ECONOMIC STRUCTURE IN APPALACHIA'S URBAN REGIONS: SUPPLEMENT 3

Clustering and Diversification Strategies

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07-Jun-2021

Key words: Industrial Clusters, Location Quotients, Shift-Share, Input-Output Analysis, Cluster Analysis and Diversification (CADS)

Table of Contents

Chapter 1. Johnson City, TN

Study Area Overview

The Johnson City, TN study region occupies 853 square-miles and had a 2018 population of 202,719. The employed share of the regional labor force during the 2014-2018 period averaged 95.67%. 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 24.17% of the region's economy. The region's 2018 coefficient of specialization (COS) is 35.61, 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 Johnson City, 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 Junior Colleges, Colleges, Universities, and Professional Schools, whose employment grew by 2,202 followed by Business Support 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 4.68, 4.68, and 2.57.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
144	Junior Colleges, Colleges, Universities, and Professional Schools	2,202	1,729	4.68
137	Business Support Services	1,381	1,295	4.68
146	Offices of Physicians	1,347	872	2.57
133	Management of Companies and Enterprises	1,165	1,060	1.28
167	Food Services and Drinking Places	1,156	-957	1.41
154	Nursing and Residential Care Facilities	810	475	1.67
149	Outpatient Care Centers	490	405	1.24
128	Computer Systems Design and Related Services	434	343	0.53
151	Home Health Care Services	308	118	0.73
92	Motor Vehicle and Parts Dealers	274	220	1.50

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 Johnson City, TN, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.46, 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 Johnson City, 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.

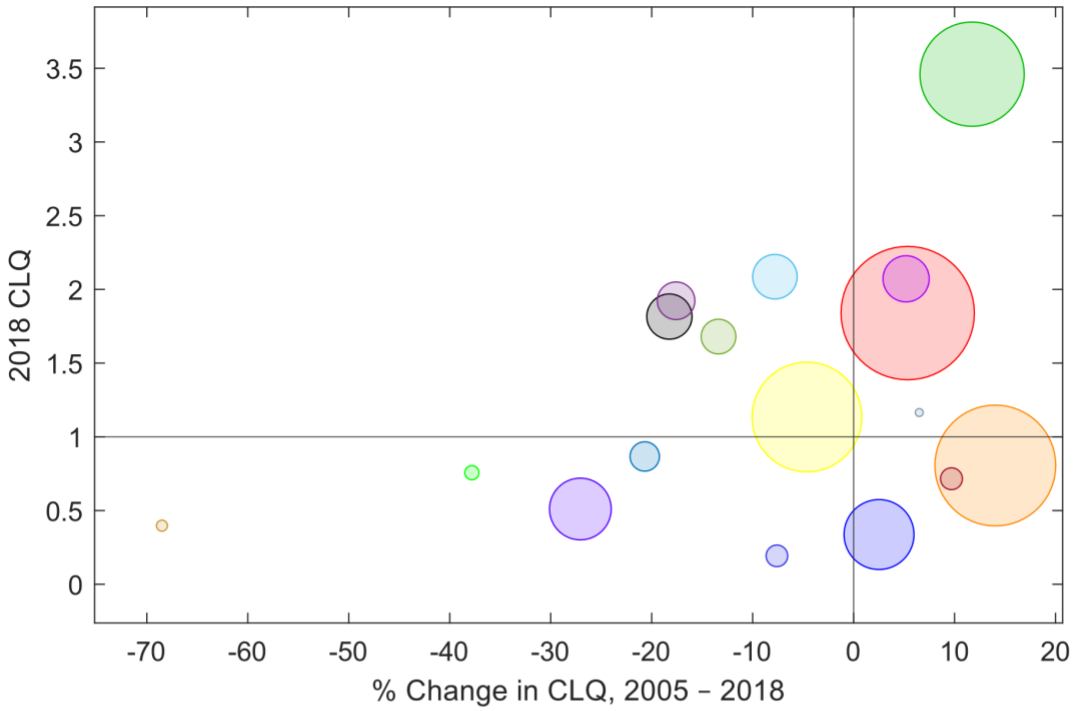
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.75	1.84	14,819
5	Business and Financial Services	0.71	0.81	12,050
3	Arts, Entertainment, Recreation and Visitor Industries	1.19	1.13	9,853
9	Education and Knowledge Creation	3.10	3.46	8,840
8	Defense and Security	0.33	0.34	3,789
16	Transportation and Logistics	0.70	0.51	2,905
6	Chemicals and Chemical-Based Products	1.97	2.07	1,577
15	Primary and Fabricated Metal Products	2.22	1.82	1,512
7	Computer, Electronic, and Electrical Products	2.26	2.09	1,464
13	Machinery	2.33	1.92	1,042
12	Information Technology and Telecommunications	1.94	1.68	888
11	Forest and Wood Products	1.09	0.87	648
10	Energy (Fossil and Renewable)	0.65	0.72	401
1	Agribusiness, Food Processing and Technology	0.21	0.19	394
14	Mining, Glass and Ceramics	1.22	0.76	257
17	Transportation Equipment	1.26	0.40	230
2	Apparel and Textiles	1.09	1.16	221

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Johnson City, TN



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (14,819)
Business and Financial Services (12,050)
Arts, Entertainment, Recreation and Visitor Industries (9,853)
Education and Knowledge Creation (8,840)
Defense and Security (3,789)
Transportation and Logistics (2,905)
Chemicals and Chemical-Based Products (1,577)
Primary and Fabricated Metal Products (1,512)
Computer, Electronic, and Electrical Products (1,464)
Machinery (1,042)
Information Technology and Telecommunications (888)
Forest and Wood Products (648)
Energy (Fossil and Renewable) (401)
Agribusiness, Food Processing and Technology (394)
Mining, Glass and Ceramics (257)
Transportation Equipment (230)
Apparel and Textiles (221)

2. CADS Analysis

The 2018 CADS analysis of the economy of Johnson City, TN identifies 6 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 Monetary Authorities, Credit Intermediation, and Related Activities, 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	115	Monetary Authorities, Credit Intermediation, and Related Activities	2,965	2,995
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	1,950	3,297
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	1,979	4,182
5	Business and Financial Services	133	Management of Companies and Enterprises	300	1,465
5	Business and Financial Services	137	Business Support Services	756	2,137
4	Biomedical/Biotechnical (Life Sciences)	154	Nursing and Residential Care Facilities	1,907	2,717

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
115	Monetary Authorities, Credit Intermediation, and Related Activities	2.31	280	-8.42	1.03	0.91	0.09

146	Offices of Physicians	2.57	872	24.38	69.08	0.94	0.06
144	Junior Colleges, Colleges, Universities, and Professional Schools	4.68	1,729	23.90	111.25	0.90	0.05
133	Management of Companies and Enterprises	1.28	1,060	34.84	387.90	0.90	0.04
137	Business Support Services	4.68	1,295	11.43	182.73	0.92	0.02
154	Nursing and Residential Care Facilities	1.67	475	17.58	42.47	0.90	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 115

Monetary Authorities, Credit Intermediation, and Related Activities

Industry #	Industry Name	Employment
2	Animal Production	N/A
20	Animal Slaughtering and Processing	-1
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-4
96	Air Transportation	-11
100	Transit and Ground Passenger Transportation	N/A
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	N/A
129	Management, Scientific, and Technical Consulting Services	N/A
134	Office Administrative Services	N/A
135	Facilities Support Services	-1
138	Travel Arrangement and Reservation Services	N/A
161	Independent Artists, Writers, and Performers	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	N/A	-2
20	Animal Slaughtering and Processing	-2	-1
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-7	-3
96	Air Transportation	-17	-6
100	Transit and Ground Passenger Transportation	N/A	-15
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	N/A	-7
129	Management, Scientific, and Technical Consulting Services	-44	-80
134	Office Administrative Services	N/A	-22
135	Facilities Support Services	-5	-5
138	Travel Arrangement and Reservation Services	N/A	-5
161	Independent Artists, Writers, and Performers	-4	-4

Table 7. Phase 3 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-8	-13
20	Animal Slaughtering and Processing	-11	-9
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-8	-1
96	Air Transportation	-20	-3
100	Transit and Ground Passenger Transportation	N/A	-5
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	N/A	-5
129	Management, Scientific, and Technical Consulting Services	-52	-8
134	Office Administrative Services	N/A	-4
135	Facilities Support Services	-6	-1
138	Travel Arrangement and Reservation Services	-1	-2
161	Independent Artists, Writers, and Performers	-6	-2

Table 8. Phase 4 Deficits Adding Anchor Industry 133

Management of Companies and Enterprises

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-9	-0
20	Animal Slaughtering and Processing	-11	-0
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-11	-3
96	Air Transportation	-21	-1
100	Transit and Ground Passenger Transportation	N/A	-2
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-0	-3
129	Management, Scientific, and Technical Consulting Services	-92	-40
134	Office Administrative Services	-4	-6

135	Facilities Support Services	-7	-1
138	Travel Arrangement and Reservation Services	-9	-8
161	Independent Artists, Writers, and Performers	-10	-4

Table 9. Phase 5 Deficits Adding Anchor Industry 137

Business Support Services

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-9	-1
20	Animal Slaughtering and Processing	-11	-0
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-14	-2
96	Air Transportation	-25	-4
100	Transit and Ground Passenger Transportation	-6	-6
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-9	-9
129	Management, Scientific, and Technical Consulting Services	-127	-35
134	Office Administrative Services	-20	-16
135	Facilities Support Services	-11	-4
138	Travel Arrangement and Reservation Services	-10	-1
161	Independent Artists, Writers, and Performers	-12	-2

Table 10. Phase 6 Deficits Adding Anchor Industry 154

Nursing and Residential Care Facilities

Industry #	Industry Name	Employment	Added to Deficit
2	Animal Production	-19	-10
20	Animal Slaughtering and Processing	-19	-8
69	Computer and Peripheral Equipment Manufacturing, Excluding Digital Camera Manufacturing	-14	-1
96	Air Transportation	-27	-1
100	Transit and Ground Passenger Transportation	-11	-5
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-12	-3
129	Management, Scientific, and Technical Consulting Services	-153	-26
134	Office Administrative Services	-30	-10
135	Facilities Support Services	-13	-2
138	Travel Arrangement and Reservation Services	-11	-1
161	Independent Artists, Writers, and Performers	-14	-2

Chapter 2. Johnstown, PA

Study Area Overview

The Johnstown, PA study region occupies 688 square-miles and had a 2018 population of 131,730. 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 Elementary and Secondary Schools and All Other Retail. These three industries account for a combined 19.34% of the region's economy. The region's 2018 coefficient of specialization (COS) is 30.89, 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 Johnstown, 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 Junior Colleges, Colleges, Universities, and Professional Schools, whose employment grew by 591 followed by Individual and Family Services and Navigational, Measuring, Electromedical, and Control Instruments 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 3.41, 1.99, and 3.39.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
144	Junior Colleges, Colleges, Universities, and Professional Schools	591	256	3.41
155	Individual and Family Services	493	-635	1.99
73	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	439	439	3.39
151	Home Health Care Services	422	270	1.25
149	Outpatient Care Centers	334	55	2.13
146	Offices of Physicians	278	39	1.50
82	Aerospace Product and Parts Manufacturing	254	239	2.39
85	Other Transportation Equipment Manufacturing	221	221	20.17
133	Management of Companies and Enterprises	177	97	0.54
48	Iron and Steel Mills and Ferroalloy Manufacturing	158	158	5.88

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 Johnstown, PA, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.36, followed by Primary and Fabricated Metal Products 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 Johnstown, 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.

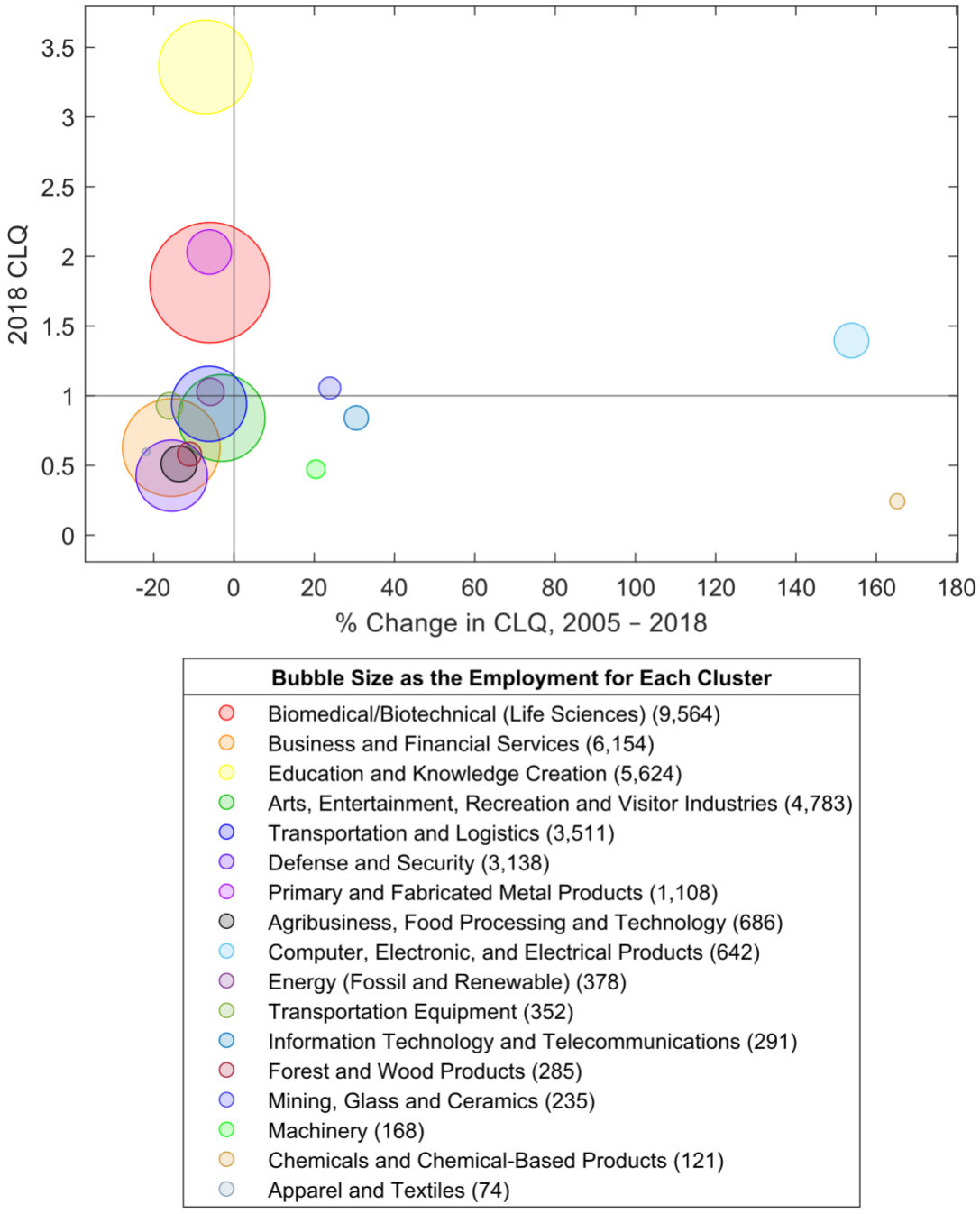
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.93	1.81	9,564
5	Business and Financial Services	0.74	0.63	6,154
9	Education and Knowledge Creation	3.62	3.36	5,624
3	Arts, Entertainment, Recreation and Visitor Industries	0.87	0.84	4,783
16	Transportation and Logistics	1.00	0.94	3,511
8	Defense and Security	0.50	0.43	3,138
15	Primary and Fabricated Metal Products	2.16	2.03	1,108
1	Agribusiness, Food Processing and Technology	0.59	0.51	686
7	Computer, Electronic, and Electrical Products	0.55	1.40	642
10	Energy (Fossil and Renewable)	1.09	1.03	378
17	Transportation Equipment	1.11	0.93	352
12	Information Technology and Telecommunications	0.64	0.84	291
11	Forest and Wood Products	0.65	0.58	285
14	Mining, Glass and Ceramics	0.85	1.06	235
13	Machinery	0.39	0.47	168
6	Chemicals and Chemical-Based Products	0.09	0.24	121
2	Apparel and Textiles	0.76	0.60	74

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Johnstown, PA



2. CADS Analysis

The 2018 CADS analysis of the economy of Johnstown, PA identifies 4 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 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	1,402	1,993
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	980	1,258
4	Biomedical/Biotechnical (Life Sciences)	149	Outpatient Care Centers	331	664
4	Biomedical/Biotechnical (Life Sciences)	151	Home Health Care Services	192	614

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	3.41	256	23.90	42.19	0.93	0.04
146	Offices of Physicians	1.50	39	24.38	28.37	0.91	0.04
149	Outpatient Care Centers	2.13	55	84.40	100.90	0.91	0.01
151	Home Health Care Services	1.25	270	79.39	219.79	0.86	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
38	Pharmaceutical and Medicine Manufacturing	-0
150	Medical and Diagnostic Laboratories	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
38	Pharmaceutical and Medicine Manufacturing	-6	-6
150	Medical and Diagnostic Laboratories	-1	-32

Table 7. Phase 3 Deficits Adding Anchor Industry 149

Outpatient Care Centers

Industry #	Industry Name	Employment	Added to Deficit
38	Pharmaceutical and Medicine Manufacturing	-10	-4
150	Medical and Diagnostic Laboratories	-16	-16

Table 8. Phase 4 Deficits Adding Anchor Industry 151

Home Health Care Services

Industry #	Industry Name	Employment	Added to Deficit
38	Pharmaceutical and Medicine Manufacturing	-10	-1
150	Medical and Diagnostic Laboratories	-16	-0

Chapter 3. Kingsport-Bristol-Bristol, TN-VA

Study Area Overview

The Kingsport-Bristol-Bristol, TN-VA study region occupies 2,010 square-miles and had a 2018 population of 306,616. The employed share of the regional labor force during the 2014-2018 period averaged 94.9%. 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 21.18% of the region's economy. The region's 2018 coefficient of specialization (COS) is 30.31, 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 Kingsport-Bristol-Bristol, TN-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 2,380 followed by Government and Unclassified and Business Support 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 1.27, 0.35, and 2.68.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	2,380	-214	1.27
181	Government and Unclassified	931	752	0.35
137	Business Support Services	918	813	2.68
133	Management of Companies and Enterprises	668	189	1.19
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	660	681	12.25
143	Elementary and Secondary Schools	640	-1,128	8.49
42	Plastics Product Manufacturing	628	653	2.35
136	Employment Services	496	483	0.81
93	Food and Beverage Stores	496	320	1.35
146	Offices of Physicians	474	-274	1.85

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 Kingsport-Bristol-Bristol, TN-VA, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 8.48, followed by Transportation Equipment 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 Kingsport-Bristol-Bristol, TN-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.

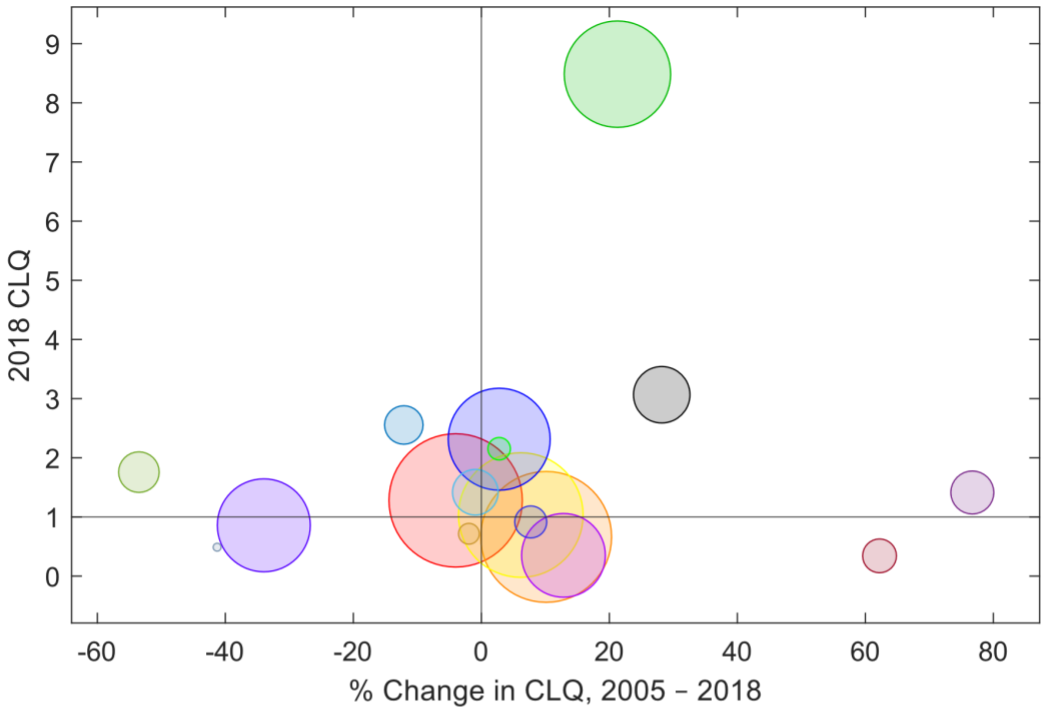
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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/Biotechnical (Life Sciences)	1.33	1.28	15,431
5	Business and Financial Services	0.60	0.66	14,839
3	Arts, Entertainment, Recreation and Visitor Industries	0.97	1.03	13,414
6	Chemicals and Chemical-Based Products	7.00	8.48	9,665
9	Education and Knowledge Creation	2.25	2.31	8,849
16	Transportation and Logistics	1.30	0.86	7,310
8	Defense and Security	0.31	0.35	5,894
17	Transportation Equipment	2.39	3.07	2,654
15	Primary and Fabricated Metal Products	1.43	1.42	1,766
11	Forest and Wood Products	0.80	1.41	1,582
13	Machinery	3.78	1.76	1,425
14	Mining, Glass and Ceramics	2.91	2.55	1,299
1	Agribusiness, Food Processing and Technology	0.21	0.34	1,047
7	Computer, Electronic, and Electrical Products	0.85	0.92	962
2	Apparel and Textiles	2.09	2.15	611
12	Information Technology and Telecommunications	0.73	0.72	566
10	Energy (Fossil and Renewable)	0.83	0.49	410

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Kingsport-Bristol-Bristol, TN-VA



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (15,431)
Business and Financial Services (14,839)
Arts, Entertainment, Recreation and Visitor Industries (13,414)
Chemicals and Chemical-Based Products (9,665)
Education and Knowledge Creation (8,849)
Transportation and Logistics (7,310)
Defense and Security (5,894)
Transportation Equipment (2,654)
Primary and Fabricated Metal Products (1,766)
Forest and Wood Products (1,582)
Machinery (1,425)
Mining, Glass and Ceramics (1,299)
Agribusiness, Food Processing and Technology (1,047)
Computer, Electronic, and Electrical Products (962)
Apparel and Textiles (611)
Information Technology and Telecommunications (566)
Energy (Fossil and Renewable) (410)

2. CADS Analysis

The 2018 CADS analysis of the economy of Kingsport-Bristol-Bristol, TN-VA 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 Business Support Services, 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	137	Business Support Services	916	1,834

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
137	Business Support Services	2.68	813	11.43	100.15	0.97	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 137

Business Support Services

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 4. Knoxville, TN

Study Area Overview

The Knoxville, TN study region occupies 1,857 square-miles and had a 2018 population of 745,862. The employed share of the regional labor force during the 2014-2018 period averaged 95.79%. 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 21.05% of the region's economy. The region's 2018 coefficient of specialization (COS) is 24.47, 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 Knoxville, 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 5,367 followed by Management of Companies and Enterprises 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 1.25, 1.37, and 6.54.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	5,367	-2,713	1.25
133	Management of Companies and Enterprises	4,033	2,999	1.37
143	Elementary and Secondary Schools	3,580	127	6.54
136	Employment Services	3,025	2,975	1.18
146	Offices of Physicians	2,533	709	1.75
137	Business Support Services	2,414	2,291	1.71
79	Motor Vehicle Manufacturing	2,189	2,189	4.26
140	Services to Buildings and Dwellings	2,017	527	1.35
93	Food and Beverage Stores	1,815	1,415	1.13
134	Office Administrative Services	1,541	698	2.94

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 Knoxville, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 3.71, 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 Knoxville, 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.

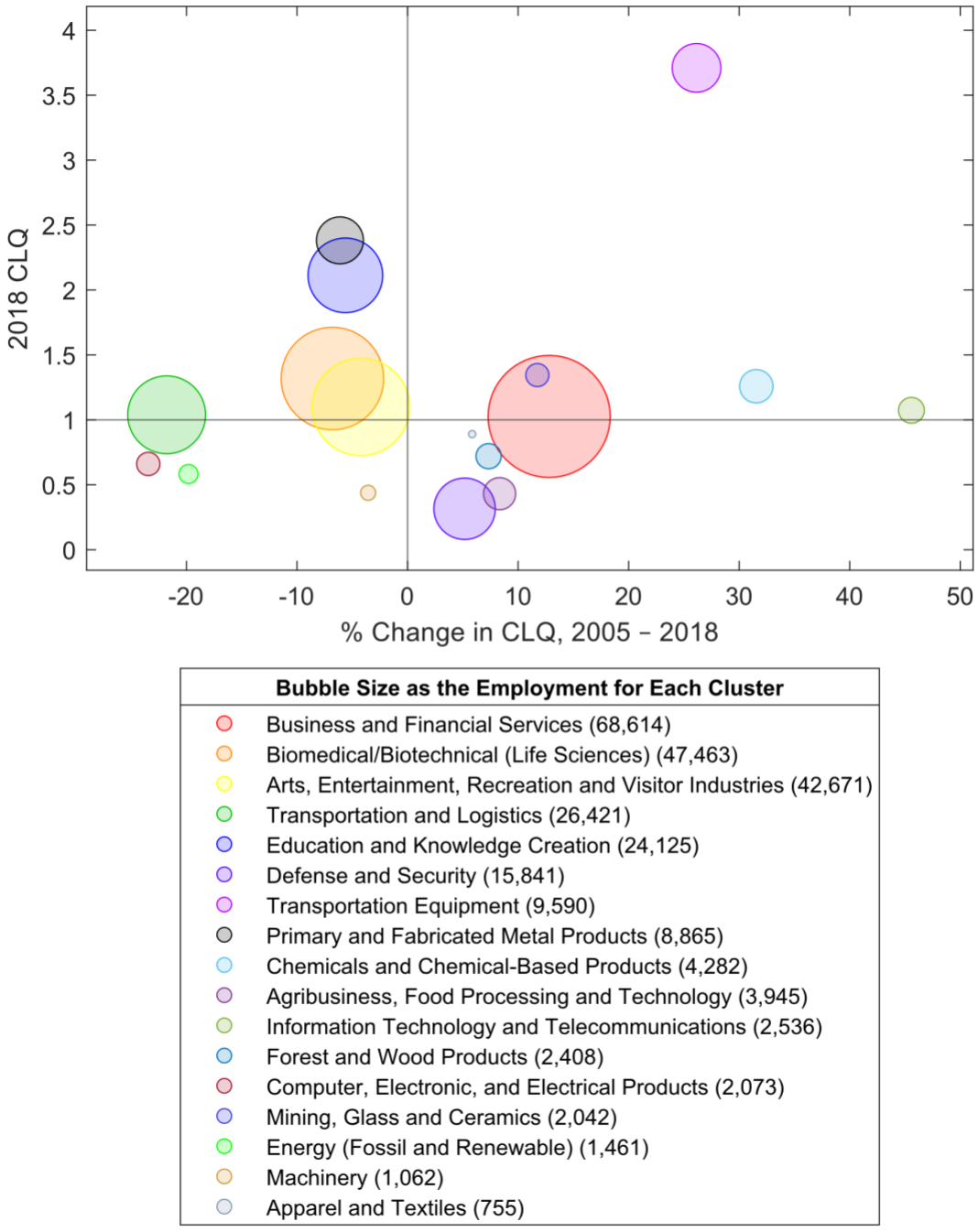
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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	0.91	1.03	68,614
4	Biomedical/Biotechnical (Life Sciences)	1.41	1.32	47,463
3	Arts, Entertainment, Recreation and Visitor Industries	1.15	1.10	42,671
16	Transportation and Logistics	1.33	1.04	26,421
9	Education and Knowledge Creation	2.24	2.11	24,125
8	Defense and Security	0.30	0.32	15,841
17	Transportation Equipment	2.94	3.71	9,590
15	Primary and Fabricated Metal Products	2.54	2.38	8,865
6	Chemicals and Chemical-Based Products	0.96	1.26	4,282
1	Agribusiness, Food Processing and Technology	0.40	0.43	3,945
12	Information Technology and Telecommunications	0.74	1.07	2,536
11	Forest and Wood Products	0.67	0.72	2,408
7	Computer, Electronic, and Electrical Products	0.86	0.66	2,073
14	Mining, Glass and Ceramics	1.20	1.35	2,042
10	Energy (Fossil and Renewable)	0.73	0.58	1,461
13	Machinery	0.45	0.44	1,062
2	Apparel and Textiles	0.84	0.89	755

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Knoxville, TN



2. CADS Analysis

The 2018 CADS analysis of the economy of Knoxville, TN identifies 8 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	5,568	6,514
5	Business and Financial Services	115	Monetary Authorities, Credit Intermediation, and Related Activities	8,556	8,535
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	7,482	10,016
15	Primary and Fabricated Metal Products	61	Other Fabricated Metal Product Manufacturing	4,700	5,404
5	Business and Financial Services	133	Management of Companies and Enterprises	2,969	7,002
16	Transportation and Logistics	99	Truck Transportation	5,363	5,680
5	Business and Financial Services	140	Services to Buildings and Dwellings	6,316	8,333
5	Business and Financial Services	137	Business Support Services	1,078	3,492

