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The Economic Geography of SouthCoastal New England

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by

Elise Rapoza, MPP, MS
Senior Research Associate, the Public Policy Center (PPC)

Michael D. Goodman, Ph.D.
Executive Director, the Public Policy Center (PPC)
Associate Professor of Public Policy

David Borges, MPA
Research Director, the Public Policy Center

And Graduate Research Assistants
Holly Stickles, MPP and Trevor Mattos, MPP

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REPORT AUTHORS

Elise Rapoza, MS, MPP, Senior Research Associate, Public Policy Center
Michael Goodman, PhD, Executive Director, Public Policy Center
David R. Borges, MPA, Director of Research, Public Policy Center
Holly Stickles, Graduate Research Assistant, Public Policy Center
Trevor Mattos, Graduate Research Assistant, Public Policy Center

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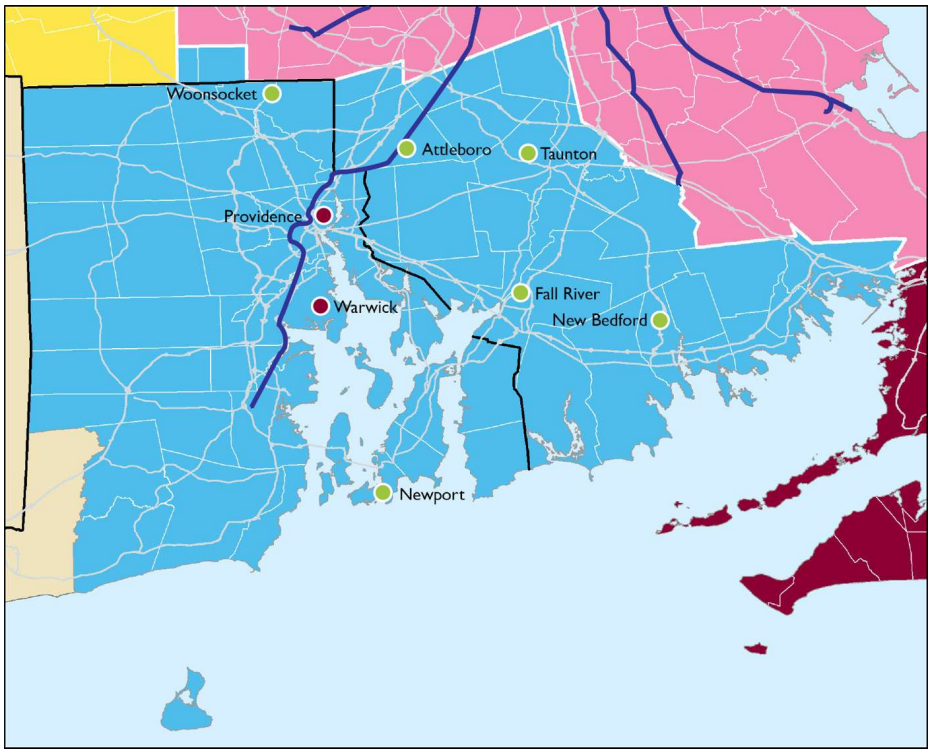
EXECUTIVE SUMMARY

A detailed analysis of commuting patterns, industrial composition, and media markets reveals that much of southeastern Massachusetts and the vast majority of the state of Rhode Island are part of a shared functional economic region. For lack of a better term, this cross-border region is referred to here as SouthCoastal New England. The cities and towns in this region are home to a common labor force, a common media market, and share key industrial strengths. Both sides of the border also share important cultural connections to the Portuguese and Lusophone community, among others, and rely heavily on ocean resources, which fuel significant economic and scientific activities on both sides of the border. There are, however, distinct sub-regional labor market areas, as defined by commuting patterns. The PPC's analysis revealed three commuting zones that intersect this economic region; the Greater Providence and the SouthCoast commuting zones are contained in this region and the remainder is contained within Greater Boston.[1]

Figure 1 The SouthCoastal New England Region



The PPC identified regional jobs centers, which were defined as communities that rank in the top 10 percent of municipalities in New England by total employment and also are home to more jobs than employed residents (in other words, they must import labor). The SouthCoastal New England region is home to two job centers: Providence and Warwick, Rhode Island.[2] The SouthCoastal New England region is Massachusetts' only economic region in which none of Massachusetts' cities are job centers. Accessible rail

[1] While commuting relationships connect some towns more strongly to Greater Boston, the combination of labor market exchange, industrial similarities, and shared media outlets provides compelling evidence that these towns are part of SouthCoastal New England rather than Greater Boston.

[2] Other cities in the region meet the size threshold, but must export labor and are therefore not considered to be job centers. In other words, they are home to fewer jobs than employed residents.

3 *Rhode Island Innovates: A Competitive Strategy for the Ocean State.* Prepared by Battelle Technology Partnership in association with the Metropolitan Policy Program at Brookings, January 2016.

service into the economically dynamic Greater Boston region may help to explain economic disparities on this side of the border; while there is commuter rail service between Providence, Warwick, and Boston, there is limited service on the Massachusetts side of the region. Additionally, commuter rail access to the Greater Boston area is coterminous with the eastern boundary of the SouthCoastal New England region.

SHARED INDUSTRIAL COMPOSITION

The PPC, building on the industry cluster definitions developed for the 2016 *Rhode Island Innovates*[3] report, identified shared growth potential in the following industry clusters. These clusters were found to be highly concentrated, growing, or growing faster than the United States average on both sides of the border.

- Boat and Ship Building and Repair;
- Energy Production, Distribution, and Storage;
- Medical Devices; and
- Plastic Laminate, Films, Specialty Chemicals and Resins.

The two states have a shared opportunity in offshore wind development; Providence, RI is home to a leading offshore wind developer—Deepwater Wind—and New Bedford, MA is home to the New Bedford Marine Commerce Terminal—a facility built by the MA Clean Energy Center to be the nation's first staging area to support offshore wind projects. Recent legislation in Massachusetts requiring utilities to purchase 1,600 MW of offshore wind power is expected to lead to significant economic development in the region. Rhode Island is home to the nation's first offshore wind farm, which is being developed off of Block Island, giving both sides of the border a potential edge in an important emerging economic sector.

Both sides of the border also share above average employment in marine-related industries and high levels of scientific and applied research in marine and ocean science. Leading research institutions in the cross-border region include the Metcalf Institute at the University of Rhode Island (URI), the School for Marine Science and Technology at the University of Massachusetts Dartmouth (UMass-D), the UMass-D Center for Innovation & Entrepreneurship, and the Naval Undersea Warfare Center in Newport. An examination of the degree of scientific collaboration between institutions on both sides of the border reveals significant levels of collaborative activity, most notably in the areas of ocean and marine science. Ongoing efforts related to offshore wind development and coastal climate change resiliency strongly suggest there is substantial potential in both of these areas for these institutions and the larger regional economy if emerging opportunities can be seized and developed on a larger scale.

The cross-border region's proximity to the dynamic innovation ecosystem in Greater Boston – especially the renowned life sciences super-cluster – in addition to its existing industry base of manufacturers in plastics and metalworking firms, suggests that the SouthCoastal New England region is well positioned for growth opportunities in the rapidly growing Massachusetts innovation economy, particularly in medical devices. Above-average regional employment in related sectors and the presence of leading medical device companies like Saint-Gobain and Smith & Nephew make it clear that significant connections already exist.

COMMON CHALLENGES

If these opportunities are to be fully realized, both sides of the border need to address many of the same challenges. These continued challenges have impaired their regional competitiveness and have stymied numerous efforts to enhance economic development and improve regional outcomes for decades. In sum, both sides of the border:

- Rely heavily on industries that are in long-term decline, including textiles, jewelry, fishing, and traditional manufacturing;
- Have a workforce that has comparatively low levels of educational attainment and technical skill;
- And are disadvantaged by inadequate transportation infrastructure and access to employment and economic opportunities in Greater Boston.

STRATEGIC OPPORTUNITIES

Our work has identified several areas of potentially mutually beneficial cross-border collaborative and economic development opportunities. These include:

- Enhancing university collaborations and technology transfer, especially in marine and ocean science fields;
- Expediting and maximizing the local benefits of offshore wind energy development;
- Improving transportation connections, including to economic opportunities in Greater Boston;
- Raising educational aspirations and outcomes;
- Coordinating marketing efforts in key areas like tourism and economic development (business retention and relocation).

1 ECONOMIC REGIONS: THEORY, DEFINITIONS, AND LOCAL CASES

1.1 ECONOMIC REGIONS THEORY

Many different conceptions and theories of regions exist, as do the methods by which regions are delineated. Generally, regions are understood to be geographic areas demarcated to support analysis, planning, or public policy. That is, regions provide neat groupings of geographically contiguous populations that enable governments, and even organizations in the private and nongovernmental sectors, to better understand common attributes or functional connections in contained geographic areas. Regions may be described in many different ways, though the relevant academic literature distinguishes between homogenous, function, nodal, and administrative regions. Homogenous regions present similar characteristics, such as having similar income levels, educational attainment, or ethno-racial communities grouped together. Homogenous regions are useful for statistical purposes, since they provide the greatest fidelity to the geographic patterns in the data. However, for the purposes of regional economic planning, which is the motivation driving the present study, functional economic regions (FERs) are the most informative. FERs are connected by economic linkages, such as labor markets or industry supply chains, and are defined using the best available data on the economic conditions and relationships. Administrative regions, on the other hand, are delineated for policy purposes and are often simply the product of historical accident, though they may show consideration of any combination of both the relative degree of homogeneity and functional economic linkages.

In addition to the distinctions between homogenous, functional, and administrative regions, regions, as they are defined, may be nodal/core-based or non-nodal/non-core-based. Nodal regions are a type of functional region with a major center that is connected to other smaller communities. (Depending on the degree of inter-dependence, nodal regions may have multiple nodes.) For example, the Greater Boston region includes the city of Boston, as well as surrounding economic centers along the route 128/95 corridor, many of which are economically tied to industry based in Boston, as well as their surrounding suburbs. In the United States (U.S.), metropolitan statistical areas (MSAs), as defined by the Office of Management and Budget (OMB), and the Bureau of Economic Analysis's (BEA) Economic Areas are both core-based. The only exception is the U.S. Department of Agriculture's (USDA) Commuting Zones, which takes a non-core-based, non-metropolitan approach in order to allow for a unique identity for the country's more rural areas. Believing that different types of areas (e.g. rural vs. non-rural) require different economic strategies, and finding that the core-based approach often produces regions that are too large for many practical purposes, the commuting zones and economic regions defined in this report are non-core-based.

Perhaps most relevant to the present study is that functional regions may, and often do differ from administrative boundaries, such as counties or other municipal divisions. Where functional regions are delineated across administrative entities, they may aptly be referred to as cross-border regions. Where cross-border regions fuse together different administrative regions via functional linkages, increased policy and administrative collaboration can facilitate deeper economic ties and expand economic opportunities in one or both administrative regions. This study is concerned with the presence of a cross-border region linking Southeastern Massachusetts to the Greater Providence, Rhode Island area.

While there is no universally agreed on approach to defining functional economic regions, most definitions of rely on analysis of commuting data, and thus incorporate the geographic boundaries of the local labor markets. A survey conducted in 2000 of 22 Organization for Economic Co-operation and Development (OECD) member countries found that of the 13 countries that had delineated functional regions, all used commuting data in their analysis. Of these, three included an additional variable: population density, retail trade, or cooperation between municipalities. In the United States, Economic Areas are defined by the BEA and are based primarily on commuting patterns. Newspaper readership data is used to supplement the commuting data for less populous areas. The present study is consistent with other approaches in that commuting is the foundational element of the grouping process. The first stage of this study involves the building of commuting zones out of cities and towns based on the degree of commuting interchange. However, in the second stage, the creation of the FERs expands on other methods by also incorporating industrial agglomeration, as measured by industry cluster location quotients, and media market areas.

1.2 CURRENT GEOGRAPHIC DELINEATIONS

The cities and towns of Massachusetts are divided up in many different ways, depending on the purpose. There are different areas for regional planning, regional economic development, workforce development, tourism, and policy analysis. For towns in the SouthCoast of Massachusetts, examples of these types of regions include the SouthCoastal Regional Planning and Economic Development District, the SouthCoast Development Partnership, the Bristol Workforce Investment Area (WIA), the Bristol County Tourism Region, and the MassBenchmarks Southeast Region, respectfully. The regional boundaries differ for all of these types of regions. As a result, for example, the SouthCoast spans more than one WIA and more than one Tourism Region, more or less matches with the economic development region, and is a subset of the planning district. The boundaries of these regions also vary in the degree to which they were produced using a formal process or developed as a consequence of regional identity and historical linkages. The purest example of a formal process for regional delineation are the New England City and Town Areas (NECTAs), which were built using commuting data. Economic development areas, on the other hand, have tended to arise independently, with the regional territory decided in conversation with local cities and towns. Interestingly, only the purely empirical delineation, the NECTAs, resulted in cross-border regions. All of the other regions are constrained by the administrative borders of the Commonwealth of Massachusetts.

1.2.1 Massachusetts' Regional Planning Districts

The Commonwealth of Massachusetts has 13 regional planning agencies (RPAs), which serve their respective regional planning districts. RPAs are not direct arms of the state or federal government, but rather are a "consortia of local governments that have banded together under the provisions of state law to address problems and opportunities that are regional in scope."[3] "In 1955, Massachusetts became one of the first states in the nation to enact statewide enabling legislation that allowed for the creation of regional planning agencies. Within a decade and half, all 13 Massachusetts RPAs had been legally established, encompassing a majority of the commonwealth's 351 cities and towns."[3] It seems, based on the Massachusetts General Laws, that the initial jurisdictions were determined at the discretion of the founding members. After the boundaries of a district were demarcated, the active involvement in the RPA of constituent cities and towns was voluntary and subject to a vote. According to the Massachusetts General Laws:

> "Any group of cities, towns, or cities and towns may, by vote of their respective city councils or town meetings, vote to become members of and thus establish a planning district, which shall constitute a public body corporate. After a planning district has been thus established, any other city or town within the district area as hereinafter defined may by vote of its city council or town meeting apply for admission. Upon the affirmative vote of two thirds of the representatives of the cities and towns comprising the district, said city or town shall become a member thereof."[4]

The jurisdictions of these districts have changed over time to adjust to the preferences of the state's municipalities. The Southeastern Regional Planning and Economic Development District (SRPEDD), for example, was founded with a jurisdiction of 23 local governments, of which just eight were active members. In 1968, an act of the state government dissolved the old district and established a successor district with an expanded jurisdiction of 29 communities.[5] At this time, membership in the district was made mandatory and a ceiling was placed on assessments. In 1970, Plainville joined the district, and Plymouth (1975), Kingston (1976), and Plympton (1990) withdrew from SRPEDD to join the adjacent Old Colony Planning Council, because these municipalities were more closely associated with the South Shore.[6]

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[3] Massachusetts Association of Regional Planning Agencies, "Background Information on Massachusetts Regional Planning Agencies," http://www.govinstitute.org/wp-content/uploads/2012/07/MA-Regional-Planning-Agencies-Summary.pdf

[4] Massachusetts General Laws, Part I, Title VII, Chapter 40B, Section 3

[5] Chapter 663

[6] Southeastern Regional Planning and Economic Development District, *Basic Information Folder,* November, 2014.

Figure 2 Cities and Towns of the SRPEDD Region

1.2.2 Massachusetts' Regional Economic Development Organizations

The Massachusetts Office of Business Development runs a Regional Economic Development Organizations (REDO) program to support regionally-based efforts to help existing businesses grow and to attract new business to the state. These REDOs have tended to arise independently, with the regional territory decided in conversation with local cities and towns. REDOs must apply to the program to receive state support. The following economic development organizations received funding for Fiscal Year 2014:

- 1Berkshire Strategic Alliance
- 495/MetroWest Partnership ¦ MetroWest Chamber of Commerce (Alliance)
- Cape Cod Economic Development Council
- Blackstone Valley Chamber of Commerce ¦ Chamber of Central Mass South (Central Regional Economic Development Alliance)
- Economic Development Council of Western MA
- Merrimack Valley Economic Development Council
- Metro South Chamber of Commerce
- North Central Massachusetts Development Corp.
- North Shore Alliance for Economic Development
- Plymouth Regional Economic Development Foundation
- SouthCoast Development Partnership

1.2.3 Workforce Investment Areas

The predecessor regions to the current day Workforce Investment Areas (WIAs) were created in 1973 as part of the 1973 Comprehensive Employment and Training Act (CETA). CETA replaced a fragmented set of federal job training programs with block grants that provided funds to state and local government "prime sponsors."

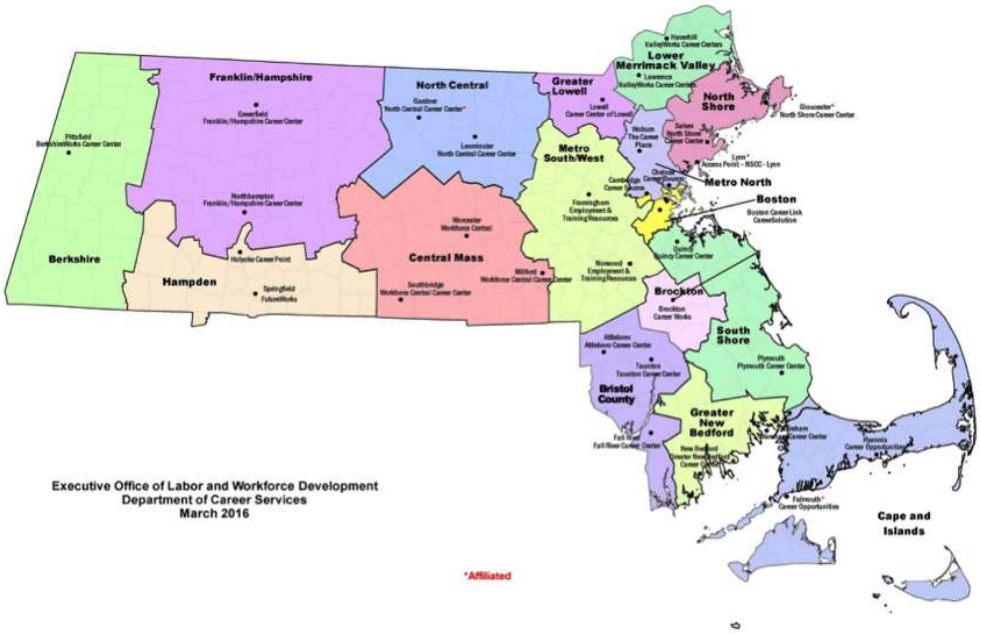
Under CETA, cities with 100,000 or more residents could become prime sponsors and were put in charge of their own job training programs. Prime sponsors could invite neighboring towns that were perceived to be part of the natural labor market to join the service area. These relationships were formalized through inter-municipality agreements. The remaining cities and town were added to the "balance-of-state" which was administered at the state level. At this time, Cape Cod and Greater New Bedford were part of the same service delivery area (SDA). At first, Fall River, MA did not have 100,000 residents and was included in the balance-of-state, but after the municipal census, Fall River was upgraded to a prime sponsor and got the balance of Bristol County in its SDA.

In 1982, CETA was replaced with the Job Training Partnership Act (JTPA). JTPA furthered the decentralization of federal job training to the local levels by eliminating the requirement of an urban core of at least 100,000 and also eliminating the balance-of-state. SDAs that existed under CETA could refile under JTPA, so there was some consistency from the CETA regions. However, there was also some reshuffling, particularly to incorporate those cities and towns that were part of the balance-of-state. At this time, Taunton left the Plymouth service area after deciding it had more direct ties with Fall River.

In 1993, the Job Training and Employment Corporation, which was the administrative entity of the New Bedford, Cape, & Islands SDA, moved from New Bedford to Hyannis. After this move, it retained only the Cape and Islands in its region and a new Greater New Bedford SDA was created, with ten communities stretching from Dartmouth to Wareham.

Finally, in 1998 the Workforce Investment Act replaced the JTPA. SDAs that existed prior to 1998 could refile to become Workforce Investment Areas (WIAs) under this new legislation. During this transition, the number of service areas remained constant (16). A special exemption was made for the Berkshires, which had difficultly meeting the population requirement.

Figure 3 Workforce Investment Areas and One-Stop Career Centers



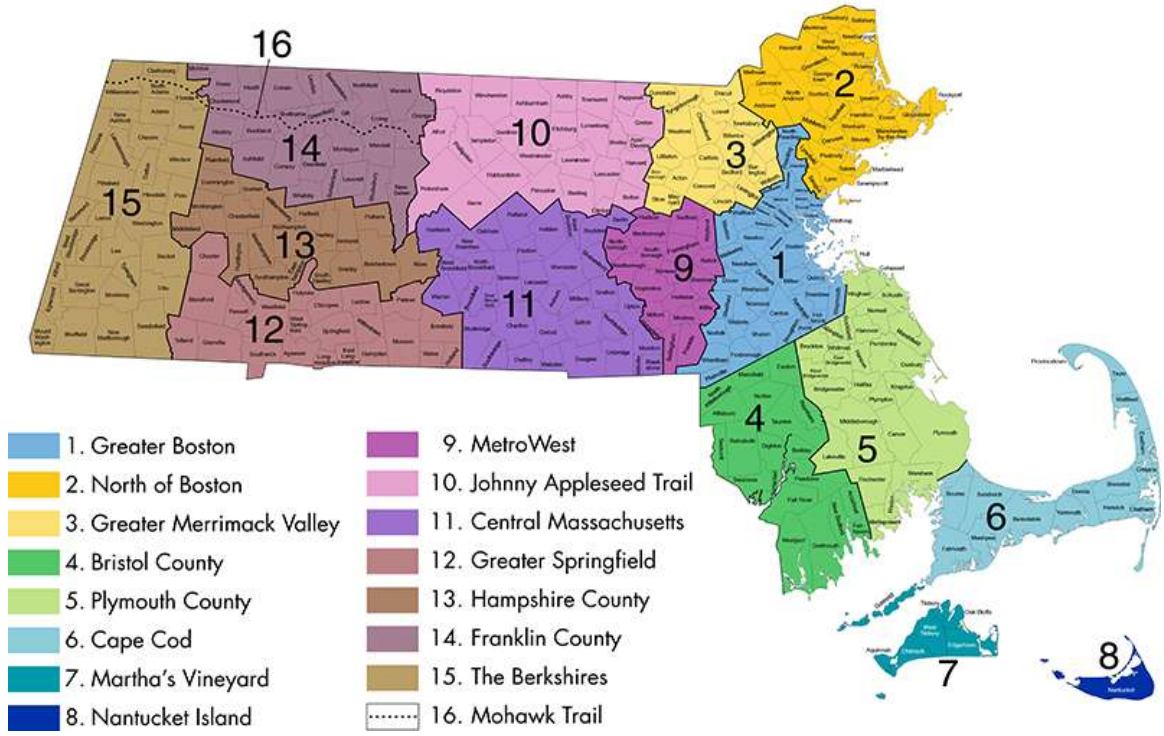
1.2.4 Massachusetts Tourism Regions[7]

The establishment of Massachusetts' Tourism Regions appears to have occurred in a piecemeal fashion, with little overarching logic as to their demarcation. While state law recognizes the Regional Tourism Councils that serve these regions, a public records request for further information yielded no results.

