


Potomac Highlands Region of West Virginia

REGIONAL INDUSTRY CLUSTER ANALYSIS

 West Virginia University
JOHN CHAMBERS COLLEGE OF
BUSINESS AND ECONOMICS
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Regional Industry Cluster Analysis for the Potomac Highlands Region of West Virginia

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Executive Summary

Industry clusters are defined as “a form of network that occurs within a geographical location, in which the proximity of firms and institutions ensures certain forms of commonality and increases the frequency and impact of interactions.”¹ In this report we identify existing industrial clusters for the Potomac Highlands region in West Virginia and examine potential industries or clusters for economic development. The primary objective of this study is to use a variety of tools to analyze the industry cluster structure for Potomac Highlands and evaluate the strengths and gaps of existing industry clusters. Our cluster analysis comprises three parts: (1) location quotient analysis, (2) shift-share analysis, and (3) input-output analysis. Results of both the location quotient and shift-share analyses are used for industry targeting, whereas input-output analysis measures existing cluster strengths and bottlenecks for potential cluster diversification strategies. Using these tools, we have identified three industry clusters that constitute the primary clusters in the Potomac Highlands region:

1. Advanced Materials
2. Forest and Wood Products
3. Printing and Publishing

We expect that these clusters identified in the extended study region should have significant impacts on the regional economy in the near future. This conclusion is based on the fact that (1) these clusters are specialized compared to the nation; (2) they have become increasingly specialized in the period between 2005 and 2015; (3) shift-share results indicate that these have positive regional competitive effects; and (4) they all have a relatively large employment size. In addition, several cluster gaps have been identified through input-output analysis for the clusters. Because most of these gap sectors are not present in the region, recruiting them can promote the economic performance of the clusters.

In addition, we have identified four other clusters that can be seen as emerging clusters in the region and may merit further study for economic development. These clusters are not currently highly specialized in the Potomac Highlands region but have seen an increase in specialization and importance over the last 10 years. These clusters are:

1. Business and Financial Services
2. Information Technology and Telecommunications
3. Machinery Manufacturing
4. Transportation Equipment Manufacturing

We intend this report to be primarily descriptive, in that we are not making recommendations for industry targeting based on this cluster analysis. However, we will utilize this analysis to inform the recommendations in the Strategic Action Plan.

¹ Porter, 1998, p. 226

1 Introduction

Industry clusters are defined as “a form of network that occurs within a geographical location, in which the proximity of firms and institutions ensures certain forms of commonality and increases the frequency and impact of interactions” (Porter, 1998, p. 226). Based on this concept, firms within a cluster are expected to be more productive than if they were not co-located. There are numerous reasons to explain this increased productivity, such as agglomeration economies (Marshall, 1890) or collaboration between firms (Reid, Smith, and Carroll, 2008). Examples of industry clusters are the Research Triangle in North Carolina and high-tech firms in Silicon Valley. In the past three decades, economic developers, planners, and regional economists have used industry cluster analysis to understand regional economic structure and develop strategies to promote economic performance.

In this report we identify existing industrial clusters for the Potomac Highlands region in West Virginia and seek potential industries or clusters for economic development. We also evaluate strengths and gaps of existing industry clusters. Our cluster analysis comprises three parts, including (1) location quotient (LQ) analysis, (2) shift-share analysis, and (3) input-output (I-O) analysis. Results of both the location quotient and shift-share analyses are used for industry targeting, whereas input-output analysis measures existing cluster strengths and bottlenecks for potential cluster diversification strategies based on Jackson’s (2015) cluster and diversification strategy (CADS). These methods and supporting data are introduced briefly in the next section, after which the application results are displayed. The final section summarizes the findings of the analysis.

2 Methodology

2.1 Data

The primary source for data used in our analyses is derived from the Quarterly Census of Employment Wages (QCEW) data at the six-digit NAICS² level from the US Bureau of Labor Statistics (BLS) in the years 2005 and 2015. These study periods should be meaningful for regional economic development in the study region, and the research team already had purchased these data from the IMPLAN, a commercial data vendor, for these periods. The IMPLAN processes these data to provide estimates for missing values due to disclosure rules in the QCEW data. Other data sources include the US Census Bureau and national benchmark input-output data from the US Bureau of Economic Analysis (BEA).

Our analysis studies both industry- and cluster-level economic structures of the study region for economic development purposes. On one hand, industries are the basic units in LQ, shift-share, and I-O analyses. Because the six-digit NAICS codes in the original QCEW data are different from the industry code in the BEA's national benchmark input-output data, the original six-digit NAICS sectors cannot be the analytical units. Instead, based on the BEA Industry Economic Accounts, the research team aggregated the original six-digit sectors into 370 industries for input-output analysis. Furthermore, to combine the result of I-O analysis, both location quotient and shift-share analyses focus on the 370 industries rather than the original six-digit NAICS sectors in the QCEW data.

Clusters are defined based on a study conducted by the Purdue Center for Regional Development, Indiana Business Research Center, and Strategic Development Group (2007). The study identified 17 industry clusters in the US. Among these clusters, the "Manufacturing Supercluster" was further divided into six sub-clusters to provide additional details of their economic activities like Machinery and Computer and Electronic Products. However, our analysis excludes the Defense and Security cluster because most industries in this cluster are national security sectors that are beyond the scope of regional development. As shown in Table 1, a total of 21 clusters or sub-clusters were considered, and their employment are the sum of employment in the industries that make up each cluster.³ As such, LQ and shift-share analyses can detect the dynamics of industry clusters.

² NAICS stands for the North American Industry Classification System and is the standard system for classifying establishments in terms of their primary business activities. For more information about the NAICS, see <https://www.census.gov/eos/www/naics/>.

³ For more information about the detailed composition of these industry clusters, see Appendix A.

Table 1: List of Clusters

No.	Clusters
1	Advanced Materials
2	Agribusiness, Food Processing, and Technology
3	Apparel and Textiles
4	Arts, Entertainment, Recreation, and Visitor Industries
5	Biomedical/Biotechnical (Life Sciences)
6	Business and Financial Services
7	Chemicals and Chemical-Based Products
8	Education and Knowledge Creation
9	Energy (Fossil and Renewable)
10	Forest and Wood Products
11	Glass and Ceramics
12	Information Technology and Telecommunications
Manufacturing Supercluster	
13	Primary Metals
14	Fabricated Metal Products
15	Machinery
16	Computer and Electronic Products
17	Electrical Equipment, Appliance, and Components
18	Transportation Equipment
19	Mining (Non-Energy)
20	Printing and Publishing
21	Transportation and Logistics

Data Source: Purdue Center for Regional Development, Indiana Business Research Center, and Strategic Development Group (2007)

2.2 Location Quotient Analysis

Location quotients (LQs) indicate where the region's comparative advantages might lie and can be calculated as the ratio of the regional share of an industry or cluster to the national share of the same industry or cluster in terms of economic activity, such as employment or number of establishments. In our analysis, we compute LQs based on both industry- and cluster-level employment and compare them with a location quotient value of one. For a given region, if the LQ of an industry in the region is greater than one, the region is more specialized in that industry than the national average; conversely, if the LQ is less than one, the region is less specialized than the national average for that industry.