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	5.05	1,590	-11.56	16.99	0.83	0.09

115	Monetary Authorities, Credit Intermediation, and Related Activities	1.47	700	-8.42	-0.25	0.99	0.06
146	Offices of Physicians	1.75	709	24.38	33.86	0.99	0.04
61	Other Fabricated Metal Product Manufacturing	8.86	773	-1.46	14.98	0.94	0.04
133	Management of Companies and Enterprises	1.37	2,999	34.84	135.84	0.97	0.04
99	Truck Transportation	1.55	253	1.19	5.91	0.97	0.03
140	Services to Buildings and Dwellings	1.35	527	23.59	31.94	0.99	0.01
137	Business Support Services	1.71	2,291	11.43	223.95	1.00	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 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
8	Metal Ore Mining	-44
48	Iron and Steel Mills and Ferroalloy Manufacturing	-80
49	Steel Product Manufacturing From Purchased Steel	-37
51	Nonferrous Metal (except Aluminum) Production and Processing	-14
52	Foundries	-489
53	Forging and Stamping	-291
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-203
66	Metalworking Machinery Manufacturing	-20
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-77
72	Semiconductor and Other Electronic Component Manufacturing	-511
97	Rail Transportation	-60

114	Other Information Services	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
8	Metal Ore Mining	-45	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-81	-2
49	Steel Product Manufacturing From Purchased Steel	-38	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-16	-2
52	Foundries	-490	-1
53	Forging and Stamping	-293	-2
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-210	-7
66	Metalworking Machinery Manufacturing	-21	-1
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-78	-1
72	Semiconductor and Other Electronic Component Manufacturing	-523	-13
97	Rail Transportation	-63	-3
114	Other Information Services	-28	-40

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-46	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-83	-1
49	Steel Product Manufacturing From Purchased Steel	-39	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-18	-2
52	Foundries	-491	-1
53	Forging and Stamping	-294	-2
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-217	-8
66	Metalworking Machinery Manufacturing	-22	-1
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-79	-1
72	Semiconductor and Other Electronic Component Manufacturing	-534	-11
97	Rail Transportation	-66	-3
114	Other Information Services	-44	-15

Table 8. Phase 4 Deficits Adding Anchor Industry 61

Other Fabricated Metal Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-70	-24
48	Iron and Steel Mills and Ferroalloy Manufacturing	-187	-104
49	Steel Product Manufacturing From Purchased Steel	-103	-64
51	Nonferrous Metal (except Aluminum) Production and Processing	-159	-140
52	Foundries	-593	-102
53	Forging and Stamping	-397	-102
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-459	-242
66	Metalworking Machinery Manufacturing	-69	-47
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-82	-3
72	Semiconductor and Other Electronic Component Manufacturing	-640	-106
97	Rail Transportation	-85	-18
114	Other Information Services	-55	-11

Table 9. Phase 5 Deficits Adding Anchor Industry 133

Management of Companies and Enterprises

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-70	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-188	-1
49	Steel Product Manufacturing From Purchased Steel	-103	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-159	-1
52	Foundries	-593	-0
53	Forging and Stamping	-397	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-468	-9
66	Metalworking Machinery Manufacturing	-70	-1
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-83	-1
72	Semiconductor and Other Electronic Component Manufacturing	-647	-7
97	Rail Transportation	-86	-1
114	Other Information Services	-80	-25

Table 10. Phase 6 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-71	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-190	-2
49	Steel Product Manufacturing From Purchased Steel	-105	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-161	-1
52	Foundries	-595	-1
53	Forging and Stamping	-399	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-480	-12
66	Metalworking Machinery Manufacturing	-72	-2
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-85	-2
72	Semiconductor and Other Electronic Component Manufacturing	-654	-7
97	Rail Transportation	-110	-24
114	Other Information Services	-86	-6

Table 11. Phase 7 Deficits Adding Anchor Industry 140

Services to Buildings and Dwellings

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-72	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-191	-1
49	Steel Product Manufacturing From Purchased Steel	-105	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-162	-1
52	Foundries	-595	-1
53	Forging and Stamping	-399	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-485	-6
66	Metalworking Machinery Manufacturing	-73	-1
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-87	-1
72	Semiconductor and Other Electronic Component Manufacturing	-659	-5
97	Rail Transportation	-112	-2
114	Other Information Services	-92	-7

Table 12. Phase 8 Deficits Adding Anchor Industry 137

Business Support Services

Industry #	Industry Name	Employment	Added to Deficit
8	Metal Ore Mining	-72	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-191	-0
49	Steel Product Manufacturing From Purchased Steel	-106	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-162	-0
52	Foundries	-596	-0
53	Forging and Stamping	-400	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-488	-3
66	Metalworking Machinery Manufacturing	-73	-0
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-87	-0
72	Semiconductor and Other Electronic Component Manufacturing	-661	-2
97	Rail Transportation	-113	-1
114	Other Information Services	-104	-12

Chapter 5. La Follette, TN

Study Area Overview

The La Follette, TN study region occupies 480 square-miles and had a 2018 population of 39,583. The employed share of the regional labor force during the 2014-2018 period averaged 92.6%. The Elementary and Secondary Schools industry was the region's largest employer in 2018, followed by All Other Retail and Food Services and Drinking Places. These three industries account for a combined 26.1% of the region's economy. The region's 2018 coefficient of specialization (COS) is 37.78, 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 La Follette, 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 Elementary and Secondary Schools, whose employment grew by 378 followed by Government and Unclassified and Household Appliance 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 13.16, 0.6, and 81.31.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
143	Elementary and Secondary Schools	378	241	13.16
181	Government and Unclassified	222	200	0.60
76	Household Appliance Manufacturing	189	218	81.31
167	Food Services and Drinking Places	177	-7	1.12
148	Offices of Other Health Practitioners	159	119	3.54
20	Animal Slaughtering and Processing	143	137	9.86
136	Employment Services	133	133	0.67
165	Other Amusement and Recreation Industries	93	54	2.68
144	Junior Colleges, Colleges, Universities, and Professional Schools	80	67	1.23
41	Other Chemical Product and Preparation Manufacturing	78	88	25.84

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 La Follette, TN, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 6.09, 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 La Follette, 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.

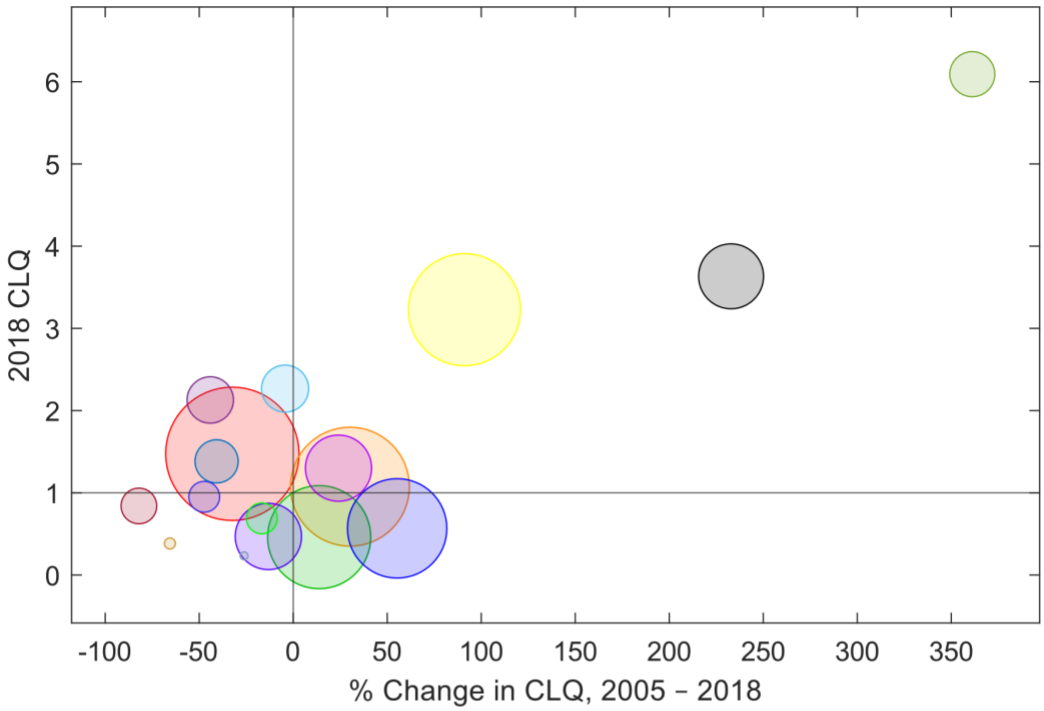
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	2.18	1.47	1,451
3	Arts, Entertainment, Recreation and Visitor Industries	0.83	1.07	1,140
9	Education and Knowledge Creation	1.69	3.23	1,007
5	Business and Financial Services	0.40	0.46	842
8	Defense and Security	0.37	0.57	779
16	Transportation and Logistics	0.54	0.47	326
1	Agribusiness, Food Processing and Technology	1.05	1.30	325
7	Computer, Electronic, and Electrical Products	1.09	3.63	312
10	Energy (Fossil and Renewable)	2.37	2.27	155
17	Transportation Equipment	3.81	2.13	150
2	Apparel and Textiles	1.32	6.09	141
6	Chemicals and Chemical-Based Products	2.33	1.38	129
15	Primary and Fabricated Metal Products	4.69	0.84	85
13	Machinery	1.81	0.95	63
11	Forest and Wood Products	0.83	0.69	63
14	Mining, Glass and Ceramics	1.12	0.38	16
12	Information Technology and Telecommunications	0.32	0.23	15

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of La Follette, TN



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (1,451)
Arts, Entertainment, Recreation and Visitor Industries (1,140)
Education and Knowledge Creation (1,007)
Business and Financial Services (842)
Defense and Security (779)
Transportation and Logistics (326)
Agribusiness, Food Processing and Technology (325)
Computer, Electronic, and Electrical Products (312)
Energy (Fossil and Renewable) (155)
Transportation Equipment (150)
Apparel and Textiles (141)
Chemicals and Chemical-Based Products (129)
Primary and Fabricated Metal Products (85)
Machinery (63)
Forest and Wood Products (63)
Mining, Glass and Ceramics (16)
Information Technology and Telecommunications (15)

2. CADS Analysis

The 2018 CADS analysis of the economy of La Follette, TN 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	162	305
17	Transportation Equipment	81	Motor Vehicle Parts Manufacturing	123	139

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
20	Animal Slaughtering and Processing	9.86	137	3.38	87.75	0.37	0.10
81	Motor Vehicle Parts Manufacturing	3.95	31	-11.56	13.36	0.55	0.07

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	-40
2	Animal Production	-307
15	Animal Food Manufacturing	-12
42	Plastics Product Manufacturing	-5
72	Semiconductor and Other Electronic Component Manufacturing	-2
133	Management of Companies and Enterprises	-8

Table 6. Phase 2 Deficits Adding Anchor Industry 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-41	-1
2	Animal Production	-307	-0
15	Animal Food Manufacturing	-12	-0
42	Plastics Product Manufacturing	-13	-7
72	Semiconductor and Other Electronic Component Manufacturing	-14	-12
133	Management of Companies and Enterprises	-21	-13

Chapter 6. Lawrenceburg, TN

Study Area Overview

The Lawrenceburg, TN study region occupies 617 square-miles and had a 2018 population of 43,734. The employed share of the regional labor force during the 2014-2018 period averaged 92.1%. 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 24.34% of the region's economy. The region's 2018 coefficient of specialization (COS) is 41.36, 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 Lawrenceburg, 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 Manufacturing, whose employment grew by 548 followed by Food Services and Drinking Places 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 35.51, 1.45, and 0.47.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
79	Motor Vehicle Manufacturing	548	548	35.51
167	Food Services and Drinking Places	228	-43	1.45
181	Government and Unclassified	153	133	0.47
146	Offices of Physicians	125	93	1.48
55	Architectural and Structural Metals Manufacturing	102	103	4.57
53	Forging and Stamping	87	111	51.30
11	Electric Power Generation, Transmission and Distribution	77	81	9.06
14	Construction	66	76	0.80
99	Truck Transportation	59	54	4.46
126	Architectural, Engineering, and Related Services	57	56	0.67

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 Lawrenceburg, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 10.33, followed by Mining, Glass and Ceramics 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 Lawrenceburg, 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.

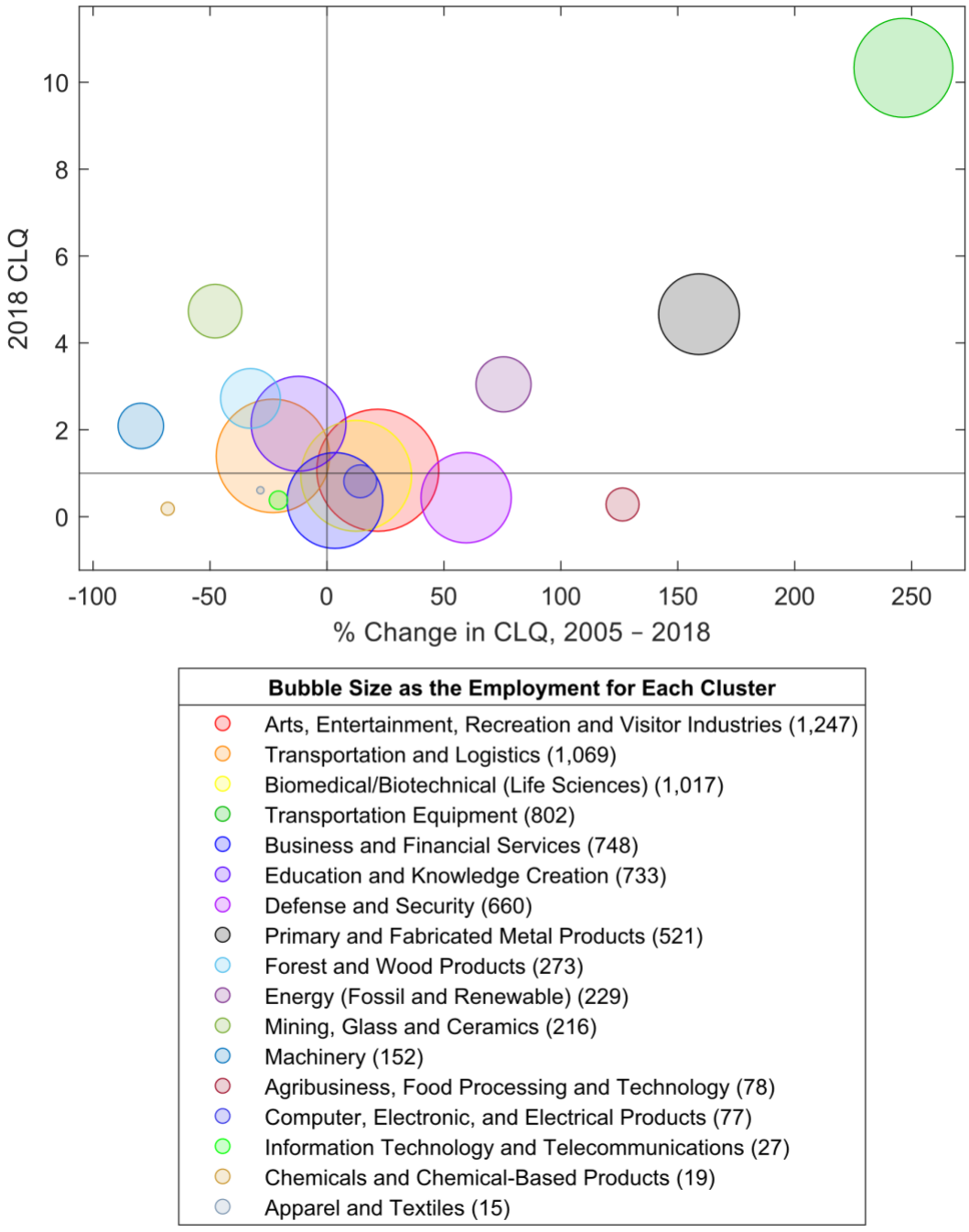
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
3	Arts, Entertainment, Recreation and Visitor Industries	0.88	1.07	1,247
16	Transportation and Logistics	1.82	1.40	1,069
4	Biomedical/Biotechnical (Life Sciences)	0.84	0.94	1,017
17	Transportation Equipment	2.98	10.33	802
5	Business and Financial Services	0.36	0.37	748
9	Education and Knowledge Creation	2.44	2.14	733
8	Defense and Security	0.27	0.44	660
15	Primary and Fabricated Metal Products	1.80	4.66	521
11	Forest and Wood Products	4.05	2.72	273
10	Energy (Fossil and Renewable)	1.74	3.05	229
14	Mining, Glass and Ceramics	9.07	4.73	216
13	Machinery	10.24	2.09	152
1	Agribusiness, Food Processing and Technology	0.12	0.28	78
7	Computer, Electronic, and Electrical Products	0.71	0.82	77
12	Information Technology and Telecommunications	0.48	0.38	27
6	Chemicals and Chemical-Based Products	0.57	0.18	19
2	Apparel and Textiles	0.85	0.61	15

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Lawrenceburg, TN



2. CADS Analysis

The 2018 CADS analysis of the economy of Lawrenceburg, 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 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	548

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
79	Motor Vehicle Manufacturing	35.51	548	-3.98	N/A	0.36	0.52

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	-104
52	Foundries	-102
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-148
67	Engine, Turbine, and Power Transmission Equipment Manufacturing	-87
71	Audio and Video Equipment Manufacturing	-109
72	Semiconductor and Other Electronic Component Manufacturing	-131
81	Motor Vehicle Parts Manufacturing	-682
91	Wholesale Trade	-166
104	Warehousing and Storage	-136
133	Management of Companies and Enterprises	-147

Chapter 7. Lewisburg, PA

Study Area Overview

The Lewisburg, PA study region occupies 316 square-miles and had a 2018 population of 44,785. The employed share of the regional labor force during the 2014-2018 period averaged 97%. The Junior Colleges, Colleges, Universities, and Professional Schools 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 31.5% of the region's economy. The region's 2018 coefficient of specialization (COS) is 35.54, 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 Lewisburg, 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 Food Services and Drinking Places, whose employment grew by 318 followed by Junior Colleges, Colleges, Universities, and Professional Schools 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 1.4, 9.42, and 1.04.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	318	-145	1.40
144	Junior Colleges, Colleges, Universities, and Professional Schools	278	-116	9.42
136	Employment Services	264	263	1.04
153	Hospitals	246	96	1.89
68	Other General Purpose Machinery Manufacturing	196	196	6.41
146	Offices of Physicians	185	74	2.18
154	Nursing and Residential Care Facilities	104	-32	2.37
24	Beverage Manufacturing	76	46	4.50
133	Management of Companies and Enterprises	73	3	1.04
104	Warehousing and Storage	72	72	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 Lewisburg, PA, the cluster with the largest CLQ in 2018 is Forest and Wood Products with a CLQ of 6.01, 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 Lewisburg, 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.

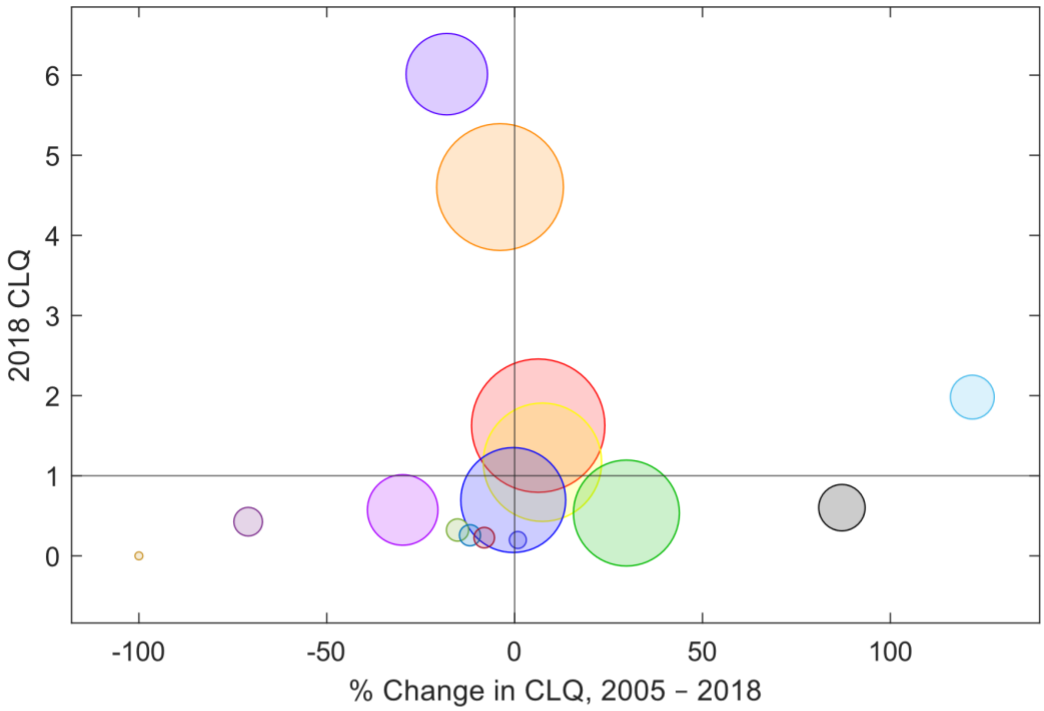
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.53	1.63	3,000
9	Education and Knowledge Creation	4.79	4.60	2,694
3	Arts, Entertainment, Recreation and Visitor Industries	1.09	1.17	2,325
5	Business and Financial Services	0.41	0.53	1,831
8	Defense and Security	0.70	0.70	1,792
11	Forest and Wood Products	7.34	6.01	1,030
16	Transportation and Logistics	0.82	0.57	747
1	Agribusiness, Food Processing and Technology	0.32	0.60	282
13	Machinery	0.89	1.98	246
15	Primary and Fabricated Metal Products	1.47	0.43	81
12	Information Technology and Telecommunications	0.38	0.32	39
10	Energy (Fossil and Renewable)	0.29	0.26	33
17	Transportation Equipment	0.25	0.23	30
14	Mining, Glass and Ceramics	0.20	0.20	15
6	Chemicals and Chemical-Based Products	0.00	0.03	6
2	Apparel and Textiles	0.07	0.00	0
7	Computer, Electronic, and Electrical Products	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Lewisburg, PA



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (3,000)
Education and Knowledge Creation (2,694)
Arts, Entertainment, Recreation and Visitor Industries (2,325)
Business and Financial Services (1,831)
Defense and Security (1,792)
Forest and Wood Products (1,030)
Transportation and Logistics (747)
Agribusiness, Food Processing and Technology (282)
Machinery (246)
Primary and Fabricated Metal Products (81)
Information Technology and Telecommunications (39)
Energy (Fossil and Renewable) (33)
Transportation Equipment (30)
Mining, Glass and Ceramics (15)
Chemicals and Chemical-Based Products (6)
Apparel and Textiles (0)
Computer, Electronic, and Electrical Products (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Lewisburg, PA 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 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	827	1,073
13	Machinery	68	Other General Purpose Machinery Manufacturing	0	196

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	1.89	96	18.09	29.73	0.69	0.10
68	Other General Purpose Machinery Manufacturing	6.41	196	1.24	N/A	0.53	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
77	Electrical Equipment Manufacturing	-1
89	Medical Equipment and Supplies Manufacturing	-11
117	Insurance Carriers	-28
139	Investigation and Security Services	-9

Table 6. Phase 2 Deficits Adding Anchor Industry 68

Other General Purpose Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
77	Electrical Equipment Manufacturing	-14	-13
89	Medical Equipment and Supplies Manufacturing	-11	-0
117	Insurance Carriers	-29	-1
139	Investigation and Security Services	-11	-2

Chapter 8. Lewistown, PA

Study Area Overview

The Lewistown, PA study region occupies 411 square-miles and had a 2018 population of 46,222. 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 Individual and Family Services and Nursing and Residential Care Facilities. These three industries account for a combined 19.12% of the region's economy. The region's 2018 coefficient of specialization (COS) is 43.22, 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 Lewistown, 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 Individual and Family Services, whose employment grew by 691 followed by Converted Paper Product 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 3.73, 19.26, and 0.99.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
155	Individual and Family Services	691	439	3.73
32	Converted Paper Product Manufacturing	438	454	19.26
167	Food Services and Drinking Places	217	-68	0.99
154	Nursing and Residential Care Facilities	169	38	2.75
153	Hospitals	119	8	1.45
78	Other Electrical Equipment and Component Manufacturing	105	105	7.26
38	Pharmaceutical and Medicine Manufacturing	102	102	4.40
42	Plastics Product Manufacturing	99	140	12.11
145	Other Educational Services	99	88	1.26
83	Railroad Rolling Stock Manufacturing	78	85	55.80

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 Lewistown, PA, the cluster with the largest CLQ in 2018 is Forest and Wood Products with a CLQ of 8.19, 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 Lewistown, 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.

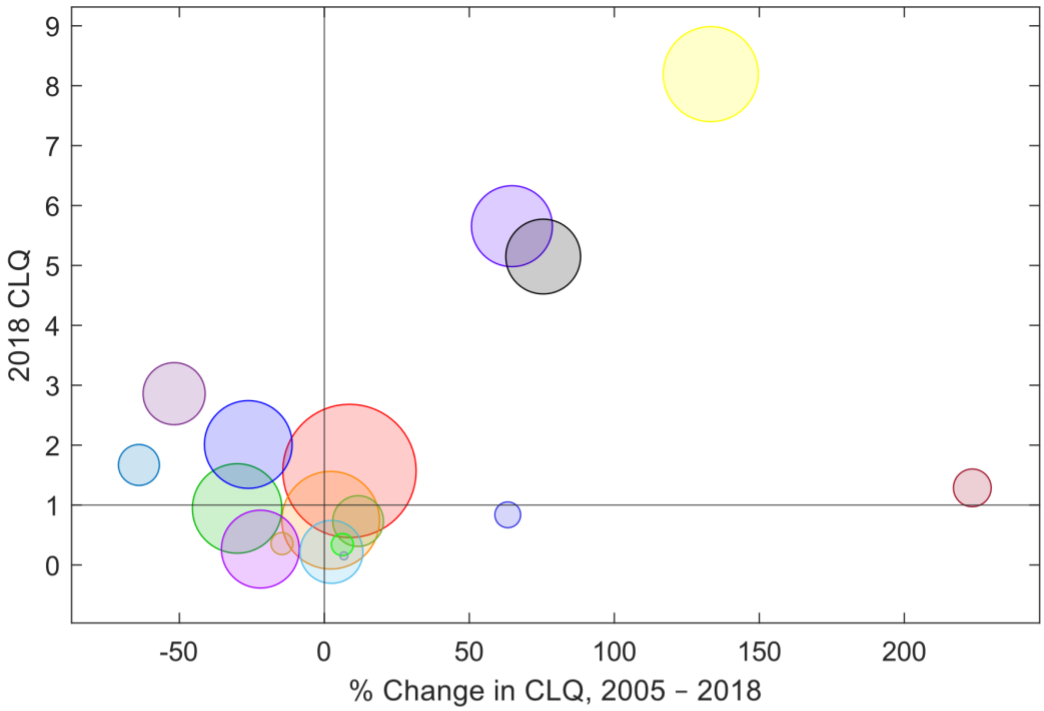
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.44	1.57	2,582
3	Arts, Entertainment, Recreation and Visitor Industries	0.73	0.75	1,325
11	Forest and Wood Products	3.51	8.19	1,251
16	Transportation and Logistics	1.35	0.94	1,096
9	Education and Knowledge Creation	2.73	2.01	1,049
6	Chemicals and Chemical-Based Products	3.43	5.66	879
5	Business and Financial Services	0.34	0.26	807
7	Computer, Electronic, and Electrical Products	2.93	5.15	738
8	Defense and Security	0.21	0.22	501
15	Primary and Fabricated Metal Products	5.93	2.86	486
1	Agribusiness, Food Processing and Technology	0.66	0.73	306
13	Machinery	4.63	1.67	185
17	Transportation Equipment	0.40	1.29	152
14	Mining, Glass and Ceramics	0.51	0.84	58
10	Energy (Fossil and Renewable)	0.32	0.34	39
12	Information Technology and Telecommunications	0.42	0.36	39
2	Apparel and Textiles	0.14	0.15	6

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Lewistown, PA



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (2,582)
Arts, Entertainment, Recreation and Visitor Industries (1,325)
Forest and Wood Products (1,251)
Transportation and Logistics (1,096)
Education and Knowledge Creation (1,049)
Chemicals and Chemical-Based Products (879)
Business and Financial Services (807)
Computer, Electronic, and Electrical Products (738)
Defense and Security (501)
Primary and Fabricated Metal Products (486)
Agribusiness, Food Processing and Technology (306)
Machinery (185)
Transportation Equipment (152)
Mining, Glass and Ceramics (58)
Energy (Fossil and Renewable) (39)
Information Technology and Telecommunications (39)
Apparel and Textiles (6)

2. CADS Analysis

The 2018 CADS analysis of the economy of Lewistown, PA 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 Plastics 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	42	Plastics Product Manufacturing	607	707
11	Forest and Wood Products	32	Converted Paper Product Manufacturing	77	515
11	Forest and Wood Products	30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	344	359

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
42	Plastics Product Manufacturing	12.11	140	-6.65	16.38	0.62	0.12
32	Converted Paper Product Manufacturing	19.26	454	-21.07	570.73	0.56	0.11
30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	14.68	105	-26.04	4.36	0.80	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 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	N/A
26	Textile Mills and Textile Product Mills	-13
31	Pulp, Paper, and Paperboard Mills	-4
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-46
41	Other Chemical Product and Preparation Manufacturing	-6
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-6
72	Semiconductor and Other Electronic Component Manufacturing	-13
97	Rail Transportation	-7
104	Warehousing and Storage	-12
126	Architectural, Engineering, and Related Services	-4
136	Employment Services	-13
139	Investigation and Security Services	-7

Table 6. Phase 2 Deficits Adding Anchor Industry 32

Converted Paper Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-10	-13
26	Textile Mills and Textile Product Mills	-36	-23
31	Pulp, Paper, and Paperboard Mills	-64	-61
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-51	-5

41	Other Chemical Product and Preparation Manufacturing	-11	-5
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-26	-20
72	Semiconductor and Other Electronic Component Manufacturing	-22	-9
97	Rail Transportation	-13	-7
104	Warehousing and Storage	-49	-37
126	Architectural, Engineering, and Related Services	-18	-14
136	Employment Services	-34	-21
139	Investigation and Security Services	-12	-5

Table 7. Phase 3 Deficits Adding Anchor Industry 30

Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-17	-6
26	Textile Mills and Textile Product Mills	-39	-3
31	Pulp, Paper, and Paperboard Mills	-64	-0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-52	-1
41	Other Chemical Product and Preparation Manufacturing	-11	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-30	-4
72	Semiconductor and Other Electronic Component Manufacturing	-27	-5
97	Rail Transportation	-15	-1
104	Warehousing and Storage	-74	-25
126	Architectural, Engineering, and Related Services	-25	-7
136	Employment Services	-42	-8
139	Investigation and Security Services	-14	-2

Chapter 9. Lock Haven, PA

Study Area Overview

The Lock Haven, PA study region occupies 888 square-miles and had a 2018 population of 38,684. The employed share of the regional labor force during the 2014-2018 period averaged 95.2%. The Converted Paper Product Manufacturing 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 26.33% of the region's economy. The region's 2018 coefficient of specialization (COS) is 38.15, 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 Lock Haven, 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 Converted Paper Product Manufacturing, whose employment grew by 753 followed by Support Activities for Mining and Wholesale Trade. 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 67.89, 8.41, and 0.91.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
32	Converted Paper Product Manufacturing	753	917	67.89
10	Support Activities for Mining	246	246	8.41
91	Wholesale Trade	175	173	0.91
14	Construction	123	138	0.92
156	Community and Vocational Rehabilitation Services	121	121	3.53
134	Office Administrative Services	90	90	2.10
39	Paint, Coating, and Adhesive Manufacturing	88	94	38.91
65	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	87	88	8.44
49	Steel Product Manufacturing From Purchased Steel	83	87	30.81
154	Nursing and Residential Care Facilities	79	28	1.32

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 Lock Haven, PA, the cluster with the largest CLQ in 2018 is Forest and Wood Products with a CLQ of 13.46, followed by Energy (Fossil and Renewable) 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 Lock Haven, 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.

