



Agricultural and Food Industry Clusters in the Northeast U.S.: Technical Report

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“Contributing to the well-being of small towns and rural communities.”

Agricultural and Food Industry Clusters in the Northeast U.S.: Technical Report

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Executive Summary

Interest in industry clusters has increased dramatically in recent years, as state and local economic development agencies explore new ways of targeting workforce training and development efforts. Through its focus on local concentration of employment in different industry sectors, as well as earnings, industry cluster analysis offers a potentially rigorous tool for efficiently allocating workforce and other economic development resources (Herr 2003, page iii). This study identifies areas of potential local competitive advantage in the food and agriculture industry that have the potential to provide for future employment and earnings growth.

The present study uses several analytical tools to analyze datasets from County Business Patterns, Census of Agriculture and IMPLAN on the food and agriculture industry of Northeast counties, paying particular attention to employment, wages and establishments associated with defined industry clusters within the region. These tools include: local employment analysis, location quotients, shift share analysis, wages, bubble charts, the local Moran's I, locational correlation, and input-output analysis. While these analytical tools are neither complete nor conclusive, they represent an uncommonly large palette for identifying industry clusters. Accordingly, our analysis is strengthened by its ability to compare the results that are obtained using alternative tools to identify existing and nascent clusters. Because our analysis is largely exploratory at this point, the results have to be viewed cautiously.

According to the local employment analysis, commercial bakeries, poultry processing, retail bakeries, soft drink manufacturing, meat processed from carcasses and fluid milk manufacturing were the leading food processing employers in 2001 in the Northeast. Location quotients reveal that chocolate & confectionery manufacturing from cacao beans, coffee & tea manufacturing, seafood canning, ice cream & frozen dessert manufacturing, spice & extract manufacturing, breweries, cane sugar refining and other tobacco product manufacturing lead in terms of employment concentration in the Northeast states. Based on shift share analysis, coffee & tea manufacturing, other tobacco product manufacturing, retail bakeries, fresh & frozen seafood processing, commercial bakeries, soft drink manufacturing, fruit & vegetable canning, chocolate & confectionery manufacturing from cacao beans, and ice cream & frozen dessert manufacturing are the most competitive industries in the region.

Using so-called bubble charts, we find that ice cream and frozen dessert manufacturing has the potential to be an important targeted industry cluster in Pennsylvania and Massachusetts. Flavoring syrup and chocolate manufacturing emerges as a potentially highly competitive industry cluster in Connecticut, while the same is true of spice and extract manufacturing in Maryland and New Jersey. Appendix A summarized the top clusters identified in selected Northeast states using the different tools; in a future paper, we will present the results of a more formal meta analysis.

An important innovation of this report is the use of spatial statistical analysis to identify potential industry clusters. The local Moran's I identifies sets of geographically concen-

trated counties with higher-than-expected numbers of firms in particular industries. This leads to sets of spatially grouped counties, rather than single numbers for individual counties, as the LQ approach provides. By its very nature, this measure incorporates the notion of spatial proximity that underlies the idea of clusters. Using this method, we identify four groups of counties for each specific industry cluster: central counties in clusters, peripheral counties in clusters, non-cluster counties and no-establishment counties. Using GIS, we present the distribution of industry clusters across counties of the Northeast.

Another less-commonly used statistical measure is that of the county-level locational correlation coefficient. This is simply the coefficient of correlation for firms in two different local industries. Using this method, we identify industry clusters with locational correlation greater than 0.75 for a broad definition of food and agriculture industries; in essence, this shows patterns of industries that predominantly co-locate within the same counties. These identified industry concentrations may help us to better understand the linkages and types of externalities that exist across different industries.

Using IMPLAN's input-output analysis, we find that the total value added to Pennsylvania's economy from the food and related agricultural cluster was \$36 billion in 2000 (our initial analysis is limited to only this state because IMPLAN data have to be purchased on a state-by-state basis). Of this, \$12.8 billion (35.6 percent) is attributable to the total food and forestry-processing sector. In comparison, the total output of food and related agricultural sectors was \$83.8 billion. The food and related agricultural cluster accounts for about \$22.4 billion of total income and over 861,000 jobs in Pennsylvania.

Using IMPLAN's input-output model, we also identified the top 25 individual food industry clusters based on total industry output, employment, total value added and total industry output per employee, total value added per employee for Pennsylvania food and agricultural sectors in 2001. Confectionery manufacturing from cacao beans has the largest output, of nearly \$2.7 billion. The single largest employer in Pennsylvania's food and agriculture sector is cattle ranching and farming establishments (dairying), accounting for 40,417 jobs, or about 21.4 percent of all food and agriculture sector employment. Bread and bakery manufacturing products (except frozen) contributes the highest total value added, \$1.1 billion. The greatest total output per job, and total value added per job, is cigarette manufacturing, but these numbers are skewed because of the very small number of jobs (4) in that industry.

Agricultural and Food Industry Clusters in the Northeast U.S.:

Technical Report

Introduction

Industry clusters have become an increasingly important concept in economic development research and practice. Clusters are geographic concentrations of firms in related industries that benefit not only from agglomeration economies¹ derived from their spatial proximity, but also from the increased competitive pressure as a result of the co-location. Policymakers and professional developers use industry clusters to select, describe and promote groups of regional industries that already exhibit or have the potential to develop a regional competitive advantage (Smith 2003, page 1). Herr (2003, page iii) argues that “industry cluster identification and analysis can also allow planners to identify local industries that have concentration of employment beyond the national average that may be an indicator of current stability and future growth or an ideal focus for the investment of public sector dollars.”

Perhaps the best-known name associated with clusters is Harvard University’s Michael Porter, who wrote about and popularized these concepts in *The Competitive Advantage of Nations* (1990). Because it focuses on wage and employment growth, cluster analysis is widely viewed as providing “a solid foundation and effective tool around which planning, policymaking and service delivery activities can be focused” (Herr 2003, page iii).

In many ways, cluster analysis is still in its infancy--more art than science--commonly using the location quotient (a somewhat arbitrary measure that is defined below) as a first step in identifying clusters. The concept is also tautological, in the sense that industries are competitive because they cluster, and they cluster because they are competitive. This study identifies potential local competitive advantage in the agricultural and food industry in the Northeast region of the United States, using and comparing alternative analytical techniques. One important goal of cluster analysis, and of this study, is to help focus public sector investments to those areas with the highest potential for economic growth in the region.

This study differs from previous work in three important ways. First, we focus on both food and agriculture, whereas previous studies have tended to ignore the clustering of farms. Second, and perhaps more importantly, we use spatial analytical tools to examine geographic clustering across counties and states. Virtually all published reports examine only clusters within states, because they are commissioned by state governments. Yet some of the most important synergies may exist across state borders. Third, as noted, we use alternative analytical tools to identify clusters, and we demonstrate that different techniques – not surprisingly – do yield different results.

¹ These are cost-savings that arise when firms co-locate in close proximity to one another. For example, agglomerations of firms in particular regions may lead to greater competition among input suppliers for that industry (providing lower-cost or higher-quality inputs), a larger pool of trained workers with the specific skills needed by the industry and better logistics and transportation facilities, and more competitively organized market outlets, allowing firms to obtain higher prices for their products.

The primary dataset used in this analysis is the 1998 and 2001 County Business Patterns (CBP) data (U.S. Census of Bureau), covering establishments, employment and wages by county at the six-digit NAICS (North American Industry Classification System) level.² Since CBP data do not include agriculture, we use 2002 Census of Agriculture data to identify farm clusters in the region (U.S. Department of Agriculture). For the input-output analysis (Pennsylvania only), we use the 2000 and 2001 IMPLAN databases.

The study is organized into three sections. Section 1 reviews the concept of industry cluster as a framework for identifying Northeast region's key food and related agricultural industries. Section 2 presents results of our analysis, while Section 3 provides a summary and conclusions.

Section 1: Definition and Research Methods

The Concept of an Industry Cluster

Numerous definitions can be found in the literature for industry clusters. Gibbs and Bernat (1997, p. 18) suggest that this is due to the different types of clustering that exist, and due to the difficulty of precisely measuring cluster features. The Colorado Department of Labor and Employment (2003, page 1) describes industry clusters as follows:

An industry cluster can be a group of interrelated industries that drive wealth creation within a region, primarily through the export of goods and services. An industry cluster may consist of industries that share the same or similar workforce, factors of production or infrastructure. It may also be defined by the production of similar outputs, complementary output or other interdependent relations. Unlike the traditional Standard Industrial Classification (SIC) System or the North American Industry Classification System (NAICS), industry clusters can represent the entire value chain of a broadly defined industry from shared suppliers to end products, including supporting services and specialized infrastructure. Analyses of industry clusters therefore, help in defining economic drivers (key industries) within a geographic region, and facilitate a better understanding of regional economies and how they evolve over time.

The emphasis on exports is important. Regional economists for many years have distinguished between basic and non-basic activity in a given region. For the most part, basic activity involves *exports* from the region, that is, the activity brings new income and wealth into the local economy. This can be cars, chocolates or legal services. A key distinction is that the non-basic sectors do not in and of themselves generate new income or wealth. Instead, they serve to make the basic economy function. Examples include grocery stores, retailers such as Wal-Mart, or hairdressers. While basic sectors are important, because they serve the non-basic sectors, their contribution to local prosperity depends closely on the prosperity of the basic sector. In other words, they are not themselves generators of new growth or economic activity. Along with the fact that manufacturers tend also to pay higher wages, this is why industrial recruiters usually pursue manufacturing facilities that export goods outside the region, rather than retail-

² To read more about the NAICS code, see Shields (2003a) at <http://cecd.aers.psu.edu/pubs/ReadMe1st.pdf>

ers. It is also why the loss of a manufacturer, as opposed to a retailer, is usually seen as a significant loss to a community.

In terms of data, it is possible to use establishment counts, earnings or employment numbers for each of the following. We maintain that the best variable is the establishment as a unit of analysis, because that is most closely aligned with the concept of a cluster: after all, clusters are about firms competing cooperatively, or cooperating competitively with one another. Thus, it is the number of establishments or firms that matters most, not the size of the workforce, in identifying a cluster. Another important advantage of using establishment counts is that they, unlike employment data, are never suppressed due to disclosure rules. Nevertheless, because it is jobs that are of primary interest to decisionmakers, we present a mixture of results using both employment and establishment data (employment data are imputed where necessary).

Analytical Tools

To identify the Northeast region's industry clusters for food and agriculture industry, we compare the following analytical tools (see also Munnich 1999 and Smith 2003, p. 5). These tools are neither complete nor do they necessarily provide conclusive results. They are simply means of helping us better understand the *potential* competitive advantage of particular food and agricultural industries.

Local Employment Analysis

In local employment analysis (LEA), the percent of local employment in a particular industry is calculated to identify the relative importance of an industry to the local economy. As an additional step, changes over time in the employment shares are calculated and analyzed to identify potential threats to, and opportunities for, the local employment base. It is important to note that "high concentrations of employment do not specifically correlate into competitive advantages" (Smith 2003, p. 5).

Location Quotient

Perhaps the most widely used tool in industry cluster analysis is that of the location quotient, which is an extension of the LEA.³ Numerous important assumptions are needed in order to use this measure, however, and they are often ignored (see Shaffer et al. 2004). The quotient is calculated as the share (percent) of employment or earnings in a given local industry divided by the share of employment in that industry nationally. For example, if in a community 30% of all jobs are in manufacturing while nationally 15% of all jobs are in that sector, then the location quotient would be $(30\%/15\%) = 2.0$. In this case, manufacturing is "relatively more important" to the local economy than it is nationally. The opposite would be true if the local share were only 10%, in which case the $LQ = (10\%/15\%) = 0.66$. Thus, the location quotient goes beyond the LEA coefficient to compare the local economy to the national or state economy (depending on the objective).

³ To read more about location quotients and how they can be used to identify local strengths, opportunities and industry clusters, see Shields (2003b) at <http://cecd.aers.psu.edu/pubs/Tool%203.pdf>

In terms of interpreting the LQ, a coefficient for an industry that is greater than 1.0 (or for more certainty 1.25) suggests that the local economy is exporting goods from that particular industry, while a coefficient of less than 1.0 implies that the economy imports goods in that industry from elsewhere in the nation. A coefficient near 1.0 implies the economy is self-sufficient. It is important to note that the more detailed the industry code (i.e., the larger the number of NAICS digits), the greater the likelihood of a large LQ. For example, Cortland, NY for many years was the last place in the U.S. to manufacture typewriters (Smith Corona). Thus, the LQ for that industry in that county was potentially infinite (since the U.S. share of employment in typewriter manufacturing was very small or negligible, and dividing a number by a very small number yields a large number).

It is important to understand, however, the limitations of the LQ. For example, while Cortland had a high typewriter industry LQ, the industry eventually closed down completely (in the late 1990s). Thus, the large LQ did not guarantee perpetual competitiveness.

In industry cluster analysis, all industries are of potential interest. Those that are already exporting could be enhanced to expand and export even more goods, bringing in more money into the community. In contrast, those with location quotients of less than 1.0 represent potential opportunities for import substitution (where goods that were previously imported are now produced locally).

Shift-Share Analysis

In shift-share analysis, the change in local employment in different industries is decomposed into one of the following three components.⁴

1. Competitive share: local job growth due to the fact that the county is, in a sense, drawing away jobs from other places in the nation. The county offers more competitive conditions than other communities, and so firms and jobs are relocating into the county.
2. Mix: the county has a portfolio of industries that are growing more rapidly nationally, and as a result the county has more favorable growth (faster than the national average).
3. National: the county's job base is growing simply because the nation is growing.

Adding together these three components yields the actual change in employment in a county, which can be negative, zero or positive.

Wages

Wages are of obvious importance in cluster analysis, as they tend to reflect worker productivity and competitiveness. There are also important to economic developers as they affect standards of living and economic well-being. At the same time, high LQs do not necessarily imply high wages, or vice versa (San Diego Association of Governments, page 7; Smith 2003, page 5).

⁴ For a discussion of how shift share analysis can be used to identify engines of economic growth in a local community, see Shields (2003c): <http://cecd.aers.psu.edu/pubs/Tool%204.pdf>

Bubble Chart

So-called bubble charts are widely used to identify and compare clusters within a region. In part they are popular because they do “not require assigning degrees of importance to measures” (National Governors Association 2002, page 18). Usually, “[t]wo variables are chosen for the ‘x’ axis and ‘y’ axis, which might be growth rates and wages. A third variable is represented by the size (radius) of a circle around the point on the graph. A fourth variable can be represented by the degree of shading in the circles” (National Governors Association 2002, page 19).

Local Moran’s I

In their pioneering work, Gibbs and Bernat (1997, p. 19) state that they developed “[t]his method for identifying clusters for each industry [that] separates counties into four groups: (1) counties without establishments in a given industry, (2) those with non-clustered establishments, (3) peripheral counties of clusters, and (4) central counties in clusters, those with the highest concentration of establishments relative to their neighbors.” They calculate a local Moran’s I to identify those counties which have a number of firms in an establishment that is greater or smaller than would be expected based purely on chance (p.20).

An important feature of this measure is that, unlike the LQ that is limited to a particular geography (e.g., county), the Moran’s I picks up relationships over space, and across county or community borders. Moreover, it can be used to identify industry clusters that straddle one or more state borders (see Gibbs and Bernat 1997).

Locational correlation

Locational correlation is another spatially explicit measure of clustering. Porter (2003, p. 562) notes that “using the locational correlation of employment across industries can reveal externalities and define cluster boundaries. For example, if computer hardware employment is nearly always associated geographically with software employment, this provides a strong indication of locational linkages.” This is an interesting supplement to the spatial results obtained using the Moran’s I. However, it captures clustering propensities across rather than within industries, and although it takes into account spatial relationships (i.e., co-location), it does not capture spillovers across county or state lines. In this study, we define clusters as those industries that have a locational correlation of greater than 0.75 across any two pair of industries.

Input-Output Analysis

Input-output (also known as make-and-use) models track flows of goods and services among industries of an economy. Early in the 20th Century, Russian planner W. Leontief devised this mathematical tool to describe the Soviet economy; his goal was to improve the functioning of the economy by better understanding and modeling the flows of inputs and outputs across its various sectors. I-O analysis can be used to measure the relative importance of different industries or sectors within the economy (Sporleder 2003, page 2) and also to calculate so-called economic multipliers. For example, it can be used to address the question, if a given manufacturing facility

expands production, by how much do jobs, earnings and output increase in the overall local economy (beyond the direct effects that occur at the facility).

For this analysis, we use the IMPLAN software and data for Pennsylvania to carry out the input-output analysis following Sporleder’s (2003) work in Ohio. In essence, the approach allows us to identify the horizontal and vertical links and interrelationships among agricultural producers and food manufacturers in a given county. Again, this procedure involves a number of important assumptions, as described in greater detail Shaffer et al. 2004. Following Sporleder, we define five components to delineate the cluster: (1) farm inputs and machinery, (2) on-farm production, (3) food and forestry products processing, (4) food and forestry products wholesale and retail, and (5) food services. Readers are cautioned that including food services is a potential concern, because the sector traditionally is not normally considered part of the economic (or export) base.

IMPLAN provides estimates of total jobs, earnings, output and value-added in each sector of the local economy, in addition to economic multipliers for the sectors of interest. These numbers can then in turn be used to identify the top 25 clusters in a county, following the approach in Muench and Deller (2001). The information generated can then be used to identify opportunities for import substitution, by focusing on those goods and services that are used locally but imported into the state. Further, we search for gaps or disconnects by singling out industries with specific commodities that are purchased by local businesses that are not produced in Pennsylvania. Also, the local purchasing patterns (or the local purchase coefficient) is scrutinized by verifying the amount of goods and services that are imported from outside the state.

Section 2: Results

We present the results of our study in the same order as the sequence of analytical tools listed above. Our study area in the Northeast region, as defined by the USDA, includes Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Rhode Island, Pennsylvania, Vermont and West Virginia. A key purpose of our work is to show that different analytical tools identify different combinations and sets of food and agricultural clusters. Thus, caution is needed when comparing the results obtained from different methods.

Table 1 shows the six-digit food industries from the 2001 County Business Patterns that are included in this study. This is the most current year for which data are presently available.

Table 1. NAICS Codes for the Food Industry.

NAICS	Industry Title
311111	Dog & cat food manufacturing
311119	Other animal food manufacturing
311211	Flour milling
311213	Malt manufacturing
311221	Wet corn milling
311222	Soybean processing
311223	Other oilseed processing
311225	Fats & oils refining & blending

311230	Breakfast cereal manufacturing
311311	Sugarcane mills
311312	Cane sugar refining
311313	Beet sugar manufacturing
311320	Chocolate & confectionery manufacturing from cacao beans
311330	Confectionery manufacturing from purchased chocolate
311340	Non-chocolate confectionery manufacturing
311411	Frozen fruit, juice & vegetable manufacturing
311412	Frozen specialty food manufacturing
311421	Fruit & vegetable canning
311422	Specialty canning
311423	Dried & dehydrated food manufacturing
311511	Fluid milk manufacturing
311512	Creamery butter manufacturing
311513	Cheese manufacturing
311514	Dry, condensed, evaporated dairy product manufacturing
311520	Ice cream & frozen dessert manufacturing
311611	Animal (except poultry) slaughtering
311612	Meat processed from carcasses
311613	Rendering & meat by-product processing
311615	Poultry processing
311711	Seafood canning
311712	Fresh & frozen seafood processing
311811	Retail bakeries
311812	Commercial bakeries
311813	Frozen cakes, pies & other pastries manufacturing
311821	Cookie & cracker manufacturing
311822	Flour mixes & dough manufacturing from purchased flour
311823	Dry pasta manufacturing
311830	Tortilla manufacturing
311911	Roasted nuts & peanut butter manufacturing
311919	Other snack food manufacturing
311920	Coffee & tea manufacturing
311930	Flavoring syrup & concentrate manufacturing
311941	Mayonnaise, dressing & other prepared sauce manufacturing
311942	Spice & extract manufacturing
311991	Perishable prepared food manufacturing
311999	All other miscellaneous food manufacturing
312111	Soft drink manufacturing
312112	Bottled water manufacturing
312113	Ice manufacturing
312120	Breweries
312130	Wineries
312140	Distilleries
312210	Tobacco stemming & redrying
312221	Cigarette manufacturing
312229	Other tobacco product manufacturing

Source: County Business Patterns, 2001 (accessed 2004)

Local Employment Analysis

Table 2 shows food industry employment in 2001, the percent of total cluster employment, and employment growth rate between 1998 and 2001 for the entire Northeast U.S. The employment data are based on the number of employees for the week including March 12 and represent the sum of each Northeast states' employment. Due to data suppression, employment data had to be imputed using the mid-point of categorical data in a number of cases.

The industries are sorted in descending order of 2001 employment. The most significant industries by employment are commercial bakeries, poultry processing, retail bakeries, soft drink manufacturing, meat processed from carcasses and fluid milk manufacturing. However, employment rank does not predict employment growth well. With the exception of commercial bakeries, the other top employment rank industry clusters all have negative employment growth rate during 1998 and 2001.

One question that is raised by this analysis is whether or not commercial bakeries are important clusters that represent potential engines of regional economic growth. If the products of these bakeries are exported outside the region of interest (whatever that may be), then they would qualify potentially. However, if they are not – that is if the bakeries are not part of the economic base but are important only because the Northeast has large population centers – then they would not qualify as a potential cluster.

Table 2. Industry Employment and Employment Growth, Northeast US.

