



HARVARD | BUSINESS | SCHOOL

Pennsylvania Competitiveness: State and Cluster Economic Performance



Prepared for Governor Tom Corbett

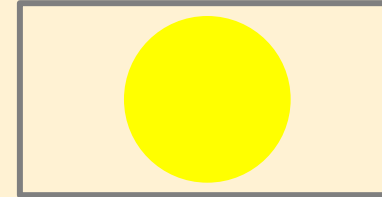
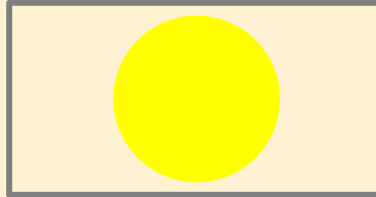
Professor Michael E. Porter
National Governors Association Winter Meeting
February 26, 2011

Pennsylvania Performance Snapshot

Position

Trend

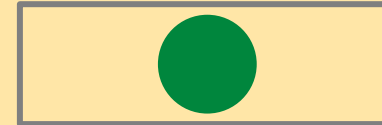
Prosperity



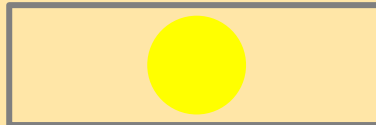
Productivity



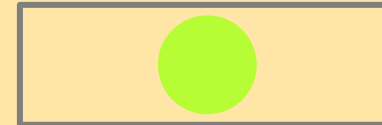
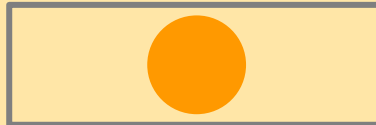
Labor Mobilization



Innovation



Cluster Strength



Leading Clusters

- Education and Knowledge Creation
- Metal Manufacturing
- Heavy Machinery
- Medical Devices
- Lighting and Electrical Equipment

State Comparative Performance

Pennsylvania Competitiveness

Overall Economic Performance Indicators

Prosperity		
Gross State Product per capita, 2009		
• In Pennsylvania:	\$44,013	Rank: 27
• In the US:	\$46,093	
• State difference to US:	-4.5%	
Growth in Gross State Product per capita, real annual rate, 1999-2009		
• In Pennsylvania:	0.94%	Rank: 28
• In the US:	0.86%	

Productivity		
Gross State Product per labor force participant, 2009		
• In Pennsylvania:	\$86,773	Rank: 23
• In the US:	\$92,382	
• State difference to US:	-6.1%	
Growth in Gross State Product per labor force participant*, 1999-2009		
• In Pennsylvania:	0.73%	Rank: 41
• In the US:	1.09%	
Average private wage, 2008		
• In Pennsylvania:	\$41,251	Rank: 17
• In the US:	\$42,435	
• State difference to US:	-2.8%	
Private wage Growth, annual rate, 1998-2008		
• In Pennsylvania:	3.35%	Rank: 23
• In the US:	3.32%	

Innovation Output		
Patents Per 10,000 Employees, 2009		
• In Pennsylvania:	5.08	Rank: 24
• In the US:	6.83	
Growth in total patents, annual rate, 1998-2009		
• In Pennsylvania:	-2.14%	Rank: 39
• In the US:	0.23%	
Traded establishment formation, annual growth rate, 1998-2008		
• In Pennsylvania:	1.49%	Rank: 31
• In the US:	1.79%	

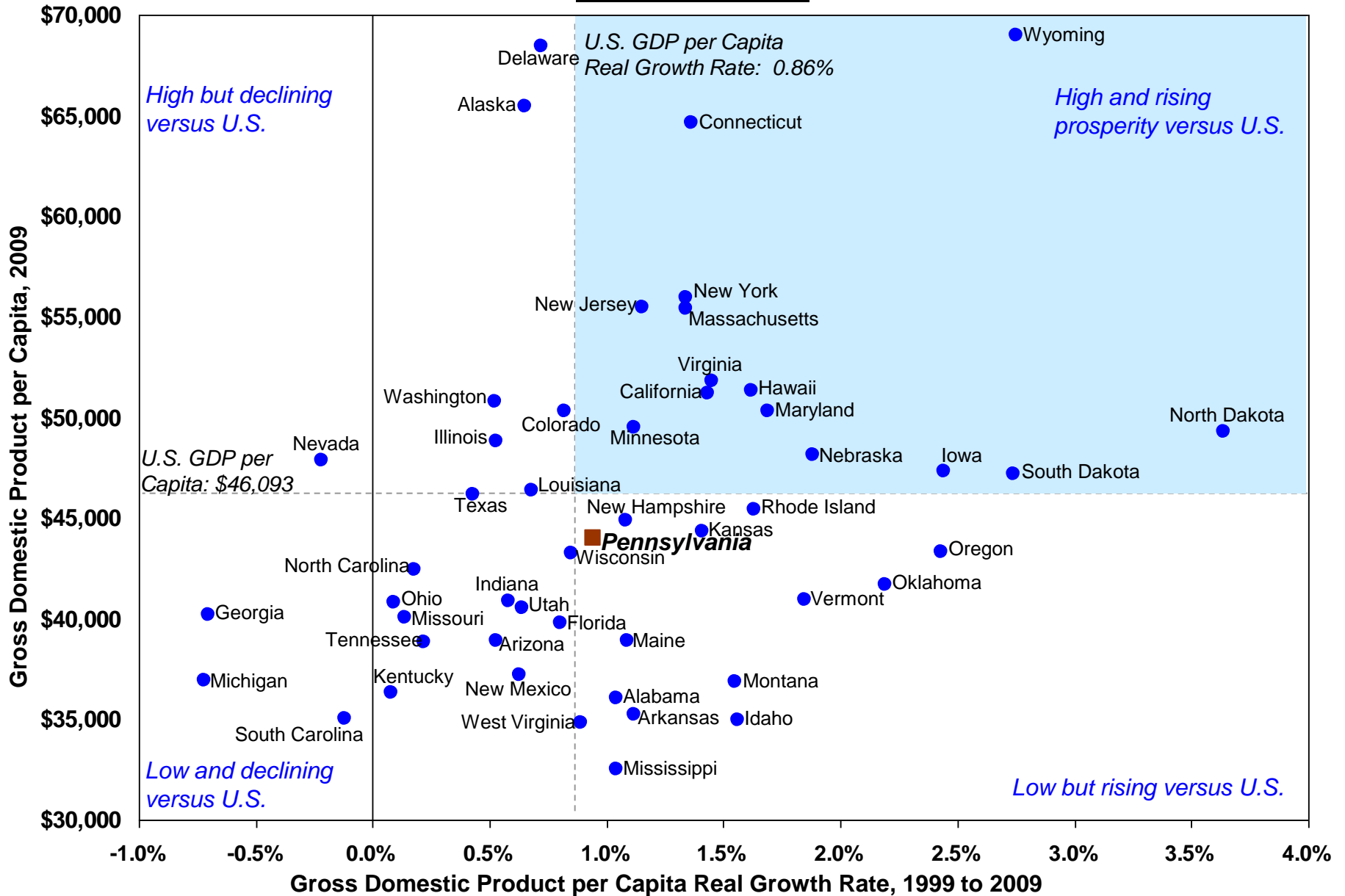
Cluster		
Share of State Traded Employment in Strong Clusters, 2008		
• In Pennsylvania:	27.7%	Rank: 39
• In the US:	41.8%	
Change in Share of National Employment in Strong Clusters, 1998-2008		
• In Pennsylvania:	0.30%	Rank: 11
• In the US:	-0.06%	
Share of Employment in Traded Clusters, 1998-2008		
• In Pennsylvania:	28.6%	Rank: 19
• In the US:	27.4%	
Change in Share of Employment in Traded Clusters, 1998-2008		
• In Pennsylvania:	-1.6%	Rank: 23
• In the US:	-2.2%	

Labor Mobilization		
Population, 2009		
• In Pennsylvania:	12,604,729	Rank: 6
• % of US:	4.11%	
Population growth, annual rate, 1999-2009		
• In Pennsylvania:	0.27%	Rank: 45
• In the US:	0.96%	
Labor Force Participation, 2009		
• In Pennsylvania:	64.3	Rank: 34
• In the US:	65.4	
Employment, 2010 (December)		
• In Pennsylvania:	5,819,394	Rank: 6
• % of US:	4.18%	
Employment growth, annual rate, 2000-2010 (December)		
• In Pennsylvania:	-0.07%	Rank: 37
• In the US:	0.11%	
Unemployment, 2010 (December)		
• In Pennsylvania:	8.5%	Rank: 24
• In the US:	9.4%	
Change in Unemployment, 2000-2010 (December)		
• In Pennsylvania:	4.2%	Rank: 25
• In the US:	5.5%	

Note: Ranks are among the 50 US states plus the District of Columbia. Growth calculated as compound annual growth rate. *Real annual rate.

Long Term State Prosperity Performance

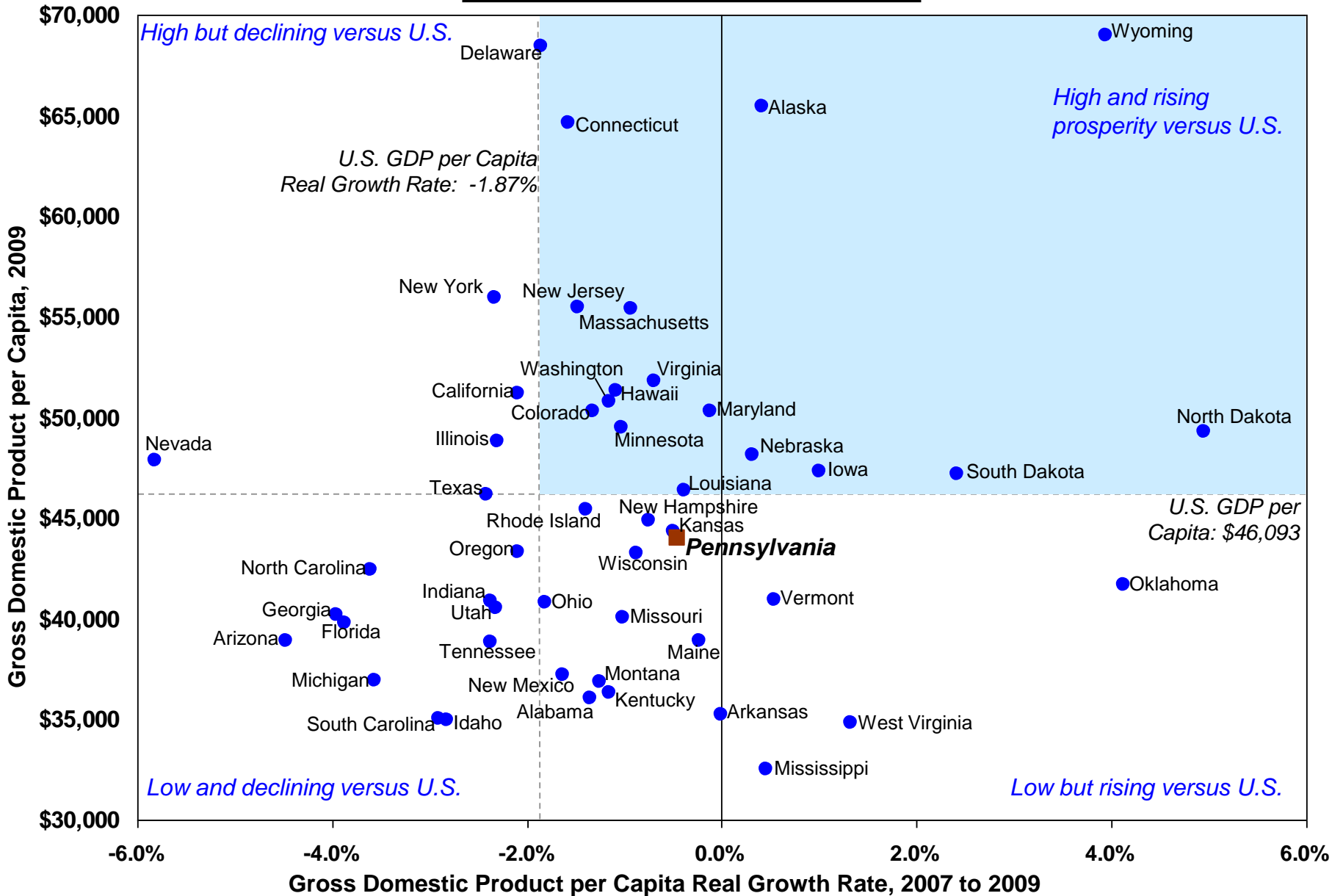
1999 to 2009



Notes: Real GDP figures in 2005 chained US dollars from the Bureau of Economic Analysis. Growth rate is calculated as compound annual growth rate. D.C. excluded

Near Term State Prosperity Performance

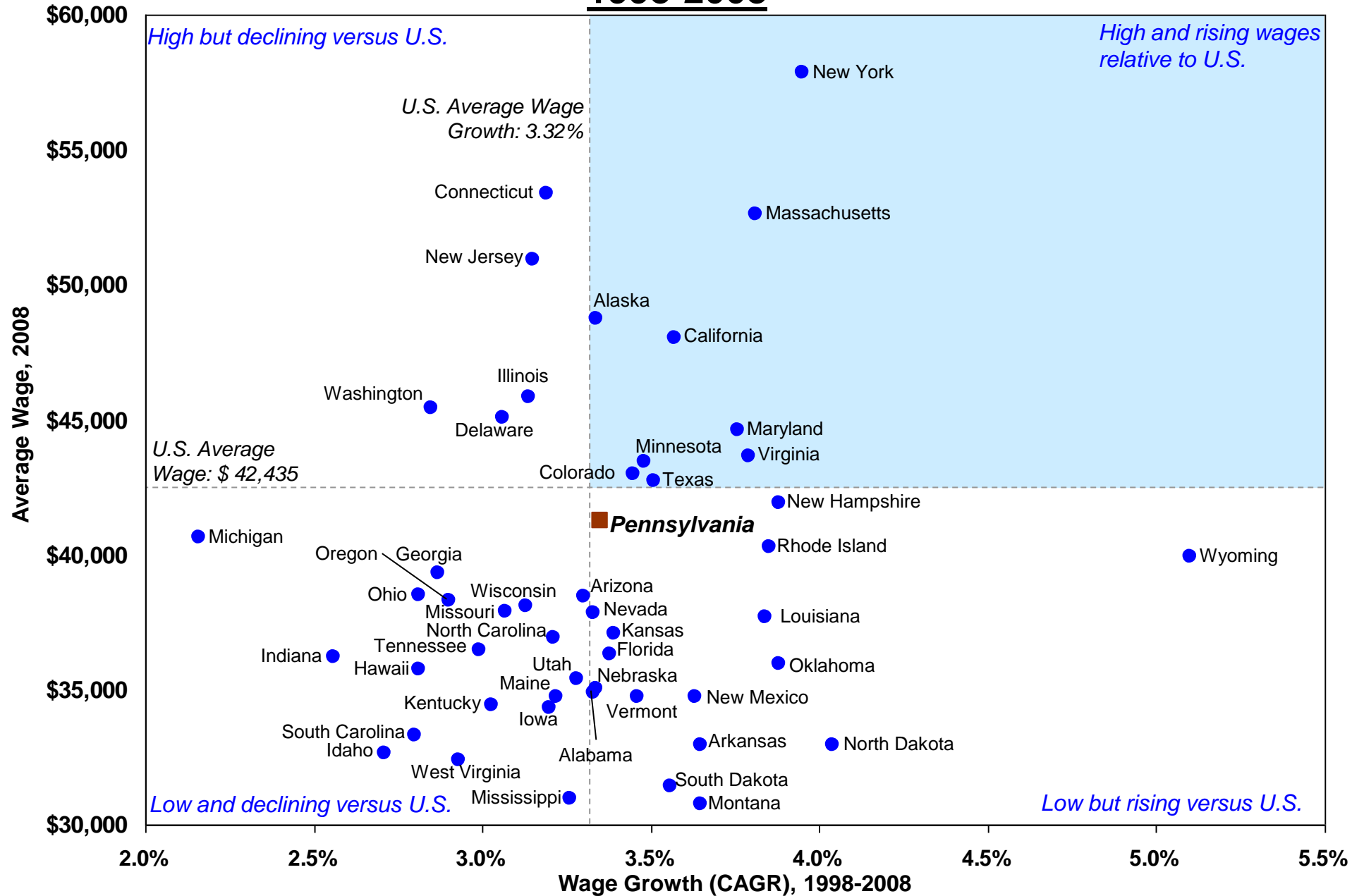
U.S. States, 2007 to 2009



Notes: Real GDP figures in 2005 chained US dollars from the Bureau of Economic Analysis. Growth rate is calculated as compound annual growth rate.

State Private Sector Wage Performance

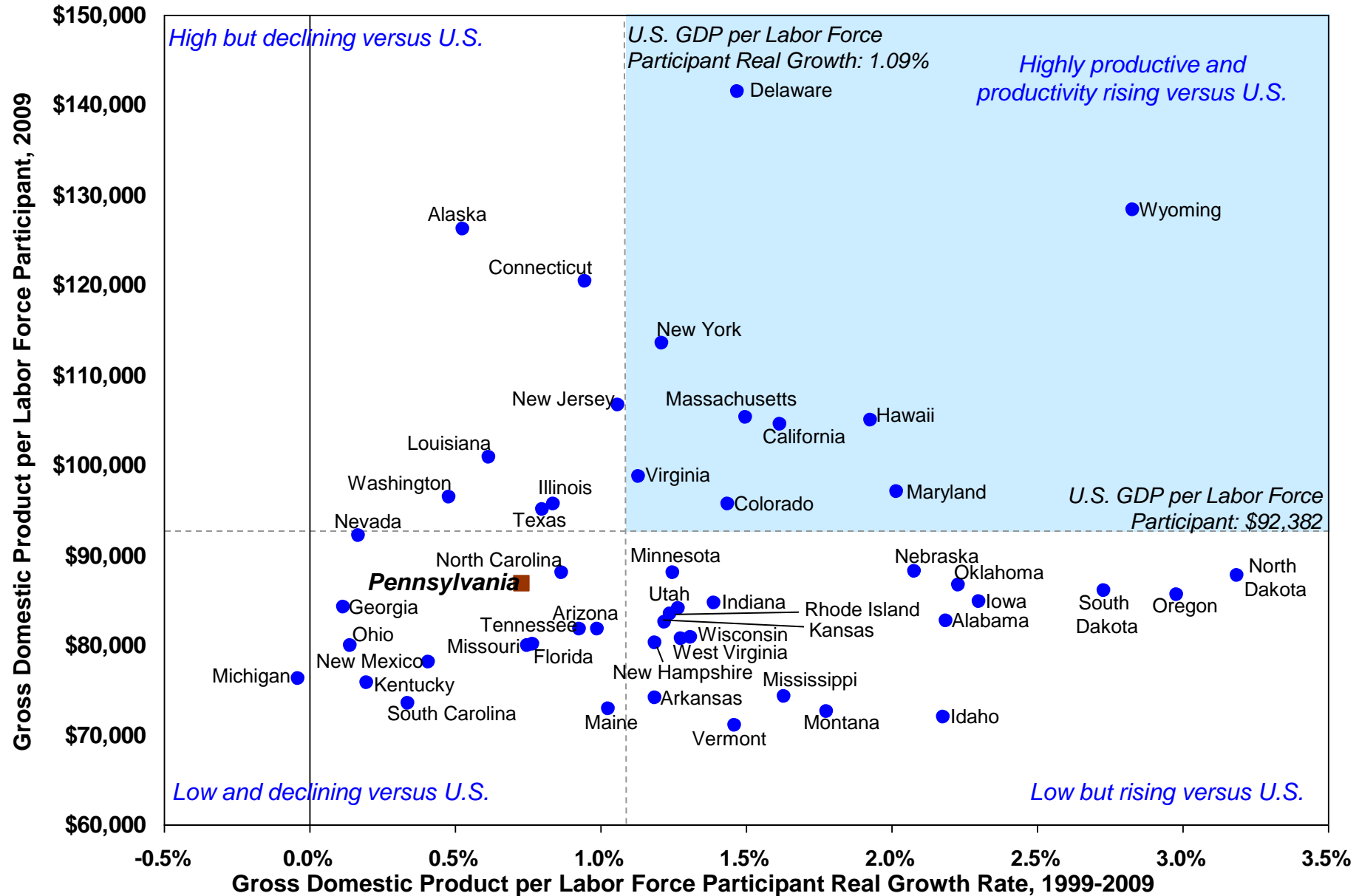
1998-2008



Source: Census CBP report; private, non-agricultural employment. Growth is calculated on nominal wage levels.