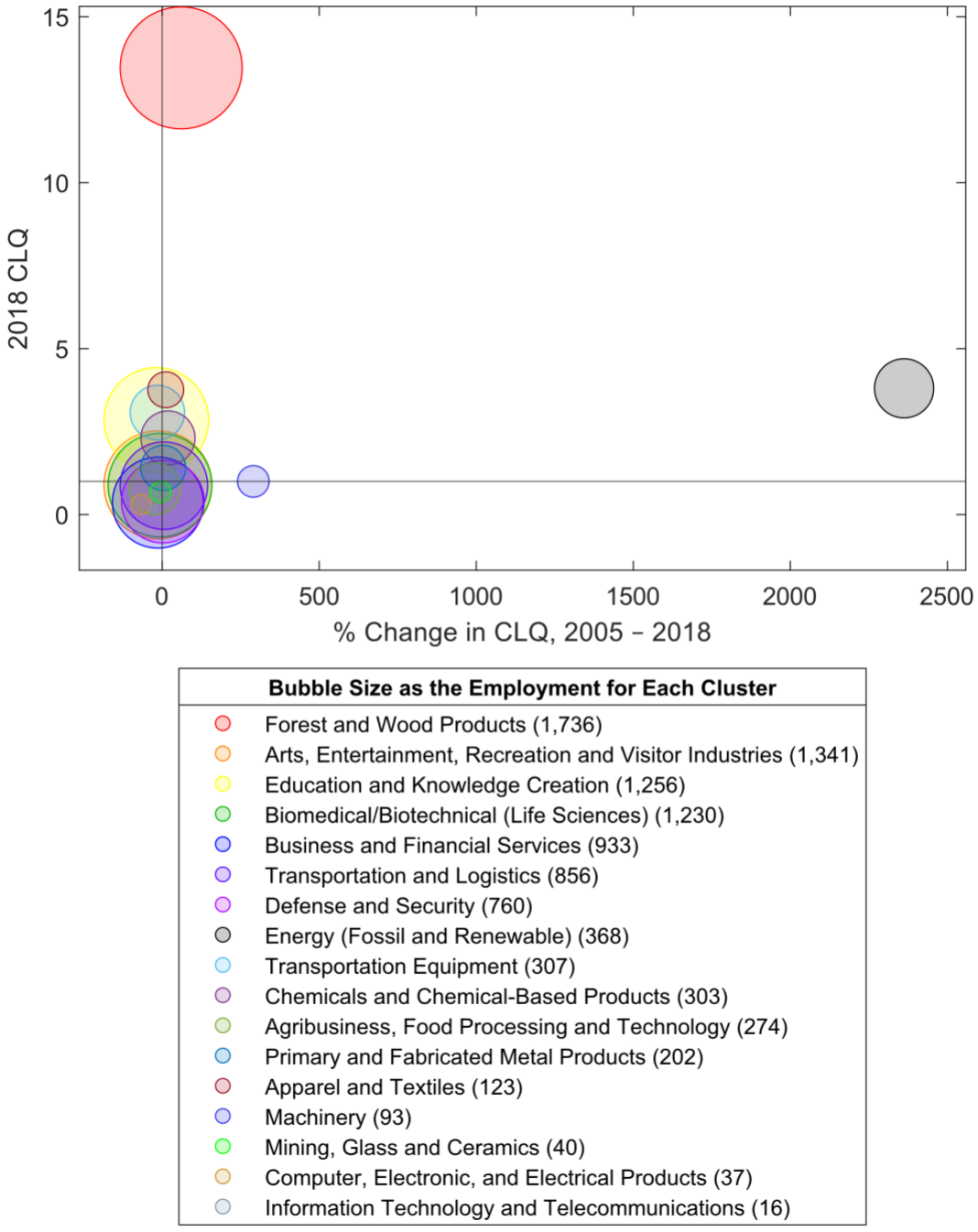
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
11	Forest and Wood Products	8.38	13.46	1,736
3	Arts, Entertainment, Recreation and Visitor Industries	1.03	0.90	1,341
9	Education and Knowledge Creation	3.50	2.85	1,256
4	Biomedical/Biotechnical (Life Sciences)	0.95	0.89	1,230
5	Business and Financial Services	0.42	0.36	933
16	Transportation and Logistics	0.83	0.87	856
8	Defense and Security	0.38	0.39	760
10	Energy (Fossil and Renewable)	0.15	3.80	368
17	Transportation Equipment	3.63	3.07	307
6	Chemicals and Chemical-Based Products	1.95	2.31	303
1	Agribusiness, Food Processing and Technology	1.01	0.78	274
15	Primary and Fabricated Metal Products	1.37	1.41	202
2	Apparel and Textiles	3.37	3.76	123
13	Machinery	0.26	1.00	93
14	Mining, Glass and Ceramics	0.72	0.68	40
7	Computer, Electronic, and Electrical Products	0.94	0.30	37
12	Information Technology and Telecommunications	0.25	0.18	16

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Lock Haven, PA



2. CADS Analysis

The 2018 CADS analysis of the economy of Lock Haven, PA 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 Converted Paper 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
11	Forest and Wood Products	32	Converted Paper Product Manufacturing	780	1,533

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
32	Converted Paper Product Manufacturing	67.89	917	-21.07	96.54	0.46	0.32

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 32

Converted Paper Product Manufacturing

Industry #	Industry Name	Employment
3	Forestry and Logging	-42
26	Textile Mills and Textile Product Mills	-33
31	Pulp, Paper, and Paperboard Mills	-189
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-52
60	Coating, Engraving, Heat Treating, and Allied Activities	-38
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-29
104	Warehousing and Storage	-71
126	Architectural, Engineering, and Related Services	-30
133	Management of Companies and Enterprises	-66
136	Employment Services	-60

Chapter 10. London, KY

Study Area Overview

The London, KY study region occupies 434 square-miles and had a 2018 population of 60,669. The employed share of the regional labor force during the 2014-2018 period averaged 93.3%. The Business Support Services 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 23.61% of the region's economy. The region's 2018 coefficient of specialization (COS) is 41.4, 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 London, 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 Business Support Services, whose employment grew by 2,304 followed by Employment Services 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 16.14, 2.39, and 6.93.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
137	Business Support Services	2,304	2,277	16.14
136	Employment Services	708	702	2.39
104	Warehousing and Storage	671	103	6.93
81	Motor Vehicle Parts Manufacturing	505	541	8.26
93	Food and Beverage Stores	359	340	1.21
146	Offices of Physicians	305	209	1.58
43	Rubber Product Manufacturing	287	292	13.66
128	Computer Systems Design and Related Services	221	212	0.63
140	Services to Buildings and Dwellings	207	181	0.66
94	General Merchandise Stores	200	167	1.69

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 London, KY, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 4.13, followed by Agribusiness, Food Processing and Technology 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 London, 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.

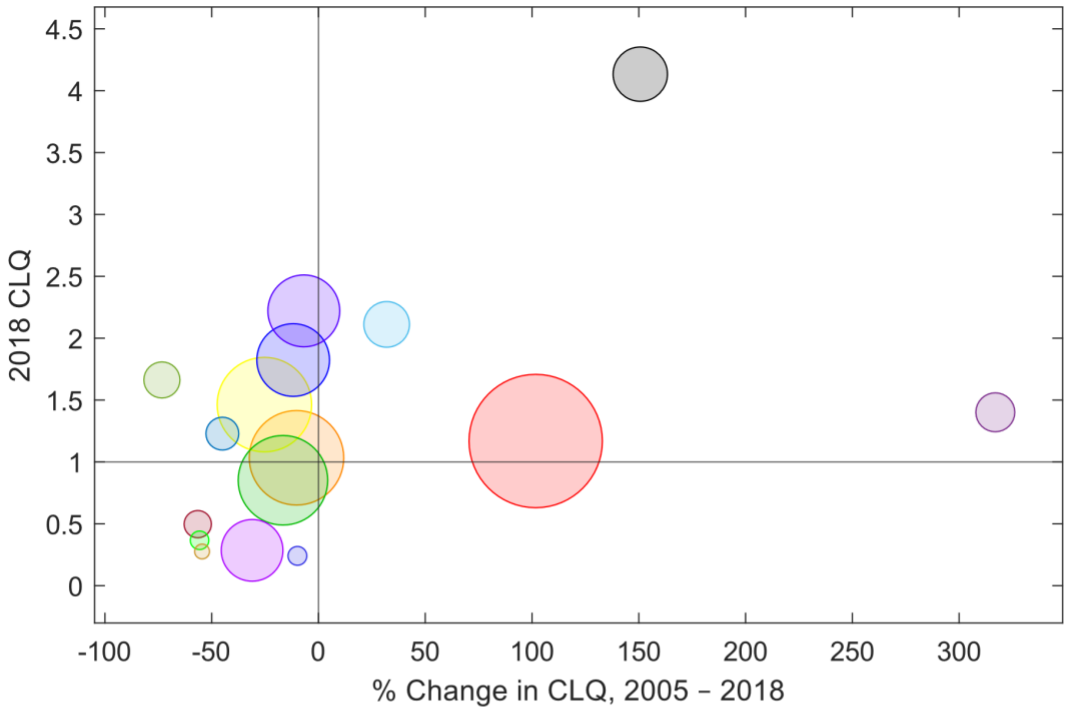
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
5	Business and Financial Services	0.58	1.17	6,034
4	Biomedical/Biotechnical (Life Sciences)	1.15	1.03	2,874
16	Transportation and Logistics	1.96	1.46	2,873
3	Arts, Entertainment, Recreation and Visitor Industries	1.02	0.85	2,553
9	Education and Knowledge Creation	2.07	1.82	1,608
1	Agribusiness, Food Processing and Technology	2.38	2.22	1,567
8	Defense and Security	0.41	0.29	1,107
17	Transportation Equipment	1.65	4.13	825
11	Forest and Wood Products	1.60	2.11	545
6	Chemicals and Chemical-Based Products	0.34	1.40	368
12	Information Technology and Telecommunications	6.23	1.66	303
10	Energy (Fossil and Renewable)	2.23	1.23	238
15	Primary and Fabricated Metal Products	1.14	0.50	143
13	Machinery	0.27	0.24	45
14	Mining, Glass and Ceramics	0.83	0.37	43
2	Apparel and Textiles	0.61	0.28	18
7	Computer, Electronic, and Electrical Products	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of London, KY



Bubble Size as the Employment for Each Cluster
Business and Financial Services (6,034)
Biomedical/Biotechnical (Life Sciences) (2,874)
Transportation and Logistics (2,873)
Arts, Entertainment, Recreation and Visitor Industries (2,553)
Education and Knowledge Creation (1,608)
Agribusiness, Food Processing and Technology (1,567)
Defense and Security (1,107)
Transportation Equipment (825)
Forest and Wood Products (545)
Chemicals and Chemical-Based Products (368)
Information Technology and Telecommunications (303)
Energy (Fossil and Renewable) (238)
Primary and Fabricated Metal Products (143)
Machinery (45)
Mining, Glass and Ceramics (43)
Apparel and Textiles (18)
Computer, Electronic, and Electrical Products (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of London, KY 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 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	319	823
5	Business and Financial Services	137	Business Support Services	239	2,543
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	393	698
16	Transportation and Logistics	99	Truck Transportation	437	471

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	8.26	541	-11.56	158.25	0.47	0.14
137	Business Support Services	16.14	2,277	11.43	965.96	0.81	0.09
146	Offices of Physicians	1.58	209	24.38	77.61	0.78	0.04
99	Truck Transportation	1.67	29	1.19	7.78	0.85	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 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
27	Apparel, Leather and Allied Product Manufacturing	-29
42	Plastics Product Manufacturing	-45
48	Iron and Steel Mills and Ferroalloy Manufacturing	-36
51	Nonferrous Metal (except Aluminum) Production and Processing	-24
52	Foundries	-82
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-107
60	Coating, Engraving, Heat Treating, and Allied Activities	-26
61	Other Fabricated Metal Product Manufacturing	-27
72	Semiconductor and Other Electronic Component Manufacturing	-73
133	Management of Companies and Enterprises	-73

Table 6. Phase 2 Deficits Adding Anchor Industry 137

Business Support Services

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-31	-2
42	Plastics Product Manufacturing	-49	-4
48	Iron and Steel Mills and Ferroalloy Manufacturing	-36	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-25	-0
52	Foundries	-82	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-110	-3
60	Coating, Engraving, Heat Treating, and Allied Activities	-27	-1
61	Other Fabricated Metal Product Manufacturing	-29	-2
72	Semiconductor and Other Electronic Component Manufacturing	-75	-2
133	Management of Companies and Enterprises	-113	-40

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-31	-0
42	Plastics Product Manufacturing	-53	-4
48	Iron and Steel Mills and Ferroalloy Manufacturing	-36	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-25	-0
52	Foundries	-82	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-110	-1
60	Coating, Engraving, Heat Treating, and Allied Activities	-27	-0
61	Other Fabricated Metal Product Manufacturing	-30	-0
72	Semiconductor and Other Electronic Component Manufacturing	-76	-1
133	Management of Companies and Enterprises	-132	-19

Table 8. Phase 4 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
27	Apparel, Leather and Allied Product Manufacturing	-32	-0
42	Plastics Product Manufacturing	-54	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-37	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-25	-0
52	Foundries	-82	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-111	-1
60	Coating, Engraving, Heat Treating, and Allied Activities	-28	-1
61	Other Fabricated Metal Product Manufacturing	-30	-0
72	Semiconductor and Other Electronic Component Manufacturing	-76	-1
133	Management of Companies and Enterprises	-142	-10

Chapter 11. Martinsville, VA

Study Area Overview

The Martinsville, VA study region occupies 393 square-miles and had a 2018 population of 63,855. The employed share of the regional labor force during the 2014-2018 period averaged 91.9%. The All Other Retail 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 19.74% of the region's economy. The region's 2018 coefficient of specialization (COS) is 38.63, 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 Martinsville, 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 Individual and Family Services, whose employment grew by 632 followed by Plastics Product Manufacturing 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 1.89, 14.21, and 0.9.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
155	Individual and Family Services	632	500	1.89
42	Plastics Product Manufacturing	568	619	14.21
153	Hospitals	323	249	0.90
179	Private Households	272	279	3.59
137	Business Support Services	240	158	6.44
156	Community and Vocational Rehabilitation Services	203	204	3.65
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	200	224	27.47
181	Government and Unclassified	196	155	0.37
129	Management, Scientific, and Technical Consulting Services	179	170	0.72
167	Food Services and Drinking Places	161	-271	0.84

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 Martinsville, VA, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 8.63, followed by Chemicals and Chemical-Based 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 Martinsville, 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.

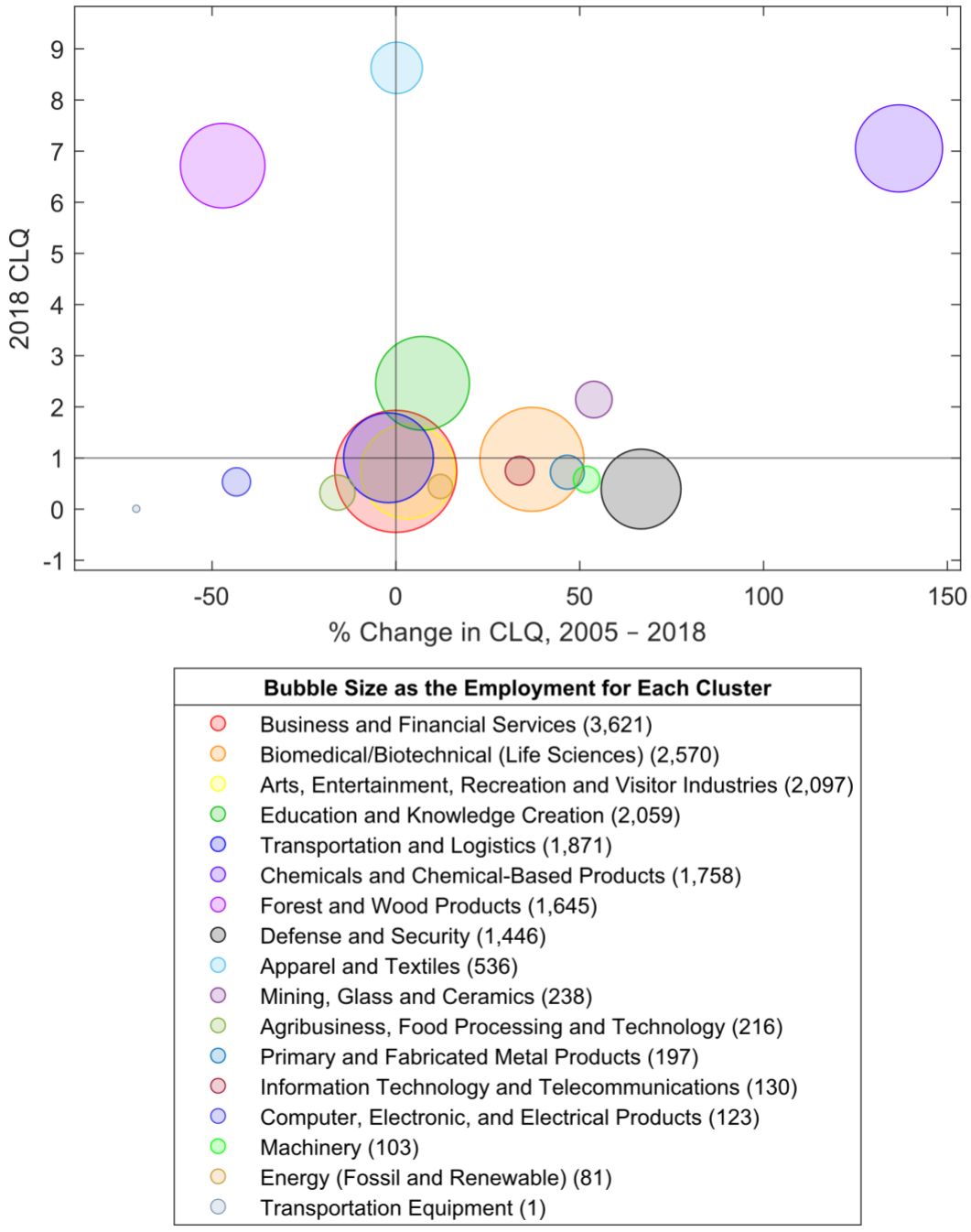
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
5	Business and Financial Services	0.74	0.74	3,621
4	Biomedical/Biotechnical (Life Sciences)	0.71	0.97	2,570
3	Arts, Entertainment, Recreation and Visitor Industries	0.71	0.74	2,097
9	Education and Knowledge Creation	2.29	2.46	2,059
16	Transportation and Logistics	1.02	1.00	1,871
6	Chemicals and Chemical-Based Products	2.98	7.05	1,758
11	Forest and Wood Products	12.70	6.72	1,645
8	Defense and Security	0.24	0.39	1,446
2	Apparel and Textiles	8.61	8.63	536
14	Mining, Glass and Ceramics	1.39	2.14	238
1	Agribusiness, Food Processing and Technology	0.38	0.32	216
15	Primary and Fabricated Metal Products	0.49	0.72	197
12	Information Technology and Telecommunications	0.56	0.75	130
7	Computer, Electronic, and Electrical Products	0.94	0.53	123
13	Machinery	0.38	0.58	103
10	Energy (Fossil and Renewable)	0.40	0.44	81
17	Transportation Equipment	0.03	0.01	1

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Martinsville, VA



2. CADS Analysis

The 2018 CADS analysis of the economy of Martinsville, VA 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 Plastics 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	42	Plastics Product Manufacturing	762	1,330
6	Chemicals and Chemical-Based Products	36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	214	414
5	Business and Financial Services	137	Business Support Services	723	963

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
42	Plastics Product Manufacturing	14.21	619	-6.65	74.63	0.65	0.17
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	27.47	224	-11.32	93.38	0.41	0.17
137	Business Support Services	6.44	158	11.43	33.23	0.85	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 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-21
6	Oil and Gas Extraction	-4
35	Basic Chemical Manufacturing	-51
60	Coating, Engraving, Heat Treating, and Allied Activities	-14
61	Other Fabricated Metal Product Manufacturing	-8
72	Semiconductor and Other Electronic Component Manufacturing	-24
81	Motor Vehicle Parts Manufacturing	-5
97	Rail Transportation	-12
103	Couriers and Messengers	-9
128	Computer Systems Design and Related Services	N/A
131	Advertising and Related Services	-7
141	Other Support Services	-6

Table 6. Phase 2 Deficits Adding Anchor Industry 36

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

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-58	-37
6	Oil and Gas Extraction	-11	-7
35	Basic Chemical Manufacturing	-134	-84
60	Coating, Engraving, Heat Treating, and Allied Activities	-21	-7
61	Other Fabricated Metal Product Manufacturing	-13	-5
72	Semiconductor and Other Electronic Component Manufacturing	-36	-13

81	Motor Vehicle Parts Manufacturing	-10	-4
97	Rail Transportation	-21	-9
103	Couriers and Messengers	-16	-7
128	Computer Systems Design and Related Services	-7	-11
131	Advertising and Related Services	-12	-4
141	Other Support Services	-9	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 137

Business Support Services

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-58	-1
6	Oil and Gas Extraction	-11	-0
35	Basic Chemical Manufacturing	-135	-0
60	Coating, Engraving, Heat Treating, and Allied Activities	-22	-0
61	Other Fabricated Metal Product Manufacturing	-14	-1
72	Semiconductor and Other Electronic Component Manufacturing	-37	-1
81	Motor Vehicle Parts Manufacturing	-12	-2
97	Rail Transportation	-21	-0
103	Couriers and Messengers	-24	-9
128	Computer Systems Design and Related Services	-17	-11
131	Advertising and Related Services	-15	-3
141	Other Support Services	-12	-3

Chapter 12. McMinnville, TN

Study Area Overview

The McMinnville, TN study region occupies 433 square-miles and had a 2018 population of 40,878. The employed share of the regional labor force during the 2014-2018 period averaged 95%. 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 25.42% of the region's economy. The region's 2018 coefficient of specialization (COS) is 42.35, 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 McMinnville, 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 553 followed by Food Services and Drinking Places and Soap, Cleaning Compound, and Toilet Preparation 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 29.89, 1.03, and 26.49.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
81	Motor Vehicle Parts Manufacturing	553	652	29.89
167	Food Services and Drinking Places	268	54	1.03
40	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	247	247	26.49
181	Government and Unclassified	167	147	0.40
154	Nursing and Residential Care Facilities	122	63	1.73
140	Services to Buildings and Dwellings	108	87	0.87
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	87	88	12.89
153	Hospitals	84	35	0.86
146	Offices of Physicians	55	4	1.25
56	Boiler, Tank, and Shipping Container Manufacturing	54	54	7.43

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 McMinnville, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 15.03, followed by Chemicals and Chemical-Based Products 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 McMinnville, 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.

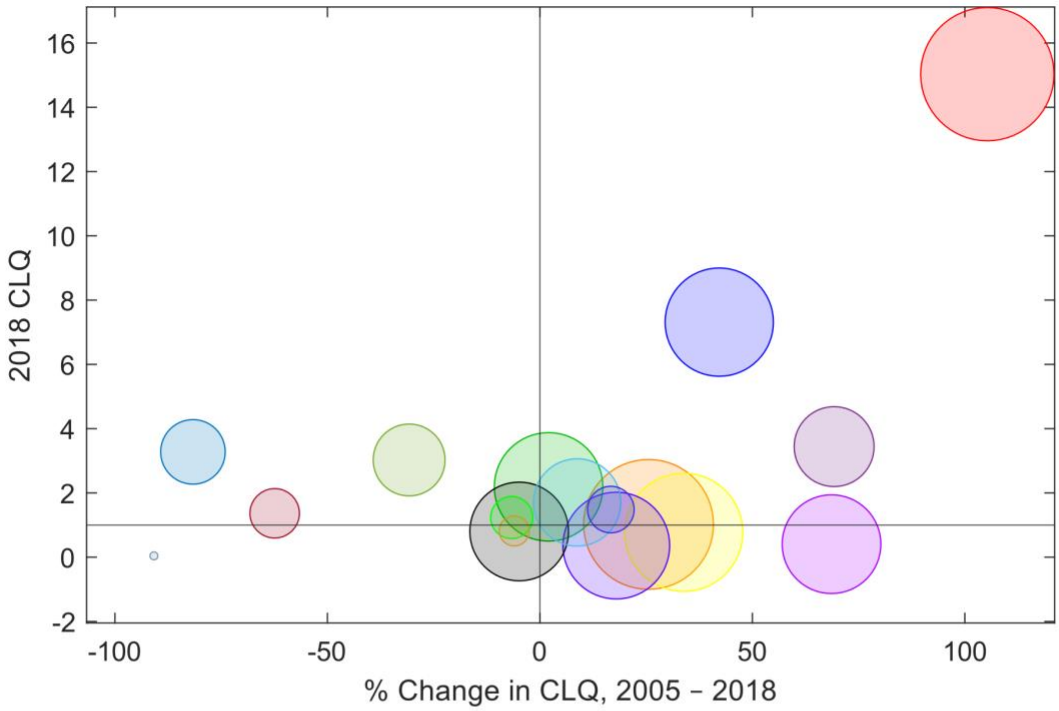
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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	7.32	15.03	1,424
4	Biomedical/Biotechnical (Life Sciences)	0.81	1.02	1,347
3	Arts, Entertainment, Recreation and Visitor Industries	0.58	0.77	1,102
9	Education and Knowledge Creation	2.15	2.19	916
6	Chemicals and Chemical-Based Products	5.14	7.31	912
5	Business and Financial Services	0.31	0.36	885
8	Defense and Security	0.24	0.41	747
16	Transportation and Logistics	0.84	0.80	746
1	Agribusiness, Food Processing and Technology	1.57	1.70	571
15	Primary and Fabricated Metal Products	2.03	3.44	470
11	Forest and Wood Products	4.37	3.03	371
13	Machinery	17.86	3.28	291
7	Computer, Electronic, and Electrical Products	3.63	1.37	157
10	Energy (Fossil and Renewable)	1.27	1.48	136
12	Information Technology and Telecommunications	1.32	1.23	107
14	Mining, Glass and Ceramics	0.87	0.82	46
2	Apparel and Textiles	0.46	0.04	1

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of McMinnville, TN



Bubble Size as the Employment for Each Cluster
Transportation Equipment (1,424)
Biomedical/Biotechnical (Life Sciences) (1,347)
Arts, Entertainment, Recreation and Visitor Industries (1,102)
Education and Knowledge Creation (916)
Chemicals and Chemical-Based Products (912)
Business and Financial Services (885)
Defense and Security (747)
Transportation and Logistics (746)
Agribusiness, Food Processing and Technology (571)
Primary and Fabricated Metal Products (470)
Forest and Wood Products (371)
Machinery (291)
Computer, Electronic, and Electrical Products (157)
Energy (Fossil and Renewable) (136)
Information Technology and Telecommunications (107)
Mining, Glass and Ceramics (46)
Apparel and Textiles (1)

2. CADS Analysis

The 2018 CADS analysis of the economy of McMinnville, 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	861	1,414

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	29.89	652	-11.56	64.17	0.55	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
27	Apparel, Leather and Allied Product Manufacturing	-50
51	Nonferrous Metal (except Aluminum) Production and Processing	-42
52	Foundries	-141
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-105
60	Coating, Engraving, Heat Treating, and Allied Activities	-43
72	Semiconductor and Other Electronic Component Manufacturing	-125
104	Warehousing and Storage	-63
126	Architectural, Engineering, and Related Services	-30
129	Management, Scientific, and Technical Consulting Services	-34
133	Management of Companies and Enterprises	-95

Chapter 13. Meadville, PA

Study Area Overview

The Meadville, PA study region occupies 1,012 square-miles and had a 2018 population of 85,063. 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 Government and Unclassified and Metalworking Machinery Manufacturing. These three industries account for a combined 18.61% of the region's economy. The region's 2018 coefficient of specialization (COS) is 38.62, 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 Meadville, 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 Individual and Family Services, whose employment grew by 643 followed by Plastics Product Manufacturing and Machine Shops; Turned Product; and Screw, Nut, and Bolt 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 2.3, 10.68, and 13.7.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
155	Individual and Family Services	643	172	2.30
42	Plastics Product Manufacturing	355	410	10.68
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	336	323	13.70
10	Support Activities for Mining	242	192	5.11
153	Hospitals	184	-45	1.50
149	Outpatient Care Centers	131	31	1.34
133	Management of Companies and Enterprises	122	96	0.44
15	Animal Food Manufacturing	121	62	26.73
2	Animal Production	118	128	1.31
178	Civic, Social, Professional, and Similar Organizations	115	133	3.32

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 Meadville, PA, the cluster with the largest CLQ in 2018 is Machinery with a CLQ of 8.49, followed by Primary and Fabricated Metal 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 Meadville, 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.