NAICS	Industry Title	2001 Employment	% of total Industry Employment	Employment Growth 98-01
311812	Commercial bakeries	36983	14.14	3.15%
311615	Poultry processing	19629	7.51	-10.35%
311811	Retail bakeries	18409	7.04	-8.23%
312111	Soft drink manufacturing	14723	5.63	-1.21%
311612	Meat processed from carcasses	13110	5.01	-6.44%
311511	Fluid milk manufacturing	13102	5.01	-3.36%
311330	Confectionery manuf. frm. prchsd choc.	11305	4.32	-4.89%
311421	Fruit & vegetable canning	8020	3.07	-25.45%
311611	Animal (except poultry) slaughtering	7685	2.94	9.96%
311821	Cookie & cracker manufacturing	7552	2.89	-15.84%
311919	Other snack food manufacturing	7184	2.75	-17.73%
311520	Ice cream & frozen dessert manuf.	6398	2.45	7.37%
311999	All other misc. food manufacturing	6273	2.40	7.23%
311513	Cheese manufacturing	6164	2.36	6.17%
311340	Nonchocolate confectionery manuf.	5875	2.25	17.97%
311320	Choc. & confect. manuf. frm cacao beans	5777	2.21	-7.73%
311412	Frozen specialty food manufacturing	5564	2.13	-9.60%
312120	Breweries	5501	2.10	-19.99%
311712	Fresh & frozen seafood processing	5002	1.91	2.12%
311119	Other animal food manufacturing	4823	1.84	22.35%
311422	Specialty canning	4025	1.54	26.18%

311411	Frozen fruit, juice & vegetable manuf.	3836	1.47	5.85%
311813	Frozen cakes, pies & othr pastries manuf.	3686	1.41	-13.11%
311991	Perishable prepared food manufacturing	3594	1.37	6.36%
311942	Spice & extract manufacturing	3378	1.29	19.15%
311941	Mayonnaise, dressing & othr prep. sauce manufacturing	2790	1.07	-5.93%
311920	Coffee & tea manufacturing	2736	1.05	9.13%
312130	Wineries	2570	0.98	22.09%
311111	Dog & cat food manufacturing	2521	0.96	-1.91%
311822	Flour mixes & dough manufacturing from purchased flour	2477	0.95	3.21%
311711	Seafood canning	2162	0.83	16.99%
312229	Other tobacco product manufacturing	2075	0.79	106.47%
311230	Breakfast cereal manufacturing	1875	0.72	0.00%
311514	Dry, cond., evap. dairy product manuf.	1753	0.67	-2.34%
311211	Flour milling	1639	0.63	35.57%
311823	Dry pasta manufacturing	1298	0.50	2.93%
311312	Cane sugar refining	1135	0.43	-24.83%
312112	Bottled water manufacturing	1060	0.41	44.02%
312113	Ice manufacturing	1056	0.40	13.30%
312140	Distilleries	1043	0.40	7.53%
311930	Flavoring syrup & concentrate manuf.	998	0.38	-11.92%
311613	Rendering & meat by-product processing	979	0.37	6.07%
311911	Roasted nuts & peanut butter manuf.	875	0.33	10.90%
311225	Fats & oils refining & blending	690	0.26	-5.48%
311423	Dried & dehydrated food manufacturing	661	0.25	-12.45%
311222	Soybean processing	325	0.12	-21.69%
311830	Tortilla manufacturing	270	0.10	38.46%
311512	Creamery butter manufacturing	255	0.10	218.75%
311221	Wet corn milling	195	0.07	0.00%
311213	Malt manufacturing	140	0.05	7.69%
311223	Other oilseed processing	120	0.05	100.00%
311313	Beet sugar manufacturing	70	0.03	16.67%
312210	Tobacco stemming & redrying	70	0.03	-41.67%
312221	Cigarette manufacturing	70	0.03	0.00%
311311	Sugarcane mills	30	0.01	50.00%

Commercial bakeries were the largest employers across the region in this overall sector, with moderate to slow employment growth over the period studied. To a large extent, this likely reflects growth in population along the eastern seaboard, rather than the emergence of a nationally competitive sector (but this warrants further analysis; also, the data do not reflect, obviously, the low-carb food trend that has been popularized by the Atkins and other diets). Retail bakeries, the third largest sector as measured by employment, experienced a noticeable decline in employment, although that was smaller than the decline in poultry processing and fruit & vegetable canning.

These trends need to be dissected further, to determine if these particular industries are merely going through their own business cycle (which is less likely because the demand for food is very stable over time), and whether the employment reductions are due to labor-saving technological

change, outsourcing of jobs, or both. Here it would also be important to determine if production is shifting to other parts of the nation as relative competitive advantages change, or to foreign locations. This additional analysis is beyond the scope of this technical report, and requires the insights of knowledgeable industry observers (rather than sole reliance on secondary data). It is important to note that manufacturing activity overall was also in decline over the period analyzed.

Some of the obvious outliers in the table are worthy of additional analysis, such as the very rapid increase in Creamery Butter Manufacturing and Other Tobacco Products. The increase in bottled water manufacturing is noteworthy, and likely represents the increased marketing of that particular product, as consumers are willing to spend more money on a re-packaged commodity.

In general, the results of this LEA show which sector is most important in terms of employment within the food industry complex, and how the employment base is shifting over time among the different industries as competitive and other pressures come into play. This kind of analysis can obviously be repeated for individual states and counties within the Northeast, to determine how jobs are being reallocated spatially. Nevertheless, the analysis of secondary data is only a first step.

Location Quotient

We calculate six-digit food industry location quotients (LQ) for each Northeast state using imputed employment data for 2001 and 1998, and list the industries with a 1998 location quotient of greater than 1.25 in Table 3, along with the 2001 LQ. This cut-off point is arbitrary, but preferred by some analysts. Also, as noted earlier, some key assumptions are necessary in using this measure, including that consumers everywhere have similar tastes and preferences.

The industry clusters are sorted in descending order by 2001 LQ for each state. The interpretation of the results is that a larger LQ points to a potential industry cluster. Again, however, the results have to be viewed with caution. If consumers in Connecticut have disproportionately stronger preferences for products manufactured by retail bakeries, then the high LQ of 3.65 in Table 3 would not be unexpected. However, if Connecticut residents are like other Americans in terms of their consumption of bakery products, then the high LQ could indicate a clustered industry that has a strong export focus (perhaps supplying cafeterias in New York City or Boston). Of course, the LQ is calculated here using employment numbers; to determine if the industry is also potentially competitive, it would be important to see how many firms are in fact located in that state.

It is interesting to note how the location quotient changes over time, sometimes increasing noticeably and in other cases declining, in response to dynamically changing competitive positions of the industries in the different states – both relative to other states in the Northeast and to other states outside the region. In some cases, changing LQs appear to reflect firms relocating from one state in the Northeast to another. For example, Connecticut's LQ for confectionary manufacturing from purchased chocolate declined from 3.46 to 2.03 between 1998 and 2001, while Massachusetts' LQ increased from 2.51 to 3.65. It is possible that this reflects a relocation of firms in

this NAICS code from Massachusetts to bordering Connecticut. That state also experienced a significant increase in coffee and tea manufacturing.

Delaware increased its employment concentration in seafood canning (with the LQ rising from 10.73 to 14.01), but lost considerable activity in fruit and vegetable canning (with the LQ slipping from 2.07 to 0.55). In New York, the LQ for seafood canning slipped slightly, from 1.27 to 1.14. It is important to reiterate that the LQ is a relative concept, and that in Delaware total employment in fruit and vegetable canning may still exceed total employment in seafood canning, even after the apparent loss of competitive advantage.

Table 3. Industry Clusters by 2001 and 1998 Location Quotients.

Connecticut			
NAICS	Industry Cluster	LQ01	LQ98
311920	Coffee & tea manufacturing	6.03	2.14
311520	Ice cream & frozen dessert manufacturing	3.75	2.83
311811	Retail bakeries	3.65	4.72
311919	Other snack food manufacturing	2.58	3.38
312113	Ice manufacturing	2.31	1.97
311823	Dry pasta manufacturing	2.29	1.77
311822	Flour mixes & dough manufacturing from purchased flour	2.21	1.80
311813	Frozen cakes, pies & other pastries manufacturing	2.14	2.20
311812	Commercial bakeries	2.14	2.59
311330	Confectionery manufacturing from purchased chocolate	2.03	3.46
312229	Other tobacco product manufacturing	1.75	1.43
311612	Meat processed from carcasses	1.51	1.40
311511	Fluid milk manufacturing	1.28	1.38
Delaware			
NAICS	Industry Cluster	LQ01	LQ98
311711	Seafood canning	14.01	10.73
311615	Poultry processing	5.10	4.93
311999	All other miscellaneous food manufacturing	3.17	2.77
311222	Soybean processing	1.51	1.46
311421	Fruit & vegetable canning	0.55	2.07
Massachusetts			
NAICS	Industry Cluster	LQ01	LQ98
311520	Ice cream & frozen dessert manufacturing	6.03	5.50
311712	Fresh & frozen seafood processing	3.97	3.12
311941	Mayonnaise, dressing & other prepared sauce manuf.	3.65	2.41
311330	Confectionery manufacturing from purchased chocolate	3.27	2.51
311811	Retail bakeries	2.41	2.91
311822	Flour mixes & dough manufacturing from purchased flour	2.38	1.68
311920	Coffee & tea manufacturing	2.08	1.90
311511	Fluid milk manufacturing	2.06	2.10
312140	Distilleries	2.02	1.84
312112	Bottled water manufacturing	2.01	1.99
311230	Breakfast cereal manufacturing	1.96	1.99
311222	Soybean processing	1.85	2.01
311812	Commercial bakeries	1.70	1.89
312111	Soft drink manufacturing	1.57	1.61

311813	Frozen cakes, pies & other pastries manufacturing	1.41	2.02
311823	Dry pasta manufacturing	0.79	2.26
311930	Flavoring syrup & concentrate manufacturing	0.68	2.13
Maryland			
NAICS	Industry Cluster	LQ01	LQ98
311942	Spice & extract manufacturing	10.67	10.07
311312	Cane sugar refining	8.93	14.68
312140	Distilleries	5.19	4.78
311225	Fats & oils refining & blending	3.83	3.30
311520	Ice cream & frozen dessert manufacturing	3.17	2.84
312111	Soft drink manufacturing	2.23	2.06
311712	Fresh & frozen seafood processing	1.88	1.62
311613	Rendering & meat by-product processing	1.88	1.65
311941	Mayonnaise, dressing & other prepared sauce manuf.	1.49	2.77
311812	Commercial bakeries	1.32	1.56
311511	Fluid milk manufacturing	1.32	1.64
311615	Poultry processing	1.10	1.28
311991	Perishable prepared food manufacturing	0.64	1.65
Maine			
NAICS	Industry Cluster	LQ01	LQ98
311711	Seafood canning	26.16	27.55
312112	Bottled water manufacturing	9.56	6.90
311411	Frozen fruit, juice & vegetable manufacturing	6.71	9.03
311512	Creamery butter manufacturing	5.13	1.29
312140	Distilleries	4.49	5.53
311221	Wet corn milling	2.78	3.92
312113	Ice manufacturing	1.77	2.59
311813	Frozen cakes, pies & other pastries manufacturing	1.64	2.35
311712	Fresh & frozen seafood processing	1.57	2.19
311422	Specialty canning	1.56	2.31
311511	Fluid milk manufacturing	1.33	1.36
311612	Meat processed from carcasses	0.58	1.71
New Hampshire			
NAICS	Industry Cluster	LQ01	LQ98
312120	Breweries	10.18	10.78
311712	Fresh & frozen seafood processing	4.71	4.46
312112	Bottled water manufacturing	4.58	5.24
311612	Meat processed from carcasses	3.47	3.79
311511	Fluid milk manufacturing	2.94	3.00
311320	Choc & confectionery manufacturing from cacao beans	2.71	2.59
311920	Coffee & tea manufacturing	2.21	2.14
311813	Frozen cakes, pies & other pastries manufacturing	1.68	1.78
311412	Frozen specialty food manufacturing	1.65	1.67
311811	Retail bakeries	1.45	1.37
311822	Flour mixes & dough manufacturing from purchased flour	0.29	1.79
311991	Perishable prepared food manufacturing	0.18	1.25
New Jersey			
NAICS	Industry Cluster	LQ01	LQ98
311711	Seafood canning	7.93	3.80
311930	Flavoring syrup & concentrate manufacturing	3.81	3.82

311823	Dry pasta manufacturing	3.77	3.30
311942	Spice & extract manufacturing	3.49	2.25
311811	Retail bakeries	3.02	3.02
311920	Coffee & tea manufacturing	2.92	2.00
311821	Cookie & cracker manufacturing	2.73	3.41
311822	Flour mixes & dough manufacturing from purchased flour	2.43	2.30
311422	Specialty canning	2.31	2.25
311320	Choc & confectionery manufacturing from cacao beans	2.17	3.31
311999	All other miscellaneous food manufacturing	1.89	2.08
312111	Soft drink manufacturing	1.79	1.47
311340	Nonchocolate confectionery manufacturing	1.29	1.40
311941	Mayonnaise, dressing & other prepared sauce manuf.	1.28	3.42
312120	Breweries	1.17	2.58
311421	Fruit & vegetable canning	1.17	1.35
New York			
NAICS	Industry Cluster	LQ01	LQ98
311312	Cane sugar refining	5.57	5.07
311811	Retail bakeries	2.97	2.94
311320	Choc & confectionery manufacturing from cacao beans	2.11	2.03
312113	Ice manufacturing	2.07	1.43
311421	Fruit & vegetable canning	2.06	1.81
311513	Cheese manufacturing	1.90	1.70
312130	Wineries	1.87	2.49
311812	Commercial bakeries	1.79	1.96
311520	Ice cream & frozen dessert manufacturing	1.71	1.62
311511	Fluid milk manufacturing	1.70	1.63
311230	Breakfast cereal manufacturing	1.62	1.66
311991	Perishable prepared food manufacturing	1.55	1.49
311213	Malt manufacturing	1.53	1.67
311920	Coffee & tea manufacturing	1.50	1.85
312120	Breweries	1.48	1.68
311821	Cookie & cracker manufacturing	1.42	1.35
312111	Soft drink manufacturing	1.33	1.54
311330	Confectionery manufacturing from purchased chocolate	1.22	1.53
311711	Seafood canning	1.14	1.27
Pennsylvania			
NAICS	Industry Cluster	LQ01	LQ98
311320	Choc & confectionery manufacturing from cacao beans	7.92	7.81
312229	Other tobacco product manufacturing	5.27	2.22
311919	Other snack food manufacturing	3.91	3.34
311330	Confectionery manufacturing from purchased chocolate	3.32	3.83
311422	Specialty canning	3.12	2.18
311813	Frozen cakes, pies & other pastries manufacturing	2.53	3.16
311821	Cookie & cracker manufacturing	1.95	1.75
311340	Nonchocolate confectionery manufacturing	1.82	1.63
311111	Dog & cat food manufacturing	1.80	1.71
311511	Fluid milk manufacturing	1.33	1.32
311823	Dry pasta manufacturing	1.29	1.34
311421	Fruit & vegetable canning	0.69	1.42
Rhode Island			

NAICS	Industry Cluster	LQ01	LQ98
311920	Coffee & tea manufacturing	7.51	5.98
311340	Nonchocolate confectionery manufacturing	7.39	6.54
311823	Dry pasta manufacturing	6.10	4.95
311811	Retail bakeries	3.61	5.65
312111	Soft drink manufacturing	2.67	2.33
311712	Fresh & frozen seafood processing	2.56	2.00
311812	Commercial bakeries	2.05	2.03
311520	Ice cream & frozen dessert manufacturing	1.60	1.30
311991	Perishable prepared food manufacturing	1.28	3.50
312130	Wineries	1.20	1.30
311930	Flavoring syrup & concentrate manufacturing	0.88	4.68
311813	Frozen cakes, pies & other pastries manufacturing	0.33	1.71
Vermont			
NAICS	Industry Cluster	LQ01	LQ98
311320	Choc & confectionery manufacturing from cacao beans	13.56	6.21
311514	Dry, condensed, evaporated dairy product manufacturing	9.02	9.05
311520	Ice cream & frozen dessert manufacturing	6.89	6.97
311513	Cheese manufacturing	6.27	8.24
311822	Flour mixes & dough manufacturing from purchased flour	4.07	1.48
311213	Malt manufacturing	3.27	3.64
311119	Other animal food manufacturing	2.60	1.98
311511	Fluid milk manufacturing	2.35	2.47
312120	Breweries	1.90	2.07
311941	Mayonnaise, dressing & other prepared sauce manuf.	1.56	1.64
311812	Commercial bakeries	0.84	1.82
312112	Bottled water manufacturing	0.61	4.31
West Virginia			
NAICS	Industry Cluster	LQ01	LQ98
312229	Other tobacco product manufacturing	8.24	5.52
312113	Ice manufacturing	3.73	7.57
311615	Poultry processing	3.32	3.52
311613	Rendering & meat by-product processing	2.27	1.41
311812	Commercial bakeries	1.48	2.34
311511	Fluid milk manufacturing	0.96	1.36

Table 3 reveals that chocolate & confectionery manufacturing from cacao beans (PA), coffee & tea manufacturing (CT), sea food canning (DE), ice cream & frozen dessert manufacturing (MA), spice & extract manufacturing (MD), breweries (NH), cane sugar refining (NY) and other tobacco product manufacturing (WV) are the top industry clusters, based on 2001 location quotients, in the Northeast states.

Shift Share Analysis

With shift share analysis we can decompose total employment change in any given industry into three components of change: one due to national growth, one due to a favorable or non-favorable mix of existing jobs, and one due to the fact that the state's economy is more or less competitive

than that of other states in the Northeast. Adding up these three components yields the total change in the number of jobs over time. Industries with growth due to positive competitive advantage (in a sense, the ability to draw jobs away from other states because of favorable local conditions) are listed in Table 4. The industries are sorted according to declining competitive advantage for each state, as measured by the total number of jobs generated because the state was more competitive in that industry than the nation (or other states). The national component is small in most places because not much growth occurred in this industry nationally over the period studied, reflecting a general slump in overall manufacturing.

Table 4. Shift Share Analysis for the Food Industry.

Pennsylvania				
NAICS	Industry Cluster	National	Competitive	Mix
312229	Other tobacco product manufacturing	1	995	3
311422	Specialty canning	3	738	103
311919	Other snack food manufacturing	11	689	-1165
311119	Other animal food manufacturing	3	654	27
311812	Commercial bakeries	15	410	139
311999	All other miscellaneous food manufacturing	2	312	-63
311821	Cookie & cracker manufacturing	7	288	-521
311520	Ice cream & frozen dessert manufacturing	2	287	-56
311340	Nonchocolate confectionery manufacturing	4	204	86
312112	Bottled water manufacturing	0	136	4
311941	Mayonnaise, dressing & other prepared sauce manuf.	1	118	-3
311512	Creamery butter manufacturing	0	110	5
312111	Soft drink manufacturing	7	76	-76
311942	Spice & extract manufacturing	1	69	51
311423	Dried & dehydrated food manufacturing	1	40	-41
311111	Dog & cat food manufacturing	3	36	-51
311412	Frozen specialty food manufacturing	3	32	-36
312140	Distilleries	0	20	-21
311514	Dry, condensed, evaporated dairy product manufacturing	1	19	-20
312210	Tobacco stemming & redrying	0	17	-18
311911	Roasted nuts & peanut butter manufacturing	0	15	-4
311411	Frozen fruit, juice & vegetable manufacturing	1	13	-13
311920	Coffee & tea manufacturing	0	11	-11
311830	Tortilla manufacturing	0	10	5
311711	Seafood canning	0	10	-10
311230	Breakfast cereal manufacturing	1	10	-11
311613	Rendering & meat by-product processing	1	2	-22
311211	Flour milling	1	2	-2
Connecticut				
NAICS	Industry Cluster	National	Competitive	Mix
311920	Coffee & tea manufacturing	0	211	-11
311991	Perishable prepared food manufacturing	0	109	6
311423	Dried & dehydrated food manufacturing	0	51	-1
311941	Mayonnaise, dressing & other prepared sauce manuf.	0	50	0

311930	Flavoring syrup & concentrate manufacturing	0	50	0
312112	Bottled water manufacturing	0	49	1
312130	Wineries	0	47	3
311520	Ice cream & frozen dessert manufacturing	1	26	-17
311712	Fresh & frozen seafood processing	0	14	-14
311999	All other miscellaneous food manufacturing	0	8	-9
311421	Fruit & vegetable canning	0	8	-8
312111	Soft drink manufacturing	1	7	-8
311412	Frozen specialty food manufacturing	0	3	-4
311514	Dry, condensed, evaporated dairy product manufacturing	0	3	-3
311823	Dry pasta manufacturing	0	3	-3
311320	Choc & confectionery manufacturing from cacao beans	0	1	-1
311111	Dog & cat food manufacturing	0	0	0
311822	Flour mixes & dough manufacturing from purchased flour	0	0	-1
311211	Flour milling	0	0	0

Delaware

NAICS	Industry Cluster	National	Competitive	Mix
311811	Retail bakeries	0	73	-14
311711	Seafood canning	1	61	-61
311513	Cheese manufacturing	0	49	1
311999	All other miscellaneous food manufacturing	1	35	-37
312111	Soft drink manufacturing	0	3	-4
311411	Frozen fruit, juice & vegetable manufacturing	0	2	-2
311511	Fluid milk manufacturing	0	1	-2
311920	Coffee & tea manufacturing	0	1	-1
311520	Ice cream & frozen dessert manufacturing	0	0	0

Massachusetts

NAICS	Industry Cluster	National	Competitive	Mix
311712	Fresh & frozen seafood processing	3	492	-145
311330	Confectionery manufacturing from purchased chocolate	2	442	60
311340	Nonchocolate confectionery manufacturing	1	287	18
311941	Mayonnaise, dressing & other prepared sauce manuf.	1	267	-4
311612	Meat processed from carcasses	2	259	66
311520	Ice cream & frozen dessert manufacturing	3	197	-75
311822	Flour mixes & dough manufacturing from purchased flour	1	171	-1
311611	Animal (except poultry) slaughtering	0	125	11
311613	Rendering & meat by-product processing	0	119	-4
311999	All other miscellaneous food manufacturing	1	86	-18
311991	Perishable prepared food manufacturing	1	83	35
311711	Seafood canning	0	55	-2
311423	Dried & dehydrated food manufacturing	0	51	-1
311830	Tortilla manufacturing	0	49	1
311911	Roasted nuts & peanut butter manufacturing	0	48	-4
312130	Wineries	0	47	3
311920	Coffee & tea manufacturing	1	42	-23
311411	Frozen fruit, juice & vegetable manufacturing	0	36	-1
312113	Ice manufacturing	0	20	2
312140	Distilleries	0	20	-21

311821	Cookie & cracker manufacturing	0	14	-32
311511	Fluid milk manufacturing	3	13	-17
311320	Choc & confectionery manufacturing from cacao beans	0	13	-13
311514	Dry, condensed, evaporated dairy product manufacturing	0	9	-9
312111	Soft drink manufacturing	3	7	-34
312112	Bottled water manufacturing	0	6	16
311111	Dog & cat food manufacturing	0	6	-7
311230	Breakfast cereal manufacturing	1	5	-6
311311	Sugarcane mills	0	2	-2
311211	Flour milling	0	0	0