Long Term State Labor Productivity Performance

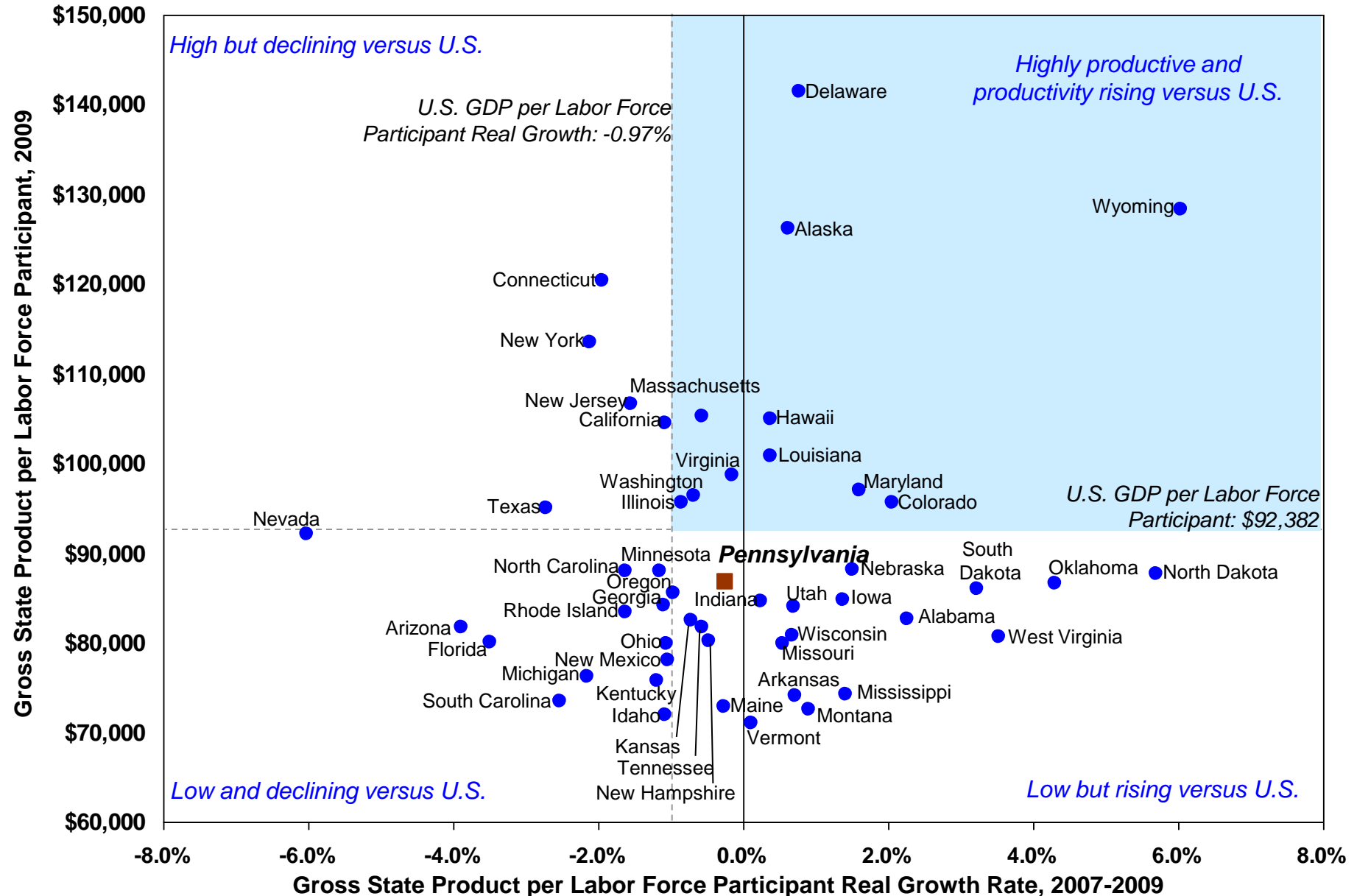
1999-2009



Source: Bureau of Economic Analysis. Notes: Growth rate calculated as compound annual growth rate (CAGR).
 NGA 2011 – Pennsylvania

Near Term State Labor Productivity Performance

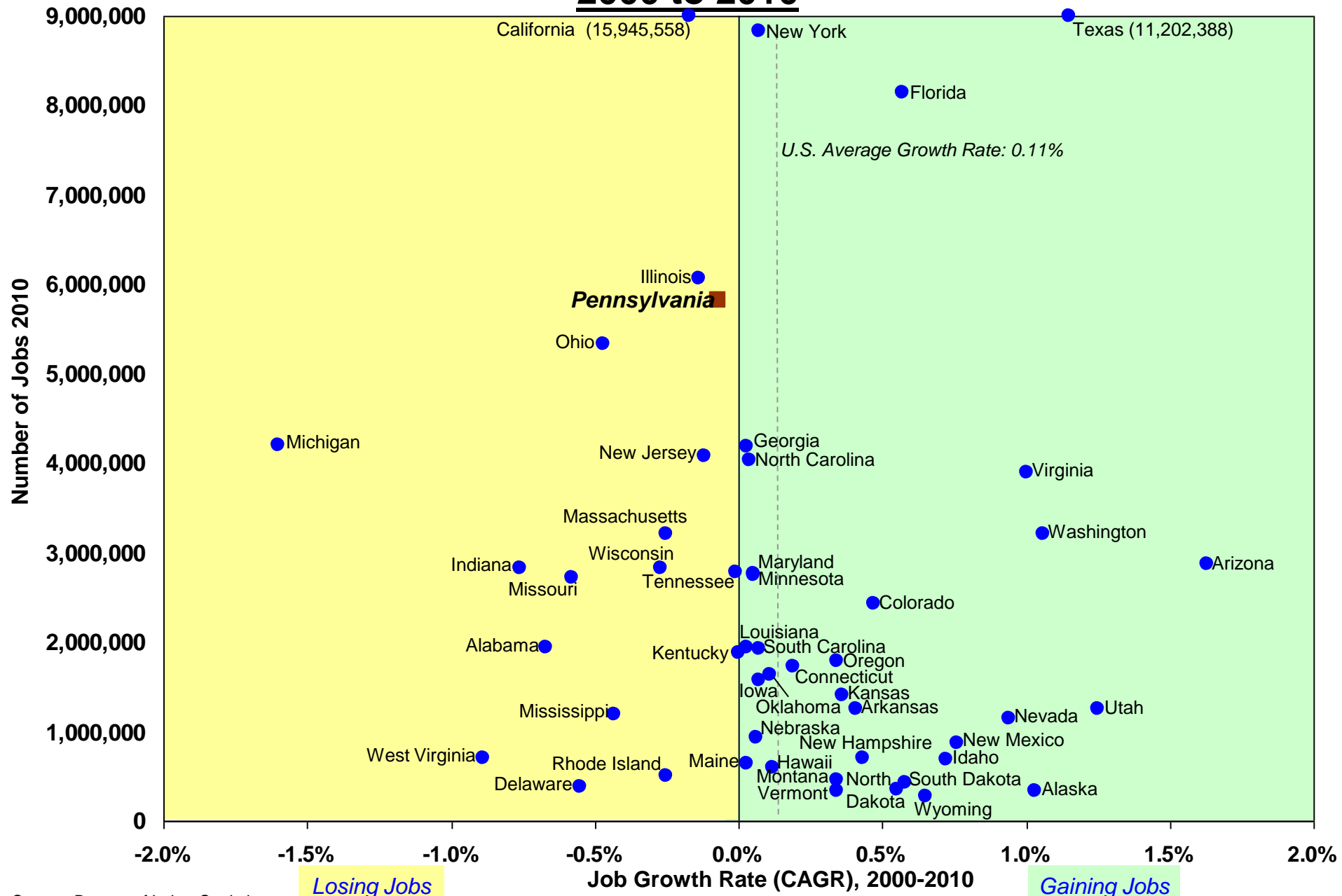
2007-2009



Source: Bureau of Economic Analysis. Notes: Growth rate calculated as compound annual growth rate (CAGR).
 NGA 2011 – Pennsylvania

Long Term State Job Growth

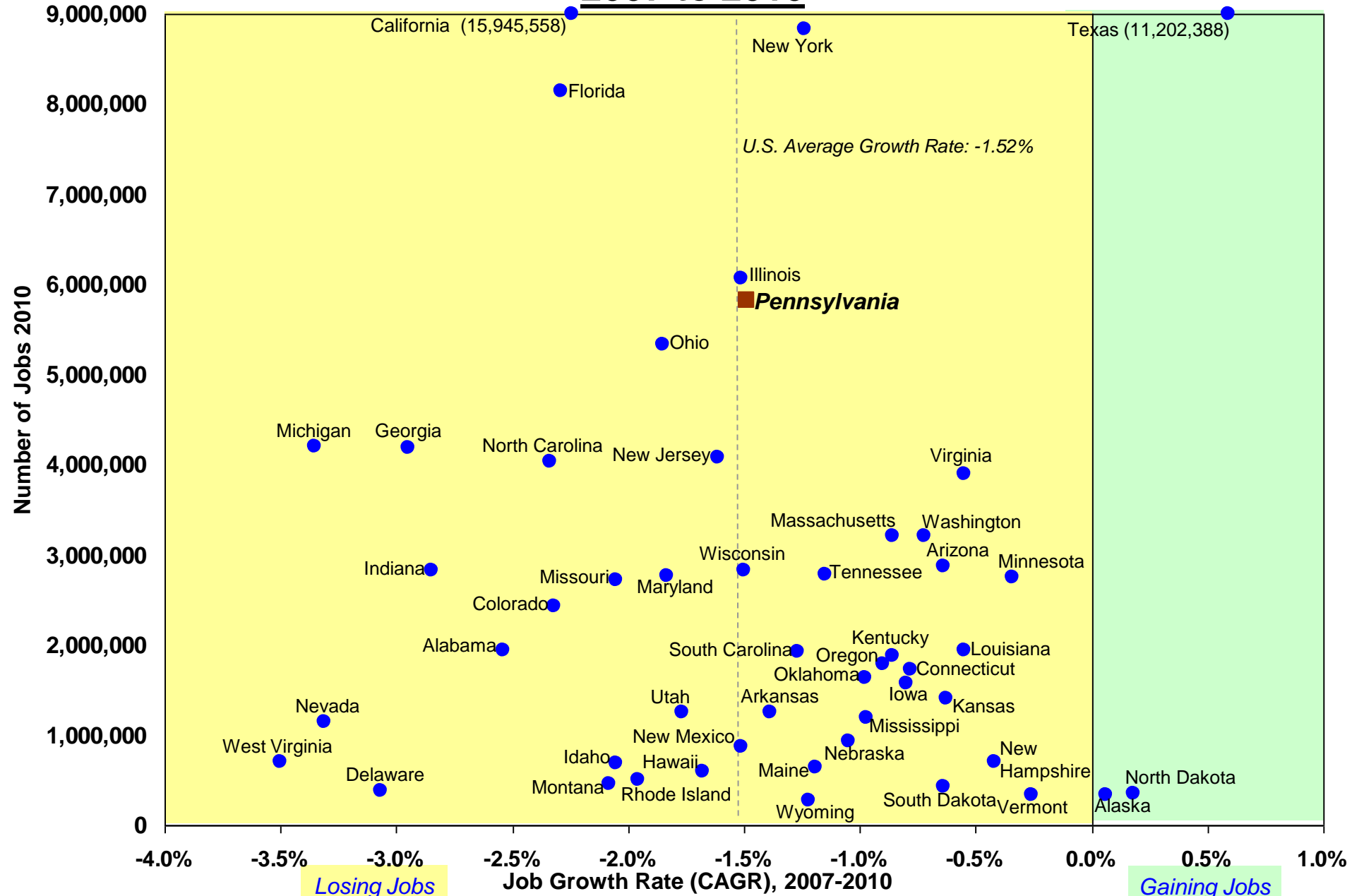
2000 to 2010



Source: Bureau of Labor Statistics
 NGA 2011 – Pennsylvania

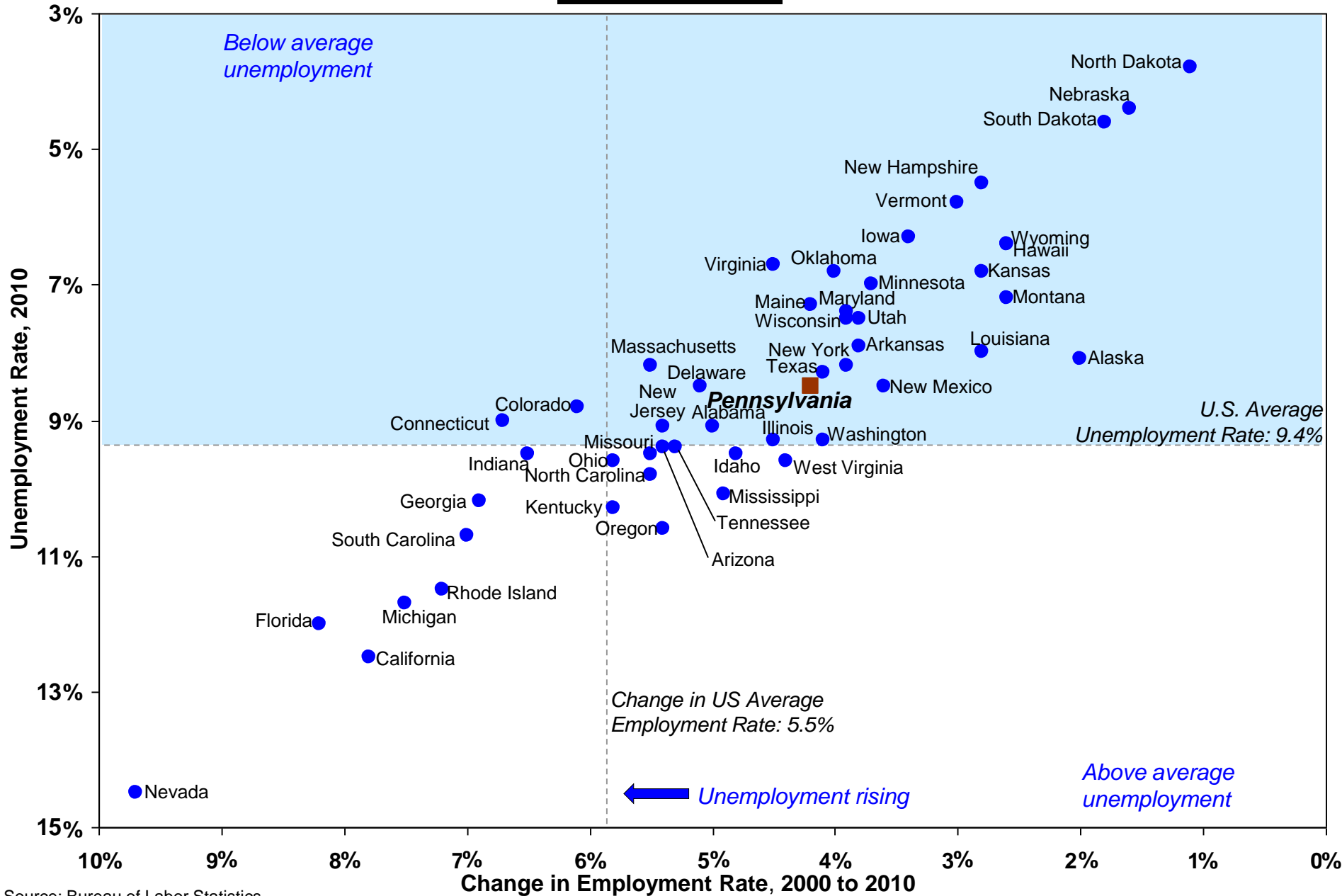
Near Term State Job Growth

2007 to 2010



Source: Bureau of Labor Statistics

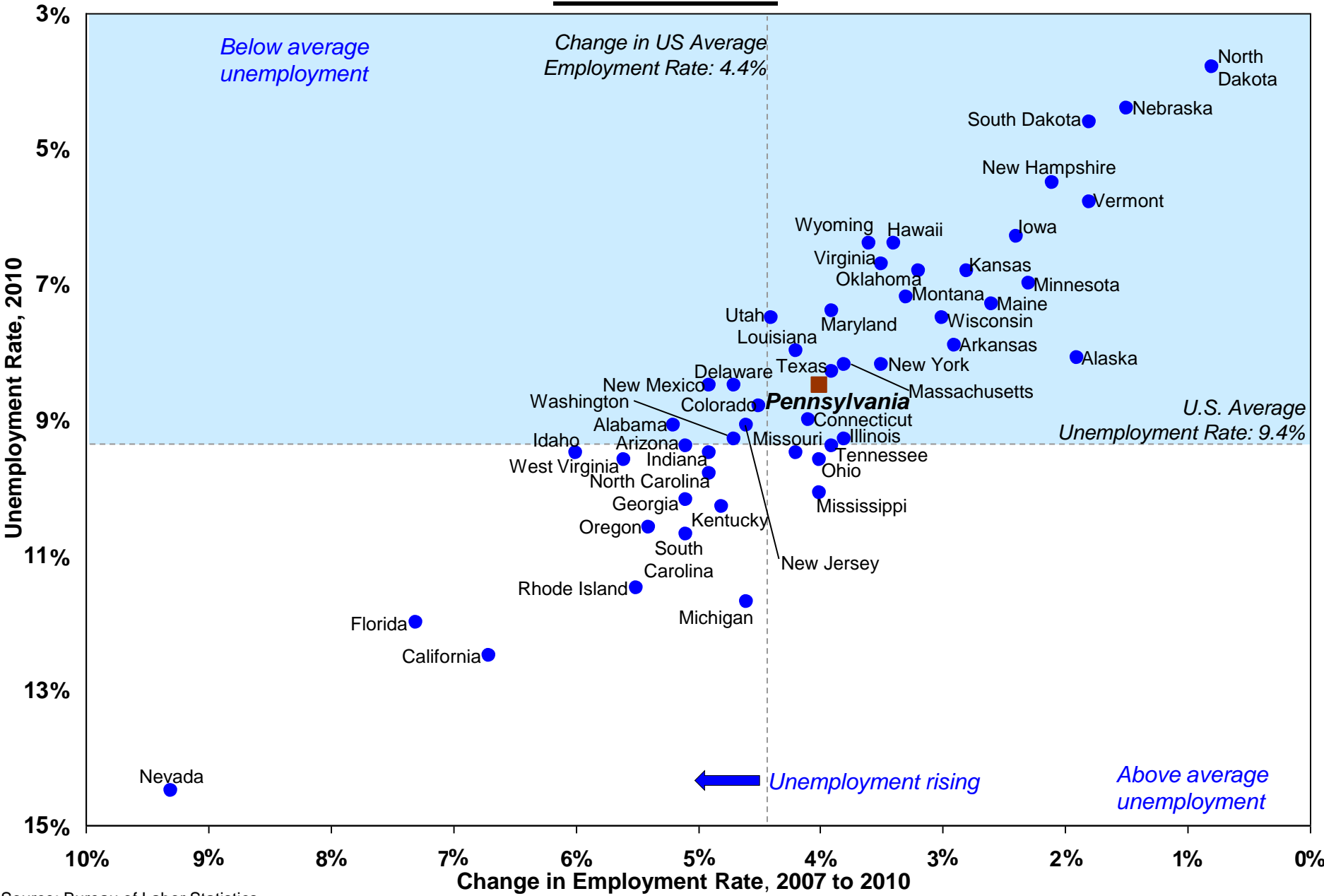
Long Term State Unemployment Rate 2000 to 2010



