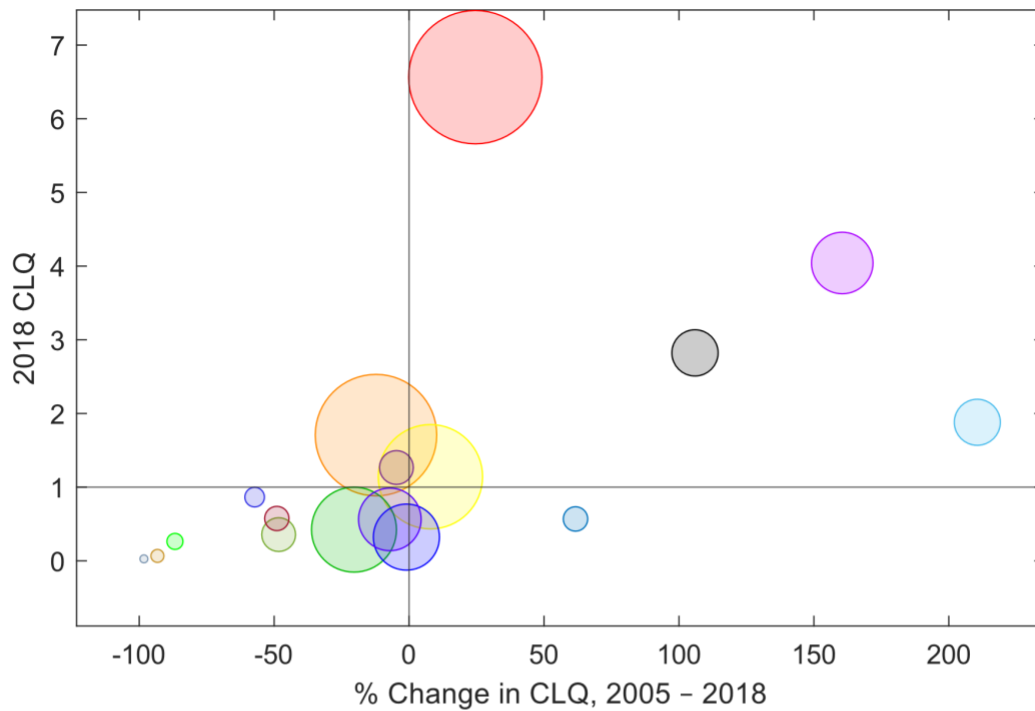
Bubble Size as the Employment for Each Cluster

- ○ Education and Knowledge Creation (2,554)
- ○ Biomedical/Biotechnical (Life Sciences) (2,093)
- ○ Arts, Entertainment, Recreation and Visitor Industries (1,510)
- ○ Business and Financial Services (965)
- ○ Defense and Security (551)
- ○ Transportation and Logistics (488)
- ○ Chemicals and Chemical-Based Products (469)
- ○ Energy (Fossil and Renewable) (241)
- ○ Primary and Fabricated Metal Products (238)
- ○ Transportation Equipment (112)
- ○ Agribusiness, Food Processing and Technology (111)
- ○ Machinery (47)
- ○ Information Technology and Telecommunications (46)
- ○ Apparel and Textiles (25)
- ○ Mining, Glass and Ceramics (14)
- ○ Computer, Electronic, and Electrical Products (7)
- ○ Forest and Wood Products (3)

2. CADS Analysis

The 2018 CADS analysis of the economy of Corbin, KY identifies 5 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Junior Colleges, Colleges, Universities, and Professional Schools, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	533	995
6	Chemicals and Chemical-Based Products	43	Rubber Product Manufacturing	64	227
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	365	456
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	157	196
15	Primary and Fabricated Metal Products	59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	96	189

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
144	Junior Colleges, Colleges, Universities, and Professional Schools	7.32	335	23.90	86.83	0.82	0.08
43	Rubber Product Manufacturing	22.29	174	-17.19	254.20	0.69	0.07
146	Offices of Physicians	2.34	2	24.38	24.93	0.80	0.06
42	Plastics Product Manufacturing	4.50	50	-6.65	25.05	0.61	0.05