Maryland

NAICS	Industry Cluster	National	Competitive	Mix
311811	Retail bakeries	1	1059	-61
311119	Other animal food manufacturing	0	196	3
311211	Flour milling	0	66	-1
311712	Fresh & frozen seafood processing	1	61	-62
311612	Meat processed from carcasses	1	60	39
311813	Frozen cakes, pies & other pastries manufacturing	0	50	0
311920	Coffee & tea manufacturing	0	48	-11
312130	Wineries	0	47	3
312111	Soft drink manufacturing	3	32	-36
311520	Ice cream & frozen dessert manufacturing	1	32	-32
311225	Fats & oils refining & blending	1	31	-32
311822	Flour mixes & dough manufacturing from purchased flour	0	28	0
311340	Nonchocolate confectionery manufacturing	0	25	7
311421	Fruit & vegetable canning	1	17	-18
311613	Rendering & meat by-product processing	0	11	-12
311711	Seafood canning	0	10	-10
312140	Distilleries	1	6	-44
311111	Dog & cat food manufacturing	0	6	-7
311411	Frozen fruit, juice & vegetable manufacturing	0	6	-6
311320	Choc & confectionery manufacturing from cacao beans	0	4	-4
311514	Dry, condensed, evaporated dairy product manufacturing	0	3	-3
311821	Cookie & cracker manufacturing	0	1	-1
311911	Roasted nuts & peanut butter manufacturing	0	1	-1
311823	Dry pasta manufacturing	0	0	0

Maine

NAICS	Industry Cluster	National	Competitive	Mix
311812	Commercial bakeries	1	2985	13
311711	Seafood canning	1	183	-111
312112	Bottled water manufacturing	0	181	19
311511	Fluid milk manufacturing	1	136	-4
311421	Fruit & vegetable canning	0	118	-3
311330	Confectionery manufacturing from purchased chocolate	0	112	3
311811	Retail bakeries	1	67	-25
311411	Frozen fruit, juice & vegetable manufacturing	3	58	-62
311412	Frozen specialty food manufacturing	0	50	0
311512	Creamery butter manufacturing	0	49	1

312140	Distilleries	0	20	-21
312111	Soft drink manufacturing	0	3	-4
311999	All other miscellaneous food manufacturing	0	3	-3
311311	Sugarcane mills	0	2	-2
311821	Cookie & cracker manufacturing	0	1	-1
311712	Fresh & frozen seafood processing	1	1	-34
311320	Choc & confectionery manufacturing from cacao beans	0	1	-1
311613	Rendering & meat by-product processing	0	1	-1
311920	Coffee & tea manufacturing	0	1	-1
311941	Mayonnaise, dressing & other prepared sauce manuf.	0	0	0
311822	Flour mixes & dough manufacturing from purchased flour	0	0	0

New Hampshire

NAICS	Industry Cluster	National	Competitive	Mix
312111	Soft drink manufacturing	0	116	-1
312140	Distilleries	0	51	-1
312113	Ice manufacturing	0	50	0
311712	Fresh & frozen seafood processing	1	30	-31
311811	Retail bakeries	0	14	-14
311320	Choc & confectionery manufacturing from cacao beans	0	4	-4
311920	Coffee & tea manufacturing	0	4	-4
311412	Frozen specialty food manufacturing	0	3	-4
311999	All other miscellaneous food manufacturing	0	3	-3
311511	Fluid milk manufacturing	1	3	-4
311919	Other snack food manufacturing	0	2	-2
311711	Seafood canning	0	2	-2
311821	Cookie & cracker manufacturing	0	1	-1
311823	Dry pasta manufacturing	0	0	0
311520	Ice cream & frozen dessert manufacturing	0	0	0
311211	Flour milling	0	0	0

New Jersey

NAICS	Industry Cluster	National	Competitive	Mix
311812	Commercial bakeries	6	904	56
311611	Animal (except poultry) slaughtering	1	351	24
311711	Seafood canning	1	315	-67
312130	Wineries	0	298	17
312111	Soft drink manufacturing	4	264	-45
311942	Spice & extract manufacturing	1	259	61
311920	Coffee & tea manufacturing	1	176	-35
311612	Meat processed from carcasses	3	165	103
311712	Fresh & frozen seafood processing	1	81	-32
311919	Other snack food manufacturing	0	68	-26
311991	Perishable prepared food manufacturing	0	65	18
311330	Confectionery manufacturing from purchased chocolate	2	59	41
311223	Other oilseed processing	0	20	-20
311823	Dry pasta manufacturing	1	17	-18
311225	Fats & oils refining & blending	0	15	-15
311613	Rendering & meat by-product processing	0	11	-12
312140	Distilleries	0	7	-7

311111	Dog & cat food manufacturing	0	6	-7
311211	Flour milling	0	1	-1
New York				
NAICS	Industry Cluster	National	Competitive	Mix
311421	Fruit & vegetable canning	6	585	-156
311999	All other miscellaneous food manufacturing	2	445	-52
311211	Flour milling	1	377	-2
311513	Cheese manufacturing	4	359	134
311340	Nonchocolate confectionery manufacturing	2	357	34
311411	Frozen fruit, juice & vegetable manufacturing	1	309	-24
311811	Retail bakeries	11	278	-482
311511	Fluid milk manufacturing	6	264	-31
311119	Other animal food manufacturing	2	235	20
311941	Mayonnaise, dressing & other prepared sauce manuf.	1	232	-4
311823	Dry pasta manufacturing	0	208	-8
311813	Frozen cakes, pies & other pastries manufacturing	1	178	11
311611	Animal (except poultry) slaughtering	1	172	31
311911	Roasted nuts & peanut butter manufacturing	0	169	-4
311821	Cookie & cracker manufacturing	4	148	-273
312113	Ice manufacturing	0	126	11
311520	Ice cream & frozen dessert manufacturing	2	105	-53
311991	Perishable prepared food manufacturing	2	101	117
311312	Cane sugar refining	1	93	-95
311712	Fresh & frozen seafood processing	0	70	-9
311320	Choc & confectionery manufacturing from cacao beans	1	55	-56
311615	Poultry processing	1	52	17
312229	Other tobacco product manufacturing	0	50	0
311514	Dry, condensed, evaporated dairy product manufacturing	1	19	-20
312221	Cigarette manufacturing	0	17	-17
311822	Flour mixes & dough manufacturing from purchased flour	1	15	-1
311230	Breakfast cereal manufacturing	1	10	-11
311111	Dog & cat food manufacturing	1	6	-24
311225	Fats & oils refining & blending	0	5	-5
312112	Bottled water manufacturing	0	4	17
311613	Rendering & meat by-product processing	0	4	-4
311313	Beet sugar manufacturing	0	3	-4
Rhode Island				
NAICS	Industry Cluster	National	Competitive	Mix
311999	All other miscellaneous food manufacturing	0	50	0
312113	Ice manufacturing	0	50	0
311513	Cheese manufacturing	0	49	1
311712	Fresh & frozen seafood processing	0	14	-14
311920	Coffee & tea manufacturing	0	11	-11
311823	Dry pasta manufacturing	0	3	-3
311421	Fruit & vegetable canning	0	3	-3
311520	Ice cream & frozen dessert manufacturing	0	3	-3
311411	Frozen fruit, juice & vegetable manufacturing	0	2	-2
311711	Seafood canning	0	2	-2

311821	Cookie & cracker manufacturing	0	1	-1
311412	Frozen specialty food manufacturing	0	1	-1
311511	Fluid milk manufacturing	0	0	-1
311211	Flour milling	0	0	0
311822	Flour mixes & dough manufacturing from purchased flour	0	0	0
Vermont				
NAICS	Industry Cluster	National	Competitive	Mix
311320	Choc & confectionery manufacturing from cacao beans	0	213	-13
311999	All other miscellaneous food manufacturing	0	118	-3
311822	Flour mixes & dough manufacturing from purchased flour	0	115	0
311330	Confectionery manufacturing from purchased chocolate	0	112	3
311612	Meat processed from carcasses	0	111	4
311119	Other animal food manufacturing	0	69	3
311712	Fresh & frozen seafood processing	0	51	-1
311991	Perishable prepared food manufacturing	0	49	1
311412	Frozen specialty food manufacturing	0	20	-1
311514	Dry, condensed, evaporated dairy product manufacturing	1	19	-20
311520	Ice cream & frozen dessert manufacturing	1	17	-17
311811	Retail bakeries	0	14	-14
311821	Cookie & cracker manufacturing	0	8	-8
311611	Animal (except poultry) slaughtering	0	4	4
312111	Soft drink manufacturing	0	3	-4
311511	Fluid milk manufacturing	1	3	-4
311421	Fruit & vegetable canning	0	3	-3
311919	Other snack food manufacturing	0	2	-2
311823	Dry pasta manufacturing	0	0	0
311941	Mayonnaise, dressing & other prepared sauce manuf.	0	0	0
311911	Roasted nuts & peanut butter manufacturing	0	0	0
311211	Flour milling	0	0	0
West Virginia				
NAICS	Industry Cluster	National	Competitive	Mix
311520	Ice cream & frozen dessert manufacturing	0	118	-3
311821	Cookie & cracker manufacturing	0	51	-1
311811	Retail bakeries	0	14	-14
311919	Other snack food manufacturing	0	12	-12
311421	Fruit & vegetable canning	0	8	-8
311613	Rendering & meat by-product processing	0	4	-4
311320	Choc & confectionery manufacturing from cacao beans	0	1	-1
311823	Dry pasta manufacturing	0	0	0
311412	Frozen specialty food manufacturing	0	0	0
311211	Flour milling	0	0	0

The results of the shift share analysis suggest that coffee & tea manufacturing (CT), other tobacco product manufacturing (PA), retail bakeries (DE, MD), fresh & frozen seafood processing (MA), commercial bakeries (ME, NJ), soft drink manufacturing (NH), fruit & vegetable canning

(NY), chocolate & confectionery manufacturing from cacao beans (VT), all other miscellaneous foods and ice manufacturing (RI) and ice cream & frozen dessert manufacturing (WV) are the most competitive industries in the Northeast states.

This shows, again, that these results have to be interpreted with great care. For example, Maine is highly competitive according to the shift share analysis in commercial bakeries (according to these results), but that sector does not show up prominently in the location quotient results.

Wages

Another important aspect of cluster activity is that of wages. In this study, wage data are calculated by aggregated annual payroll divided by employees for the Northeast. Due to data suppression, some industry clusters have no payroll data in the County Business Patterns file. The results are provided in Table 5. It is apparent that the ranking by average annual wages does not follow the order of the employment ranking.

Spice and extract manufacturing had the highest average annual wages in 2001, at \$45,251. Cookie and cracker manufacturing followed with a wage of \$37,566. A gradual decline in wages is observed for each subsequent cluster, until we reach fresh and frozen seafood processing where the drop is more significant. The overall average wage range ranges from a low of \$1,794 to a high of \$45,251. There is clearly some concern about the reliability of these low wage numbers, which like represent seasonal employment and other statistical problems related to the data suppression used, and they need to be interpreted with extreme caution.

Table 5. Average Wages and Wage Growth.

NAICS	Industry Cluster Title	2001 Average Wages	1998 Average Wages	Wage Growth 98-01
311942	Spice & extract manufacturing	45251	42557	6.33%
311821	Cookie & cracker manufacturing	37566	33444	12.32%
311930	Flavoring syrup & concentrate manufacturing	35125	27846	26.14%
311320	Chocolate & confectionery manuf. from cacao beans	32380	28677	12.91%
312111	Soft drink manufacturing	31636	20512	54.23%
311511	Fluid milk manufacturing	31388	27154	15.59%
311513	Cheese manufacturing	29612	26729	10.78%
311919	Other snack food manufacturing	29332	23776	23.37%
311111	Dog & cat food manufacturing	28390	29693	-4.39%
311611	Animal (except poultry) slaughtering	27558	24443	12.74%
311612	Meat processed from carcasses	27363	28116	-2.68%
311911	Roasted nuts & peanut butter manufacturing	27331	26563	2.89%
311813	Frozen cakes, pies & other pastries manufacturing	27020	25062	7.81%
311991	Perishable prepared food manufacturing	26227	20846	25.81%
311119	Other animal food manufacturing	26073	22894	13.89%
311340	Nonchocolate confectionery manufacturing	26053	19765	31.81%
311812	Commercial bakeries	25338	25086	1.01%
311999	All other miscellaneous food manufacturing	25039	12043	107.91%

311330	Confectionery manufacturing from purchased chocolate	24544	24144	1.66%
311941	Mayonnaise, dressing & other prepared sauce manuf.	23485	33174	-29.21%
311822	Flour mixes & dough manufacturing from purchased flour	22474	5796	287.73%
311920	Coffee & tea manufacturing	22164	28486	-22.19%
311712	Fresh & frozen seafood processing	18364	2607	604.41%
311520	Ice cream & frozen dessert manufacturing	18149	29090	-37.61%
311811	Retail bakeries	13952	7407	88.35%
311613	Rendering & meat by-product processing	11764	13610	-13.56%
311615	Poultry processing	11516	8845	30.19%
312120	Breweries	11165	21576	-48.25%
311412	Frozen specialty food manufacturing	10547	15188	-30.56%
311711	Seafood canning	8647	16655	-48.08%
311411	Frozen fruit, juice & vegetable manufacturing	8179	11562	-29.26%
311823	Dry pasta manufacturing	7919	8655	-8.50%
311421	Fruit & vegetable canning	6213	26586	-76.63%
311211	Flour milling	5350	5065	5.63%
312113	Ice manufacturing	1794	12337	-85.46%

Bubble Chart Analysis

To illustrate employment, employment growth, wages and location quotients in one chart for different industries, we created bubble charts to help visualize clusters in each state. In the bubble chart, 1998 wages are plotted along the *x*-axis, while the *y*-axis measures job growth between 1998 and 2001. The size (radius) of the circle reflects the number of employees in 1998, while the color of the bubble represents location quotients. The purple color represents location quotient greater than 2.5, blue greater than 2 but equal to or less than 2.5, and yellow a location quotient greater than 1.5 but less than or equal to 2. White represents location quotient less than or equal to 1.5. Results for Pennsylvania, Connecticut, Massachusetts, Maryland, and New Jersey are shown in Figures 1-5 (these are the states for which the data are reasonably reliable; for the states that are not shown, we lacked sufficient confidence in the data reported at the level of states).

Appendix A summarized the top clusters identified in selected Northeast states using the different tools; in a future paper, we will present the results of a more formal meta analysis.