LQ analysis can also be extended to consider industry dynamics by comparing the changes in the location quotients over time. According to a report from the Purdue Center for Regional Development, Indiana Business Research Center, and Strategic Development Group (2007), four categories of industries or clusters can be identified based on their LQ and change in LQ (ΔLQ):

1. "Star": industries or clusters are more specialized ($LQ > 1$) relative to the national economy and are becoming more specialized over time ($\Delta LQ > 0$).
2. "Emerging": industries or clusters are less specialized ($LQ < 1$) relative to the national economy but are becoming more specialized over time ($\Delta LQ > 0$).
3. "Mature": industries or clusters are more specialized ($LQ > 1$) relative to the national economy but are becoming less specialized over time ($\Delta LQ < 0$).
4. "Transforming": industries or clusters are less specialized ($LQ < 1$) relative to the national economy and are becoming less specialized over time ($\Delta LQ < 0$).

2.3 Shift-Share Analysis

Although location quotient analysis can provide an initial impression of the region's economy for different years, it fails to explain the sources of change in terms of how this local change differs from the national trend. To overcome this problem, shift-share analysis is thus applied.

Methodologically, shift-share analysis decomposes changes of economic activities like employment into three main factors: (1) national share, (2) industry mix, and (3) regional shift. National share refers to the impact of national growth on an industry. For instance, if the total employment of the US increases two percent from 2005 to 2015, the national share factor is the product of two percent and the employment of industry or cluster X in 2005. By comparison, industry mix reveals how the national change of an individual industry can affect a local economy. Finally, regional shift quantifies the changes that cannot be explained by national or industrial trends, which reflects the effects of region-specific factors.

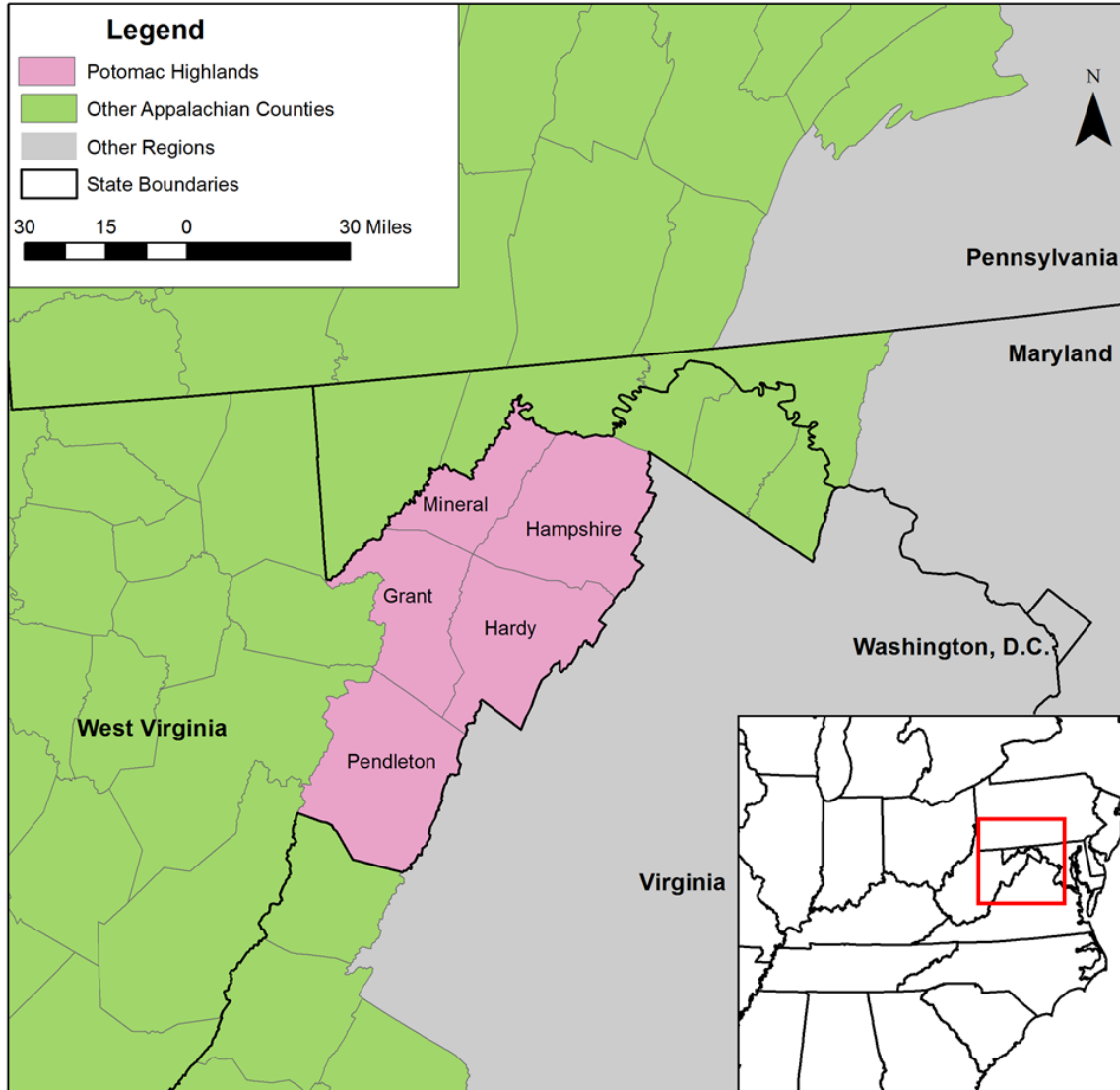
2.4 Input-Output Analysis

Based on Jackson's (2015) cluster and diversification strategy, we seek to answer the question of whether existing clusters are well supported by other sectors—in other words, we evaluate existing gaps in the regional economy in terms of supply deficits. Conceptually, an industry gap is identified when a particular good or service is imported into the region because the good or service cannot meet the needs of the local economy (Goetz, Deller, and Harris, 2007). From a methodological perspective, the logic of CADS is first to estimate the input requirements for supporting economic clusters through the I-O accounting framework and then to compare these requirements with the existing distribution.

3 Analysis

As shown in Figure 1, Potomac Highlands in West Virginia includes five counties (namely Pendleton, Grant, Hampshire, Hardy and Mineral). The study region is also located in the periphery of Appalachia and shares its boundaries with the states of Maryland, Virginia, and some counties in West Virginia.

Figure 1: Potomac Highlands Region



Data Source: Census Bureau

Table 2 lists county employment for the study region along with its immediate (first order) neighbors. The employment for the five core counties is less than 10,000. By comparison, great disparity can be found in the employment level of the neighboring counties. For example, the employment of Highland County, VA, is only 480 while that number for Rockingham County, VA, is 59,238. To illustrate this point, Figure 2 depicts the employment for all counties. Four counties—Allegany in Maryland and Frederick,

Rockingham, and Augusta in Virginia—stand out because of their employment size. These counties should have effects of the Potomac Highlands region in terms of spatial interactions.