59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	6.96	91	2.18	96.64	0.65	0.03

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment
1	Crop Production	-3
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-0
72	Semiconductor and Other Electronic Component Manufacturing	-1
104	Warehousing and Storage	N/A
126	Architectural, Engineering, and Related Services	-0
133	Management of Companies and Enterprises	N/A
136	Employment Services	N/A
137	Business Support Services	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 43

Rubber Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-10	-8
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-7	-7
72	Semiconductor and Other Electronic Component Manufacturing	-6	-5
104	Warehousing and Storage	-2	-16

126	Architectural, Engineering, and Related Services	-5	-4
133	Management of Companies and Enterprises	N/A	-10
136	Employment Services	N/A	-8
137	Business Support Services	-2	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-11	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-8	-0
72	Semiconductor and Other Electronic Component Manufacturing	-7	-1
104	Warehousing and Storage	-4	-2
126	Architectural, Engineering, and Related Services	-7	-2
133	Management of Companies and Enterprises	-5	-12
136	Employment Services	-11	-19
137	Business Support Services	-8	-6

Table 8. Phase 4 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-14	-3
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-19	-11
72	Semiconductor and Other Electronic Component Manufacturing	-10	-3
104	Warehousing and Storage	-15	-12
126	Architectural, Engineering, and Related Services	-10	-3
133	Management of Companies and Enterprises	-12	-8
136	Employment Services	-17	-7
137	Business Support Services	-11	-2

Table 9. Phase 5 Deficits Adding Anchor Industry 59

Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-15	-0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-19	-0
72	Semiconductor and Other Electronic Component Manufacturing	-12	-3
104	Warehousing and Storage	-27	-12
126	Architectural, Engineering, and Related Services	-12	-2
133	Management of Companies and Enterprises	-19	-6
136	Employment Services	-22	-5
137	Business Support Services	-12	-2

Chapter 30. Corinth, MS

Study Area Overview

The Corinth, MS study region occupies 400 square-miles and had a 2018 population of 36,925. The employed share of the regional labor force during the 2014-2018 period averaged 91.8%. The Employment Services industry was the region's largest employer in 2018, followed by Hospitals and Food Services and Drinking Places. These three industries account for a combined 28.85% of the region's economy. The region's 2018 coefficient of specialization (COS) is 43.14, which indicates that it is more specialized than the average micropolitan and metropolitan region fully within the Appalachian Region. The average COS for all of these regions is 37.73.

Employment changes in Corinth, MS can reveal important recent trends in underlying economic structure. Table 1 shows the top ten employment growth industries from 2005 to 2018. We rank employment growth rather than employment growth rate because some industries with high growth rates might be quite small and insignificant relative to regional totals. The highest growth industry was Employment Services, whose employment grew by 1,074 followed by Food Services and Drinking Places and Warehousing and Storage. The regional shift (RS) values in Table 1 measure industry employment growth attributable to regional factors unrelated to overall national or industry-specific growth trends. Table 1 also shows location quotients (LQ) for these industries. Industry LQs reflect their relative concentrations within the region. Values exceeding 1.0 indicate regional concentration and imply potential advantage relative to national averages. The three fastest growing regional industries have LQ values of 4.32, 1.24, and 2.76.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
136	Employment Services	1,074	1,071	4.32
167	Food Services and Drinking Places	329	29	1.24
104	Warehousing and Storage	239	204	2.76
153	Hospitals	190	-26	3.02
143	Elementary and Secondary Schools	175	41	6.51
181	Government and Unclassified	146	126	0.34
146	Offices of Physicians	121	67	1.46
81	Motor Vehicle Parts Manufacturing	106	114	3.30
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	102	97	78.31
27	Apparel, Leather and Allied Product Manufacturing	96	113	9.49