Figure 1. Pennsylvania Food Industry Clusters

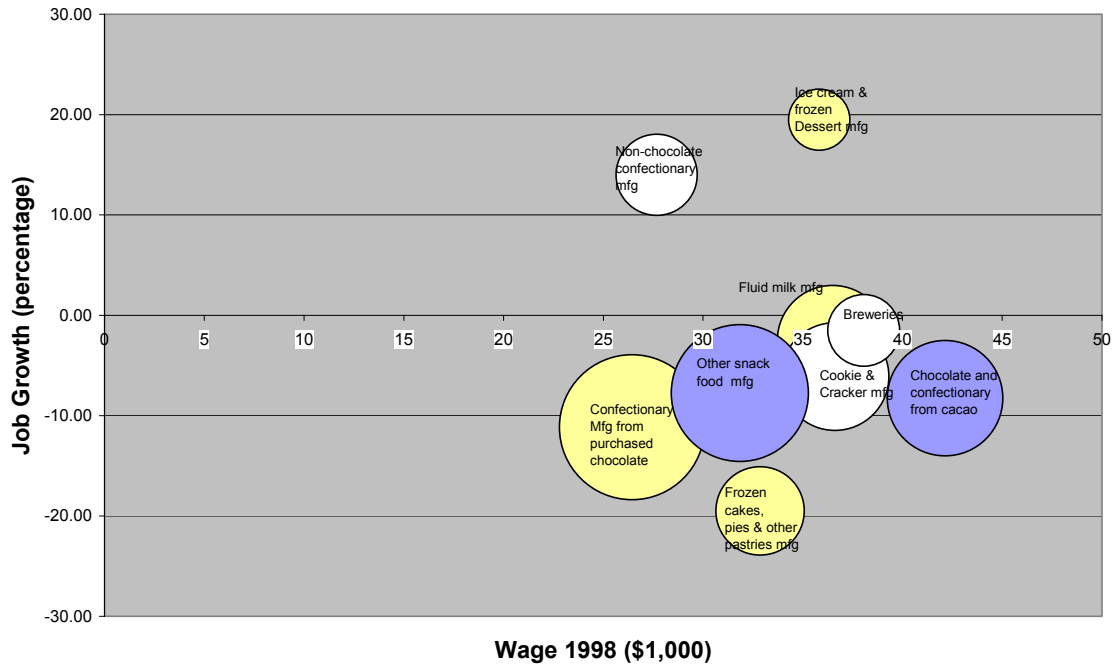


Figure 2. Connecticut Food Industry Clusters

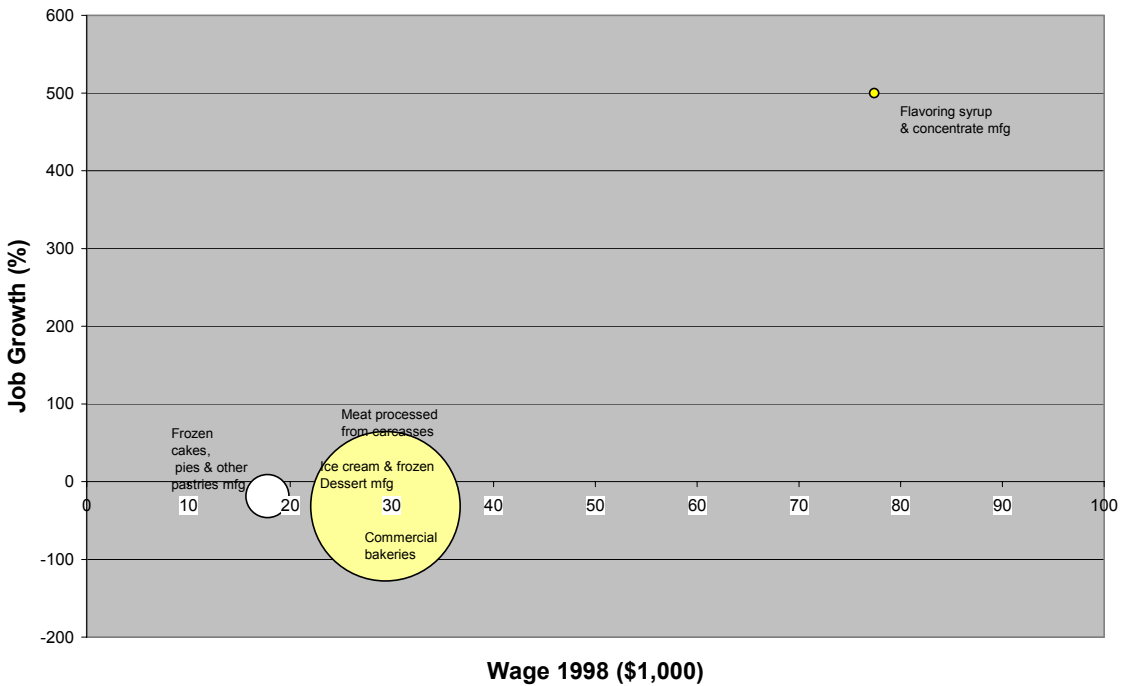


Figure 3. Massachusetts Food Industry Clusters

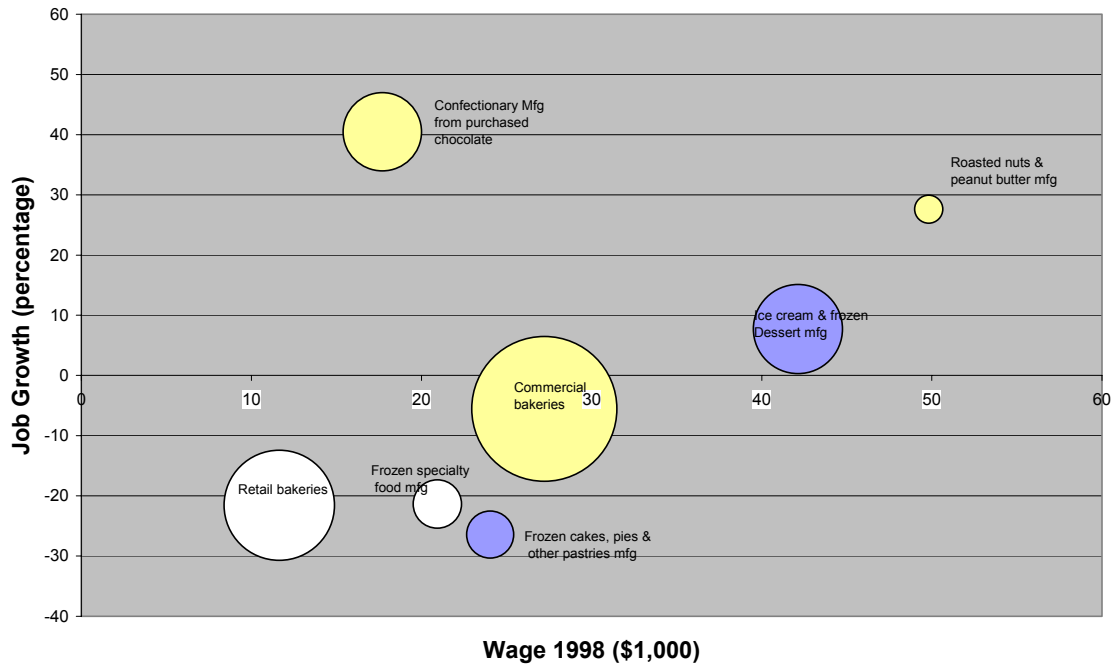


Figure 4. Maryland Food Industry Clusters

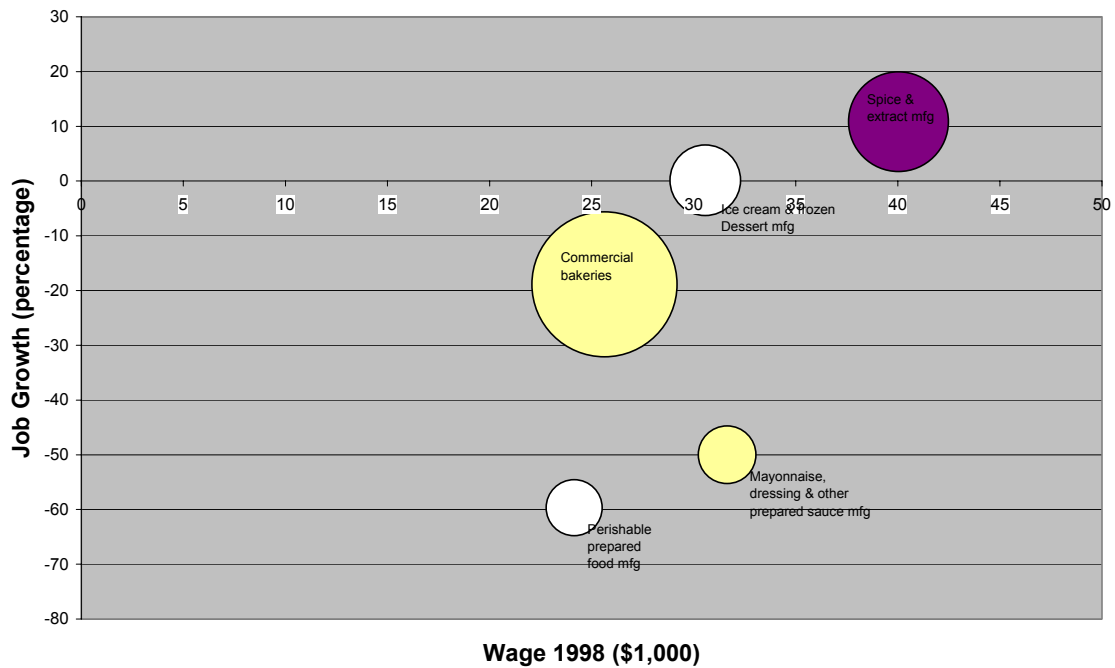


Figure 5. New Jersey Food Industry Clusters

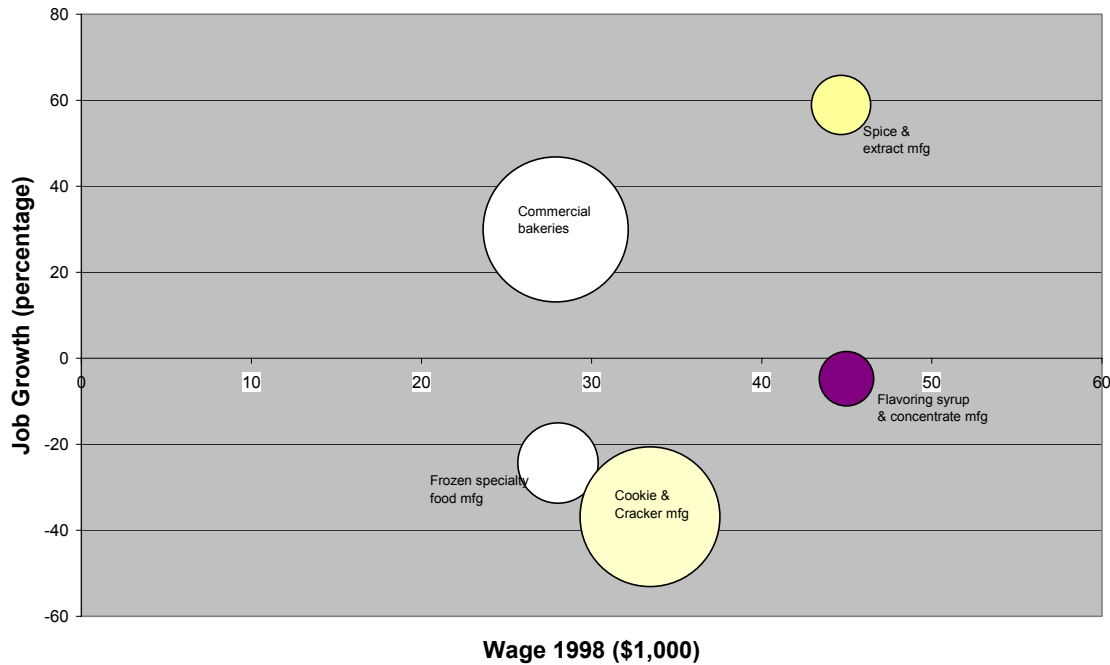


Figure 1 reveals that in Pennsylvania, ice cream and frozen dessert manufacturing had high job growth during 1998 and 2001 and relatively high average wages in 1998. The sector also had a competitive advantage as revealed by its location quotient of greater than 1.5. In Connecticut, (Figure 2) flavoring syrup and concentrate manufacturing had high job growth and average wages in 1998. However, this may also be due to the relatively small size of employment in 1998. In Massachusetts (Figure 3), both ice cream and frozen dessert manufacturing, and roasted nuts and peanut butter manufacturing showed positive job growth and relative high wages in 1998. The two industries all have location quotients greater than 1.5. In Maryland (Figure 4), spice and extract manufacturing distinguished itself by high wages in 1998 and positive job growth rate during 1998 and 2001, and location quotients greater than 2.5; the findings for New Jersey are similar (Figure 5). Spice and extract manufacturing had high wages in 1998 and high job growth during 1998-2001, although the location quotient is not as high as Maryland's.

Local Moran's I

Following Gibbs and Bernat (1997) in using the local Moran's I statistic and county-level establishment data, we identified four groups of counties: central cluster counties, counties peripheral to the clusters, counties that have establishments from the industry in question but that do not meet the clustering criterion, and counties without any establishment for the given industry. In addition to using establishment data for food industries from the County Business Patterns, we also included farm production data from the 2002 Census of Agriculture. Table 6 presents sum-

mary statistics for these food and agricultural industry clusters. The detailed distributions of the industry clusters for the Northeast are shown in the following Maps (Figure 6).

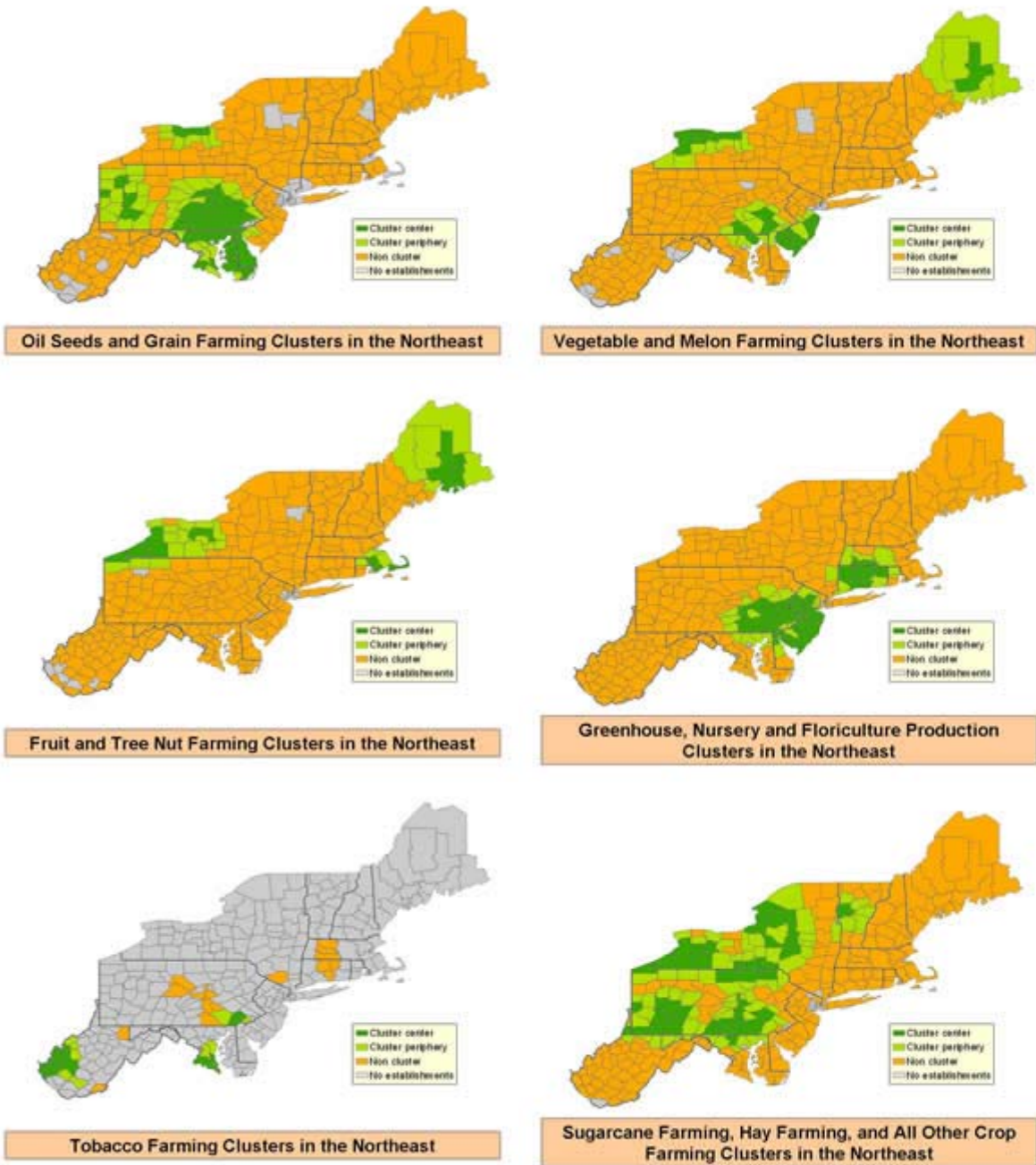
Table 6. Characteristics of Industry Clusters.

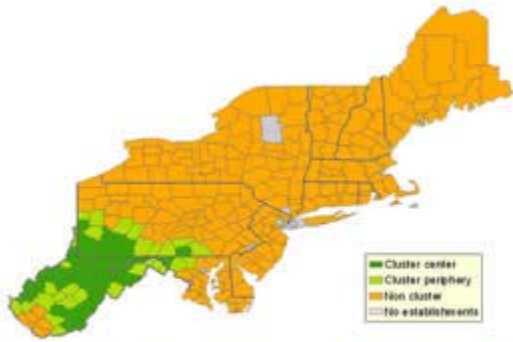
Industry Cluster Title	No. of Counties with Establishments	No. of Counties with Above Average Establishments	No. of Counties with Sig. High-high Local Moran's I	Central Clusters	Peripheral Clusters
Dog & cat food mfg	29	3	2	0	0
Other animal food mfg	104	43	19	12	19
Flour milling	45	11	4	2	4
Malt mfg	6	1	0	0	0
Wet corn milling	3	1	6	0	0
Soybean processing	9	0	0	0	0
Other oilseed processing	3	0	2	0	0
Fats & oils refining & blending	13	0	2	0	0
Breakfast cereal manufacturing	8	1	1	0	0
Sugarcane mills	3	0	0	0	0
Cane sugar refining	5	1	1	0	0
Beet sugar mfg	2	0	0	0	0
Choc & confectionery mfg from cacao beans	50	13	5	0	0
Confectionery mfg from purchased chocolate	110	33	26	9	23
Nonchocolate confectionery mfg	81	34	18	9	17
Frozen fruit, juice & vegetable mfg	33	7	3	0	0
Frozen specialty food mfg	63	23	16	8	6
Fruit & vegetable canning	86	24	17	9	15
Specialty canning	23	3	3	0	0
Dried & dehydrated food mfg	13	1	0	0	0
Fluid milk mfg	96	34	19	10	16
Creamery butter mfg	6	1	0	0	0
Cheese mfg	65	25	13	7	7
Dry, condensed, evaporated dairy product mfg	37	4	3	0	0
Ice cream & frozen dessert mfg	77	30	19	14	16
Animal (except poultry) slaughtering	142	65	12	11	12
Meat processed from carcasses	93	38	16	11	11
Rendering & meat by-product processing	20	3	2	0	0
Poultry processing	41	15	14	7	9

Seafood canning	32	8	5	2	1
Fresh & frozen seafood processing	57	9	11	3	3
Retail bakeries	217	53	15	15	19
Commercial bakeries	154	45	16	16	17
Frozen cakes, pies & other pastries mfg	51	14	16	7	12
Cookie & cracker mfg	48	13	13	7	6
Flour mixes & dough mfg from purchased flour	43	9	10	2	2
Dry pasta mfg	42	17	13	9	8
Tortilla mfg	15	3	0	0	0
Roasted nuts & peanut butter mfg	16	4	3	1	2
Other snack food mfg	46	16	7	4	5
Coffee & tea mfg	41	13	10	6	5
Flavoring syrup & concentrate mfg	24	11	4	3	1
Mayonnaise, dressing & other prepared sauce mfg	56	20	11	9	11
Spice & extract mfg	42	12	11	5	7
Perishable prepared food mfg	65	25	9	6	8
All other miscellaneous food mfg	74	21	15	10	11
Soft drink mfg	83	35	12	7	12
Bottled water mfg	41	7	7	1	4
Ice mfg	75	21	8	4	7
Breweries	80	21	11	8	9
Wineries	75	22	7	6	8
Distilleries	11	1	0	0	0
Tobacco stemming & redrying	4	0	0	0	0
Cigarette mfg	2	0	0	0	0
Other tobacco product mfg	28	6	8	6	3
Timber tract operations	45	5	3	3	3
Forest nurseries & gathering forest products	29	5	0	0	0
Logging	245	74	17	17	15
Finfish fishing	55	12	2	2	2
Shellfish fishing	45	11	4	4	5
Other marine fishing	3	0	0	0	0
Hunting & trapping	59	12	4	4	6
Cotton ginning	3	0	0	0	0
Soil preparation, planting, & cultivating	91	26	4	4	10
Crop harvesting, primarily by machine	11	2	2	2	0
Postharvest crop activities (exc ginning)	48	8	3	3	3
Farm labor contractors & crew leaders	27	2	1	1	2
Farm management ser-	29	6	0	0	0

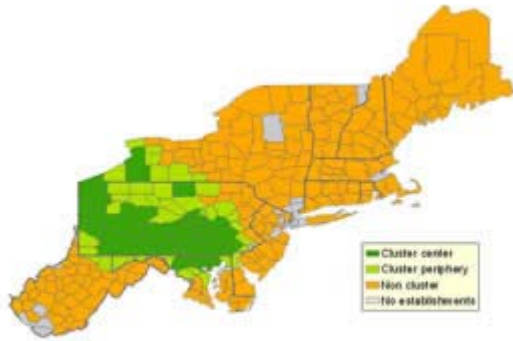
vices					
Animal production support activities	189	50	21	21	43
+ Forestry support activities	111	43	10	10	47
Oilseed and grain farming	264	100	42	41	41
Vegetable and melon farming	280	109	19	19	29
Fruit and tree nut farming	280	80	10	10	24
Greenhouse, nursery, and floriculture production	295	112	32	32	29
Tobacco farming	36	23	11	11	9
Sugarcane farming, hay farming, and all other crop farming	285	121	38	38	67
Beef cattle ranching and farming	285	103	41	41	31
Cattle feedlots	271	85	43	43	38
Dairy cattle and milk production	251	79	38	38	39
Hog and pig farming	256	90	25	25	31
Poultry and egg production	264	51	19	19	18
Sheep and goat farming	275	109	22	22	30
Animal aquaculture and other animal production	291	108	19	19	27

Figure 6. Food and Agriculture Industry Cluster Maps.

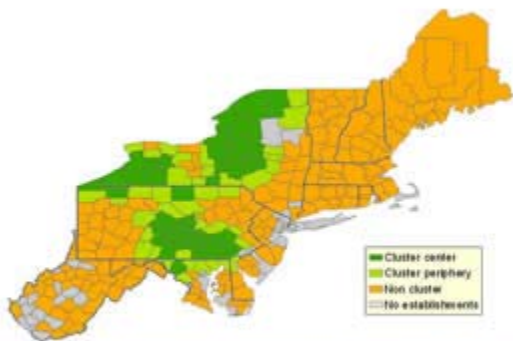




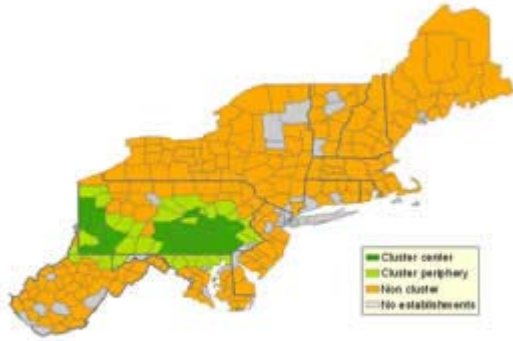
Beef Cattle Ranching and Farming Clusters in the Northeast



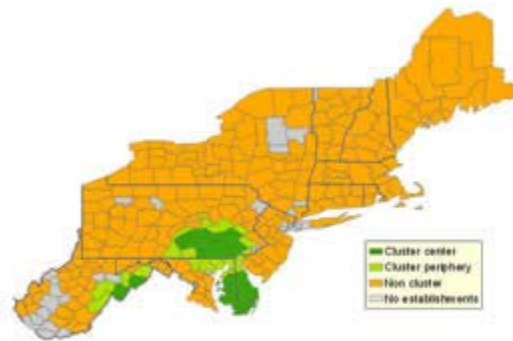
Cattle Feedlots Clusters in the Northeast



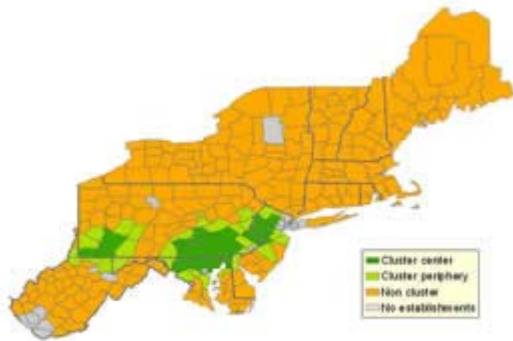
Dairy Cattle and Milk Production Clusters in the Northeast



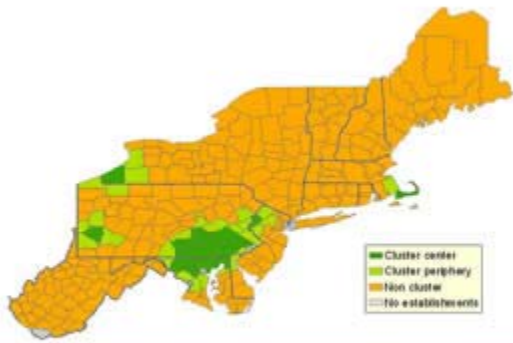
Hog and Pig Farming Clusters in the Northeast



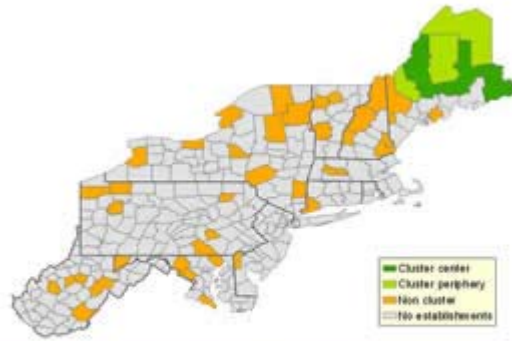
Poultry and Egg Production Clusters in the Northeast



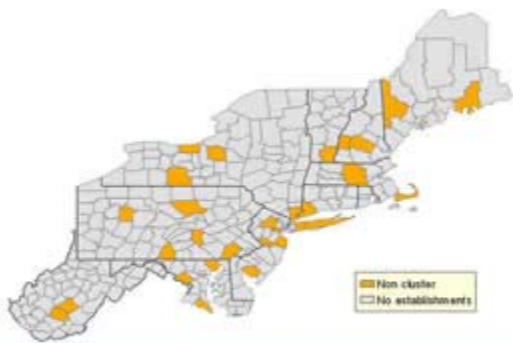
Sheep and Goat Farming Clusters in the Northeast



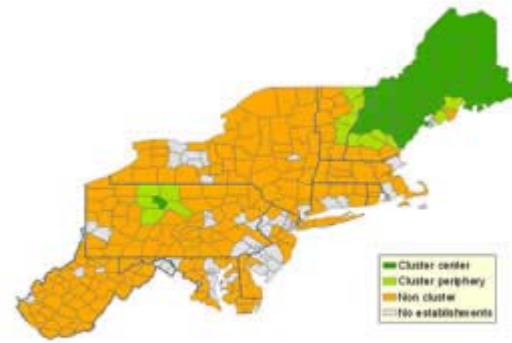
Animal Aquaculture and Other Animal Production Clusters in the Northeast



Timber Tract Operations Clusters in the Northeast



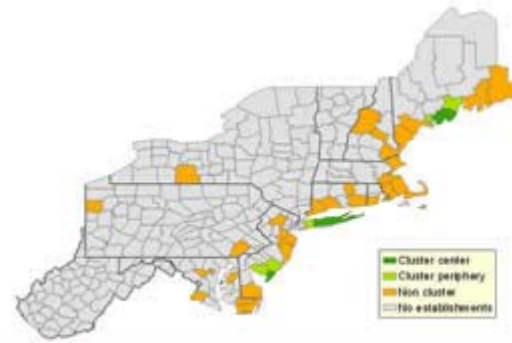
Forest Nurseries & Gathering Forest Products in the Northeast



Logging Clusters in the Northeast



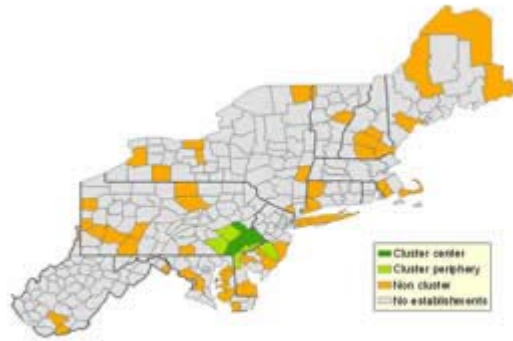
Finfish Fishing Clusters in the Northeast



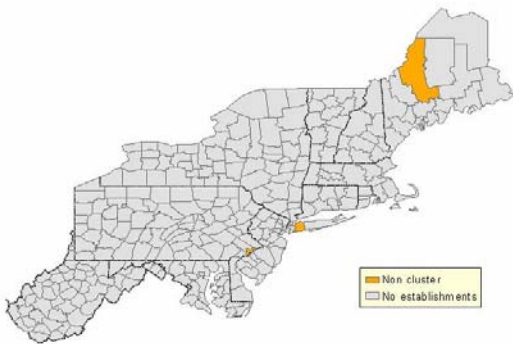
Shellfish Fishing Clusters in the Northeast