Table 1 Regional Tourism Councils and Year Established

Regional Tourism Council	Year Established	Regional Tourism Council	Year Established
Hampshire County	1919	Greater Springfield	1950
Franklin County	1919	North of Boston	1955
Central MA	1920	Plymouth County	1975
Cape Cod	1921	Southeastern MA (Bristol County)	1975
Mohawk Trail	1924	Boston GBCVB	1975
Nantucket Chamber	1934	Merrimack Valley	1992
Berkshires	1936	Johnny Appleseed	2000
Martha's Vineyard	1948	MetroWest	2011

Figure 4 Massachusetts' Tourism Regions



[7] http://www.massvacation.com/navigate/regional-tourism-councils/

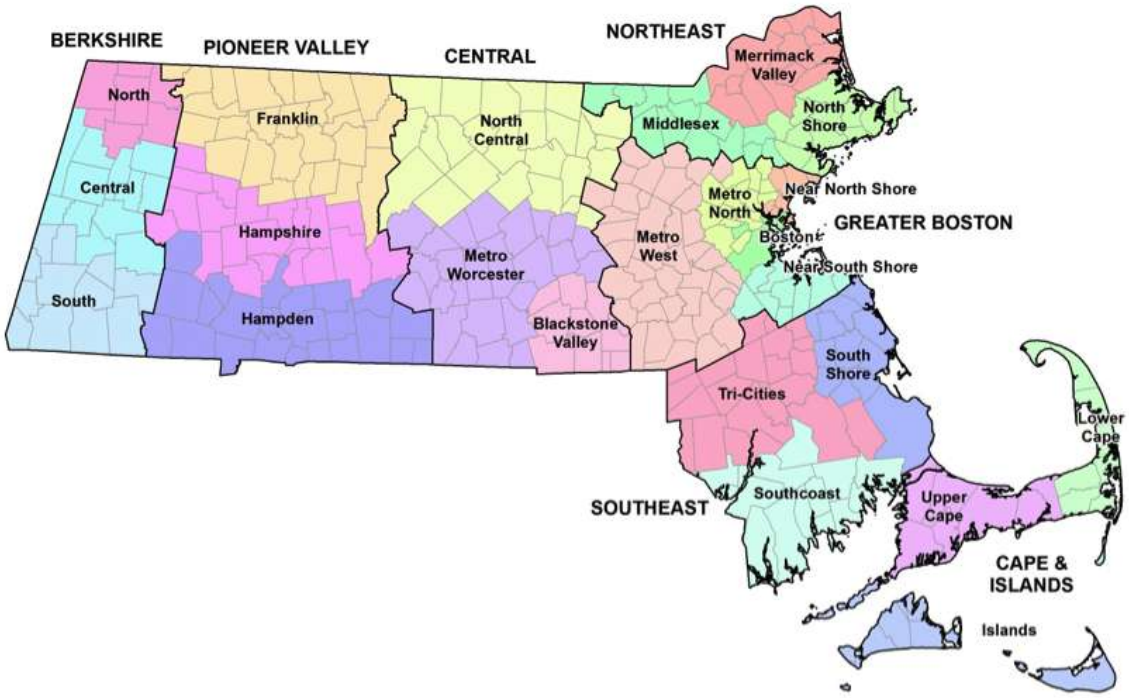
1.2.5 *Mass*Benchmarks Regions

*Mass*Bechmarks is a journal of the Massachusetts economy, published in cooperation with the Federal Reserve Bank of Boston. It is produced by the UMass Donahue Institute's Economic and Public Policy Research Unit, in collaboration with faculty on all five campuses of the University of Massachusetts system. In support of the economic analysis conducted for this publication, the *Mass*Benchmarks project divided the Commonwealth into seven major economic regions: the Berkshires, Pioneer Valley, Central, Northeast, Southeast, Boston Metro, and Cape & Islands. These regions are further divided into subregions.

These regions, developed at the start of a 1997 project, were based around the regions used in *Choosing to Compete: a Statewide Strategy for Job Creation and Economic Growth*, a report on the Massachusetts economy and its regions, published by the Weld Administration in 1993. The regions were developed for use by the Commonwealth's Executive Office of Economic Affairs and served as the primary definitions for regional economic development efforts by the Commonwealth's Office of Business Development. For the most part, the geographic delineations were designed to accommodate administrative boundaries and thus followed the borders of counties and regional planning districts. Traditional labor market areas and regional commuting sheds around key transportation networks were also considered when creating these regional geographies.

In order to confirm the validity of the geographic definitions used in *Choosing to Compete* and their ability meaningfully describe regional economic activity, the *Mass*Benchmarks project invited feedback from representatives of economic development organizations and regional planning agencies from every region the state. After this period of feedback and comment, definitions of the regions were finalized by *Mass*Benchmarks regional analysts studying each region.[8]

Figure 5 *Mass*Benchmarks Regions and Subregions



[8] *Mass*Benchmarks project, http://www.massbenchmarks.org. Economic and Public Policy group, UMass Donahue Institute.

1.2.6 New England City and Town Areas

New England City and Town Areas (NECTAs) were created by the OMB for data collection and aggregation purposes. NECTAs are city and town based alternatives to county-based Metropolitan Statistical Areas (MSAs). They were created with the understanding that in New England government and economic activity is organized at the city and town level rather than the county level. We focus here on NECTAs since MSAs are not particularly meaningful in the New England context.

In the Bureau of Labor Statistics, NECTAs and MSAs are collectively referred to as Labor Market Areas (LMAs). According to the BLS, a LMA "is an economically integrated geographic area within which individuals can reside and find employment within a reasonable distance or can readily change employment without changing their place of residence. In addition, LMAs are non-overlapping and geographically exhaustive. Since these areas are based on the degree of economic integration as measured by commuting flows without regard to state boundaries, interstate LMAs exist."

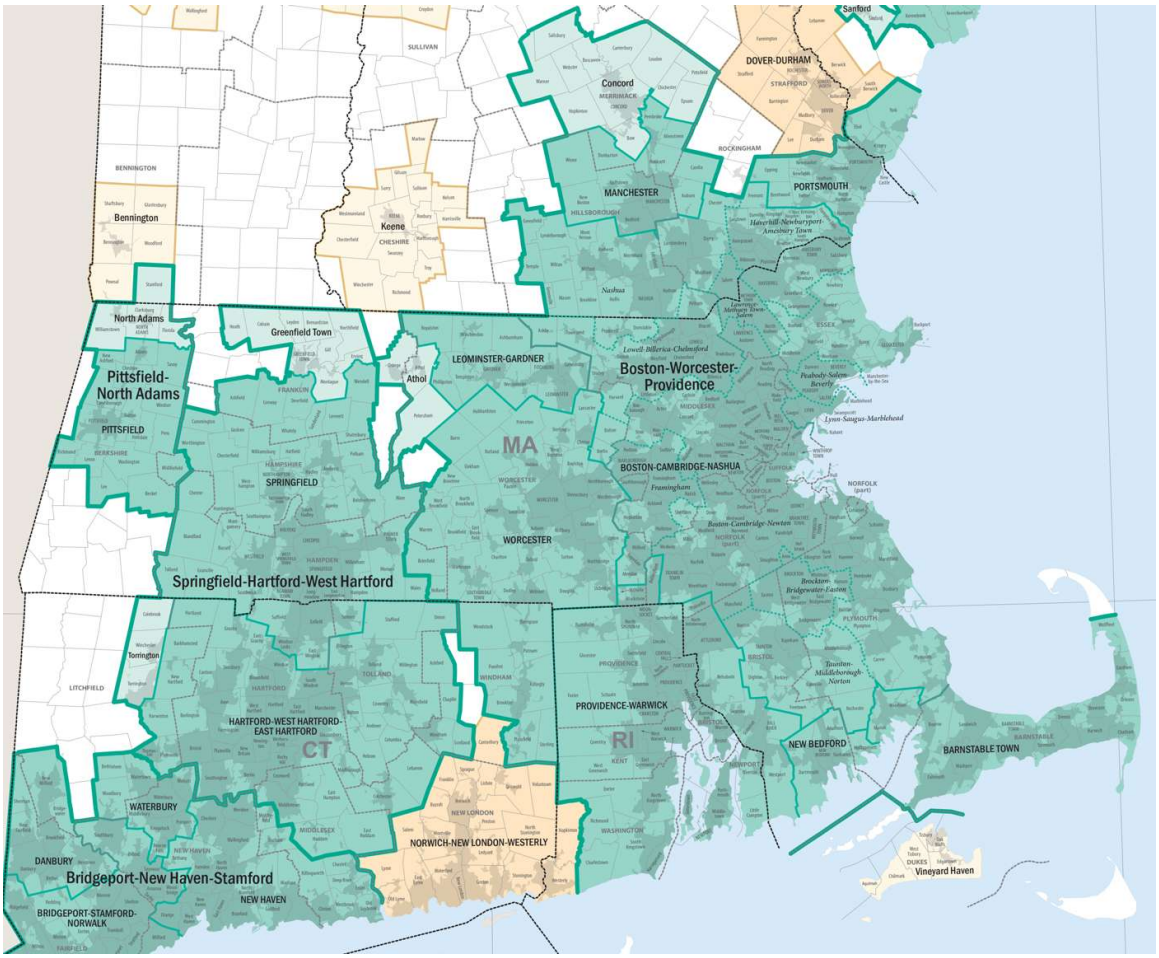
NECTAs are core-based statistical areas (CBSAs), and as such have central cities with at least 10,000 people. The central cities associated with an urbanized area or urban cluster are grouped to form a single cluster of cities for the purposes of measuring commuting to and from outlying communities. A city or town qualifies as an outlying area of the CBSA if it meets one of the following commuting requirements:

a) At least 25 percent of the workers living in the area work in the central cities or cities; or
b) At least 25 percent of the employment in the area is accounted for by workers who reside in the central city or cities.

Two adjacent CBSAs will merge if the central city or cities of one CBSA qualifies as an outlying city of another CBSA using the criteria (a) or (b) above.

A map of Massachusetts' NECTAs reveals some interesting patterns. The Providence-Warwick NECTA includes the Blackstone Valley communities of Millville, Blackstone, and Bellingham, Massachusetts as well as all of the cities and towns along Rhode Island's eastern border. These include Plainville, North Attleborough, Attleboro, Seekonk, Rehoboth, Swansea, Somerset, Fall River, and Westport, Massachusetts. New Bedford has its own NECTA of just a few towns, which includes Dartmouth, Acushnet, Fairhaven, and Mattapoisett, Massachusetts. The remaining cities and towns that are traditionally considered to be part of Southeastern Massachusetts are either part of the Boston or Barnstable NECTAs.

Figure 6 New England City and Towns Areas (NECTAs)



The PPC identifies two shortcomings in using NECTAs to define functional economic regions: they are core-based and they don't incorporate other types of linkages, such as industry base and regional identity. The problem with CBSAs is that they don't allow for a unique identity for the country's more rural areas. This is problematic in terms of crafting regionally appropriate economic development solutions. In the OMB's own words:

> "The purpose of the Metropolitan and Micropolitan Statistical Area standards is to provide nationally consistent delineations for collecting, tabulating, and publishing Federal statistics for a set of geographic areas. The Office of Management and Budget establishes and maintains these areas solely for statistical purposes.
>
> Metropolitan and Micropolitan Statistical Areas are not designed as a general-purpose geographic framework for nonstatistical activities or for use in program funding formulas. The CBSA classification is not an urban-rural classification; Metropolitan and Micropolitan Statistical Areas and many counties outside CBSAs contain both urban and rural populations."[9]

[9] Federal Register, Part IV, Office of Management and Budget, "2010 Standards for Delineating Metropolitan and Micropolitan Statistical Areas; Notice," June 28, 2010.

2 COMMUTING ZONES

Commuting zones represent areas are highly interconnected via commutes between home and work. The commuting zones presented here were built using a clustering algorithm similar to the methods used by the U.S. Department of Agriculture (USDA) to define their county-based commuting zones, but instead use cities and towns as the primary building blocks. In order to allow for unique identities for Massachusetts' more rural locations, this methodology deviates from the Office of Management and Budget's (OMB's) New England city and town areas (NECTAs) by taking a geographically representative instead of core-based approach. This creates a more accurate portrayal of the commuting flows.

2.1 COMMUTING DATA

Commuting data were obtained from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program's Origin-Destination Employment Statistics (LODES). The LEHD program uses Social Security numbers to match employment data collected from unemployment insurance filings (through the ES-202 program) with survey data and other administrative records collected through the Statistical Administrative Records System (StARS) database. This allows the Census Bureau to match residential addresses to work addresses on an individual basis. The data is then anonymized and noise is added to protect confidentiality. One weakness of the data is that there is no way to separate out people who are telecommuting or otherwise not physically moving between the home and work addresses.

A major benefit of this data is that it is accurate down to the level of the census block. This means we were able to build the commuting zones out of county subdivisions—otherwise known as cities and towns—instead of counties. The use of county subdivisions is preferable since government in New England is organized at the county subdivision level more so than at the county level. Also, the higher level of granularity this affords means that we were able to detect commuting patterns more precisely than with county level data, which blurs within county differences.

We collected 2014 data containing all jobs (instead of just primary jobs) for people living in or commuting to Connecticut, Massachusetts, New Hampshire, and Rhode Island. Data for the other neighboring states of New York and Vermont were excluded due to low total flows over those borders. Of all people who work in Massachusetts, 0.7% come from New York and 0.1% come from Vermont. Likewise, of all people who live in Massachusetts, 0.8% commute to New York and 0.1% commute to Vermont. In both cases, a large proportion of the New York commuters are going to or from New York City. The remaining percentage of people commuting to or from Albany or Rensselaer Counties is less than 0.1%.

2.2 MEASUREMENT

Within the methodologies used by the federal government, there are two different measurements of commuting interchange: the proportional flow measure used by the USDA and the employment interchange measure (EIM) used by the OMB. Conceptually, the EIM measure appears to be superior to the proportional flow measure, since unlike proportional flow, it includes both the number of residents and the number of jobs in the smaller community, thereby limiting the corrupting influence of bedrooms communities on the data. To be sure, we tested them both and assessed how they performed.

2.2.1 Proportional Flow

We first ran the analysis using the USDA's proportional flow measure. The proportional flow measure was created as an improvement on the original method used by the OMB, which only measured the unidirectional flow of commuters into urban cores. Instead, this method takes into account the total flow of commuters moving in both directions between two areas. Proportional flow is defined as the following:

$$Proportional\ Flow = \frac{(sum(commuters\ from\ i\ to\ j) + sum(commuters\ from\ j\ to\ i))}{total\ commuters\ living\ in\ smaller\ region}$$

According the USDA: "By adjusting the number of commuters by the size of the labor force in the smaller county, we ensure that no large county will dominate the analysis simply because of its absolute size." However, by only including the number of residents in the smaller region, it fails to adjust for the number of jobs.

2.2.2 Employment Interchange Measure

Heading into 2001, the OMB adjusted their measurement of commuting flows to capture the bidirectional flows between two regions, instead of simply measuring the amount of flow into urban cores. Given a small community "*i*" and a large community "*j*", the EIM is defined as the flow of commuters from *i* to *j* as a percent of the number of workers living in *i* plus the flow of commuters from *j* to *i* as a percentage of the total number of jobs in *i*. This is very similar to the proportional flow measure used by the USDA, but instead of just dividing by the number of workers living in the smaller community, it also adjusted for the number of jobs in the smaller community.

$$EIM = \frac{sum\ (commuters\ from\ i\ to\ j)}{total\ number\ of\ workers\ living\ in\ i} + \frac{sum(\ commuters\ from\ j\ to\ i)}{total\ number\ of\ jobs\ in\ i}$$

where i and j are selected such that the number of workers living in i is less than the number of workers living in j.

Testing the two methodologies, we found that the EIM resulted in more coherent regions. Given these results and the better conceptual match of the EIM, we determined that it was the better approach for measuring the strength of commuting relationships between regions.

2.3 CLUSTERING ALGORITHM

An agglomerative hierarchical clustering approach was used to combine cities and towns into commuting zones. Agglomerative clustering is a bottom-up approach, in which each city and town starts off as its own cluster. During each iteration of the algorithm, clusters merge with the cluster with which they have the strongest commuting relationships, as determined by the EIM. At each step, more than two clusters can be joined. This is because of the transitive, "small world" nature of the commuting network. For example, Town A and Town B might both be connected with Town C, or Town A could be connected with Town B, which is connected with Town C. In either case, Town A, B, and C would all merge together. Traditionally, this is continued until there is only one cluster remaining—all cities and towns are part of the same cluster. The result is a hierarchy of commuting zones, in which each set of municipalities is a subset of a proceeding cluster. In other words, after each iteration no two clusters can share the same subcluster.

In the jargon of cluster analysis, the EIM is a measure of the "distance" or "similarity" between clusters. The most common clustering algorithms use pairwise comparisons between individual members of each cluster. So, for example, the distance between clusters might be determined by the pair of towns, one from each cluster, that have the weakest or the strongest commuting linkage. Another common option is to look at the average distance, but this is not possible for relational data like the EIM. The PPC's custom algorithm improves on these methods by aggregating the data up to the cluster level during each iteration of the clustering algorithm. This enabled us to look at the distance between clusters, rather than between cluster members. In addition to being an arguably more valid approach, the aggregation has the added benefit of smoothing out the effect of cities that draw from across a wide region, such as Boston.

As mentioned earlier, multiple clusters can merge at each step of the algorithm. Consequently, clusters can get very large, very quickly. The commuting network is an example of a "small world" because every city and town is connected to every

other city and town by a commuting relationship, whether directly or indirectly. As a result, it was necessary to impose a constraining parameter to identify intermediate areas between the local and the national level commuting zones. To do this, we imposed a size penalty that scales down the EIM when the cluster size is large. This is defensible based on the idea that it is desirable to reduce the total spatial distance from the center of the cluster. We selected the scaling parameter $\frac{N-n}{N}$, where *N* is the total number of cities and towns at the outset and *n* is the cluster size of each cluster with which a region could potentially merge. This has the effect of modestly downsizing the EIM when *n* is large.

Despite the use of a constraining parameter, the clustering occurred very quickly, with almost all of Massachusetts joining Greater Boston by the third iteration of the algorithm. We chose to stop the clustering after the second iteration, which produced clusters that are an appropriate size for sub-state regional planning. Two of the clusters had fewer than ten cities or towns—the islands off of Cape Cod and a few towns along Route 2 north of Worcester. Due to their small size, they were added to the adjacent cluster with which they had the highest EIM.

2.4 RESULTS

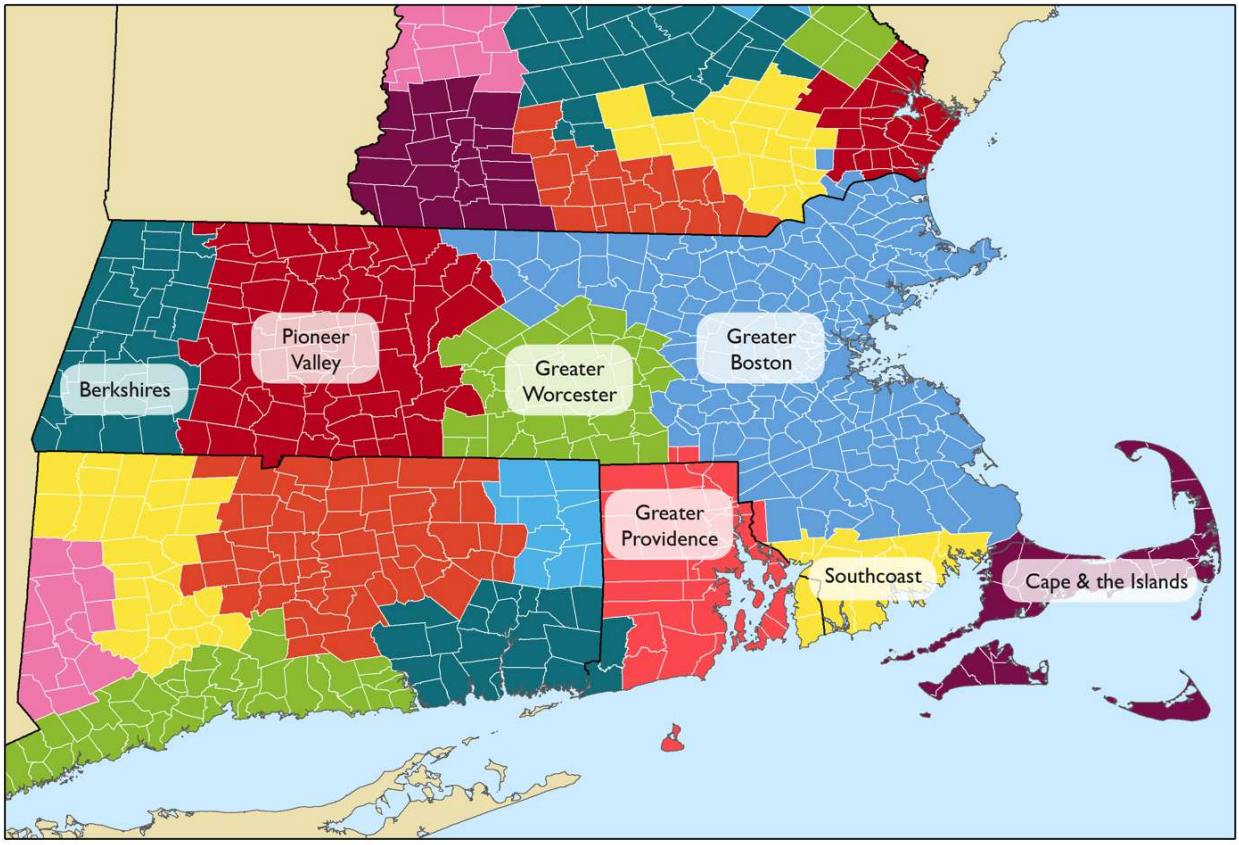
Massachusetts' cities and towns can be found in seven of the region's commuting zones: The Berkshires, the Pioneer Valley, Greater Worcester, Greater Boston, Greater Providence, the SouthCoast, and Cape Cod & the Islands. Interestingly, these zones mostly follow state lines. The exceptions include Plaistow, Newton, and Danville, New Hampshire, which are grouped with Greater Boston; Millville, Blackstone, and Seekonk, Massachusetts, which are grouped with Greater Providence; and Tiverton and Little Compton, Rhode Island, which are grouped with the SouthCoast.

The original set of commuting zones generated by the clustering algorithm separated the northern and southern portions of the Pioneer Valley. This because the northern portion is pulled in two directions: southward towards the southern Pioneer Valley and eastward towards Greater Boston. However, this region cannot be viewed as a commuting zone since it fails to capture a majority of the commuting activity. In other words, less than 50% of all employed people living in the Northern Pioneer Valley also work in the Northern Pioneer Valley (see Table 2). As a result, it was joined with the Southern Pioneer Valley, with which it has the strongest commuting relationship, thus making the Pioneer Valley whole. The final set of commuting zones is presented in Figure 7.

Table 2 Number of People Working and Living Locally as a Percent of All Residents and Local Employment

	People Working and Living Locally	% of All Employed Residents	% of Jobs Located Locally
Cape & Islands	69,994	67.6%	76.4%
Berkshires	42,783	75.2%	82.0%
SouthCoast	88,314	54.1%	67.2%
Greater Boston	2,112,081	91.4%	85.0%
N. Pioneer Valley	17,018	44.3%	63.1%
S. Pioneer Valley	195,032	71.8%	75.5%
Greater Worcester	149,640	55.6%	62.3%
Greater Providence	379,158	81.2%	85.3%

Figure 7 Commuting Zones In and Around Massachusetts



It is somewhat surprising that the Hartford-Springfield region known as the Knowledge Corridor and the Lowell-Lawrence-Nashua-Manchester region known as the Merrimack Valley are not apparent in these commuting zones. There are large cross-border flows of commuters at these locations, but they are counterweighted by internal connections with others parts of the Commonwealth. For example, if we define the Massachusetts portion of the Merrimack Valley as being comprised of the Greater Lowell Workforce Investment Area (WIA) and the Lower Merrimack Valley WIA, we find that among people who live here, 45.8 percent of workers stay local and 44.0 percent work in Metro-Boston.[10] Only 10.2 percent of residents commute to all other locations. So clearly, for residents of the Merrimack Valley, the pull is southward, toward Metro-Boston. There are many more New Hampshire residents than Massachusetts residents crossing the border, with 19.8 percent of residents of the Manchester-Nashua, NH MSA commuting into Massachusetts for work. However, since the EIM includes commuting flows both into and out of a region, we find that most New Hampshire cities and towns are most highly connected to communities within the same state, with which they share a more mutual relationship.

In addition, since there are job centers (see Figure 8) on both sides of the Connecticut and New Hampshire borders, residents of neighboring communities do not need to cross the border to find the closest job center. As a result, the commuting zones at these locations remain mostly within state borders. Since the boundary along the Connecticut border is strangely clean cut, we closely scrutinized all of the border towns along Hampden County, MA, and found that the highest Employment Interchange Measure (EIM) is always with other cities and towns in Massachusetts.

2.4.1 Cross-Border Flows with Neighboring States

The commuting interchange with New Hampshire is the greatest of any border state in absolute terms, but when taking population size and reciprocity into account, we find that the commuting relationship with Rhode Island is the strongest. In terms of the total flow of commuters in either direction, there are more people crossing the Massachusetts-New Hampshire border than for any of Massachusetts' other neighbors. However, the commuting relationship is strongest with Rhode Island on a proportional basis, when adjusting for the size of the population and the number of jobs. In addition, Rhode Island is the top destination of any state for Massachusetts' workers employed outside of the Commonwealth.