Source: Bureau of Labor Statistics
NGA 2011 - Pennsylvania

Near Term State Unemployment Rate

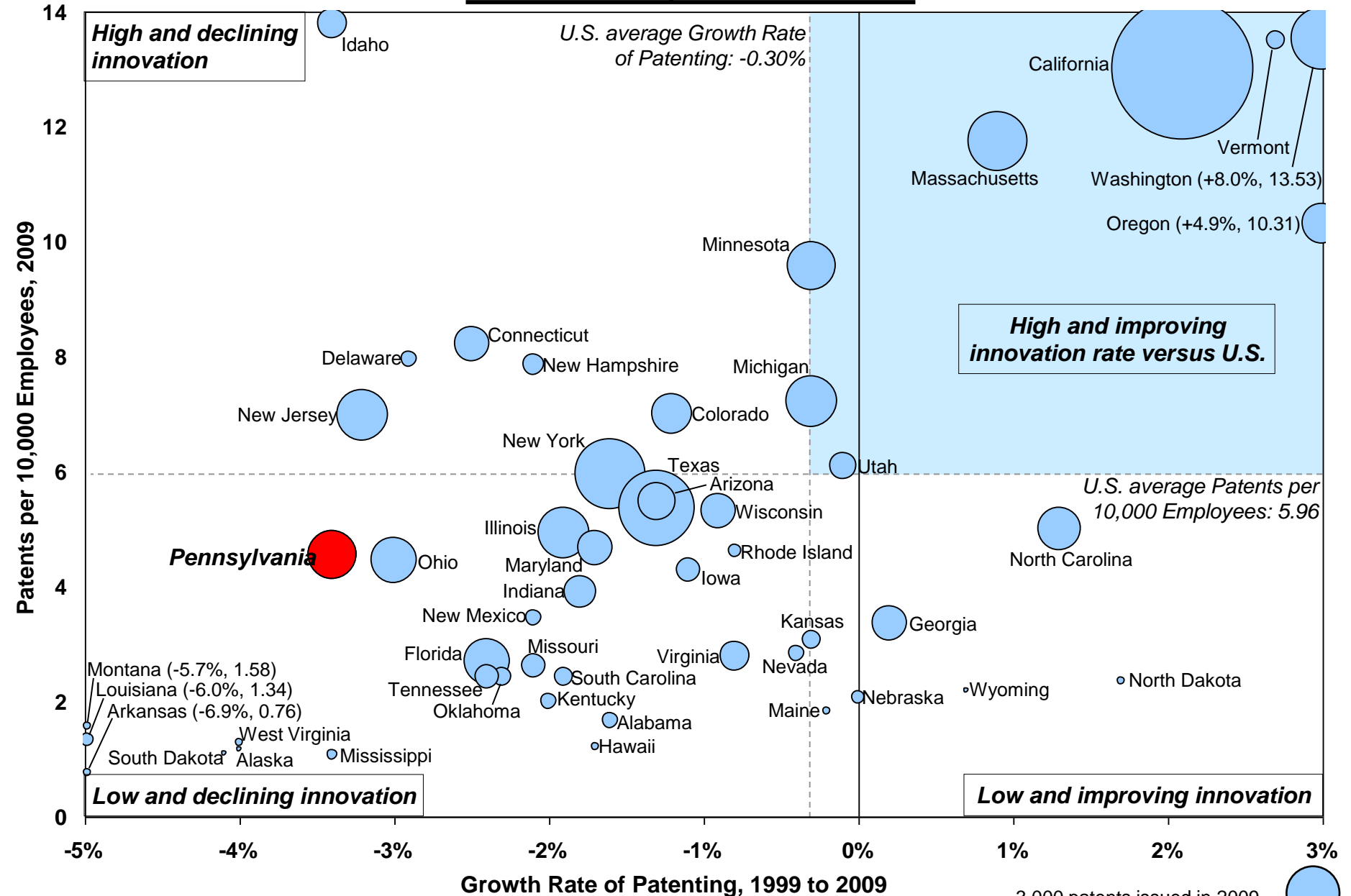
2007 to 2010



Source: Bureau of Labor Statistics
 NGA 2011 - Pennsylvania

Long Term State Patenting Performance

U.S. States, 1999 to 2009





Source: USPTO, Bureau of Labor Statistics. Note: Growth rate calculated as compound annual growth rate (CAGR).

Pennsylvania Patents by Organization

Rank	Organization	Patents 2005-2009
1	Agere Systems Inc.	288
2	Tyco Electronics Corporation	251
3	E. I. Du Pont De Nemours And Company	208
4	Air Products And Chemicals, Inc.	201
5	Ppg Industries Ohio Inc.	198
6	Lutron Electronics Company, Inc.	195
7	Rohm And Haas Company	166
8	University Of Pennsylvania	144
9	Eaton Corporation	140
10	Merck + Co., Inc.	132
11	General Electric Company	125
12	Fci Americas Technology, Inc.	115
13	Wyeth	112
14	Columbia Insurance Company	110
15	Interdigital Technology Corporation	107
16	Bristol-Myers Squibb Company	105
17	Smithkline Beecham Corporation	93
18	General Instrument Corporation	91
19	Penn State Research Foundation, Inc.	90
20	Cnh America Llc	84
21	University Of Pittsburgh	78
22	Kennametal Inc.	77
23	Seagate Technology, Llc	75
24	Arlington Industries, Inc.	73
25	Unisys Corporation	72

Rank	Organization	Patents 2005-2009
26	Graham Packaging Company, L.P.	71
27	Alcoa Inc.	68
28	Hon Hai Precision Ind. Co., Ltd.	61
29	Ortho-Mcneil Pharmaceutical, Inc.	57
30	Carnegie-Mellon University	56
31	Chemimage Corporation	54
32	Lockheed Martin Corporation	52
32	Lyondell Chemical Technology, L.P.	52
34	Graco Children'S Products, Inc.	47
35	Black & Decker Inc.	46
36	Medrad, Inc.	45
37	Osram Sylvania Inc.	43
38	Ric Investments, Llc	42
39	Bayer Materialscience Llc	41
40	Thermal Corporation	40
41	International Business Machines Corporation	38
42	Janssen Pharmaceutica N.V.	37
42	Certainteed Corp.	37
42	Awi Licensing Company	37
45	Lasko Holdings, Inc.	36
45	Siemens Medical Solutions Health Services Corporation	36
45	Sioptical, Inc.	36
48	Arkema Inc.	35
49	Lattice Semiconductor Corporation	33
50	Honeywell International Inc.	32

	Universities and Research Institutions
	Government Organizations

The Impact of Cluster Mix and Cluster Strength on Wages

U.S. States, 2008

State	State Traded Wage versus National Average	Cluster Mix Effect	Relative Cluster Wage Effect
New York	+34,578	5,188	29,390
Connecticut	+20,008	6,898	13,109
Massachusetts	+17,308	5,191	12,117
New Jersey	+12,157	4,638	7,519
California	+9,597	121	9,476
Maryland	+6,435	2,778	3,657
Washington	+4,827	3,058	1,769
Virginia	+2,550	945	1,605
Illinois	+2,501	-61	2,562
Alaska	+2,386	-3,044	5,431
Texas	+1,400	2,796	-1,396
Colorado	+753	2,292	-1,539
Delaware	+612	13,346	-12,733
Louisiana	-4,172	573	-4,745
Minnesota	-4,404	43	-4,448
Wyoming	-4,423	1,408	-5,831
Michigan	-4,981	-2,534	-2,447
Pennsylvania	-5,182	-1,064	-4,118
New Hampshire	-6,359	1,224	-7,584
Georgia	-7,262	-1,923	-5,338
Arizona	-8,662	1,557	-10,219
Kansas	-8,828	1,820	-10,648
Ohio	-9,766	-1,436	-8,330
Oregon	-9,774	-2,355	-7,420
Wisconsin	-10,479	-3,341	-7,138

State	State Traded Wage versus National Average	Cluster Mix Effect	Relative Cluster Wage Effect
North Carolina	-10,673	-5,131	-5,543
Missouri	-10,953	-1,634	-9,319
Rhode Island	-11,089	-1,370	-9,719
Florida	-11,780	-1,473	-10,307
Oklahoma	-12,225	1,533	-13,758
Alabama	-12,301	-4,713	-7,588
Tennessee	-13,063	-3,987	-9,076
Vermont	-13,095	-2,936	-10,159
Indiana	-13,309	-5,495	-7,814
Nebraska	-14,659	41	-14,699
Utah	-14,947	327	-15,274
South Carolina	-15,256	-5,694	-9,562
Nevada	-15,429	-2,829	-12,600
Maine	-15,826	-726	-15,100
North Dakota	-16,437	2,940	-19,378
Iowa	-16,963	-2,602	-14,361
New Mexico	-16,991	-125	-16,866
Kentucky	-17,303	-5,013	-12,291
West Virginia	-17,357	-4,290	-13,067
Arkansas	-17,616	-5,171	-12,445
Hawaii	-18,103	-14,124	-3,980
Idaho	-18,636	-1,567	-17,069
Mississippi	-20,859	-6,165	-14,694
South Dakota	-21,211	955	-22,166
Montana	-22,488	-3,494	-18,994

Cluster mix: a region's particular mix of lower and higher average wage clusters

Relative cluster wage: a region's cluster wage relative to the average national wage in that cluster

The cluster mix and the cluster wage level effects add up to the total difference between a region's average wage and the national average wage. On average, the wage level effect is responsible for 76.3% of the total difference in state wages to the national average.

Effect of Urban and Rural Areas on Average State Wages

U.S. States, 2008

State	Average Overall Wage Difference to U.S.	Metro-Rural Mix	Relative Metro Wage	Relative Rural Wage
New York	+15,412	982	14,078	353
Connecticut	+10,919	1,013	9,592	315
Massachusetts	+10,197	1,674	8,333	190
New Jersey	+8,488	1,631	6,765	92
Alaska	+6,538	-1,438	5,158	2,818
California	+5,584	1,476	3,844	265
Illinois	+3,427	411	3,277	-261
Washington	+3,013	832	2,122	58
Delaware	+2,664	-191	2,895	-40
Maryland	+2,201	1,159	775	267
Virginia	+1,182	509	709	-36
Minnesota	+1,024	-903	2,130	-202
Colorado	+539	-110	-66	714
Texas	+325	350	-234	209
New Hampshire	-504	-2,856	924	1,428
Pennsylvania	-1,184	262	-1,480	34
Michigan	-1,785	-165	-1,576	-44
Rhode Island	-2,143	1,720	-3,846	-17
Wyoming	-2,478	-6,929	-2,304	6,755
Georgia	-3,136	-120	-2,542	-475
Ohio	-3,925	-224	-3,799	98
Arizona	-3,962	937	-4,897	-2
Oregon	-4,116	-359	-3,505	-251
Wisconsin	-4,336	-910	-3,419	-7
Missouri	-4,540	-573	-3,103	-865

State	Average Overall Wage Difference to U.S.	Metro-Rural Mix	Relative Metro Wage	Relative Rural Wage
Nevada	-4,560	815	-5,752	377
Louisiana	-4,739	-630	-4,764	655
Kansas	-5,371	-2,175	-2,535	-661
North Carolina	-5,505	-1,262	-3,796	-446
Tennessee	-5,992	-538	-4,973	-481
Florida	-6,132	-128	-6,074	70
Indiana	-6,225	-630	-5,665	70
Oklahoma	-6,501	-2,030	-4,496	25
Hawaii	-6,583	-1,892	-4,871	179
Utah	-7,054	169	-7,273	50
Vermont	-7,280	-6,080	-968	-232
Nebraska	-7,419	-2,652	-3,621	-1,146
Alabama	-7,544	-1,206	-5,701	-636
Maine	-7,697	-2,479	-5,243	24
Kentucky	-7,978	-2,179	-5,285	-515
Iowa	-8,096	-3,123	-4,509	-464
New Mexico	-8,531	-1,843	-6,548	-140
South Carolina	-9,137	-609	-8,203	-325
Arkansas	-9,482	-2,207	-6,283	-992
Idaho	-9,766	-1,928	-6,872	-966
North Dakota	-9,973	-2,963	-6,607	-403
West Virginia	-10,074	-3,104	-7,013	43
South Dakota	-10,976	-3,811	-5,475	-1,690
Mississippi	-11,446	-4,569	-5,493	-1,383
Montana	-11,792	-5,468	-5,495	-829

Metro-rural mix: average wage impact from a state's relative proportion of metro and rural regions

Relative metro wage: average wage impact from state relative performance in metro regions

Relative rural wage: average wage impact from state relative performance in rural regions

On average 66.3% of the average wage gap in a state is due to the metro wage effect.

Note: Data are based on private, non-agricultural employment.

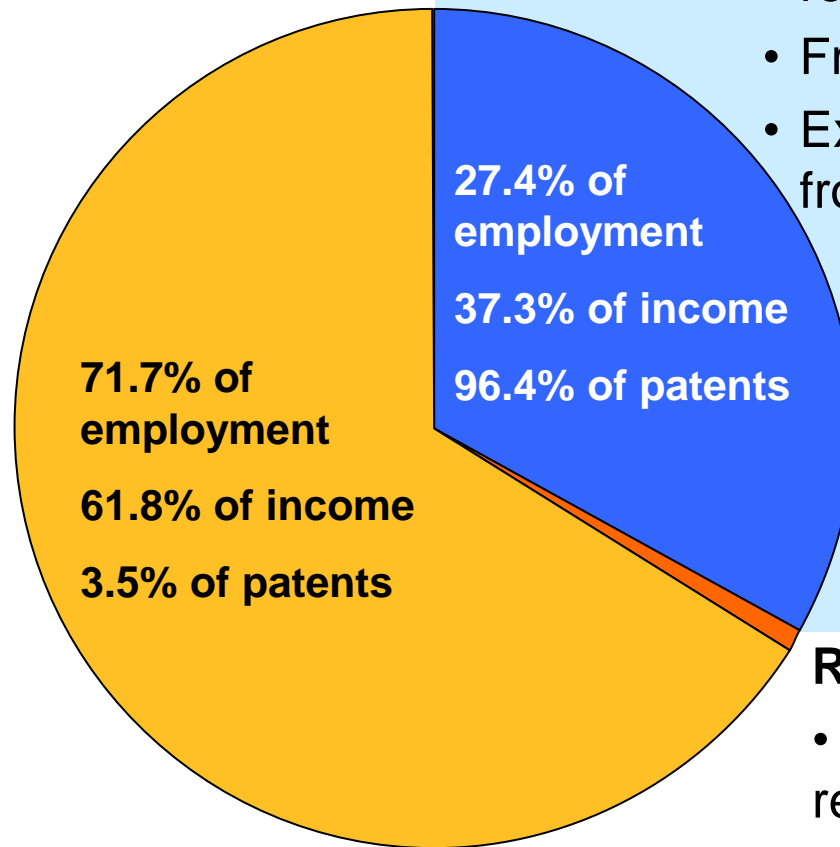
Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

Composition of the Pennsylvania Economy and Cluster Performance

Composition of Regional Economies, United States

Local Clusters

- Serve almost exclusively the local market
- Not exposed to cross-regional competition for employment