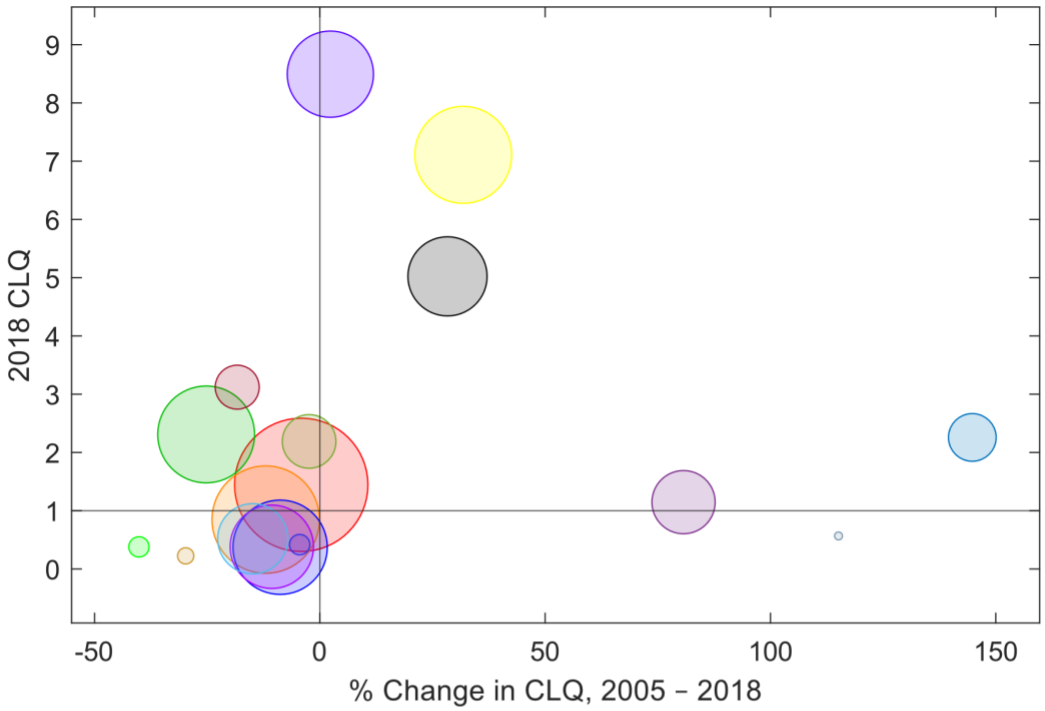
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.51	1.44	4,532
3	Arts, Entertainment, Recreation and Visitor Industries	0.96	0.85	2,867
15	Primary and Fabricated Metal Products	5.39	7.11	2,306
9	Education and Knowledge Creation	3.09	2.31	2,299
5	Business and Financial Services	0.41	0.37	2,173
13	Machinery	8.30	8.49	1,793
8	Defense and Security	0.43	0.38	1,667
6	Chemicals and Chemical-Based Products	3.91	5.02	1,489
16	Transportation and Logistics	0.61	0.52	1,150
1	Agribusiness, Food Processing and Technology	0.63	1.15	914
11	Forest and Wood Products	2.24	2.19	638
10	Energy (Fossil and Renewable)	0.92	2.26	493
14	Mining, Glass and Ceramics	3.82	3.12	413
12	Information Technology and Telecommunications	0.44	0.42	86
17	Transportation Equipment	0.63	0.38	85
7	Computer, Electronic, and Electrical Products	0.32	0.23	62
2	Apparel and Textiles	0.26	0.57	42

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Meadville, PA



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (4,532)
Arts, Entertainment, Recreation and Visitor Industries (2,867)
Primary and Fabricated Metal Products (2,306)
Education and Knowledge Creation (2,299)
Business and Financial Services (2,173)
Machinery (1,793)
Defense and Security (1,667)
Chemicals and Chemical-Based Products (1,489)
Transportation and Logistics (1,150)
Agribusiness, Food Processing and Technology (914)
Forest and Wood Products (638)
Energy (Fossil and Renewable) (493)
Mining, Glass and Ceramics (413)
Information Technology and Telecommunications (86)
Transportation Equipment (85)
Computer, Electronic, and Electrical Products (62)
Apparel and Textiles (42)

2. CADS Analysis

The 2018 CADS analysis of the economy of Meadville, PA 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 Animal 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	15	Animal Food Manufacturing	199	320
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	834	1,189
13	Machinery	66	Metalworking Machinery Manufacturing	1,708	1,604
15	Primary and Fabricated Metal Products	59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	614	950
15	Primary and Fabricated Metal Products	53	Forging and Stamping	394	390
10	Energy (Fossil and Renewable)	10	Support Activities for Mining	95	337
11	Forest and Wood Products	30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	339	418

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

				Industry Growth Rate (%)	Industry Growth Rate (%)	

Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
15	Animal Food Manufacturing	26.73	62	29.94	61.00	0.66	0.11
42	Plastics Product Manufacturing	10.68	410	-6.65	42.57	0.54	0.11
66	Metalworking Machinery Manufacturing	46.29	89	-11.28	-6.09	0.82	0.08
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	13.70	323	2.18	54.72	0.83	0.06
53	Forging and Stamping	20.84	35	-9.92	-0.93	0.85	0.05
10	Support Activities for Mining	5.11	192	52.54	254.74	0.84	0.03
30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	8.96	167	-26.04	23.25	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 15

Animal Food Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-504
4	Fishing, Hunting and Trapping	-13
5	Support Activities for Agriculture and Forestry	-9
20	Animal Slaughtering and Processing	-34
32	Converted Paper Product Manufacturing	-15
35	Basic Chemical Manufacturing	-7
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-2
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-9
56	Boiler, Tank, and Shipping Container Manufacturing	-30

72	Semiconductor and Other Electronic Component Manufacturing	-7
77	Electrical Equipment Manufacturing	-2
97	Rail Transportation	-17
99	Truck Transportation	N/A
104	Warehousing and Storage	N/A
128	Computer Systems Design and Related Services	N/A
133	Management of Companies and Enterprises	N/A
137	Business Support Services	-12

Table 6. Phase 2 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-526	-22
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-12	-3
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-35	-20
35	Basic Chemical Manufacturing	-51	-44
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-77	-75
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-1
56	Boiler, Tank, and Shipping Container Manufacturing	-31	-1
72	Semiconductor and Other Electronic Component Manufacturing	-27	-20
77	Electrical Equipment Manufacturing	-8	-6
97	Rail Transportation	-27	-11
99	Truck Transportation	-13	-39
104	Warehousing and Storage	-60	-78
128	Computer Systems Design and Related Services	-5	-15
133	Management of Companies and Enterprises	N/A	-52
137	Business Support Services	-27	-15

Table 7. Phase 3 Deficits Adding Anchor Industry 66

Metalworking Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-528	-1
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-12	-0
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-38	-3
35	Basic Chemical Manufacturing	-53	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-78	-1
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-0
56	Boiler, Tank, and Shipping Container Manufacturing	-33	-1
72	Semiconductor and Other Electronic Component Manufacturing	-51	-24
77	Electrical Equipment Manufacturing	-36	-27
97	Rail Transportation	-30	-2
99	Truck Transportation	-33	-20

104	Warehousing and Storage	-112	-52
128	Computer Systems Design and Related Services	-33	-28
133	Management of Companies and Enterprises	N/A	-95
137	Business Support Services	-35	-8

Table 8. Phase 4 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	-529	-1
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-12	-0
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-40	-3
35	Basic Chemical Manufacturing	-54	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-78	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-0
56	Boiler, Tank, and Shipping Container Manufacturing	-34	-1
72	Semiconductor and Other Electronic Component Manufacturing	-63	-13
77	Electrical Equipment Manufacturing	-41	-5
97	Rail Transportation	-32	-2
99	Truck Transportation	-47	-14
104	Warehousing and Storage	-172	-60
128	Computer Systems Design and Related Services	-43	-10
133	Management of Companies and Enterprises	-29	-31
137	Business Support Services	-44	-9

Table 9. Phase 5 Deficits Adding Anchor Industry 53

Forging and Stamping

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-530	-1
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-12	-0
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-44	-3
35	Basic Chemical Manufacturing	-55	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-79	-1
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-0
56	Boiler, Tank, and Shipping Container Manufacturing	-35	-1
72	Semiconductor and Other Electronic Component Manufacturing	-72	-9
77	Electrical Equipment Manufacturing	-42	-1
97	Rail Transportation	-35	-4
99	Truck Transportation	-67	-20
104	Warehousing and Storage	-213	-41
128	Computer Systems Design and Related Services	-49	-6
133	Management of Companies and Enterprises	-46	-17
137	Business Support Services	-54	-9

Table 10. Phase 6 Deficits Adding Anchor Industry 10

Support Activities for Mining

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-531	-1
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-12	-0
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-45	-1
35	Basic Chemical Manufacturing	-56	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-79	-0
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-0
56	Boiler, Tank, and Shipping Container Manufacturing	-35	-0
72	Semiconductor and Other Electronic Component Manufacturing	-74	-2
77	Electrical Equipment Manufacturing	-43	-1
97	Rail Transportation	-36	-1
99	Truck Transportation	-73	-6
104	Warehousing and Storage	-217	-3
128	Computer Systems Design and Related Services	-53	-4
133	Management of Companies and Enterprises	-58	-12
137	Business Support Services	-60	-6

Table 11. Phase 7 Deficits Adding Anchor Industry 30

Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-538	-7
4	Fishing, Hunting and Trapping	-13	-0
5	Support Activities for Agriculture and Forestry	-18	-6
20	Animal Slaughtering and Processing	-35	-0
32	Converted Paper Product Manufacturing	-46	-2
35	Basic Chemical Manufacturing	-57	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-80	-1
37	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	-11	-0
56	Boiler, Tank, and Shipping Container Manufacturing	-35	-0
72	Semiconductor and Other Electronic Component Manufacturing	-79	-5
77	Electrical Equipment Manufacturing	-46	-3
97	Rail Transportation	-38	-2
99	Truck Transportation	-84	-12
104	Warehousing and Storage	-245	-28
128	Computer Systems Design and Related Services	-56	-3
133	Management of Companies and Enterprises	-66	-8
137	Business Support Services	-63	-3

Chapter 14. Middlesborough, KY

Study Area Overview

The Middlesborough, KY study region occupies 359 square-miles and had a 2018 population of 26,569. The employed share of the regional labor force during the 2014-2018 period averaged 90.6%. 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 28.24% of the region's economy. The region's 2018 coefficient of specialization (COS) is 47.43, 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 Middlesborough, 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 Religious Organizations, whose employment grew by 100 followed by Community and Vocational Rehabilitation 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 1.15, 3.08, and 0.75.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
176	Religious Organizations	100	100	1.15
156	Community and Vocational Rehabilitation Services	75	75	3.08
155	Individual and Family Services	63	27	0.75
30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	60	60	4.79
167	Food Services and Drinking Places	55	-208	1.53
22	Bakeries and Tortilla Manufacturing	50	50	2.90
181	Government and Unclassified	49	32	0.45
121	Consumer Goods Rental and General Rental Centers	49	54	6.17
52	Foundries	38	44	9.99
20	Animal Slaughtering and Processing	34	20	17.30

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 Middlesborough, KY, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 9.61, followed by Education and Knowledge Creation and Agribusiness, Food Processing and Technology. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Middlesborough, 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.

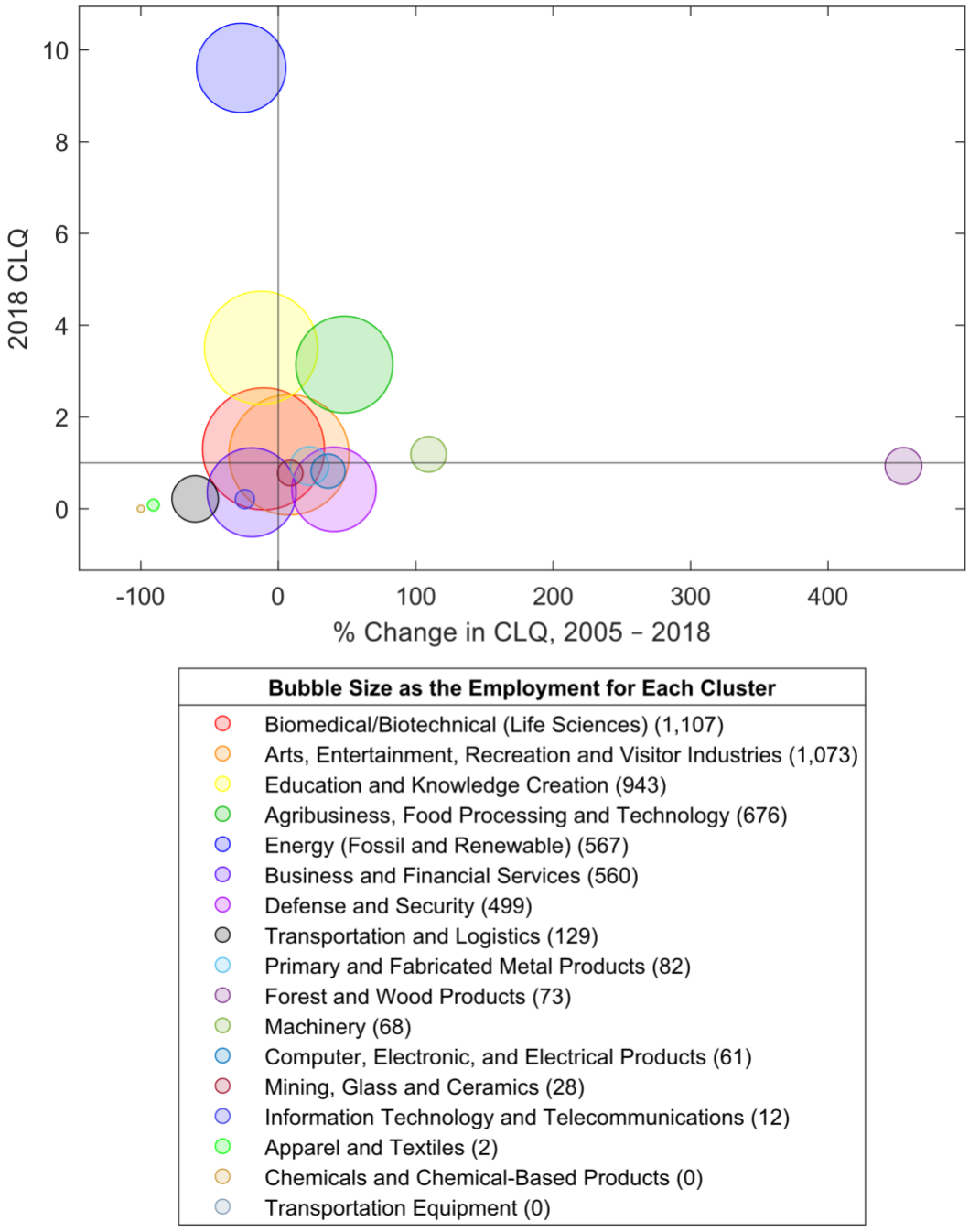
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
4	Biomedical/Biotechnical (Life Sciences)	1.46	1.31	1,107
3	Arts, Entertainment, Recreation and Visitor Industries	1.09	1.17	1,073
9	Education and Knowledge Creation	4.01	3.51	943
1	Agribusiness, Food Processing and Technology	2.12	3.14	676
10	Energy (Fossil and Renewable)	13.16	9.61	567
5	Business and Financial Services	0.44	0.36	560
8	Defense and Security	0.30	0.42	499
16	Transportation and Logistics	0.55	0.22	129
15	Primary and Fabricated Metal Products	0.76	0.93	82
11	Forest and Wood Products	0.17	0.93	73
13	Machinery	0.57	1.19	68
7	Computer, Electronic, and Electrical Products	0.60	0.82	61
14	Mining, Glass and Ceramics	0.72	0.78	28
12	Information Technology and Telecommunications	0.28	0.21	12
2	Apparel and Textiles	0.90	0.08	2
6	Chemicals and Chemical-Based Products	1.43	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 Middlesborough, KY



2. CADS Analysis

The 2018 CADS analysis of the economy of Middlesborough, KY 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 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	427	461

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
20	Animal Slaughtering and Processing	17.30	20	3.38	8.03	0.33	0.15

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	-71
2	Animal Production	-456
5	Support Activities for Agriculture and Forestry	-16
15	Animal Food Manufacturing	-18
99	Truck Transportation	-40
104	Warehousing and Storage	-12
133	Management of Companies and Enterprises	-26

Chapter 15. Morgantown, WV

Study Area Overview

The Morgantown, WV study region occupies 1,009 square-miles and had a 2018 population of 140,259. The employed share of the regional labor force during the 2014-2018 period averaged 94.99%. The Hospitals industry was the region's largest employer in 2018, followed by Junior Colleges, Colleges, Universities, and Professional Schools and Food Services and Drinking Places. These three industries account for a combined 34.47% of the region's economy. The region's 2018 coefficient of specialization (COS) is 35.51, 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 Morgantown, 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 Junior Colleges, Colleges, Universities, and Professional Schools, whose employment grew by 6,249 followed by Hospitals 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 8.95, 4.64, and 1.24.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
144	Junior Colleges, Colleges, Universities, and Professional Schools	6,249	6,164	8.95
153	Hospitals	2,499	1,232	4.64
167	Food Services and Drinking Places	2,093	942	1.24
38	Pharmaceutical and Medicine Manufacturing	943	905	21.51
134	Office Administrative Services	779	739	4.20
181	Government and Unclassified	729	624	0.39
146	Offices of Physicians	523	334	1.23
14	Construction	501	574	0.93
128	Computer Systems Design and Related Services	491	383	0.73
94	General Merchandise Stores	487	436	1.23

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 Morgantown, WV, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 4.59, followed by Chemicals and Chemical-Based Products 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 Morgantown, 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.

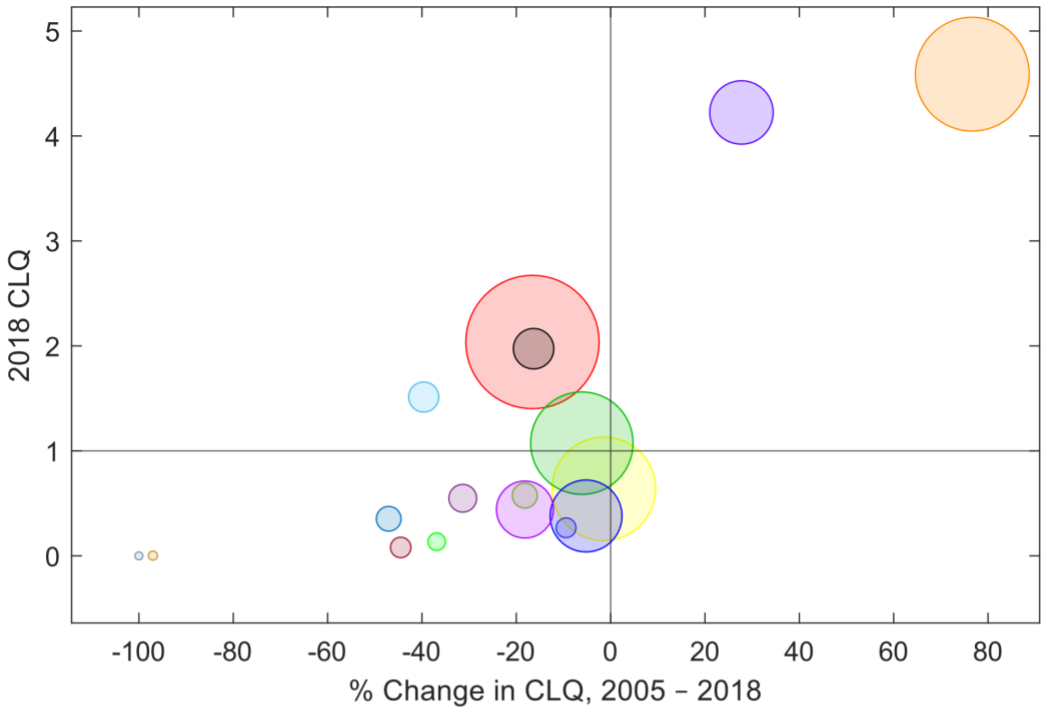
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	2.44	2.04	13,567
9	Education and Knowledge Creation	2.60	4.59	9,691
5	Business and Financial Services	0.65	0.64	7,893
3	Arts, Entertainment, Recreation and Visitor Industries	1.14	1.07	7,706
8	Defense and Security	0.40	0.38	3,528
6	Chemicals and Chemical-Based Products	3.31	4.22	2,657
16	Transportation and Logistics	0.54	0.44	2,075
10	Energy (Fossil and Renewable)	2.36	1.97	914
14	Mining, Glass and Ceramics	2.51	1.51	425
11	Forest and Wood Products	0.80	0.55	339
12	Information Technology and Telecommunications	0.70	0.57	251
15	Primary and Fabricated Metal Products	0.67	0.35	243
1	Agribusiness, Food Processing and Technology	0.14	0.08	135
13	Machinery	0.30	0.27	120
7	Computer, Electronic, and Electrical Products	0.21	0.13	78
17	Transportation Equipment	0.09	0.00	1
2	Apparel and Textiles	0.19	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Morgantown, WV



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (13,567)
Education and Knowledge Creation (9,691)
Business and Financial Services (7,893)
Arts, Entertainment, Recreation and Visitor Industries (7,706)
Defense and Security (3,528)
Chemicals and Chemical-Based Products (2,657)
Transportation and Logistics (2,075)
Energy (Fossil and Renewable) (914)
Mining, Glass and Ceramics (425)
Forest and Wood Products (339)
Information Technology and Telecommunications (251)
Primary and Fabricated Metal Products (243)
Agribusiness, Food Processing and Technology (135)
Machinery (120)
Computer, Electronic, and Electrical Products (78)
Transportation Equipment (1)
Apparel and Textiles (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Morgantown, WV 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 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	1,608	2,551
4	Biomedical/Biotechnical (Life Sciences)	153	Hospitals	7,003	9,501
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	360	6,609
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	3,859	5,952

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
38	Pharmaceutical and Medicine Manufacturing	21.51	905	2.37	58.68	0.88	0.22
153	Hospitals	4.64	1,232	18.09	35.68	0.77	0.21
144	Junior Colleges, Colleges, Universities, and Professional Schools	8.95	6,164	23.90	1,737.58	0.87	0.09
167	Food Services and Drinking Places	1.24	942	29.84	54.25	0.82	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 38

Pharmaceutical and Medicine Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	-33
2	Animal Production	-15
32	Converted Paper Product Manufacturing	-22
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-8
41	Other Chemical Product and Preparation Manufacturing	-10
42	Plastics Product Manufacturing	-65
72	Semiconductor and Other Electronic Component Manufacturing	-14
81	Motor Vehicle Parts Manufacturing	-8
89	Medical Equipment and Supplies Manufacturing	N/A
97	Rail Transportation	-7
117	Insurance Carriers	N/A
118	Agencies, Brokerages, and Other Insurance Related Activities	N/A
129	Management, Scientific, and Technical Consulting Services	N/A
136	Employment Services	N/A
141	Other Support Services	-13

Table 6. Phase 2 Deficits Adding Anchor Industry 153

Hospitals

Industry #	Industry Name	Employment	Added to Deficit

1	Crop Production	-54	-21
2	Animal Production	-40	-26
32	Converted Paper Product Manufacturing	-41	-19
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-13	-5
41	Other Chemical Product and Preparation Manufacturing	-14	-4
42	Plastics Product Manufacturing	-98	-33
72	Semiconductor and Other Electronic Component Manufacturing	-28	-14
81	Motor Vehicle Parts Manufacturing	-20	-12
89	Medical Equipment and Supplies Manufacturing	-61	-113
97	Rail Transportation	-11	-4
117	Insurance Carriers	-279	-296
118	Agencies, Brokerages, and Other Insurance Related Activities	-54	-199
129	Management, Scientific, and Technical Consulting Services	-289	-296
136	Employment Services	-480	-709
141	Other Support Services	-42	-28

Table 7. Phase 3 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-72	-18
2	Animal Production	-61	-21
32	Converted Paper Product Manufacturing	-45	-4
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-14	-1
41	Other Chemical Product and Preparation Manufacturing	-15	-1
42	Plastics Product Manufacturing	-107	-9
72	Semiconductor and Other Electronic Component Manufacturing	-33	-4
81	Motor Vehicle Parts Manufacturing	-23	-3
89	Medical Equipment and Supplies Manufacturing	-61	-0
97	Rail Transportation	-13	-2
117	Insurance Carriers	-287	-8
118	Agencies, Brokerages, and Other Insurance Related Activities	-63	-10
129	Management, Scientific, and Technical Consulting Services	-304	-15
136	Employment Services	-533	-53
141	Other Support Services	-52	-10

Table 8. Phase 4 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-92	-20
2	Animal Production	-87	-26
32	Converted Paper Product Manufacturing	-50	-6
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-15	-1
41	Other Chemical Product and Preparation Manufacturing	-16	-1
42	Plastics Product Manufacturing	-119	-12
72	Semiconductor and Other Electronic Component Manufacturing	-36	-3

81	Motor Vehicle Parts Manufacturing	-26	-3
89	Medical Equipment and Supplies Manufacturing	-61	-0
97	Rail Transportation	-15	-2
117	Insurance Carriers	-295	-7
118	Agencies, Brokerages, and Other Insurance Related Activities	-70	-7
129	Management, Scientific, and Technical Consulting Services	-323	-19
136	Employment Services	-583	-49
141	Other Support Services	-56	-4

Chapter 16. Morristown, TN

Study Area Overview

The Morristown, TN study region occupies 716 square-miles and had a 2018 population of 141,726. The employed share of the regional labor force during the 2014-2018 period averaged 94.28%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Motor Vehicle Parts Manufacturing and Elementary and Secondary Schools. These three industries account for a combined 20.91% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.12, 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 Morristown, 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 1,413 followed by Motor Vehicle Parts Manufacturing 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 1.04, 17.88, and 0.33.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	1,413	702	1.04
81	Motor Vehicle Parts Manufacturing	1,043	1,296	17.88
181	Government and Unclassified	756	702	0.33
90	Other Miscellaneous Manufacturing	677	712	8.83
99	Truck Transportation	632	614	4.18
40	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	380	380	11.12
155	Individual and Family Services	332	218	0.58
20	Animal Slaughtering and Processing	328	302	6.87
137	Business Support Services	325	309	1.64
151	Home Health Care Services	313	201	0.97

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 Morristown, TN, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 9.91, 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 Morristown, 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.