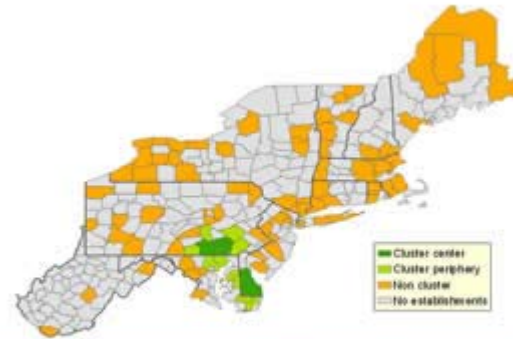
Other Marine Fishing in the Northeast



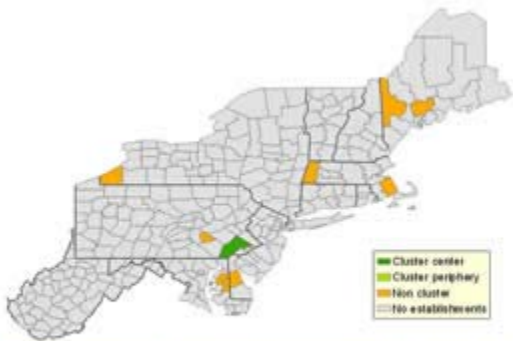
Hunting and Trapping Clusters in the Northeast



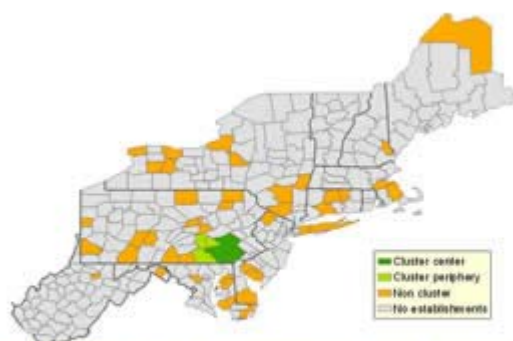
Cotton Ginning in the Northeast



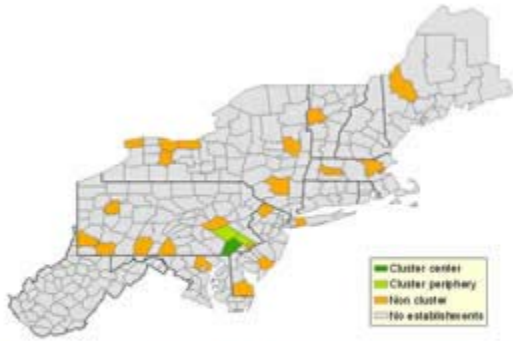
Soil Preparation, Planting, & Cultivating Clusters in the Northeast



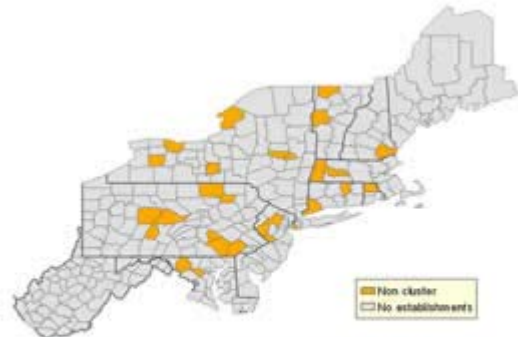
Crop Harvesting, Primarily by Machine Clusters in the Northeast



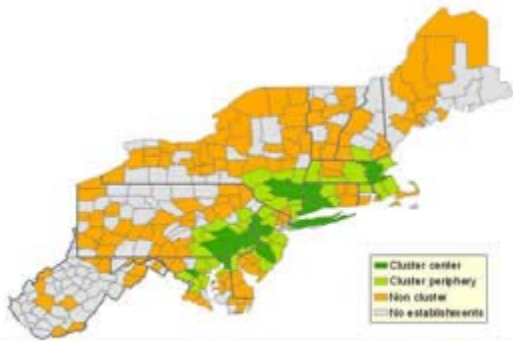
Post-harvest Crop Activities (except Ginning) Clusters in the Northeast



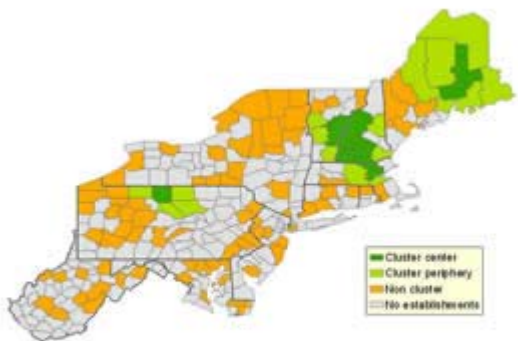
Farm Labor Contractors & Crew Leaders Clusters in the Northeast



Farm Management Services in the Northeast



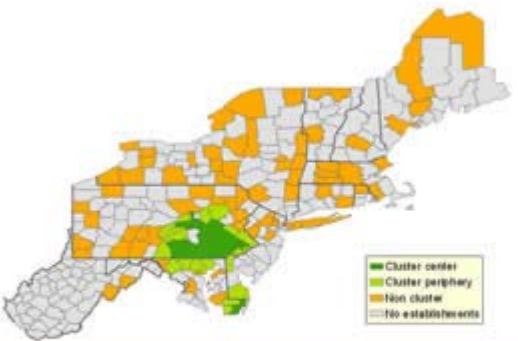
Animal Production Support Activity Clusters in the Northeast



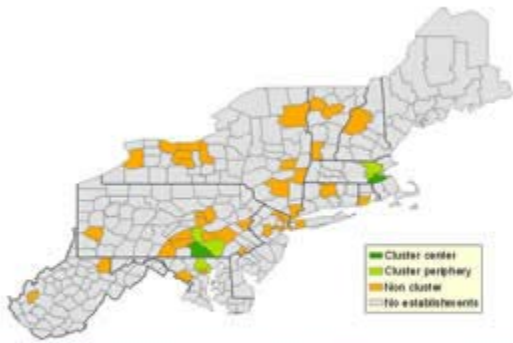
Forestry Support Activity Clusters in the Northeast



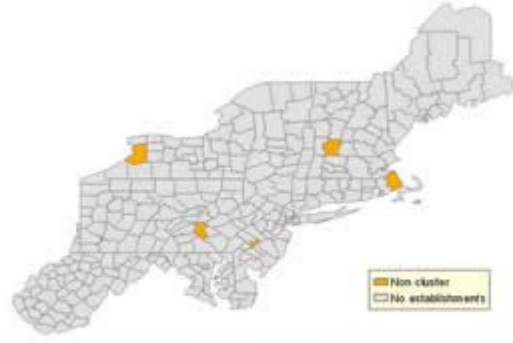
Dog and Cat Food Manufacturing in the Northeast



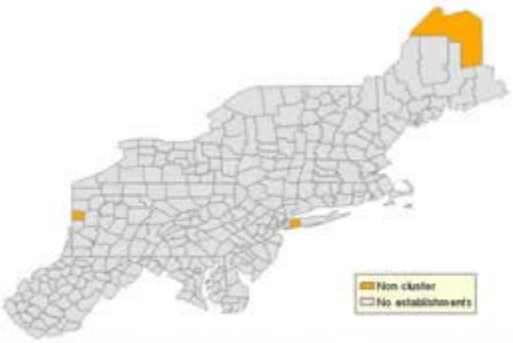
Other Animal Food Industry Clusters in the Northeast



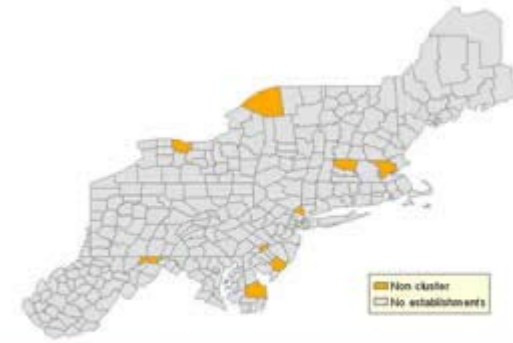
Flour Milling Industry Clusters in the Northeast



Malt Manufacturing in the Northeast



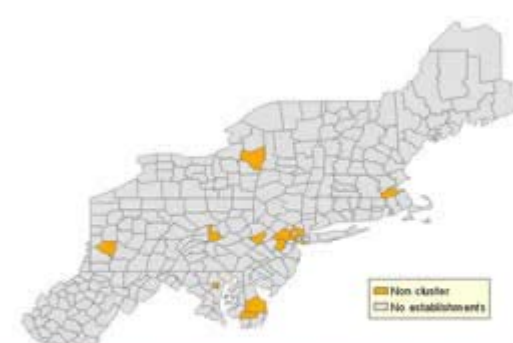
Wet Corn Milling in the Northeast



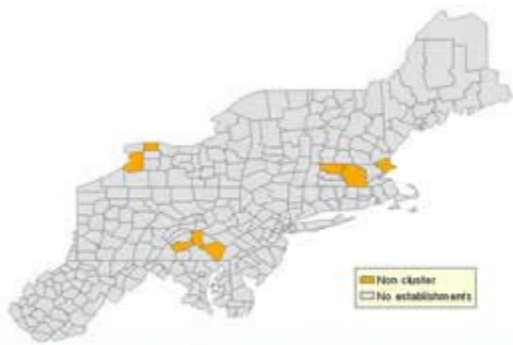
Soybean Processing in the Northeast



Other Oilseed Processing in the Northeast



Fats and Oils Refining and Blending in the Northeast



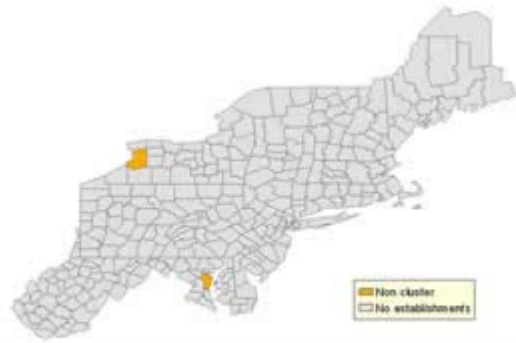
Breakfast Cereal Manufacturing in the Northeast



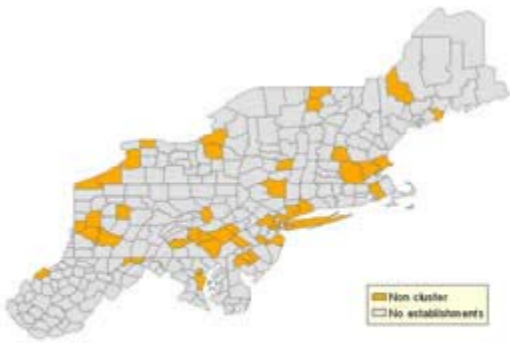
Sugarcane Mills in the Northeast



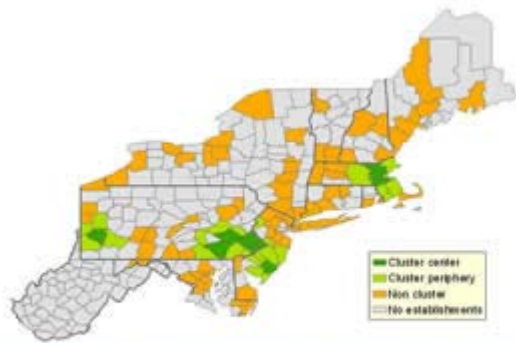
Cane Sugar Refining in the Northeast



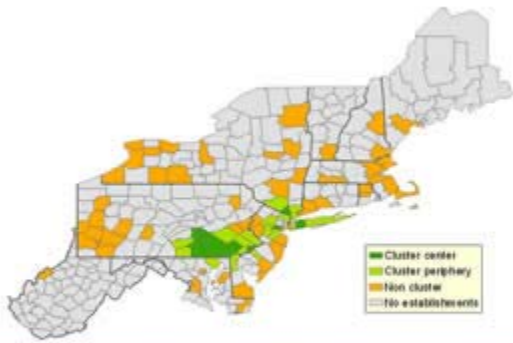
Beet Sugar Manufacturing in the Northeast



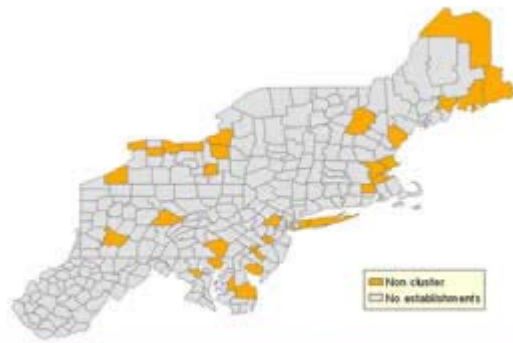
Chocolate & Confectionery Manufacturing from Cacao Beans in the Northeast



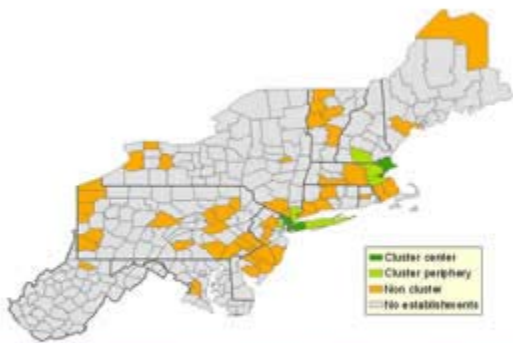
Confectionery Manufacturing from Purchased Chocolate Clusters in the Northeast



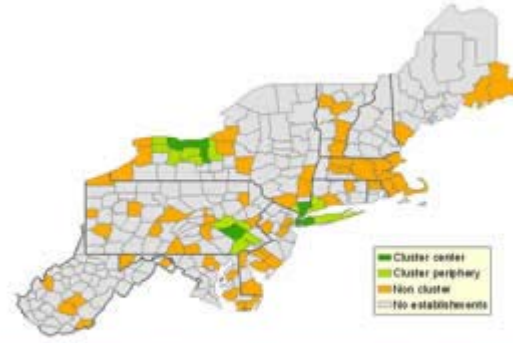
Nonchocolate Confectionery Manufacturing Clusters in the Northeast



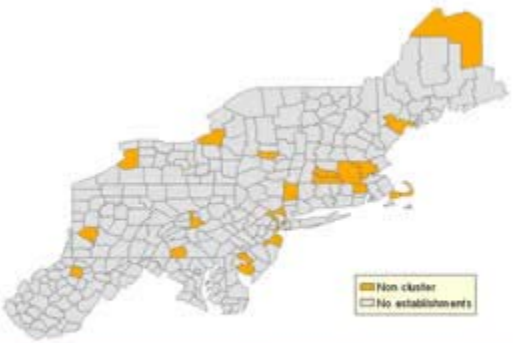
Frozen Fruit, Juice & Vegetable Manufacturing in the Northeast



Frozen Specialty Food Manufacturing Clusters in the Northeast



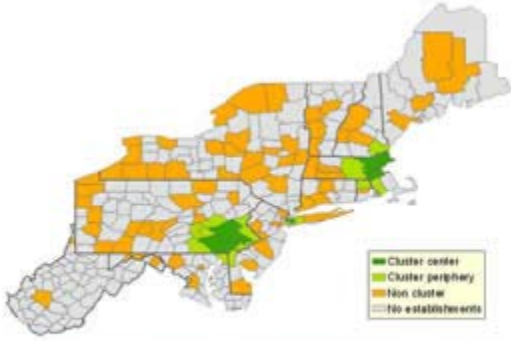
Fruit and Vegetable Canning Clusters in the Northeast



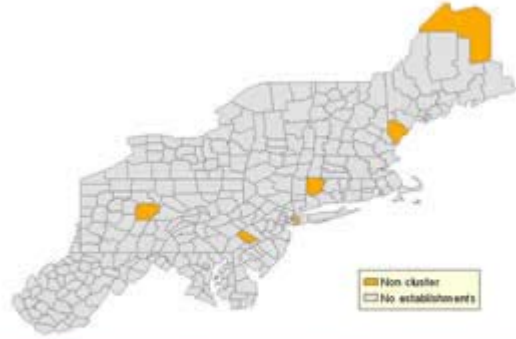
Specialty Canning in the Northeast



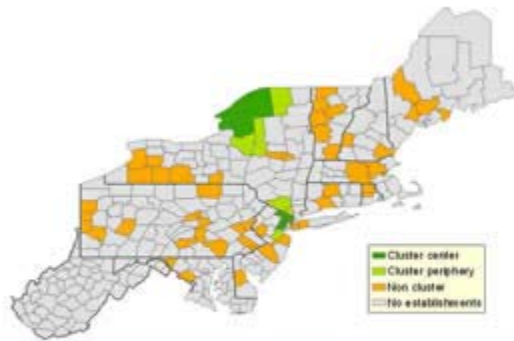
Dried and Dehydrated Food Manufacturing in the Northeast



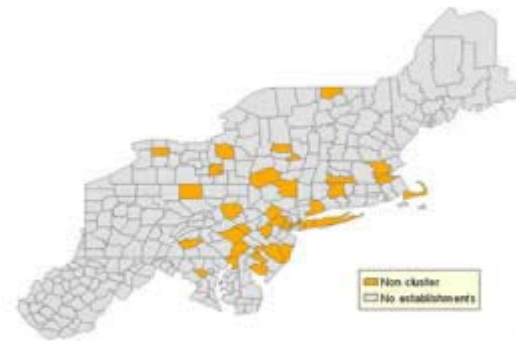
Fluid Milking Manufacturing Clusters in the Northeast



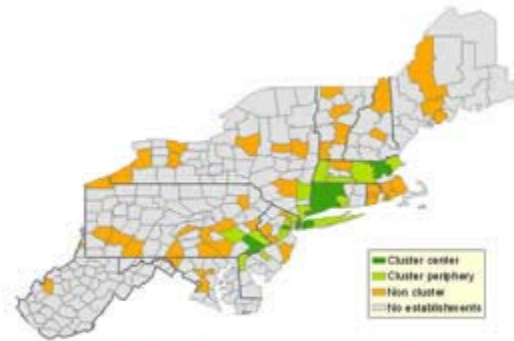
Creamery Butter Manufacturing in the Northeast



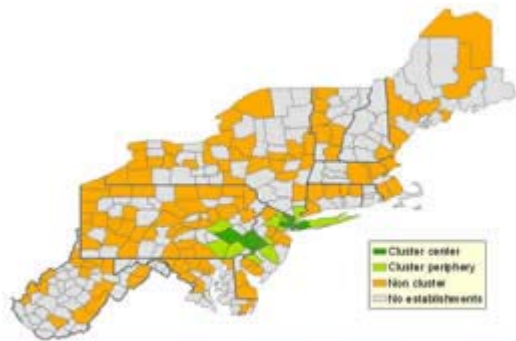
Cheese Manufacturing Clusters in the Northeast



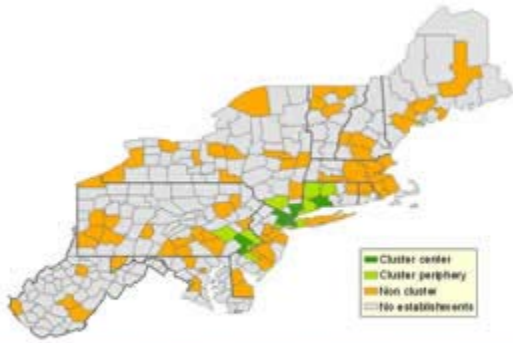
Dry, Condensed, Evaporated Dairy Product Manufacturing in the Northeast



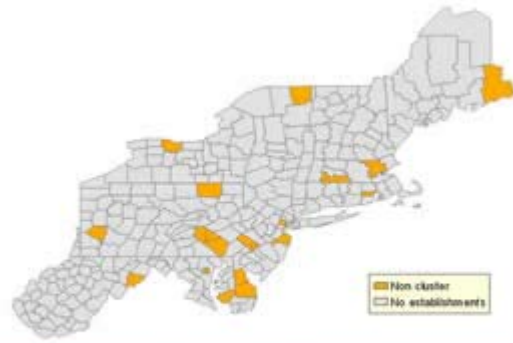
Ice Cream and Frozen Dessert Manufacturing Clusters in the Northeast



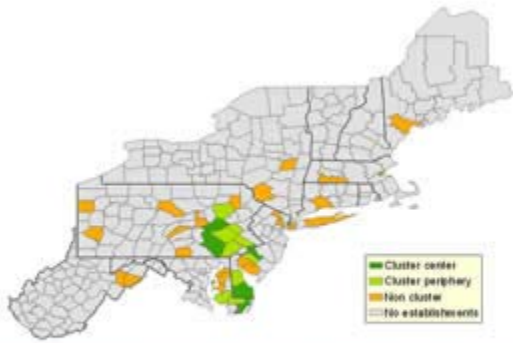
Animal (except Poultry) Slaughtering Manufacturing Clusters in the Northeast



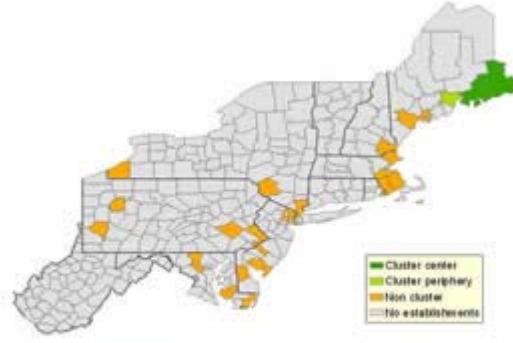
Meat Processed from Carcasses Manufacturing Clusters in the Northeast



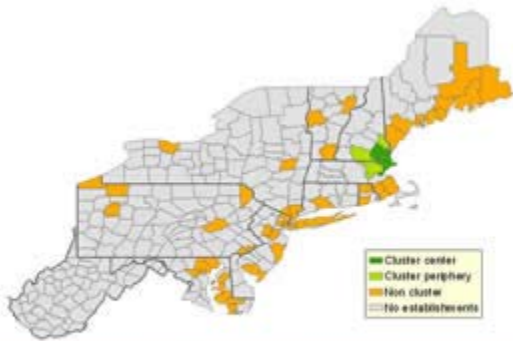
Rendering and Meat Byproduct Processing in the Northeast



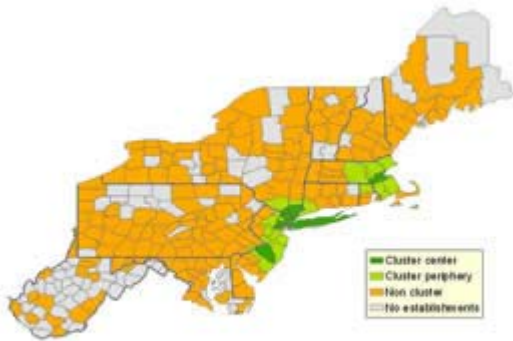
Poultry Processing Clusters in the Northeast