Cluster Analysis Results

1. Regional Cluster Concentrations, 2005 and 2018

Table 2 presents a high-level view of the existing distribution of industry employment relative to the 17 clusters. Just as an industry whose location quotient value exceeds 1.0 implies relative regional concentration, cluster location quotient (CLQ) values exceeding 1.0 also imply relative concentration of the set of industries in the cluster. Likewise, clusters whose CLQ are less than 1.0 are relatively less concentrated in the region than they are in the national economy. In Corinth, MS, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 12.41, followed by Machinery and Forest and Wood Products. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Corinth, MS cluster characteristics graphically. The size of each cluster bubble is proportional to its 2018 employment level and the legend is presented in order of decreasing cluster size. Cluster employment appears in parentheses in each legend entry. So, in addition to identifying the clusters by color code and by reference to the values in Table 2, the largest bubble in the chart corresponds to the first cluster listed in the legend, the second largest bubble corresponds to the second largest cluster, and so on. The vertical axis marks the 2018 value of the CLQ, and the horizontal axis marks the change in CLQ from 2005 to 2018. CLQ changes can be positive or negative and CLQ values can be greater than or less than 1.0, which allows us to define four chart quadrants numbered I – IV beginning at the top right and moving counter-clockwise. Clusters centered in quadrants I and II have CLQ values greater than 1.0 indicating relative concentration, implying some degree of specialization relative to national averages. Clusters centered in quadrants I and IV have become more specialized within the region during the period of analysis, while those in II and III have become relatively less concentrated within the region.

As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in share of regional employment relative to the national industry's share of national employment, both of which can have changed over time due to industry specific and total employment changes within the region, in the entire nation, or both. Clusters in quadrant III are relatively less concentrated in the region than in the nation and have become even less so between 2005 and 2018.

Table 2. Cluster Concentrations, 2005 and 2018

Cluster #	Cluster Name	2005 CLQ	2018 CLQ	Employment
4	Biomedical/Biotechnical (Life Sciences)	1.73	1.70	2,522
5	Business and Financial Services	0.71	0.85	2,336
3	Arts, Entertainment, Recreation and Visitor Industries	0.82	0.95	1,523
16	Transportation and Logistics	0.82	0.87	913
8	Defense and Security	0.27	0.34	709
13	Machinery	5.77	6.97	696
9	Education and Knowledge Creation	1.26	1.46	689
11	Forest and Wood Products	4.59	3.28	452
2	Apparel and Textiles	5.44	12.41	434
7	Computer, Electronic, and Electrical Products	3.09	2.46	318
6	Chemicals and Chemical-Based Products	2.46	2.00	281
10	Energy (Fossil and Renewable)	1.17	1.80	186
17	Transportation Equipment	0.54	1.65	176
15	Primary and Fabricated Metal Products	0.55	0.92	141
1	Agribusiness, Food Processing and Technology	0.21	0.13	51
12	Information Technology and Telecommunications	0.36	0.36	35
14	Mining, Glass and Ceramics	0.59	0.19	12

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Corinth, MS
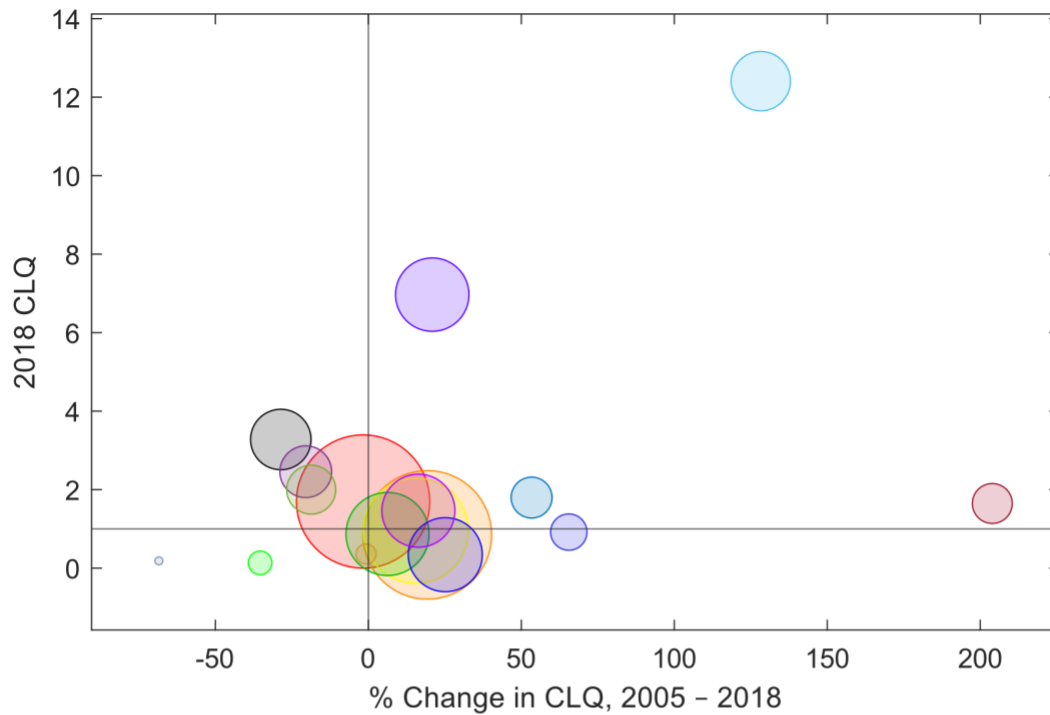
Bubble Size as the Employment for Each Cluster