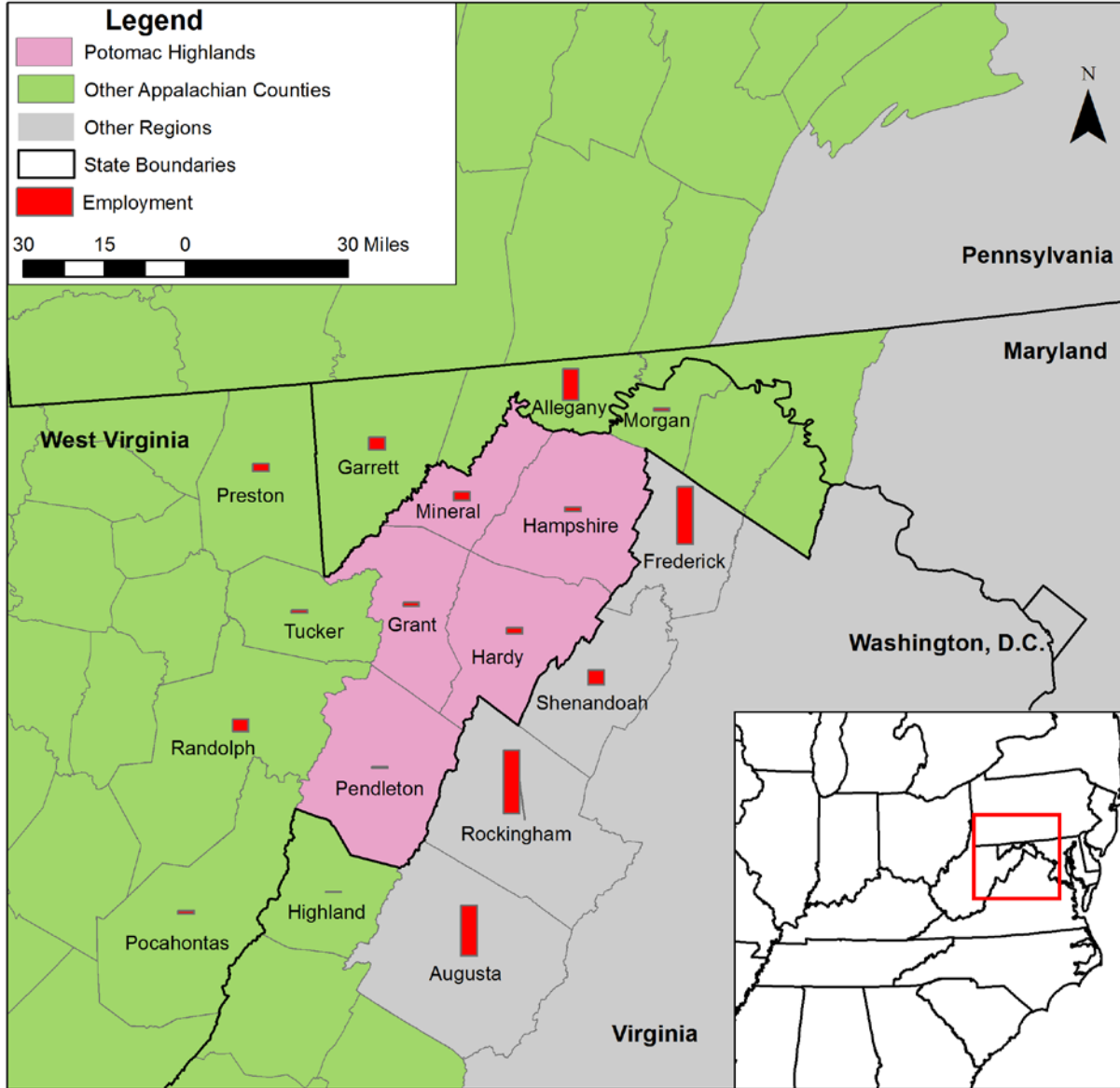
Table 2: Employment of the study region and its neighbors

County	2015 Employment
Mineral County, West Virginia	7,724
Grant County, West Virginia	3,409
Pendleton County, West Virginia	1,536
Hardy County, West Virginia	5,742
Hampshire County, West Virginia	3,994
Garrett County, Maryland	11,792
Allegany County, Maryland	28,978
Morgan County, West Virginia	2,692
Frederick County, Virginia	53,798
Shenandoah County, Virginia	13,852
Rockingham County, Virginia	59,238
Augusta County, Virginia	47,184
Highland County, Virginia	480
Pocahontas County, West Virginia	3,006
Randolph County, West Virginia	11,452
Tucker County, West Virginia	2,714
Preston County, West Virginia	7,290

Note: Counties in the Potomac Highlands are in bold.

Data Source: Bureau of Labor Statistics

Figure 2: Employment Distribution of the Potomac Highlands Region and Its Neighbors