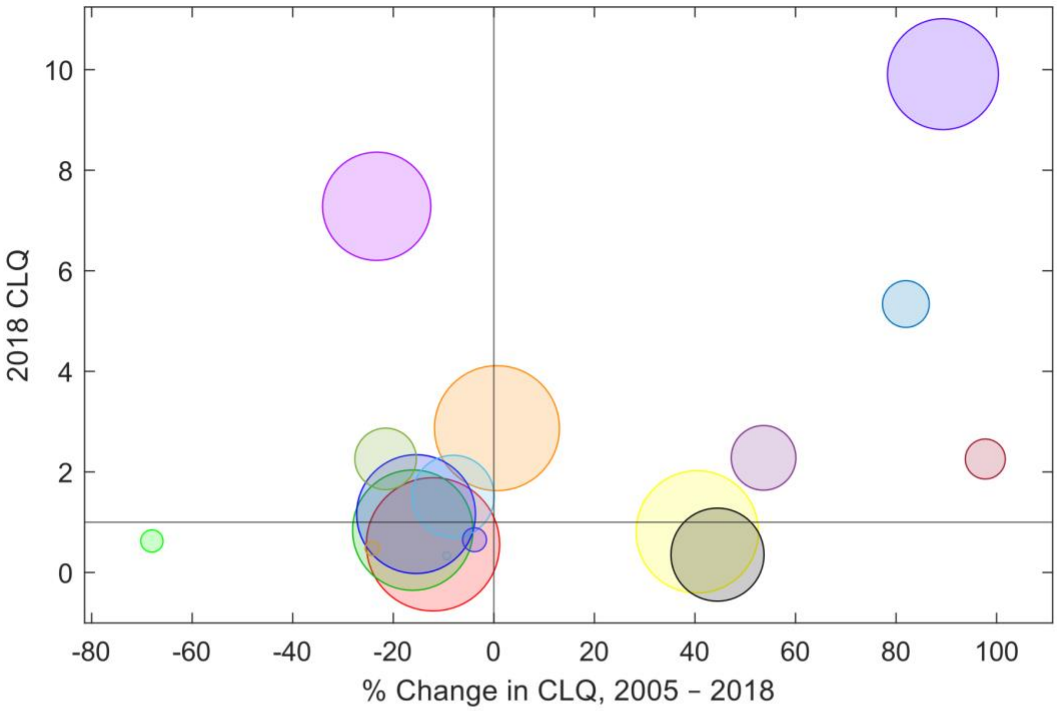
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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	0.64	0.56	5,236
9	Education and Knowledge Creation	2.85	2.87	4,583
3	Arts, Entertainment, Recreation and Visitor Industries	0.58	0.81	4,386
4	Biomedical/Biotechnical (Life Sciences)	1.00	0.84	4,239
16	Transportation and Logistics	1.37	1.16	4,129
17	Transportation Equipment	5.23	9.91	3,582
11	Forest and Wood Products	9.50	7.28	3,404
8	Defense and Security	0.25	0.35	2,491
1	Agribusiness, Food Processing and Technology	1.65	1.51	1,933
15	Primary and Fabricated Metal Products	1.48	2.28	1,187
6	Chemicals and Chemical-Based Products	2.88	2.26	1,075
2	Apparel and Textiles	2.93	5.34	633
14	Mining, Glass and Ceramics	1.14	2.26	479
10	Energy (Fossil and Renewable)	0.68	0.65	228
13	Machinery	1.96	0.63	212
12	Information Technology and Telecommunications	0.63	0.48	158
7	Computer, Electronic, and Electrical Products	0.36	0.33	145

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Morristown, TN



Bubble Size as the Employment for Each Cluster
Business and Financial Services (5,236)
Education and Knowledge Creation (4,583)
Arts, Entertainment, Recreation and Visitor Industries (4,386)
Biomedical/Biotechnical (Life Sciences) (4,239)
Transportation and Logistics (4,129)
Transportation Equipment (3,582)
Forest and Wood Products (3,404)
Defense and Security (2,491)
Agribusiness, Food Processing and Technology (1,933)
Primary and Fabricated Metal Products (1,187)
Chemicals and Chemical-Based Products (1,075)
Apparel and Textiles (633)
Mining, Glass and Ceramics (479)
Energy (Fossil and Renewable) (228)
Machinery (212)
Information Technology and Telecommunications (158)
Computer, Electronic, and Electrical Products (145)

2. CADS Analysis

The 2018 CADS analysis of the economy of Morristown, TN 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 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	2,183	3,226
1	Agribusiness, Food Processing and Technology	20	Animal Slaughtering and Processing	760	1,088
11	Forest and Wood Products	90	Other Miscellaneous Manufacturing	212	889

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	17.88	1,296	-11.56	47.80	0.64	0.29
20	Animal Slaughtering and Processing	6.87	302	3.38	43.12	0.47	0.07
90	Other Miscellaneous Manufacturing	8.83	712	-16.56	320.02	0.82	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 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
1	Crop Production	N/A
2	Animal Production	N/A
43	Rubber Product Manufacturing	-50
48	Iron and Steel Mills and Ferroalloy Manufacturing	-101
49	Steel Product Manufacturing From Purchased Steel	-85
52	Foundries	-163
55	Architectural and Structural Metals Manufacturing	-84
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-316
72	Semiconductor and Other Electronic Component Manufacturing	-284
78	Other Electrical Equipment and Component Manufacturing	-53
104	Warehousing and Storage	-103
133	Management of Companies and Enterprises	-77

Table 6. Phase 2 Deficits Adding Anchor Industry 20

Animal Slaughtering and Processing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-78	-168
2	Animal Production	-1,062	-1,088
43	Rubber Product Manufacturing	-52	-2
48	Iron and Steel Mills and Ferroalloy Manufacturing	-102	-1
49	Steel Product Manufacturing From Purchased Steel	-86	-1
52	Foundries	-164	-1
55	Architectural and Structural Metals Manufacturing	-87	-2
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-321	-4

72	Semiconductor and Other Electronic Component Manufacturing	-290	-5
78	Other Electrical Equipment and Component Manufacturing	-56	-3
104	Warehousing and Storage	-140	-37
133	Management of Companies and Enterprises	-149	-71

Table 7. Phase 3 Deficits Adding Anchor Industry 90

Other Miscellaneous Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-89	-11
2	Animal Production	-1,062	-1
43	Rubber Product Manufacturing	-53	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-106	-5
49	Steel Product Manufacturing From Purchased Steel	-89	-3
52	Foundries	-167	-3
55	Architectural and Structural Metals Manufacturing	-90	-3
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-338	-18
72	Semiconductor and Other Electronic Component Manufacturing	-305	-15
78	Other Electrical Equipment and Component Manufacturing	-58	-1
104	Warehousing and Storage	-183	-43
133	Management of Companies and Enterprises	-178	-30

Chapter 17. Mount Airy, NC

Study Area Overview

The Mount Airy, NC study region occupies 532 square-miles and had a 2018 population of 71,948. The employed share of the regional labor force during the 2014-2018 period averaged 96.8%. The Construction 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 25.7% of the region's economy. The region's 2018 coefficient of specialization (COS) is 36, 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 Mount Airy, 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 Architectural and Structural Metals Manufacturing, whose employment grew by 531 followed by Management of Companies and Enterprises 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 9.15, 1.02, and 1.41.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
55	Architectural and Structural Metals Manufacturing	531	533	9.15
133	Management of Companies and Enterprises	432	429	1.02
153	Hospitals	410	246	1.41
167	Food Services and Drinking Places	363	-267	1.12
94	General Merchandise Stores	217	163	2.32
151	Home Health Care Services	215	-102	2.18
126	Architectural, Engineering, and Related Services	177	167	1.01
144	Junior Colleges, Colleges, Universities, and Professional Schools	135	58	1.36
166	Accommodation	127	120	0.51
42	Plastics Product Manufacturing	107	120	2.74

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 Mount Airy, NC, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 8.15, 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 Mount Airy, 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.

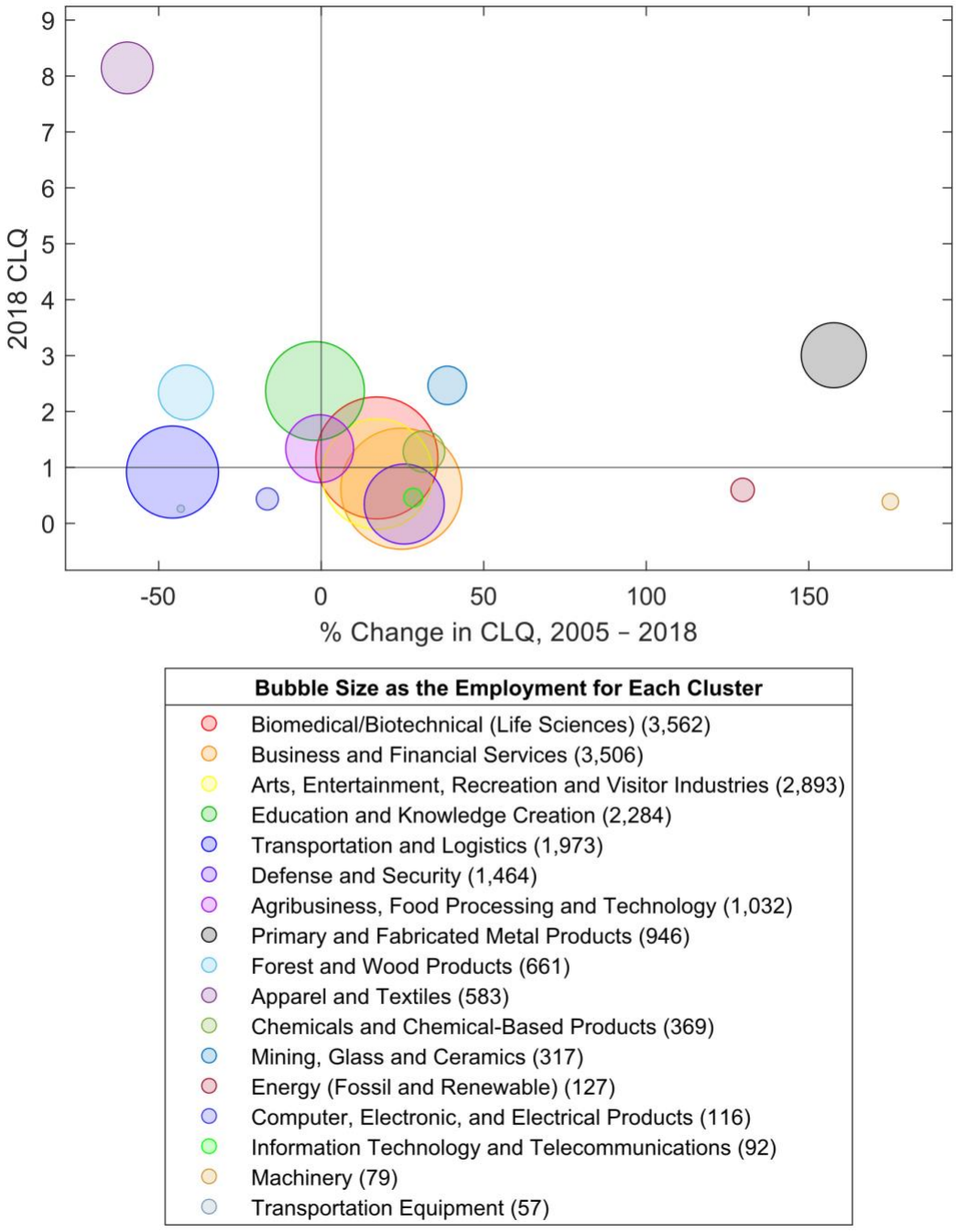
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.00	1.17	3,562
5	Business and Financial Services	0.50	0.62	3,506
3	Arts, Entertainment, Recreation and Visitor Industries	0.75	0.88	2,893
9	Education and Knowledge Creation	2.41	2.37	2,284
16	Transportation and Logistics	1.69	0.92	1,973
8	Defense and Security	0.27	0.35	1,464
1	Agribusiness, Food Processing and Technology	1.34	1.34	1,032
15	Primary and Fabricated Metal Products	1.17	3.01	946
11	Forest and Wood Products	4.01	2.34	661
2	Apparel and Textiles	20.21	8.15	583
6	Chemicals and Chemical-Based Products	0.98	1.29	369
14	Mining, Glass and Ceramics	1.78	2.47	317
10	Energy (Fossil and Renewable)	0.26	0.60	127
7	Computer, Electronic, and Electrical Products	0.52	0.44	116
12	Information Technology and Telecommunications	0.36	0.46	92
13	Machinery	0.14	0.39	79
17	Transportation Equipment	0.46	0.26	57

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Mount Airy, NC



2. CADS Analysis

The 2018 CADS analysis of the economy of Mount Airy, NC 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 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	905	1,315
15	Primary and Fabricated Metal Products	55	Architectural and Structural Metals Manufacturing	128	659
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	189	296
9	Education and Knowledge Creation	144	Junior Colleges, Colleges, Universities, and Professional Schools	323	458

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	1.41	246	18.09	45.32	0.71	0.07
55	Architectural and Structural Metals Manufacturing	9.15	533	-1.47	416.19	0.57	0.05
42	Plastics Product Manufacturing	2.74	120	-6.65	56.58	0.48	0.03
144	Junior Colleges, Colleges, Universities, and Professional Schools	1.36	58	23.90	41.73	0.86	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 153

Hospitals

Industry #	Industry Name	Employment
32	Converted Paper Product Manufacturing	-3
35	Basic Chemical Manufacturing	-2
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-1
38	Pharmaceutical and Medicine Manufacturing	-10
48	Iron and Steel Mills and Ferroalloy Manufacturing	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	N/A
72	Semiconductor and Other Electronic Component Manufacturing	-2
89	Medical Equipment and Supplies Manufacturing	-16
103	Couriers and Messengers	-6
117	Insurance Carriers	-33
129	Management, Scientific, and Technical Consulting Services	-10
139	Investigation and Security Services	N/A
152	Other Ambulatory Health Care Services	-17

Table 6. Phase 2 Deficits Adding Anchor Industry 55

Architectural and Structural Metals Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
32	Converted Paper Product Manufacturing	-5	-3
35	Basic Chemical Manufacturing	-4	-2

36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-2	-1
38	Pharmaceutical and Medicine Manufacturing	-10	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-22	-22
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-32	-34
72	Semiconductor and Other Electronic Component Manufacturing	-12	-10
89	Medical Equipment and Supplies Manufacturing	-16	-0
103	Couriers and Messengers	-10	-4
117	Insurance Carriers	-35	-2
129	Management, Scientific, and Technical Consulting Services	-17	-7
139	Investigation and Security Services	-14	-15
152	Other Ambulatory Health Care Services	-18	-0

Table 7. Phase 3 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
32	Converted Paper Product Manufacturing	-10	-5
35	Basic Chemical Manufacturing	-14	-11
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-20	-18
38	Pharmaceutical and Medicine Manufacturing	-10	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-23	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-37	-5
72	Semiconductor and Other Electronic Component Manufacturing	-17	-5
89	Medical Equipment and Supplies Manufacturing	-16	-0
103	Couriers and Messengers	-12	-2
117	Insurance Carriers	-36	-1
129	Management, Scientific, and Technical Consulting Services	-22	-5
139	Investigation and Security Services	-16	-3
152	Other Ambulatory Health Care Services	-18	-0

Table 8. Phase 4 Deficits Adding Anchor Industry 144

Junior Colleges, Colleges, Universities, and Professional Schools

Industry #	Industry Name	Employment	Added to Deficit
32	Converted Paper Product Manufacturing	-10	-0
35	Basic Chemical Manufacturing	-15	-0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-20	-0
38	Pharmaceutical and Medicine Manufacturing	-10	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-23	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-38	-0
72	Semiconductor and Other Electronic Component Manufacturing	-18	-0
89	Medical Equipment and Supplies Manufacturing	-16	-0
103	Couriers and Messengers	-13	-0
117	Insurance Carriers	-37	-1
129	Management, Scientific, and Technical Consulting Services	-23	-1
139	Investigation and Security Services	-17	-1
152	Other Ambulatory Health Care Services	-18	-0

Chapter 18. Mount Sterling, KY

Study Area Overview

The Mount Sterling, KY study region occupies 680 square-miles and had a 2018 population of 47,037. The employed share of the regional labor force during the 2014-2018 period averaged 94.24%. The Elementary and Secondary Schools 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 22.44% of the region's economy. The region's 2018 coefficient of specialization (COS) is 43.89, 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 Mount Sterling, 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 Motor Vehicle Parts Manufacturing, whose employment grew by 288 followed by Food Services and Drinking Places and Other Electrical Equipment and Component 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 14.87, 1.02, and 24.02.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
81	Motor Vehicle Parts Manufacturing	288	339	14.87
167	Food Services and Drinking Places	224	-12	1.02
78	Other Electrical Equipment and Component Manufacturing	206	199	24.02
48	Iron and Steel Mills and Ferroalloy Manufacturing	174	174	24.98
143	Elementary and Secondary Schools	164	-131	13.12
155	Individual and Family Services	131	111	0.72
146	Offices of Physicians	113	78	1.18
103	Couriers and Messengers	90	90	1.44
140	Services to Buildings and Dwellings	81	63	0.66
49	Steel Product Manufacturing From Purchased Steel	61	61	13.11

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 Mount Sterling, KY, the cluster with the largest CLQ in 2018 is Transportation Equipment with a CLQ of 8.63, followed by Chemicals and Chemical-Based 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 Mount Sterling, 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.

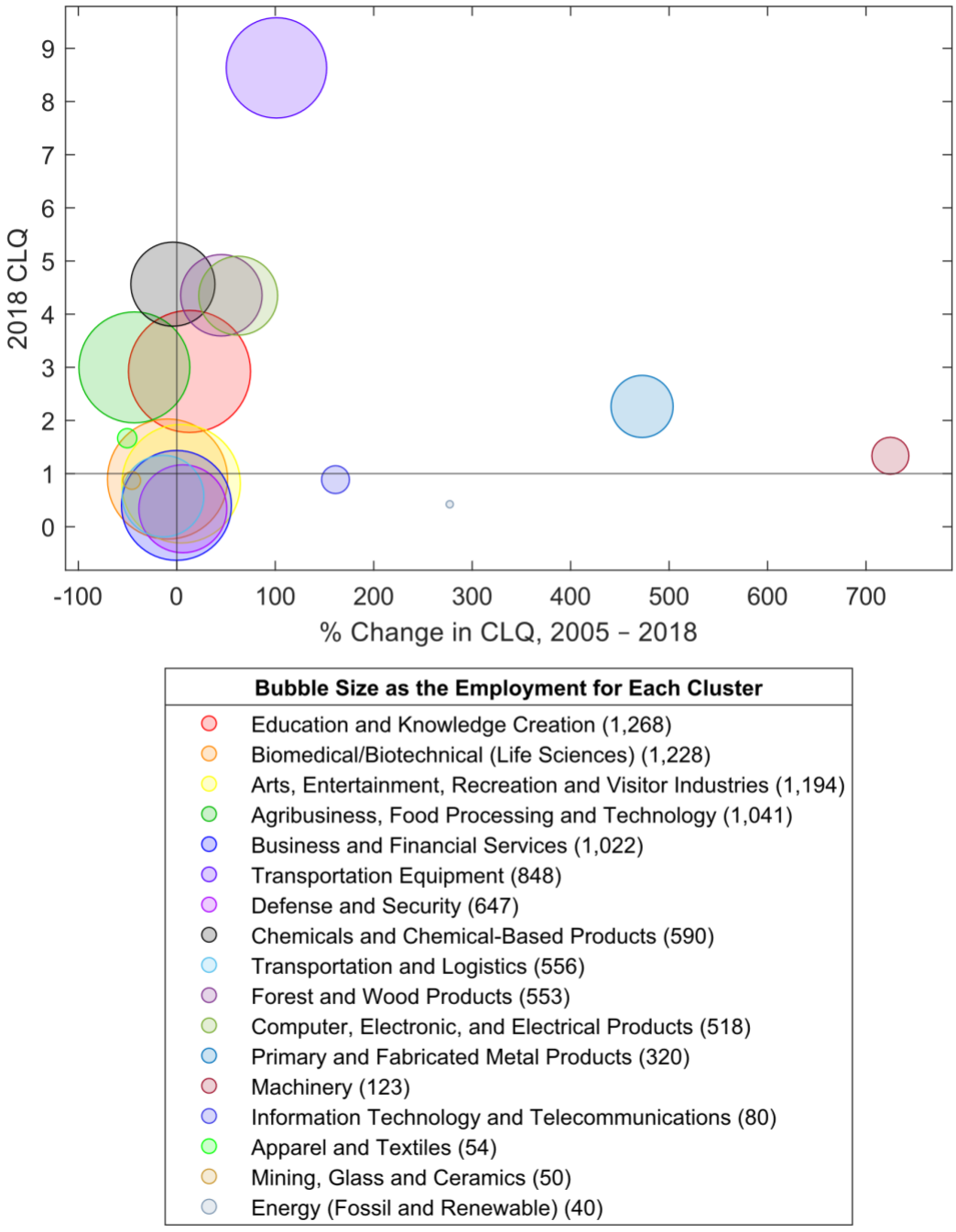
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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	2.59	2.92	1,268
4	Biomedical/Biotechnical (Life Sciences)	0.99	0.90	1,228
3	Arts, Entertainment, Recreation and Visitor Industries	0.78	0.81	1,194
1	Agribusiness, Food Processing and Technology	5.27	3.00	1,041
5	Business and Financial Services	0.40	0.40	1,022
17	Transportation Equipment	4.29	8.63	848
8	Defense and Security	0.32	0.34	647
6	Chemicals and Chemical-Based Products	4.75	4.56	590
16	Transportation and Logistics	0.67	0.58	556
11	Forest and Wood Products	3.00	4.36	553
7	Computer, Electronic, and Electrical Products	2.68	4.35	518
15	Primary and Fabricated Metal Products	0.40	2.26	320
13	Machinery	0.16	1.34	123
12	Information Technology and Telecommunications	0.34	0.89	80
2	Apparel and Textiles	3.36	1.67	54
14	Mining, Glass and Ceramics	1.60	0.87	50
10	Energy (Fossil and Renewable)	0.11	0.42	40

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Mount Sterling, KY



2. CADS Analysis

The 2018 CADS analysis of the economy of Mount Sterling, KY 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 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	442	729
7	Computer, Electronic, and Electrical Products	78	Other Electrical Equipment and Component Manufacturing	84	290
7	Computer, Electronic, and Electrical Products	76	Household Appliance Manufacturing	181	156
11	Forest and Wood Products	86	Household and Institutional Furniture and Kitchen Cabinet Manufacturing, Excluding Wood TV, Radio and Sewing Machine Cabinet Manufacturing	356	301

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
81	Motor Vehicle Parts Manufacturing	14.87	339	-11.56	65.13	0.61	0.23
78	Other Electrical Equipment and Component Manufacturing	24.02	199	8.84	245.05	0.51	0.06
76	Household Appliance Manufacturing	29.97	20	-25.03	-13.72	0.68	0.03

86	Household and Institutional Furniture and Kitchen Cabinet Manufacturing, Excluding Wood TV, Radio and Sewing Machine Cabinet Manufacturing	13.35	67	-34.24	-15.50	0.73	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 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
51	Nonferrous Metal (except Aluminum) Production and Processing	-22
52	Foundries	-73
53	Forging and Stamping	-33
55	Architectural and Structural Metals Manufacturing	-19
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-44
61	Other Fabricated Metal Product Manufacturing	-24
72	Semiconductor and Other Electronic Component Manufacturing	-64
133	Management of Companies and Enterprises	-62
136	Employment Services	-14
137	Business Support Services	-17
139	Investigation and Security Services	-14

Table 6. Phase 2 Deficits Adding Anchor Industry 78

Other Electrical Equipment and Component Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
51	Nonferrous Metal (except Aluminum) Production and Processing	-52	-31
52	Foundries	-74	-2

53	Forging and Stamping	-37	-4
55	Architectural and Structural Metals Manufacturing	-22	-3
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-54	-11
61	Other Fabricated Metal Product Manufacturing	-27	-2
72	Semiconductor and Other Electronic Component Manufacturing	-86	-21
133	Management of Companies and Enterprises	-74	-11
136	Employment Services	-25	-11
137	Business Support Services	-21	-4
139	Investigation and Security Services	-18	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 76

Household Appliance Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
51	Nonferrous Metal (except Aluminum) Production and Processing	-54	-2
52	Foundries	-77	-2
53	Forging and Stamping	-42	-5
55	Architectural and Structural Metals Manufacturing	-24	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-61	-7
61	Other Fabricated Metal Product Manufacturing	-28	-1
72	Semiconductor and Other Electronic Component Manufacturing	-90	-4
133	Management of Companies and Enterprises	-79	-6
136	Employment Services	-29	-4
137	Business Support Services	-23	-1
139	Investigation and Security Services	-19	-1

Table 8. Phase 4 Deficits Adding Anchor Industry 86

Household and Institutional Furniture and Kitchen Cabinet Manufacturing, Excluding Wood TV, Radio and Sewing Machine Cabinet Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
51	Nonferrous Metal (except Aluminum) Production and Processing	-55	-0
52	Foundries	-77	-0
53	Forging and Stamping	-42	-0
55	Architectural and Structural Metals Manufacturing	-25	-1
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-64	-2
61	Other Fabricated Metal Product Manufacturing	-28	-0
72	Semiconductor and Other Electronic Component Manufacturing	-94	-4
133	Management of Companies and Enterprises	-84	-4
136	Employment Services	-33	-4
137	Business Support Services	-24	-1
139	Investigation and Security Services	-20	-1

Chapter 19. New Castle, PA

Study Area Overview

The New Castle, PA study region occupies 358 square-miles and had a 2018 population of 86,184. 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 Construction and Individual and Family Services. These three industries account for a combined 22.16% of the region's economy. The region's 2018 coefficient of specialization (COS) is 32.97, 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 New Castle, 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 Individual and Family Services, whose employment grew by 1,304 followed by Construction 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 4.12, 1.33, and 1.21.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
155	Individual and Family Services	1,304	720	4.12
14	Construction	355	400	1.33
133	Management of Companies and Enterprises	247	155	1.21
140	Services to Buildings and Dwellings	223	53	1.84
157	Child Day Care Services	186	181	1.41
104	Warehousing and Storage	176	116	1.20
53	Forging and Stamping	152	185	27.35
167	Food Services and Drinking Places	148	-509	1.09
148	Offices of Other Health Practitioners	131	18	1.66
63	Industrial Machinery Manufacturing	119	120	6.78

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 New Castle, PA, the cluster with the largest CLQ in 2018 is Mining, Glass and Ceramics with a CLQ of 5.7, 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 New Castle, 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.