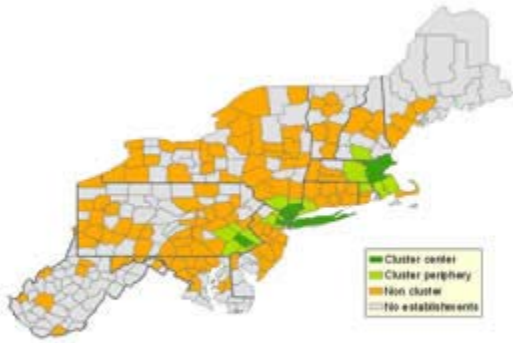
Seafood Canning Clusters in the Northeast



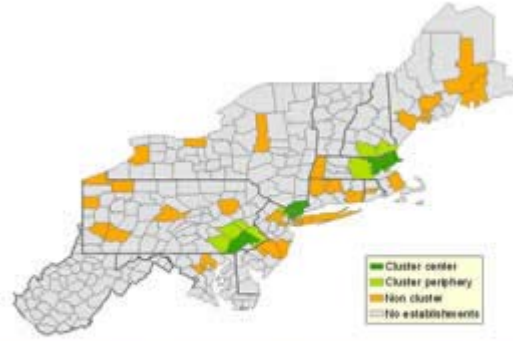
Fresh & Frozen Seafood Processing Clusters in the Northeast



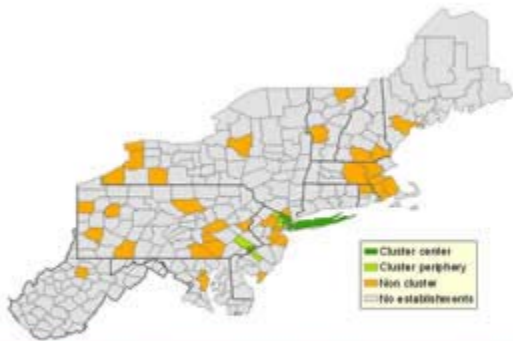
Retail Bakeries Clusters in the Northeast



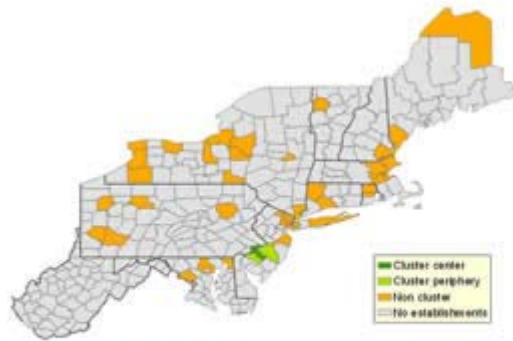
Commercial Bakeries Clusters in the Northeast



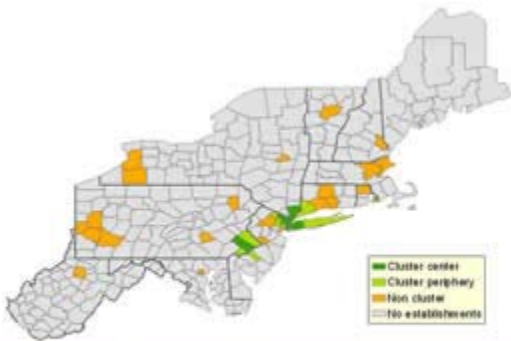
Frozen Cakes, Pies & Other Pastries Manufacturing Clusters in the Northeast



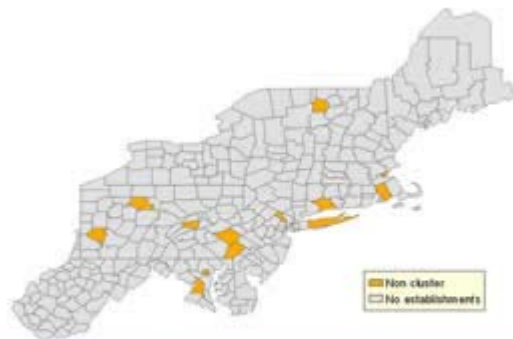
Cookie and Cracker Manufacturing Clusters in the Northeast



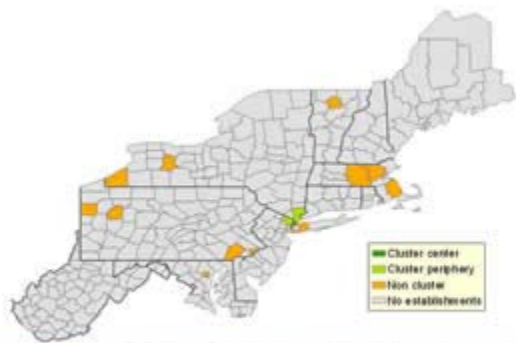
Flour Mixes & Dough Manufacturing from Purchased Flour Clusters in the Northeast



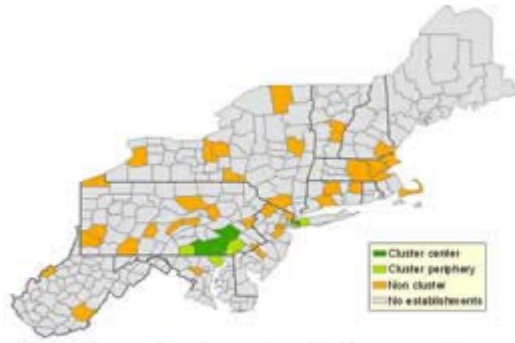
Dry Pasta Manufacturing Clusters in the Northeast



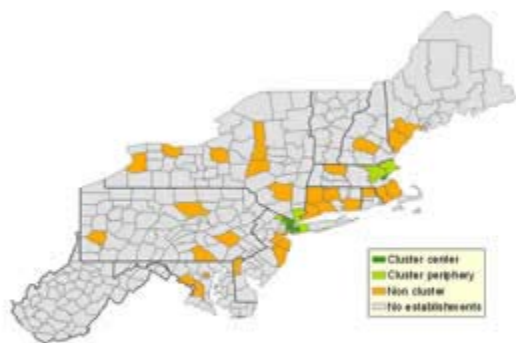
Tortilla Manufacturing in the Northeast



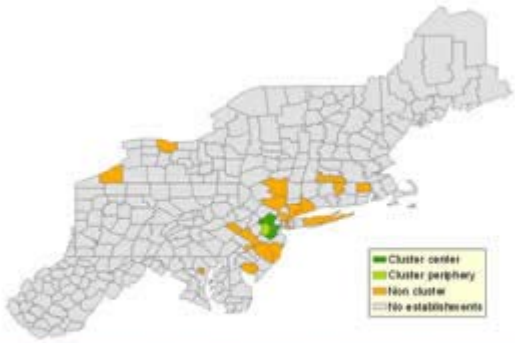
Roasted Nuts & Peanut Butter Manufacturing Clusters in the Northeast



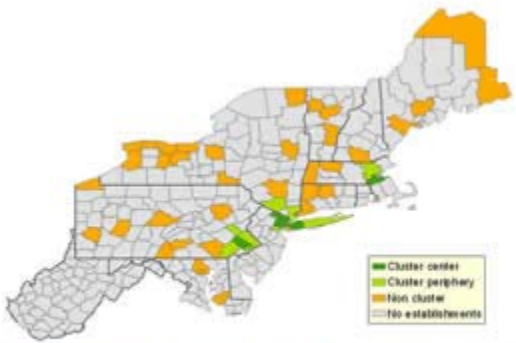
Other Snack Food Manufacturing Clusters in the Northeast



Coffee and Tea Manufacturing Clusters in the Northeast



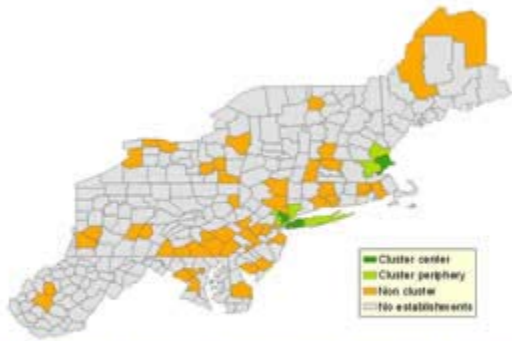
Flavoring Syrup and Concentrate Manufacturing Clusters in the Northeast



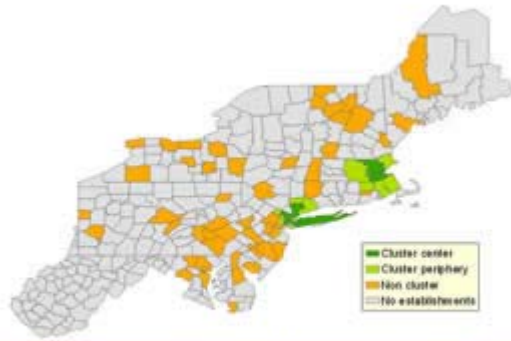
Mayonnaise, Dressing & Other Prepared Sauce Manufacturing Clusters in the Northeast



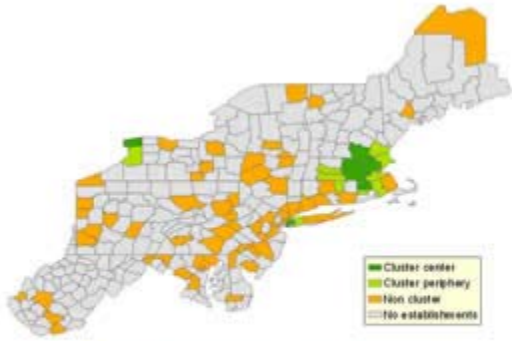
Spice and Extract Manufacturing in the Northeast



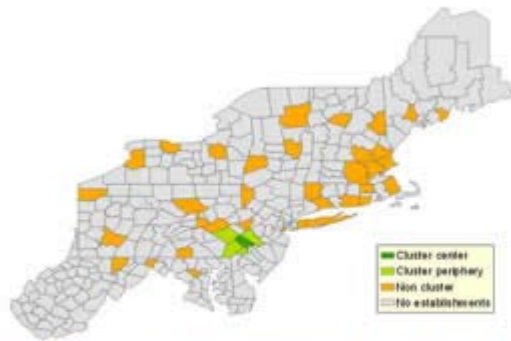
Perishable Prepared Food Manufacturing in the Northeast



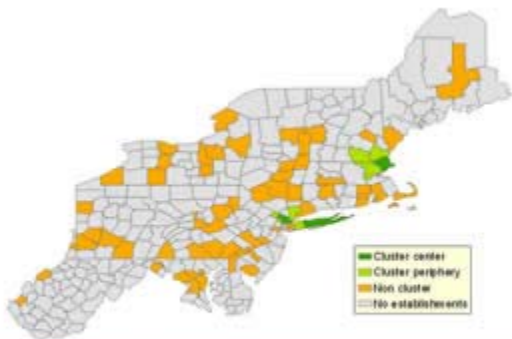
All Other Miscellaneous Food Manufacturing in the Northeast



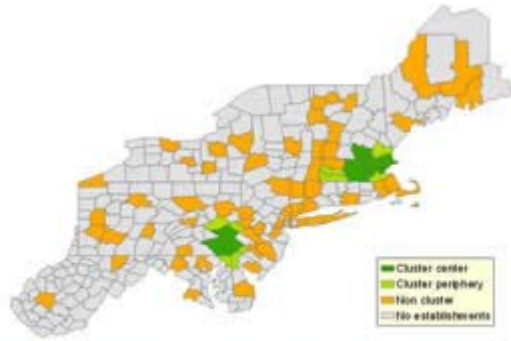
Soft Drink Manufacturing in the Northeast



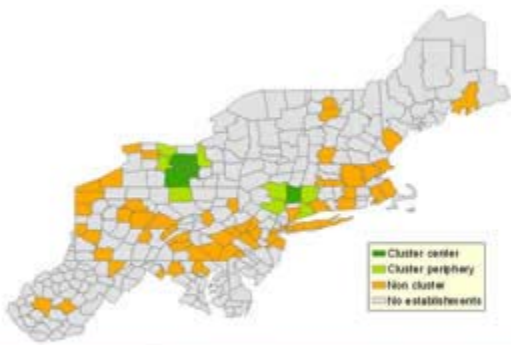
Bottled Water Manufacturing in the Northeast



Ice Manufacturing in the Northeast



Breweries in the Northeast



Wineries in the Northeast



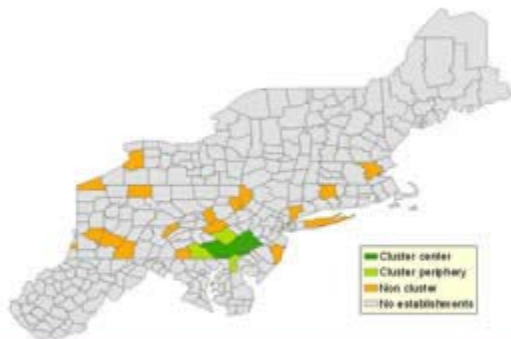
Distilleries in the Northeast



Tobacco Stemming & Redrying in the Northeast



Cigarette Manufacturing in the Northeast



Other Tobacco Product Manufacturing in the Northeast

From Figure 6 it is clear that some industry clusters are more concentrated than others in counties in particular Northeast states, such as seafood canning and timber tract operations, that are more concentrated in Maine. Some industries are clustered across state borders. For example, beef cattle ranching and farming are clustered across the Pennsylvania and West Virginia border. The mapping of industry clusters in the entire study area helps us better understand the geographic distribution of food and agriculture industry clusters in the Northeast. It also shows where the potential exists for agglomeration economies among firms, and where it does not.

Locational Correlation

The locational correlation method potentially points us to geographic clustering of “linked industries” within individual counties. We again use the same broad definition of food and agricultural industries in our locational correlation analysis as was used above. The industry starts with the growing of food crops, including grains and livestock, and ends with wholesaling and retailing functions for these products. The cluster also includes supporting industries such as refrigerated storage and fertilizer production. Most of these food and agriculture industry clusters overlap with industry clusters examined in the report *Pennsylvania’s Targeted Industry Clusters: Agriculture and Food Production* (Center for Workforce Information and Analysis 2004).

The list of industry clusters with locational correlation coefficients, for locations within the same county, that are above 0.75 is provided in Table 7. The first coefficient, of 0.77, for example, shows that there is a 77 percent correlation between hog and pig farming and other animal food farming firms in the Northeast; in other words, these firms are very likely to be (co-)located in the same county (77 percent of the time). This correlation is even higher for retail bakeries and general line grocery wholesalers (0.94). Thus, this analysis goes beyond the single-industry focus of a cluster, to begin to understand which firms from different industries may be more (or less) likely to associate with one another by locating in the same county. Of course, especially for wholesalers and retailers, much of this co-location is likely being driven by a third factor – namely, population concentrations.

This analysis can begin to shed light on vertical linkages within the industry complex (as opposed only to horizontal, competing linkages). It can shed light not only on how many firms from a given industry need to cluster to develop agglomeration economies, but also which complementary or supporting industries need to be present in order to make a cluster competitive.

Table 7. Locational Correlation of Industry Clusters.

Industry Cluster Title	Other Animal Food Manufacturing
Hog and pig farming	0.77
Industry Cluster Title	Retail Bakeries
Commercial bakeries	0.95
Cookie & cracker manufacturing	0.75
Dry pasta manufacturing	0.82
General Line Grocery Wholesalers	0.94
Packaged Frozen Food Wholesalers	0.89
Dairy Product (except Dried or Canned) Wholesalers	0.91

Poultry and Poultry Product Wholesalers	0.76
Confectionery Wholesalers	0.91
Meat and Meat Product Wholesalers	0.93
Fresh Fruit and Vegetable Wholesalers	0.82
Other Grocery and Related Products Wholesalers	0.94
Beer and Ale Wholesalers	0.77
Wine and Distilled Alco. Beverage Wholesalers	0.75
Book, Periodical, and Newspaper Wholesalers	0.83
Flower, Nursery Stock, and Florists Supplies Wholesalers	0.81
Tobacco and Tobacco Product Wholesalers	0.89
Supermarkets and Other Grocery Stores	0.96
Convenience Stores	0.81
Meat Markets	0.94
Fish and Seafood Markets	0.90
Fruit and Vegetable Markets	0.89
Baked Goods Stores	0.96
Confectionery and Nut Stores	0.81
All Other Specialty Food Stores	0.93
Beer, Wine, and Liquor Stores	0.84
Other Warehousing and Storage	0.77
Industry Cluster Title	Commercial Bakeries
Retail bakeries	0.95
Cookie & cracker manufacturing	0.76
Dry pasta manufacturing	0.77
Perishable prepared food manufacturing	0.79
All other miscellaneous food manufacturing	0.77
General Line Grocery Wholesalers	0.91
Packaged Frozen Food Wholesalers	0.86
Dairy Product (except Dried or Canned) Wholesalers	0.87
Confectionery Wholesalers	0.87
Meat and Meat Product Wholesalers	0.85
Fresh Fruit and Vegetable Wholesalers	0.78
Other Grocery and Related Products Wholesalers	0.90
Beer and Ale Wholesalers	0.76
Book, Periodical, and Newspaper Wholesalers	0.79
Flower, Nursery Stock, and Florists Supplies Wholesalers	0.76
Tobacco and Tobacco Product Wholesalers	0.85
Supermarkets and Other Grocery Stores	0.93
Convenience Stores	0.78
Meat Markets	0.92
Fish and Seafood Markets	0.89
Fruit and Vegetable Markets	0.89
Baked Goods Stores	0.93
Confectionery and Nut Stores	0.77
All Other Specialty Food Stores	0.87
Beer, Wine, and Liquor Stores	0.81
Other Warehousing and Storage	0.78
Industry Cluster Title	Cookie and Cracker Manufacturing

Retail bakeries	0.75
Commercial bakeries	0.76
General Line Grocery Wholesalers	0.77
Industry Cluster Title	Dry Pasta Manufacturing
Retail bakeries	0.82
Commercial bakeries	0.77
General Line Grocery Wholesalers	0.78
Dairy Product(except Dried or Canned)Wholesalers	0.75
Meat and Meat Product Wholesalers	0.78
Other Grocery and Related Products Wholesalers	0.76
Supermarkets and Other Grocery Stores	0.77
Baked Goods Stores	0.79
All Other Specialty Food Stores	0.76
Industry Cluster Title	Perishable Prepared Food Manufacturing
Commercial bakeries	0.79
Meat Markets	0.76
Fruit and Vegetable Markets	0.77
Industry Cluster Title	All Other Miscellaneous Food Manufacturing
Commercial bakeries	0.77
General Line Grocery Wholesalers	0.75
Industry Cluster Title	Farm Machinery and Equipment Manufacturing
Hog and pig farming	0.79
Industry Cluster Title	General Line Grocery Wholesalers
Retail bakeries	0.94
Commercial bakeries	0.91
Cookie & cracker manufacturing	0.77
Dry pasta manufacturing	0.78
All other miscellaneous food manufacturing	0.75
Packaged Frozen Food Wholesalers	0.92
Dairy Product(except Dried or Canned)Wholesalers	0.90
Confectionery Wholesalers	0.90
Meat and Meat Product Wholesalers	0.89
Fresh Fruit and Vegetable Wholesalers	0.80
Other Grocery and Related Products Wholesalers	0.93
Other Farm Product Raw Material Wholesalers	0.75
Wine and Distilled Alco. Beverage Wholesalers	0.79
Book, Periodical, and Newspaper Wholesalers	0.85
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Tobacco and Tobacco Product Wholesalers	0.85
Supermarkets and Other Grocery Stores	0.89
Convenience Stores	0.82
Meat Markets	0.86
Fish and Seafood Markets	0.85
Fruit and Vegetable Markets	0.82
Baked Goods Stores	0.92
Confectionery and Nut Stores	0.80
All Other Specialty Food Stores	0.88

Beer, Wine, and Liquor Stores	0.83
Other Warehousing and Storage	0.80
Industry Cluster Title	Packaged Frozen Food Wholesalers
Retail bakeries	0.89
Commercial bakeries	0.86
General Line Grocery Wholesalers	0.92
Dairy Product(except Dried or Canned)Wholesalers	0.84
Confectionery Wholesalers	0.92
Meat and Meat Product Wholesalers	0.86
Fresh Fruit and Vegetable Wholesalers	0.76
Other Grocery and Related Products Wholesalers	0.90
Other Farm Product Raw Material Wholesalers	0.78
Wine and Distilled Alco. Beverage Wholesalers	0.81
Book, Periodical, and Newspaper Wholesalers	0.85
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Tobacco and Tobacco Product Wholesalers	0.84
Supermarkets and Other Grocery Stores	0.82
Convenience Stores	0.84
Meat Markets	0.82
Fish and Seafood Markets	0.82
Baked Goods Stores	0.86
Confectionery and Nut Stores	0.85
All Other Specialty Food Stores	0.89
Beer, Wine, and Liquor Stores	0.83
Veterinary Services	0.76
Industry Cluster Title	Dairy Product (Except Dried or Canned) Wholesalers
Retail bakeries	0.91
Commercial bakeries	0.87
Dry pasta manufacturing	0.75
General Line Grocery Wholesalers	0.90
Packaged Frozen Food Wholesalers	0.84
Confectionery Wholesalers	0.87
Meat and Meat Product Wholesalers	0.91
Fresh Fruit and Vegetable Wholesalers	0.79
Other Grocery and Related Products Wholesalers	0.93
Book, Periodical, and Newspaper Wholesalers	0.78
Flower, Nursery Stock, Florists Supplies Wholesalers	0.80
Tobacco and Tobacco Product Wholesalers	0.84
Supermarkets and Other Grocery Stores	0.91
Meat Markets	0.89
Fish and Seafood Markets	0.85
Fruit and Vegetable Markets	0.84
Baked Goods Stores	0.90
All Other Specialty Food Stores	0.88
Other Warehousing and Storage	0.77
Industry Cluster Title	Poultry and Poultry Product Wholesalers
Retail bakeries	0.76
Fresh Fruit and Vegetable Wholesalers	0.76