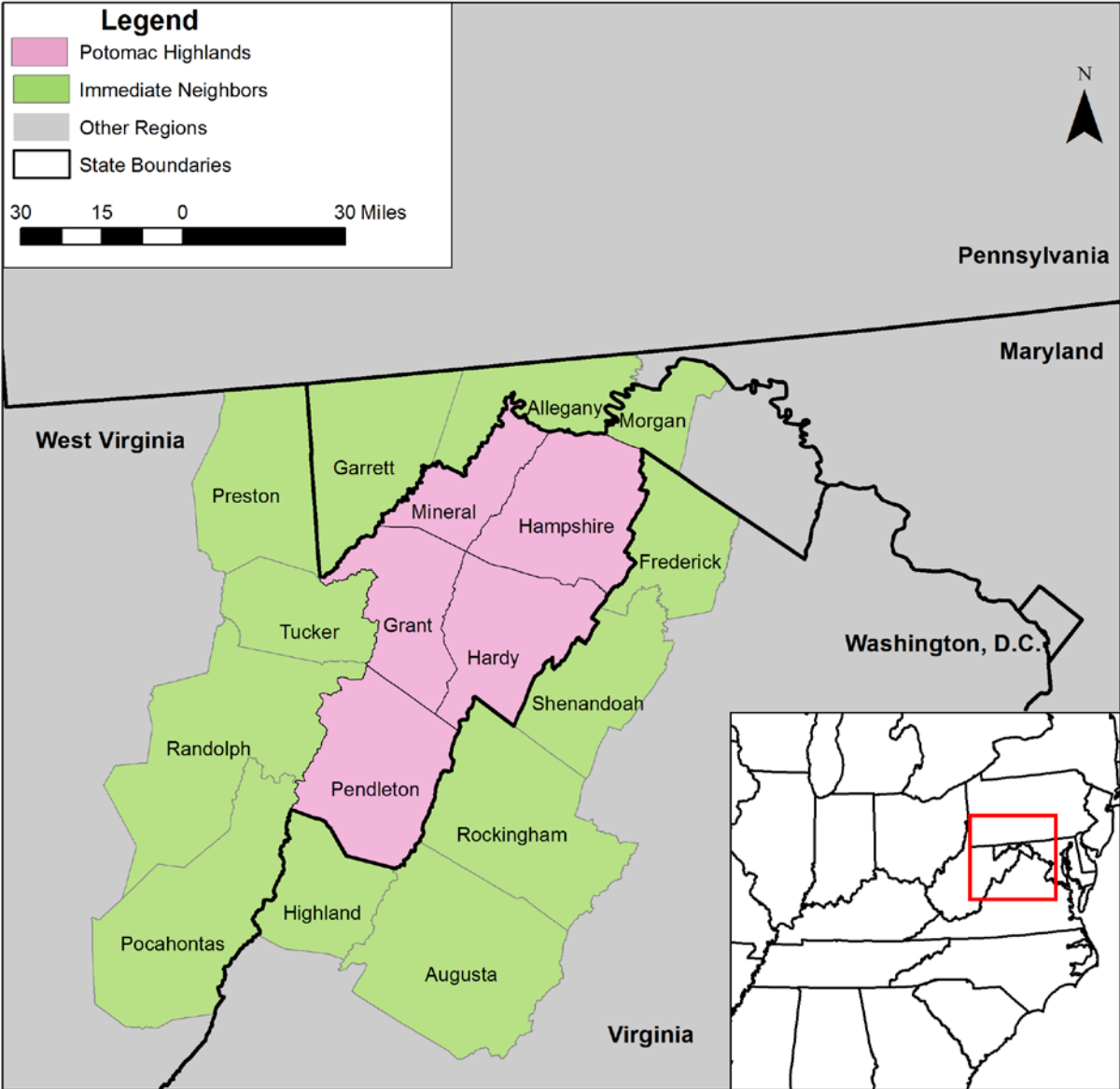


Data Sources: Census Bureau and Bureau of Labor Statistics

To account for neighborhood effects, the study region is extended by including the immediate neighbors of the Potomac Highlands (12 counties). We also checked the commuting flows for the second-order neighbors of the study region (immediate neighbors of the first-order neighbors). However, because these second-order neighbors appear not to have strong ties with the first-order neighbors, no additional counties are included. The extended study region⁴ is shown altogether in Figure 3.

⁴ Unless it is mentioned explicitly, our cluster analysis only focuses on the extended study region.

Figure 3: Extended Study Region

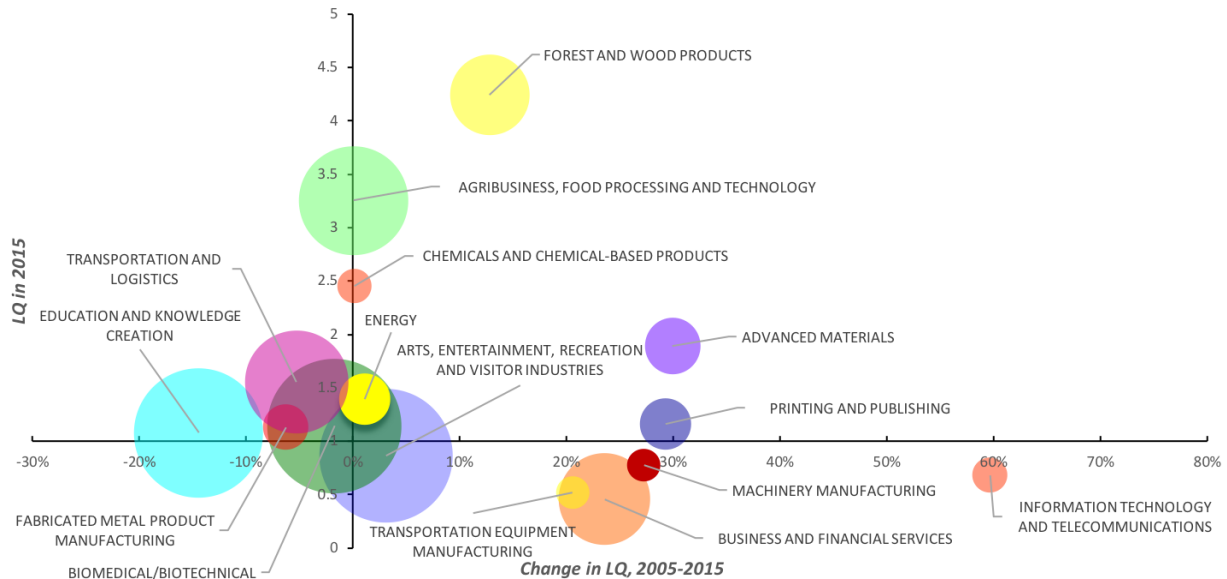


Data Sources: Census Bureau and Bureau of Labor Statistics

3.1 Location Quotient Analysis

The Purdue Center for Regional Development, Indiana Business Research Center, and Strategic Development Group (2007) proposed a cluster template for regional development. Based on this template, 21 clusters are identified in this analysis. However, there are six clusters with employment of 1,000 or less. For increased focus, Figure 4 excludes these clusters and illustrates the employment size, LQ and change in LQ of the remaining clusters with 2015 employment greater than 1,000. Note that the size of the bubble reflects employment size.

Figure 4: LQ and Change in LQ of Clusters



Data Source: Bureau of Labor Statistics

Clusters with high LQs in 2015 are Forest and Wood Products (4.24), Agribusiness, Food Processing and Technology (3.25), and Chemicals and Chemical-Based Products (2.45). Meanwhile, as suggested by the positive LQ changes, these clusters have become more specialized from 2005 to 2015. Similarly, there are other clusters that have LQs greater than one with increasing specializations. These “star” clusters include Advanced Materials (1.89), Energy (1.40), and Printing and Publishing (1.16).

Five other clusters have LQs greater than one, but their comparative advantages diminish during the period of 2005-2015 (i.e., “mature” clusters). These clusters include Mining (1.88), Transportation and Logistics (1.55), Biomedical/Biotechnical (1.14), Education and Knowledge Creation (1.08), and Fabricated Metal Product Manufacturing (1.13). From a life-cycle perspective, these clusters may decline significantly in the near future because of changes in taste or technology (Purdue Center for Regional Development, 2011). Because of this, these clusters are generally not the target for economic development.

Five clusters have low LQs but show an increase in specialization (i.e., “emerging” clusters): Arts, Entertainment, Recreation, and Visitor Industries (0.86); Business and Financial Services (0.46); Information Technology and Telecommunications (0.68); Machinery Manufacturing (0.78); and Transportation Equipment Manufacturing (0.52). The concept of “emerging clusters” means that clusters in this category might be potentially specialized in the future. Practically, the Information Technology and Telecommunications cluster has the greatest LQ change (59.65 percent) from 2005 to 2015. This cluster might be considered for future development.

In addition to cluster-based LQ analysis, Table 3 lists ten industries with the largest LQ values in 2015. The highest location quotient is associated with the Transportation Equipment Manufacturing cluster.

This is because Orbital ATK, a space industry company, has a rocket manufacturing plant in the region. Other clusters with large industry LQs are Advanced Materials, Agribusiness, Food Processing and Technology, Forest and Wood Products, Biomedical/Biotechnical, and Chemicals and Chemical-Based Products.

Table 3: Industries with Large LQ Values

Rank	Disaggregated Industry	LQ	Aggregated Cluster
1	Propulsion Units and Parts for Space Vehicles and Guided Missiles	46.89	Transportation Equipment Manufacturing
2	Poultry Processing	19.96	Agribusiness, Food Processing, and Technology
3	Medicinal and Botanical Manufacturing	19.34	Biomedical/Biotechnical
4	Fluid Milk and Butter Manufacturing	17.14	Agribusiness, Food Processing, and Technology
5	Sawmills and Wood Preservation	13.85	Forest and Wood Products
6	Sugar and Confectionery Product Manufacturing	12.82	Agribusiness, Food Processing, and Technology
7	Other Furniture Related Product Manufacturing	12.55	Forest and Wood Products
8	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing	9.93	Advanced Materials
9	Asphalt paving mixture and block manufacturing	9.26	Advanced Materials
10	Lime and gypsum product manufacturing	8.64	Chemicals and Chemical-Based Products

Data Source: Bureau of Labor Statistics

3.2 Shift-Share Analysis

Shift-share analysis provides a good supplement to LQ analysis in explaining changes in economic activities in terms of national and industry trends and local effects (Jackson and Haynes, 2009). The results of shift-share analysis are shown in Table 4. “Expected Change” is the joint effect of national (“National Growth”) and industry (“Industry Mix”) trends, while “Regional Shift” is the difference between “Job Change” and “Expected Change.”