Table 3 Cross-border Commuting Relationships with Massachusetts

Total Flows, both directions:		Proportional Flows, both directions (EIM):	
New Hampshire	140,619	Rhode Island	25.8
Rhode Island	121,379	New Hampshire	21.7
Connecticut	72,328	Connecticut	4.7
New York	47,454	Vermont	3.1
Vermont	9,274	New York	1.4

Table 4 Cross-border Commuting Relationships

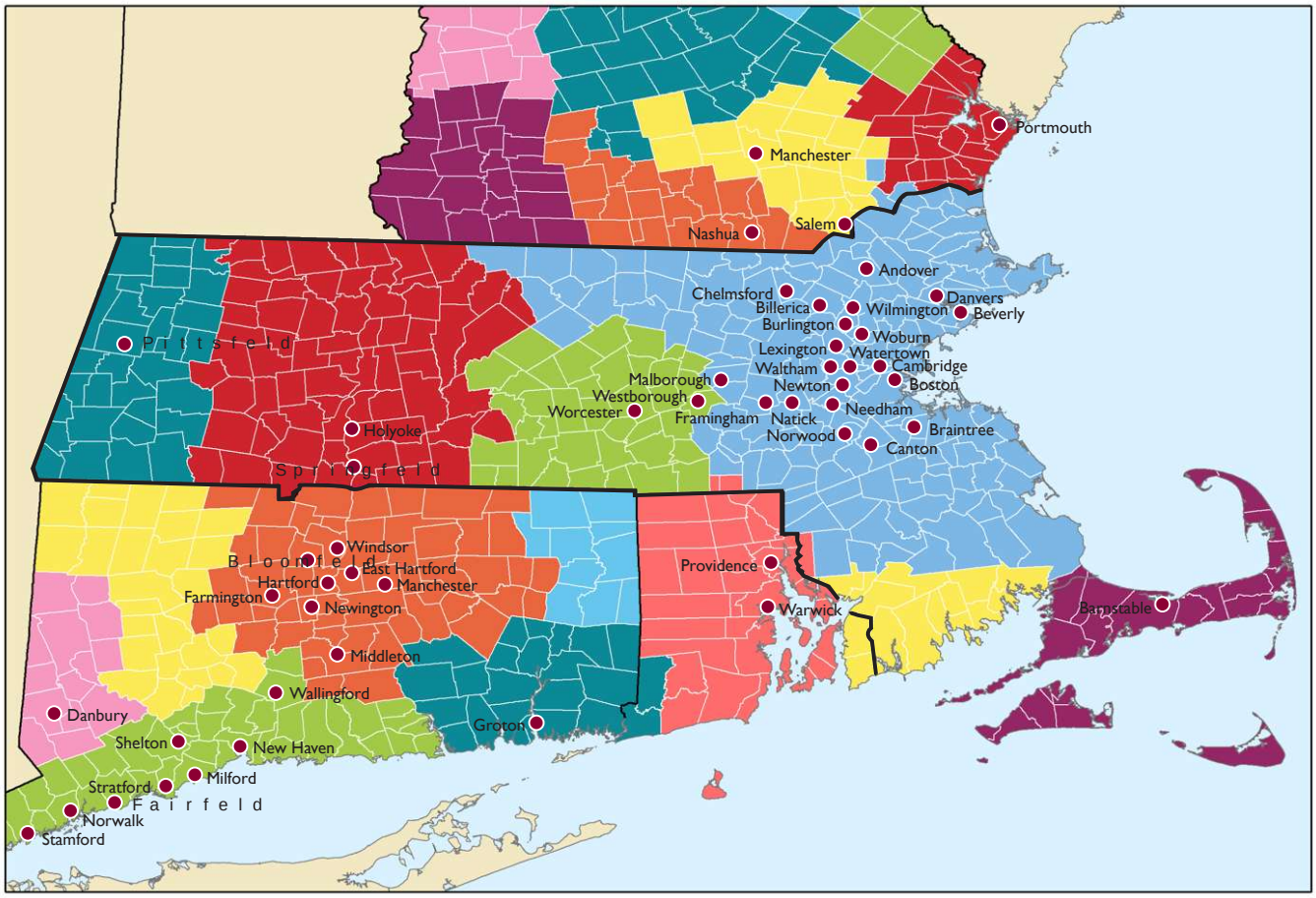
Commuting into Massachusetts:		Commuting out of Massachusetts:	
New Hampshire	99,260	Rhode Island	48,934
Rhode Island	72,445	New Hampshire	41,359
Connecticut	33,194	Connecticut	39,359
New York	22,044	Vermont	25,410
Vermont	4,684	New York	4,590

[10] For this analysis, we used the definition of Metro-Boston employed by the Metropolitan Area Planning council.

2.4.2 Job Centers

Job centers were defined as having both of the following two attributes: (1) they are in the top 10% of all cities and towns included in the commuting analysis in terms of the number of jobs[11] and (2) there are more jobs located there than employed people residing there.[12] All of the commuting zones contain at least one job center, with the exception of the SouthCoast. Interestingly, in Greater Boston, there are no job centers south of Canton, MA. New Bedford and Fall River, MA, which are in the SouthCoast, meet the size threshold for a job center, but there are more employed people living in these cities than jobs available. The closest jobs centers to the SouthCoast are Providence and Warwick, RI and Barnstable, MA. However, very few people commute from the SouthCoast to Cape Cod.

Figure 8 Commuting Zones and Job Centers



Consistent with the absence of any job centers, the SouthCoast and the region's main cities—New Bedford and Fall River—are all net labor exporters. That is, there are more people commuting out of the region than into the region to get to work (see Table 5).

[11] Included all cities and towns in New Hampshire, Massachusetts, Rhode Island, & Connecticut.

[12] For this part of the analysis, we switched from looking at all jobs to just primary jobs, so there would be a one-to-one relationship between residents and jobs and to avoid any double counting.

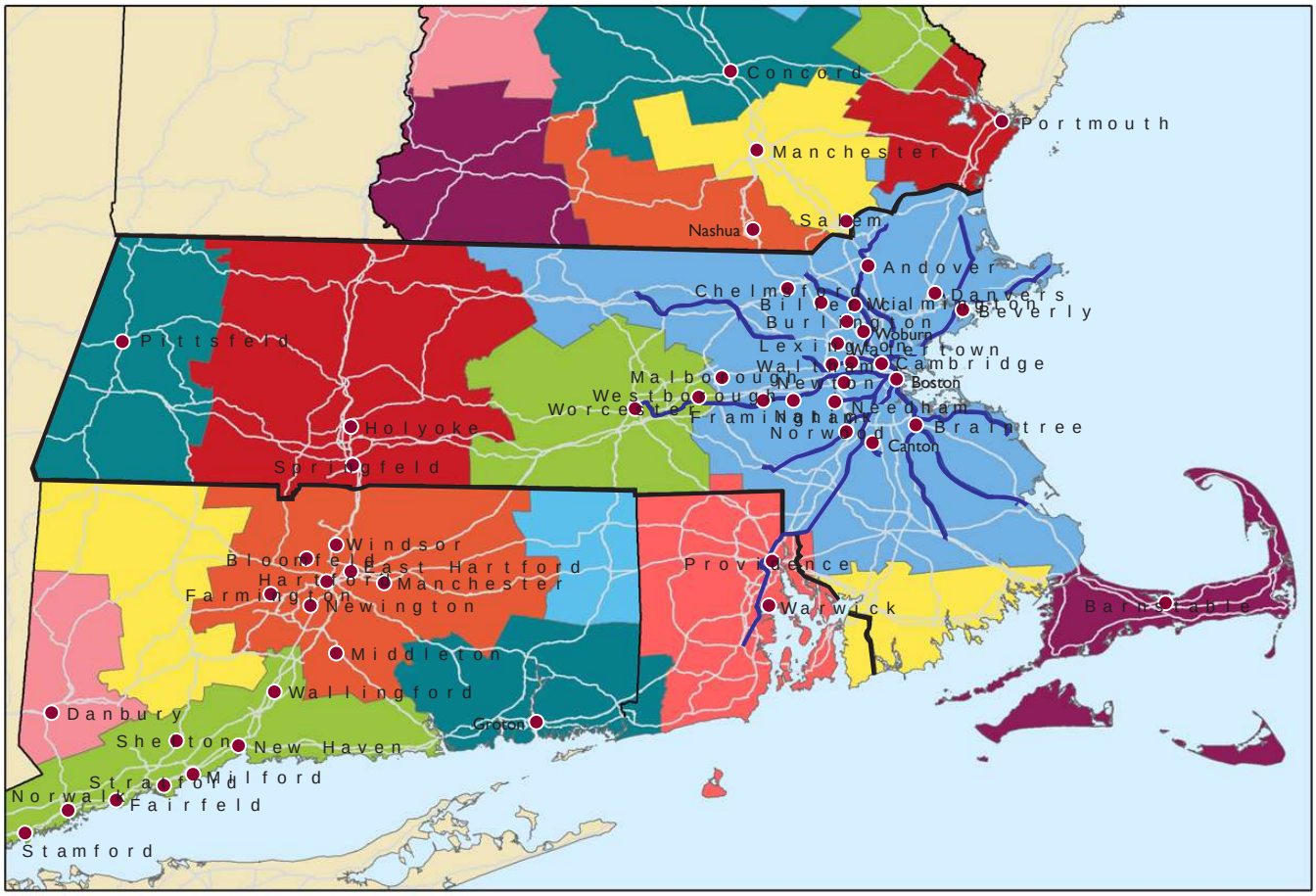
Table 5 Inflow/Outflow Job Counts, the SouthCoast, All Jobs

	Count	Share
Employed in the SouthCoast	115,641	100.0%
Employed in the SouthCoast but Living Outside	44,341	38.3%
Employed and Living in the SouthCoast	71,300	61.7%
Living in the SouthCoast	150,433	100.0%
Living in the SouthCoast but Employed Outside	79,133	52.6%
Living and Employed in the SouthCoast	71,300	47.4%

2.4.3 Transportation Networks

Placing the job centers and commuter rails on the same map reveals a significant pattern: the majority of the job centers in Massachusetts have commuter rail access to the City of Boston (See Figure 9). Consistent with this finding, the majority of Massachusetts' job centers are located in Greater Boston. In addition, the outer boundary of the Greater Boston commuting zone is shaped by the presence and absence of commuter rail service. For example, the towns of Lakeville and Middleborough, which are home to the southernmost commuter rail station, are at the southern boundary of Greater Boston as defined by the clustering algorithm. 10.9 percent of Lakeville workers (568 out of 5,190) and 11.6 percent of Middleborough workers (1,285 out of 11,072) commute to the City of Boston for their primary job. Moving just one town further to the south, these numbers are cut in half. Just 4.5 percent of Freetown workers (170 out of 3,820) and 4.7 percent of Rochester workers (111 out of 2,372) commute to the City of Boston for their primary job. In addition, the top destinations for Lakeville and Middleborough workers consists of more communities in the Greater Boston commuting zone than for Freetown and Rochester workers.

Figure 9 Commuting Zones with Job Centers and Transportation Networks



2.4.4 Commuting Flows Within and Between Zones

The commuting zones are mostly self-contained in that the majority of people live and work within the same commuting zone (see Table 6). However, there is a substantial amount of commuting between the commuting zones. Greater Boston is the top destination for workers who leave their commuting zone to get to work, including out as far as the Berkshires.

Table 6 Number of People Working and Living Locally as a Percent of Residents and Local Employment

	People Working and Living Locally	% of All Employed Residents	% of Jobs Located Locally
Cape & Islands	69,994	67.6%	76.4%
Berkshires	42,783	75.2%	82.0%
SouthCoast	88,314	54.1%	67.2%
Greater Boston	2,112,081	91.4%	85.0%
Pioneer Valley	17,018	68.4%	74.4%
Greater Worcester	149,640	55.6%	62.3%
Greater Providence	379,158	81.2%	85.3%

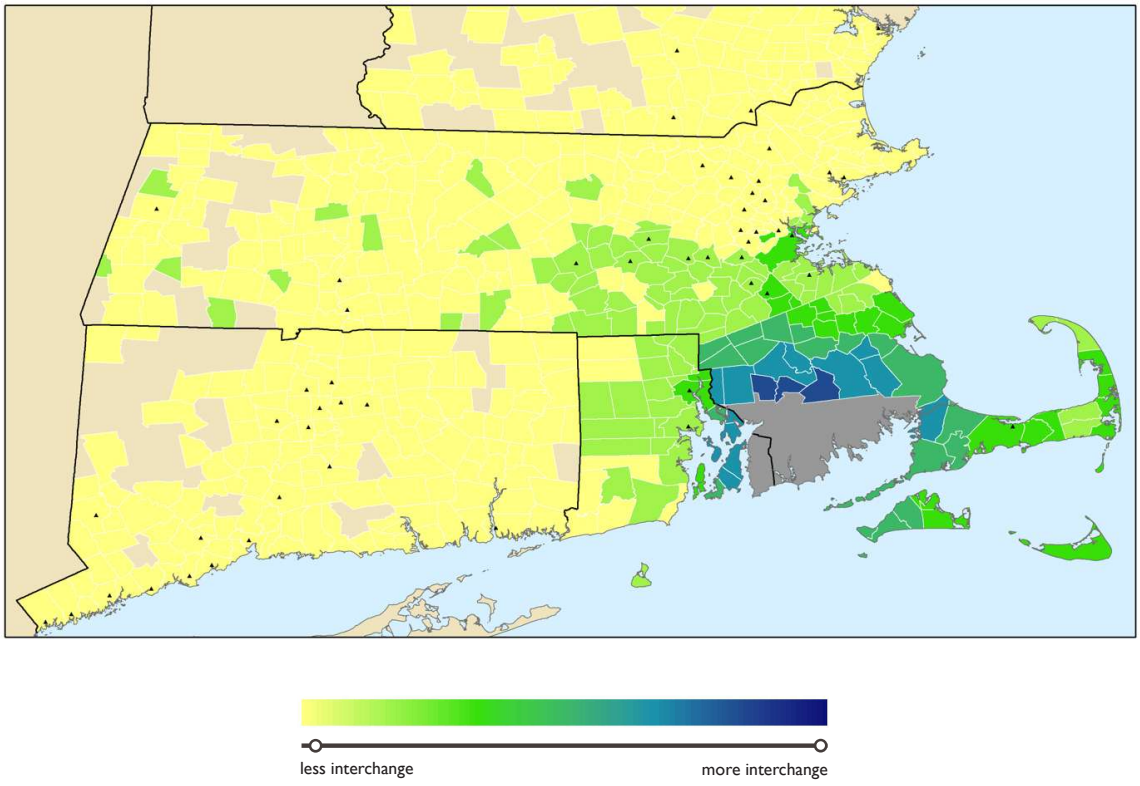
Table 7 Commuting Flows Between Commuting Zones

Location of Employment \ Location of Residence	Cape & Islands	Berkshires	SouthCoast	Greater Boston	Pioneer Valley	Greater Worcester	Greater Providence
Cape & Islands	69,994	164	4,763	12,898	852	1,020	868
Berkshires	154	42,783	259	3,081	3,683	769	229
SouthCoast	4,191	276	88,314	25,118	1,606	2,009	8,692
Greater Boston	25,063	6,092	46,951	2,113,251	37,103	94,689	58,209
Pioneer Valley	1,058	4,343	2,018	24,165	226,084	10,657	1,879
Greater Worcester	1,448	1,363	2,867	57,762	12,298	149,820	6,275
Greater Providence	1,070	108	17,248	28,627	755	4,433	379,194

2.4.5 Commuting Relationships with the SouthCoast and Greater Providence

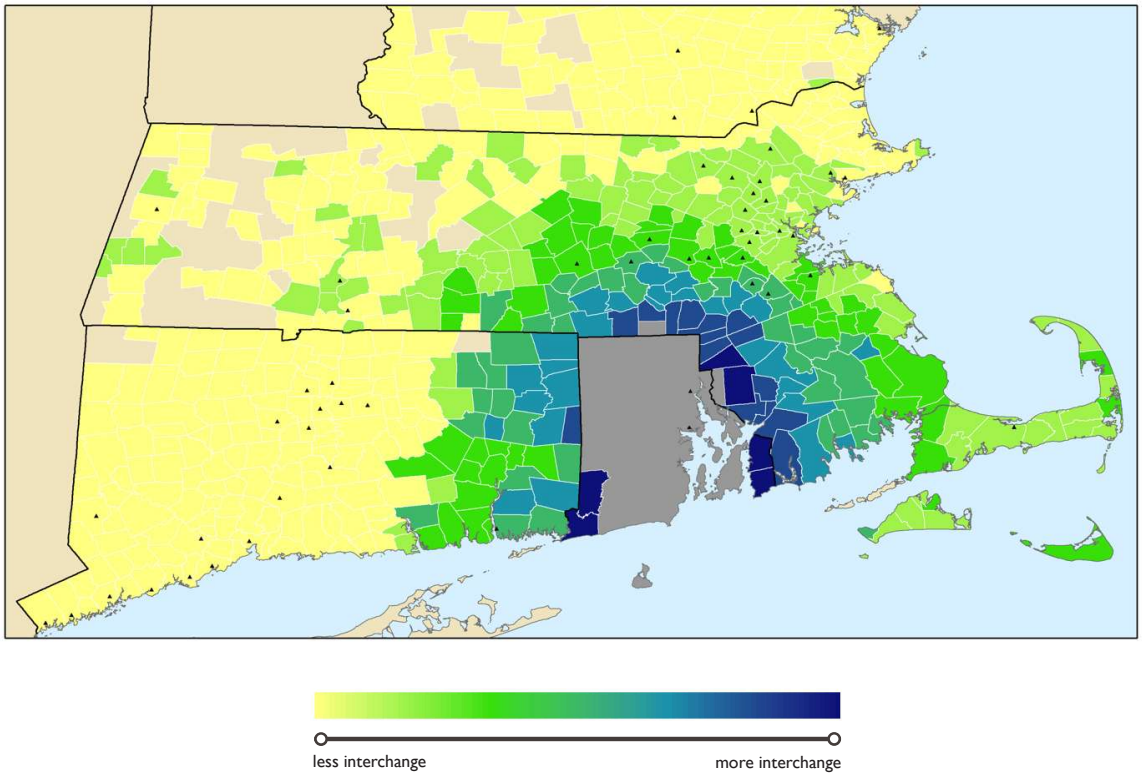
The commuting flows between commuting zones hides some of the patterns at the city and town level. To enable a more fine-grained analysis, we measured the proportional flow (EIM) of commuters between the SouthCoast and individual cities and towns and as well as between Greater Providence and individual cities and towns. For the SouthCoast, while there is a substantial amount of commuting interchange with Greater Boston, this relationship is mostly confined to the area south of Canton, MA, revealing a geographic isolation from most of the job centers. It appears that the area could benefit from stronger linkages to the job centers in Greater Boston, as well as in Greater Providence, which is closer than Boston to most communities in the SouthCoast.

Figure 10 Commuting Relationships With The SouthCoast (EIM)



The map of commuting relationships with Greater Providence reveals a stronger relationship with communities in Massachusetts than in Connecticut. In fact, Massachusetts is the top destination for Rhode Island workers crossing state borders. Also, the cross-border exchange extends out the furthest along I-95 and the Providence to Boston commuter line, which run through the same corridor.

Figure 11 Commuting Relationships With Greater Providence (EIM)



3 FUNCTIONAL ECONOMIC REGIONS

As discussed in Section 1, most attempts to define economic regions involve the use of commuting data. For example, this is how New England City and Town Areas (NECTAs) are delineated. Our analysis goes a step further by incorporating data on employment concentrations by industry and news media markets (also known as Designated Market Areas, or DMAs).

Industry employment concentrations were added to capture industrial agglomeration, which is the tendency of some firms of a similar industry to cluster near one another. Industrial agglomeration occurs when co-location reduces the costs of transporting goods, people, and ideas. As is the case for the SouthCoast, industrial agglomeration can also occur when there is a shared relationship with a fixed natural resource (e.g. the ocean). The presence of similar industries in neighboring cities or towns is evidence that they belong to the same functional economic region.

DMAs were added as an indicator for the major city the people in an area identify with in terms of local news and entertainment. A DMA is a group of counties that form an exclusive geographic area in which the home market television stations hold a dominance of total hours viewed. They are defined and updated annually by the Nielsen Company. One shortcoming is that they are built using county-level data, so they blur variation at the local level.

3.1 INDUSTRY DATA

Industry employment data for the year 2015 were obtained from the Economic Modeling Specialists International (Emsi) "Complete Employment" data set. This dataset includes a wider range of jobs and a higher level of granularity than publicly available datasets, such as the Quarterly Census of Employment and Wages (QCEW). According to EMSI, "QCEW-derived data are a widely used resource in regional/local economic and labor market research. However, they exclude some payroll jobs and all non-payroll jobs such as proprietors and partners. Particularly in some sectors, such as agriculture, construction, professional/technical services, or real estate, non-payroll workers may have a very significant presence. EMSI seeks to overcome this limitation of QCEW with its Complete Employment dataset. This data set attempts to record nearly every job in every sector at the local level." Since this dataset includes jobs not found in other datasets, employment numbers may appear inflated to some researchers.

Data sources for the Complete Employment data set include the BLS's QCEW, the Census Bureau's Nonemployer Statistics, the BEA's Regional Economic Account and State/Local Personal Income reports, the BEA's Current Employment Statistics, the Census Bureau's County Business Patterns, and the Ten-Year Industry Projections, which are produced by the BLS and various state agencies. These data are combined and manipulated to yield higher levels of granularity with respect to industry sector and geography than is available with publicly available sources.

In order to group industries in a way that captures inter-industry linkages, the PPC used industry cluster definitions from the U.S. Cluster Mapping Project.[13] These cluster definitions distinguish between industries that are "traded" or "local." "Traded industries are industries that are concentrated in a subset of geographic areas and sell to other regions and nations. Local industries are industries present in most (if not all) geographic areas, and primarily sell locally."[14] The traded industries were organized into traded clusters based on "an overall measure of relatedness between individual industries across a range of linkages, including input-output measures, use of labor occupations, and co-location patterns of employment and establishments."[15]

Only traded clusters were included in the PPC's analysis, since these clusters bring new money into the region by selling to markets outside the local economy. Also, we used only traded clusters for which either Massachusetts or Rhode Island has a location quotient above 1.0, indicating a concentration of employment in that cluster that is above the national average. This way, we only included industries that have a significant presence in either of the states. The list of clusters used in our analysis

[13] Delgado, M., M.E. Porter, and S. Stern (2014), "Defining Clusters of Related Industries." *NBER Working Paper No. 20375. http://www.nber.org/papers/w20375.pdf*
[14] Ibid.
[15] "Cluster Mapping Methodology," U.S. Cluster Mapping, http://clustermapping.us/content/cluster-mapping-methodology.

and the North American Industry Classification System (NAICS) definitions for those industries are included in Appendix I (pg. 49). This data was incorporated into the Grouping Analysis in the form of municipal-level location quotients.

3.2 MEDIA MARKET DATA

As discussed earlier, DMAs are geographic areas that represent specific television markets as defined by and updated annually by the Nielsen Company. According to Nielsen, "a DMA region is a group of counties that form an exclusive geographic area in which the home market television stations hold a dominance of total hours viewed." Nielsen determines which DMA to assign a county to based on viewing habits. If more than 50% of homes in a county watch Baltimore TV stations, then the county is assigned to the Baltimore DMA. That is true even if the county is geographically closer to another city, like Washington, DC. Data on the DMA by city and town were obtained from TruckAds, which provides the most reliable cost-free media market maps.