Tobacco and Tobacco Product Wholesalers	0.75
Supermarkets and Other Grocery Stores	0.77
Meat Markets	0.77
Industry Cluster Title	Confectionery Wholesalers
Retail bakeries	0.91
Commercial bakeries	0.87
General Line Grocery Wholesalers	0.90
Packaged Frozen Food Wholesalers	0.92
Dairy Product(except Dried or Canned)Wholesalers	0.87
Meat and Meat Product Wholesalers	0.89
Other Grocery and Related Products Wholesalers	0.94
Other Farm Product Raw Material Wholesalers	0.79
Wine and Distilled Alco. Beverage Wholesalers	0.83
Book, Periodical, and Newspaper Wholesalers	0.87
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Tobacco and Tobacco Product Wholesalers	0.87
Supermarkets and Other Grocery Stores	0.85
Convenience Stores	0.80
Meat Markets	0.84
Fish and Seafood Markets	0.82
Fruit and Vegetable Markets	0.77
Baked Goods Stores	0.90
Confectionery and Nut Stores	0.83
All Other Specialty Food Stores	0.93
Beer, Wine, and Liquor Stores	0.80
Other Warehousing and Storage	0.77
Industry Cluster Title	Meat and Meat Product Wholesalers
Retail bakeries	0.93
Commercial bakeries	0.85
Dry pasta manufacturing	0.78
General Line Grocery Wholesalers	0.89
Packaged Frozen Food Wholesalers	0.86
Dairy Product(except Dried or Canned)Wholesalers	0.91
Confectionery Wholesalers	0.89
Fresh Fruit and Vegetable Wholesalers	0.80
Other Grocery and Related Products Wholesalers	0.94
Wine and Distilled Alco. Beverage Wholesalers	0.78
Book, Periodical, and Newspaper Wholesalers	0.80
Flower, Nursery Stock, Florists Supplies Wholesalers	0.81
Tobacco and Tobacco Product Wholesalers	0.87
Supermarkets and Other Grocery Stores	0.90
Meat Markets	0.91
Fish and Seafood Markets	0.86
Fruit and Vegetable Markets	0.80
Baked Goods Stores	0.90
Confectionery and Nut Stores	0.76
All Other Specialty Food Stores	0.91
Beer, Wine, and Liquor Stores	0.76
Industry Cluster Title	Fresh Fruit and Vegetable Wholesalers
Retail bakeries	0.82

Commercial bakeries	0.78
General Line Grocery Wholesalers	0.80
Packaged Frozen Food Wholesalers	0.76
Dairy Product(except Dried or Canned)Wholesalers	0.79
Poultry and Poultry Product Wholesalers	0.76
Meat and Meat Product Wholesalers	0.80
Tobacco and Tobacco Product Wholesalers	0.79
Supermarkets and Other Grocery Stores	0.85
Meat Markets	0.81
Fish and Seafood Markets	0.77
Fruit and Vegetable Markets	0.75
Baked Goods Stores	0.76
Industry Cluster Title	Other Grocery and Related Products Wholesalers
Retail bakeries	0.94
Commercial bakeries	0.90
Dry pasta manufacturing	0.76
General Line Grocery Wholesalers	0.93
Packaged Frozen Food Wholesalers	0.90
Dairy Product(except Dried or Canned)Wholesalers	0.93
Confectionery Wholesalers	0.94
Meat and Meat Product Wholesalers	0.94
Other Farm Product Raw Material Wholesalers	0.81
Wine and Distilled Alco. Beverage Wholesalers	0.80
Book, Periodical, and Newspaper Wholesalers	0.86
Flower, Nursery Stock, Florists Supplies Wholesalers	0.85
Tobacco and Tobacco Product Wholesalers	0.86
Supermarkets and Other Grocery Stores	0.90
Convenience Stores	0.79
Meat Markets	0.90
Fish and Seafood Markets	0.88
Fruit and Vegetable Markets	0.84
Baked Goods Stores	0.93
Confectionery and Nut Stores	0.79
All Other Specialty Food Stores	0.93
Beer, Wine, and Liquor Stores	0.79
Other Warehousing and Storage	0.78
Industry Cluster Title	Other Farm Product Raw Material Wholesalers
General Line Grocery Wholesalers	0.75
Packaged Frozen Food Wholesalers	0.78
Confectionery Wholesalers	0.79
Other Grocery and Related Products Wholesalers	0.81
Book, Periodical, and Newspaper Wholesalers	0.77
Industry Cluster Title	Beer and Ale Wholesalers
Retail bakeries	0.77
Commercial bakeries	0.76
Tobacco and Tobacco Product Wholesalers	0.78
Supermarkets and Other Grocery Stores	0.78
Meat Markets	0.77

All Other Specialty Food Stores	0.76
Industry Cluster Title	Wine and Distilled Alcohol Beverage Wholesalers
Retail bakeries	0.75
General Line Grocery Wholesalers	0.79
Packaged Frozen Food Wholesalers	0.81
Confectionery Wholesalers	0.83
Meat and Meat Product Wholesalers	0.78
Other Grocery and Related Products Wholesalers	0.80
Book, Periodical, and Newspaper Wholesalers	0.86
Tobacco and Tobacco Product Wholesalers	0.75
Baked Goods Stores	0.75
All Other Specialty Food Stores	0.81
Industry Cluster Title	Book, Periodical and Newspaper Wholesalers
Retail bakeries	0.83
Commercial bakeries	0.79
General Line Grocery Wholesalers	0.85
Packaged Frozen Food Wholesalers	0.85
Dairy Product(except Dried or Canned)Wholesalers	0.78
Confectionery Wholesalers	0.87
Meat and Meat Product Wholesalers	0.80
Other Grocery and Related Products Wholesalers	0.86
Other Farm Product Raw Material Wholesalers	0.77
Wine and Distilled Alco. Beverage Wholesalers	0.86
Flower, Nursery Stock, Florists Supplies Wholesalers	0.83
Tobacco and Tobacco Product Wholesalers	0.77
Convenience Stores	0.85
Baked Goods Stores	0.83
Confectionery and Nut Stores	0.82
All Other Specialty Food Stores	0.88
Beer, Wine, and Liquor Stores	0.84
Veterinary Services	0.83
Industry Cluster Title	Flower, Nursery Stock, and Florist Supplies Wholesalers
Retail bakeries	0.81
Commercial bakeries	0.76
General Line Grocery Wholesalers	0.82
Packaged Frozen Food Wholesalers	0.82
Dairy Product (except Dried or Canned) Wholesalers	0.80
Confectionery Wholesalers	0.82
Meat and Meat Product Wholesalers	0.81
Other Grocery and Related Products Wholesalers	0.85
Book, Periodical, and Newspaper Wholesalers	0.83
Convenience Stores	0.82
Baked Goods Stores	0.82
Confectionery and Nut Stores	0.82
All Other Specialty Food Stores	0.86
Beer, Wine, and Liquor Stores	0.81
Veterinary Services	0.80

Industry Cluster Title	Tobacco and Tobacco Product Wholesalers
Retail bakeries	0.89
Commercial bakeries	0.85
General Line Grocery Wholesalers	0.85
Packaged Frozen Food Wholesalers	0.84
Dairy Product(except Dried or Canned)Wholesalers	0.84
Poultry and Poultry Product Wholesalers	0.75
Confectionery Wholesalers	0.87
Meat and Meat Product Wholesalers	0.87
Fresh Fruit and Vegetable Wholesalers	0.79
Other Grocery and Related Products Wholesalers	0.86
Beer and Ale Wholesalers	0.78
Wine and Distilled Alco. Beverage Wholesalers	0.75
Book, Periodical, and Newspaper Wholesalers	0.77
Supermarkets and Other Grocery Stores	0.87
Meat Markets	0.86
Fish and Seafood Markets	0.80
Fruit and Vegetable Markets	0.77
Baked Goods Stores	0.82
Confectionery and Nut Stores	0.77
All Other Specialty Food Stores	0.84
Beer, Wine, and Liquor Stores	0.77
Industry Cluster Title	Supermarkets and Other Grocery Stores
Retail bakeries	0.96
Commercial bakeries	0.93
Dry pasta manufacturing	0.77
General Line Grocery Wholesalers	0.89
Packaged Frozen Food Wholesalers	0.82
Dairy Product(except Dried or Canned)Wholesalers	0.91
Poultry and Poultry Product Wholesalers	0.77
Confectionery Wholesalers	0.85
Meat and Meat Product Wholesalers	0.90
Fresh Fruit and Vegetable Wholesalers	0.85
Other Grocery and Related Products Wholesalers	0.90
Beer and Ale Wholesalers	0.78
Tobacco and Tobacco Product Wholesalers	0.87
Meat Markets	0.97
Fish and Seafood Markets	0.90
Fruit and Vegetable Markets	0.94
Baked Goods Stores	0.93
All Other Specialty Food Stores	0.88
Beer, Wine, and Liquor Stores	0.77
Industry Cluster Title	Convenience Stores
Retail bakeries	0.81
Commercial bakeries	0.78
General Line Grocery Wholesalers	0.82
Packaged Frozen Food Wholesalers	0.84
Confectionery Wholesalers	0.80

Other Grocery and Related Products Wholesalers	0.79
Book, Periodical, and Newspaper Wholesalers	0.85
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Fish and Seafood Markets	0.75
Baked Goods Stores	0.81
Confectionery and Nut Stores	0.87
All Other Specialty Food Stores	0.81
Beer, Wine, and Liquor Stores	0.92
Veterinary Services	0.84
Industry Cluster Title	Meat Markets
Retail bakeries	0.94
Commercial bakeries	0.92
Perishable prepared food manufacturing	0.76
General Line Grocery Wholesalers	0.86
Packaged Frozen Food Wholesalers	0.82
Dairy Product(except Dried or Canned)Wholesalers	0.89
Poultry and Poultry Product Wholesalers	0.77
Confectionery Wholesalers	0.84
Meat and Meat Product Wholesalers	0.91
Fresh Fruit and Vegetable Wholesalers	0.81
Other Grocery and Related Products Wholesalers	0.90
Beer and Ale Wholesalers	0.77
Tobacco and Tobacco Product Wholesalers	0.86
Supermarkets and Other Grocery Stores	0.97
Fish and Seafood Markets	0.91
Fruit and Vegetable Markets	0.93
Baked Goods Stores	0.90
All Other Specialty Food Stores	0.88
Industry Cluster Title	Fish and Sea Food Markets
Retail bakeries	0.90
Commercial bakeries	0.89
General Line Grocery Wholesalers	0.85
Packaged Frozen Food Wholesalers	0.82
Dairy Product(except Dried or Canned)Wholesalers	0.85
Confectionery Wholesalers	0.82
Meat and Meat Product Wholesalers	0.86
Fresh Fruit and Vegetable Wholesalers	0.77
Other Grocery and Related Products Wholesalers	0.88
Tobacco and Tobacco Product Wholesalers	0.80
Supermarkets and Other Grocery Stores	0.90
Convenience Stores	0.75
Meat Markets	0.91
Fruit and Vegetable Markets	0.87
Baked Goods Stores	0.88
All Other Specialty Food Stores	0.82
Beer, Wine, and Liquor Stores	0.76
Industry Cluster Title	Fruit and Vegetable Markets
Retail bakeries	0.89
Commercial bakeries	0.89
Perishable prepared food manufacturing	0.77

General Line Grocery Wholesalers	0.82
Dairy Product(except Dried or Canned)Wholesalers	0.84
Confectionery Wholesalers	0.77
Meat and Meat Product Wholesalers	0.80
Fresh Fruit and Vegetable Wholesalers	0.75
Other Grocery and Related Products Wholesalers	0.84
Tobacco and Tobacco Product Wholesalers	0.77
Supermarkets and Other Grocery Stores	0.94
Meat Markets	0.93
Fish and Seafood Markets	0.87
Baked Goods Stores	0.87
All Other Specialty Food Stores	0.79
Industry Cluster Title	Baked Good Stores
Retail bakeries	0.96
Commercial bakeries	0.93
Dry pasta manufacturing	0.79
General Line Grocery Wholesalers	0.92
Packaged Frozen Food Wholesalers	0.86
Dairy Product(except Dried or Canned)Wholesalers	0.90
Confectionery Wholesalers	0.90
Meat and Meat Product Wholesalers	0.90
Fresh Fruit and Vegetable Wholesalers	0.76
Other Grocery and Related Products Wholesalers	0.93
Wine and Distilled Alco. Beverage Wholesalers	0.75
Book, Periodical, and Newspaper Wholesalers	0.83
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Tobacco and Tobacco Product Wholesalers	0.82
Supermarkets and Other Grocery Stores	0.93
Convenience Stores	0.81
Meat Markets	0.90
Fish and Seafood Markets	0.88
Fruit and Vegetable Markets	0.87
Confectionery and Nut Stores	0.78
All Other Specialty Food Stores	0.93
Beer, Wine, and Liquor Stores	0.82
Other Warehousing and Storage	0.77
Industry Cluster Title	Confectionery and Nut Stores
Retail bakeries	0.81
Commercial bakeries	0.77
General Line Grocery Wholesalers	0.80
Packaged Frozen Food Wholesalers	0.85
Confectionery Wholesalers	0.83
Meat and Meat Product Wholesalers	0.76
Other Grocery and Related Products Wholesalers	0.79
Book, Periodical, and Newspaper Wholesalers	0.82
Flower, Nursery Stock, Florists Supplies Wholesalers	0.82
Tobacco and Tobacco Product Wholesalers	0.77
Convenience Stores	0.87
Baked Goods Stores	0.78
All Other Specialty Food Stores	0.84

Beer, Wine, and Liquor Stores	0.84
Veterinary Services	0.82
Industry Cluster Title	All Other Specialty Food Stores
Retail bakeries	0.93
Commercial bakeries	0.87
Dry pasta manufacturing	0.76
General Line Grocery Wholesalers	0.88
Packaged Frozen Food Wholesalers	0.89
Dairy Product(except Dried or Canned)Wholesalers	0.88
Confectionery Wholesalers	0.93
Meat and Meat Product Wholesalers	0.91
Other Grocery and Related Products Wholesalers	0.93
Beer and Ale Wholesalers	0.76
Wine and Distilled Alco. Beverage Wholesalers	0.81
Book, Periodical, and Newspaper Wholesalers	0.88
Flower, Nursery Stock, and Florists Supplies Whole- salers	0.86
Tobacco and Tobacco Product Wholesalers	0.84
Supermarkets and Other Grocery Stores	0.88
Convenience Stores	0.81
Meat Markets	0.88
Fish and Seafood Markets	0.82
Fruit and Vegetable Markets	0.79
Baked Goods Stores	0.93
Confectionery and Nut Stores	0.84
Beer, Wine, and Liquor Stores	0.81
Veterinary Services	0.77
Industry Cluster Title	Beer, Wine and Liquor Stores
Retail bakeries	0.84
Commercial bakeries	0.81
General Line Grocery Wholesalers	0.83
Packaged Frozen Food Wholesalers	0.83
Confectionery Wholesalers	0.80
Meat and Meat Product Wholesalers	0.76
Other Grocery and Related Products Wholesalers	0.79
Book, Periodical, and Newspaper Wholesalers	0.84
Flower, Nursery Stock, Florists Supplies Wholesalers	0.81
Tobacco and Tobacco Product Wholesalers	0.77
Supermarkets and Other Grocery Stores	0.77
Convenience Stores	0.92
Fish and Seafood Markets	0.76
Baked Goods Stores	0.82
Confectionery and Nut Stores	0.84
All Other Specialty Food Stores	0.81
Veterinary Services	0.83
Industry Cluster Title	Other Warehousing and Storage
Retail bakeries	0.77
Commercial bakeries	0.78
General Line Grocery Wholesalers	0.80
Dairy Product (except Dried or Canned) Wholesalers	0.77

Confectionery Wholesalers	0.77
Other Grocery and Related Products Wholesalers	0.78
Baked Goods Stores	0.77
Industry Cluster Title	Veterinary Services
Packaged Frozen Food Wholesalers	0.76
Book, Periodical, and Newspaper Wholesalers	0.83
Flower, Nursery Stock, Florists Supplies Wholesalers	0.80
Convenience Stores	0.84
Confectionery and Nut Stores	0.82
All Other Specialty Food Stores	0.77
Beer, Wine, and Liquor Stores	0.83
Animal production support activities	0.79
Industry Cluster Title	Finfish Fishing
Shellfish fishing	0.84
Industry Cluster Title	Dairy Cattle and Milk Production
Cattle feedlots	0.78
Hog and pig farming	0.82
Industry Cluster Title	Hog and Pig Farming
Other animal food manufacturing	0.77
Farm Machinery and Equipment Manufacturing	0.79
Cattle feedlots	0.83
Dairy cattle and milk production	0.82
Industry Cluster Title	Animal Aquaculture and Other Animal
Greenhouse, nursery, and floriculture production	0.75

Input-Output Analysis

Using the IMPLAN input-output software and Sporleder's (2003) sector definitions, we develop total output, value added, income and employment statistics for Pennsylvania's food & related agricultural sector in 2000 (Table 8). Total output of the sector was \$83.8 billion, distributed across the food and agricultural cluster (five components). Processed food and forestry products make up the largest component (\$41.5 billion of the output, or about 49.5 percent of the total). This \$41.5 billion is in turn made up of food processing (\$25.4 billion) and forestry processing (\$16.1 billion), including manufacturing of paper, wood processing, and wood furniture. Processing of food makes up approximately 61 cents of every dollar of output from food and forestry-processing overall.

In Pennsylvania, agricultural production adds close to \$5.7 billion or about 7 percent of the total output of the state's economy. Within the agricultural sector, the nursery and horticultural industries contribute largest shares, of approximately \$2.1 billion in output. Dairy farms account for more than \$1.5 billion in sector output.

In 2000, the total value added to Pennsylvania's economy by the food and agricultural cluster was \$36 billion. Total value added takes into account the amount of output of a state's economy that is produced elsewhere but is imported into the state. It is an important and useful measure for comparing the net relative importance of the sectors of an economy. Of this \$36 billion, 35.6

percent is attributable to the total food and forestry-processing sector. Wholesaling and retailing in food and forestry make up another 34 percent of the entire total value added by the food and related agricultural cluster (\$12.3 billion). Food service contributes \$6.7 billion while farming and farm inputs and machinery account for 2 and 9.5 percent, respectively, of all value added.

Close to \$22.4 billion of total income is generated in the food and related agricultural cluster. Roughly one-third of this output (\$7.46 billion) is contributed by the food and forestry product processing sector, which is virtually tied with food and forestry products wholesaling and retailing at \$7.5 billion. Farm production income is was \$563 million in 2000.

Over 861 thousand jobs existed in Pennsylvania in 2000 in the food and agricultural sector. Two-thirds of these jobs were in wholesaling and retailing and food services (for approximately 638 thousand total jobs). The food and forestry processing sectors accounted for nearly 178 thousand jobs (21 percent of the cluster's employment), while farm production provided 24 thousand jobs (about 3 percent of the total).

Table 8. Pennsylvania Food & Related Agricultural Cluster Output, Value Added, Income and Employment, 2000.

	Total Out-put	Total Value Added	Income	Employment
	\$ Millions	\$ Millions	\$ Millions	Person Years
Food & Related Agricultural Cluster				
Farm Inputs & Machinery	7,496.3	3,432.9	2,123.8	21,455
Farming	5,658.6	729.8	563.6	23,603
Dairy Farms	1,520.4	458.6	403.6	10,189
Poultry & Eggs	647.3	102.1	76.4	3,168
Cattle Feeding	145.4	34.8	28.0	794
Swine	155.1	24.6	18.1	2,089
Miscellaneous Livestock	79.8	22.0	17.4	3,704
Food Grains	23.2	7.9	3.8	695
Feed Grains	282.2	106.5	55.5	5,161
Nursery & Horticulture	2,125.5	1,220.2	766.8	48,093
Fruits & Vegetables	222.6	87.9	66.0	3,211
Oil Bearing Crops	65.8	28.2	15.9	1,603
Misc Crops/Hay/Sugar/Tobacco/Nuts	12.9	3.3	1.6	247
Forestry, Fishing, Ag Services	378.5	271.2	160.1	13,414
Processing	41,545.0	12,831.3	7,457.6	177,732
Food Processing	25,444.0	7,277.0	3,780.0	87,589
Processed Meat, Fish & Eggs	3,983.7	703.6	562.6	15,681
Dairy Processing	2,669.4	502.8	306.3	7,258
Processed Food & Kindred Products	15,162.7	5,048.5	2,417.2	54,782
Grain Milling & Flour	779.5	167.3	100.5	1,586
Fats & Oils	138.6	34.6	18.2	415
Beverage Processing	2,710.1	820.2	375.2	7,867
Wood/Paper/Furniture Manufacturing	16,100.9	5,554.3	3,677.6	90,143

Food & Forestry Wholesaling/Retailing	16,439.1	12,286.4	7,525.0	291,656
Food Services	12,666.5	6,740.7	4,770.6	346,735
Total Food & Related Agricultural Cluster	83,805.5	36,021.1	22,440.6	861,181

Note: Each sector's output, value added, income and employment are provided through IMPLAN database for Pennsylvania 2000. The definition of each sectors is provided by OHFOOD: An Ohio Food

Industries Input-Output Model (Sporleder, 2003). The wholesaling and retailing sector is treated as one sector for purposes of the input-output model definition. Similar to Sporleder (2003)'s paper, the percentage of payroll (23.9%) is used to estimate the proportion of food- and agriculture-related output, valued-added and income. The percentage of employment (28.5%) is used to allocate employment in a similar fashion.

We next report Type II economic multipliers, which capture the direct, indirect and induced effects of a shift in final demand for the products of a sector on total output, employment, value added or earnings in an economy. More specifically, the output multiplier shows the total change in output that would result from a \$1.00 change in the final demand for a sector's output. Analogous multipliers exist for income, employment and value added. In particular, a \$1.00 change in the final demand for the output of dairy farms leads to a total economy increase in income of \$1.892, after the multiplier effect has taken its course (Table 9). In that table, high employment and income multipliers are evident for the dairy sector in Pennsylvania.

Table 9. Pennsylvania Food & Related Agricultural Cluster Multipliers: Output, Value Added, Income and Employment, 2000.