Table 4: Cluster-Based Shift-Share Analysis Results

No.	Name	Job Change	National Growth	Industry Mix	Expected Change	Regional Shift
1	Advanced Materials	271	312	-557	-245	516
2	Agribusiness, Food Processing, and Technology	-540	1341	-546	796	-1336
3	Arts, Entertainment, Recreation, and Visitor Industries	2143	1715	1794	3509	-1366
4	Biomedical/Biotechnical	3484	1588	4298	5886	-2402
5	Business and Financial Services	1715	732	5	738	977
6	Chemicals and Chemical-Based Products	-410	165	-447	-282	-128
7	Education and Knowledge Creation	408	1756	3915	5671	-5263
8	Energy (Fossil and Renewable)	159	268	153	421	-261
9	Fabricated Metal Products Manufacturing	-518	274	-392	-117	-401
10	Forest and Wood Products	-2647	946	-3743	-2797	151
11	Information Technology and Telecommunications	315	102	-204	-102	417
12	Machinery Manufacturing	104	105	-154	-50	154
13	Printing and Publishing	-13	289	-727	-438	425
14	Transportation and Logistics	-914	1243	-234	1009	-1923
15	Transportation Equipment Manufacturing	-50	121	-270	-149	100

Data Source: Bureau of Labor Statistics

As suggested by previous studies (e.g., Barkley and Henry, 2005; Goetz, Deller and Harris, 2007), the targeted industries for economic development are normally those with large regional shifts. In that sense, these clusters with positive regional shifts are potential targets for economic development: Advanced Materials (516), Business and Financial Services (977), Forest and Wood Products (151), Information Technology and Telecommunications (417), Machinery Manufacturing (154), Printing and Publishing (425), and Transportation Equipment Manufacturing (100). Particularly, with the exception of the Business and Financial Services cluster, all of these clusters have negative industry mix effects,

suggesting that they were poor performers nationally, but better in the region than in the nation. As for the Business and Financial Services cluster, its industry mix effect (5) is positive. An interpretation of the industry mix and regional shift effects is that this cluster was a good performer nationally and even better in the region than in the nation. By comparison, the remaining eight clusters have negative regional shifts. On one hand, although the clusters of Arts, Entertainment, Recreation, and Visitor Industries (-1,336); Biomedical/Biotechnical (-2,402); Education and Knowledge Creation (-5,263); and Energy (-261) have negative regional shifts, their industry mix effects are positive. This tells us that these clusters performed well nationally but poorly in the region. On the other hand, the Agribusiness, Food Processing and Technology, Chemicals and Chemical-Based Products, Fabricated Metal Products Manufacturing, and Transportation and Logistics clusters have negative industry mix effects, indicating that these clusters were poor performers nationally, and even poorer in the region than in the nation.

Our analysis also detects regional shift at the industry level. Table 5 lists industries with the largest regional shifts. Two points are worthy of note. First, three of ten industries are in the Agribusiness, Food Processing, and Technology cluster. Second, the industry of propulsion units and parts for space vehicles and guided missiles has a large regional shift; in other words, region-specific factors benefit this industry.

Table 5: Industries with Large Regional Shifts

Rank	Disaggregated Industry	Regional Shift	Aggregated Cluster
1	Monetary Authorities and Depository Credit Intermediation	1439	Business and Financial Services
2	Fluid Milk and Butter Manufacturing	840	Agribusiness, Food Processing, and Technology
3	Printing	661	Printing and Publishing
4	Propulsion Units and Parts for Space Vehicles and Guided Missiles	591	Transportation Equipment Manufacturing
5	Truck Transportation	574	Transportation and Logistics
6	Sugar and Confectionery Product Manufacturing	545	Agribusiness, Food Processing, and Technology
7	Fruit and Vegetable Canning, Pickling, and Drying	282	Agribusiness, Food Processing, and Technology
8	Air Conditioning, Refrigeration, and Warm Air Heating Equipment Manufacturing	277	Machinery Manufacturing
9	Other Furniture Related Product Manufacturing	271	Forest and Wood Products
10	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing	247	Advanced Materials

Data Source: Bureau of Labor Statistics

3.3 Cluster Selection

Taken together, we use the following criteria for selecting industries as significant clusters in the Potomac Highlands region:

1. The number of employees is greater than 1,000 in 2015;
2. The location quotient is greater than 1.0 in 2015;
3. The location quotient increases in the period of 2005-2015;
4. The regional shift of shift-share analysis is positive.

Note that these criteria are proposed based on previous cluster studies such as Barkely and Henry (2005) and Goetz, Deller, and Harris (2007). These criteria may be modified for different cases and other useful criteria also can be added.⁵

Table 6 summarizes the related data for clusters with employment over 1,000. The three clusters that meet all four criteria and therefore merit further scrutiny are:

1. Advanced Materials
2. Forest and Wood Products
3. Printing and Publishing

In addition, we have identified four other clusters that may be seen as emerging clusters in the region and may merit further study for economic development. These clusters meet criteria 1, 3, and 4, but currently do not have LQs above 1, and thus are not currently highly clustered in the region. However, these clusters are growing in specialization and the shift-share analysis shows they are increasingly important in the region. These clusters are:

1. Business and Financial Services
2. Information Technology and Telecommunications
3. Machinery Manufacturing
4. Transportation Equipment Manufacturing

Additionally, three other clusters meet three of the four criteria for the primary clusters. These clusters are star clusters with negative regional shifts. As such, economic developers should be cautious about these clusters for resource investment:

1. Agribusiness, Food Processing, and Technology
2. Chemicals and Chemical-Based Products
3. Energy

For the remainder of our analysis, we focus on the three primary clusters to understand their relevance in the region.

⁵ For example, several studies indicated that industries or clusters with location quotients greater than 1.2 are specialized.

Table 6: Indicators for Cluster Selection and Prioritization

No.	Name	2015 Employment	2015 LQ	LQ Change	Regional Shift
1	Advanced Materials	3,425	1.89	29.93%	516
2	Agribusiness, Food Processing, and Technology	13,032	3.25	0.09%	-1,336
3	Arts, Entertainment, Recreation, and Visitor Industries	19,496	0.86	3.12%	-1,366
4	Biomedical/Biotechnical	19,554	1.14	-1.73%	-2,402
5	Business and Financial Services	9,123	0.46	23.58%	977
6	Chemicals and Chemical-Based Products	1,255	2.45	0.15%	-128
7	Education and Knowledge Creation	18,176	1.08	-14.43%	-5,263
8	Energy (Fossil and Renewable)	2,870	1.40	1.13%	-261
9	Fabricated Metal Products Manufacturing	2,257	1.13	-6.29%	-401
10	Forest and Wood Products	6,924	4.24	12.80%	151
11	Information Technology and Telecommunications	1,350	0.68	59.65%	417
12	Machinery Manufacturing	1,162	0.78	27.22%	154
13	Printing and Publishing	2,908	1.16	29.26%	425
14	Transportation and Logistics	11,659	1.55	-5.28%	-1,923
15	Transportation Equipment Manufacturing	1,174	0.52	20.57%	100

Data Source: Bureau of Labor Statistics

Table 7 displays employment in these three clusters by region (Potomac Highlands, Immediate Neighbors, or Extended Study Region Total). The Advanced Materials cluster meets all the criteria in both Potomac Highlands and the immediate neighbors. By comparison, the cluster of Forest and Wood Products has a positive regional shift in the immediate neighbors whereas a negative regional shift in Potomac Highlands. Moreover, the Printing and Publishing cluster is not specialized and its LQ decreases from 2005 to 2015 in Potomac Highlands. This cluster also has a negative regional shift whereas it is specialized in the immediate neighboring counties. In that sense, the Advanced Materials cluster has higher priority than the other two.