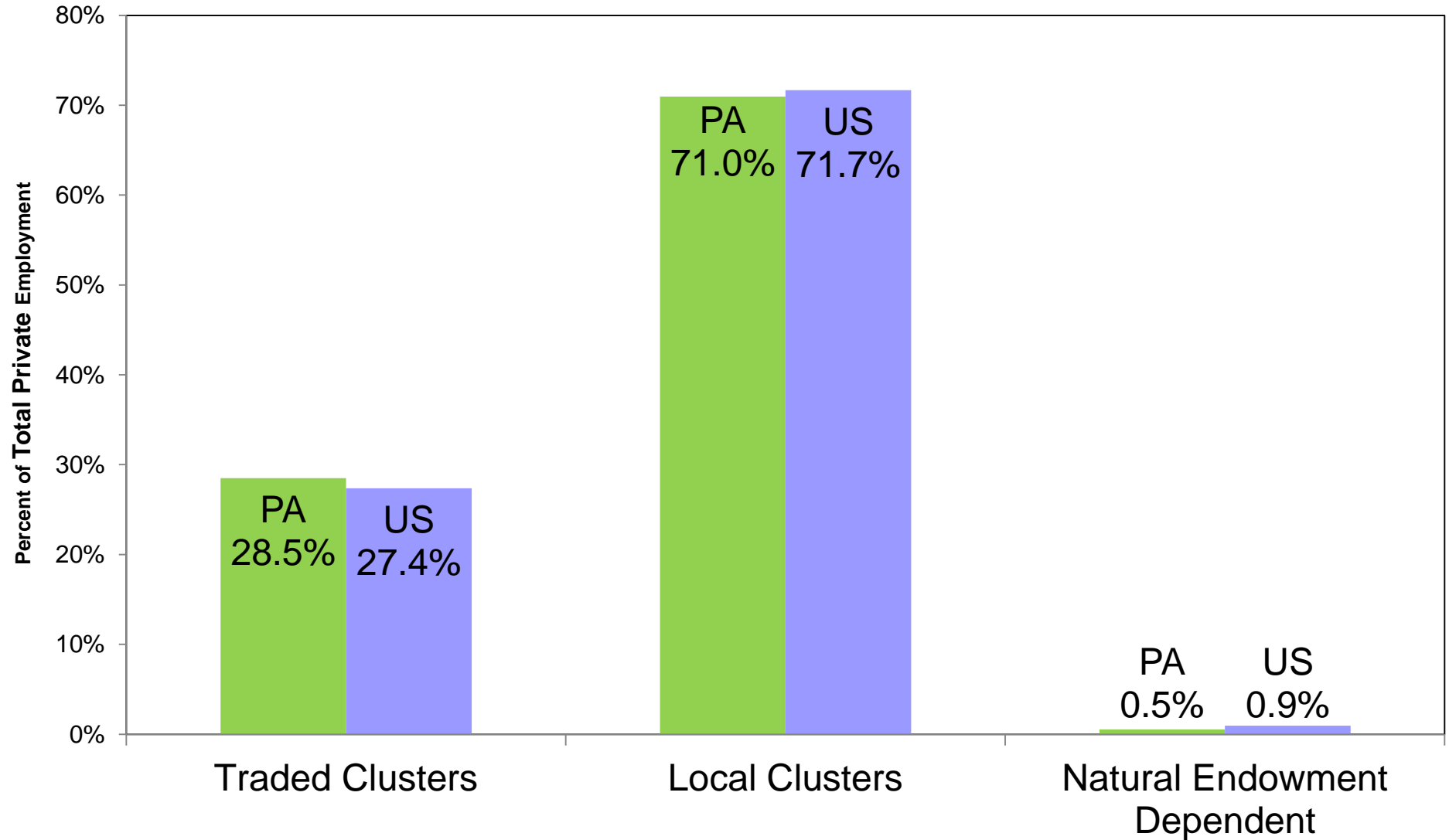
Traded Clusters

- Serve markets in other regions and countries
- Free to choose location
- Exposed to competition from other regions

Resource-based Clusters

- Location determined by resource availability
- <1% of income, employment, and patents in the U.S.

Overall Composition of the Pennsylvania Economy, 2008

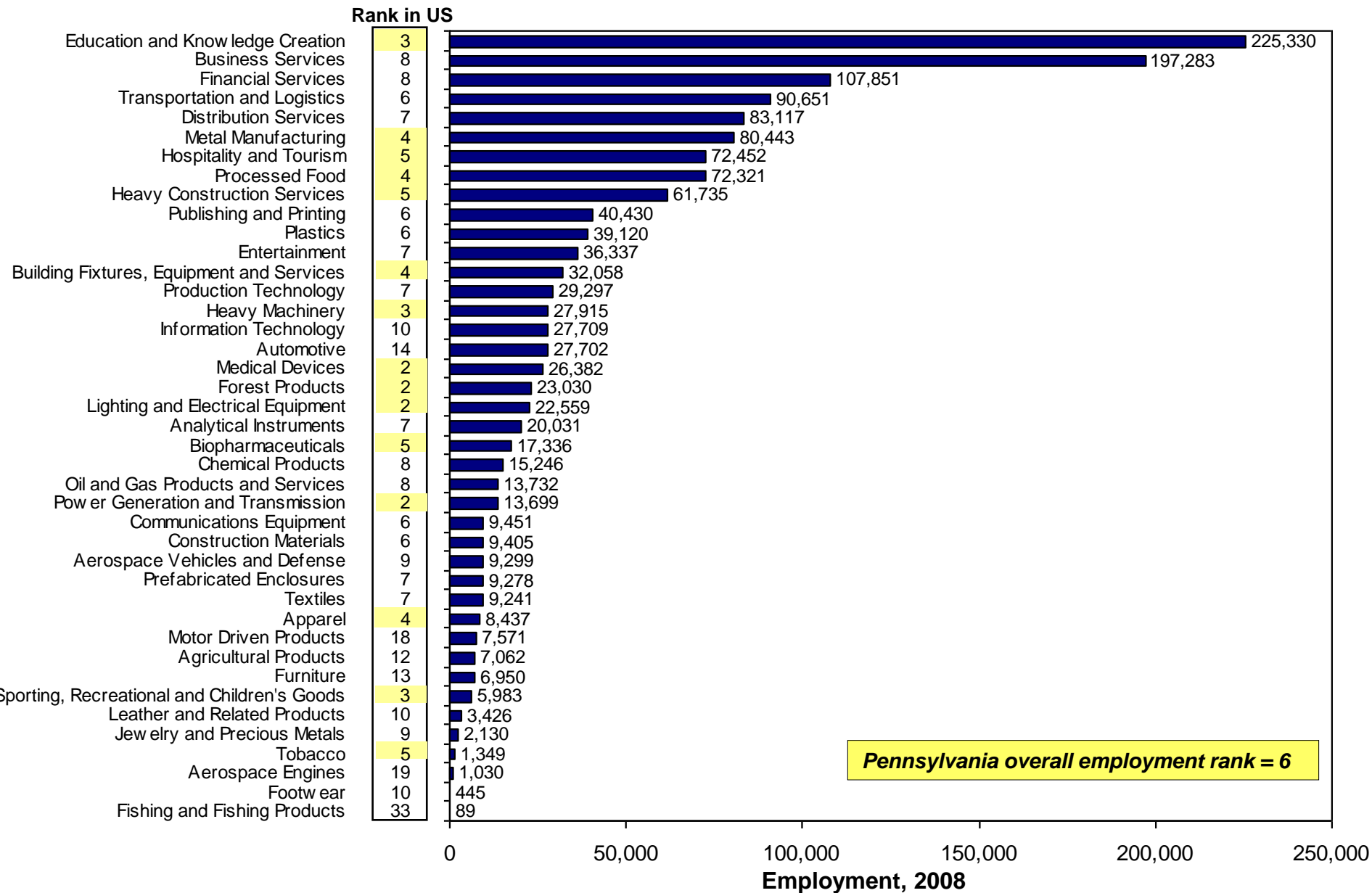


Note: Data throughout this section of the report are based on private, non-agricultural employment.

Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

Composition of the Pennsylvania Economy

Employment by Traded Cluster, 2008

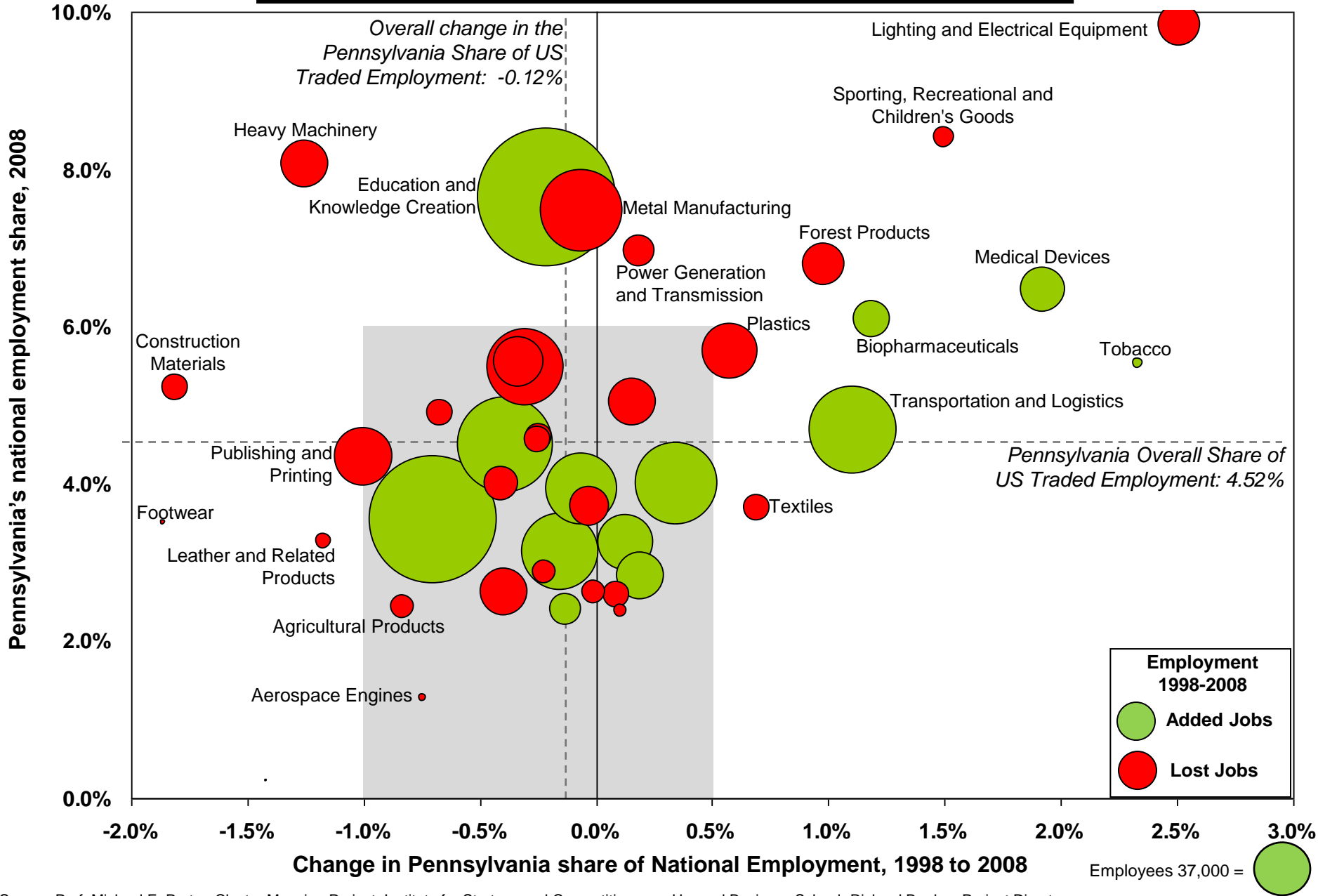


Note: Ranks are among the 50 US states plus the District of Columbia.

Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

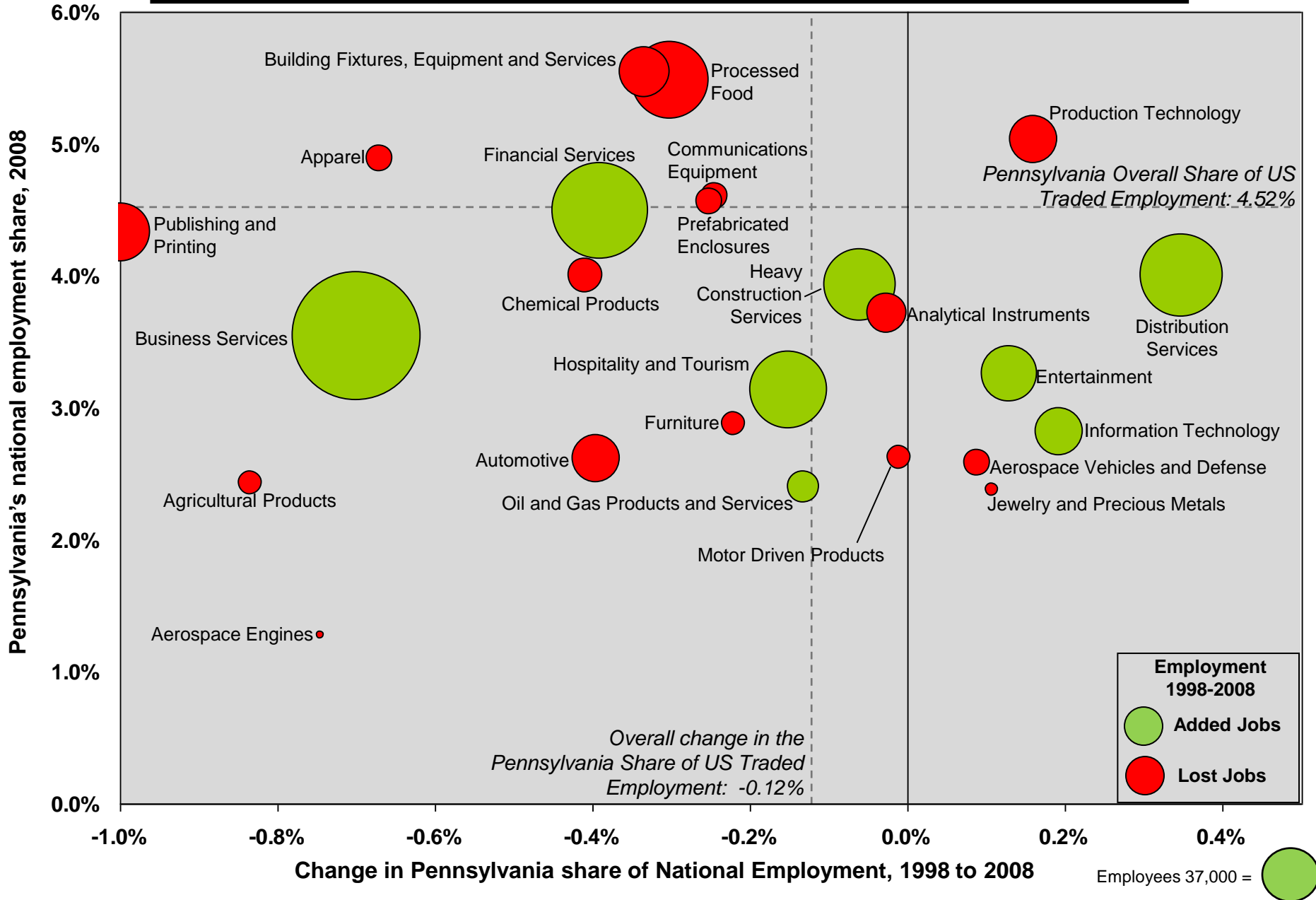
Composition of the Pennsylvania Economy

Specialization by Traded Cluster, 1998 to 2008



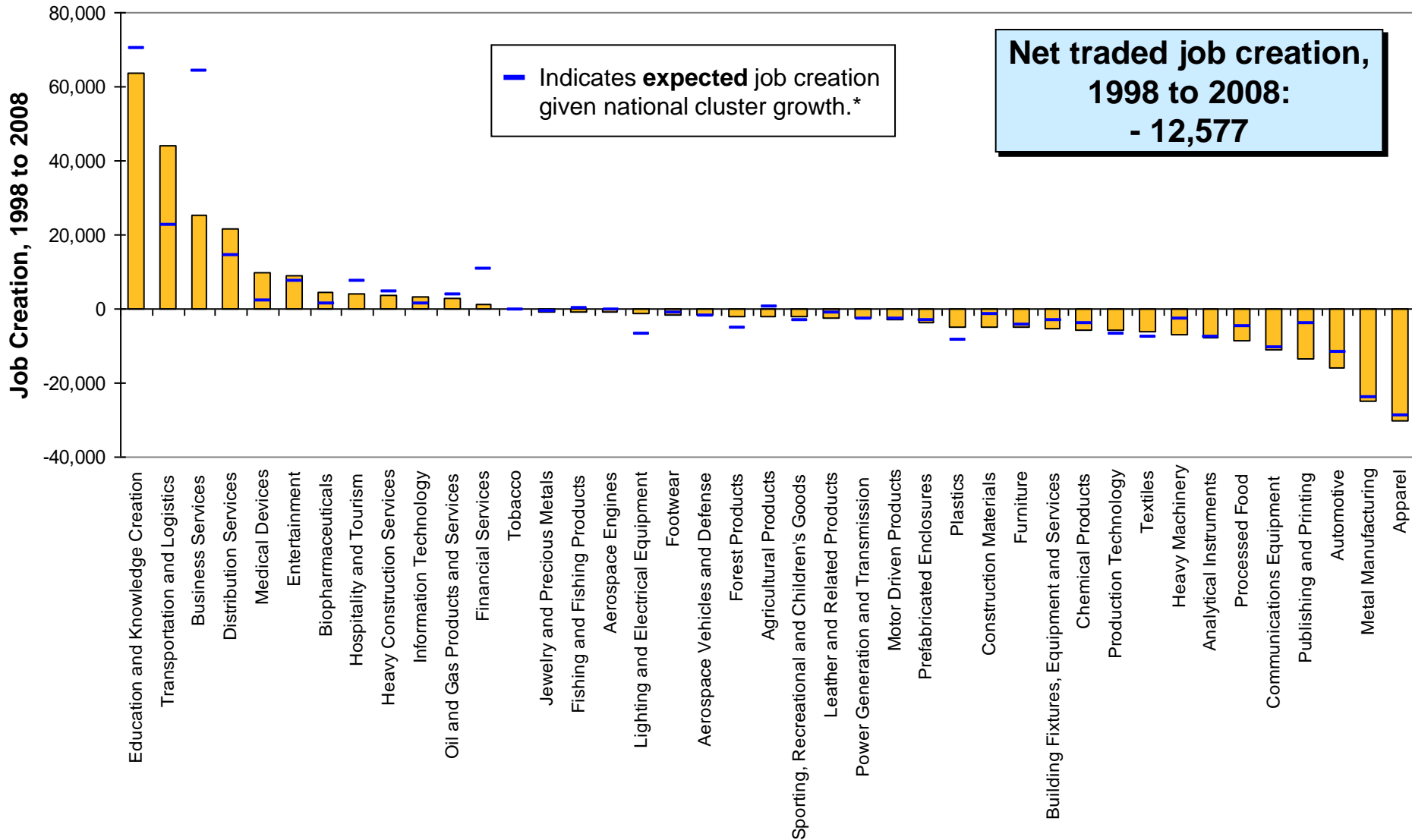
Composition of the Pennsylvania Economy

Specialization by Traded Cluster, 1998 to 2008 (continued)