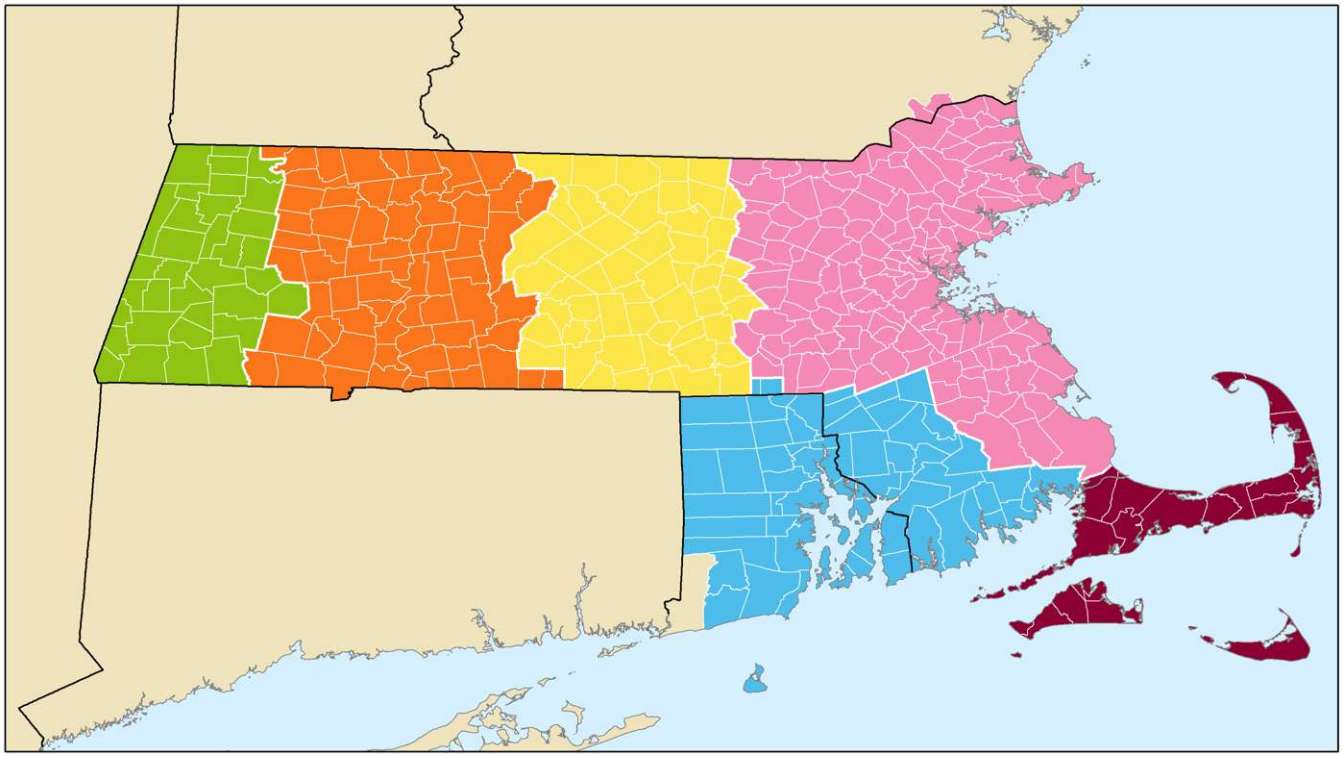
3.3 GROUPING ANALYSIS

The PPC used the ArcGIS Grouping Analysis Tool to group cities and towns based on commuting zones, media markets, and industrial composition. Given the number of groups to create, this software looks for a solution that minimizes the differences between cities and towns within a group and maximizes the differences between groups. A continuity constraint guaranteed that only adjacent cities and towns were joined in a group (adjustments for islands were made after the fact). A Pseudo F-statistic was calculated in order to determine the optimal number of groups. Grouping effectiveness is measured using the Calinski-Harabasz pseudo F-statistic, which is a ratio reflecting within-group similarity and between-group difference. We chose the number of groups with the largest F-statistic without producing groups of very small size (three or fewer communities).

3.4 RESULTS

Grouping Massachusetts' cities and towns based on commuting zones, media markets, and industrial composition, we find that Massachusetts is comprised of six functional economic regions (FERs): the Berkshires, the Pioneer Valley, Central Massachusetts, Greater Boston, Cape Cod & the Islands, and a cross-border region that's comprised of southeastern Massachusetts and most of Rhode Island, which we will refer to here as SouthCoastal New England.

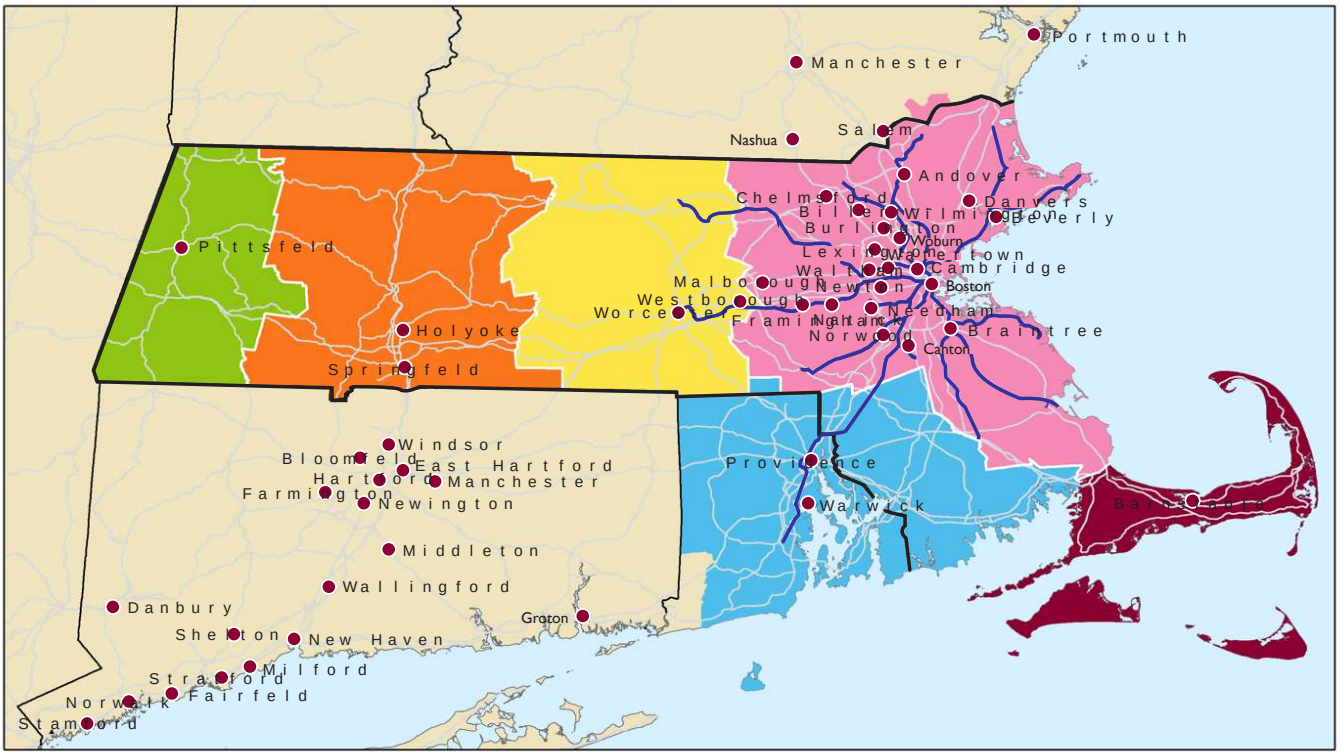
Figure 12 Economic Regions



Every FER contains at least one job center, which adds to the validity of the regions (see Figure 13). Greater Boston contains the greatest number of job centers by far, with 21 out of the 29 job centers in Massachusetts FERs. The SouthCoastal New England region is home to two job centers: Providence and Warwick, Rhode Island.[16] The SouthCoastal New England region is Massachusetts' only economic region in which none of Massachusetts' cities are job centers. Accessible rail service into the economically dynamic Greater Boston region may help to explain economic disparities on this side of the border; while Providence and Warwick have commuter rail service to Boston, there is limited service on the Massachusetts side of the region. Additionally, commuter rail access to the Greater Boston area is coterminous with the eastern boundary of the SouthCoastal New England region (see Figure 13). Therefore, to increase prosperity in this part of the state, it may make sense to improve transportation connections to Greater Boston or facilitate cross-border activity with Rhode Island.

[16] Other cities in the region meet the size threshold, but must export labor and are therefore not considered to be job centers. In other words, they are home to fewer jobs than employed residents.

Figure 13 Economic Regions with Job Centers and Transportation Networks



3.5 FOCUS ON THE SOUTHCOASTAL REGION

3.5.1 Industrial Similarity

Looking at the Massachusetts side of the SouthCoastal region, employment concentrations reveal much more industrial similarity with Rhode Island than with the rest of Massachusetts. In the nine most specialized industries in the region (Location Quotient (LQ) > 3), the Rhode Island side of the region has an above average concentration in seven, while for the rest of Massachusetts this is only true of two. Unfortunately, many of the specialized industries in the region are in decline (e.g. textiles and jewelry manufacturing). This highlights a shared set of challenges and the potential to collaborate on solutions that benefit the region.

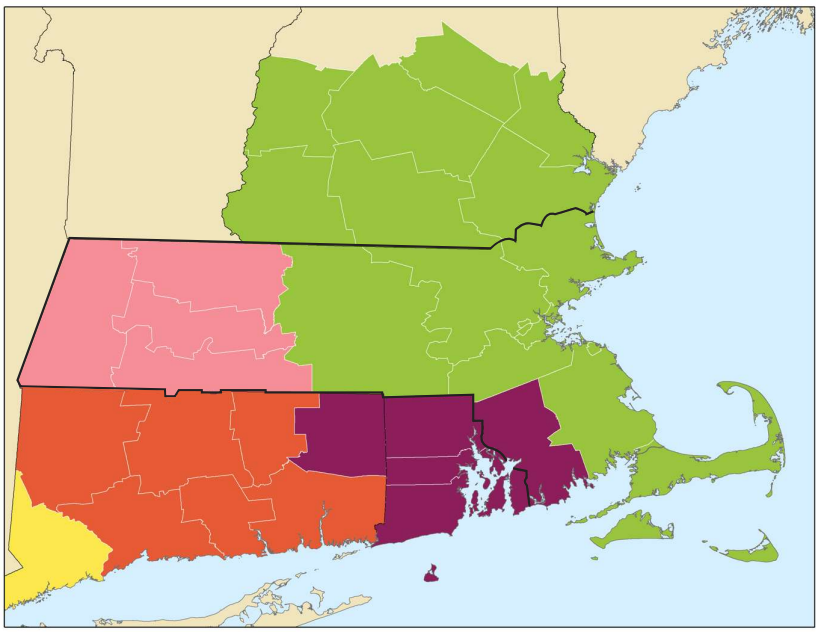
Figure 14 Employment Concentrations in U.S. Cluster Mapping Industry Clusters

Harvard Business School Industry Clusters, LQ > 3	SE Region, MA Only	SE Region, RI Only	MA Remainder
Medical Devices	5.03	1.6	1.55
Leather and Related Products	3.19	2.19	0.12
Lighting and Electrical	4.38	0.04	0.21
Textile Manufacturing	3.02	2.74	0.3
Fishing and Fishing	21.68	2.67	1.42
Jewelry and Precious Metals	23.39	38.64	0.46
Apparel	6.45	0.7	0.41
Electric Power Generation and Transmission	4.18	1.14	0.21
Recreational and Small Electric Goods	5.09	1.4	0.19
Count LQ >1		**7**	**2**

3.5.2 Media Markets

Bristol County, MA and the State of Rhode Island belong to the same DMA, as shown in Figure 15. This tells us that households in the region share similar habits in terms of media consumption.

Figure 15 Designated Market Areas



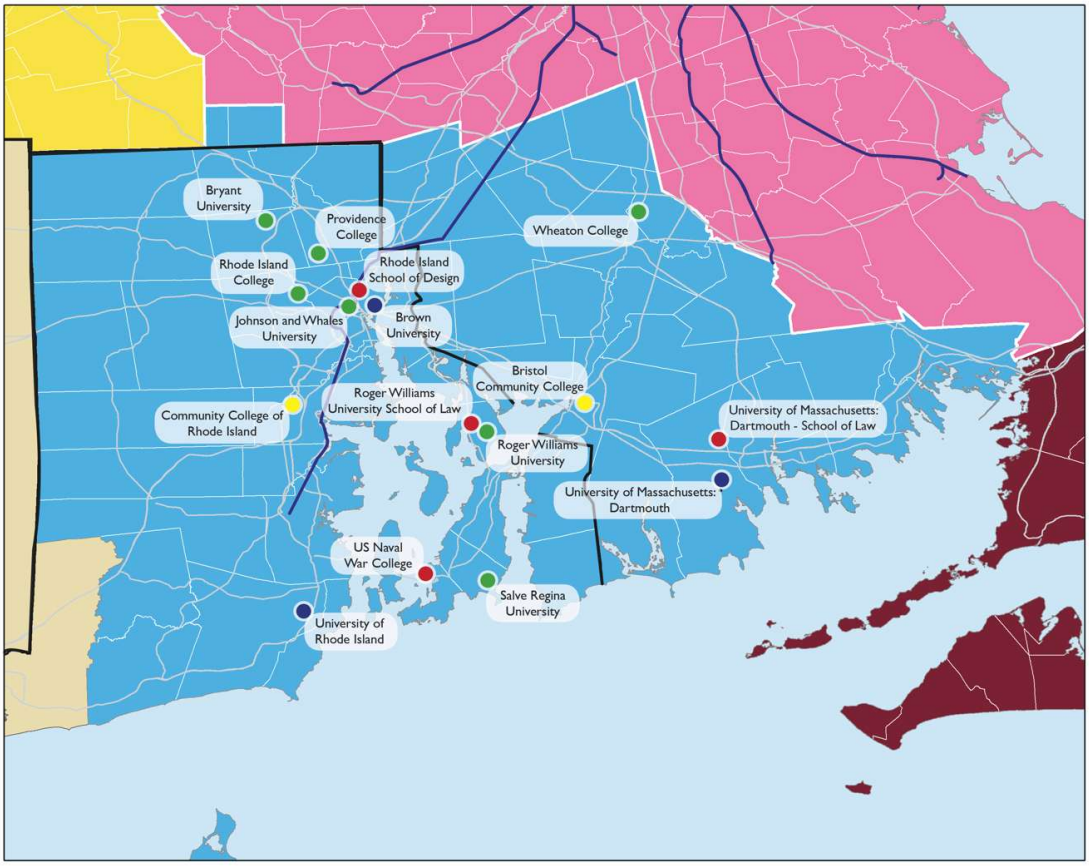
4 CROSS-BORDER CONNECTIONS

The PPC also examined existing cross-border connections in order to highlight common interests for residents on either side of the border. We found that there is a shared interest in maritime activities, and that regional organizations have developed to promote tourism, small-scale food producers, and local artisans.

4.1 UNIVERSITY RESEARCH COLLABORATIONS

One measure of cross-border interaction is journal article collaborations between university researchers. There are three main research universities in this region: the University of Massachusetts Dartmouth (UMass-D), Brown University, and the University of Rhode Island (URI) (see Figure 16). We examined one form of research collaboration between these universities: researchers who worked together on the same journal article appearing in the Web of Science database.

Figure 16 The SouthCoastal Economic Region and Constituent Colleges and Universities



During the period from January 2001 to April 2016, researchers from UMass-D were most likely to collaborate on scientific research articles with researchers at the Woods Hole Oceanographic Institute (WHOI). WHOI is not in SouthCoastal New England, but rather on Cape Cod. However, it is the leading oceanographic research institution in the United States by total research and development expenditures ($142 million in 2014[17]). Similarly, the number two institution by oceanographic R&D expenditures is the University of California (UC) San Diego ($119 million)—and it is also the number two organization in terms of collaborations with UMass-D's scientific researchers. UC-San Diego is then followed by the National Oceanic and Atmospheric Administration (NOAA). This pattern displays UMass-D's strengths in the ocean sciences.

Excluding the oceanographic heavy-hitters, the universities that UMass-D scientists collaborate most frequently with are the other research universities in SouthCoastal New England: Brown University and URI. Collaborations with these two institutions accounts for 5.4 percent of the 1,355 journal articles by UMass-D researchers appearing on the Web of Science database between 2001 and April 2016.

Table 8 Collaborations with UMASS-D Researchers, Top 15

Organizations	Records 2001-April 2016	% of total (1355)
Woods Hole Oceanographic Institution	84	6.19
University Of California System	66	4.87
University Of California San Diego	44	3.24
National Oceanic Atmospheric Admin NOAA USA	44	3.24
Brown University	37	2.73
University Of Rhode Island	36	2.65
Shanghai Ocean University	36	2.65
Massachusetts Institute Of Technology MIT	27	1.99
University System Of Georgia	26	1.91
United States Department Of Defense	21	1.55
Harvard University	21	1.55
University System Of Maryland	19	1.40
University Of Prince Edward Island	18	1.32
University Of Electronic Science Technology Of China	17	1.25
United States Department Of Energy DOE	17	1.25

Researchers at UMass-D have collaborated with Brown University researchers on 37 out of 1,355 articles appearing in the Web of Science database. These research collaborations span a wide variety of fields, including mathematics, geology, psychology, and pediatrics. The most frequent field of collaboration, accounting for 6 of the 37 collaborations, is mathematics. This represents the influence of a UMass-D faculty member who is an alumna of the Brown University mathematics department.

[17] NSF Higher Education Research and Development Survey, 2014

Table 9 Research Areas of Collaboration Between UMASS-D and Brown University Researchers

Research Areas	Records 2001-April 2016	% of 37
Mathematics	6	16.21
Geology	4	10.81
Substance Abuse	3	8.10
Psychology	3	8.10
Pediatrics	3	8.10
Mechanics	3	8.10
Materials Science	3	8.10
Environmental Sciences Ecology	3	8.10
Engineering	3	8.10
Chemistry	3	8.10
Toxicology	2	5.40
Psychiatry	2	5.40
Oceanography	2	5.40
Health Care Sciences Services	2	5.40
Geochemistry Geophysics	2	5.40

Researchers at UMass-D have collaborated with URI researchers on 36 out of 1,355 articles appearing in the Web of Science database. These research collaborations are dominated by research in the ocean sciences, including oceanography, marine freshwater biology, and fisheries research. Like WHOI and UC-San Diego, URI performs a high amount of research in oceanography, with $27 million in R&D expenditures in 2014. The same year, UMass-D performed $9 million in oceanographic R&D. This sum is much smaller than for the top performers, but it accounts for 31 percent of all R&D conducted at UMass-D that year and is the top field at UMass-D in terms of R&D expenditures.[18]

Table 10 Research Areas of Collaboration Between UMASS-D and URI Researchers

Research Areas	Records 2001-April 2016	% of 36
Oceanography	13	36.11
Marine Freshwater Biology	8	22.22
Environmental Sciences Ecology	5	13.88
Mechanics	4	11.11
Fisheries	3	8.33
Engineering	3	8.33
Operations Research Management Science	2	5.55
Nursing	2	5.55
Materials Science	2	5.55
Chemistry	2	5.55
Audiology Speech Language Pathology	2	5.55
Acoustics	2	5.55

[18] NSF Higher Education Research and Development Survey, 2014

4.2 INSTITUTIONAL CROSS-BORDER COLLABORATIONS

Presently, several organizations and initiatives recognize and incorporate the cross-border connections between Massachusetts and Rhode Island. In most instances, these connections are tied a common interest in the coastal areas and marine resources. Several – The Coastal Wine Trail, the FarmCoast, and South Coast Artists Inc. – conduct promotional activities on behalf of small businesses on the either side of the border to attract attention and tourism to the vineyards, New England villages, and artists along the scenic southeastern New England coastline. Two others—the New England Coast Watershed Restoration Program and the Southern New England Collaborative Research Initiative—are examples of a mutual interest in protecting our marine resources. While these examples are somewhat limited, they suggest that many residents on either side of the Massachusetts-Rhode Island border already consider cross-border partnerships for promotional activities and to study and protect shared natural resources.

- The Coastal Wine Trail – an American Viticultural Area extending from the Cape & Islands along the coast to Connecticut.
- SouthCoast Artists, Inc – a nonprofit organization that gives access to the work of visual artists living and working in the townships of Dartmouth and Westport, MA and Tiverton and Little Compton, RI by producing annual open studio tours and related events in the region.
- The FarmCoast – an organization and marketing slogan representing the interests of local business owners/operators in the villages contained in Tiverton, RI; Little Compton, RI; Westport, MA; and Dartmouth, MA. The FarmCoast is a picturesque rural area of villages, farms, and coastline that reflects the rural quality of 19th century New England. According to their 2009 brochure, they have come together to "promote local business to the local and tourist communities through a variety of means."[19]
- New England Coast Watershed Restoration Program – EPA program encouraging collaboration between governmental and non-governmental organizations to improve conditions of coastal watersheds in RI and MA.
- Southern New England Collaborative Research Initiative – a research program supporting teams of scientists, managers, and members of the commercial fishing industry to research projects important to the commercial fishing industry in the southern New England region.
- Southeastern New England Defense Industry Alliance – an advocacy organization that supports defense organizations and related industries in Massachusetts, Rhode Island, and Connecticut.
- Rhode Island Public Radio – RIPR recently acquired the radio station at UMass Dartmouth (WUMD). This move doubles the reach of the radio station to include more of Rhode Island and most of Southeastern Massachusetts.
- Offshore Wind Area of Mutual Interest – the Governors of Rhode Island and Massachusetts signed a Memorandum of Understanding in July of 2010 agreeing to collaborate in the development of offshore wind resources in an area of federal waters that straddles the line between the two states. The MOU includes an agreement to collaborate on the planning and share the economic costs and benefits.

[19] Taken with permission of The FarmCoast http://farmcoast.com/area-information/about-the-farmcoast-name/ with minor changes

4.3 OPPORTUNITY AREAS

While the exploration of new possibilities for cross-border collaboration will be conducted as a follow-up to this study, two possibilities are immediately apparent: building around a mutual pursuit of offshore wind energy and shared expertise in marine and ocean science. These opportunities are consistent with other cross-border linkages in that it reflects a shared connection to the ocean and waterfront.

- Offshore Wind Energy –The two states have a shared interest in offshore wind development. Providence, RI is home to the United States' leading offshore wind developer—Deepwater Wind. New Bedford, MA is home to the New Bedford Marine Commerce Terminal—a structure built by the Clean Energy Center to be the nation's first staging area to support offshore wind projects. In addition, the industry has very recently taken some major steps forward. The nation's first offshore wind farm ware recently built off of Block Island (New Shoreham), RI. It is expected to be operational in the Fall of 2016. Meanwhile, in August of 2016, the Massachusetts State Legislature passed a comprehensive energy bill that includes a requirement for utilities to contract 1,600 MW of offshore wind power. It is possible that a collaboration between the two states could help each to develop best practices around offshore wind development in the U.S. context and to discover ways to maximize the local economic impact.

- Marine Research Collaboration – Both sides of the border also share above average employment in marine-related industries and high levels of scientific and applied research in marine and ocean science. Leading research institutions in the cross-border region include the Metcalf Institute at the University of Rhode Island (URI), the School for Marine Science and Technology at the University of Massachusetts Dartmouth (UMass-D), the UMass-D Center for Innovation & Entrepreneurship, and the Naval Undersea Warfare Center in Newport. An examination of the degree of scientific collaboration between institutions on both sides of the border reveals significant levels of collaborative activity, most notably in the areas of ocean and marine science. Ongoing efforts related to offshore wind development and coastal climate change resiliency strongly suggest there is substantial potential in both of these areas for these institutions and the larger regional economy if emerging opportunities can be seized and developed on a larger scale.

In addition, an analysis of the cluster definitions developed for the 2016 *Rhode Island Innovates*[20] report, identified shared growth potential in the following industry clusters. (Full analysis is presented in Table 11.) These clusters were found to be highly concentrated, growing, or growing faster than the United States average on both sides of the border.

- Boat and Ship Building and Repair;
- Energy Production, Distribution, and Storage;
- Medical Devices; and
- Plastic Laminate, Films, Specialty Chemicals and Resins.

The cross-border region's proximity to the dynamic innovation ecosystem in Greater Boston – especially the renowned life sciences super-cluster – in addition to its existing industry base of manufacturers in plastics and metalworking firms, suggests that the SouthCoastal New England region is well positioned for growth opportunities in the rapidly growing Massachusetts innovation economy, particularly in medical devices. Above-average regional employment in related sectors and the presence of leading medical device companies like Saint-Gobain and Smith & Nephew make it clear that significant connections already exist.

[20] *Rhode Island Innovates: A Competitive Strategy for the Ocean State.* Prepared by Battelle Technology Partnership in association with the Metropolitan Policy Program at Brookings, January 2016. These cluster definitions were adjusted to add Energy Production, Distribution & Storage and to correct for double counting.