Table 7: Cluster Employment by Region

Cluster/Region	2015 Employment	2015 LQ	LQ Change	Regional Shift
Advanced Materials				
Potomac Highlands	276	1.29	63.12%	70
Immediate Neighbors	3,184	1.97	26.76%	446
Extended Study Region Total	3,425	1.89	29.93%	517
Forest and Wood Products				
Potomac Highlands	1,411	7.35	19.07%	-32
Immediate Neighbors	5,512	3.82	12.55%	182
Extended Study Region Total	6,924	4.24	12.80%	151
Printing and Publishing				
Potomac Highlands	87	0.30	-15.32%	-38
Immediate Neighbors	2,820	1.27	30.23%	463
Extended Study Region Total	2,908	1.16	29.26%	425

Data Source: Bureau of Labor Statistics

Table 8 lists the three largest industries in each cluster in terms of employment. For example, the top three industries in the Printing and Publishing cluster are (1) Printing; (2) News syndicates, libraries, archives, and all other information services; and (3) Newspaper publishers. In each cluster, more than 50 percent of the employment comes from the top three industries. These industries also have LQ values greater than one in 2015, suggesting that they are more specialized in the Potomac Highlands region than the national average. In addition, although the Advanced Materials cluster has a positive regional shift, the largest sector (i.e., other plastic product manufacturing) has a negative regional shift.

Table 8: Cluster Employment by Industry

Cluster/Industry	2015 Employment	2005 LQ	2015 LQ	Regional Shift
Advanced Materials	3,424	0.84	1.89	516
1. Other plastics product manufacturing	1,448	3.65	3.51	-213
2. Plastics packaging materials and unlaminated film and sheet manufacturing	588	2.75	4.82	217
3. Laminated plastics plate, sheet (except packaging), and shape manufacturing	248	0	9.93	247
Forest and Wood Products	6,924	3.54	4.24	151
1. Sawmills and wood preservation	1,746	14.44	13.85	-263
2. Millwork	1,139	7.77	8.55	-4
3. Wood kitchen cabinet and countertop manufacturing	800	3.43	5.29	227
Printing and Publishing	2,908	0.85	1.16	425
1. Printing	1,840	1.84	3.16	661
2. News syndicates, libraries, archives, and all other information services	443	1.20	1.68	96
3. Newspaper publishers	378	1.00	1.45	90

Data Source: Bureau of Labor Statistics

3.4 Input-Output Analysis

Based on the results of location quotient and shift-share analyses, three clusters are defined as the region's primary clusters. They include Advanced Materials, Forest and Wood Products, and Printing and Publishing. The final part of this analysis examines whether these economic clusters are well supported by suppliers in the region.

Table 9 lists ten cluster gaps in terms of supply deficits. Note that "Additional Requirement" is the difference between the current employment in the industry and the number of workers required in

supporting industries that would be needed to fully sustain the three primary clusters given the current size of the cluster anchor industries. Given the identified additional needs, these supporting industries or cluster gaps can also be targets for economic development.

Table 9: Top 10 Identified Cluster Gaps

Rank	Industry	Total Worker Demand	Additional Workers Required
1	Fabric Mills	133	131
2	Coating, Engraving, Heat Treating and Allied Activities	106	104
3	Other Motor Vehicle Parts Manufacturing	82	82
4	Textile and Fabric Finishing and Fabric Coating Mills	71	71
5	Fiber, Yarn, and Thread Mills	68	68
6	Apparel Manufacturing	134	63
7	Iron and Steel Mills and Ferroalloy Manufacturing	60	60
8	Spring and Wire Product Manufacturing	66	35
9	Crown and Closure Manufacturing and Metal Stamping	33	33
10	Other Financial Investment Activities	88	31

Data Source: Bureau of Labor Statistics

4 Summary

The primary objective of this study is to use different tools to analyze the industry cluster structure for Potomac Highlands in West Virginia. Specifically, because of strong socioeconomic ties, this study has extended the original study region by including its immediate neighbors into the analysis. Three primary industry clusters—including Advanced Materials, Forest and Wood Products, and Printing and Publishing—have been identified in the extended study region and are expected to have significant impacts on the regional economy in the near future. This conclusion is based on the fact that (1) these clusters are specialized compared to the nation; (2) they have become increasingly specialized in the period between 2005 and 2015; (3) shift-share results indicate that these have positive regional competitive effects; and (4) they all have a relatively large employment size. In addition, several cluster gaps have been identified through input-output analysis for the clusters. Because most of these gap sectors are not present in the region, recruiting them can promote the economic performance of the clusters.

We intend this report to be primarily descriptive, in that we are not making recommendations for industry targeting based on this cluster analysis. However, we will utilize this analysis to inform future recommendations in the forthcoming Strategic Action Plan. In addition, other steps can be taken to build on and supplement the analysis in this report. First, we recommend generating an asset map that provides information on transportation networks, universities, and natural resources. We also recommend combining other techniques and data sets to formulate development strategies, and in the associated project from which this report was drawn, these steps are underway. Second, after finalizing the targeted clusters, development agencies should assess the alignment of target industry locational requirements, preferably in conjunction with industry specialists, researchers, government officials, and other stakeholders. Finally, workforce supply and readiness must always enter into the industrial targeting and retention equation.

5 References

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6 Appendix A: Detailed Cluster Definitions

6.1 Advanced Materials

Industry	BEA Code
Electromedical and electrotherapeutic apparatus manufacturing	334510
All other miscellaneous manufacturing	339990
Leather and allied product manufacturing	316000
Asphalt paving mixture and block manufacturing	324121
Asphalt shingle and coating materials manufacturing	324122
Other petroleum and coal products manufacturing	324190
Petrochemical manufacturing	325110
Industrial gas manufacturing	325120
Synthetic dye and pigment manufacturing	325130
Other basic inorganic chemical manufacturing	325180
Other basic organic chemical manufacturing	325190
Plastics material and resin manufacturing	325211
Synthetic rubber and artificial and synthetic fibers and filaments manufacturing	3252A0
Fertilizer manufacturing	325310
Pesticide and other agricultural chemical manufacturing	325320
Paint and coating manufacturing	325510
Adhesive manufacturing	325520
Soap and cleaning compound manufacturing	325610
Toilet preparation manufacturing	325620
Printing ink manufacturing	325910
All other chemical product and preparation manufacturing	3259A0
Plastics packaging materials and unlaminated film and sheet manufacturing	326110
Plastics pipe, pipe fitting, and unlaminated profile shape manufacturing	326120
Laminated plastics plate, sheet (except packaging), and shape manufacturing	326130

Industry	BEA Code
Polystyrene foam product manufacturing	326140
Urethane and other foam product (except polystyrene) manufacturing	326150
Plastics bottle manufacturing	326160
Other plastics product manufacturing	326190