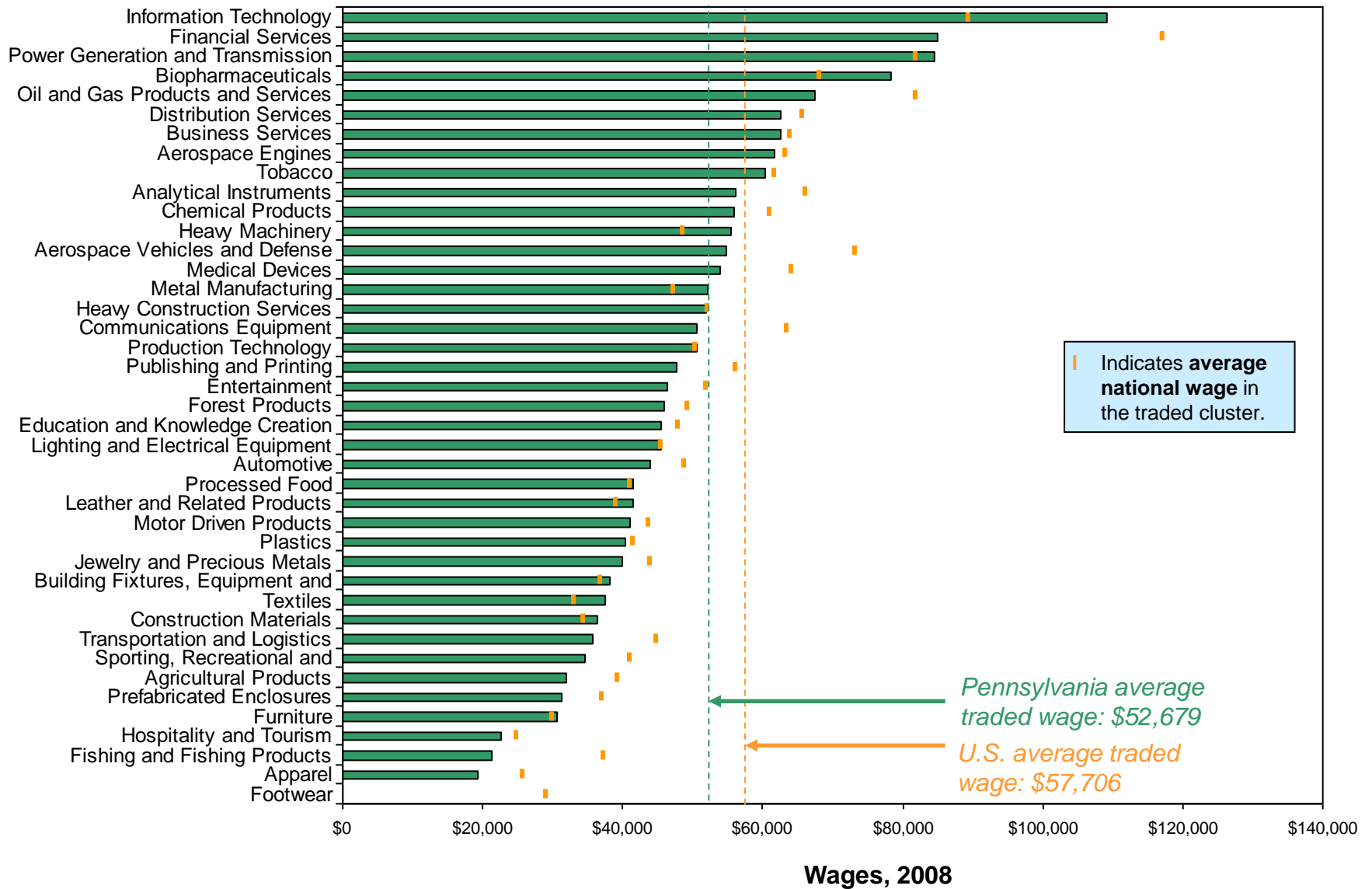
Pennsylvania Job Creation by Traded Cluster

1998 to 2008



* Percent change in national benchmark times starting regional employment. Overall traded job creation in Pennsylvania, if it matched national benchmarks, would be -48,063
 Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

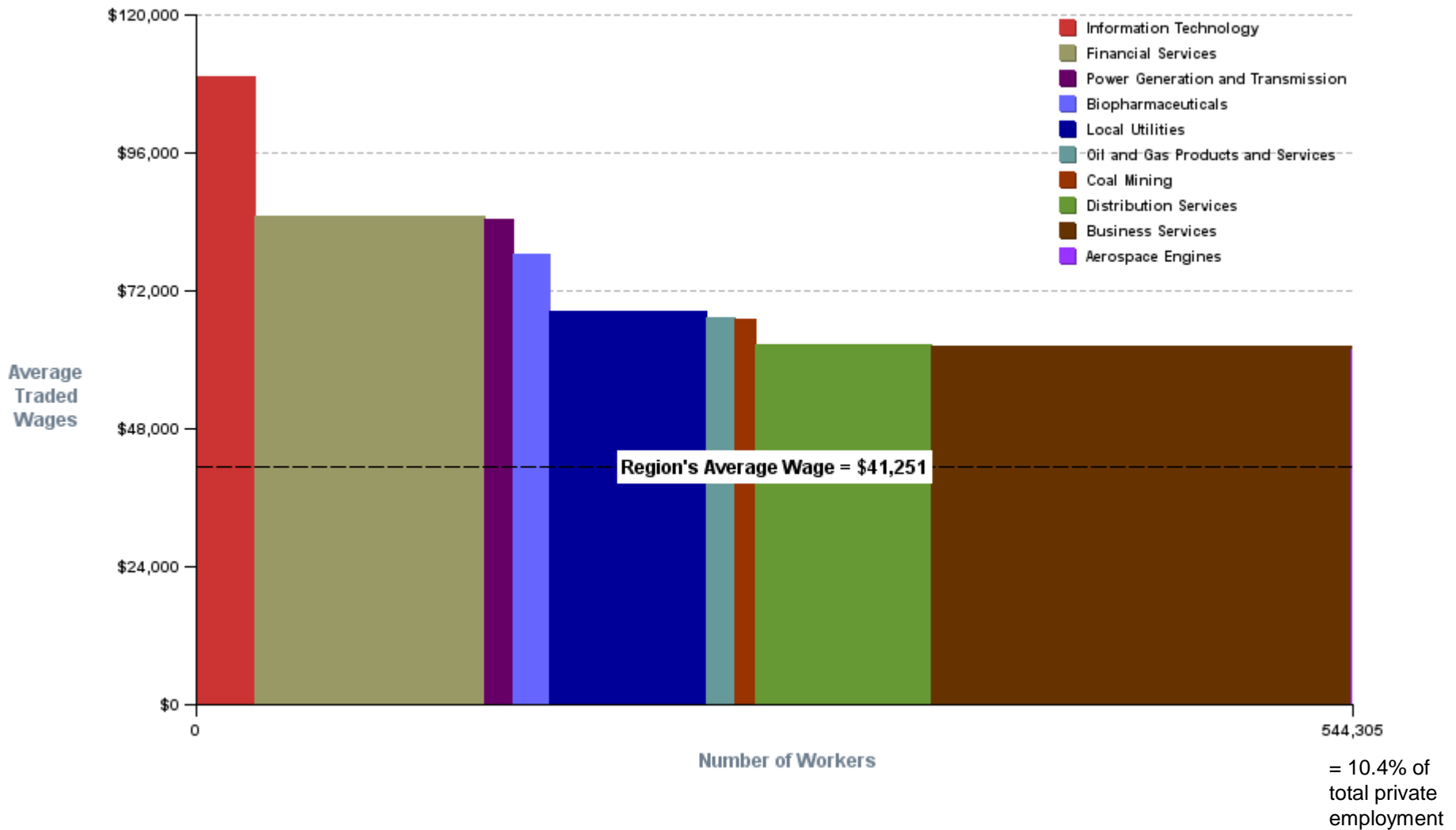
Pennsylvania Wages by Traded Cluster vs. National Benchmarks



Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

Pennsylvania

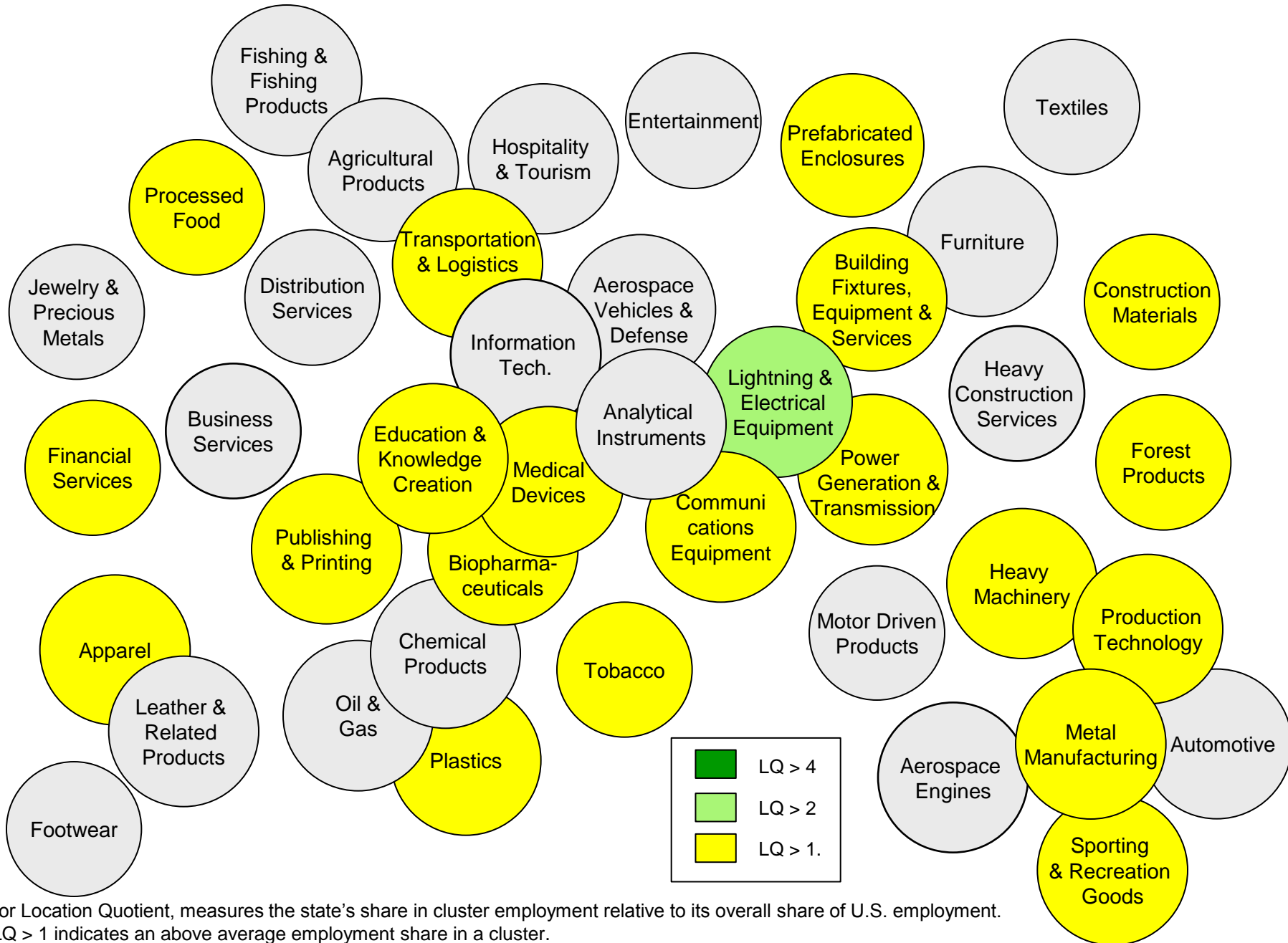
Employment in Highest Wage Clusters, 2008



Total private, non-agricultural employment in Pennsylvania: 5,231,026.

Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

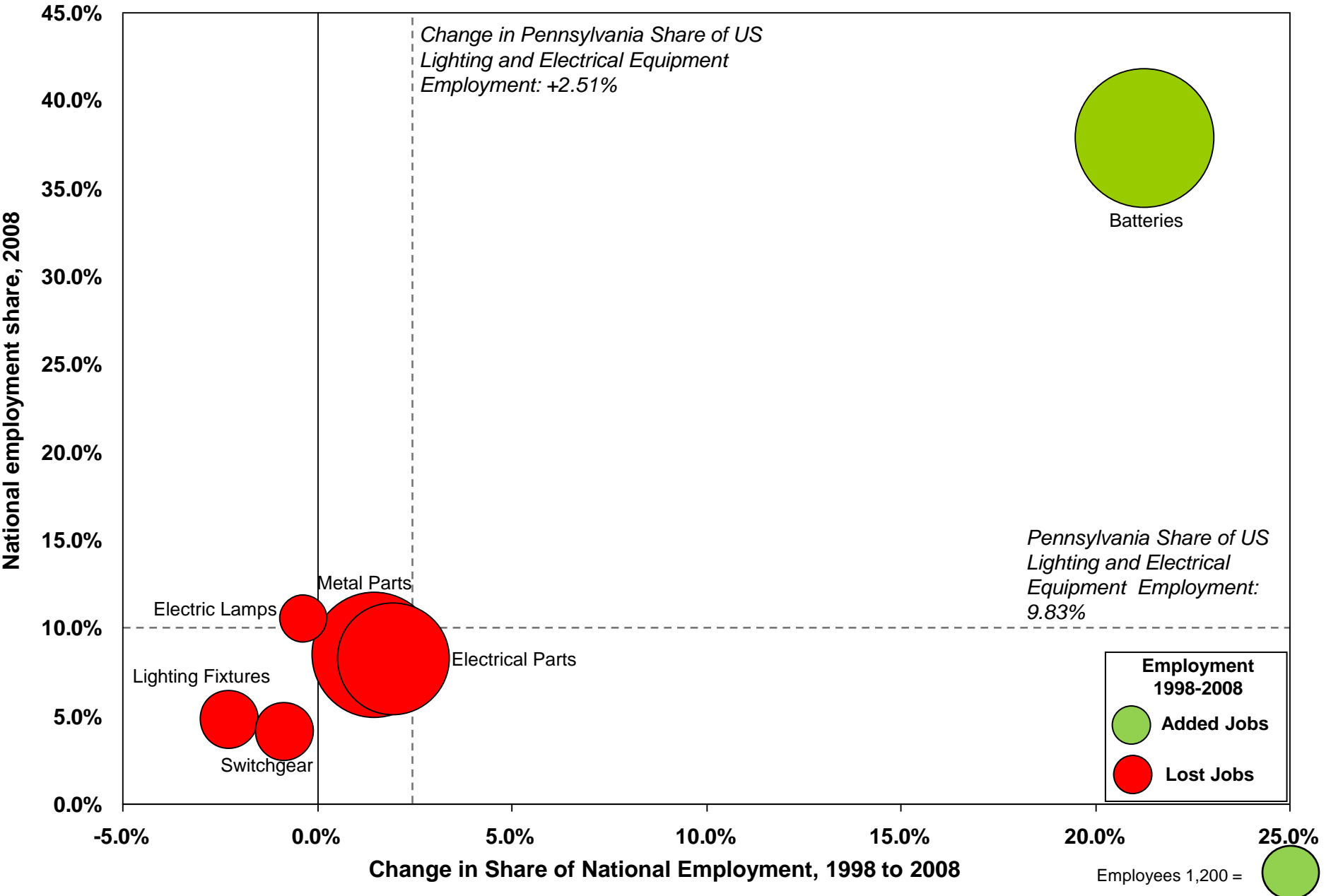
Pennsylvania Cluster Portfolio, 2008



LQ, or Location Quotient, measures the state's share in cluster employment relative to its overall share of U.S. employment. An LQ > 1 indicates an above average employment share in a cluster.