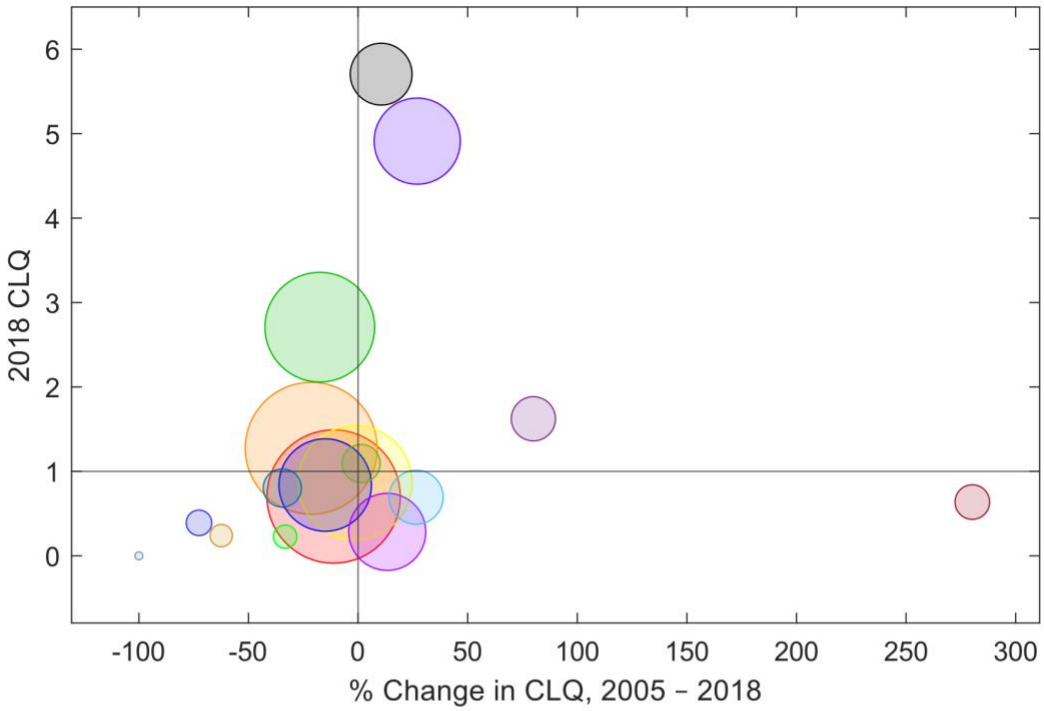
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
5	Business and Financial Services	0.79	0.70	3,881
4	Biomedical/Biotechnical (Life Sciences)	1.62	1.27	3,794
3	Arts, Entertainment, Recreation and Visitor Industries	0.88	0.87	2,781
9	Education and Knowledge Creation	3.28	2.71	2,557
16	Transportation and Logistics	0.99	0.84	1,763
15	Primary and Fabricated Metal Products	3.87	4.91	1,511
8	Defense and Security	0.25	0.28	1,178
14	Mining, Glass and Ceramics	5.16	5.70	716
1	Agribusiness, Food Processing and Technology	0.55	0.69	524
13	Machinery	0.90	1.62	325
10	Energy (Fossil and Renewable)	1.08	1.09	227
6	Chemicals and Chemical-Based Products	1.23	0.80	226
11	Forest and Wood Products	0.17	0.64	176
12	Information Technology and Telecommunications	1.43	0.39	76
7	Computer, Electronic, and Electrical Products	0.34	0.23	59
17	Transportation Equipment	0.64	0.24	51
2	Apparel and Textiles	1.15	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of New Castle, PA



Bubble Size as the Employment for Each Cluster
Business and Financial Services (3,881)
Biomedical/Biotechnical (Life Sciences) (3,794)
Arts, Entertainment, Recreation and Visitor Industries (2,781)
Education and Knowledge Creation (2,557)
Transportation and Logistics (1,763)
Primary and Fabricated Metal Products (1,511)
Defense and Security (1,178)
Mining, Glass and Ceramics (716)
Agribusiness, Food Processing and Technology (524)
Machinery (325)
Energy (Fossil and Renewable) (227)
Chemicals and Chemical-Based Products (226)
Forest and Wood Products (176)
Information Technology and Telecommunications (76)
Computer, Electronic, and Electrical Products (59)
Transportation Equipment (51)
Apparel and Textiles (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of New Castle, PA 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 Forging and Stamping, 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	53	Forging and Stamping	334	486
5	Business and Financial Services	140	Services to Buildings and Dwellings	721	944
4	Biomedical/Biotechnical (Life Sciences)	148	Offices of Other Health Practitioners	189	320

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
53	Forging and Stamping	27.35	185	-9.92	45.51	0.85	0.07
140	Services to Buildings and Dwellings	1.84	53	23.59	30.91	0.83	0.02
148	Offices of Other Health Practitioners	1.66	18	59.61	69.31	0.79	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 53

Forging and Stamping

Industry #	Industry Name	Employment
50	Alumina and Aluminum Production and Processing	-12
72	Semiconductor and Other Electronic Component Manufacturing	-13
81	Motor Vehicle Parts Manufacturing	-9
136	Employment Services	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 140

Services to Buildings and Dwellings

Industry #	Industry Name	Employment	Added to Deficit
50	Alumina and Aluminum Production and Processing	-12	-0
72	Semiconductor and Other Electronic Component Manufacturing	-14	-1
81	Motor Vehicle Parts Manufacturing	-13	-4
136	Employment Services	-10	-25

Table 7. Phase 3 Deficits Adding Anchor Industry 148

Offices of Other Health Practitioners

Industry #	Industry Name	Employment	Added to Deficit
50	Alumina and Aluminum Production and Processing	-12	-0
72	Semiconductor and Other Electronic Component Manufacturing	-14	-0
81	Motor Vehicle Parts Manufacturing	-13	-0
136	Employment Services	-18	-7

Chapter 20. New Philadelphia-Dover, OH

Study Area Overview

The New Philadelphia-Dover, OH study region occupies 568 square-miles and had a 2018 population of 92,176. The employed share of the regional labor force during the 2014-2018 period averaged 96.7%. 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 21.43% of the region's economy. The region's 2018 coefficient of specialization (COS) is 34.83, 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 New Philadelphia-Dover, 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 Employment Services, whose employment grew by 483 followed by Clay Product and Refractory 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 0.82, 57.72, and 1.11.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
136	Employment Services	483	481	0.82
44	Clay Product and Refractory Manufacturing	407	465	57.72
155	Individual and Family Services	395	141	1.11
154	Nursing and Residential Care Facilities	323	72	2.29
153	Hospitals	307	120	1.14
10	Support Activities for Mining	271	230	4.38
142	Waste Management and Remediation Services	235	162	4.83
145	Other Educational Services	234	210	1.28
7	Coal Mining	217	241	25.03
80	Motor Vehicle Body and Trailer Manufacturing	184	186	6.77

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 New Philadelphia-Dover, OH, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 5.68, followed by Machinery 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 New Philadelphia-Dover, 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.

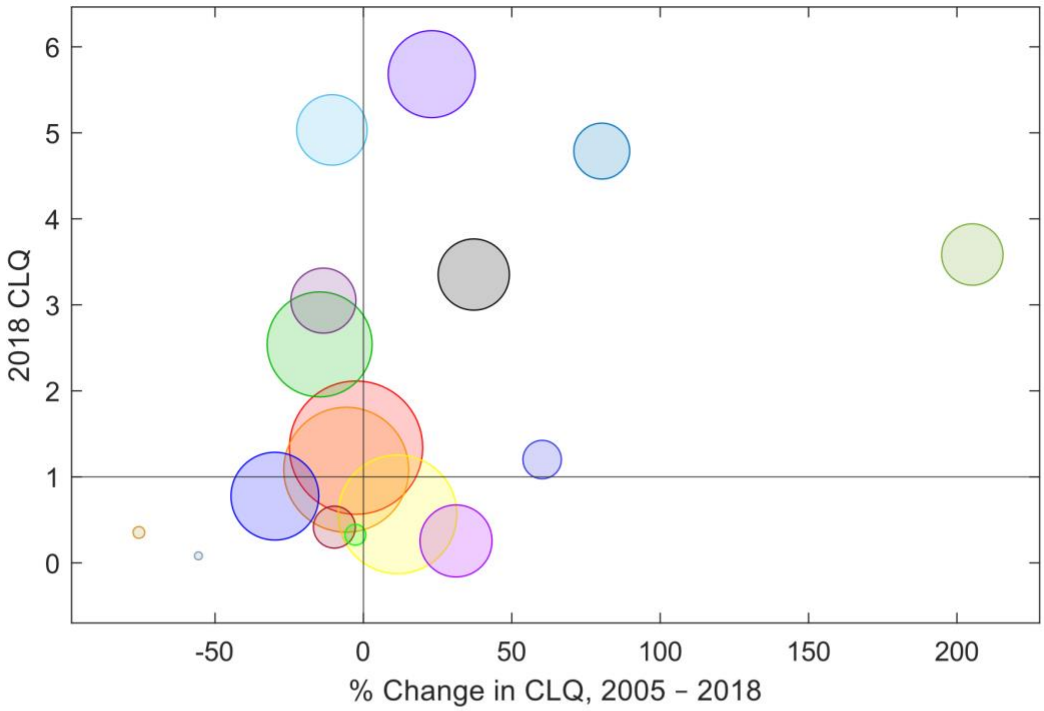
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.37	1.34	5,096
3	Arts, Entertainment, Recreation and Visitor Industries	1.15	1.08	4,441
5	Business and Financial Services	0.51	0.56	3,983
9	Education and Knowledge Creation	2.98	2.54	3,064
16	Transportation and Logistics	1.11	0.78	2,083
6	Chemicals and Chemical-Based Products	4.62	5.68	2,042
8	Defense and Security	0.19	0.25	1,352
15	Primary and Fabricated Metal Products	2.44	3.35	1,318
13	Machinery	5.63	5.03	1,288
11	Forest and Wood Products	3.52	3.05	1,077
10	Energy (Fossil and Renewable)	1.17	3.59	949
14	Mining, Glass and Ceramics	2.66	4.79	768
1	Agribusiness, Food Processing and Technology	0.46	0.42	401
17	Transportation Equipment	0.75	1.20	328
12	Information Technology and Telecommunications	0.34	0.33	82
2	Apparel and Textiles	1.45	0.35	32
7	Computer, Electronic, and Electrical Products	0.18	0.08	27

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of New Philadelphia-Dover, OH



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (5,096)
Arts, Entertainment, Recreation and Visitor Industries (4,441)
Business and Financial Services (3,983)
Education and Knowledge Creation (3,064)
Transportation and Logistics (2,083)
Chemicals and Chemical-Based Products (2,042)
Defense and Security (1,352)
Primary and Fabricated Metal Products (1,318)
Machinery (1,288)
Forest and Wood Products (1,077)
Energy (Fossil and Renewable) (949)
Mining, Glass and Ceramics (768)
Agribusiness, Food Processing and Technology (401)
Transportation Equipment (328)
Information Technology and Telecommunications (82)
Apparel and Textiles (32)
Computer, Electronic, and Electrical Products (27)

2. CADS Analysis

The 2018 CADS analysis of the economy of New Philadelphia-Dover, OH identifies 8 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 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	750	849
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	580	679
16	Transportation and Logistics	99	Truck Transportation	637	669
4	Biomedical/Biotechnical (Life Sciences)	154	Nursing and Residential Care Facilities	1,432	1,755
14	Mining, Glass and Ceramics	44	Clay Product and Refractory Manufacturing	152	559
4	Biomedical/Biotechnical (Life Sciences)	89	Medical Equipment and Supplies Manufacturing	320	385
5	Business and Financial Services	142	Waste Management and Remediation Services	258	494
13	Machinery	66	Metalworking Machinery Manufacturing	480	489

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
43	Rubber Product Manufacturing	26.83	228	-17.19	13.20	0.73	0.07

42	Plastics Product Manufacturing	5.03	138	-6.65	17.07	0.73	0.05
99	Truck Transportation	1.73	24	1.19	5.02	0.90	0.03
154	Nursing and Residential Care Facilities	2.29	72	17.58	22.59	0.93	0.03
44	Clay Product and Refractory Manufacturing	57.72	465	-38.17	267.71	0.86	0.03
89	Medical Equipment and Supplies Manufacturing	5.22	52	4.20	20.28	0.78	0.02
142	Waste Management and Remediation Services	4.83	162	28.36	91.21	0.89	0.02
66	Metalworking Machinery Manufacturing	11.64	63	-11.28	1.88	0.78	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	-20
3	Forestry and Logging	-43
5	Support Activities for Agriculture and Forestry	-12
26	Textile Mills and Textile Product Mills	-66
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-27
48	Iron and Steel Mills and Ferroalloy Manufacturing	-7
53	Forging and Stamping	-8
72	Semiconductor and Other Electronic Component Manufacturing	-20
97	Rail Transportation	-4

102	Scenic and Sightseeing Transportation and Support Activities for Transportation	N/A
104	Warehousing and Storage	N/A
117	Insurance Carriers	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-32	-12
3	Forestry and Logging	-45	-2
5	Support Activities for Agriculture and Forestry	-13	-2
26	Textile Mills and Textile Product Mills	-77	-11
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-68	-41
48	Iron and Steel Mills and Ferroalloy Manufacturing	-8	-1
53	Forging and Stamping	-9	-1
72	Semiconductor and Other Electronic Component Manufacturing	-31	-11
97	Rail Transportation	-10	-6
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	N/A	-8
104	Warehousing and Storage	-41	-43
117	Insurance Carriers	N/A	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-33	-1
3	Forestry and Logging	-46	-0
5	Support Activities for Agriculture and Forestry	-14	-0
26	Textile Mills and Textile Product Mills	-77	-0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-68	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-8	-0
53	Forging and Stamping	-9	-0
72	Semiconductor and Other Electronic Component Manufacturing	-32	-1
97	Rail Transportation	-13	-3
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-39	-56
104	Warehousing and Storage	-71	-30
117	Insurance Carriers	-4	-9

Table 8. Phase 4 Deficits Adding Anchor Industry 154

Nursing and Residential Care Facilities

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-36	-3
3	Forestry and Logging	-46	-0
5	Support Activities for Agriculture and Forestry	-14	-0
26	Textile Mills and Textile Product Mills	-84	-6

36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-69	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-9	-0
53	Forging and Stamping	-10	-0
72	Semiconductor and Other Electronic Component Manufacturing	-33	-1
97	Rail Transportation	-14	-0
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-41	-2
104	Warehousing and Storage	-74	-3
117	Insurance Carriers	-8	-3

Table 9. Phase 5 Deficits Adding Anchor Industry 44

Clay Product and Refractory Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-38	-2
3	Forestry and Logging	-47	-1
5	Support Activities for Agriculture and Forestry	-15	-1
26	Textile Mills and Textile Product Mills	-91	-7
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-69	-1
48	Iron and Steel Mills and Ferroalloy Manufacturing	-10	-1
53	Forging and Stamping	-14	-4
72	Semiconductor and Other Electronic Component Manufacturing	-41	-8
97	Rail Transportation	-18	-4
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-45	-4
104	Warehousing and Storage	-92	-18
117	Insurance Carriers	-11	-4

Table 10. Phase 6 Deficits Adding Anchor Industry 89

Medical Equipment and Supplies Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-39	-2
3	Forestry and Logging	-48	-1
5	Support Activities for Agriculture and Forestry	-15	-0
26	Textile Mills and Textile Product Mills	-98	-7
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-72	-3
48	Iron and Steel Mills and Ferroalloy Manufacturing	-11	-1
53	Forging and Stamping	-16	-2
72	Semiconductor and Other Electronic Component Manufacturing	-47	-6
97	Rail Transportation	-19	-1
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-47	-1
104	Warehousing and Storage	-107	-15
117	Insurance Carriers	-12	-1

Table 11. Phase 7 Deficits Adding Anchor Industry 142

Waste Management and Remediation Services

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-40	-1
3	Forestry and Logging	-48	-0
5	Support Activities for Agriculture and Forestry	-15	-0
26	Textile Mills and Textile Product Mills	-99	-1
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-72	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-12	-1
53	Forging and Stamping	-16	-1
72	Semiconductor and Other Electronic Component Manufacturing	-48	-1
97	Rail Transportation	-19	-0
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-53	-6
104	Warehousing and Storage	-110	-3
117	Insurance Carriers	-15	-3

Table 12. Phase 8 Deficits Adding Anchor Industry 66

Metalworking Machinery Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
1	Crop Production	-40	-0
3	Forestry and Logging	-48	-0
5	Support Activities for Agriculture and Forestry	-15	-0
26	Textile Mills and Textile Product Mills	-99	-0
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-73	-0
48	Iron and Steel Mills and Ferroalloy Manufacturing	-16	-4
53	Forging and Stamping	-18	-2
72	Semiconductor and Other Electronic Component Manufacturing	-56	-7
97	Rail Transportation	-20	-1
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-54	-1
104	Warehousing and Storage	-125	-15
117	Insurance Carriers	-16	-1

Chapter 21. Newport, TN

Study Area Overview

The Newport, TN study region occupies 435 square-miles and had a 2018 population of 35,774. The employed share of the regional labor force during the 2014-2018 period averaged 90.6%. 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 30.71% of the region's economy. The region's 2018 coefficient of specialization (COS) is 47.48, 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 Newport, 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 261 followed by Other Fabricated Metal Product Manufacturing and Spring and Wire 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 1.65, 12.33, and 115.13.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
167	Food Services and Drinking Places	261	52	1.65
61	Other Fabricated Metal Product Manufacturing	168	168	12.33
58	Spring and Wire Product Manufacturing	143	169	115.13
95	All Other Retail	113	125	1.32
143	Elementary and Secondary Schools	92	-143	17.02
181	Government and Unclassified	87	71	0.48
165	Other Amusement and Recreation Industries	86	67	2.16
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	86	86	18.69
152	Other Ambulatory Health Care Services	62	55	4.76
30	Other Wood Product Manufacturing, Including Wood TV, Radio and Sewing Machine Cabinet Manufacturing	62	71	8.08

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 Newport, TN, the cluster with the largest CLQ in 2018 is Forest and Wood Products with a CLQ of 5.81, 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 Newport, 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.

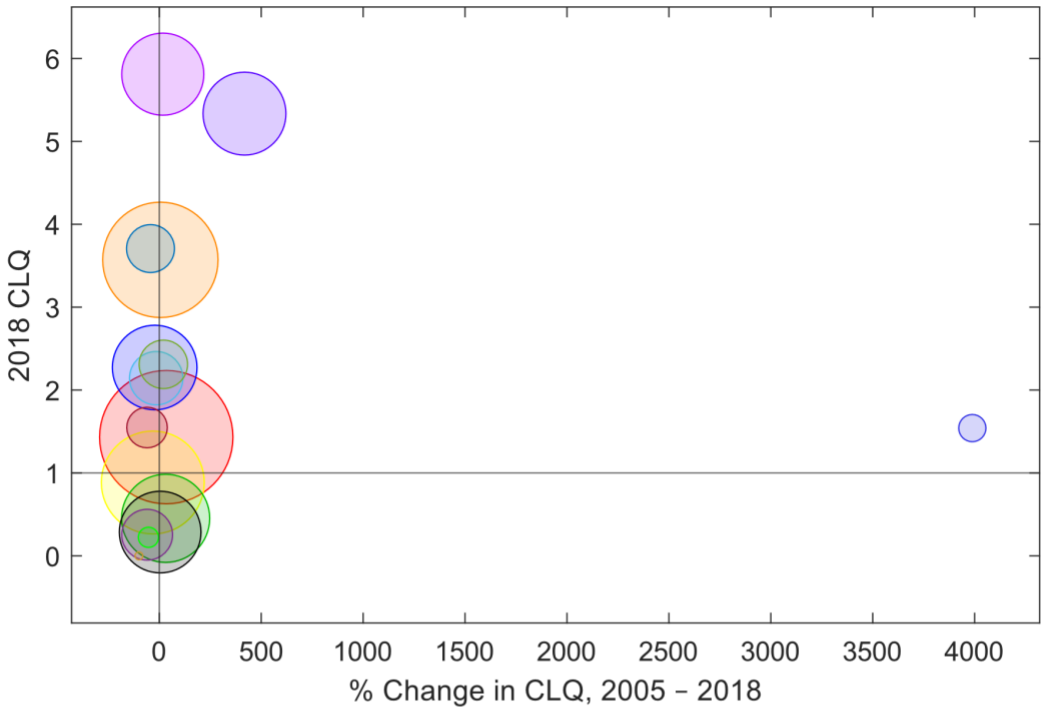
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
3	Arts, Entertainment, Recreation and Visitor Industries	1.07	1.43	1,243
9	Education and Knowledge Creation	3.39	3.57	912
4	Biomedical/Biotechnical (Life Sciences)	1.30	0.88	713
8	Defense and Security	0.35	0.45	508
1	Agribusiness, Food Processing and Technology	2.93	2.27	464
15	Primary and Fabricated Metal Products	1.03	5.33	444
11	Forest and Wood Products	4.96	5.81	434
5	Business and Financial Services	0.27	0.29	429
6	Chemicals and Chemical-Based Products	2.53	2.14	163
16	Transportation and Logistics	0.63	0.25	145
10	Energy (Fossil and Renewable)	1.93	2.31	129
14	Mining, Glass and Ceramics	6.51	3.71	126
13	Machinery	3.88	1.55	84
2	Apparel and Textiles	0.04	1.54	29
12	Information Technology and Telecommunications	0.48	0.22	12
7	Computer, Electronic, and Electrical Products	0.34	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 Newport, TN



Bubble Size as the Employment for Each Cluster
Arts, Entertainment, Recreation and Visitor Industries (1,243)
Education and Knowledge Creation (912)
Biomedical/Biotechnical (Life Sciences) (713)
Defense and Security (508)
Agribusiness, Food Processing and Technology (464)
Primary and Fabricated Metal Products (444)
Forest and Wood Products (434)
Business and Financial Services (429)
Chemicals and Chemical-Based Products (163)
Transportation and Logistics (145)
Energy (Fossil and Renewable) (129)
Mining, Glass and Ceramics (126)
Machinery (84)
Apparel and Textiles (29)
Information Technology and Telecommunications (12)
Computer, Electronic, and Electrical Products (0)
Transportation Equipment (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Newport, TN 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 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	101	109
3	Arts, Entertainment, Recreation and Visitor Industries	167	Food Services and Drinking Places	701	962
11	Forest and Wood Products	32	Converted Paper Product Manufacturing	156	133

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	5.77	10	-2.47	7.81	0.51	0.10
167	Food Services and Drinking Places	1.65	52	29.84	37.29	0.72	0.07
32	Converted Paper Product Manufacturing	10.13	10	-21.07	-14.91	0.48	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 11

Electric Power Generation, Transmission and Distribution

Industry #	Industry Name	Employment
31	Pulp, Paper, and Paperboard Mills	-0
104	Warehousing and Storage	-3
136	Employment Services	-40

Table 6. Phase 2 Deficits Adding Anchor Industry 167

Food Services and Drinking Places

Industry #	Industry Name	Employment	Added to Deficit
31	Pulp, Paper, and Paperboard Mills	-0	-0
104	Warehousing and Storage	-5	-2
136	Employment Services	-49	-9

Table 7. Phase 3 Deficits Adding Anchor Industry 32

Converted Paper Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
31	Pulp, Paper, and Paperboard Mills	-16	-16
104	Warehousing and Storage	-15	-10
136	Employment Services	-54	-5

Chapter 22. North Wilkesboro, NC

Study Area Overview

The North Wilkesboro, NC study region occupies 754 square-miles and had a 2018 population of 68,557. The employed share of the regional labor force during the 2014-2018 period averaged 94.9%. The Animal Slaughtering and Processing 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 28.44% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.34, 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 North Wilkesboro, 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 Services to Buildings and Dwellings, whose employment grew by 364 followed by Food Services and Drinking Places 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 1.47, 1.03, and 4.44.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
140	Services to Buildings and Dwellings	364	314	1.47
167	Food Services and Drinking Places	350	-51	1.03
156	Community and Vocational Rehabilitation Services	236	236	4.44
144	Junior Colleges, Colleges, Universities, and Professional Schools	210	140	2.00
26	Textile Mills and Textile Product Mills	153	210	8.90
165	Other Amusement and Recreation Industries	146	127	1.07
46	Cement and Concrete Product Manufacturing	145	148	6.00
95	All Other Retail	142	182	1.28
45	Glass and Glass Product Manufacturing	123	131	13.08
94	General Merchandise Stores	120	96	1.45

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 North Wilkesboro, NC, the cluster with the largest CLQ in 2018 is Apparel and Textiles with a CLQ of 5.91, followed by Agribusiness, Food Processing and Technology 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 North Wilkesboro, 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.

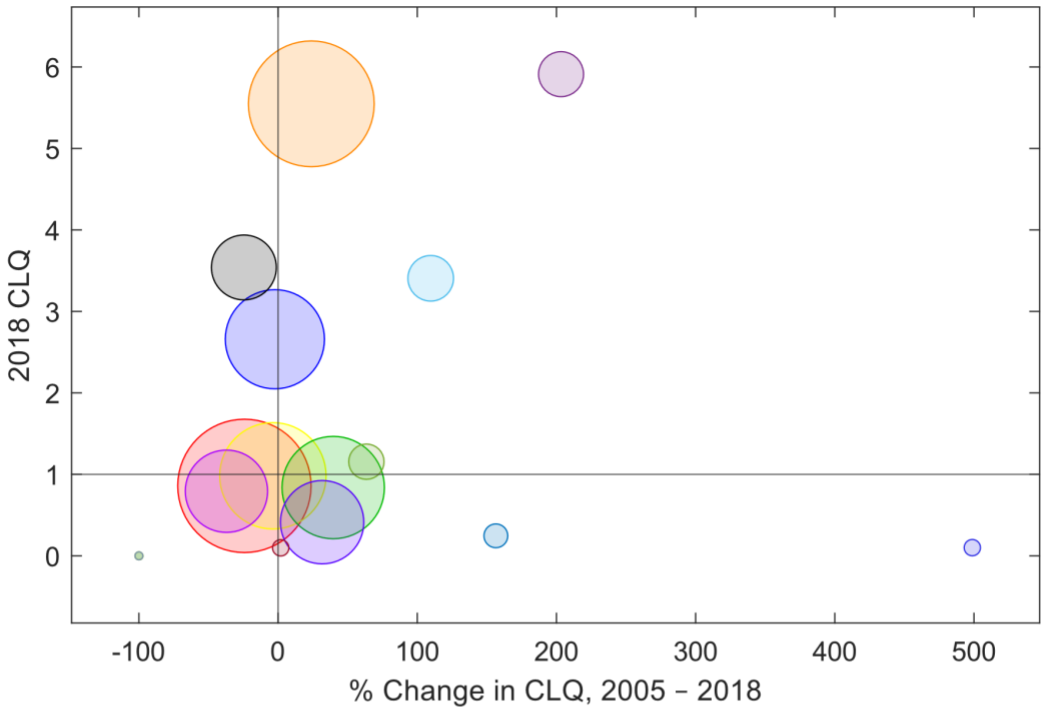
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
5	Business and Financial Services	1.13	0.86	3,637
1	Agribusiness, Food Processing and Technology	4.48	5.55	3,212
4	Biomedical/Biotechnical (Life Sciences)	1.02	0.98	2,241
3	Arts, Entertainment, Recreation and Visitor Industries	0.60	0.84	2,061
9	Education and Knowledge Creation	2.72	2.66	1,923
8	Defense and Security	0.31	0.41	1,314
16	Transportation and Logistics	1.26	0.79	1,278
11	Forest and Wood Products	4.69	3.54	749
14	Mining, Glass and Ceramics	1.62	3.41	328
2	Apparel and Textiles	1.95	5.91	318
12	Information Technology and Telecommunications	0.71	1.16	173
15	Primary and Fabricated Metal Products	0.10	0.25	58
17	Transportation Equipment	0.10	0.10	16
10	Energy (Fossil and Renewable)	0.02	0.10	16
6	Chemicals and Chemical-Based Products	0.24	0.00	0
7	Computer, Electronic, and Electrical Products	0.57	0.00	0
13	Machinery	1.34	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of North Wilkesboro, NC



Bubble Size as the Employment for Each Cluster
Business and Financial Services (3,637)
Agribusiness, Food Processing and Technology (3,212)
Biomedical/Biotechnical (Life Sciences) (2,241)
Arts, Entertainment, Recreation and Visitor Industries (2,061)
Education and Knowledge Creation (1,923)
Defense and Security (1,314)
Transportation and Logistics (1,278)
Forest and Wood Products (749)
Mining, Glass and Ceramics (328)
Apparel and Textiles (318)
Information Technology and Telecommunications (173)
Primary and Fabricated Metal Products (58)
Transportation Equipment (16)
Energy (Fossil and Renewable) (16)
Chemicals and Chemical-Based Products (0)
Computer, Electronic, and Electrical Products (0)
Machinery (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of North Wilkesboro, 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 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	2,773	2,893

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
20	Animal Slaughtering and Processing	40.32	26	3.38	4.32	0.39	0.39

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	-398
2	Animal Production	-2,811
5	Support Activities for Agriculture and Forestry	-63
15	Animal Food Manufacturing	-40
32	Converted Paper Product Manufacturing	-53
42	Plastics Product Manufacturing	-51
99	Truck Transportation	-199
102	Scenic and Sightseeing Transportation and Support Activities for Transportation	-39
104	Warehousing and Storage	-101
137	Business Support Services	-30

Chapter 23. Oak Hill, WV

Study Area Overview

The Oak Hill, WV study region occupies 662 square-miles and had a 2018 population of 43,018. The employed share of the regional labor force during the 2014-2018 period averaged 93.8%. The Government and Unclassified 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 26.46% of the region's economy. The region's 2018 coefficient of specialization (COS) is 35.49, 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 Oak Hill, 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 Child Day Care Services, whose employment grew by 170 followed by Coal Mining 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 2.6, 147.28, and 1.13.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
157	Child Day Care Services	170	169	2.60
7	Coal Mining	142	245	147.28
167	Food Services and Drinking Places	112	-117	1.13
153	Hospitals	110	69	1.00
178	Civic, Social, Professional, and Similar Organizations	104	105	2.53
179	Private Households	80	80	1.81
152	Other Ambulatory Health Care Services	70	32	6.80
94	General Merchandise Stores	65	49	1.95
13	Water, Sewage and Other Systems	64	52	41.35
140	Services to Buildings and Dwellings	54	44	0.52

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 Oak Hill, WV, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 7.68, 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 Oak Hill, 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.