Table 11 Performance of *Rhode Island Innovates* Clusters on the Two Sides of the SouthCoastal New England Region

	Performance Category							
	2016 Employment Size		Industry Specialization, 2016		Adding Jobs, 2011-2016		Relative Growth Faster than U.S., 2011-2016	
Detailed Industry Cluster	**RI-Only**	**MA-Only**	**RI-Only**	**MA-Only**	**RI-Only**	**MA-Only**	**RI-Only**	**MA-Only**
Pharmaceuticals	1,362	20	✓					
Boat & Ship Building	4,940	358	✓	✓	✓	✓	✓	✓
Computer Systems & Software	6,859	1,477			✓	✓		
Corporate, Administrative Offices	12,616	3,557	✓		✓		✓	
Data Processing & Internet	2,779	118	✓					
Electronics	666	1,445		✓				
Fabricated Metal Products	4,447	2,010	✓	✓				
Finance and Insurance	24,586	5,175	✓		✓		✓	
Industrial Machinery	1,488	526	✓		✓	✓	✓	✓
Jewelry	3,746	1,191	✓	✓		✓		✓
Medical Devices	1,645	2,651	✓	✓		✓		✓
Metal Refining & Metalworking	1,490	531	✓	✓	✓		✓	
Plastic Laminates and Films	2,224	946	✓	✓	✓	✓		✓
R&D and Medical Labs	1,315	1,261			✓		✓	
Sensors and Instruments	2,066	652	✓	✓				
Specialty Chemicals & Resins	1,332	388	✓	✓	✓	✓	✓	✓
Toys and Novelty Goods	555	1,738	✓	✓				
Wiring and Related Products	494	1,834	✓	✓				
Energy Production, Distribution, & Storage	568	1,560		✓	✓	✓	✓	✓
Arts, Hospitality, and Tourism	32,640	13,636	✓		✓	✓	✓	
Design Services	657	283	✓		✓	✓		
Retail Displays/Signage	957	205	✓		✓		✓	
Freight Transportation	2,646	2,000			✓	✓	✓	✓
Furniture	757	120			✓	✓		
Glass and Stone Products	382	363				✓		✓
Hospitals and Healthcare	28,406	12,012	✓	✓	✓			
Logistics Support Services	1,448	754			✓	✓	✓	✓
Food Products	3,222	2,584	✓	✓	✓	✓		✓
Packaging	1,792	808	✓	✓	✓		✓	
Higher Education	23,773	6,132	✓			✓		✓
Textile Mills	2,339	1,511	✓	✓			✓	
Warehousing	1,375	2,322		✓	✓	✓		
Wholesale Distribution	14,653	11,782		✓	✓	✓		

4.3.1 How the FarmCoast Got Its Name

"A dozen years ago, a group of merchants from this area developed an organization known as the Coastal Villages Cooperative to "market the storefront businesses from Tiverton Four Corners to Padanaram." The intent was to create a marketing concept to provide information for visitors who were unfamiliar with the area and were interested in day trips or weekend visits. The coastal areas of Tiverton, Little Compton, Westport, and Dartmouth all share a unique, picturesque, and physical landscape of antique houses, colonial-era villages, church steeples, general stores, mill ponds, stone walls, salt marshes, and rural pastures rolling down to the sea or rivers. Although bisected by two states, a visitor from afar would perceive this area as a single community.

Being divided by two states, however, the identity of this area has been different for each state, thus creating a situation where there is no name for the common geographic area shared by each community. Rhode Islanders consider Tiverton and Little Compton to be a part of its East Bay while Massachusetts looks at the area as being part of its newly coined SouthCoast, an area that stretches from Fall River to Marion along the coast of Buzzard's Bay…To further complicate things, the SouthCoast designation is not recognized by the Massachusetts Bureau of Tourism which had already divided up Massachusetts into various tourism sectors, and the area along the coast is combined with the inland manufacturing cities of Taunton, Attleboro, and Plymouth.

Accordingly, a group of members met to think through the process of what was unique to identify this picturesque area. It became self-evident to everyone that the attraction for all of these communities was the distinctive rural quality of the area with farms running down to the salt marshes and coastal areas. In revisiting the naming process, it was also recalled that an earlier designation for the area was The Heritage Farm Coast, a name introduced by the Westport Rivers Vineyard. The villages, of course, remain an important aspect of the rural character, and we will continue, in general, to refer to the Coastal Villages of FarmCoast New England." (Source: http://farmcoast.com/area-information/about-the-farmcoast-name/)

5 COMPARATIVE DEMOGRAPHIC AND ECONOMIC PROFILES

5.1 SOCIO-DEMOGRAPHIC INDICATORS

A requisite step in this project involved the analysis of various sub-regions that make up southeastern Massachusetts and the state of Rhode Island. We began our analysis of pre-defined regions, such as the Workforce Investment Areas (WIA) within southeastern Massachusetts and Rhode Island. We also collected data for the Southeastern Regional Planning and Economic Development District (SRPEDD), an economic development area that includes many of the same communities that are covered under the southeastern Massachusetts WIAs. Table 12 offers a brief overview of the size of each of the regions and which communities they include. [21]

Table 12 Regional Composition

Area Name	State	Counties Intersected	# of County Subdivisions	% Urban	% Suburban
Bristol WIA	MA	Bristol	14	21%	79%
GNB WIA	MA	Plymouth, Bristol	10	10%	90%
SRPEDD	MA	Bristol, Plymouth, Norfolk	27	15%	85%
Prov.-Cranston WIA	RI	Providence	2	100%	0%
Greater RI WIA	RI	Bristol, Kent, Newport, Providence, Washington	38	16%	84%
S.C. New England	MA, RI	Bristol (MA), Bristol (RI), Kent, Newport, Plymouth, Providence, Washington, Norfolk, Worcester	65	18%	82%

In sum, we found that all of the regions have very similar demographic profiles. For example, each area's population grew over recent years and the populations are distributed similarly in terms of age, race, language, and nativity/citizenship. On the other hand, in terms of socio-economic data, we found that the southeastern Massachusetts communities have more in common with the Rhode Island communities than Massachusetts as a whole. For example, Massachusetts' per capita income is higher than that of each of the sub-regions and the unemployment rate is lower in Massachusetts as a whole than it is in the other regions. These data suggest that the sub-regions share a cultural identity and a common set of economic development challenges.

5.1.1 Population

Table 13 Population Trends, 1970-2014

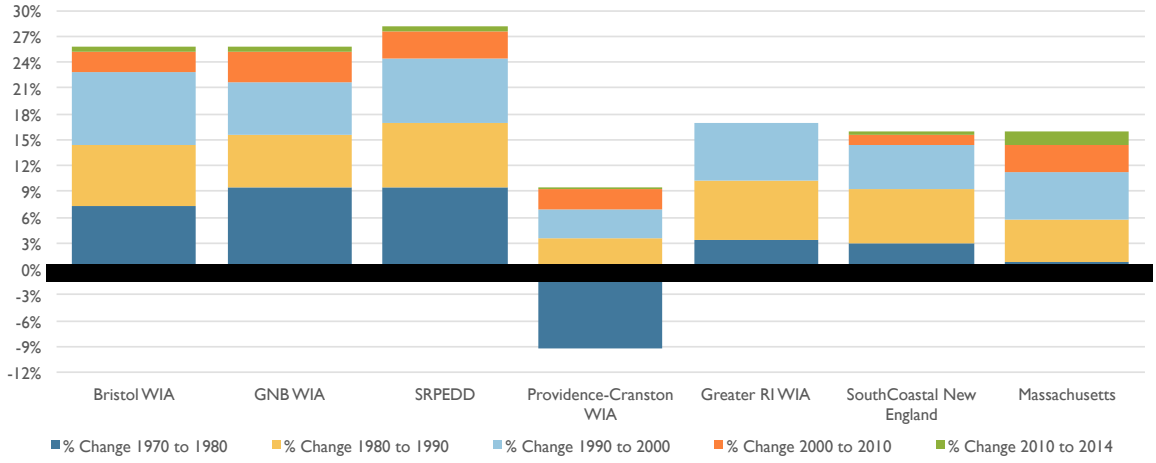
Area Name	1970	1980	1990	2000	2010	2014	% Change '70-'14	% Change '00-'14
Bristol WIA	283198	304053	325139	353153	361023	363003	28%	3%
GNB WIA	174550	191087	202658	205354	212758	214115	23%	4%
SRPEDD	478728	524389	563130	597294	616670	620781	30%	4%
Prov.-Cranston WIA	252250	228796	236788	252887	258429	259242	3%	3%
Greater RI WIA	694475	718358	766676	795432	794138	794010	14%	0%
S.C. New England	1407273	1448051	1539725	1617534	1638965	1643891	17%	2%
Massachusetts	5689377	5737093	6016425	6349097	6547629	6657291	17%	5%

Source: 1970-2010 U.S. Census Bureau Summary File 1, 2014 ACS 5-Year Estimates

[21] For a list of county subdivisions included within each region, see detailed data on each region provided in separate appendices.

All of the regions have grown at similar rates over the past few decades, with the exception of the Providence-Cranston WIA, where population growth has been more or less flat. However, this difference may simply be the product of being 100 percent urban. The cities of Providence and Cranston experienced population decline to the same extent that other cities across the border did, such as Fall River and New Bedford, where population dropped by 8 percent and 7 percent between 1970 and 2014 respectively. It is also important to note that while most of the regions grew by similar rates from 2000 to 2014, the Greater Rhode Island WIA experienced a modest population decrease.

Figure 17 Percent Population Change by Decade, 1970-2014

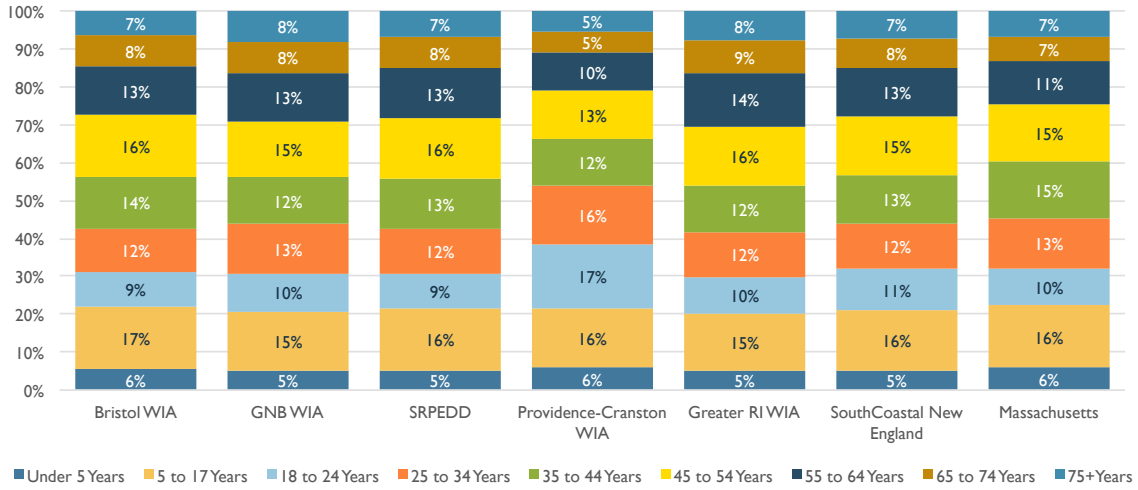


Source: 1970-2010 U.S. Census Bureau Summary File 1, 2014 ACS 5-Year Estimates

5.1.2 Age Cohorts

All of the regions are distributed similarly in terms of age. It could be said that the population of the Providence-Cranston WIA is younger than that of the other regions. The Providence-Cranston WIA has larger portions of people in the 18 to 34 range than the other regions do, though only slightly larger.

Figure 18 Relative Size of Age Cohorts, 2014

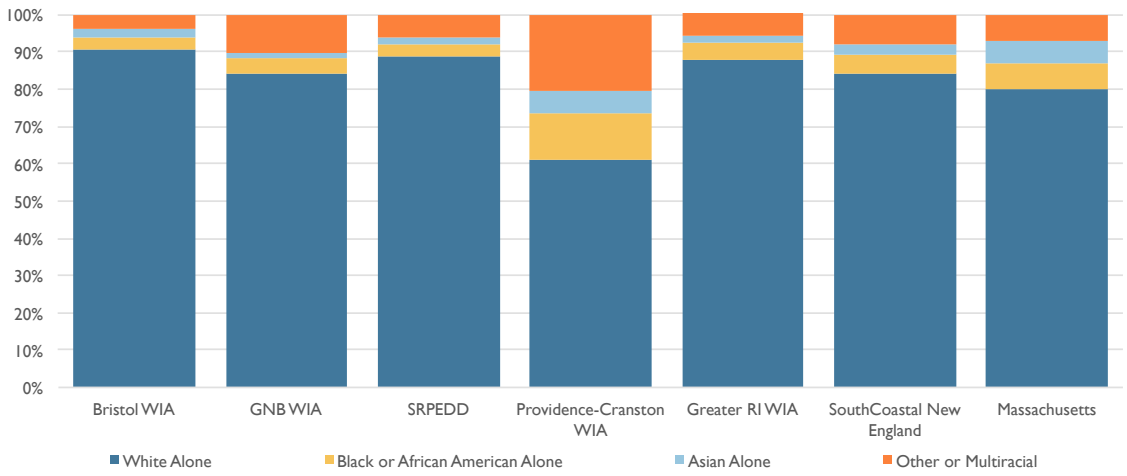


Source: 2005-2009 ACS 5-year estimates, 2010-2014 ACS 5-year estimates

5.1.3 Race / Ethnicity

All of the regional populations share similar racial backgrounds, with the exception of the Providence-Cranston WIA, which is a bit more diverse than the other areas. Once again, this apparent difference is less evident when comparing Providence and Cranston to other cities that are included in the SouthCoastal New England region.

Figure 19 Relative Size of Racial/Ethnic Groups, 2014



Source: 2010-2014 ACS 5-year estimates

Each of the regions are similar in that they have large portions of Irish, Italian, English, and French residents. However, it is evident that a distinguishing feature of the SouthCoastal New England regions is the presence of a large portion of Portuguese residents. Breaking the SouthCoastal New England region into the Rhode Island and Massachusetts halves, reveals that both sides have a much higher proportion of Portuguese and Cape Verdean residents than for the Massachusetts remainder. For most of the remaining ancestries, the Providence-Cranston WIA seems to be distributed more like Massachusetts as a whole than the other regions. While the exact reason for this is not clear, the fact that almost half of the people living within the Providence-Cranston WIA reported "Other" is likely a contributing factor. This may coincide with the fact that the Providence-Cranston WIA population is much more diverse than any of the other regions.

Figure 20 Ancestry, 2014

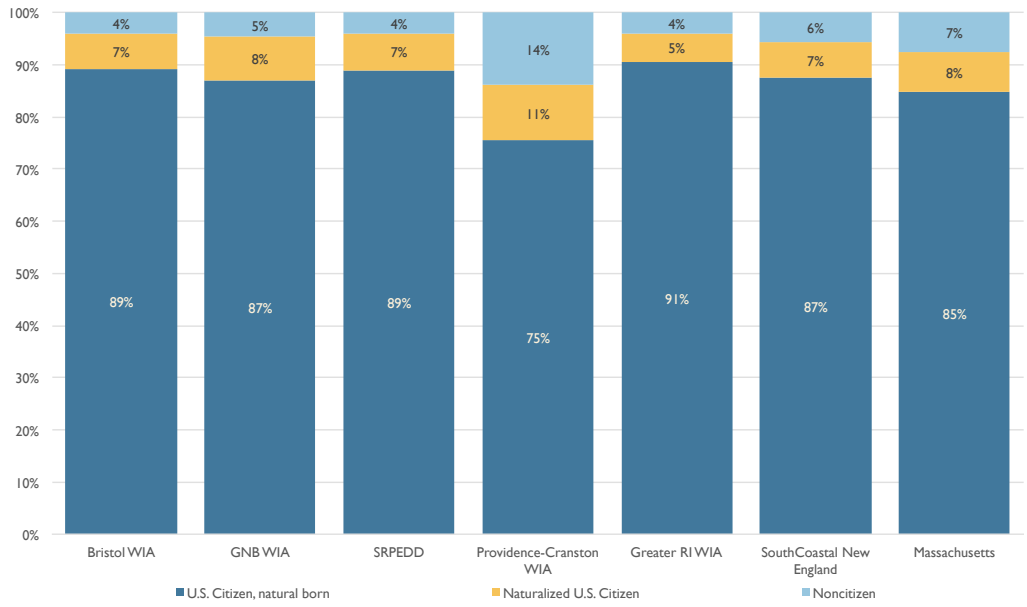
	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Massachusetts
American	3%	3%	3%	2%	3%	3%	4%
English	10%	10%	10%	5%	10%	10%	9%
French (except Basque)	10%	9%	9%	4%	10%	9%	6%
French Canadian	4%	4%	4%	2%	5%	4%	3%
German	4%	3%	4%	3%	5%	4%	6%
Irish	18%	13%	17%	10%	17%	16%	20%
Italian	9%	6%	8%	16%	16%	8%	12%
Polish	3%	3%	3%	2%	4%	3%	4%
Portuguese	22%	26%	22%	4%	9%	21%	4%
Scottish	2%	1%	2%	1%	2%	2%	2%
Swedish	1%	1%	1%	1%	2%	1%	2%
Cape Verdean	1%	5%	2%	2%	2%	2%	1%
Other Group Reported	14%	15%	14%	47%	16%	16%	27%
Total Reported	330,247	195,652	564,999	237,996	724,564	560,208	6,005,221

Source: 2010-2014 ACS 5-year estimates

5.1.4 Nativity and Citizenship

The majority of the populations are natural born U.S. citizens. Again, the Providence-Cranston WIA has a slightly larger portion of residents that are naturalized U.S. citizens or noncitizens, but once more this is likely due to the fact that the region is made up of just two urban communities.

Figure 21 Nativity/Citizenship, 2014

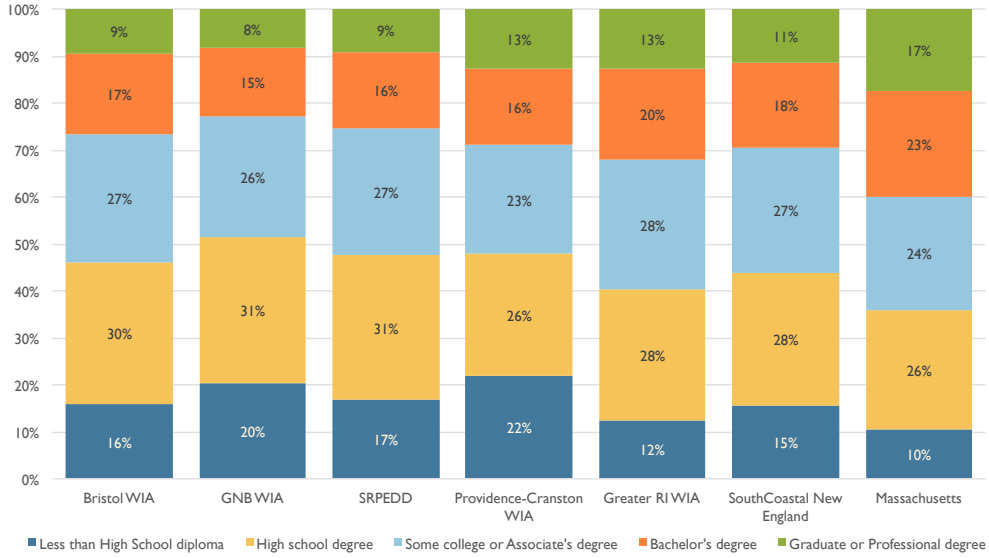


Source: 2010-2014 ACS 5-year estimates

5.1.5 Educational Attainment

The educational attainment levels are similar in each region as well. Massachusetts as a whole has the largest percentages of people with high levels of educational attainment. For instance, in comparison to the other regions, Massachusetts as a whole has a much larger portion of people with a graduate or professional degree.

Figure 22 Educational Attainment, 2014



Source: 2010-2014 ACS 5-year estimates

This gap between Massachusetts' educational attainment levels and the SouthCoastal New England region is more obvious when we view the education levels of the sub-regions as a percent of that of Massachusetts as a whole. (See Table 14.) All of the sub-regions have a considerably smaller portion of people with college experience than the state as a whole. Correspondingly, each sub-region has a substantially larger portion of people with no college experience than the state as a whole.

Table 14 Educational Attainment as a Percent of Massachusetts' Educational Attainment, 2014

	College Experience	No College Experience
Bristol WIA	84%	128%
GNB WIA	79%	137%
SRPEDD	82%	132%
Providence- Cranston WIA	81%	133%
Greater RI WIA	93%	112%
SouthCoastal New England	88%	122%
Massachusetts	100%	100%

Source: 2010-2014 ACS 5-year estimates

5.2 SOCIO-ECONOMIC INDICATORS

5.2.1 Per Capita Income

The per capita income within each of the regions we analyzed is below that of the entire state of Massachusetts.[22] This has been the case consistently over the years, since at least 2000.

Table 15 Per Capita Income, 2000-2014

	2000	2009	2014	% Change 2000 to 2009	% Change 2009 to 2014
Bristol WIA	$29,417.80	$28,468.09	$30,138.11	-3.2%	5.9%
Greater New Bedford WIA	$27,215.02	$29,145.88	$27,732.99	7.1%	-4.8%
SRPEDD Region	$29,882.90	$30,565.89	$29,619.28	2.3%	-3.1%
Providence-Cranston WIA	$24,124.15	$25,349.46	$24,399.40	5.1%	-3.7%
Greater RI WIA	$31,621.04	$33,567.71	$32,843.38	6.2%	-2.2%
SouthCoastal New England	$33,298.27	$32,974.15	$30,198.40	-1.0%	-8.4%
Massachusetts	$35,678.12	$36,922.24	$36,441.00	3.0%	-1.0%

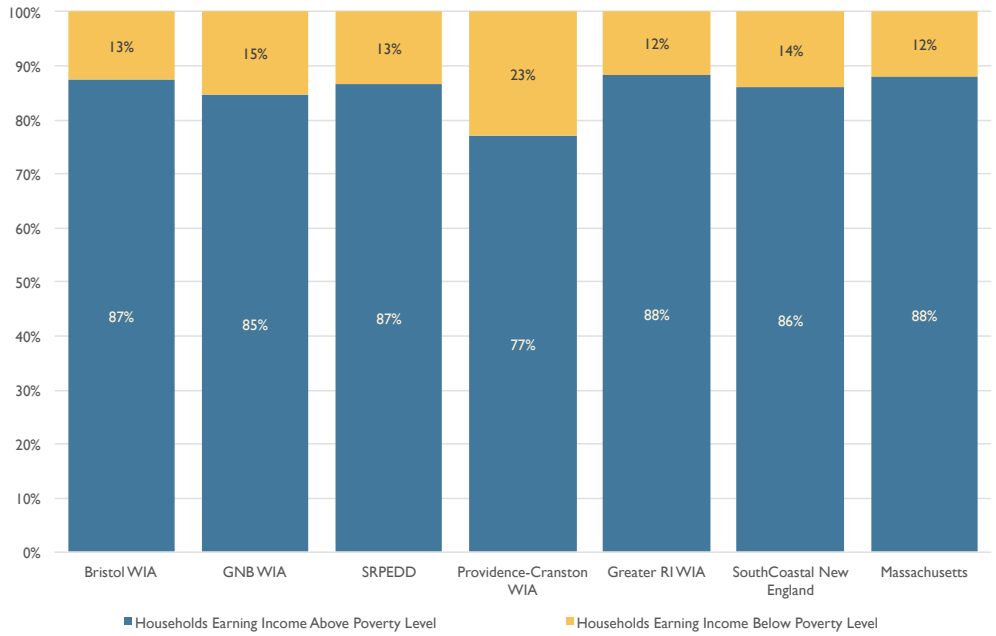
Source: 2000 Census, 2005-2009 ACS 5-year estimates, 2010-2014 ACS 5-year estimates

[22] All per capita income values were adjusted for inflation to 2014.

5.2.2 Household Poverty

The percentage of people who earn income above and below the poverty level are also similar within each region.