Pennsylvania Lighting and Electrical Equipment Cluster, 1998-2008

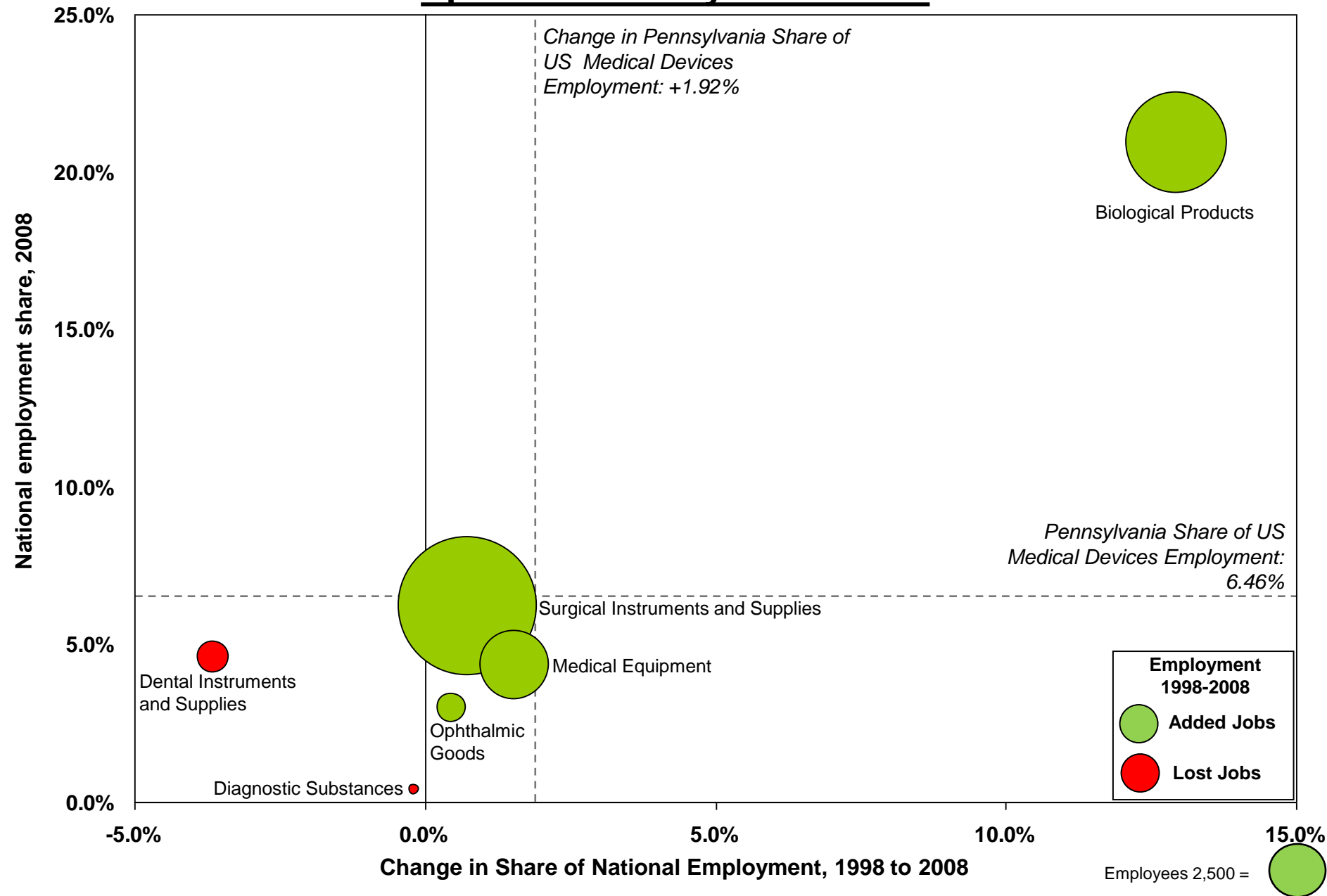
Specialization by Subcluster



Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

Pennsylvania Medical Devices, 1998-2008



Specialization by Subcluster



Pennsylvania

Top 50 Subclusters by National Employment Share, 2008



	Subcluster	Cluster	Employment	Employment Rank in U.S.	Employment Share in U.S.	Change in Employment Share in U.S. 1998-2008
1	Batteries	Lighting and Electrical Equipment	7,500	1	37.8%	21.3%
2	Supplies	Education and Knowledge Creation	1,750	1	36.3%	19.6%
3	Railroad Equipment and Rental	Heavy Machinery	10,751	1	28.8%	0.6%
4	Motorcycles and Bicycles	Sporting, Recreational and Children's Goods	3,750	1	26.5%	4.4%
5	Defense Equipment	Aerospace Vehicles and Defense	3,750	1	25.5%	2.1%
6	Mining Machinery	Heavy Machinery	2,702	1	24.5%	-3.2%
7	Biological Products	Medical Devices	7,500	1	20.9%	12.9%
8	Steam and Air-conditioning	Building Fixtures, Equipment and Services	375	2	18.4%	3.4%
9	Candy and Chocolate	Processed Food	9,578	1	17.3%	-1.2%
10	Porcelain, Carbon and Graphite Components	Power Generation and Transmission	2,191	1	15.7%	-1.6%
11	Other Tobacco Products	Tobacco	914	2	15.6%	4.3%
12	Cutlery	Jewelry and Precious Metals	750	4	15.4%	11.0%
13	Metal Alloys	Metal Manufacturing	379	2	15.1%	9.2%
14	Refractories	Chemical Products	1,273	2	13.9%	-1.3%
15	Valves and Pipe Fittings	Heavy Machinery	2,235	2	13.3%	-4.4%
16	Caskets	Prefabricated Enclosures	559	4	12.2%	-10.9%
17	Inked Paper and Ribbons	Publishing and Printing	198	2	12.0%	5.7%
18	Iron and Steel Mills and Foundries	Metal Manufacturing	22,510	3	11.8%	-0.3%
19	Fabricated Metal Products	Metal Manufacturing	11,829	1	10.7%	0.6%
20	Electric Lamps	Lighting and Electrical Equipment	941	4	10.5%	-0.3%
21	Containers	Biopharmaceuticals	3,750	1	10.4%	4.2%
22	Accessories	Apparel	1,992	3	10.1%	5.7%
23	Paper Industries Machinery	Forest Products	1,012	2	10.0%	2.5%
24	Printing Services	Business Services	1,626	4	9.8%	3.6%
25	Floor Coverings	Building Fixtures, Equipment and Services	430	4	9.6%	-29.5%

 Rising national employment share
 Declining national employment share

Pennsylvania

Top 50 Subclusters by National Employment Share, 2008 (continued)

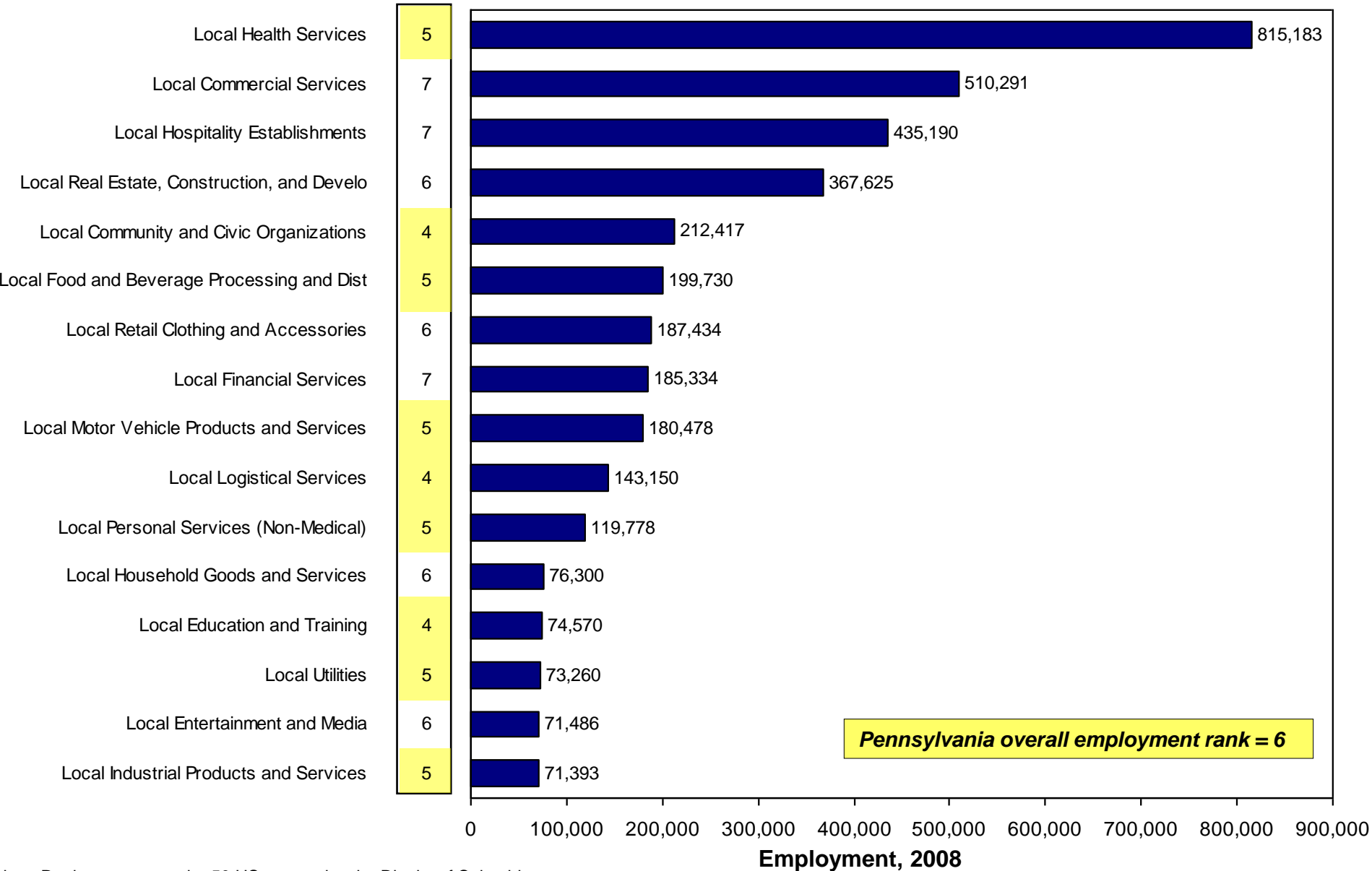
	Subcluster	Cluster	Employment	Employment Rank in U.S.	Employment Share in U.S.	Change in Employment Share in U.S. 1998-2008
26	Plumbing Fixtures	Construction Materials	375	6	9.2%	1.3%
27	Educational Institutions	Education and Knowledge Creation	174,389	3	8.7%	-0.2%
28	Elevators and Moving Stairways	Prefabricated Enclosures	750	3	8.5%	0.7%
29	Wire and Springs	Metal Manufacturing	5,478	1	8.5%	0.2%
30	Construction Machinery	Heavy Machinery	7,658	3	8.4%	-1.3%
31	Metal Parts	Lighting and Electrical Equipment	6,264	3	8.4%	1.5%
32	Specialty Fabric Mills	Textiles	2,302	4	8.4%	-0.1%
33	Prefabricated Wood Products	Forest Products	10,022	2	8.3%	2.0%
34	Games, Toys, and Children's Vehicles	Sporting, Recreational and Children's Goods	758	3	8.3%	1.4%
35	Electrical Parts	Lighting and Electrical Equipment	5,019	2	8.2%	2.0%
36	Nonferrous Mills and Foundries	Metal Manufacturing	5,424	2	8.2%	1.1%
37	Electrical and Electronic Components	Communications Equipment	6,283	2	8.1%	-1.5%
38	Bus Transportation	Transportation and Logistics	1,211	4	8.1%	3.9%
39	Entertainment Equipment	Entertainment	2,125	3	7.9%	1.7%
40	Baked Packaged Foods	Processed Food	18,759	2	7.8%	-0.1%
41	Heating and Lighting	Building Fixtures, Equipment and Services	2,810	2	7.6%	0.2%
42	Knitting Mills	Apparel	1,118	3	7.6%	0.9%
43	Paper Products	Publishing and Printing	4,144	3	7.6%	-0.5%
44	Tile, Brick and Glass	Construction Materials	2,428	4	7.5%	-7.2%
45	Metal and Glass Containers	Processed Food	3,708	3	7.5%	1.5%
46	Fabricated Plate Work	Production Technology	7,069	2	7.4%	0.8%
47	Textile Machinery	Textiles	511	5	7.3%	4.5%
48	Milk and Frozen Desserts	Processed Food	5,610	3	7.3%	0.8%
49	Fabricated Materials	Building Fixtures, Equipment and Services	3,123	4	7.3%	0.8%
50	Electric Services	Power Generation and Transmission	9,171	2	7.1%	0.6%

 Rising national employment share
 Declining national employment share

Pennsylvania Employment by Local Cluster

2008

Rank in US

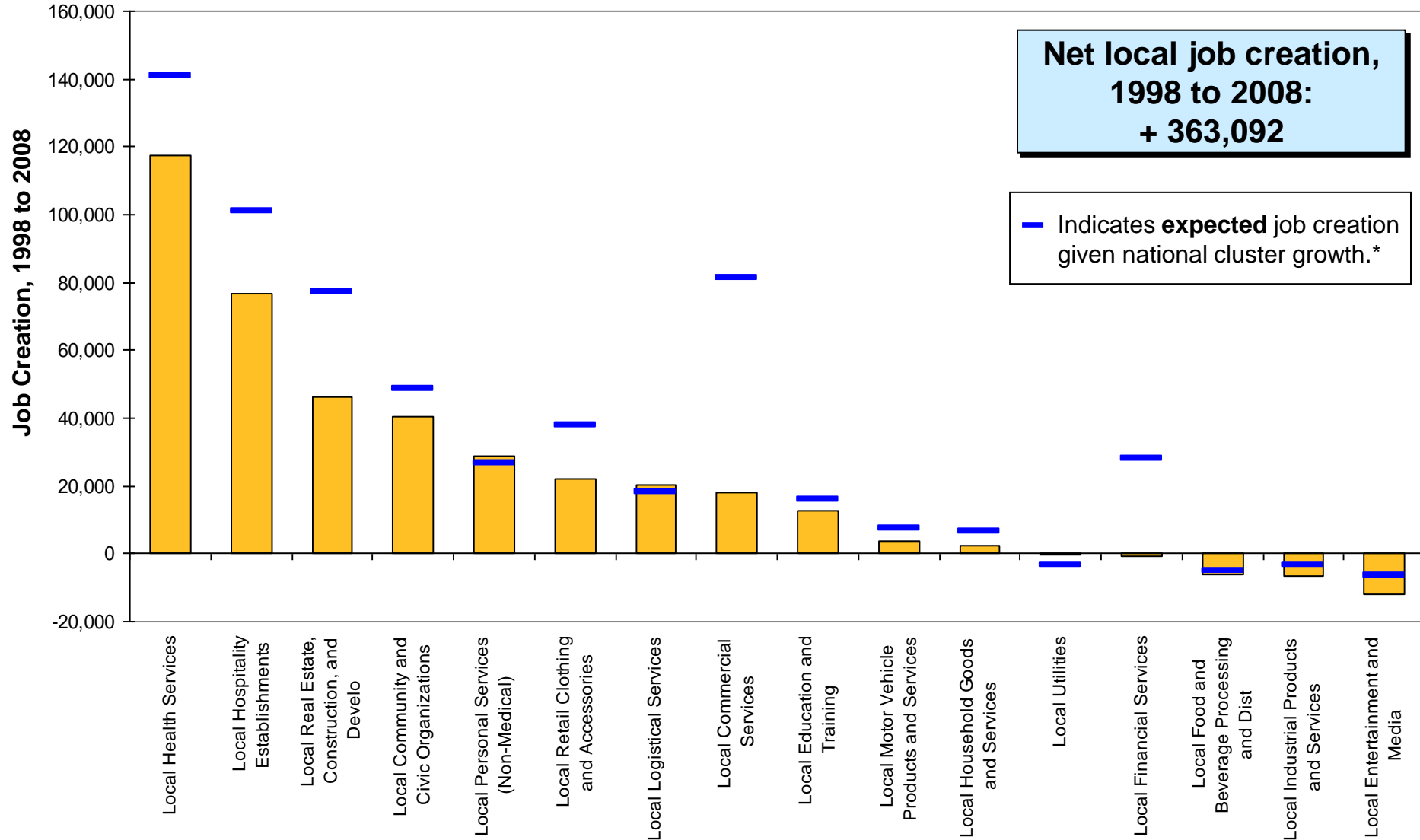


Note: Ranks are among the 50 US states plus the District of Columbia.

Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

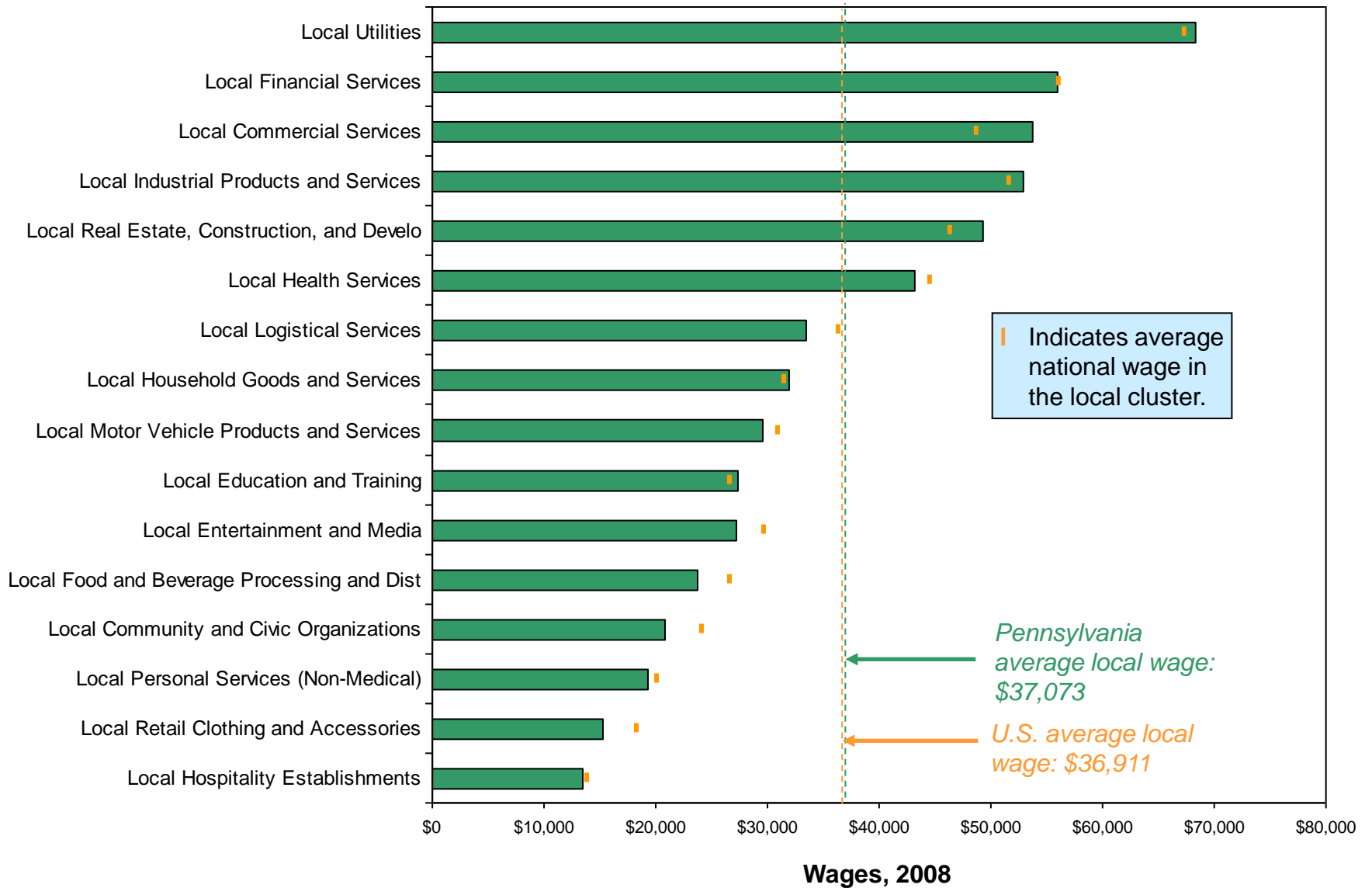
Pennsylvania Job Creation by Local Cluster

1998 to 2008



* Percent change in national benchmark times starting regional employment. Overall local job creation in Pennsylvania, if it matched national benchmarks, would be +569,850
 Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

Pennsylvania Wages by Local Cluster vs. National Benchmarks



Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.

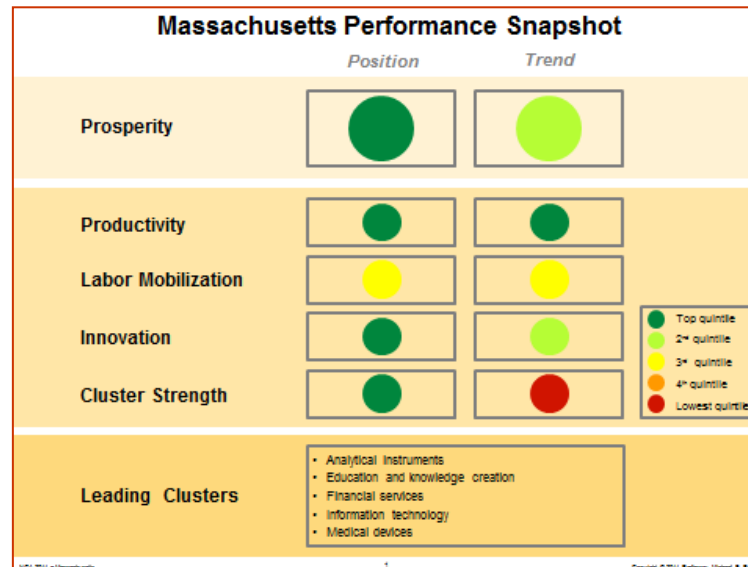
Appendix: Chart Descriptions, Interpretation, and Sources

State Snapshot

The snapshot chart summarizes the relative performance of a state on levels and trends in five key measures. The circles in the chart indicate quintile of performance as shown in chart legend.