○	Biomedical/Biotechnical (Life Sciences) (2,522)
○	Business and Financial Services (2,336)
○	Arts, Entertainment, Recreation and Visitor Industries (1,523)
○	Transportation and Logistics (913)
○	Defense and Security (709)
○	Machinery (696)
○	Education and Knowledge Creation (689)
○	Forest and Wood Products (452)
○	Apparel and Textiles (434)
○	Computer, Electronic, and Electrical Products (318)
○	Chemicals and Chemical-Based Products (281)
○	Energy (Fossil and Renewable) (186)
○	Transportation Equipment (176)
○	Primary and Fabricated Metal Products (141)
○	Agribusiness, Food Processing and Technology (51)
○	Information Technology and Telecommunications (35)
○	Mining, Glass and Ceramics (12)

2. CADS Analysis

The 2018 CADS analysis of the economy of Corinth, MS identifies 4 anchor industries in 4 different clusters. Identified anchors and their parent clusters are presented in Table 3 along with 2005 and 2018 employment. Table 4 provides additional industry-specific information for the identified anchors. Both tables list anchor industries and related information in the order in which industries were added to the set of anchors, which also corresponds, according to the CADS algorithm, to their importance to the regional economy. The leading anchor industry is Engine, Turbine, and Power Transmission Equipment Manufacturing, which is the most dominant regional industry that also meets the CADS analysis criteria.

To further understand the potential influence of an anchor industry on the existing local economy, anchor strength (AS) and anchor dominance (AD) indicators are provided in Table 4. As described in the Section 3 of the accompanying overview and technical document, both AS and AD range from zero to one. The AS value shown in Table 4 measures the extent to which regional industry output can satisfy the input requirements for the anchor industry. A low AS value implies that the industry must rely heavily on other regions to satisfy its direct and indirect input demands, whereas higher AS values identify industries whose direct and indirect input demands can be satisfied more fully by local industries. The AD value measures the extent to which the industry dominates the local economy, directly and indirectly. Regions are more heavily dependent, again directly and indirectly, on industries with larger AD values on industries with smaller AD values. The AS measures the industry's dependence on the region while the AD measures the region's dependence on the industry. The fortunes of the regional economy are clearly more strongly tied to industries with larger AS and AD values than to those with lower AS and AD values.

Table 3. Anchors, Clusters, and Employment

Cluster #	Cluster Name	Anchor #	Anchor Industry Name	Anchor Emp. 2005	Anchor Emp. 2018
13	Machinery	67	Engine, Turbine, and Power Transmission Equipment Manufacturing	581	683
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	70	176
2	Apparel and Textiles	26	Textile Mills and Textile Product Mills	346	303
16	Transportation and Logistics	104	Warehousing and Storage	41	280

Table 4. Anchors, Location Quotients, Regional Shift, and Growth Rates

Anchor #	Anchor Industry Name	LQ	RS	Industry Growth Rate (%) National	Industry Growth Rate (%) Regional	AS	AD
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	78.31	97	0.82	17.56	0.58	0.20
81	Motor Vehicle Parts Manufacturing	3.30	114	-11.56	152.66	0.61	0.05
26	Textile Mills and Textile Product Mills	14.30	101	-41.39	-12.19	0.58	0.04
104	Warehousing and Storage	2.76	204	88.22	589.75	0.85	0.02