Figure 23 Poverty by Household, 2014

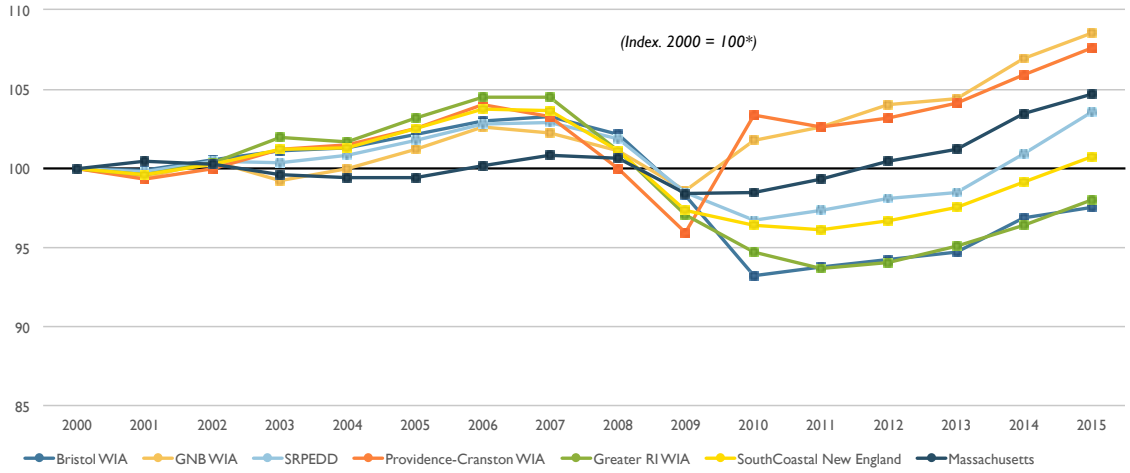


Source: 2010-2014 ACS 5-year estimates

5.2.3 Total Employment

Figure 8 displays the trends in employment within the regions from 2000 to 2016. Each each of the regions followed a similar pattern; between 2000 and 2010 all of the regions declined in terms of total employment. Then, after 2010, the employment trends in each region reversed, with total employment increasing in every region. The Greater New Bedford WIA, SRPEDD, Providence-Cranston WIA, SouthCoastal New England, and Massachusetts employment levels all exceeded 2000 levels by 2015, while the Bristol WIA and the Greater Rhode Island WIA have not yet fully recovered.

Figure 24 Total Employment, 2000-2015, Indexed to 2000 Levels

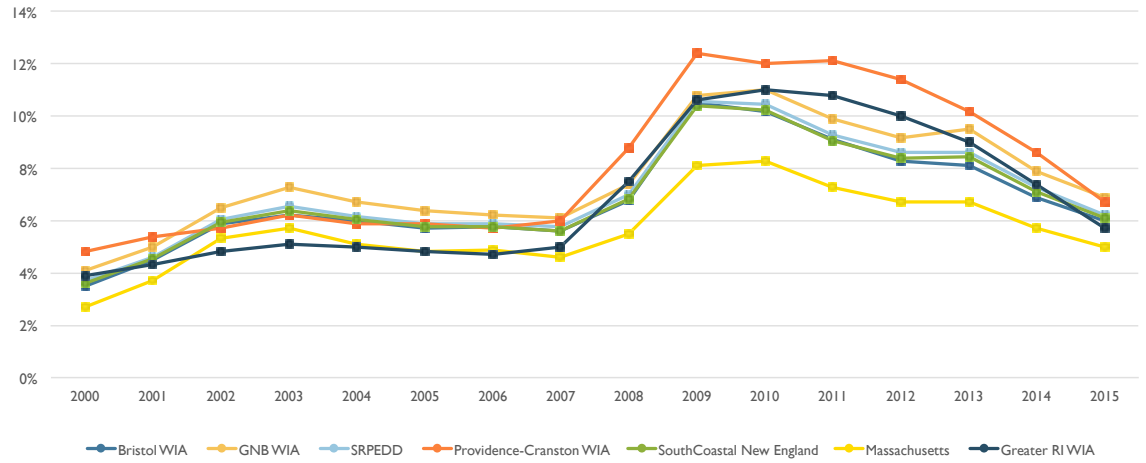


Source: Massachusetts Executive Office of Labor and Workforce Development, Local Area Unemployment Statistics (LAUS), not seasonally adjusted.

5.2.4 Unemployment Rate

The Unemployment rate for Massachusetts was lower than the other regions examined for most of the period from 2000 to 2015. The Providence-Cranston WIA was hit the hardest by the Great Recession, but is now on par with neighboring regions.

Figure 25 Unemployment Rates, 2000-2015



Source: Massachusetts Executive Office of Labor and Workforce Development, Local Area Unemployment Statistics (LAUS), not seasonally adjusted.

5.3 INDUSTRIES AND OCCUPATIONS

5.3.1 Industry Cluster Analysis

Industry clusters are "geographic concentrations of interconnected companies and institutions in a particular field."[23] The presence of a large number of employers within a particular cluster indicates a regional specialization in that field. While there are many different NAICS-based cluster definitions, for the purpose of this project, we selected the industry cluster definitions used in the *Rhode Island Innovates* report, by Batelle Technology Partnership, to enable cross-border conversation.[24] We also incorporated an industry cluster, not defined by Batelle, that includes energy production, distribution, and storage.[25] The original set of industry cluster definitions were created by examining "the full suite of 6-digit NAICS industries in Rhode Island using specialized clustering algorithms incorporating variables related to shared markets, defined supply chains, and/or shared bodies of knowledge (such as in biosciences, materials or information technology)." An emphasis was placed on traded clusters, to highlight those industries that bring new wealth into a region.

Industry data was examined to determine industry cluster size, percent growth, specialization (location quotient), and occupational composition. After analyzing each of the sub-regions of southeastern Massachusetts and Rhode Island, and Massachusetts as a whole, we found that southeastern Massachusetts and Rhode Island are more similar to each other than to Massachusetts as a whole. This is not surprising, given that the industrial similarity was a key criterion in defining the region.

[23] Porter, Michael. "Clusters and the New Economics of Competition," *The Harvard Business Review.* November-December, 1998

[24] *Rhode Island Innovates: A Competitive Strategy for the Ocean State.* Prepared by Battelle Technology Partnership in association with the Metropolitan Policy Program at Brookings, January 2016. These cluster definitions were adjusted to add Energy Production, Distribution & Storage and to correct for double counting. Results may also differ because different data sources were used.

[25] See appendices for detailed description of each of the industry clusters by NAIC codes.

5.3.2 Industry Cluster Size

Table 16 shows the number of jobs in 2015 within each of the *Rhode Island Innovates*[26] clusters by region. The top five largest clusters by job number in each region is consistent across Massachusetts and Rhode Island. The Arts, Hospitality and Tourism, Hospitals and Healthcare Centers, Colleges and Universities, Finance and Insurance, and Wholesale Distribution clusters are the largest clusters in each region.

Table 16 Industry Cluster Employment, 2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Remainder of MA
Arts, Hospitality, & Tourism	8201	4551	13771	10352	23738	46345	198212
Colleges & Universities	2634	1658	4309	14973	10597	31800	199858
Computer Systems & Software	1207	135	1382	2499	4143	8036	101600
Corporate Headquarters/Managing Offices	2575	827	3440	4144	8072	15687	60592
Data Processing, Facilities, & Internet	103	8	113	1860	918	2887	16373
Design Services	123	71	202	259	342	865	4364
Displays	109	83	197	227	708	1140	1731
Electronics	1052	303	1364	144	576	2205	14527
Energy Production,Distribution, & Storage	552	64	619	114	385	2007	3856
Fabricated Metal Products	1447	566	2251	861	3848	6652	23429
Finance & Insurance	3273	1566	5634	9441	15364	29411	164055
Freight Transportation	1021	689	1786	610	1952	4399	16172
Furniture	79	45	124	105	652	867	2159
Glass and Stone Products	186	37	251	51	308	686	2847
Hospitals & Healthcare Centers	8434	3367	11854	16657	11932	39840	208567
Industrial Machinery Mfg	260	47	542	313	1161	1931	7333
Instruments	312	332	682	485	1645	2771	15669
Jewelry	1176	3	1232	1050	2630	4914	376
Logistics Support Srcs	569	86	699	184	1148	2037	6632
Metals Refining & Metalworking	334	186	542	686	759	1973	1234
Packaging	672	62	773	64	1653	2405	7133
Perishable Foods Mfg & Processing	1264	1279	2554	790	2357	5612	20533
Pharmaceutical	18	1	19	244	1140	1403	10677
Plastic Laminate and Films Mfg	101	804	916	220	1969	3056	8909
Primary & Secondary Textile Mills	915	638	1553	68	2632	3922	3953
R&D and Medical Labs	914	348	1263	461	845	2554	52700
Ship Building	273	57	331	62	4682	5074	435
Specialty Chemicals & Resins Mfg	113	220	344	98	1332	1777	4090
Surgical & Medical Device Mfg	1871	608	2567	668	958	4283	12490
Toy & Novelty Goods	79	1613	1701	149	414	2257	3644
Warehousing	1712	602	2357	238	1042	3635	7527
Wholesale Distribution	8027	2993	11637	4401	10732	26697	102546
Wiring & Related Products	1815	71	1886	174	400	2471	2529
All Indsutry Clusters	**51,422**	**23,922**	**78,895**	**72,653**	**121,034**	**271,603**	**1,286,753**
All Indsutries	**143,010**	**82,776**	**251,431**	**148,754**	**306,511**	**672,000**	**3,480,700**
	Number of Jobs						

Source: EMSI- Industry Group Comparison-Largest Industries–2015

5.3.3 Industry Cluster Location Quotient

Unlike raw employment numbers, the location quotient (LQ), which measures the concentration of jobs in a particular industry relative to a reference region, controls for region size, giving a sense of area specialization. In this case, LQs were measured in relation to the U.S. total. SouthCoastal New England is much more specialized[27] than the Massachusetts remainder in the following industries. In all of these industries, the employment is also more concentrated than at the national level.

- Jewelry,
- Ship Building,
- Wiring & Related Products,
- Primary & Secondary Textile Mills,
- Metals Refining & Metalworking
- Toy & Novelty Goods

[26] It should be noted that the industry clusters do not account for all jobs in all sectors. These clusters emphasize those industries that bring in wealth from outside the region.
[27] Difference in LQ greater than 0.5.

- Displays, Specialty Chemicals, & Resins Manufacturing,
- Surgical & Medical Device Manufacturing,
- Energy Production, Distribution, & Storage, and
- Plastic Laminates & Films Manufacturing.

The SouthCoastal New England region has a much lower concentration[28] than the Massachusetts remainder in Data Processing, Facilities, & Internet, Electronics, Colleges & Universities, Instruments, Pharmaceutical, Computer Systems & Software, R&D and Medical Labs. However, among these, the region still has a higher employment concentration than the nation in Data Processing, Facilities, & Internet, Colleges & Universities, Instruments, and Pharmaceuticals. The following industries are those the region is less concentrated in than both the U.S. and the Massachusetts remainder:

- Electronics,
- Computer Systems & Software, and
- R&D and Medical Labs.

Interestingly, the SouthCoastal New England region is more diversified than the Massachusetts remainder, with above average employment in more of the *Rhode Island Innovates* clusters (22 versus 15). In fact, this region specializes in more industries than any of the sub-regions, providing an instance of the whole being greater than the sum of the parts. However, many of these are industries that have been in long-term decline, such as Jewelry and Textiles. In addition, in each of the sub-regions, most of the industries that are highly concentrated are not particularly large in terms of absolute employment size. (See Table 16 and Table 17.)

Table 17 Industry Cluster Location Quotient, 2015

Industry Cluster Location Quotient, 2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Remainder of MA
Arts, Hospitality, & Tourism	0.93	0.95	0.95	1.19	1.24	1.11	1.04
Colleges & Universities	0.49	0.56	0.48	2.78	0.90	1.24	1.70
Computer Systems & Software	0.51	0.11	0.36	1.07	0.81	0.72	2.00
Corporate Headquarters/Managing Offices	1.14	0.67	0.92	1.84	1.64	1.46	1.24
Data Processing, Facilities, & Internet	0.18	0.02	0.12	3.27	0.74	1.06	1.32
Design Services	0.66	0.70	0.66	1.41	0.85	0.98	1.09
Displays	0.82	1.16	0.90	1.73	2.46	1.81	0.60
Electronics	2.19	1.17	1.72	0.30	0.55	0.97	1.40
Energy Production,Distribution, & Storage	1.82	0.39	1.24	0.38	0.59	1.39	0.59
Fabricated Metal Products	1.26	0.91	1.19	0.75	1.54	1.22	0.94
Finance & Insurance	0.53	0.47	0.55	1.54	1.14	1.00	1.23
Freight Transportation	0.58	0.72	0.61	0.35	0.51	0.52	0.42
Furniture	0.30	0.31	0.28	0.40	1.14	0.69	0.38
Glass and Stone Products	0.86	0.32	0.70	0.24	0.65	0.67	0.61
Hospitals & Healthcare Centers	1.23	0.91	1.05	2.45	0.80	1.23	1.41
Industrial Machinery Mfg	0.80	0.27	1.01	0.97	1.65	1.26	1.05
Instruments	1.25	2.44	1.65	1.95	3.03	2.33	2.89
Jewelry	30.43	0.13	19.35	27.40	31.37	26.79	0.45
Logistics Support Srcs	1.01	0.28	0.75	0.33	0.94	0.76	0.54
Metals Refining & Metalworking	1.86	1.91	1.83	3.85	1.95	2.31	0.32
Packaging	1.59	0.27	1.11	0.15	1.80	1.20	0.78
Perishable Foods Mfg & Processing	1.50	2.81	1.85	0.95	1.29	1.41	1.13
Pharmaceutical	0.06	0.01	0.04	0.84	1.79	1.01	1.68
Plastic Laminate and Films Mfg	0.23	3.38	1.27	0.51	2.07	1.47	0.94
Primary & Secondary Textile Mills	3.68	4.73	3.79	0.27	4.88	3.32	0.74
R&D and Medical Labs	1.10	0.78	0.93	0.56	0.47	0.65	2.94
Ship Building	1.34	0.52	0.99	0.31	10.62	5.26	0.10
Specialty Chemicals & Resins Mfg	0.56	2.01	1.04	0.49	3.05	1.86	0.94
Surgical & Medical Device Mfg	4.81	2.89	4.01	1.73	1.14	2.32	1.49
Toy & Novelty Goods	0.45	17.02	5.91	0.86	1.09	2.72	0.97
Warehousing	2.06	1.34	1.72	0.29	0.58	0.92	0.42
Wholesale Distribution	1.29	0.89	1.13	0.71	0.79	0.90	0.76
Wiring & Related Products	13.50	0.97	8.51	1.30	1.37	3.87	0.87
	Location Quotient						

Source: EMSI Industry Group Comparison-Industry Group Location Quotient, 2015

[28] Difference greater than 0.25.

5.3.4 Industry Cluster Growth

The clusters Arts, Hospitality, & Tourism, Colleges & Universities, Computer Systems & Software, Hospitals & Healthcare Centers, and Logistics Support Services grew in every sub-region (not including the Massachusetts remainder) from 2001 to 2015. These industries also grew in the five years from 2010-2015 in every sub-region except the Greater Rhode Island WIA. With the exception of Logistic Support Services, these are also some of the largest industry clusters, in terms of total employment. Once again excluding Logistic Support Services, these industries tend to be clustered in major cities and job centers. Thus, high LQs indicating regional specializations are mostly limited to the Providence-Cranston WIA and the remainder of Massachusetts.

From 2010 to 2015, SouthCoastal New England outperformed[29] the remainder of Massachusetts in terms of percentage growth in the following eight industries. Collectively, these industries added 6,294 jobs to the SouthCoastal New England economy.

- Corporate Headquarters/Managing Offices,
- Energy Production, Distribution, & Storage,
- Industrial Machinery Manufacturing,
- Logistics Support Services,
- Plastic Laminate & Film Manufacturing,
- Ship Building,
- Specialty Chemicals & Resins, and
- Surgical & Medical Device Manufacturing.

Growth in Corporate Headquarters/Managing Offices is driven entirely by growth on Rhode Island side of the border, where the two job centers, Providence and Warwick, are located. Growth in Surgical & Medical Device Manufacturing is mostly occurring on the Massachusetts side of the border. For the remaining industries, job growth is distributed on both sides of the SouthCoastal New England region. Growth in five of these eight industries—Energy Production, Distribution, & Storage, Industrial Machinery Manufacturing, Plastic Laminate & Films Manufacturing, Specialty Chemicals & Resins, and Surgical & Medical Devices clusters—is counter-weighted by job losses during the previous five years, and has not yet returned to the previous high. This leaves just Corporate Headquarters/Managing Offices, Logistics Support Services, and Ship Building that have been on an upward trend since 2001. That said, for some of the industries that have catching up to do, such as Energy, there are reasons to expect additional growth in the future.

The following industries have experienced persistent job losses in both the SouthCoastal New England region and the Massachusetts remainder. Collectively, these industries shrank by 1,277 jobs from 2001 to 2015 within SouthCoastal New England.

- Electronics,
- Furniture,
- Metals Refining & Metalworking,
- Packaging,
- Primary & Secondary Textile Mills, and
- Toy & Novelty Goods.

[29] Defined as positive growth in SouthCoastal New England and percentage point difference greater than 5 percent.

Table 18 Industry Cluster Employment Percent Growth, 2010-2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Remainder of MA
Arts, Hospitality, & Tourism	13%	12%	12%	18%	12%	14%	13%
Colleges & Universities	15%	42%	25%	17%	-5%	9%	16%
Computer Systems & Software	17%	51%	20%	29%	10%	17%	33%
Corporate Headquarters/Managing Offices	-8%	0%	-6%	49%	25%	21%	14%
Data Processing, Facilities, & Internet	5%	-46%	-3%	-8%	-11%	-9%	25%
Design Services	0%	-15%	-4%	2%	-5%	-3%	4%
Displays	-10%	-2%	-6%	9%	18%	11%	20%
Electronics	-13%	-21%	-15%	-41%	10%	-12%	-17%
Energy Production,Distribution, & Storage	28%	9%	25%	60%	166%	49%	-34%
Fabricated Metal Products	-1%	14%	6%	5%	-5%	-2%	9%
Finance & Insurance	-5%	-4%	-5%	5%	4%	2%	0%
Freight Transportation	7%	7%	7%	12%	9%	8%	9%
Furniture	-11%	-20%	-15%	42%	-8%	-5%	-13%
Glass and Stone Products	24%	53%	37%	-27%	-10%	9%	12%
Hospitals & Healthcare Centers	-5%	6%	-2%	-3%	1%	-2%	6%
Industrial Machinery Mfg	-5%	47%	20%	4%	13%	14%	-2%
Instruments	-15%	-15%	-14%	14%	-22%	-15%	8%
Jewelry	6%	6%	7%	-16%	-18%	-12%	17%
Logistics Support Srcs	52%	44%	40%	52%	0%	16%	7%
Metals Refining & Metalworking	-49%	2%	-39%	9%	5%	-11%	-26%
Packaging	-19%	103%	-12%	-62%	13%	-2%	-6%
Perishable Foods Mfg & Processing	-3%	-6%	-4%	1%	6%	-1%	11%
Pharmaceutical	-43%	-89%	-56%	684%	-13%	1%	12%
Plastic Laminate and Films Mfg	66%	49%	49%	5%	1%	15%	2%
Primary & Secondary Textile Mills	-20%	-4%	-14%	-9%	-3%	-8%	-4%
R&D and Medical Labs	-7%	6%	-4%	1%	24%	5%	14%
Ship Building	33%	-13%	22%	9%	46%	44%	-20%
Specialty Chemicals & Resins Mfg	30%	34%	32%	42%	14%	16%	-9%
Surgical & Medical Device Mfg	13%	12%	11%	2%	-9%	5%	-10%
Toy & Novelty Goods	-56%	-15%	-19%	-8%	-15%	-18%	-7%
Warehousing	7%	-9%	3%	20%	16%	7%	12%
Wholesale Distribution	-2%	-12%	-4%	18%	4%	2%	0%
Wiring & Related Products	1%	-44%	-2%	1%	-45%	-14%	42%
	% Job Growth (2010-2015)						

Industry Cluster with Negative Job Growth

Industry Cluster with Positive Job Growth

Source: EMSI- Industry Group Comparison-Fastest Grwing Industries– 2010- 2015

Table 19 Industry Cluster Employment Percent Growth, 2001-2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Remainder of MA
Arts, Hospitality, & Tourism	18%	22%	21%	31%	17%	20%	21%
Colleges & Universities	50%	159%	69%	51%	16%	30%	25%
Computer Systems & Software	130%	58%	117%	77%	17%	49%	19%
Corporate Headquarters/Managing Offices	4%	-13%	-1%	97%	83%	61%	-10%
Data Processing, Facilities, & Internet	108%	-46%	68%	27%	27%	29%	8%
Design Services	15%	15%	16%	-23%	-20%	-6%	-7%
Displays	-39%	20%	-22%	-17%	-9%	-11%	-17%
Electronics	-39%	-52%	-43%	-67%	-69%	-56%	-53%
Energy Production,Distribution, & Storage	-6%	-96%	-74%	-34%	-61%	-50%	-53%
Fabricated Metal Products	-22%	-24%	-17%	-49%	-44%	-41%	-21%
Finance & Insurance	-10%	4%	-5%	-5%	1%	-1%	-10%
Freight Transportation	8%	38%	16%	-13%	-17%	-1%	-10%
Furniture	-25%	-65%	-47%	-40%	-13%	-24%	-45%
Glass and Stone Products	37%	58%	43%	-31%	-52%	-27%	-40%
Hospitals & Healthcare Centers	11%	18%	13%	10%	3%	10%	32%
Industrial Machinery Mfg	-33%	-75%	-23%	-28%	-36%	-30%	-45%
Instruments	-41%	-9%	-25%	-18%	-31%	-30%	-12%
Jewelry	-58%	-85%	-58%	-61%	-63%	-62%	-16%
Logistics Support Srcs	66%	64%	58%	55%	33%	56%	-7%
Metals Refining & Metalworking	-80%	-60%	-75%	-48%	-10%	-54%	-66%
Packaging	-33%	-14%	-30%	165%	-34%	-27%	-43%
Perishable Foods Mfg & Processing	-9%	20%	4%	-4%	9%	7%	20%
Pharmaceutical	-61%	0%	-58%	284%	153%	147%	37%
Plastic Laminate and Films Mfg	2%	77%	60%	-56%	-28%	-13%	-41%
Primary & Secondary Textile Mills	-81%	-53%	-74%	-72%	-55%	-66%	-56%
R&D and Medical Labs	-3%	1%	-2%	38%	36%	15%	72%
Ship Building	87%	-46%	32%	1240%	40%	47%	-49%
Specialty Chemicals & Resins Mfg	-71%	-35%	-53%	-72%	-24%	-40%	-16%
Surgical & Medical Device Mfg	-22%	26%	-16%	-17%	46%	-8%	-18%
Toy & Novelty Goods	-79%	-27%	-35%	-67%	-66%	-46%	-55%
Warehousing	155%	-51%	23%	26%	32%	28%	-5%
Wholesale Distribution	-4%	-12%	-11%	1%	1%	-3%	-18%
Wiring & Related Products	7%	-81%	-8%	-57%	-66%	-35%	-56%
	% Job Growth (2001-2015)						

Industry Cluster with Negative Job Growth Industry Cluster with Positive Job Growth

Source: EMSI- Industry Group Comparison-Fastest Growing Industries, 2001-2015

5.4 OCCUPATIONS

5.4.1 Largest Occupational Groups

The comparison regions are all very similar in terms of occupational makeup. A significant portion of each region's jobs are in Office & Administrative Support, Sales, Food Preparation & Serving, Production (manufacturing), Education & Training, and Healthcare occupations.

The two-sides of the economic region offer many complementarities, with weaknesses in one being offset by strengths in another, resulting in an economic region that has a similar occupational profile to the Massachusetts remainder. For example, the Providence-Cranston WIA has a higher proportion of people in Business & Financial and Computer & Mathematical occupations than the Massachusetts sub-regions, which is consistent with the presence and absence of job centers. Conversely, the sub-regions on the Massachusetts side of the region have a higher proportion of people in Management, Sales, and Transportation occupations.

However, there are some distinctive ways in which the economic region is different from the Massachusetts remainder. These are a low proportion of jobs in Life, Physical, & Social Science occupations on the one hand, and a higher proportion of jobs in Production occupations on the other. This difference is true for both sides of the border, indicating a regional economy that is still in the process of transitioning to the knowledge-based economy and is more reliant on manufacturing jobs.