1. **Prosperity:** State GDP per capita and 10-year trend
2. **Productivity:** Average private wage and 10-year trend
3. **Labor Mobilization:** Total labor force as a share of civilian population and 10-year trend
4. **Innovation:** Utility patents per 10,000 workers and 10-year trend
5. **Cluster Strength:**
 - A “strong cluster” is identified by relative employment rank in the top 20% across all states. A state’s “cluster strength” is in turn the state’s total share of traded employment in these strong clusters.
 - A positive trend in cluster strength is indicated by a state’s increasing national cluster share across these strong clusters.

Leading Clusters: A listing of the state’s strong clusters is included. A state may have more than five strong clusters; the top five by employment size in the state are shown in this section.



Components of Regional Economies

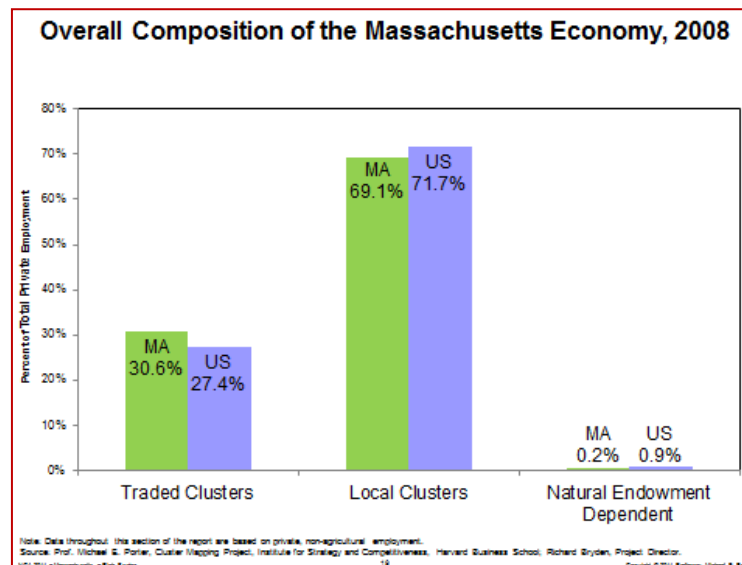
A state's or region's economy can be divided into traded clusters, local clusters, and natural endowment industries:

Traded clusters include those industries that compete across regions, and which tend to concentrate in particular locations. Traded clusters are the engines of regional economic competitiveness. While they account for only about a third of employment, they achieve the highest wages and productivity levels and drive demand for localized businesses.

Local clusters involve activities serving almost exclusively the local market. Local clusters are present in every region in roughly the same proportions. They employ the majority of people in any regional economy, so their efficiency is critical for competitiveness in traded clusters. However, they cannot prosper over the long run without success in the traded clusters.

Natural Endowment-dependent industries concentrate at natural resource sites. They account for a small and declining share of national employment but can be relatively high wage.

The Cluster Mapping Project data presented in this report focuses primarily on traded clusters, though it contains some information about other categories of industries. The performance of traded clusters holds the key to present and future competitiveness.



Employment by Traded Cluster

Within the broad category of traded clusters, a state's economy can be divided into individual clusters. Clusters are geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. Examples include automotive producers in Michigan and Ohio, information technology in Silicon Valley, and money management in Boston.

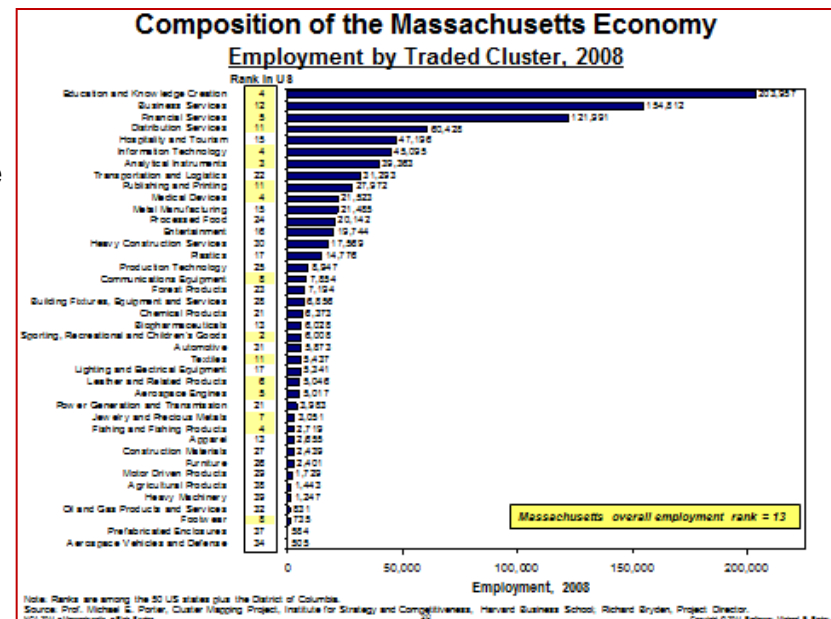
The 41 traded clusters (and their 264 component subclusters) utilized in the Cluster Mapping Project were developed using statistical analysis of the actual patterns of business location in the U.S. economy. Clusters and subclusters are listed at the end of this appendix.

Interpretation:

This chart gives total employment in the state economy by each traded cluster.

Employment by cluster gives a more detailed profile of the activities in the state economy that make up the job base. It can be used to understand the importance of the health of various groups or industries on the overall prosperity of the region. z

Also shown on the chart are employment ranks for each cluster versus those in the 50 U.S. states plus D.C. Ranks above the region's overall share of national employment are an indication of cluster specialization in the state and are highlighted on the chart.



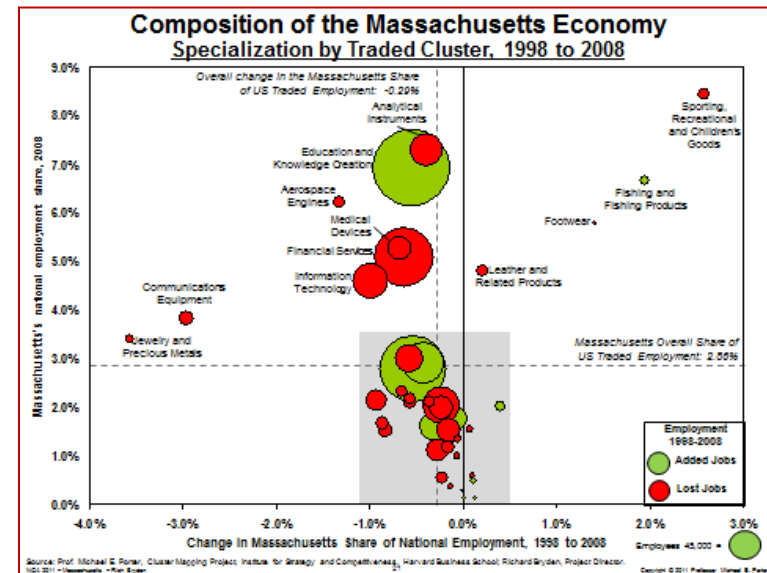
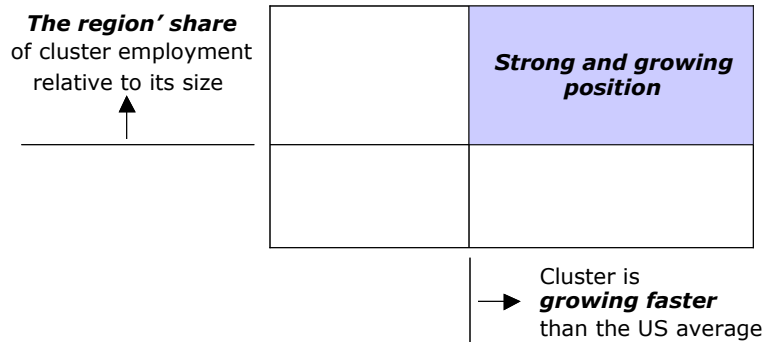
Specialization by Traded Cluster

While other charts in this report focus on absolute employment and changes in employment, the Specialization chart shows the region's competitive position by traded cluster.

The size of each cluster "bubble" is proportional to the number of jobs in the region.

The location of each cluster bubble on the chart identifies a cluster's relative performance in the US economy:

- Clusters on the **top** half of the chart have local employment levels that are more than proportionate to the region's overall employment. These are clusters in which the region is relatively specialized.
- Clusters on the **right** half of the chart are growing employment at a faster rate than the national average for those clusters. These are clusters in which the region is gaining position in terms of relative employment.

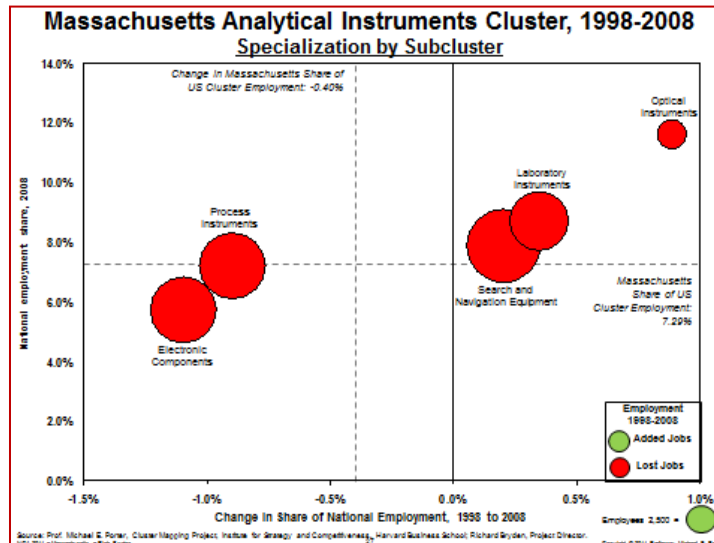
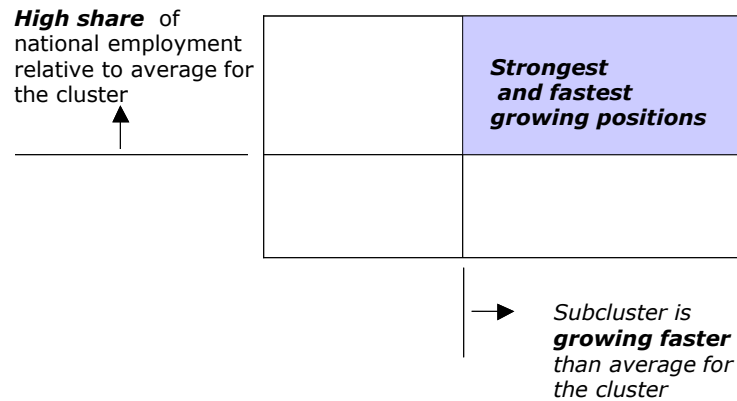


When present, a gray shaded area on the chart indicates that further detail is available on a second version of the chart immediately following the current page.

Specialization by Subcluster

The specialization by subcluster chart is interpreted similarly to the specialization chart for all traded clusters. Additional insight on particular cluster strengths and trends in cluster composition can be observed.

Please note that only one or a few subcluster charts were included in this report. Specialization charts and other data for *all* subclusters are available online at the Cluster Mapping Project reached from www.isc.hbs.edu.



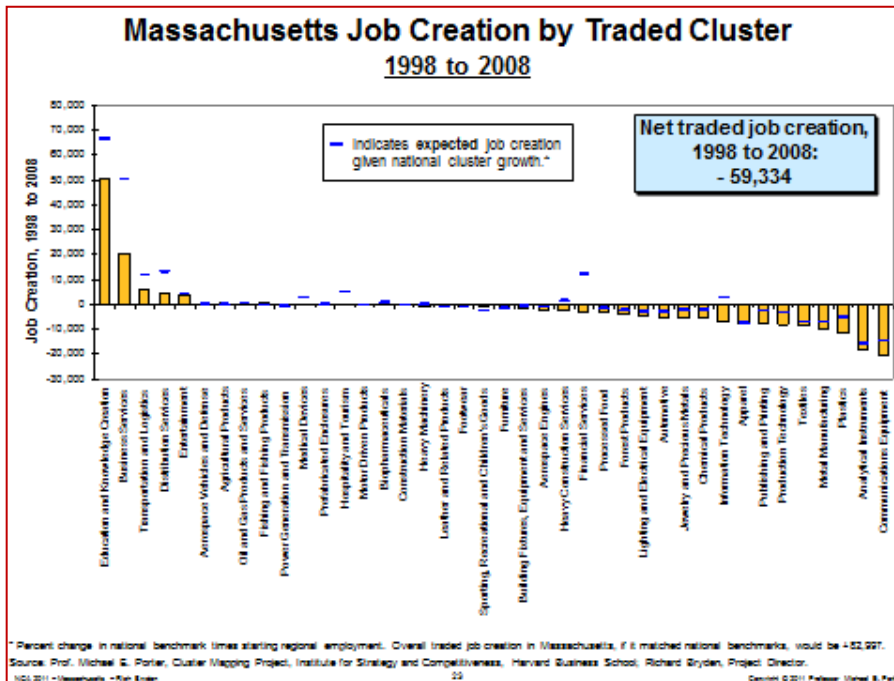
Job Creation by Traded Cluster

This chart shows the overall net change in traded jobs in the state over the period from 1998 to 2008 and the net gain or loss by traded cluster. The clusters are arranged in order of net jobs created. The blue bars provide benchmarks for job creation based upon rates of growth in the cluster throughout the U.S.

Interpretation:

This chart allows a state to identify its biggest job generators and job losers among traded clusters over the last decade. A few clusters often account for a large majority of the overall employment gain. Clusters with job losses are a cause for concern. It is helpful to compare job performance with the policy priorities a region has set.

Comparison of job growth relative to the U.S. benchmarks provides insights into the strengths and weaknesses in the region's economy and shifts in the region's competitive position. A region might not be participating in a cluster which is surging nation-wide; or a region might be gaining market position in an important cluster.



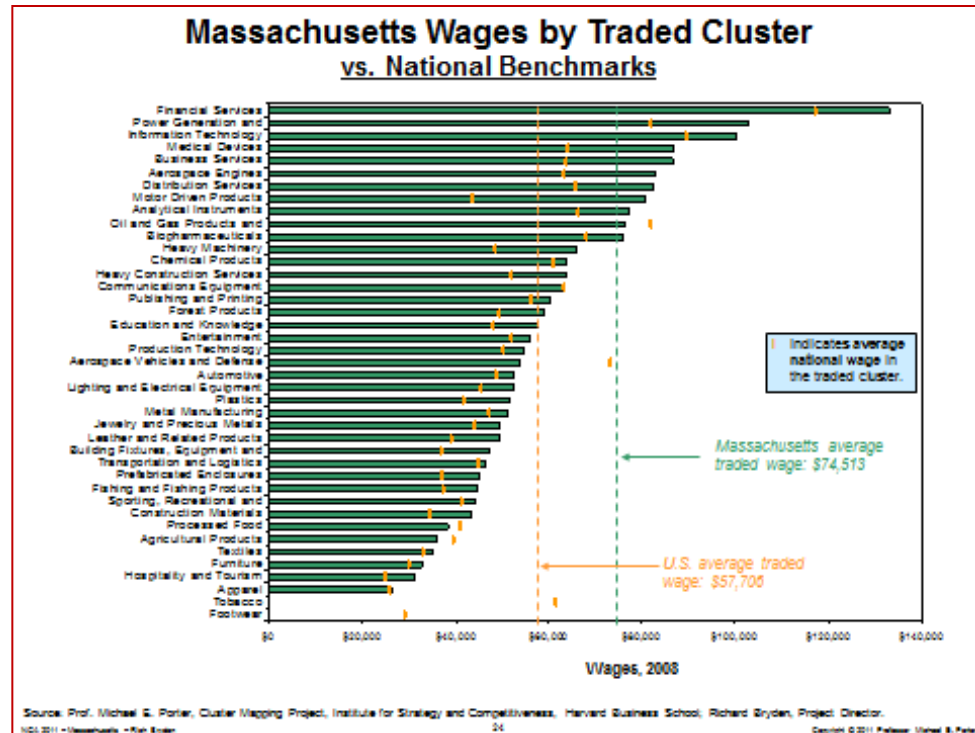
Wages by Traded Cluster

The state's clusters are listed in order by average wage. The yellow bars show the benchmark average wage for the cluster nationally. The average wage across all traded clusters in the region is indicated by the green dashed line.

Wages are a direct measure of a cluster's productivity and competitiveness. Clusters that are exceptionally productive (the value of output produced per unit of labor) can sustain higher wages.

Note: The wages for some clusters may not be reported due to data suppression in the underlying government reports. When few employers in an industry are present in a given region, wage and precise employment figures are omitted to protect the confidentiality of the data.

Benchmark lines provide a comparison to wages in the cluster across the U.S.

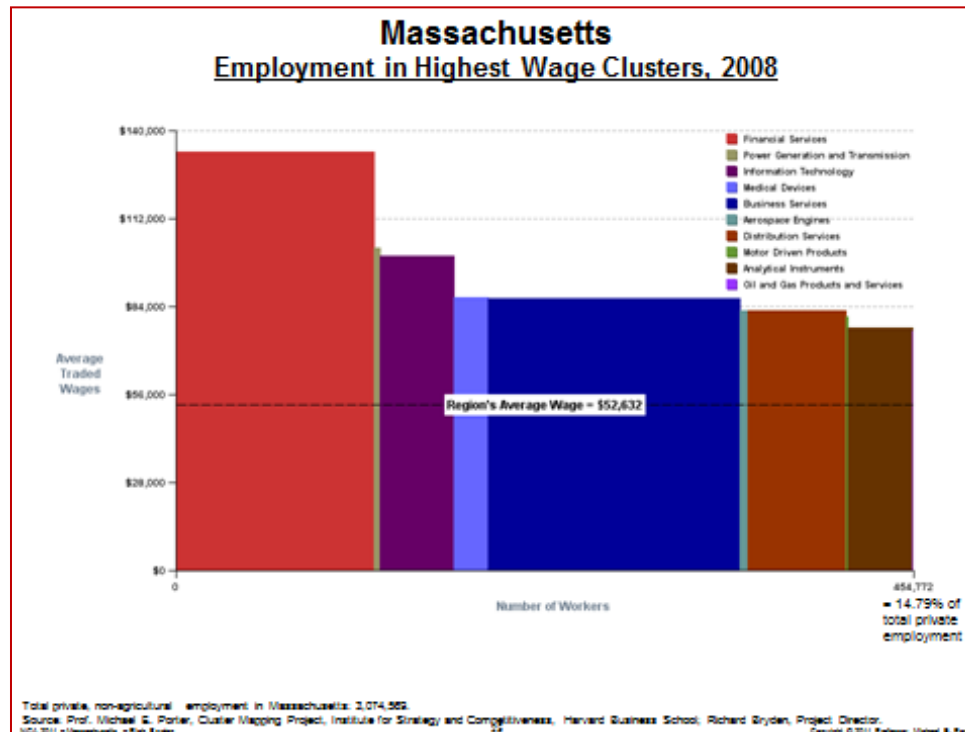


Employment in Highest Wage Clusters

The ten highest wage traded clusters in the state are shown in decreasing order, with the width of the columns proportional to the number of workers in each cluster. The area of each cluster is thus equivalent to the overall wage sum the cluster generated in the state.