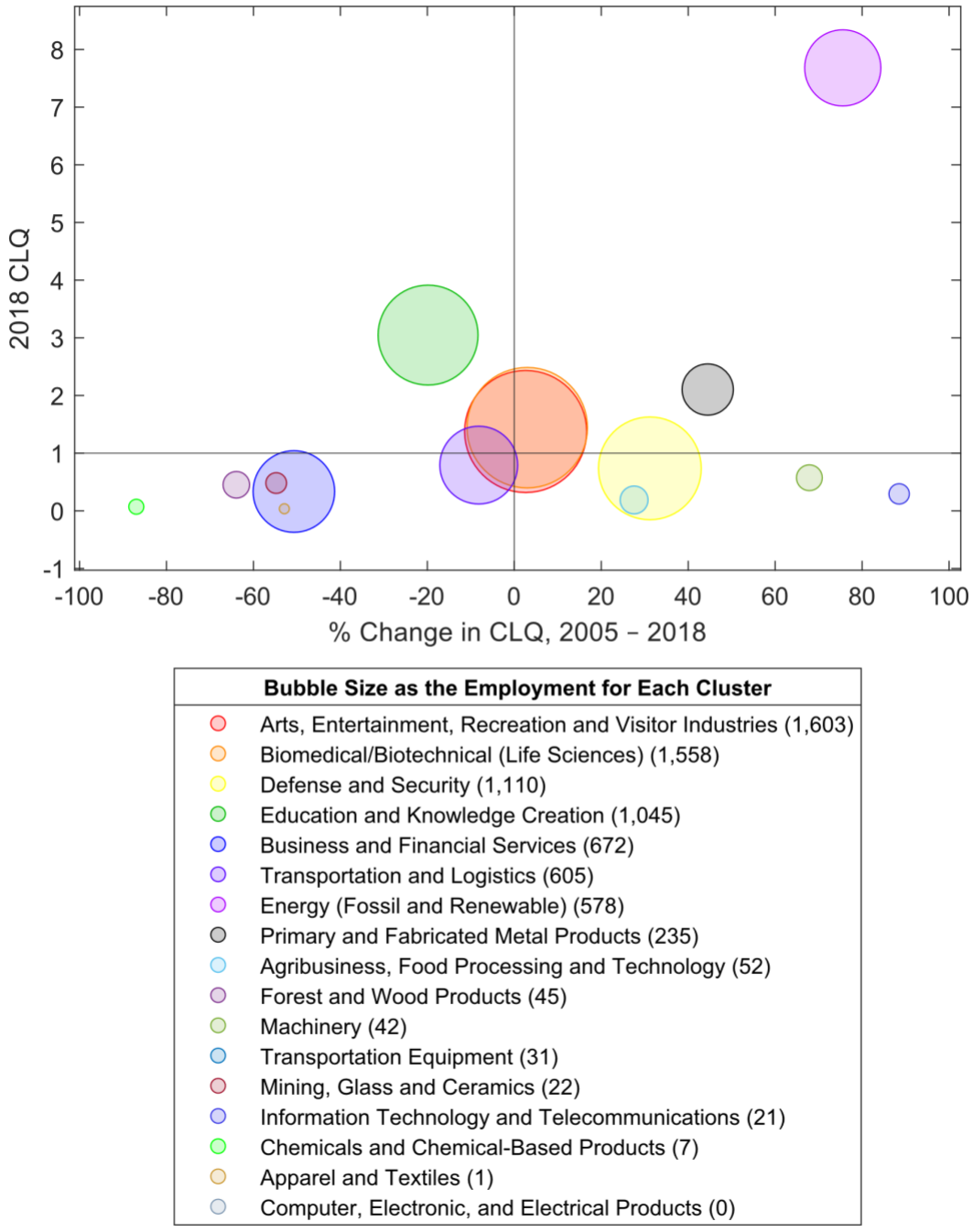
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
3	Arts, Entertainment, Recreation and Visitor Industries	1.34	1.38	1,603
4	Biomedical/Biotechnical (Life Sciences)	1.40	1.44	1,558
8	Defense and Security	0.56	0.74	1,110
9	Education and Knowledge Creation	3.80	3.05	1,045
5	Business and Financial Services	0.68	0.33	672
16	Transportation and Logistics	0.86	0.79	605
10	Energy (Fossil and Renewable)	4.38	7.68	578
15	Primary and Fabricated Metal Products	1.46	2.10	235
1	Agribusiness, Food Processing and Technology	0.15	0.19	52
11	Forest and Wood Products	1.25	0.45	45
13	Machinery	0.34	0.57	42
17	Transportation Equipment	0.00	0.40	31
14	Mining, Glass and Ceramics	1.06	0.48	22
12	Information Technology and Telecommunications	0.16	0.29	21
6	Chemicals and Chemical-Based Products	0.54	0.07	7
2	Apparel and Textiles	0.07	0.04	1
7	Computer, Electronic, and Electrical Products	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Oak Hill, WV



2. CADS Analysis

The 2018 CADS analysis of the economy of Oak Hill, 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 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	361	503

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
7	Coal Mining	147.28	245	-28.42	39.42	0.53	0.28

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
43	Rubber Product Manufacturing	-14
81	Motor Vehicle Parts Manufacturing	-11
97	Rail Transportation	-15
104	Warehousing and Storage	-14
116	Securities, Commodity Contracts, Fund, Trusts and Other Financial Investments and Vehicles and Related Activities	-11
126	Architectural, Engineering, and Related Services	-10
133	Management of Companies and Enterprises	-32
136	Employment Services	-19

Chapter 24. Oil City, PA

Study Area Overview

The Oil City, PA study region occupies 674 square-miles and had a 2018 population of 51,266. 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 All Other Retail and Nursing and Residential Care Facilities. These three industries account for a combined 18.6% of the region's economy. The region's 2018 coefficient of specialization (COS) is 39.38, 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 Oil City, 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 Junior Colleges, Colleges, Universities, and Professional Schools, whose employment grew by 657 followed by Electrical Equipment 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 3.19, 27.96, and 1.53.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
144	Junior Colleges, Colleges, Universities, and Professional Schools	657	657	3.19
77	Electrical Equipment Manufacturing	270	281	27.96
155	Individual and Family Services	102	-238	1.53
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	86	83	5.89
55	Architectural and Structural Metals Manufacturing	77	79	5.41
48	Iron and Steel Mills and Ferroalloy Manufacturing	76	122	41.07
148	Offices of Other Health Practitioners	60	-51	2.04
103	Couriers and Messengers	58	33	1.85
133	Management of Companies and Enterprises	55	48	0.28
136	Employment Services	43	41	0.94

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 Oil City, PA, the cluster with the largest CLQ in 2018 is Primary and Fabricated Metal Products with a CLQ of 6.84, followed by Machinery 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 Oil City, 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.

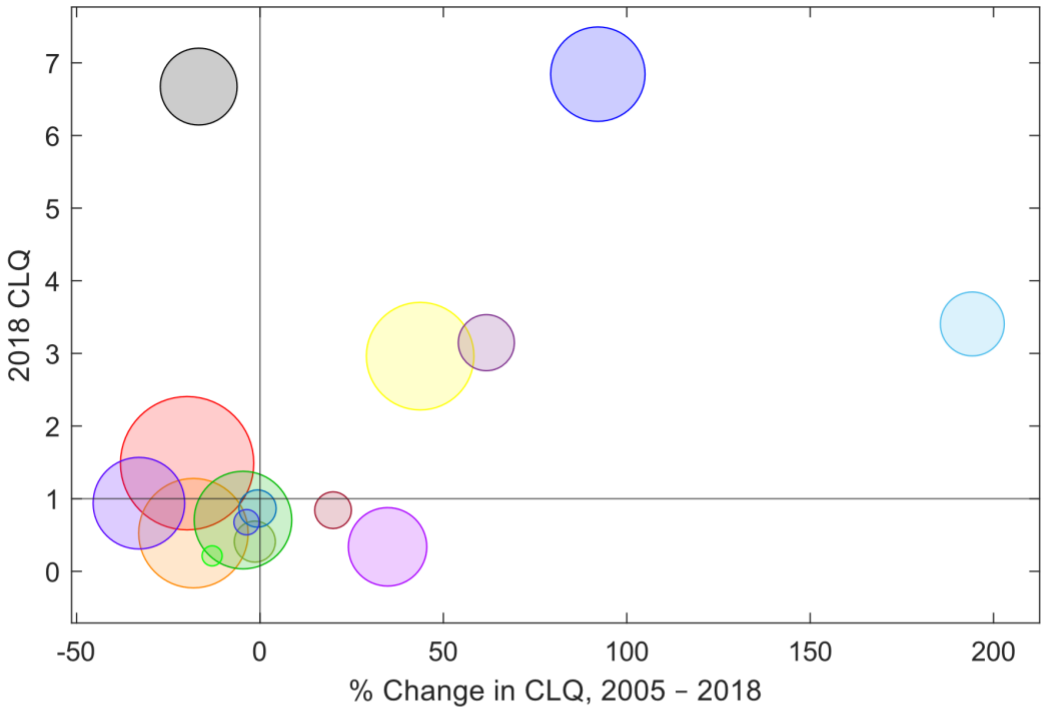
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.86	1.49	2,769
5	Business and Financial Services	0.64	0.53	1,814
9	Education and Knowledge Creation	2.06	2.96	1,748
3	Arts, Entertainment, Recreation and Visitor Industries	0.74	0.71	1,415
15	Primary and Fabricated Metal Products	3.56	6.84	1,316
16	Transportation and Logistics	1.40	0.94	1,232
8	Defense and Security	0.25	0.34	874
13	Machinery	8.01	6.67	835
7	Computer, Electronic, and Electrical Products	1.16	3.41	552
10	Energy (Fossil and Renewable)	1.95	3.15	407
1	Agribusiness, Food Processing and Technology	0.41	0.41	193
6	Chemicals and Chemical-Based Products	0.87	0.86	152
11	Forest and Wood Products	0.70	0.84	145
14	Mining, Glass and Ceramics	0.70	0.68	53
12	Information Technology and Telecommunications	0.24	0.21	26
2	Apparel and Textiles	0.00	0.25	11
17	Transportation Equipment	0.00	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Oil City, PA



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (2,769)
Business and Financial Services (1,814)
Education and Knowledge Creation (1,748)
Arts, Entertainment, Recreation and Visitor Industries (1,415)
Primary and Fabricated Metal Products (1,316)
Transportation and Logistics (1,232)
Defense and Security (874)
Machinery (835)
Computer, Electronic, and Electrical Products (552)
Energy (Fossil and Renewable) (407)
Agribusiness, Food Processing and Technology (193)
Chemicals and Chemical-Based Products (152)
Forest and Wood Products (145)
Mining, Glass and Ceramics (53)
Information Technology and Telecommunications (26)
Apparel and Textiles (11)
Transportation Equipment (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Oil City, PA identifies 5 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 Petroleum and Coal Products 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
10	Energy (Fossil and Renewable)	34	Petroleum and Coal Products Manufacturing	165	192
15	Primary and Fabricated Metal Products	48	Iron and Steel Mills and Ferroalloy Manufacturing	312	388
15	Primary and Fabricated Metal Products	49	Steel Product Manufacturing From Purchased Steel	187	225
15	Primary and Fabricated Metal Products	55	Architectural and Structural Metals Manufacturing	161	238
15	Primary and Fabricated Metal Products	59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	156	242

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
34	Petroleum and Coal Products Manufacturing	14.94	22	3.12	16.34	0.49	0.33
48	Iron and Steel Mills and Ferroalloy Manufacturing	41.07	122	-14.74	24.22	0.72	0.18
49	Steel Product Manufacturing From Purchased Steel	35.35	49	-6.38	19.91	0.85	0.04

55	Architectural and Structural Metals Manufacturing	5.41	79	-1.47	47.83	0.84	0.02
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	5.89	83	2.18	55.13	0.84	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 34

Petroleum and Coal Products Manufacturing

Industry #	Industry Name	Employment
6	Oil and Gas Extraction	-164
8	Metal Ore Mining	-2
51	Nonferrous Metal (except Aluminum) Production and Processing	N/A
81	Motor Vehicle Parts Manufacturing	-10
97	Rail Transportation	-12
104	Warehousing and Storage	N/A
117	Insurance Carriers	-33
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-10
127	Specialized Design Services	-14
128	Computer Systems Design and Related Services	-68
129	Management, Scientific, and Technical Consulting Services	-24
131	Advertising and Related Services	-10
133	Management of Companies and Enterprises	-75
142	Waste Management and Remediation Services	-4

Table 6. Phase 2 Deficits Adding Anchor Industry 48

Iron and Steel Mills and Ferroalloy Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-164	-1
8	Metal Ore Mining	-36	-34
51	Nonferrous Metal (except Aluminum) Production and Processing	-48	-55
81	Motor Vehicle Parts Manufacturing	-24	-15
97	Rail Transportation	-37	-25
104	Warehousing and Storage	-58	-73
117	Insurance Carriers	-41	-8
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-13	-3
127	Specialized Design Services	-25	-10
128	Computer Systems Design and Related Services	-86	-19
129	Management, Scientific, and Technical Consulting Services	-46	-22
131	Advertising and Related Services	-16	-7
133	Management of Companies and Enterprises	-114	-39
142	Waste Management and Remediation Services	-35	-31

Table 7. Phase 3 Deficits Adding Anchor Industry 49

Steel Product Manufacturing From Purchased Steel

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-164	-0
8	Metal Ore Mining	-37	-1
51	Nonferrous Metal (except Aluminum) Production and Processing	-53	-5
81	Motor Vehicle Parts Manufacturing	-26	-1
97	Rail Transportation	-38	-1
104	Warehousing and Storage	-71	-13
117	Insurance Carriers	-42	-1
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-13	-0
127	Specialized Design Services	-26	-1
128	Computer Systems Design and Related Services	-88	-2
129	Management, Scientific, and Technical Consulting Services	-48	-2
131	Advertising and Related Services	-17	-1
133	Management of Companies and Enterprises	-118	-4
142	Waste Management and Remediation Services	-36	-1

Table 8. Phase 4 Deficits Adding Anchor Industry 55

Architectural and Structural Metals Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
6	Oil and Gas Extraction	-164	-0
8	Metal Ore Mining	-37	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-54	-1
81	Motor Vehicle Parts Manufacturing	-26	-1
97	Rail Transportation	-38	-0
104	Warehousing and Storage	-81	-10
117	Insurance Carriers	-42	-0
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-13	-0
127	Specialized Design Services	-27	-1
128	Computer Systems Design and Related Services	-89	-2

129	Management, Scientific, and Technical Consulting Services	-50	-2
131	Advertising and Related Services	-18	-1
133	Management of Companies and Enterprises	-124	-6
142	Waste Management and Remediation Services	-37	-0

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
6	Oil and Gas Extraction	-164	-0
8	Metal Ore Mining	-37	-0
51	Nonferrous Metal (except Aluminum) Production and Processing	-55	-1
81	Motor Vehicle Parts Manufacturing	-27	-0
97	Rail Transportation	-38	-0
104	Warehousing and Storage	-90	-10
117	Insurance Carriers	-42	-0
122	Commercial and Industrial Machinery and Equipment Rental and Leasing	-13	-0
127	Specialized Design Services	-28	-1
128	Computer Systems Design and Related Services	-91	-2
129	Management, Scientific, and Technical Consulting Services	-51	-1
131	Advertising and Related Services	-18	-1
133	Management of Companies and Enterprises	-129	-5
142	Waste Management and Remediation Services	-37	-0

Chapter 25. Olean, NY

Study Area Overview

The Olean, NY study region occupies 1,308 square-miles and had a 2018 population of 76,840. The employed share of the regional labor force during the 2014-2018 period averaged 95%. The Government and Unclassified industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Food Services and Drinking Places. These three industries account for a combined 33.16% of the region's economy. The region's 2018 coefficient of specialization (COS) is 33.69, 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 Olean, 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 Government and Unclassified, whose employment grew by 436 followed by Gambling Industries (except Casino Hotels) 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 1.03, 28.86, and 1.02.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
181	Government and Unclassified	436	295	1.03
164	Gambling Industries (except Casino Hotels)	306	351	28.86
167	Food Services and Drinking Places	264	-319	1.02
165	Other Amusement and Recreation Industries	165	108	1.39
155	Individual and Family Services	153	-20	0.70
46	Cement and Concrete Product Manufacturing	106	110	3.56
166	Accommodation	103	57	1.46
177	Grantmaking and Giving Services and Social Advocacy Organizations	99	71	2.52
2	Animal Production	97	110	1.35
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	79	87	8.66

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 Olean, NY, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 4.98, 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 Olean, 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.

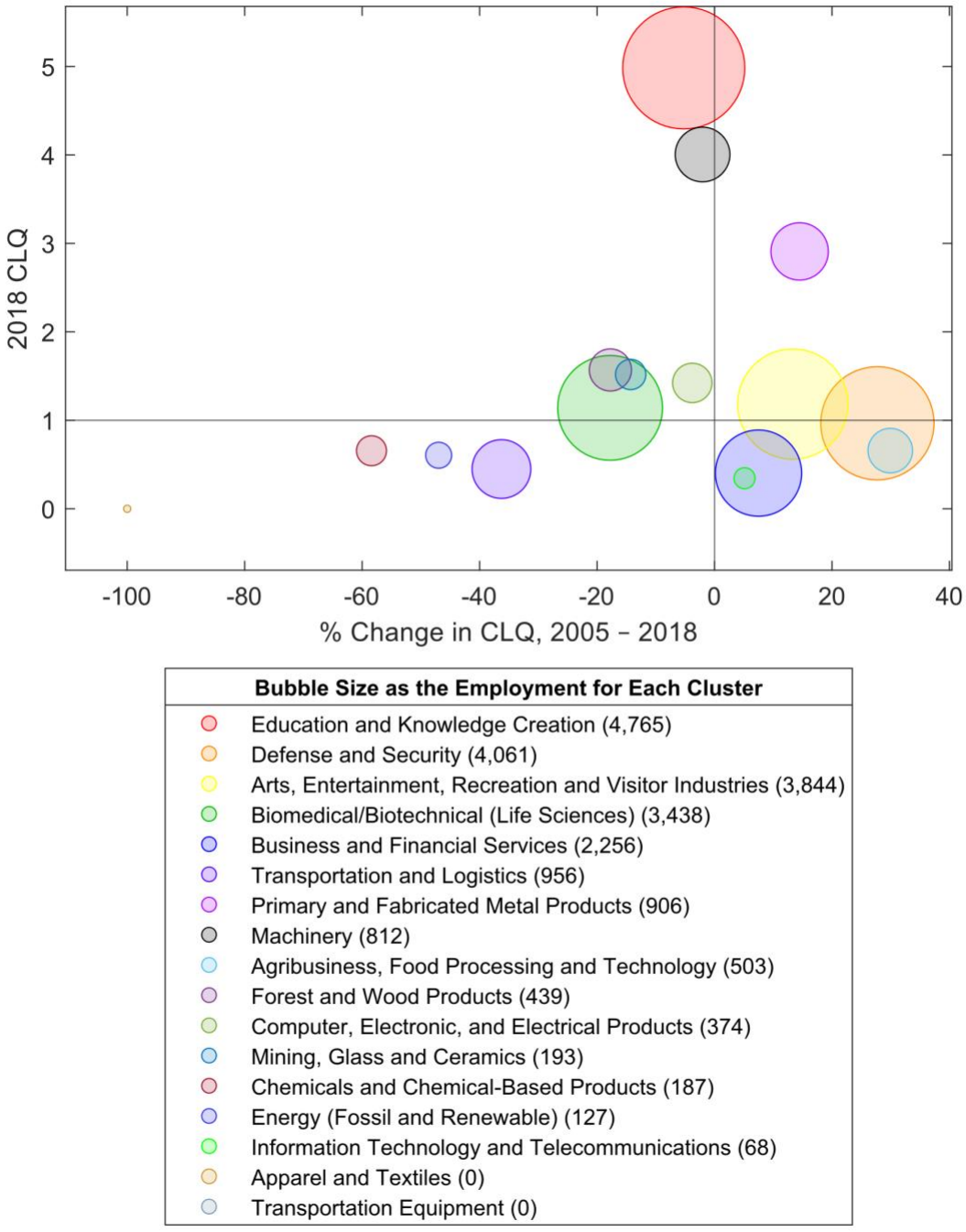
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
9	Education and Knowledge Creation	5.26	4.98	4,765
8	Defense and Security	0.76	0.97	4,061
3	Arts, Entertainment, Recreation and Visitor Industries	1.04	1.18	3,844
4	Biomedical/Biotechnical (Life Sciences)	1.39	1.14	3,438
5	Business and Financial Services	0.38	0.40	2,256
16	Transportation and Logistics	0.71	0.45	956
15	Primary and Fabricated Metal Products	2.54	2.91	906
13	Machinery	4.09	4.01	812
1	Agribusiness, Food Processing and Technology	0.51	0.66	503
11	Forest and Wood Products	1.91	1.57	439
7	Computer, Electronic, and Electrical Products	1.48	1.42	374
14	Mining, Glass and Ceramics	1.77	1.52	193
6	Chemicals and Chemical-Based Products	1.58	0.66	187
10	Energy (Fossil and Renewable)	1.14	0.61	127
12	Information Technology and Telecommunications	0.33	0.35	68
2	Apparel and Textiles	0.16	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 Olean, NY



2. CADS Analysis

The 2018 CADS analysis of the economy of Olean, NY identifies 3 anchor industries in 1 different cluster. 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 Gambling Industries (except Casino Hotels), 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
3	Arts, Entertainment, Recreation and Visitor Industries	164	Gambling Industries (except Casino Hotels)	350	655
3	Arts, Entertainment, Recreation and Visitor Industries	166	Accommodation	439	542
3	Arts, Entertainment, Recreation and Visitor Industries	165	Other Amusement and Recreation Industries	205	370

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
164	Gambling Industries (except Casino Hotels)	28.86	351	-12.91	87.49	0.82	0.06
166	Accommodation	1.46	57	10.44	23.46	0.85	0.02
165	Other Amusement and Recreation Industries	1.39	108	27.89	80.49	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 164

Gambling Industries (except Casino Hotels)

Industry #	Industry Name	Employment
161	Independent Artists, Writers, and Performers	-14

Table 6. Phase 2 Deficits Adding Anchor Industry 166

Accommodation

Industry #	Industry Name	Employment	Added to Deficit
161	Independent Artists, Writers, and Performers	-15	-1

Table 7. Phase 3 Deficits Adding Anchor Industry 165

Other Amusement and Recreation Industries

Industry #	Industry Name	Employment	Added to Deficit
161	Independent Artists, Writers, and Performers	-15	-0

Chapter 26. Oneonta, NY

Study Area Overview

The Oneonta, NY study region occupies 1,002 square-miles and had a 2018 population of 59,749. The employed share of the regional labor force during the 2014-2018 period averaged 94.8%. The Hospitals industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Food Services and Drinking Places. These three industries account for a combined 30.18% of the region's economy. The region's 2018 coefficient of specialization (COS) is 40.79, 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 Oneonta, 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 Community and Vocational Rehabilitation Services, whose employment grew by 421 followed by Junior Colleges, Colleges, Universities, and Professional Schools 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 7.2, 5.62, and 2.21.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
156	Community and Vocational Rehabilitation Services	421	423	7.20
144	Junior Colleges, Colleges, Universities, and Professional Schools	395	122	5.62
154	Nursing and Residential Care Facilities	374	246	2.21
146	Offices of Physicians	271	221	1.21
165	Other Amusement and Recreation Industries	204	139	2.03
166	Accommodation	144	92	2.11
145	Other Educational Services	136	123	1.13
140	Services to Buildings and Dwellings	94	70	0.46
152	Other Ambulatory Health Care Services	71	48	2.37
72	Semiconductor and Other Electronic Component Manufacturing	64	73	2.05

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 Oneonta, NY, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 5.46, 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 Oneonta, 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.

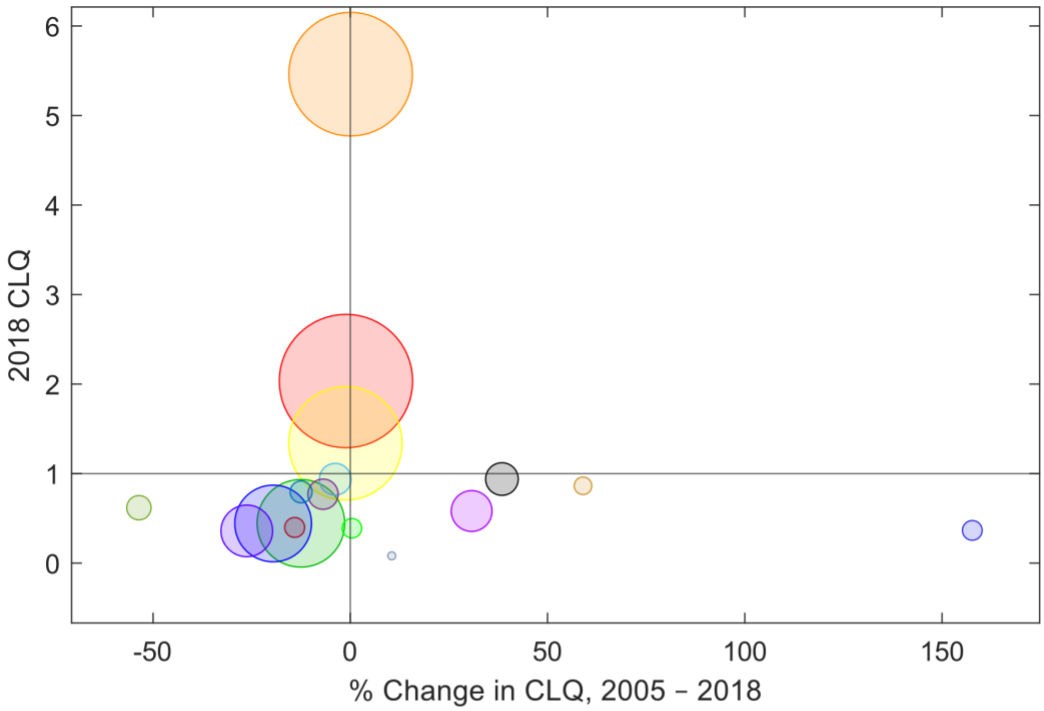
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	2.06	2.03	5,007
9	Education and Knowledge Creation	5.46	5.46	4,264
3	Arts, Entertainment, Recreation and Visitor Industries	1.36	1.34	3,552
5	Business and Financial Services	0.51	0.44	2,034
8	Defense and Security	0.55	0.44	1,520
16	Transportation and Logistics	0.49	0.36	626
1	Agribusiness, Food Processing and Technology	0.45	0.58	364
11	Forest and Wood Products	0.68	0.94	215
7	Computer, Electronic, and Electrical Products	0.97	0.94	201
6	Chemicals and Chemical-Based Products	0.83	0.77	179
10	Energy (Fossil and Renewable)	1.33	0.62	106
14	Mining, Glass and Ceramics	0.91	0.80	83
13	Machinery	0.46	0.40	66
17	Transportation Equipment	0.14	0.37	65
12	Information Technology and Telecommunications	0.39	0.39	63
2	Apparel and Textiles	0.54	0.86	50
15	Primary and Fabricated Metal Products	0.07	0.08	21

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Oneonta, NY



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (5,007)
Education and Knowledge Creation (4,264)
Arts, Entertainment, Recreation and Visitor Industries (3,552)
Business and Financial Services (2,034)
Defense and Security (1,520)
Transportation and Logistics (626)
Agribusiness, Food Processing and Technology (364)
Forest and Wood Products (215)
Computer, Electronic, and Electrical Products (201)
Chemicals and Chemical-Based Products (179)
Energy (Fossil and Renewable) (106)
Mining, Glass and Ceramics (83)
Machinery (66)
Transportation Equipment (65)
Information Technology and Telecommunications (63)
Apparel and Textiles (50)
Primary and Fabricated Metal Products (21)

2. CADS Analysis

The 2018 CADS analysis of the economy of Oneonta, NY 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 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	1,139	1,534
3	Arts, Entertainment, Recreation and Visitor Industries	166	Accommodation	495	639
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	204	475
4	Biomedical/Biotechnical (Life Sciences)	154	Nursing and Residential Care Facilities	724	1,097
3	Arts, Entertainment, Recreation and Visitor Industries	165	Other Amusement and Recreation Industries	235	439

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	5.62	122	23.90	34.65	0.86	0.07
166	Accommodation	2.11	92	10.44	29.09	0.83	0.03
146	Offices of Physicians	1.21	221	24.38	132.84	0.82	0.03
154	Nursing and Residential Care Facilities	2.21	246	17.58	51.62	0.84	0.03

165	Other Amusement and Recreation Industries	2.03	139	27.89	87.08	0.85	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
104	Warehousing and Storage	-3
136	Employment Services	-9
137	Business Support Services	-2

Table 6. Phase 2 Deficits Adding Anchor Industry 166

Accommodation

Industry #	Industry Name	Employment	Added to Deficit
104	Warehousing and Storage	-6	-3
136	Employment Services	-26	-17
137	Business Support Services	-4	-3

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
104	Warehousing and Storage	-8	-2
136	Employment Services	-46	-20
137	Business Support Services	-10	-6

Table 8. Phase 4 Deficits Adding Anchor Industry 154

Nursing and Residential Care Facilities

Industry #	Industry Name	Employment	Added to Deficit
104	Warehousing and Storage	-10	-2
136	Employment Services	-70	-25
137	Business Support Services	-14	-4

Table 9. Phase 5 Deficits Adding Anchor Industry 165

Other Amusement and Recreation Industries

Industry #	Industry Name	Employment	Added to Deficit
104	Warehousing and Storage	-10	-1
136	Employment Services	-75	-4
137	Business Support Services	-15	-1

Chapter 27. Parkersburg-Marietta-Vienna, WV-OH

Study Area Overview

The Parkersburg-Marietta-Vienna, WV-OH study region occupies 1,361 square-miles and had a 2018 population of 157,695. The employed share of the regional labor force during the 2014-2018 period averaged 95.68%. The Food Services and Drinking Places industry was the region's largest employer in 2018, followed by Government and Unclassified and All Other Retail. These three industries account for a combined 22.94% of the region's economy. The region's 2018 coefficient of specialization (COS) is 29.28, 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 Parkersburg-Marietta-Vienna, WV-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 Government and Unclassified, whose employment grew by 479 followed by Offices of Physicians 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 0.51, 1.7, and 3.98.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
181	Government and Unclassified	479	327	0.51
146	Offices of Physicians	431	101	1.70
42	Plastics Product Manufacturing	366	404	3.98
154	Nursing and Residential Care Facilities	305	-57	1.77
149	Outpatient Care Centers	304	223	1.02
99	Truck Transportation	300	289	1.84
133	Management of Companies and Enterprises	270	146	0.67
167	Food Services and Drinking Places	269	-1,446	1.26
10	Support Activities for Mining	236	110	3.42
81	Motor Vehicle Parts Manufacturing	204	204	0.87

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 Parkersburg-Marietta-Vienna, WV-OH, the cluster with the largest CLQ in 2018 is Chemicals and Chemical-Based Products with a CLQ of 5.68, followed by Energy (Fossil and Renewable) 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 Parkersburg-Marietta-Vienna, WV-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.