6.2 Agribusiness, Food Processing and Technology

Industry	BEA Code
Oilseed farming	1111A0
Grain farming	1111B0
Vegetable and melon farming	111200
Fruit and tree nut farming	111300
Greenhouse, nursery, and floriculture production	111400
Other crop farming	111900
Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	1121A0
Dairy cattle and milk production	112120
Animal production, except cattle and poultry and eggs	112A00
Poultry and egg production	112300
Fishing, hunting and trapping	114000
Support activities for agriculture and forestry	115000
Dog and cat food manufacturing	311111
Other animal food manufacturing	311119
Flour milling and malt manufacturing	311210
Wet corn milling	311221
Soybean and other oilseed processing	31122A
Fats and oils refining and blending	311225

Industry	BEA Code
Breakfast cereal manufacturing	311230
Sugar and confectionery product manufacturing	311300
Frozen food manufacturing	311410
Fruit and vegetable canning, pickling, and drying	311420
Fluid milk and butter manufacturing	31151A
Cheese manufacturing	311513
Dry, condensed, and evaporated dairy product manufacturing	311514
Ice cream and frozen dessert manufacturing	311520
Animal (except poultry) slaughtering, rendering, and processing	31161A
Poultry processing	311615
Seafood product preparation and packaging	311700
Bread and bakery product manufacturing	311810
Cookie, cracker, pasta, and tortilla manufacturing	3118A0
Snack food manufacturing	311910
Coffee and tea manufacturing	311920
Flavoring syrup and concentrate manufacturing	311930
Seasoning and dressing manufacturing	311940
All other food manufacturing	311990
Soft drink and ice manufacturing	312110
Breweries	312120
Wineries	312130
Distilleries	312140
Tobacco product manufacturing	312200

6.3 Apparel and Textiles

Industry	BEA Code
Fiber, yarn, and thread mills	313100
Fabric mills	313200
Textile and fabric finishing and fabric coating mills	313300
Carpet and rug mills	314110
Curtain and linen mills	314120
Other textile product mills	314900
Apparel manufacturing	315000

6.4 Arts, Entertainment, Recreation and Visitor Industries

Industry	BEA Code
Sporting and athletic goods manufacturing	339920
Doll, toy, and game manufacturing	339930
Motion picture and video industries	512100
Sound recording industries	512200
Radio and television broadcasting	515100
Cable and other subscription programming	515200
Travel arrangement and reservation services	561500
Performing arts companies	711100
Spectator sports	711200
Promoters of performing arts and sports and agents for public figures	711A00
Independent artists, writers, and performers	711500
Museums, historical sites, zoos, and parks	712000
Amusement parks and arcades	713100
Gambling industries (except casino hotels)	713200
Other amusement and recreation industries	713900

Industry	BEA Code
Accommodation	721000
Full-service restaurants	722110
Limited-service restaurants	722211
All other food and drinking places	722A00

6.5 Biomedical/Biotechnical

Industry	BEA Code
Optical instrument and lens manufacturing	333314
Analytical laboratory instrument manufacturing	334516
Irradiation apparatus manufacturing	334517
Surgical and medical instrument manufacturing	339112
Surgical appliance and supplies manufacturing	339113
Dental equipment and supplies manufacturing	339114
Ophthalmic goods manufacturing	339115
Dental laboratories	339116
Medicinal and botanical manufacturing	325411
Pharmaceutical preparation manufacturing	325412
In-vitro diagnostic substance manufacturing	325413
Biological product (except diagnostic) manufacturing	325414
Waste management and remediation services	562000
Outpatient care centers	621400
Medical and diagnostic laboratories	621500
Home health care services	621600
Other ambulatory health care services	621900
Hospitals	622000
Nursing and community care facilities	623A00

6.6 Business and Financial Services

Industry	BEA Code
Monetary authorities and depository credit intermediation	52A000
Nondepository credit intermediation and related activities	522A00
Securities and commodity contracts intermediation and brokerage	523A00
Other financial investment activities	523900
Insurance carriers	524100
Insurance agencies, brokerages, and related activities	524200
Funds, trusts, and other financial vehicles	525000
Real Estate	531
Lessors of nonfinancial intangible assets	533000
Legal services	541100
Custom computer programming services	541511
Computer systems design services	541512
Other computer related services, including facilities management	54151A
Accounting, tax preparation, bookkeeping, and payroll services	541200
Architectural, engineering, and related services	541300
Specialized design services	541400
Management consulting services	541610
Environmental and other technical consulting services	5416A0
Marketing research and all other miscellaneous professional, scientific, and technical services	5419A0

6.7 Chemicals and Chemical-Based Products

Industry	BEA Code
Ready-mix concrete manufacturing	327320

Industry	BEA Code
Concrete pipe, brick, and block manufacturing	327330
Other concrete product manufacturing	327390
Lime and gypsum product manufacturing	327400
Abrasive product manufacturing	327910
Cut stone and stone product manufacturing	327991
Mineral wool manufacturing	327993
Tire manufacturing	326210
Rubber and plastics hoses and belting manufacturing	326220
Other rubber product manufacturing	326290

6.8 Education and Knowledge Creation

Industry	BEA Code
Elementary and secondary schools	611100
Junior colleges, colleges, universities, and professional schools	611A00
Other educational services	611B00

6.9 Energy (Fossil and Renewable)

Industry	BEA Code
Oil and gas extraction	211000
Coal mining	212100
Drilling oil and gas wells	213111
Other support activities for mining	21311A
Electric power generation, transmission, and distribution	221100
Natural gas distribution	221200
Water, sewage and other systems	221300
Petroleum refineries	324110

6.10 Forest and Wood Products

Industry	BEA Code
Forestry and logging	113000
Sawmills and wood preservation	321100
Veneer, plywood, and engineered wood product manufacturing	321200
Millwork	321910
All other wood product manufacturing	3219A0
Wood kitchen cabinet and countertop manufacturing	337110
Upholstered household furniture manufacturing	337121
Nonupholstered wood household furniture manufacturing	337122
Other household nonupholstered furniture	33712A
Institutional furniture manufacturing	337127
Office furniture and custom architectural woodwork and millwork manufacturing	33721A
Showcase, partition, shelving, and locker manufacturing	337215
Other furniture related product manufacturing	337900
Pulp mills	322110
Paper mills	322120
Paperboard mills	322130
Paperboard container manufacturing	322210
Paper bag and coated and treated paper manufacturing	322220
Stationery product manufacturing	322230
Sanitary paper product manufacturing	322291
All other converted paper product manufacturing	322299

6.11 Glass and Ceramics

Industry	BEA Code
Clay product and refractory manufacturing	327100
Glass and glass product manufacturing	327200
Cement manufacturing	327310
Ground or treated mineral and earth manufacturing	327992
Miscellaneous nonmetallic mineral products	327999

6.12 Information Technology Telecommunications

Industry	BEA Code
Software publishers	511200
Wired telecommunications carriers	517110
Wireless telecommunications carriers (except satellite)	517210
Satellite, telecommunications resellers, and all other telecommunications	517A00
Data processing, hosting, and related services	518200