Table 20 Occupational Employment as a Percent of Total Employment, 2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	Economic Region	Massachusetts
Architecture & Engineering Occupations	1.6%	1.5%	1.6%	1.3%	1.6%	1.5%	2.1%
Arts, Design, Entertain., Sports,& Media Occupations	1.3%	1.4%	1.4%	1.8%	1.6%	1.6%	1.9%
Building/ Grounds Cleaning & Maintenance Occupations	2.8%	2.7%	2.8%	3.3%	4.0%	3.5%	3.8%
Business & Financial Operations Occupations	3.8%	3.4%	3.8%	5.1%	4.9%	4.6%	5.6%
Community & Social Service Occupations	3.0%	2.5%	2.8%	2.2%	1.9%	2.3%	2.4%
Computer & Mathematical Occupations	1.7%	1.2%	1.5%	3.2%	2.5%	2.4%	3.7%
Construction & Extraction Occupations	4.4%	4.4%	4.6%	2.6%	4.7%	4.2%	3.9%
Education, Training, & Library Occupations	5.4%	6.6%	6.1%	6.5%	6.2%	6.2%	6.4%
Farming, Fishing, & Forestry Occupations	0.2%	1.2%	0.5%	0.1%	0.3%	0.3%	0.2%
Food Preparation &Serving Related Occupations	8.8%	9.7%	9.3%	9.1%	9.8%	9.3%	7.9%
Healthcare Practitioners & Technical Occupations	6.0%	6.1%	5.8%	8.8%	5.0%	6.0%	6.5%
Healthcare Support Occupations	3.1%	3.9%	3.3%	4.8%	3.9%	3.9%	3.0%
Installation, Maintenance, & Repair Occupations	3.5%	3.2%	3.4%	2.6%	3.5%	3.3%	3.0%
Legal Occupations	0.7%	0.6%	0.6%	1.3%	0.8%	0.9%	1.0%
Life, Physical, & Social Science Occupations	0.7%	0.8%	0.8%	0.6%	0.6%	0.7%	1.4%
Management Occupations	6.3%	6.1%	6.3%	4.8%	4.7%	5.3%	7.3%
Military Occupations	0.6%	0.6%	0.6%	0.9%	1.6%	1.1%	0.5%
Office & Administrative Support Occupations	13.6%	12.5%	13.2%	17.9%	15.0%	15.0%	14.6%
Personal Care & Service Occupations	4.3%	5.2%	4.6%	3.4%	3.4%	3.8%	4.1%
Production Occupations	6.7%	7.6%	6.9%	4.4%	6.4%	6.2%	4.4%
Protective Service Occupations	2.4%	1.4%	2.1%	2.3%	2.7%	2.3%	2.2%
Sales & Related Occupations	12.3%	10.6%	11.6%	8.6%	9.8%	10.1%	9.2%
Transportation & Material Moving Occupations	6.6%	6.6%	6.5%	4.4%	5.1%	5.4%	4.8%
All Occupations	163,177	88,326	268,371	163,601	360,397	782,357	3,823,141
	Total Number of Jobs						

Source: EMSI Highest Ranking Occupations-Largest Occupations, 2015

5.4.2 Occupational Group Growth

Table 21 shows the job growth within each of the occupation groups as a percent of total job growth from 2010 to 2015 in each region. The occupations related to Office And Administrative Support, Sales, Food Preparation & Serving, Production, Education & Training, and Healthcare grew considerably between 2010 and 2015. Interestingly, most of the growth in Healthcare Occupations is limited to regions in Massachusetts. Occupations related to Business & Financial Operations and Transportation & Material Moving grew across all regions during this time. Farming, Fishing, & Forestry occupations decreased in almost every region and Military, Legal, and Life, Physical, & Social Science occupations remained stagnant.

Table 21 Percent Change in Occupational Employment, 2010-2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	SouthCoastal New England	Massachusetts
Architecture & Engineering Occupations	1.7%	1.5%	1.6%	1.3%	1.2%	1.4%	1.2%
Arts, Design, Entertain., Sports,& Media Occupations	0.3%	1.3%	1.0%	-0.7%	-2.8%	-0.9%	2.0%
Building/ Grounds Cleaning & Maintenance Occupations	-6.2%	-3.6%	-4.4%	5.6%	7.7%	2.5%	2.0%
Business & Financial Operations Occupations	5.9%	4.7%	5.3%	5.3%	5.7%	5.7%	6.2%
Community & Social Service Occupations	10.4%	9.1%	9.1%	-1.1%	0.9%	3.4%	5.7%
Computer & Mathematical Occupations	1.7%	1.3%	1.5%	7.1%	5.2%	4.5%	6.6%
Construction & Extraction Occupations	13.3%	9.0%	11.0%	2.0%	3.5%	6.3%	6.3%
Education, Training, & Library Occupations	6.2%	6.4%	6.3%	2.8%	-0.7%	3.0%	6.9%
Farming, Fishing, & Forestry Occupations	-0.1%	-2.3%	-0.9%	0.1%	-0.3%	-0.5%	0.3%
Food Preparation &Serving Related Occupations	13.4%	10.7%	12.6%	16.4%	22.9%	17.1%	11.3%
Healthcare Practitioners & Technical Occupations	-0.2%	6.5%	2.4%	0.1%	0.4%	1.0%	5.6%
Healthcare Support Occupations	8.2%	12.0%	9.0%	3.9%	4.8%	6.1%	5.6%
Installation, Maintenance, & Repair Occupations	6.0%	3.1%	4.8%	4.0%	6.3%	5.2%	3.1%
Legal Occupations	0.6%	0.1%	0.3%	0.1%	1.1%	0.6%	-0.2%
Life, Physical, & Social Science Occupations	-0.1%	0.5%	0.1%	0.1%	0.5%	0.3%	1.4%
Management Occupations	8.4%	8.0%	8.2%	3.3%	4.8%	5.7%	9.4%
Military Occupations	0.0%	0.0%	0.0%	0.7%	0.0%	0.2%	0.0%
Office & Administrative Support Occupations	6.5%	7.9%	7.4%	28.0%	13.7%	15.3%	9.9%
Personal Care & Service Occupations	6.7%	12.6%	8.6%	3.1%	4.1%	5.1%	6.1%
Production Occupations	-1.7%	5.1%	2.1%	1.4%	4.1%	2.4%	0.5%
Protective Service Occupations	4.4%	2.8%	3.5%	2.4%	2.5%	2.9%	1.6%
Sales & Related Occupations	0.9%	-3.8%	-0.1%	5.1%	7.3%	3.7%	2.8%
Transportation & Material Moving Occupations	13.8%	7.3%	10.6%	9.0%	7.1%	8.9%	5.6%
All Occupations	7,846	5,865	15,167	11,391	15,459	41,310	302,605
	Job Growth (2010-2015)						

Greater Than 5% | Less Than 5% | Negative Growth

Source: EMSI Industry Comparison– Fastest Growing Occupations, 2010-2015

5.4.3 Average Hourly Wages by Occupation

Table 22 shows the average hourly wage of each of the occupational groups. Management occupations offer the highest wages of any category, and are growing in every region. With the exception of Legal occupations, all of the occupations offering over $25 dollars per hour are growing in most regions. Unfortunately, the occupations experiencing the fastest growth—Office & Administrative Support and Food Preparation & Serving—are not generally well paid. However, these occupations provided a much needed source of employment for those with limited education.

Table 22 Average Hourly Wage by Occupational Group, 2015

	Bristol WIA	GNB WIA	SRPEDD	Providence-Cranston WIA	Greater RI WIA	Economic Region	Massachusetts
Architecture and Engineering Occupations	$36.32	$36.00	$36.23	$38.87	$39.80	$38.40	$40.72
Arts, Design, Entertainment, Sports, and Media Occupations	$20.60	$21.48	$20.85	$22.48	$20.93	$21.26	$23.31
Building and Grounds Cleaning and Maintenance Occupations	$13.93	$14.14	$14.08	$12.01	$12.48	$12.84	$15.20
Business and Financial Operations Occupations	$31.24	$31.10	$31.28	$33.74	$32.77	$32.58	$35.76
Community and Social Service Occupations	$18.22	$18.60	$18.38	$22.32	$21.35	$20.29	$20.23
Computer and Mathematical Occupations	$37.98	$37.83	$37.99	$37.97	$37.31	$37.66	$44.55
Construction and Extraction Occupations	$21.90	$22.39	$22.26	$20.53	$20.37	$21.11	$24.62
Education, Training, and Library Occupations	$25.29	$25.35	$25.38	$29.70	$27.50	$27.34	$28.09
Farming, Fishing, and Forestry Occupations	$14.33	$15.34	$15.09	$13.10	$13.58	$14.36	$13.72
Food Preparation and Serving Related Occupations	$10.71	$10.72	$10.72	$10.54	$10.69	$10.67	$11.41
Healthcare Practitioners and Technical Occupations	$37.88	$38.62	$38.16	$42.11	$40.98	$40.48	$42.05
Healthcare Support Occupations	$14.49	$14.29	$14.44	$14.69	$14.31	$14.45	$15.65
Installation, Maintenance, and Repair Occupations	$21.61	$21.52	$21.69	$21.64	$21.47	$21.62	$23.98
Legal Occupations	$43.75	$42.15	$43.51	$41.39	$39.92	$41.27	$47.69
Life, Physical, and Social Science Occupations	$30.36	$29.96	$30.25	$33.10	$32.52	$31.72	$34.15
Management Occupations	$45.51	$43.44	$44.72	$52.45	$49.16	$48.01	$50.60
Military occupations	$19.61	$19.61	$19.61	$23.98	$26.58	$24.92	$21.76
Office and Administrative Support Occupations	$17.21	$17.29	$17.28	$18.18	$17.75	$17.73	$19.35
Personal Care and Service Occupations	$12.36	$12.30	$12.40	$11.18	$11.38	$11.74	$13.12
Production Occupations	$17.03	$16.35	$16.82	$15.97	$17.05	$16.88	$18.14
Protective Service Occupations	$24.52	$20.38	$23.84	$17.90	$23.95	$22.63	$23.88
Sales and Related Occupations	$15.66	$15.45	$15.64	$17.47	$17.47	$16.79	$19.17
Transportation and Material Moving Occupations	$15.35	$15.44	$15.44	$14.64	$15.43	$15.29	$16.43

Source: EMSI, 2015

6 APPENDIX I: U.S. CLUSTER MAPPING PROJECT INDUSTRY CLUSTERS

2012 NAICS	Name	Cluster
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Mfg	Aerospace Vehicles and Defense
336411	Aircraft Mfg	Aerospace Vehicles and Defense
336412	Aircraft Engine and Engine Parts Mfg	Aerospace Vehicles and Defense
336413	Other Aircraft Parts and Auxiliary Equipment Mfg	Aerospace Vehicles and Defense
336414	Guided Missile and Space Vehicle Mfg	Aerospace Vehicles and Defense
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Mfg	Aerospace Vehicles and Defense
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Mfg	Aerospace Vehicles and Defense
115111	Cotton Ginning	Agricultural Inputs and Services
115112	Soil Preparation, Planting, and Cultivating	Agricultural Inputs and Services
115113	Crop Harvesting, Primarily by Machine	Agricultural Inputs and Services
115114	Postharvest Crop Activities (except Cotton Ginning)	Agricultural Inputs and Services
115115	Farm Labor Contractors and Crew Leaders	Agricultural Inputs and Services
115116	Farm Management Services	Agricultural Inputs and Services
115210	Support Activities for Animal Production	Agricultural Inputs and Services
325311	Nitrogenous Fertilizer Mfg	Agricultural Inputs and Services
325314	Fertilizer (Mixing Only) Mfg	Agricultural Inputs and Services
325411	Medicinal and Botanical Mfg	Biopharmaceuticals
325412	Pharmaceutical Preparation Mfg	Biopharmaceuticals
325413	In-Vitro Diagnostic Substance Mfg	Biopharmaceuticals
325414	Biological Product (except Diagnostic) Mfg	Biopharmaceuticals
485310	Taxi Service	Business Services
485320	Limousine Service	Business Services
485999	All Other Transit and Ground Passenger Transportation	Business Services
518210	Data Processing, Hosting, and Related Services	Business Services
532112	Passenger Car Leasing	Business Services
533110	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	Business Services
541199	All Other Legal Services	Business Services
541214	Payroll Services	Business Services
541310	Architectural Services	Business Services
541320	Landscape Architectural Services	Business Services
541330	Engineering Services	Business Services
541340	Drafting Services	Business Services
541511	Custom Computer Programming Services	Business Services
541512	Computer Systems Design Services	Business Services
541513	Computer Facilities Management Services	Business Services
541519	Other Computer Related Services	Business Services
541611	Administrative Management and General Management Consulting Services	Business Services
541612	Human Resources Consulting Services	Business Services
541614	Process, Physical Distribution, and Logistics Consulting Services	Business Services
541618	Other Management Consulting Services	Business Services
541690	Other Scientific and Technical Consulting Services	Business Services
541930	Translation and Interpretation Services	Business Services
541990	All Other Professional, Scientific, and Technical Services	Business Services
551111	Offices of Bank Holding Companies	Business Services
551112	Offices of Other Holding Companies	Business Services
551114	Corporate, Subsidiary, and Regional Managing Offices	Business Services
561210	Facilities Support Services	Business Services
561311	Employment Placement Agencies	Business Services
561312	Executive Search Services	Business Services
561330	Professional Employer Organizations	Business Services
561421	Telephone Answering Services	Business Services
561422	Telemarketing Bureaus and Other Contact Centers	Business Services

561920	Convention and Trade Show Organizers	Business Services
324191	Petroleum Lubricating Oil and Grease Mfg	Downstream Chemical Products
325130	Synthetic Dye and Pigment Mfg	Downstream Chemical Products
325510	Paint and Coating Mfg	Downstream Chemical Products
325520	Adhesive Mfg	Downstream Chemical Products
325611	Soap and Other Detergent Mfg	Downstream Chemical Products
325612	Polish and Other Sanitation Good Mfg	Downstream Chemical Products
325613	Surface Active Agent Mfg	Downstream Chemical Products
325620	Toilet Preparation Mfg	Downstream Chemical Products
325920	Explosives Mfg	Downstream Chemical Products
325991	Custom Compounding of Purchased Resins	Downstream Chemical Products
325992	Photographic Film, Paper, Plate, and Chemical Mfg	Downstream Chemical Products
325998	All Other Miscellaneous Chemical Product and Preparation Mfg	Downstream Chemical Products
332215	Metal Kitchen Cookware, Utensil, Cutlery, and Flatware (except Precious) Mfg	Downstream Metal Products
332216	Saw Blade and Handtool Mfg	Downstream Metal Products
332311	Prefabricated Metal Building and Component Mfg	Downstream Metal Products
332312	Fabricated Structural Metal Mfg	Downstream Metal Products
332321	Metal Window and Door Mfg	Downstream Metal Products
332323	Ornamental and Architectural Metal Work Mfg	Downstream Metal Products
332431	Metal Can Mfg	Downstream Metal Products
332439	Other Metal Container Mfg	Downstream Metal Products
332510	Hardware Mfg	Downstream Metal Products
332992	Small Arms Ammunition Mfg	Downstream Metal Products
332993	Ammunition (except Small Arms) Mfg	Downstream Metal Products
332994	Small Arms, Ordnance, and Ordnance Accessories Mfg	Downstream Metal Products
332999	All Other Miscellaneous Fabricated Metal Product Mfg	Downstream Metal Products
541711	Research and Development in Biotechnology	Education & Knowledge Creation
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	Education & Knowledge Creation
541720	Research and Development in the Social Sciences and Humanities	Education & Knowledge Creation
611210	Junior Colleges	Education & Knowledge Creation
611310	Colleges, Universities, and Professional Schools	Education & Knowledge Creation
611410	Business and Secretarial Schools	Education & Knowledge Creation
611420	Computer Training	Education & Knowledge Creation
611430	Professional and Management Development Training	Education & Knowledge Creation
611512	Flight Training	Education & Knowledge Creation
611513	Apprenticeship Training	Education & Knowledge Creation
611630	Language Schools	Education & Knowledge Creation
611691	Exam Preparation and Tutoring	Education & Knowledge Creation
611699	All Other Miscellaneous Schools and Instruction	Education & Knowledge Creation
611710	Educational Support Services	Education & Knowledge Creation
813920	Professional Organizations	Education & Knowledge Creation
562112	Hazardous Waste Collection	Environmental Services
562119	Other Waste Collection	Environmental Services
562211	Hazardous Waste Treatment and Disposal	Environmental Services
562213	Solid Waste Combustors and Incinerators	Environmental Services
562219	Other Nonhazardous Waste Treatment and Disposal	Environmental Services
562920	Materials Recovery Facilities	Environmental Services
562998	All Other Miscellaneous Waste Management Services	Environmental Services
521110	Monetary Authorities-Central Bank	Financial Services
522120	Savings Institutions	Financial Services
522190	Other Depository Credit Intermediation	Financial Services
522210	Credit Card Issuing	Financial Services
522220	Sales Financing	Financial Services
522291	Consumer Lending	Financial Services
522292	Real Estate Credit	Financial Services
522293	International Trade Financing	Financial Services
522294	Secondary Market Financing	Financial Services
522298	All Other Nondepository Credit Intermediation	Financial Services
522310	Mortgage and Nonmortgage Loan Brokers	Financial Services
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	Financial Services

522390	Other Activities Related to Credit Intermediation	Financial Services
523110	Investment Banking and Securities Dealing	Financial Services
523120	Securities Brokerage	Financial Services
523130	Commodity Contracts Dealing	Financial Services
523140	Commodity Contracts Brokerage	Financial Services
523210	Securities and Commodity Exchanges	Financial Services
523910	Miscellaneous Intermediation	Financial Services
523920	Portfolio Management	Financial Services
523930	Investment Advice	Financial Services
523991	Trust, Fiduciary, and Custody Activities	Financial Services
523999	Miscellaneous Financial Investment Activities	Financial Services
525910	Open-End Investment Funds	Financial Services
525990	Other Financial Vehicles	Financial Services
561450	Credit Bureaus	Financial Services
114111	Finfish Fishing	Fishing and Fishing Products
114112	Shellfish Fishing	Fishing and Fishing Products
114119	Other Marine Fishing	Fishing and Fishing Products
311710	Seafood Product Preparation and Packaging	Fishing and Fishing Products
316110	Leather and Hide Tanning and Finishing	Footwear
316210	Footwear Mfg	Footwear
333242	Semiconductor Machinery Mfg	IT and Analytical Instruments
333316	Photographic and Photocopying Equipment Mfg	IT and Analytical Instruments
334111	Electronic Computer Mfg	IT and Analytical Instruments
334112	Computer Storage Device Mfg	IT and Analytical Instruments
334118	Computer Terminal and Other Computer Peripheral Equipment Mfg	IT and Analytical Instruments
334310	Audio and Video Equipment Mfg	IT and Analytical Instruments
334412	Bare Printed Circuit Board Mfg	IT and Analytical Instruments
334413	Semiconductor and Related Device Mfg	IT and Analytical Instruments
334416	Capacitor, Resistor, Coil, Transformer, and Other Inductor Mfg	IT and Analytical Instruments
334417	Electronic Connector Mfg	IT and Analytical Instruments
334418	Printed Circuit Assembly (Electronic Assembly) Mfg	IT and Analytical Instruments
334419	Other Electronic Component Mfg	IT and Analytical Instruments
334510	Electromedical and Electrotherapeutic Apparatus Mfg	IT and Analytical Instruments
334512	Automatic Environmental Control Mfg for Residential, Commercial, and Appliance Use	IT and Analytical Instruments
334513	Instruments and Related Products Mfg for Measuring, Displaying, and Controlling Industrial Process Variables	IT and Analytical Instruments
334514	Totalizing Fluid Meter and Counting Device Mfg	IT and Analytical Instruments
334515	Instrument Mfg for Measuring and Testing Electricity and Electrical Signals	IT and Analytical Instruments
334516	Analytical Laboratory Instrument Mfg	IT and Analytical Instruments
334517	Irradiation Apparatus Mfg	IT and Analytical Instruments
334519	Other Measuring and Controlling Device Mfg	IT and Analytical Instruments
334613	Blank Magnetic and Optical Recording Media Mfg	IT and Analytical Instruments
334614	Software and Other Prerecorded Compact Disc, Tape, and Record Reproducing	IT and Analytical Instruments
511210	Software Publishers	IT and Analytical Instruments
524113	Direct Life Insurance Carriers	Insurance Services
524114	Direct Health and Medical Insurance Carriers	Insurance Services
524126	Direct Property and Casualty Insurance Carriers	Insurance Services
524127	Direct Title Insurance Carriers	Insurance Services
524128	Other Direct Insurance (except Life, Health, and Medical) Carriers	Insurance Services
524130	Reinsurance Carriers	Insurance Services
524291	Claims Adjusting	Insurance Services
524298	All Other Insurance Related Activities	Insurance Services
339910	Jewelry and Silverware Mfg	Jewelry and Precious Metals
314910	Textile Bag and Canvas Mills	Leather and Related Products
316992	Women's Handbag and Purse Mfg	Leather and Related Products
316998	All Other Leather Good and Allied Product Mfg	Leather and Related Products
335110	Electric Lamp Bulb and Part Mfg	Lighting and Electrical Equipment
335121	Residential Electric Lighting Fixture Mfg	Lighting and Electrical Equipment
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Mfg	Lighting and Electrical Equipment
335129	Other Lighting Equipment Mfg	Lighting and Electrical Equipment

335311	Power, Distribution, and Specialty Transformer Mfg	Lighting and Electrical Equipment
335312	Motor and Generator Mfg	Lighting and Electrical Equipment
335313	Switchgear and Switchboard Apparatus Mfg	Lighting and Electrical Equipment
335314	Relay and Industrial Control Mfg	Lighting and Electrical Equipment
335911	Storage Battery Mfg	Lighting and Electrical Equipment
335921	Fiber Optic Cable Mfg	Lighting and Electrical Equipment
335929	Other Communication and Energy Wire Mfg	Lighting and Electrical Equipment
335931	Current-Carrying Wiring Device Mfg	Lighting and Electrical Equipment
335932	Noncurrent-Carrying Wiring Device Mfg	Lighting and Electrical Equipment
335991	Carbon and Graphite Product Mfg	Lighting and Electrical Equipment
335999	All Other Miscellaneous Electrical Equipment and Component Mfg	Lighting and Electrical Equipment
511120	Periodical Publishers	Marketing, Design, and Publishing
511130	Book Publishers	Marketing, Design, and Publishing
511140	Directory and Mailing List Publishers	Marketing, Design, and Publishing
511199	All Other Publishers	Marketing, Design, and Publishing
519110	News Syndicates	Marketing, Design, and Publishing
519120	Libraries and Archives	Marketing, Design, and Publishing
519130	Internet Publishing and Broadcasting and Web Search Portals	Marketing, Design, and Publishing
519190	All Other Information Services	Marketing, Design, and Publishing
541410	Interior Design Services	Marketing, Design, and Publishing
541420	Industrial Design Services	Marketing, Design, and Publishing
541430	Graphic Design Services	Marketing, Design, and Publishing
541490	Other Specialized Design Services	Marketing, Design, and Publishing
541613	Marketing Consulting Services	Marketing, Design, and Publishing
541810	Advertising Agencies	Marketing, Design, and Publishing
541820	Public Relations Agencies	Marketing, Design, and Publishing
541830	Media Buying Agencies	Marketing, Design, and Publishing
541840	Media Representatives	Marketing, Design, and Publishing
541850	Outdoor Advertising	Marketing, Design, and Publishing
541860	Direct Mail Advertising	Marketing, Design, and Publishing
541870	Advertising Material Distribution Services	Marketing, Design, and Publishing
541890	Other Services Related to Advertising	Marketing, Design, and Publishing
541910	Marketing Research and Public Opinion Polling	Marketing, Design, and Publishing
333314	Optical Instrument and Lens Mfg	Medical Devices
339112	Surgical and Medical Instrument Mfg	Medical Devices
339113	Surgical Appliance and Supplies Mfg	Medical Devices
339114	Dental Equipment and Supplies Mfg	Medical Devices
339115	Ophthalmic Goods Mfg	Medical Devices
327910	Abrasive Product Mfg	Metalworking Technology
332313	Plate Work Mfg	Metalworking Technology
332721	Precision Turned Product Mfg	Metalworking Technology
332722	Bolt, Nut, Screw, Rivet, and Washer Mfg	Metalworking Technology
332811	Metal Heat Treating	Metalworking Technology
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	Metalworking Technology
332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	Metalworking Technology
333511	Industrial Mold Mfg	Metalworking Technology
333514	Special Die and Tool, Die Set, Jig, and Fixture Mfg	Metalworking Technology
333515	Cutting Tool and Machine Tool Accessory Mfg	Metalworking Technology
333517	Machine Tool Mfg	Metalworking Technology
333519	Rolling Mill and Other Metalworking Machinery Mfg	Metalworking Technology
333991	Power-Driven Handtool Mfg	Metalworking Technology
333992	Welding and Soldering Equipment Mfg	Metalworking Technology
322110	Pulp Mills	Paper and Packaging
322121	Paper (except Newsprint) Mills	Paper and Packaging
322122	Newsprint Mills	Paper and Packaging
322130	Paperboard Mills	Paper and Packaging
322211	Corrugated and Solid Fiber Box Mfg	Paper and Packaging
322212	Folding Paperboard Box Mfg	Paper and Packaging
322219	Other Paperboard Container Mfg	Paper and Packaging
322220	Paper Bag and Coated and Treated Paper Mfg	Paper and Packaging