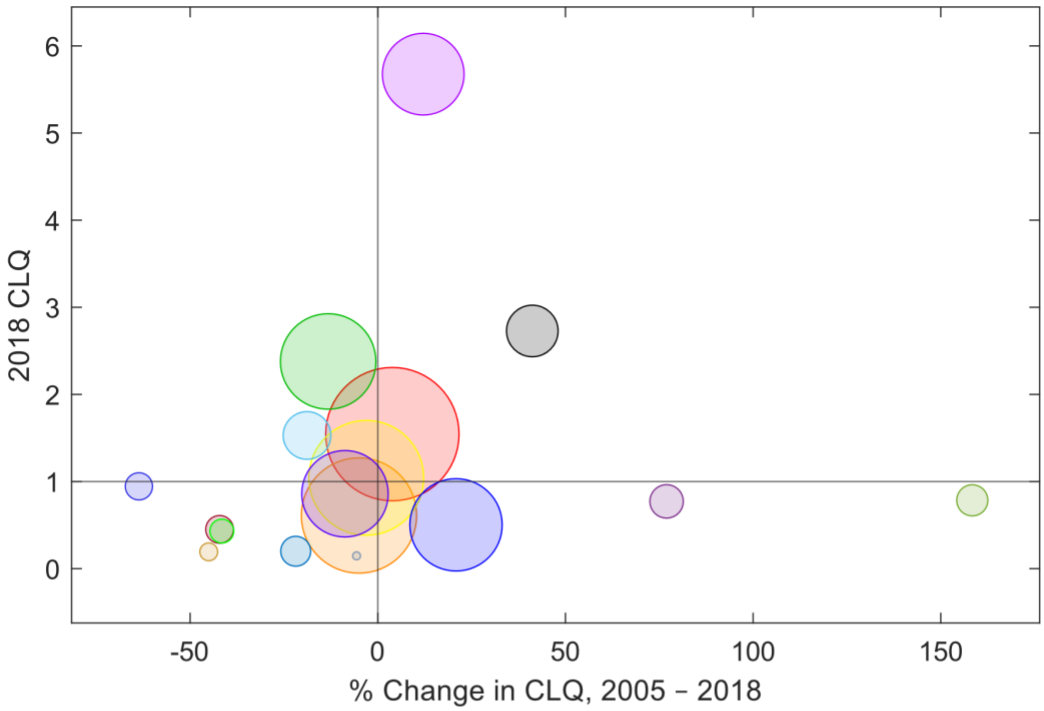
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	1.49	1.54	10,228
5	Business and Financial Services	0.64	0.61	7,501
3	Arts, Entertainment, Recreation and Visitor Industries	1.08	1.04	7,443
9	Education and Knowledge Creation	2.74	2.38	4,996
8	Defense and Security	0.42	0.50	4,643
16	Transportation and Logistics	0.94	0.86	4,022
6	Chemicals and Chemical-Based Products	5.06	5.68	3,551
10	Energy (Fossil and Renewable)	1.93	2.73	1,257
15	Primary and Fabricated Metal Products	1.88	1.53	1,047
7	Computer, Electronic, and Electrical Products	0.44	0.77	446
17	Transportation Equipment	0.30	0.78	373
1	Agribusiness, Food Processing and Technology	0.26	0.20	336
11	Forest and Wood Products	0.78	0.45	277
14	Mining, Glass and Ceramics	2.60	0.94	264
12	Information Technology and Telecommunications	0.74	0.43	187
13	Machinery	0.35	0.19	86
2	Apparel and Textiles	0.16	0.15	23

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Parkersburg-Marietta-Vienna, WV-OH



Bubble Size as the Employment for Each Cluster
Biomedical/Biotechnical (Life Sciences) (10,228)
Business and Financial Services (7,501)
Arts, Entertainment, Recreation and Visitor Industries (7,443)
Education and Knowledge Creation (4,996)
Defense and Security (4,643)
Transportation and Logistics (4,022)
Chemicals and Chemical-Based Products (3,551)
Energy (Fossil and Renewable) (1,257)
Primary and Fabricated Metal Products (1,047)
Computer, Electronic, and Electrical Products (446)
Transportation Equipment (373)
Agribusiness, Food Processing and Technology (336)
Forest and Wood Products (277)
Mining, Glass and Ceramics (264)
Information Technology and Telecommunications (187)
Machinery (86)
Apparel and Textiles (23)

2. CADS Analysis

The 2018 CADS analysis of the economy of Parkersburg-Marietta-Vienna, WV-OH 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 Plastics 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	42	Plastics Product Manufacturing	569	935
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	1,355	1,787
16	Transportation and Logistics	99	Truck Transportation	939	1,239

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
42	Plastics Product Manufacturing	3.98	404	-6.65	64.45	0.92	0.04
146	Offices of Physicians	1.70	101	24.38	31.81	0.91	0.03
99	Truck Transportation	1.84	289	1.19	32.00	0.95	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 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment
32	Converted Paper Product Manufacturing	-16
97	Rail Transportation	-9
150	Medical and Diagnostic Laboratories	N/A

Table 6. Phase 2 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
32	Converted Paper Product Manufacturing	-17	-1
97	Rail Transportation	-9	-1
150	Medical and Diagnostic Laboratories	-35	-45

Table 7. Phase 3 Deficits Adding Anchor Industry 99

Truck Transportation

Industry #	Industry Name	Employment	Added to Deficit
32	Converted Paper Product Manufacturing	-19	-2
97	Rail Transportation	-16	-6
150	Medical and Diagnostic Laboratories	-35	-0

Chapter 28. Pittsburgh, PA

Study Area Overview

The Pittsburgh, PA study region occupies 5,282 square-miles and had a 2018 population of 2,324,743. The employed share of the regional labor force during the 2014-2018 period averaged 95.74%. 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 18.71% of the region's economy. The region's 2018 coefficient of specialization (COS) is 22.82, 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 Pittsburgh, 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 Management of Companies and Enterprises, whose employment grew by 16,426 followed by Individual and Family Services 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 2.26, 1.52, and 1.06.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
133	Management of Companies and Enterprises	16,426	9,122	2.26
155	Individual and Family Services	13,538	-246	1.52
167	Food Services and Drinking Places	9,527	-14,172	1.06
128	Computer Systems Design and Related Services	6,485	1,204	0.92
146	Offices of Physicians	6,061	1,133	1.42
151	Home Health Care Services	5,789	1,148	1.08
10	Support Activities for Mining	4,757	4,311	2.29
14	Construction	4,300	5,634	0.90
144	Junior Colleges, Colleges, Universities, and Professional Schools	3,628	-4,243	2.84
154	Nursing and Residential Care Facilities	3,603	-2,504	1.63

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 Pittsburgh, PA, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 2.82, followed by Energy (Fossil and Renewable) 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 Pittsburgh, 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.

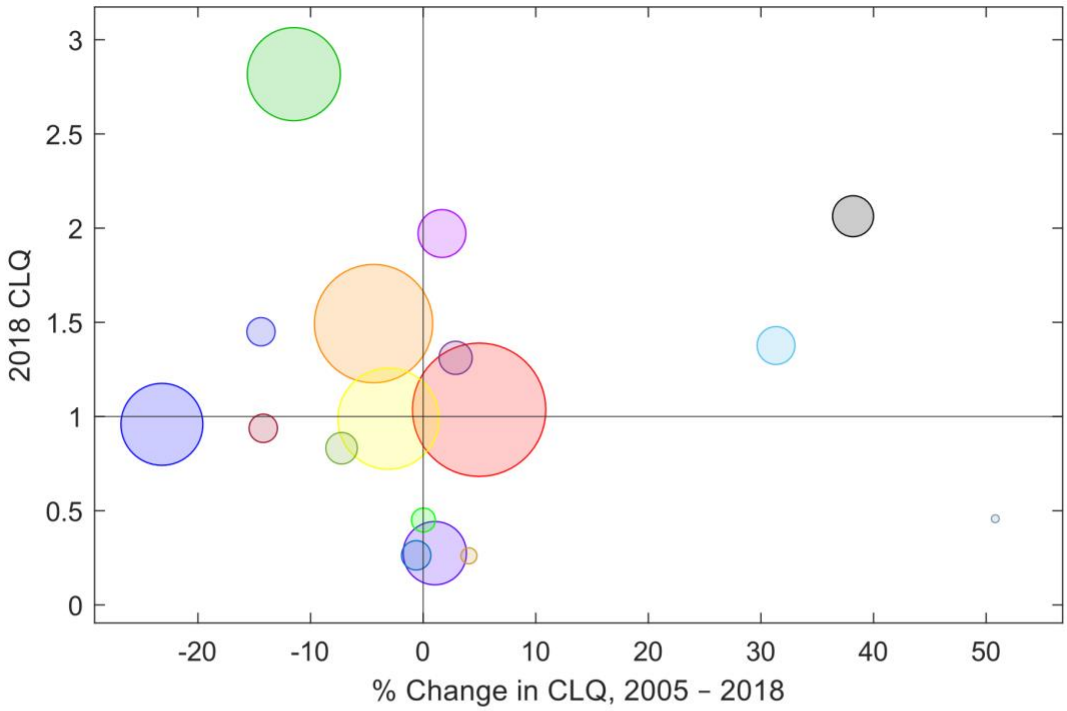
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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
5	Business and Financial Services	0.99	1.04	223,766
4	Biomedical/Biotechnical (Life Sciences)	1.56	1.49	173,718
3	Arts, Entertainment, Recreation and Visitor Industries	1.02	0.99	123,903
9	Education and Knowledge Creation	3.18	2.82	103,940
16	Transportation and Logistics	1.25	0.96	78,753
8	Defense and Security	0.27	0.27	44,563
15	Primary and Fabricated Metal Products	1.94	1.97	23,704
10	Energy (Fossil and Renewable)	1.49	2.06	16,696
7	Computer, Electronic, and Electrical Products	1.05	1.38	13,956
13	Machinery	1.27	1.31	10,263
6	Chemicals and Chemical-Based Products	0.90	0.83	9,141
1	Agribusiness, Food Processing and Technology	0.26	0.26	7,773
12	Information Technology and Telecommunications	1.09	0.94	7,158
14	Mining, Glass and Ceramics	1.69	1.45	7,113
11	Forest and Wood Products	0.45	0.45	4,865
17	Transportation Equipment	0.25	0.26	2,176
2	Apparel and Textiles	0.30	0.46	1,253

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Pittsburgh, PA



Bubble Size as the Employment for Each Cluster
Business and Financial Services (223,766)
Biomedical/Biotechnical (Life Sciences) (173,718)
Arts, Entertainment, Recreation and Visitor Industries (123,903)
Education and Knowledge Creation (103,940)
Transportation and Logistics (78,753)
Defense and Security (44,563)
Primary and Fabricated Metal Products (23,704)
Energy (Fossil and Renewable) (16,696)
Computer, Electronic, and Electrical Products (13,956)
Machinery (10,263)
Chemicals and Chemical-Based Products (9,141)
Agribusiness, Food Processing and Technology (7,773)
Information Technology and Telecommunications (7,158)
Mining, Glass and Ceramics (7,113)
Forest and Wood Products (4,865)
Transportation Equipment (2,176)
Apparel and Textiles (1,253)

2. CADS Analysis

The 2018 CADS analysis of the economy of Pittsburgh, PA identifies 4 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 Management of Companies and Enterprises, 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	133	Management of Companies and Enterprises	20,962	37,388
5	Business and Financial Services	115	Monetary Authorities, Credit Intermediation, and Related Activities	28,376	27,676
4	Biomedical/Biotechnical (Life Sciences)	146	Offices of Physicians	20,214	26,275
5	Business and Financial Services	126	Architectural, Engineering, and Related Services	15,953	17,822

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
133	Management of Companies and Enterprises	2.26	9,122	34.84	78.36	0.99	0.06
115	Monetary Authorities, Credit Intermediation, and Related Activities	1.48	1,690	-8.42	-2.47	0.99	0.06
146	Offices of Physicians	1.42	1,133	24.38	29.98	1.00	0.03
126	Architectural, Engineering, and Related Services	1.64	374	9.37	11.71	0.99	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 133

Management of Companies and Enterprises

Industry #	Industry Name	Employment
3	Forestry and Logging	N/A
4	Fishing, Hunting and Trapping	-2
31	Pulp, Paper, and Paperboard Mills	-24
97	Rail Transportation	-13
109	Cable and Other Subscription Programming	-22
134	Office Administrative 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
3	Forestry and Logging	-4	-11
4	Fishing, Hunting and Trapping	-6	-4
31	Pulp, Paper, and Paperboard Mills	-45	-22
97	Rail Transportation	-23	-10
109	Cable and Other Subscription Programming	-46	-23
134	Office Administrative Services	N/A	-153
161	Independent Artists, Writers, and Performers	-94	-102

Table 7. Phase 3 Deficits Adding Anchor Industry 146

Offices of Physicians

Industry #	Industry Name	Employment	Added to Deficit
3	Forestry and Logging	-10	-6
4	Fishing, Hunting and Trapping	-10	-4
31	Pulp, Paper, and Paperboard Mills	-53	-7
97	Rail Transportation	-32	-9
109	Cable and Other Subscription Programming	-50	-4
134	Office Administrative Services	N/A	-168
161	Independent Artists, Writers, and Performers	-125	-31

Table 8. Phase 4 Deficits Adding Anchor Industry 126

Architectural, Engineering, and Related Services

Industry #	Industry Name	Employment	Added to Deficit
3	Forestry and Logging	-18	-8
4	Fishing, Hunting and Trapping	-13	-3
31	Pulp, Paper, and Paperboard Mills	-62	-9
97	Rail Transportation	-45	-13
109	Cable and Other Subscription Programming	-53	-4
134	Office Administrative Services	-270	-296
161	Independent Artists, Writers, and Performers	-156	-31

Chapter 29. Point Pleasant, WV-OH

Study Area Overview

The Point Pleasant, WV-OH study region occupies 898 square-miles and had a 2018 population of 56,697. The employed share of the regional labor force during the 2014-2018 period averaged 95.1%. The Hospitals industry was the region's largest employer in 2018, followed by Elementary and Secondary Schools and Food Services and Drinking Places. These three industries account for a combined 26.59% of the region's economy. The region's 2018 coefficient of specialization (COS) is 42.39, 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 Point Pleasant, WV-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 Management of Companies and Enterprises, whose employment grew by 372 followed by Home Health Care Services and Transit and Ground Passenger Transportation. 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 1.92, 3.08, and 1.74.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
133	Management of Companies and Enterprises	372	339	1.92
151	Home Health Care Services	120	-175	3.08
100	Transit and Ground Passenger Transportation	118	118	1.74
81	Motor Vehicle Parts Manufacturing	117	130	3.74
143	Elementary and Secondary Schools	113	-242	11.82
153	Hospitals	89	-244	3.65
155	Individual and Family Services	64	-99	0.85
179	Private Households	62	63	1.07
145	Other Educational Services	60	23	1.40
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	46	46	1.89

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 Point Pleasant, WV-OH, the cluster with the largest CLQ in 2018 is Energy (Fossil and Renewable) with a CLQ of 7.74, followed by Education and Knowledge Creation and Transportation Equipment. The CLQs for 2005 and 2018 are presented to further illuminate the trends in cluster specialization and regional structural change.

Figure 1 illustrates the Point Pleasant, WV-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.

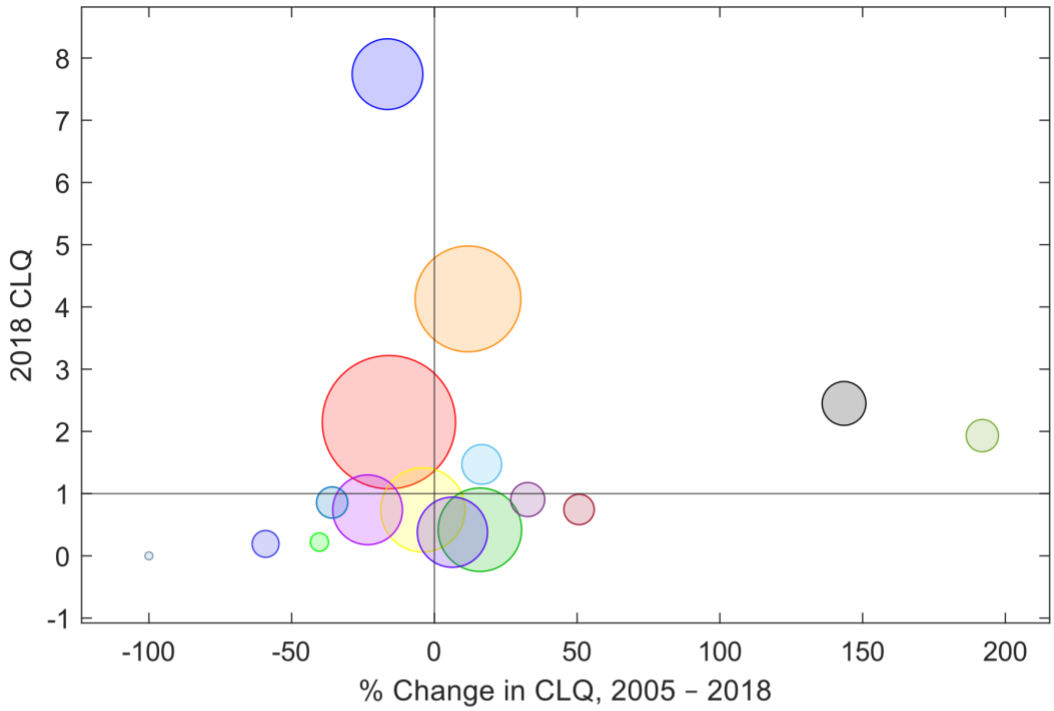
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	2.56	2.15	3,690
9	Education and Knowledge Creation	3.69	4.13	2,249
3	Arts, Entertainment, Recreation and Visitor Industries	0.77	0.74	1,366
5	Business and Financial Services	0.36	0.42	1,339
10	Energy (Fossil and Renewable)	9.26	7.74	925
8	Defense and Security	0.36	0.38	910
16	Transportation and Logistics	0.97	0.74	897
17	Transportation Equipment	1.01	2.45	302
6	Chemicals and Chemical-Based Products	1.26	1.47	238
15	Primary and Fabricated Metal Products	0.68	0.90	161
14	Mining, Glass and Ceramics	0.66	1.93	140
7	Computer, Electronic, and Electrical Products	1.34	0.86	128
11	Forest and Wood Products	0.49	0.75	119
1	Agribusiness, Food Processing and Technology	0.47	0.19	84
12	Information Technology and Telecommunications	0.37	0.22	25
2	Apparel and Textiles	0.00	0.12	5
13	Machinery	0.16	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Point Pleasant, WV-OH



Bubble Size as the Employment for Each Cluster

- Biomedical/Biotechnical (Life Sciences) (3,690)
- Education and Knowledge Creation (2,249)
- Arts, Entertainment, Recreation and Visitor Industries (1,366)
- Business and Financial Services (1,339)
- Energy (Fossil and Renewable) (925)
- Defense and Security (910)
- Transportation and Logistics (897)
- Transportation Equipment (302)
- Chemicals and Chemical-Based Products (238)
- Primary and Fabricated Metal Products (161)
- Mining, Glass and Ceramics (140)
- Computer, Electronic, and Electrical Products (128)
- Forest and Wood Products (119)
- Agribusiness, Food Processing and Technology (84)
- Information Technology and Telecommunications (25)
- Apparel and Textiles (5)
- Machinery (0)

2. CADS Analysis

The 2018 CADS analysis of the economy of Point Pleasant, WV-OH 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	113	230
5	Business and Financial Services	133	Management of Companies and Enterprises	96	468

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	3.74	130	-11.56	103.69	0.60	0.06
133	Management of Companies and Enterprises	1.92	339	34.84	389.06	0.77	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 81

Motor Vehicle Parts Manufacturing

Industry #	Industry Name	Employment
52	Foundries	-23
53	Forging and Stamping	-10
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-30
72	Semiconductor and Other Electronic Component Manufacturing	-20
104	Warehousing and Storage	-20
129	Management, Scientific, and Technical Consulting Services	-2
136	Employment Services	-6

Table 6. Phase 2 Deficits Adding Anchor Industry 133

Management of Companies and Enterprises

Industry #	Industry Name	Employment	Added to Deficit
52	Foundries	-23	-0
53	Forging and Stamping	-10	-0
59	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	-31	-1
72	Semiconductor and Other Electronic Component Manufacturing	-21	-1
104	Warehousing and Storage	-21	-1
129	Management, Scientific, and Technical Consulting Services	-18	-16
136	Employment Services	-18	-12

Chapter 30. Portsmouth, OH

Study Area Overview

The Portsmouth, OH study region occupies 610 square-miles and had a 2018 population of 75,502. The employed share of the regional labor force during the 2014-2018 period averaged 92.8%. The Hospitals 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 30.3% of the region's economy. The region's 2018 coefficient of specialization (COS) is 40.56, 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 Portsmouth, 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 660 followed by Government and Unclassified and Home Health Care 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 3.59, 0.57, and 4.79.

Table 1. Top Ten Growth Industries

Industry #	Industry Name	Employment Change	RS	LQ
153	Hospitals	660	297	3.59
181	Government and Unclassified	316	259	0.57
151	Home Health Care Services	249	-408	4.79
149	Outpatient Care Centers	221	-3	3.40
145	Other Educational Services	201	168	1.91
92	Motor Vehicle and Parts Dealers	170	151	2.00
167	Food Services and Drinking Places	144	-525	1.36
148	Offices of Other Health Practitioners	134	59	1.65
126	Architectural, Engineering, and Related Services	120	115	0.77
42	Plastics Product Manufacturing	115	124	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 Portsmouth, OH, the cluster with the largest CLQ in 2018 is Education and Knowledge Creation with a CLQ of 3.83, followed by Biomedical/Biotechnical (Life Sciences) 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 Portsmouth, 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.

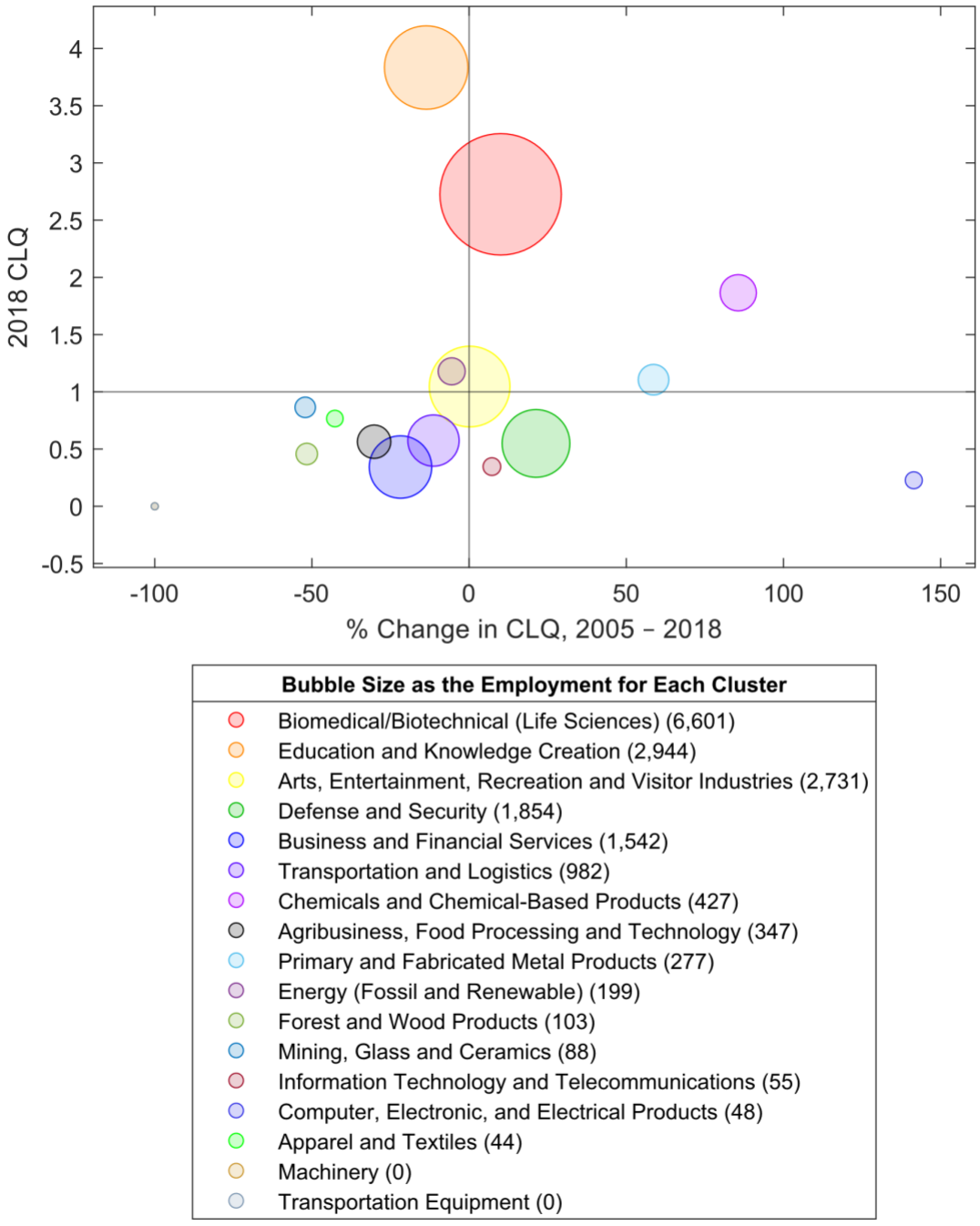
As a result of this categorization, the Star clusters that display in quadrant I are specialized and becoming more so. The Mature clusters that display in quadrant II are specialized but have become less so. Emerging clusters, those in quadrant IV, are not specialized in the region, but have gained in 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)	2.48	2.73	6,601
9	Education and Knowledge Creation	4.44	3.83	2,944
3	Arts, Entertainment, Recreation and Visitor Industries	1.04	1.05	2,731
8	Defense and Security	0.45	0.55	1,854
5	Business and Financial Services	0.44	0.34	1,542
16	Transportation and Logistics	0.65	0.57	982
6	Chemicals and Chemical-Based Products	1.01	1.87	427
1	Agribusiness, Food Processing and Technology	0.81	0.56	347
15	Primary and Fabricated Metal Products	0.70	1.11	277
10	Energy (Fossil and Renewable)	1.25	1.18	199
11	Forest and Wood Products	0.95	0.46	103
14	Mining, Glass and Ceramics	1.81	0.86	88
12	Information Technology and Telecommunications	0.32	0.35	55
7	Computer, Electronic, and Electrical Products	0.09	0.23	48
2	Apparel and Textiles	1.34	0.77	44
13	Machinery	0.15	0.00	0
17	Transportation Equipment	1.05	0.00	0

Note: Increasing cluster concentrations are highlighted in blue.

Figure 1: Cluster Bubble Chart of Portsmouth, OH



2. CADS Analysis

The 2018 CADS analysis of the economy of Portsmouth, OH 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	2,010	2,671
6	Chemicals and Chemical-Based Products	42	Plastics Product Manufacturing	135	251
4	Biomedical/Biotechnical (Life Sciences)	148	Offices of Other Health Practitioners	125	259
9	Education and Knowledge Creation	145	Other Educational Services	74	275

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

				Industry Growth Rate (%)	Industry Growth Rate (%)		
Anchor #	Anchor Industry Name	LQ	RS	National	Regional	AS	AD
153	Hospitals	3.59	297	18.09	32.85	0.67	0.17
42	Plastics Product Manufacturing	2.92	124	-6.65	85.20	0.64	0.03
148	Offices of Other Health Practitioners	1.65	59	59.61	107.20	0.76	0.01
145	Other Educational Services	1.91	168	44.75	270.44	0.86	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
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-1
38	Pharmaceutical and Medicine Manufacturing	-21
89	Medical Equipment and Supplies Manufacturing	-32
117	Insurance Carriers	-65
128	Computer Systems Design and Related Services	-11
131	Advertising and Related Services	-9
134	Office Administrative Services	-26
136	Employment Services	-166
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-13
174	Drycleaning and Laundry Services	-12

Table 6. Phase 2 Deficits Adding Anchor Industry 42

Plastics Product Manufacturing

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-16	-15
38	Pharmaceutical and Medicine Manufacturing	-21	-0
89	Medical Equipment and Supplies Manufacturing	-32	-0
117	Insurance Carriers	-66	-1

128	Computer Systems Design and Related Services	-14	-3
131	Advertising and Related Services	-10	-1
134	Office Administrative Services	-27	-1
136	Employment Services	-175	-9
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-14	-2
174	Drycleaning and Laundry Services	-13	-0

Table 7. Phase 3 Deficits Adding Anchor Industry 148

Offices of Other Health Practitioners

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-16	-0
38	Pharmaceutical and Medicine Manufacturing	-24	-3
89	Medical Equipment and Supplies Manufacturing	-32	-0
117	Insurance Carriers	-67	-0
128	Computer Systems Design and Related Services	-15	-1
131	Advertising and Related Services	-11	-1
134	Office Administrative Services	-28	-1
136	Employment Services	-181	-6
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-15	-0
174	Drycleaning and Laundry Services	-13	-0

Table 8. Phase 4 Deficits Adding Anchor Industry 145

Other Educational Services

Industry #	Industry Name	Employment	Added to Deficit
36	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	-16	-0
38	Pharmaceutical and Medicine Manufacturing	-24	-0
89	Medical Equipment and Supplies Manufacturing	-32	-0
117	Insurance Carriers	-67	-1
128	Computer Systems Design and Related Services	-17	-2
131	Advertising and Related Services	-12	-1
134	Office Administrative Services	-28	-1
136	Employment Services	-186	-5
170	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	-15	-0
174	Drycleaning and Laundry Services	-13	-0