6.13 Manufacturing Supercluster

6.13.1 Primary Metals

Industry	BEA Code
Iron and steel mills and ferroalloy manufacturing	331110
Steel product manufacturing from purchased steel	331200
Alumina refining and primary aluminum production	33131A
Secondary smelting and alloying of aluminum	331314
Aluminum product manufacturing from purchased aluminum	33131B
Primary smelting and refining of copper	331411
Primary smelting and refining of nonferrous metal (except copper and aluminum)	331419

Industry	BEA Code
Copper rolling, drawing, extruding and alloying	331420
Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	331490
Ferrous metal foundries	331510
Nonferrous metal foundries	331520

6.13.2 Fabricated Metal Products

Industry	BEA Code
All other forging, stamping, and sintering	33211A
Custom roll forming	332114
Crown and closure manufacturing and metal stamping	33211B
Cutlery and handtool manufacturing	332200
Plate work and fabricated structural product manufacturing	332310
Ornamental and architectural metal products manufacturing	332320
Power boiler and heat exchanger manufacturing	332410
Metal tank (heavy gauge) manufacturing	332420
Metal can, box, and other metal container (light gauge) manufacturing	332430
Hardware manufacturing	332500
Spring and wire product manufacturing	332600
Machine shops	332710
Turned product and screw, nut, and bolt manufacturing	332720
Coating, engraving, heat treating and allied activities	332800
Valve and fittings other than plumbing	33291A
Plumbing fixture fitting and trim manufacturing	332913
Ball and roller bearing manufacturing	332991
Ammunition, arms, ordnance, and accessories manufacturing	33299A

Industry	BEA Code
Fabricated pipe and pipe fitting manufacturing	332996
Other fabricated metal manufacturing	33299B

6.13.3 Machinery

Industry	BEA Code
Farm machinery and equipment manufacturing	333111
Lawn and garden equipment manufacturing	333112
Construction machinery manufacturing	333120
Mining and oil and gas field machinery manufacturing	333130
Other industrial machinery manufacturing	33329A
Plastics and rubber industry machinery manufacturing	333220
Semiconductor machinery manufacturing	333295
Vending, commercial laundry, and other commercial and service industry machinery manufacturing	33331A
Office machinery manufacturing	333313
Photographic and photocopying equipment manufacturing	333315
Air purification and ventilation equipment manufacturing	33341A
Heating equipment (except warm air furnaces) manufacturing	333414
Air conditioning, refrigeration, and warm air heating equipment manufacturing	333415
Industrial mold manufacturing	333511
Metal cutting and forming machine tool manufacturing	33351A
Special tool, die, jig, and fixture manufacturing	333514
Cutting and machine tool accessory, rolling mill, and other metalworking machinery manufacturing	33351B
Turbine and turbine generator set units manufacturing	333611
Speed changer, industrial high-speed drive, and gear manufacturing	333612
Mechanical power transmission equipment manufacturing	333613

Industry	BEA Code
Other engine equipment manufacturing	333618
Pump and pumping equipment manufacturing	33391A
Air and gas compressor manufacturing	333912
Material handling equipment manufacturing	333920
Power-driven handtool manufacturing	333991
Other general purpose machinery manufacturing	33399A
Packaging machinery manufacturing	333993
Industrial process furnace and oven manufacturing	333994
Fluid power process machinery	33399B

6.13.4 Computer and Electronic Products

Industry	BEA Code
Electronic computer manufacturing	334111
Computer storage device manufacturing	334112
Computer terminals and other computer peripheral equipment manufacturing	33411A
Telephone apparatus manufacturing	334210
Broadcast and wireless communications equipment	334220
Other communications equipment manufacturing	334290
Audio and video equipment manufacturing	334300
Other electronic component manufacturing	33441A
Semiconductor and related device manufacturing	334413
Printed circuit assembly (electronic assembly) manufacturing	334418
Search, detection, and navigation instruments manufacturing	334511
Automatic environmental control manufacturing	334512
Industrial process variable instruments manufacturing	334513
Totalizing fluid meter and counting device manufacturing	334514

Industry	BEA Code
Electricity and signal testing instruments manufacturing	334515
Watch, clock, and other measuring and controlling device manufacturing	33451A
Manufacturing and reproducing magnetic and optical media	334610

6.13.5 Electrical Equipment, Appliance and Components

Industry	BEA Code
Electric lamp bulb and part manufacturing	335110
Lighting fixture manufacturing	335120
Small electrical appliance manufacturing	335210
Household cooking appliance manufacturing	335221
Household refrigerator and home freezer manufacturing	335222
Household laundry equipment manufacturing	335224
Other major household appliance manufacturing	335228
Power, distribution, and specialty transformer manufacturing	335311
Motor and generator manufacturing	335312
Switchgear and switchboard apparatus manufacturing	335313
Relay and industrial control manufacturing	335314
Storage battery manufacturing	335911
Primary battery manufacturing	335912
Communication and energy wire and cable manufacturing	335920
Wiring device manufacturing	335930
Carbon and graphite product manufacturing	335991
All other miscellaneous electrical equipment and component manufacturing	335999

6.13.6 Transportation Equipment

Industry	BEA Code
Automobile manufacturing	336111
Light truck and utility vehicle manufacturing	336112
Heavy duty truck manufacturing	336120
Motor vehicle body manufacturing	336211
Truck trailer manufacturing	336212
Motor home manufacturing	336213
Travel trailer and camper manufacturing	336214
Motor vehicle gasoline engine and engine parts manufacturing	336310
Motor vehicle electrical and electronic equipment manufacturing	336320
Motor vehicle steering, suspension component (except spring), and brake systems manufacturing	3363A0
Motor vehicle transmission and power train parts manufacturing	336350
Motor vehicle seating and interior trim manufacturing	336360
Motor vehicle metal stamping	336370
Other motor vehicle parts manufacturing	336390
Aircraft manufacturing	336411
Aircraft engine and engine parts manufacturing	336412
Other aircraft parts and auxiliary equipment manufacturing	336413
Guided missile and space vehicle manufacturing	336414
Propulsion units and parts for space vehicles and guided missiles	33641A
Railroad rolling stock manufacturing	336500
Ship building and repairing	336611
Boat building	336612
Motorcycle, bicycle, and parts manufacturing	336991
Military armored vehicle, tank, and tank component manufacturing	336992

Industry	BEA Code
All other transportation equipment manufacturing	336999

6.14 Mining (Non-Energy)

Industry	BEA Code
Iron, gold, silver, and other metal ore mining	2122A0
Copper, nickel, lead, and zinc mining	212230
Stone mining and quarrying	212310
Other nonmetallic mineral mining and quarrying	2123A0

6.15 Printing and Publishing

Industry	BEA Code
Sign manufacturing	339950
Printing	323110
Support activities for printing	323120
Newspaper publishers	511110
Periodical Publishers	511120
Book publishers	511130
Directory, mailing list, and other publishers	5111A0
News syndicates, libraries, archives and all other information services	5191A0
Internet publishing and broadcasting and Web search portals	519130
Advertising, public relations, and related services	541800
Photographic services	541920

6.16 Transportation and Logistics

Industry	BEA Code
Air transportation	481000
Rail transportation	482000
Water transportation	483000
Truck transportation	484000
Transit and ground passenger transportation	485000
Pipeline transportation	486000
Scenic and sightseeing transportation and support activities for transportation	48A000
Couriers and messengers	492000
Warehousing and storage	493000
Automotive equipment rental and leasing	532100
Consumer goods and general rental centers	532A00
Commercial and industrial machinery and equipment rental and leasing	532400

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