322230	Stationery Product Mfg	Paper and Packaging
322291	Sanitary Paper Product Mfg	Paper and Packaging
322299	All Other Converted Paper Product Mfg	Paper and Packaging
711110	Theater Companies and Dinner Theaters	Performing Arts
711120	Dance Companies	Performing Arts
711130	Musical Groups and Artists	Performing Arts
711190	Other Performing Arts Companies	Performing Arts
711310	Promoters of Performing Arts, Sports, and Similar Events with Facilities	Performing Arts
711320	Promoters of Performing Arts, Sports, and Similar Events without Facilities	Performing Arts
711410	Agents and Managers for Artists, Athletes, Entertainers, and Other Public Figures	Performing Arts
711510	Independent Artists, Writers, and Performers	Performing Arts
325211	Plastics Material and Resin Mfg	Plastics
326111	Plastics Bag and Pouch Mfg	Plastics
326112	Plastics Packaging Film and Sheet (including Laminated) Mfg	Plastics
326113	Unlaminated Plastics Film and Sheet (except Packaging) Mfg	Plastics
326121	Unlaminated Plastics Profile Shape Mfg	Plastics
326122	Plastics Pipe and Pipe Fitting Mfg	Plastics
326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Mfg	Plastics
326140	Polystyrene Foam Product Mfg	Plastics
326150	Urethane and Other Foam Product (except Polystyrene) Mfg	Plastics
326160	Plastics Bottle Mfg	Plastics
326191	Plastics Plumbing Fixture Mfg	Plastics
326199	All Other Plastics Product Mfg	Plastics
339994	Broom, Brush, and Mop Mfg	Plastics
323111	Commercial Printing (except Screen and Books)	Printing Services
323113	Commercial Screen Printing	Printing Services
323117	Books Printing	Printing Services
323120	Support Activities for Printing	Printing Services
325910	Printing Ink Mfg	Printing Services
511191	Greeting Card Publishers	Printing Services
335210	Small Electrical Appliance Mfg	Recreational and Small Electric Goods
336991	Motorcycle, Bicycle, and Parts Mfg	Recreational and Small Electric Goods
337920	Blind and Shade Mfg	Recreational and Small Electric Goods
339920	Sporting and Athletic Goods Mfg	Recreational and Small Electric Goods
339930	Doll, Toy, and Game Mfg	Recreational and Small Electric Goods
339940	Office Supplies (except Paper) Mfg	Recreational and Small Electric Goods
339992	Musical Instrument Mfg	Recreational and Small Electric Goods
339993	Fastener, Button, Needle, and Pin Mfg	Recreational and Small Electric Goods
339999	All Other Miscellaneous Mfg	Recreational and Small Electric Goods
313110	Fiber, Yarn, and Thread Mills	Textile Mfg
313210	Broadwoven Fabric Mills	Textile Mfg
313220	Narrow Fabric Mills and Schiffli Machine Embroidery	Textile Mfg
313230	Nonwoven Fabric Mills	Textile Mfg
313240	Knit Fabric Mills	Textile Mfg
313310	Textile and Fabric Finishing Mills	Textile Mfg
313320	Fabric Coating Mills	Textile Mfg
314110	Carpet and Rug Mills	Textile Mfg
314120	Curtain and Linen Mills	Textile Mfg
314994	Rope, Cordage, Twine, Tire Cord, and Tire Fabric Mills	Textile Mfg
315110	Hosiery and Sock Mills	Textile Mfg
315190	Other Apparel Knitting Mills	Textile Mfg

325220	Artificial and Synthetic Fibers and Filaments Mfg	Textile Mfg
331110	Iron and Steel Mills and Ferroalloy Mfg	Upstream Metal Mfg
331210	Iron and Steel Pipe and Tube Mfg from Purchased Steel	Upstream Metal Mfg
331221	Rolled Steel Shape Mfg	Upstream Metal Mfg
331222	Steel Wire Drawing	Upstream Metal Mfg
331313	Alumina Refining and Primary Aluminum Production	Upstream Metal Mfg
331314	Secondary Smelting and Alloying of Aluminum	Upstream Metal Mfg
331315	Aluminum Sheet, Plate, and Foil Mfg	Upstream Metal Mfg
331318	Other Aluminum Rolling, Drawing, and Extruding	Upstream Metal Mfg
331410	Nonferrous Metal (except Aluminum) Smelting and Refining	Upstream Metal Mfg
331420	Copper Rolling, Drawing, Extruding, and Alloying	Upstream Metal Mfg
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	Upstream Metal Mfg
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)	Upstream Metal Mfg
332111	Iron and Steel Forging	Upstream Metal Mfg
332112	Nonferrous Forging	Upstream Metal Mfg
332117	Powder Metallurgy Part Mfg	Upstream Metal Mfg
332119	Metal Crown, Closure, and Other Metal Stamping (except Automotive)	Upstream Metal Mfg
332613	Spring Mfg	Upstream Metal Mfg
332618	Other Fabricated Wire Product Mfg	Upstream Metal Mfg
336611	Ship Building and Repairing	Water Transportation
336612	Boat Building	Water Transportation
483111	Deep Sea Freight Transportation	Water Transportation
483112	Deep Sea Passenger Transportation	Water Transportation
483113	Coastal and Great Lakes Freight Transportation	Water Transportation
483114	Coastal and Great Lakes Passenger Transportation	Water Transportation
483211	Inland Water Freight Transportation	Water Transportation
483212	Inland Water Passenger Transportation	Water Transportation
488310	Port and Harbor Operations	Water Transportation
488320	Marine Cargo Handling	Water Transportation
488330	Navigational Services to Shipping	Water Transportation
488390	Other Support Activities for Water Transportation	Water Transportation

7 APPENDIX II: MODIFIED BROOKINGS INSTITUTE INDUSTRY CLUSTERS

2012 NAICS	Name	Cluster
453920	Art Dealers	Arts, Hospitality, & Tourism
487110	Scenic and Sightseeing Transportation, Land	Arts, Hospitality, & Tourism
487210	Scenic and Sightseeing Transportation, Water	Arts, Hospitality, & Tourism
487990	Scenic and Sightseeing Transportation, Other	Arts, Hospitality, & Tourism
561510	Travel Agencies	Arts, Hospitality, & Tourism
561520	Tour Operators	Arts, Hospitality, & Tourism
561591	Convention and Visitors Bureaus	Arts, Hospitality, & Tourism
561599	All Other Travel Arrangement and Reservation Services	Arts, Hospitality, & Tourism
561920	Convention and Trade Show Organizers	Arts, Hospitality, & Tourism
711110	Theater Companies and Dinner Theaters	Arts, Hospitality, & Tourism
711120	Dance Companies	Arts, Hospitality, & Tourism
711130	Musical Groups and Artists	Arts, Hospitality, & Tourism
711190	Other Performing Arts Companies	Arts, Hospitality, & Tourism
711211	Sports Teams and Clubs	Arts, Hospitality, & Tourism
711219	Other Spectator Sports	Arts, Hospitality, & Tourism
711310	Promoters of Performing Arts, Sports, and Similar Events with Facilities	Arts, Hospitality, & Tourism
711320	Promoters of Performing Arts, Sports, and Similar Events without Facilities	Arts, Hospitality, & Tourism
711510	Independent Artists, Writers, and Performers	Arts, Hospitality, & Tourism
712110	Museums	Arts, Hospitality, & Tourism
712120	Historical Sites	Arts, Hospitality, & Tourism
712130	Zoos and Botanical Gardens	Arts, Hospitality, & Tourism
712190	Nature Parks and Other Similar Institutions	Arts, Hospitality, & Tourism
713110	Amusement and Theme Parks	Arts, Hospitality, & Tourism
713290	Other Gambling Industries	Arts, Hospitality, & Tourism
713930	Marinas	Arts, Hospitality, & Tourism
713990	All Other Amusement and Recreation Industries	Arts, Hospitality, & Tourism
721110	Hotels (except Casino Hotels) and Motels	Arts, Hospitality, & Tourism
721191	Bed-and-Breakfast Inns	Arts, Hospitality, & Tourism
721199	All Other Traveler Accommodation	Arts, Hospitality, & Tourism
721211	RV (Recreational Vehicle) Parks and Campgrounds	Arts, Hospitality, & Tourism
721214	Recreational and Vacation Camps (except Campgrounds)	Arts, Hospitality, & Tourism
722511	Full-Service Restaurants	Arts, Hospitality, & Tourism
611210	Junior Colleges	Colleges & Universities
611310	Colleges, Universities, and Professional Schools	Colleges & Universities
902612	Colleges, Universities, and Professional Schools (State Government)	Colleges & Universities
903612	Colleges, Universities, and Professional Schools (Local Government)	Colleges & Universities
511210	Software Publishers	Computer Systems & Software
541511	Custom Computer Programming Services	Computer Systems & Software
541512	Computer Systems Design Services	Computer Systems & Software
541519	Other Computer Related Services	Computer Systems & Software
551111	Offices of Bank Holding Companies	Corporate Headquarters/Managing Offices
551112	Offices of Other Holding Companies	Corporate Headquarters/Managing Offices
551114	Corporate, Subsidiary, and Regional Managing Offices	Corporate Headquarters/Managing Offices
518210	Data Processing, Hosting, and Related Services	Data Processing, Facilities, & Internet
519130	Internet Publishing and Broadcasting and Web Search Portals	Data Processing, Facilities, & Internet
541513	Computer Facilities Management Services	Data Processing, Facilities, & Internet
541420	Industrial Design Services	Design Services
541430	Graphic Design Services	Design Services
541490	Other Specialized Design Services	Design Services

337215	Showcase, Partition, Shelving, and Locker Manufacturing	Displays
339950	Sign Manufacturing	Displays
334118	Computer Terminal and Other Computer Peripheral Equipment Manufacturing	Electronics
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	Electronics
334412	Bare Printed Circuit Board Manufacturing	Electronics
334413	Semiconductor and Related Device Manufacturing	Electronics
334416	Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing	Electronics
334417	Electronic Connector Manufacturing	Electronics
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	Electronics
334419	Other Electronic Component Manufacturing	Electronics
332111	Iron and Steel Forging	Fabricated Metal Products
332112	Nonferrous Forging	Fabricated Metal Products
332216	Saw Blade and Handtool Manufacturing	Fabricated Metal Products
332312	Fabricated Structural Metal Manufacturing	Fabricated Metal Products
332313	Plate Work Manufacturing	Fabricated Metal Products
332321	Metal Window and Door Manufacturing	Fabricated Metal Products
332322	Sheet Metal Work Manufacturing	Fabricated Metal Products
332420	Metal Tank (Heavy Gauge) Manufacturing	Fabricated Metal Products
332439	Other Metal Container Manufacturing	Fabricated Metal Products
332618	Other Fabricated Wire Product Manufacturing	Fabricated Metal Products
332710	Machine Shops	Fabricated Metal Products
332721	Precision Turned Product Manufacturing	Fabricated Metal Products
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	Fabricated Metal Products
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	Fabricated Metal Products
332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	Fabricated Metal Products
332911	Industrial Valve Manufacturing	Fabricated Metal Products
332912	Fluid Power Valve and Hose Fitting Manufacturing	Fabricated Metal Products
332919	Other Metal Valve and Pipe Fitting Manufacturing	Fabricated Metal Products
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	Fabricated Metal Products
522110	Commercial Banking	Finance & Insurance
522120	Savings Institutions	Finance & Insurance
522130	Credit Unions	Finance & Insurance
522190	Other Depository Credit Intermediation	Finance & Insurance
522210	Credit Card Issuing	Finance & Insurance
522220	Sales Financing	Finance & Insurance
522291	Consumer Lending	Finance & Insurance
522292	Real Estate Credit	Finance & Insurance
522293	International Trade Financing	Finance & Insurance
522294	Secondary Market Financing	Finance & Insurance
522298	All Other Nondepository Credit Intermediation	Finance & Insurance
522310	Mortgage and Nonmortgage Loan Brokers	Finance & Insurance
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	Finance & Insurance
522390	Other Activities Related to Credit Intermediation	Finance & Insurance
523110	Investment Banking and Securities Dealing	Finance & Insurance
523120	Securities Brokerage	Finance & Insurance
523130	Commodity Contracts Dealing	Finance & Insurance
523140	Commodity Contracts Brokerage	Finance & Insurance
523210	Securities and Commodity Exchanges	Finance & Insurance
523910	Miscellaneous Intermediation	Finance & Insurance
523920	Portfolio Management	Finance & Insurance
523930	Investment Advice	Finance & Insurance
523991	Trust, Fiduciary, and Custody Activities	Finance & Insurance
523999	Miscellaneous Financial Investment Activities	Finance & Insurance
524113	Direct Life Insurance Carriers	Finance & Insurance
524114	Direct Health and Medical Insurance Carriers	Finance & Insurance
524126	Direct Property and Casualty Insurance Carriers	Finance & Insurance
524127	Direct Title Insurance Carriers	Finance & Insurance
524128	Other Direct Insurance (except Life, Health, and Medical) Carriers	Finance & Insurance
524210	Insurance Agencies and Brokerages	Finance & Insurance
524291	Claims Adjusting	Finance & Insurance

524292	Third Party Administration of Insurance and Pension Funds	Finance & Insurance
524298	All Other Insurance Related Activities	Finance & Insurance
481112	Scheduled Freight Air Transportation	Freight Transportation
483111	Deep Sea Freight Transportation	Freight Transportation
483113	Coastal and Great Lakes Freight Transportation	Freight Transportation
484110	General Freight Trucking, Local	Freight Transportation
484121	General Freight Trucking, Long-Distance, Truckload	Freight Transportation
484122	General Freight Trucking, Long-Distance, Less Than Truckload	Freight Transportation
484210	Used Household and Office Goods Moving	Freight Transportation
484220	Specialized Freight (except Used Goods) Trucking, Local	Freight Transportation
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance	Freight Transportation
488310	Port and Harbor Operations	Freight Transportation
337110	Wood Kitchen Cabinet and Countertop Manufacturing	Furniture
337121	Upholstered Household Furniture Manufacturing	Furniture
337122	Nonupholstered Wood Household Furniture Manufacturing	Furniture
337212	Custom Architectural Woodwork and Millwork Manufacturing	Furniture
337920	Blind and Shade Manufacturing	Furniture
327212	Other Pressed and Blown Glass and Glassware Manufacturing	Glass and Stone Products
327215	Glass Product Manufacturing Made of Purchased Glass	Glass and Stone Products
327320	Ready-Mix Concrete Manufacturing	Glass and Stone Products
327910	Abrasive Product Manufacturing	Glass and Stone Products
327991	Cut Stone and Stone Product Manufacturing	Glass and Stone Products
327993	Mineral Wool Manufacturing	Glass and Stone Products
621420	Outpatient Mental Health and Substance Abuse Centers	Hospitals & Healthcare Centers
621491	HMO Medical Centers	Hospitals & Healthcare Centers
621492	Kidney Dialysis Centers	Hospitals & Healthcare Centers
621493	Freestanding Ambulatory Surgical and Emergency Centers	Hospitals & Healthcare Centers
621498	All Other Outpatient Care Centers	Hospitals & Healthcare Centers
621512	Diagnostic Imaging Centers	Hospitals & Healthcare Centers
622110	General Medical and Surgical Hospitals	Hospitals & Healthcare Centers
622210	Psychiatric and Substance Abuse Hospitals	Hospitals & Healthcare Centers
622310	Specialty (except Psychiatric and Substance Abuse) Hospitals	Hospitals & Healthcare Centers
902622	Hospitals (State Government)	Hospitals & Healthcare Centers
903622	Hospitals (Local Government)	Hospitals & Healthcare Centers
333244	Printing Machinery and Equipment Manufacturing	Industrial Machinery Mfg
333249	Other Industrial Machinery Manufacturing	Industrial Machinery Mfg
333314	Optical Instrument and Lens Manufacturing	Industrial Machinery Mfg
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	Industrial Machinery Mfg
333511	Industrial Mold Manufacturing	Industrial Machinery Mfg
333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	Industrial Machinery Mfg
333515	Cutting Tool and Machine Tool Accessory Manufacturing	Industrial Machinery Mfg
333517	Machine Tool Manufacturing	Industrial Machinery Mfg
333999	All Other Miscellaneous General Purpose Machinery Manufacturing	Industrial Machinery Mfg
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	Instruments
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	Instruments
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	Instruments
334516	Analytical Laboratory Instrument Manufacturing	Instruments
339910	Jewelry and Silverware Manufacturing	Jewelry
339993	Fastener, Button, Needle, and Pin Manufacturing	Jewelry
425110	Business to Business Electronic Markets	Logistics Support Services
488320	Marine Cargo Handling	Logistics Support Services
488330	Navigational Services to Shipping	Logistics Support Services
488390	Other Support Activities for Water Transportation	Logistics Support Services
488510	Freight Transportation Arrangement	Logistics Support Services
488991	Packing and Crating	Logistics Support Services
488999	All Other Support Activities for Transportation	Logistics Support Services
541614	Process, Physical Distribution, and Logistics Consulting Services	Logistics Support Services
561910	Packaging and Labeling Services	Logistics Support Services

331221	Rolled Steel Shape Manufacturing	Metals Refining & Metalworking
331410	Nonferrous Metal (except Aluminum) Smelting and Refining	Metals Refining & Metalworking
331420	Copper Rolling, Drawing, Extruding, and Alloying	Metals Refining & Metalworking
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	Metals Refining & Metalworking
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)	Metals Refining & Metalworking
331511	Iron Foundries	Metals Refining & Metalworking
331512	Steel Investment Foundries	Metals Refining & Metalworking
331523	Nonferrous Metal Die-Casting Foundries	Metals Refining & Metalworking
331529	Other Nonferrous Metal Foundries (except Die-Casting)	Metals Refining & Metalworking
321114	Wood Preservation	Packaging
321911	Wood Window and Door Manufacturing	Packaging
321918	Other Millwork (including Flooring)	Packaging
321920	Wood Container and Pallet Manufacturing	Packaging
321999	All Other Miscellaneous Wood Product Manufacturing	Packaging
322211	Corrugated and Solid Fiber Box Manufacturing	Packaging
322212	Folding Paperboard Box Manufacturing	Packaging
322219	Other Paperboard Container Manufacturing	Packaging
322220	Paper Bag and Coated and Treated Paper Manufacturing	Packaging
322299	All Other Converted Paper Product Manufacturing	Packaging
311352	Confectionery Manufacturing from Purchased Chocolate	Perishable Foods Mfg & Processing
311511	Fluid Milk Manufacturing	Perishable Foods Mfg & Processing
311513	Cheese Manufacturing	Perishable Foods Mfg & Processing
311520	Ice Cream and Frozen Dessert Manufacturing	Perishable Foods Mfg & Processing
311612	Meat Processed from Carcasses	Perishable Foods Mfg & Processing
311710	Seafood Product Preparation and Packaging	Perishable Foods Mfg & Processing
311811	Retail Bakeries	Perishable Foods Mfg & Processing
311812	Commercial Bakeries	Perishable Foods Mfg & Processing
311813	Frozen Cakes, Pies, and Other Pastries Manufacturing	Perishable Foods Mfg & Processing
311821	Cookie and Cracker Manufacturing	Perishable Foods Mfg & Processing
311824	Dry Pasta, Dough, and Flour Mixes Manufacturing from Purchased Flour	Perishable Foods Mfg & Processing
311830	Tortilla Manufacturing	Perishable Foods Mfg & Processing
311911	Roasted Nuts and Peanut Butter Manufacturing	Perishable Foods Mfg & Processing
311919	Other Snack Food Manufacturing	Perishable Foods Mfg & Processing
311920	Coffee and Tea Manufacturing	Perishable Foods Mfg & Processing
311930	Flavoring Syrup and Concentrate Manufacturing	Perishable Foods Mfg & Processing
311941	Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing	Perishable Foods Mfg & Processing
311942	Spice and Extract Manufacturing	Perishable Foods Mfg & Processing
311991	Perishable Prepared Food Manufacturing	Perishable Foods Mfg & Processing
311999	All Other Miscellaneous Food Manufacturing	Perishable Foods Mfg & Processing
325411	Medicinal and Botanical Manufacturing	Pharmaceutical
325412	Pharmaceutical Preparation Manufacturing	Pharmaceutical
325413	In-Vitro Diagnostic Substance Manufacturing	Pharmaceutical
325414	Biological Product (except Diagnostic) Manufacturing	Pharmaceutical
326112	Plastics Packaging Film and Sheet (including Laminated) Manufacturing	Plastic Laminate and Films Mfg
326113	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing	Plastic Laminate and Films Mfg
326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing	Plastic Laminate and Films Mfg
326150	Urethane and Other Foam Product (except Polystyrene) Manufacturing	Plastic Laminate and Films Mfg
326199	All Other Plastics Product Manufacturing	Plastic Laminate and Films Mfg
326299	All Other Rubber Product Manufacturing	Plastic Laminate and Films Mfg
313	Textile Mills	Primary & Secondary Textile Mills
314	Textile Product Mills	Primary & Secondary Textile Mills
541711	Research and Development in Biotechnology	R&D and Medical Labs
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	R&D and Medical Labs
621511	Medical Laboratories	R&D and Medical Labs
336211	Motor Vehicle Body Manufacturing	Ship Building
336611	Ship Building and Repairing	Ship Building
336612	Boat Building	Ship Building
324191	Petroleum Lubricating Oil and Grease Manufacturing	Specialty Chemicals & Resins Mfg
325199	All Other Basic Organic Chemical Manufacturing	Specialty Chemicals & Resins Mfg
325211	Plastics Material and Resin Manufacturing	Specialty Chemicals & Resins Mfg

325212	Synthetic Rubber Manufacturing	Specialty Chemicals & Resins Mfg
325520	Adhesive Manufacturing	Specialty Chemicals & Resins Mfg
325611	Soap and Other Detergent Manufacturing	Specialty Chemicals & Resins Mfg
325991	Custom Compounding of Purchased Resins	Specialty Chemicals & Resins Mfg
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing	Specialty Chemicals & Resins Mfg
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	Surgical & Medical Device Mfg
339112	Surgical and Medical Instrument Manufacturing	Surgical & Medical Device Mfg
339113	Surgical Appliance and Supplies Manufacturing	Surgical & Medical Device Mfg
339114	Dental Equipment and Supplies Manufacturing	Surgical & Medical Device Mfg
339115	Ophthalmic Goods Manufacturing	Surgical & Medical Device Mfg
339116	Dental Laboratories	Surgical & Medical Device Mfg
339920	Sporting and Athletic Goods Manufacturing	Toy & Novelty Goods
339930	Doll, Toy, and Game Manufacturing	Toy & Novelty Goods
339940	Office Supplies (except Paper) Manufacturing	Toy & Novelty Goods
339991	Gasket, Packing, and Sealing Device Manufacturing	Toy & Novelty Goods
339999	All Other Miscellaneous Manufacturing	Toy & Novelty Goods
493	Warehousing and Storage	Warehousing
423	Merchant Wholesalers, Durable Goods	Wholesale Distribution
424	Merchant Wholesalers, Nondurable Goods	Wholesale Distribution
425	Wholesale Electronic Markets and Agents and Brokers	Wholesale Distribution
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	Wiring & Related Products
335314	Relay and Industrial Control Manufacturing	Wiring & Related Products
335931	Current-Carrying Wiring Device Manufacturing	Wiring & Related Products
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	Wiring & Related Products
221111	Hydroelectric Power Generation	Energy Production, Distribution, & Storage
221112	Fossil Fuel Electric Power Generation	Energy Production, Distribution, & Storage
221113	Nuclear Electric Power Generation	Energy Production, Distribution, & Storage
221114	Solar Electric Power Generation	Energy Production, Distribution, & Storage
221115	Wind Electric Power Generation	Energy Production, Distribution, & Storage
221116	Geothermal Electric Power Generation	Energy Production, Distribution, & Storage
221117	Biomass Electric Power Generation	Energy Production, Distribution, & Storage
221118	Other Electric Power Generation	Energy Production, Distribution, & Storage
333611	Turbine and Turbine Generator Set Units Manufacturing	Energy Production, Distribution, & Storage
333613	Mechanical Power Transmission Equipment Manufacturing	Energy Production, Distribution, & Storage
335311	Power, Distribution, and Specialty Transformer Manufacturing	Energy Production, Distribution, & Storage
335312	Motor and Generator Manufacturing	Energy Production, Distribution, & Storage
335911	Storage Battery Manufacturing	Energy Production, Distribution, & Storage
335912	Primary Battery Manufacturing	Energy Production, Distribution, & Storage

8 APPENDIX III: SCHOLARLY REFERENCES

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