The remaining tables report the results for each phase of the CADS analysis. The reported values for Phase 1 in Table 5 refer to the CADS analysis of the first identified anchor. Then, if a second anchor has been identified, Table 6 reports the Phase 2 analysis results and reported values in the Employment column refer to the results for the first two identified anchors combined. The Added to Deficit column reports the contributions to deficits from the newly added anchor industry. These negative values can be larger than their corresponding Employment column values when no deficits for this industry were reported in the prior phase. If a third anchor has been identified, Phase 3 results will be reported in Table 7 and refer to values for the first three anchors combined and third anchor added, and so on. The tables report estimated employment deficits for all industries whose employment deficits exceed 10 at any phase of the CADS analysis. Because the top ten deficit industries for each phase can change, there can be more than ten reported industries in these tables. There can also be CADS results tables with fewer than ten entries, which happens when there are fewer than ten support industries with identified supply deficits.

The results reported for each CADS analysis phase identify the industries whose further development could most substantially strengthen the cluster support infrastructure at that phase of the analysis. The values estimate the additional employment required to satisfy supporting industry output deficits at each phase of the analysis. Because these estimates are based on average nationwide inter-industry sales, purchases, and productivity data, they are not precise but should provide useful guidance for further analysis by region planners and other decision-makers who have a greater depth of knowledge of their local economies.

Table 5. Phase 1 Deficits for Anchor Industry 67

Engine, Turbine, and Power Transmission Equipment Manufacturing

Industry #	Industry Name	Employment
48	Iron and Steel Mills and Ferroalloy Manufacturing	-16
51	Nonferrous Metal (except Aluminum) Production and Processing	-16
52	Foundries	-65
53	Forging and Stamping	-21
55	Architectural and Structural Metals Manufacturing	-18
61	Other Fabricated Metal Product Manufacturing	-25
77	Electrical Equipment Manufacturing	-29
78	Other Electrical Equipment and Component Manufacturing	-19
128	Computer Systems Design and Related Services	-15
133	Management of Companies and Enterprises	-41

Table 6. Phase 2 Deficits Adding Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-19	-4
51	Nonferrous Metal (except Aluminum) Production and Processing	-19	-2
52	Foundries	-73	-8
53	Forging and Stamping	-24	-4
55	Architectural and Structural Metals Manufacturing	-20	-3
61	Other Fabricated Metal Product Manufacturing	-27	-3
77	Electrical Equipment Manufacturing	-30	-1
78	Other Electrical Equipment and Component Manufacturing	-20	-1

128	Computer Systems Design and Related Services	-17	-2
133	Management of Companies and Enterprises	-49	-8

Table 7. Phase 3 Deficits Adding Anchor Industry 26

Textile Mills and Textile Product Mills

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-20	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-19	-0
52	Foundries	-73	-0
53	Forging and Stamping	-24	-0
55	Architectural and Structural Metals Manufacturing	-21	-0
61	Other Fabricated Metal Product Manufacturing	-28	-1
77	Electrical Equipment Manufacturing	-31	-1
78	Other Electrical Equipment and Component Manufacturing	-20	-0
128	Computer Systems Design and Related Services	-19	-2
133	Management of Companies and Enterprises	-60	-11

Table 8. Phase 4 Deficits Adding Anchor Industry 104

Warehousing and Storage

Industry #	Industry Name	Employment	Added to Deficit
48	Iron and Steel Mills and Ferroalloy Manufacturing	-20	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-19	-0
52	Foundries	-73	-0
53	Forging and Stamping	-24	-0
55	Architectural and Structural Metals Manufacturing	-21	-0
61	Other Fabricated Metal Product Manufacturing	-28	-0
77	Electrical Equipment Manufacturing	-31	-0
78	Other Electrical Equipment and Component Manufacturing	-20	-0
128	Computer Systems Design and Related Services	-20	-0
133	Management of Companies and Enterprises	-61	-1