	Total Output	Value Added	Income	Employment
Food & Related Agricultural Cluster				
Farm Inputs & Machinery	1.806	2.049	2.020	3.008
Farming				
Dairy Farms	1.674	2.297	1.892	2.346
Poultry & Eggs	1.572	2.999	2.656	2.360
Cattle Feeding	1.657	2.554	2.161	2.471
Swine	1.684	3.304	2.880	1.647
Miscellaneous Livestock	1.683	2.343	2.003	1.137
Food Grains	1.916	2.508	2.732	1.265
Feed Grains	1.805	2.225	2.374	1.447
Nursery & Horticulture	1.855	1.922	1.905	1.457
Fruits & Vegetables	1.904	2.308	2.074	1.700
Oil Bearing Crops	1.821	2.144	2.156	1.346
Misc Crops/Hay/Sugar/Tobacco/Nuts	1.859	2.747	3.445	1.405
Forestry, Fishing, Ag Services	1.724	1.530	1.470	1.186
Processing				
Food Processing				
Processed Meat, Fish & Eggs	1.835	2.789	2.440	2.683

Dairy Processing	2.124	3.702	4.326	4.880
Processed Food & Kindred Products	1.842	2.398	2.839	2.901
Grain Milling & Flour	1.846	3.136	3.629	4.819
Fats & Oils	1.705	3.742	3.904	4.730
Beverage Processing	1.721	2.075	3.175	3.079
Wood/Paper/Furniture Manufacturing	1.897	2.334	2.168	2.185
Food & Forestry Wholesaling/Retailing	2.054	1.852	1.854	1.691
Food Services	1.913	2.000	1.880	1.354

Source: Computed based on IMPLAN Pro 2000.

We next follow the work of Muench and Deller (2001) and identify the top 25 food industry clusters as measured by total output, employment, total value added and total output per employee, total value added per employee for Pennsylvania food and agricultural sectors. These food and agricultural sectors are calculated using the IMPLAN software and 2001 Pennsylvania data, with results shown in Tables 10-14.

Confectionery manufacturing from cacao beans is the sector with largest total industry output, of nearly \$2.7 billion (Table 10). The top ten industries account for \$18.8 billion, or 57 percent of Pennsylvania's total output in this industry. Looking at the sum of the top 25 industries, we find that they account for 87 percent (\$28.5 billion) of all industry output.

Table 10. Top 25* Industries Total Industry Output, Pennsylvania, 2001.

Industry Cluster Title	Total Industry Output
Confectionery manufacturing from cacao beans	\$2,669,563,000
Bread and bakery product, except frozen, manufacturing	2,229,239,000
Cattle ranching and farming	2,211,838,000
Soft drink and ice manufacturing	2,111,722,000
Animal, except poultry, slaughtering	2,059,514,000
Fruit and vegetable canning and drying	1,948,240,000
Other snack food manufacturing	1,732,727,000
Fluid milk manufacturing	1,497,860,000
Meat processed from carcasses	1,201,946,000
Confectionery manufacturing from purchased chocolate	1,184,536,000
Other animal food manufacturing	1,183,337,000
Dog and cat food manufacturing	748,964,000
Poultry processing	739,739,000
Poultry and egg production	690,098,000
All other crop farming	687,167,000
Frozen food manufacturing	668,780,000
Breakfast cereal manufacturing	647,792,000
Cheese manufacturing	634,885,000
Other tobacco product manufacturing	585,290,000
Cookie and cracker manufacturing	549,992,000
Breweries	542,595,000
Dry, condensed, and evaporated dairy products	527,837,000

Mayonnaise, dressing, and sauce manufacturing	517,175,000
Logging	507,157,000
All other food manufacturing	457,171,000

Note: *: top 25 out of a possible 64 food and agricultural sectors.

Source: IMPLAN 2001

Cattle ranching and farming establishments in Pennsylvania are by far the single largest employer in the food and agricultural sector, accounting for 40,417 jobs, or about 21.4 percent of all sector employment (Table 11). This is followed by bread and bakery manufacturing product (except frozen) with 16,667 jobs and all other crop farming with 13,175 jobs. These top three employment sectors account for 70,259 jobs or 37.2 percent of total employment. The top 25 employment sectors account for 170,947 jobs, or 90.5 percent of all food and agriculture cluster employment. It should be noted that these employment figures include part time and full-time jobs. Therefore, caution is needed in using these results.

Table 11: Top 25* Industries Employment, Pennsylvania, 2001.

Industry Cluster Title	Employment
Cattle ranching and farming	40,417
Bread and bakery product, except frozen, manufacturing	16,667
All other crop farming	13,175
Agriculture and forestry support activities	11,335
Grain farming	9,264
Animal production, except cattle and poultry	6,870
Soft drink and ice manufacturing	6,723
Fruit and vegetable canning and drying	6,380
Confectionery manufacturing from purchased chocolate	5,805
Other snack food manufacturing	5,747
Confectionery manufacturing from cacao beans	5,370
Animal, except poultry, slaughtering	5,154
Poultry processing	5,067
Meat processed from carcasses	4,667
Logging	4,131
Greenhouse and nursery production	3,988
Fluid milk manufacturing	3,516
Poultry and egg production	2,626
Other animal food manufacturing	2,402
Cookie and cracker manufacturing	2,227
Frozen food manufacturing	2,103
All other food manufacturing	2,086
Oilseed farming	2,020
Dog and cat food manufacturing	1,630
Nonchocolate confectionery manufacturing	1,577

Note: *: top 25 out of a possible 64 food and agricultural sectors.

Source: IMPLAN 2001

The bread and bakery manufacturing product (except frozen) sector contributes the largest amount of total value added, at \$1.1 billion (Table 12), followed by confectionery manufacturing from cacao beans sector and other snack food manufacturing sector. The top three sectors account for 25.5 percent of the food and agricultural cluster's total value added.

Table 12: Top 25* Industries Total Value Added, Pennsylvania, 2001.

Industry Cluster Title	Total Value Added*
Bread and bakery product, except frozen, manufacturing	\$1,098,634,000
Confectionery manufacturing from cacao beans	815,977,000
Other snack food manufacturing	673,011,000
Fruit and vegetable canning and drying	624,757,000
Soft drink and ice manufacturing	606,268,000
Confectionery manufacturing from purchased chocolate	530,357,000
Other tobacco product manufacturing	363,470,000
Frozen food manufacturing	330,761,000
All other crop farming	319,310,000
Breweries	300,671,000
Greenhouse and nursery production	274,612,000
Cattle ranching and farming	273,920,000
Animal, except poultry, slaughtering	263,423,000
Logging	251,051,000
Meat processed from carcasses	234,311,000
Cookie and cracker manufacturing	224,148,000
Fluid milk manufacturing	208,512,000
Agriculture and forestry support activities	193,706,000
Mayonnaise, dressing, and sauce manufacturing	171,791,000
Nonchocolate confectionery manufacturing	171,325,000
Dry, condensed, and evaporated dairy products	168,267,000
Grain farming	167,108,000
Poultry processing	162,584,000
Dog and cat food manufacturing	144,681,000
Poultry and egg production	143,733,000

Note: *: top 25 out of a possible 64 food and agricultural sectors.

Source: IMPLAN 2001

Another important measure in terms of assessing the productivity and potential competitiveness of a sector, that accounts for differences across firms with varying scales of operation, is that of industry output per employee (Table 13) and total value added per employee (Table 14). The tables report statistics for the top 25 industries in the state.

Table 13: Top 25* Industries Based on Industry Output per Employee, Pennsylvania, 2001.

Industry Cluster Title	Total Output per Employee	Jobs
Cigarette manufacturing	\$13,361,000	4
Fats and oils refining and blending	1,063,551	49

Creamery butter manufacturing	983,289	76
Soybean processing	945,667	3
Breakfast cereal manufacturing	794,837	815
Wet corn milling	784,667	3
Cheese manufacturing	578,219	1,098
Dry, condensed, and evaporated dairy products	578,135	913
Tobacco stemming and redrying	527,767	120
Confectionery manufacturing from cacao beans	497,125	5,370
Other oilseed processing	496,000	3
Other animal food manufacturing	492,647	2,402
Dog and cat food manufacturing	459,487	1,630
Mayonnaise, dressing, and sauce manufacturing	443,166	1,167
Fluid milk manufacturing	426,013	3,516
Breweries	418,024	1,298
Coffee and tea manufacturing	405,287	429
Flour milling	404,174	470
Roasted nuts and peanut butter manufacturing	401,916	119
Animal, except poultry, slaughtering	399,595	5,154
Other tobacco product manufacturing	382,043	1,532
Flavoring syrup and concentrate manufacturing	352,438	397
Malt manufacturing	342,273	33
Frozen cakes and other pastries manufacturing	330,771	1,006
Rice milling	327,000	2

Note: *: top 25 out of a possible 64 food and agricultural sectors.

Source: IMPLAN 2001

Table 14: Top 25* Industries Based on Total Value Added per Employee, Pennsylvania, 2001.

Industry Cluster Title	TVA per employee	Employment
Cigarette manufacturing	\$7,794,750	4
Flavoring syrup and concentrate manufacturing	255,798	397
Other tobacco product manufacturing	237,252	1,532
Distilleries	234,411	190
Breweries	231,642	1,298
Wet corn milling	193,333	3
Dry, condensed, and evaporated dairy products	184,301	913
Frozen food manufacturing	157,281	2,103
Breakfast cereal manufacturing	153,590	815
Confectionery manufacturing from cacao beans	151,951	5,370
Mayonnaise, dressing, and sauce manufacturing	147,207	1,167
Rendering and meat byproduct processing	138,569	313
Fats and oils refining and blending	137,020	49
Spice and extract manufacturing	132,348	322
Forest nurseries, forest products, and timber	131,446	392
Roasted nuts and peanut butter manufacturing	121,513	119
Other snack food manufacturing	117,106	5,747
Nonchocolate confectionery manufacturing	108,640	1,577
Cookie and cracker manufacturing	100,650	2,227
Fruit and vegetable canning and drying	97,924	6,380
Dry pasta manufacturing	95,863	820

Frozen cakes and other pastries manufacturing	92,270	1,006
Confectionery manufacturing from purchased chocolate	91,362	5,805
Soft drink and ice manufacturing	90,178	6,723
Dog and cat food manufacturing	88,761	1,630

Note: *: top 25 out of a possible 64 food and agricultural sectors.

Source: IMPLAN 2001

The by far greatest amount of total output and value added in Pennsylvania’s food and agricultural industry in Pennsylvania per employee is cigarette manufacturing, which contributes \$13.4 million to total output and \$7.8 million to total value added per employee (Tables 13 and 14). However, the number of employment in cigarette manufacturing in Pennsylvania in 2001 is only 4 (person years), which likely skews and raises significance questions about the validity of these numbers significantly. The four employees compare with 11 workers in 2000. After cigarette manufacturing, the second largest food and agricultural industry in terms of total output per employee is fats and oils refining and blending industry, accounting for nearly \$1.1 million total output per workers. The second largest food and agriculture industry in terms of total value added per employee is flavored syrup and concentrate manufacturing, which accounts for \$255,798.

Input-output analysis applied to targeted industry cluster analysis also provides information on the size and of linkages among a state economy’s sectors, as well as the importance of imports from and exports to various sectors. This information is useful for identifying potential “gaps” or “disconnects.” In particular, Muench and Deller (2001, p.16) argue that this information can be used to launch economic development plans and strategies.

Table 15 presents findings of this “absolute gaps” analysis that identifies the four local industries that buy goods that are not manufactured in the state. The largest gap in monetary terms occurs with sugar manufacturing, where total imports exceed \$400.6 million, followed by the fishing industry with total imports of \$277.8 million. Other, although significantly smaller, gaps include imports of products from cotton farming, as well as sugarcane and sugar beet farming. Obviously, climatic and other geographic constraints will limited the feasible set of commodities that can be grown in any given state, and they need to be considered in this kind of analysis.

Table 15: Imported Commodities not Available Locally, Pennsylvania, 2001.

Importing Industry	Total Imports \$ millions
Sugar manufacturing	400.635
Fishing	277.761
Cotton farming	17.962
Sugarcane and sugar beet farming	7.010

Source: IMPLAN 2001

Locally available goods may be imported from outside the state as a result of a “disconnect” or of reasons “such as product specifications, pricing, or national contracts that supercede local con-

tracts” (Muench and Deller 2001, p.17). Table 16 presents potential disconnects as identified by our input-output analysis. For example, the cigarette manufacturing industry imports \$1.9 billion worth of goods, many of which are also available locally. In turn, Pennsylvania’s cigarette manufacturers exports \$2.6 million worth of product.

Another example of a potential disconnect involves soft drink and ice manufacturing, which imports \$1.3 billion worth of product but export \$1.8 billion. While this appears to be a significant disconnect, it might be readily explained by the types of soft drinks produced locally and needed by local demand, by pricing, by transshipment, or by the fact that the industry category is too highly aggregated (e.g., soft drinks are imported whereas ice is exported).

A comparison of the levels of local industry output along exports and imports can serve to identify gaps, disconnects and opportunities for import substitution in a state’s economy. Local industries with high production levels occurring at the same time as high levels of imports may suggest a potential disconnect. Conversely, large quantities of imports of goods and services that are not produced locally may point to gaps ripe for exploitation (Muench and Deller 2001, p.23). Tables 15 and 16 provide basic results needed to identify potential gaps or disconnects that may warrant further analysis and attention.

Table 16: Industry "Disconnect" and "Gaps", Pennsylvania, 2001.

Industry Cluster Title	Total Imports	Total Exports
Cigarette manufacturing	\$1,975,136,840	\$2,601,280
Soft drink and ice manufacturing	1,352,210,210	1,858,147,850
Fruit and vegetable canning and drying	1,348,130,490	1,854,772,410
Frozen food manufacturing	962,487,610	659,847,490
Grain farming	872,694,030	262,414,630
Poultry processing	771,751,950	51,940,720
Animal- except poultry- slaughtering	762,153,380	262,292,510
Breweries	750,262,080	432,950,700
Vegetable and melon farming	737,588,810	12,437,070
Fruit farming	593,337,460	25,700,490
Other animal food manufacturing	580,990,480	1,121,088,920
Greenhouse and nursery production	481,431,550	170,011,690
Wineries	420,816,990	28,696,450
Sugar manufacturing	400,634,550	0
Breakfast cereal manufacturing	390,957,820	509,638,530
Dog and cat food manufacturing	369,263,760	718,744,340
Cattle ranching and farming	352,490,420	12,412,800
Soybean processing	335,926,180	683,660
Seafood product preparation and packaging	331,171,300	3,787,450
Confectionery manufacturing from cacao beans	330,617,800	882,430,880
Forest nurseries- forest products- and timber trac	328,878,110	217,176,730
Wet corn milling	314,488,980	414,720
Fats and oils refining and blending	309,767,060	36,177,800
Animal production- except cattle and poultry and e	306,584,230	15,265,440
Fishing	277,760,860	0
Flavoring syrup and concentrate manufacturing	275,835,080	11,003,430

Agriculture and forestry support activities	269,038,940	276,094,720
Flour milling	266,029,300	159,138,780
Distilleries	255,565,090	43,829,400
Confectionery manuf., from purchased chocolate	240,979,310	2,316,003,420
Cheese manufacturing	224,151,730	5,316,100
Nonchocolate confectionery manufacturing	219,864,590	469,885,270
Meat processed from carcasses	219,831,210	48,342,030
All other food manufacturing	207,842,880	113,534,350
Coffee and tea manufacturing	191,408,550	14,137,500
Logging	182,827,610	39,979,090
Mixes and dough made from purchased flour	162,948,390	1,524,430
Roasted nuts and peanut butter manufacturing	156,794,220	24,233,610
All other crop farming	133,880,980	243,537,640
Fluid milk manufacturing	132,834,950	366,076,210
Poultry and egg production	120,439,950	189,589,740
Spice and extract manufacturing	117,884,320	2,985,570
Other oilseed processing	85,699,840	1,060,070
Dry- condensed- and evaporated dairy products	85,101,270	102,305,770
Rendering and meat byproduct processing	80,723,850	20,284,400
Bread and bakery product- except frozen- manuf.	72,143,780	740,902,440
Other snack food manufacturing	62,457,050	1,292,644,200
Rice milling	61,390,610	211,340
Tree nut farming	57,418,330	180,980
Tortilla manufacturing	49,448,440	0
Mayonnaise- dressing- and sauce manufacturing	46,949,780	274,827,060
Hunting and trapping	45,832,980	14,939,740
Ice cream and frozen dessert manufacturing	35,409,930	183,457,970
Oilseed farming	29,658,610	86,808,590
Tobacco farming	19,488,170	16,651,580
Cotton farming	17,962,360	0
Creamery butter manufacturing	17,505,970	7,080,360
Malt manufacturing	16,498,190	10,435,790
Dry pasta manufacturing	16,164,960	74,132,080
Other tobacco product manufacturing	11,731,500	436,563,800
Tobacco stemming and redrying	11,132,690	34,196,690
Sugarcane and sugar beet farming	7,009,980	0
Cookie and cracker manufacturing	4,680,920	94,099,700
Frozen cakes and other pastries manufacturing	4,455,060	188,556,010

Source: IMPLAN 2001

Section 3: Summary and Conclusions

Despite its shortcomings and limitations, cluster analysis is increasingly being used as a tool for policy analysis around the world. Yet, the subject remains more art than science, and we are only beginning to understand which tools are most effective for identifying clusters from secondary data.

In this technical report we used County Business Patterns data, Census of Agriculture data and the IMPLAN database to identify industry potential food and agricultural in the Northeast region of the United States. We adopt several different analytical tools to empirically identify existing or latent industry clusters: local employment analysis, location quotient, shift share analysis, wages, bubble charts, local Moran's I, locational correlation and input-output analysis. These analytical tools help us better understand the competitive advantage and possibilities of particular food and agriculture industry.

Using local employment analysis, we find that commercial bakeries, poultry processing, retail bakeries, soft drink manufacturing, meat processed from carcasses and fluid milk manufacturing exhibit the highest employment in 2001 in the Northeast. Location quotient analysis showed that chocolate & confectionery manufacturing from cacao beans, coffee & tea manufacturing, seafood canning, ice cream & frozen dessert manufacturing, spice & extract manufacturing, breweries, cane sugar refining and other tobacco product manufacturing are the most heavily concentrated or localized industries in the Northeast.

Using shift share analysis, we find that coffee & tea manufacturing, other tobacco product manufacturing, retail bakeries, fresh & frozen seafood processing, commercial bakeries, soft drink manufacturing, fruit & vegetable canning, chocolate & confectionery manufacturing from cacao beans, and ice cream & frozen dessert manufacturing are on the top of competitive advantage for Northeast states. Studying average annual wages of food industry clusters, we find that spice and extract manufacturing has the highest average annual wage in 2001, at \$45,251. Cookie and cracker manufacturing has the next highest wage, at \$37,566. It is interesting to note that the order of the wage rank for clusters does not duplicate the order of employment rank. Nevertheless, these wage statistics are of questionable value in some sectors because of federal disclosure regulations.

To combine measures of employment, employment growth, wage and location quotients, we create bubble chart to visualize and compare clusters for Pennsylvania, Connecticut, Massachusetts, Maryland, and New Jersey. Ice cream and frozen dessert manufacturing is possibly the top industry cluster in Pennsylvania and Massachusetts, according to this method. Flavoring syrup and chocolate manufacturing has the potential to be the top targeted industry cluster in Connecticut, while spice and extract manufacturing is the top industry cluster in both Maryland and New Jersey according to this analysis.

Using the local Moran's I, we identify four sets of counties for each potential industry cluster: central counties in clusters, peripheral counties in clusters, non-cluster counties and non-establishment counties. Using ArcGIS, we mapped the distribution of industry cluster across counties in the Northeast. Many industry clusters stretch across several counties and even across state borders. For example, beef cattle ranching and farming are clustered across Pennsylvania and West Virginia border. This suggests that practitioners and analysts should be careful not to limit their cluster analysis only to single counties or event states, depending on where they are located.

We then identified industry clusters with locational correlation coefficients greater than 0.75 using a broad definition of food and agriculture industries. These industries begin with the growing

of food crops, including grains and livestock and end with the wholesale and retail distribution of these products. The cluster also included support industries such as refrigerated warehousing and fertilizer manufacturing. These identified industry clusters can help us better understand the linkages and various types of externalities across industries. Of course, care must be taken in the interpretation of results. In many cases, industries may co-locate not because they are part of the same value chain but because they are attracted by the same market feature, such as a access to a transportation network, high population density or concentrated purchasing power.

Finally, using IMPLAN we find that the total value added of Pennsylvania economy in food and related agricultural cluster was \$36 billion in 2000. Of this total, 35.6 percent is attributable to the food and forestry-processing sector. In comparison, the total output of food and related agricultural sectors was \$83.8 billion. The food and related agricultural cluster accounts for about \$22.4 billion in total income and it provides over 861,000 jobs in Pennsylvania.

Using IMPLAN's input-output model, we also identified the top 25 food industry clusters based on total industry output, employment, total value added and total industry output per employee, total value added per employee for Pennsylvania's food and agricultural sectors in 2001. Confectionery manufacturing from cacao beans sector has the largest industry output, of nearly \$2.7 billion. The single largest employer in Pennsylvania's food and agriculture sector is cattle ranching and farming establishments, accounting for 40,417 jobs, or about 21.4 percent of the total employment in that sector. As for total value added, the bread and bakery manufacturing product (except frozen) sector contributes the highest total value added, at \$1.1 billion. The largest food and agriculture industry in Pennsylvania in terms of total output per job and total value added per job is cigarette manufacturing.

Using the input-output model, we also identified potential 'gaps' or 'disconnects' in Pennsylvania agricultural and farming economy. For example, the largest gap is sugar manufacturing industry with total imports of over \$400.6 million. This is followed by fishing industry with total imports of \$277.8 million. An example of a potential disconnect exists in soft drink and ice manufacturing, which imports \$1.3 billion worth of product. Meanwhile local producers of soft drink and ice manufacturing export \$1.8 billion. We go on to provide basic results to identify potential gaps or disconnects that are worthy of further consideration.

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Appendix A: Comparison of Results Obtained Using Different Methods

State	2001 LQ (jobs)	Shift-share	Bubble charts	
CT	Coffee, tea manufacturing	Coffee, tea manufacturing	Flavoring syrup and concentrate manufacturing	
DE	Seafood canning	Retail bakeries		
MA	Ice cream and frozen desserts manufacturing	Fresh and frozen seafood manufacturing	Roasted nuts and peanut butter manufacturing	
MD	Spice & extracts manufactur.	Retail bakeries	Spice and extracts manufact.	
ME	Seafood canning	Commercial bakeries		
NH	Breweries	Soft drink manufacturing		
NJ	Seafood canning	Commercial bakeries	Spice and extracts manufact.	
NY	Cane sugar refining	Fruit & vegetables canning		
PA	Chocolate & confectionary manuf. from cacao beans	Othr tobacco product manufacturing	Ice cream and frozen desserts manufacturing	
RI	Coffee & tea manuf.	All other misc food manufacturing		
VT	Chocolate & confectionary manuf. from cacao beans	Chocolate & confection. manuf. from cacao beans		
WV	Other tobacco products manufacturing	Ice cream and frozen deserts manufacturing		