The chart displays how the average wage in the state's traded clusters is built up by highest wage clusters. Some high wage clusters may have a small impact on overall wage levels because of their small size, the case in some high wage clusters. Some large, high wage clusters are often those in services.

The comparison to the U.S. average wages by cluster (on the previous chart) gives an initial benchmark to evaluate the composition of average wages in the state economy. States can increase wages in two different ways: (1) increase the employment in high wage clusters relative to low wage clusters and/or (2) increase the state's relative wages in given clusters. In practice, the second effect dominates as the explanation for why state wages differ.



Cluster Portfolio

Cluster Linkages

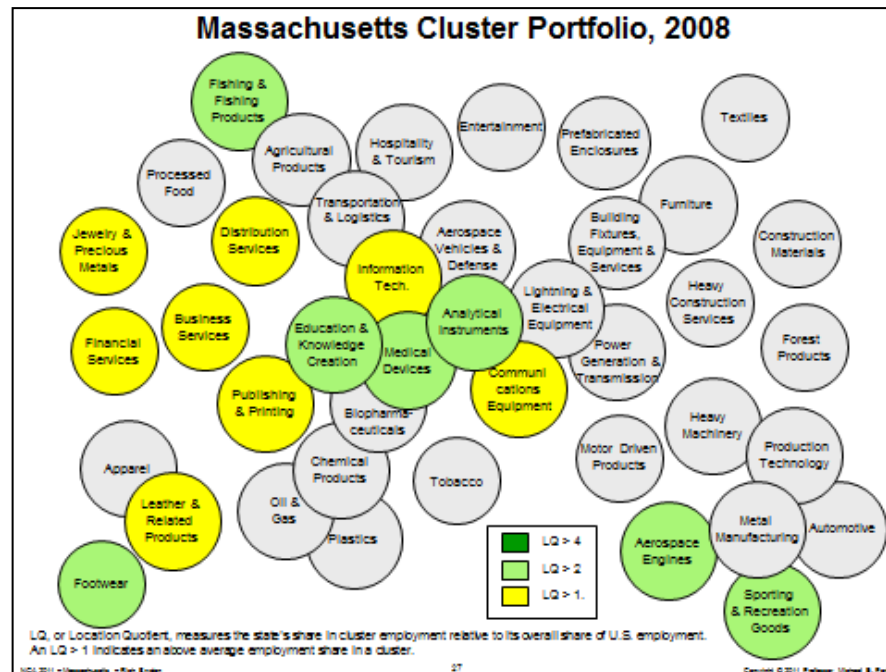
Our research on clusters, in addition to deriving a model of 41 distinct traded clusters, provides a measure for the strength of the links between these traded clusters. The strength of these links is summarized visually in the portfolio diagram below by the relative positioning and overlapping of cluster circles.

Location Quotient (LQ)

The Location Quotient is a ratio measure of the concentration of a cluster in a state relative to that state's average share of employment in the U.S. traded economy. So, LQ is a measure of a cluster's level of concentration within a state, with an $LQ > 1$ indicating higher than average concentration in that state.

Interpretation

Using Location Quotient as the measure of cluster concentration in the state, we overlay the state's cluster portfolio on the model of cluster linkages with three color levels as below. The pattern of a state's portfolio relative to the cluster linkages will often indicate paths of opportunity for development in clusters.



Top Subclusters by National Employment Share

This chart selects the sub-clusters in the region with the highest National Employment Shares. The subclusters are grouped by cluster and ordered by subcluster National Employment Share.

Sub-clusters with a high share of national employment may form the basis for developing a competitive position in a cluster. Strengths in a breadth of related sub-clusters are an indication of an established position in a cluster.

Massachusetts
Top 50 Subclusters by National Employment Share, 2008

	Subcluster	Cluster	Employment	Employment Rank in U.S.	Employment Share in U.S.	Change in Employment Share in U.S. 1999-2008
1	Saw Blades and Handaxes	Metall Manufacturing	1,770	2	38.8%	8.2%
2	Small Arms	Aerospace Engines	1,770	2	16.6%	4.2%
3	Specialty Footwear	Footwear	880	2	15.8%	2.7%
4	Cutlery	Leather and Related Goods	770	2	15.4%	3.1%
5	Games, Toys and Children's Vehicles	Sporting, Recreational and Children's Goods	1,919	1	14.4%	0.7%
6	Coated Fabrics	Leather and Related Products	1,128	2	13.0%	0.9%
7	Optical Instruments	Analytical Instruments	1,873	2	11.6%	0.9%
8	Swims and Non-sportswear	Sporting, Recreational and Services	197	2	9.7%	-1.0%
9	Sporting and Athletic Goods	Sporting, Recreational and Children's Goods	1,488	2	9.4%	5.2%
10	Medical Equipment	Medical Devices	7,221	2	9.1%	-0.6%
11	Office Equipment and Supplies	Printing and Printing	275	2	8.8%	4.4%
12	Laboratory Instruments	Analytical Instruments	7,389	2	8.7%	0.2%
13	Processed Seafoods	Printing and Printing Products	175	2	8.6%	8.6%
14	Search and Navigation Equipment	Analytical Instruments	11,288	2	7.8%	0.2%
15	Securities, Brokers, Dealers and Exchanges	Financial Services	78,221	2	7.7%	-0.2%
16	Software	Information Technology	28,222	2	7.6%	-0.6%
17	Forklifts	Traffic	2,200	2	7.2%	0.8%
18	Research Concentrators	Education and Knowledge Creation	28,275	2	7.2%	1.2%
19	Process Instruments	Analytical Instruments	8,288	2	7.2%	-0.8%
20	Educational Institutions	Education and Knowledge Creation	140,748	2	7.1%	-1.2%
21	Leather Products	Leather and Related Products	992	2	7.0%	3.1%
22	Fish Products	Printing and Printing Products	2,121	2	6.8%	2.4%
23	Photographic Equipment and Supplies	Printing and Printing	1,421	2	6.3%	-1.2%
24	Diagnostic Substances	Medical Devices	1,770	2	6.2%	1.4%
25	Electrical and Electronic Components	Communications Equipment	1,681	2	6.1%	0.8%

Rising national employment share
 Declining national employment share

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Defining the Appropriate Region

Massachusetts in BEA Economic Areas

This table lists by organization the top patent recipients in the region for the most recent five-year period. Patents are assigned to regions according to the inventor's address of residence. In the case of multiple inventors from different locations, the patent is assigned fractionally to each region. Universities and research institutes are highlighted in blue and government agencies in green.

Interpretation:

Patenting is the best single measure of innovation output. States and regions with a healthy level of innovation tend to have patents originating from a variety of corporations across a number of fields as well as significant patenting from universities and research institutes. Concerns about innovative capacity arise when the patenting rate is low, patents originate principally from a government agency, or patenting is dominated by only a few large firms.

Rank	Organization	Patents 2006-2009	Rank	Organization	Patents 2006-2009
1	EMC Corporation	530	26	Link Corporation	87
2	Harvard University and Affiliated Hospitals	492	27	Veran Semiconductor Equipment Associates, Inc.	85
3	Massachusetts Institute Of Technology	447	28	Raytheon Company	81
4	Acushnet Company	280	29	Shiley Company Inc.	80
5	Sun Microsystems, Inc.	232	30	University Of Massachusetts	80
6	Analog Devices, Inc.	201	31	Wyeth	80
6	Intel Corporation	201	32	Qualcomm, Inc.	80
8	International Business Machines Corporation	178	33	Charles Stark Draper Laboratory, Inc.	81
9	Boston Scientific Scimed, Inc.	175	33	Maxtor Corporation	81
10	Mitsubishi Electric Research Laboratories, Inc.	172	33	Millipore Corporation	81
11	Cisco Technology, Inc.	157	36	Genetics Institute, Inc.	80
12	Hewlett-Packard Development Company, L.P.	140	37	Verizon Corporate Services Group Inc.	49
12	William Pharmaceutials, Inc.	138	37	The Math Works, Inc.	49
14	SchMed Life Systems, Inc.	112	39	MIA Com, Inc.	48
15	Gillette Company	112	39	Tereosys, Inc.	48
16	Callaway Golf Company	89	41	BBN Technologies Corp.	47
16	General Electric Company	89	42	Mitsubishi Electric Industrial Co., Ltd.	48
18	Verter Pharmaceuticals, Inc.	82	43	Color Kinetics, Inc.	48
19	Noratel Networks Limited	82	44	Nokia Corporation	42
20	Bose Corporation	80	44	Sepracor Inc.	42
21	Coram Sylvatic Inc.	75	46	United States Of America, Navy	42
22	Wesco Corp. Of Indiana	74	47	MKS Instruments	41
22	Genzyme Corporation	72	47	Reado International, Ltd.	41
24	Accella Technologies, Inc.	71	47	American Power Conversion Corporation	41
25	Verizon Laboratories Inc.	70	47	Gracis International Corporation	41

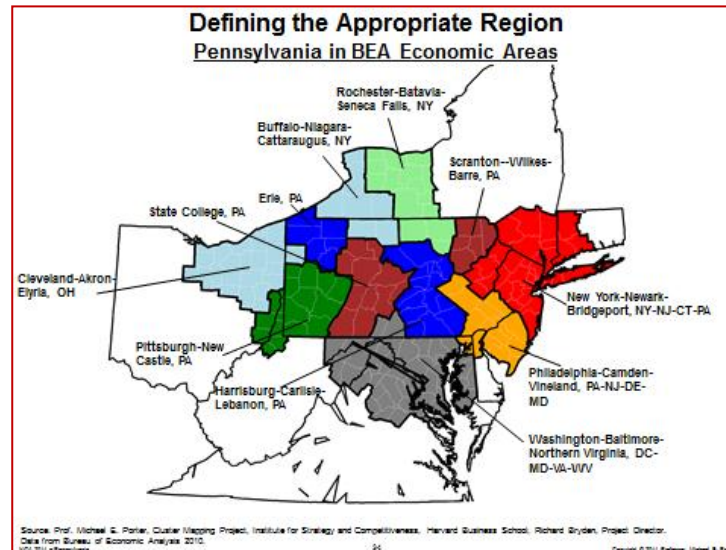
Note: Universities, research institutes, and government organizations are highlighted.
 Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School, Richard Bryden, Project Director.
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A Note on Regions

The political boundaries of a state often encompass many distinct regional economies or portions of larger regional economies. A comprehensive approach to economic development should reflect both the distinct economies within a state as well as the often strong linkages to economies in neighboring states.

The map on the following page shows the intersection of the state with the Economic Areas defined by the U.S. Bureau of Economic Analysis (BEA.) We find that the Economic Areas are a very meaningful unit of geography for exploring the specialization and linkages in the U.S. economy. BEA's 179 economic areas cover the entire U.S. and define the relevant regional markets surrounding metropolitan or micropolitan statistical areas. They consist of one or more economic nodes - metropolitan or micropolitan statistical areas that serve as regional centers of economic activity - and the surrounding counties that are economically related to the nodes.

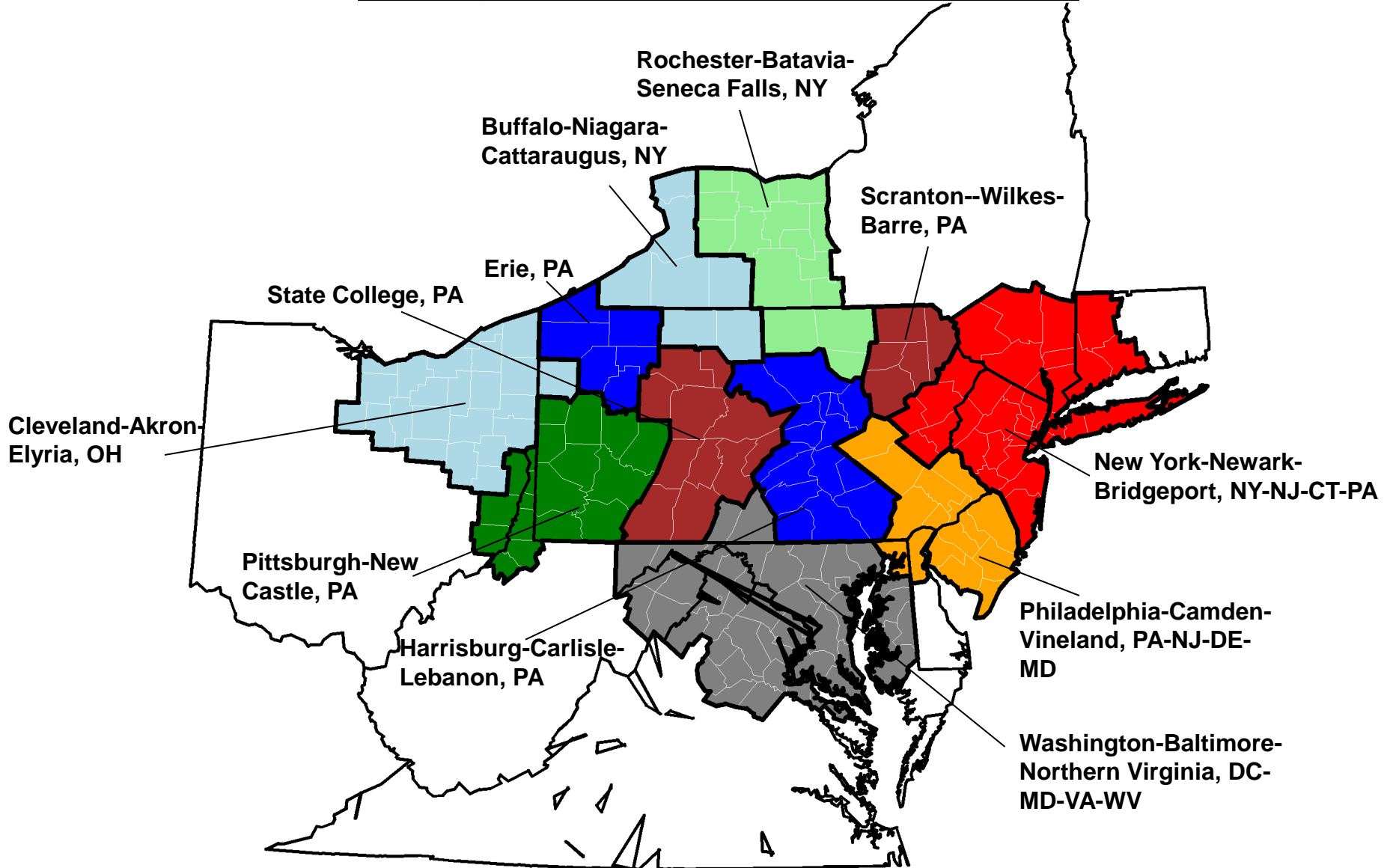
Please note that while this report has focused exclusively on the state, the website of the Cluster Mapping Project reached from www.isc.hbs.edu provides similar data and analyses for all Economic Areas (and Metropolitan Areas) in the U.S.



Note: There are 177 Economic Areas in the continental U.S. and one each for Alaska and Hawaii.

Defining the Appropriate Region

Pennsylvania in BEA Economic Areas



Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.
Data from Bureau of Economic Analysis 2010.

Traded Clusters and Subclusters in the US Economy

Aerospace Engines Aircraft Engines Precision Metal Products	Chemical Products Intermediate Chemicals and Gases Packaged Chemical Products Other Processed Chemicals Refractories Leather Tanning and Finishing Ammunition Special Packaging Treated Garments	Furniture Furniture Wood Materials and Products Furnishings Tableware and Kitchenware	Metal Manufacturing Fabricated Metal Products Metal Alloys Primary Metal Products Precision Metal Products Fasteners Wire and Springs Metal Processing Iron and Steel Mills and Foundries Nonferrous Mills and Foundries Metal Furniture Environmental Controls Pumps Saw Blades and Handsaws General Industrial Machinery Laundry and Cleaning Equipment Metal Armaments	Processed Food Milk and Frozen Desserts Baked Packaged Foods Coffee Processed Dairy and Related Products Meat and Related Products and Services Flour Specialty Foods and Ingredients Milling Candy and Chocolate Malt Beverages Paper Containers and Boxes Metal and Glass Containers Food Products Machinery
Aerospace Vehicles and Defense Aircraft Missiles and Space Vehicles Defense Equipment	Communications Equipment Communications Equipment Electrical and Electronic Components Specialty Office Machines	Heavy Construction Services Final Construction Subcontractors Primary Construction Materials Ceramic Tile Equipment Distribution and Wholesaling Fabricated Metal Structures and Piping Explosives	Motor Driven Products Motors and Generators Batteries Motorized Equipment Refrigeration and Heating Equipment Appliances Specialized Pumps Specialized Machinery Tires and Inner Tubes	Production Technology Machine Tools and Accessories Process Equipment Sub-systems and Components Hoists and Cranes Process Machinery Industrial Patterns Fabricated Plate Work Industrial Trucks and Tractors Ball and Roller Bearings
Agricultural Products Farm Management and Related Services Soil Preparation Services Irrigation Systems Packaging Fertilizers Agricultural Products Wine and Brandy Cigars Milling and Refining	Construction Materials Tile, Brick and Glass Plumbing Fixtures Wood Products Cut and Crushed Stone Gum and Wood Chemicals Rubber Products	Heavy Machinery Construction Machinery Farm Machinery Railroad Equipment and Rental Mining Machinery Machinery Components Valves and Pipe Fittings	Oil and Gas Products and Services Oil and Gas Machinery Hydrocarbons Oil and Gas Exploration and Drilling Oil Pipelines Petroleum Processing Oil and Gas Trading Water Freight Transportation Services	Publishing and Printing Publishing News Syndicates Signs and Advertising Specialties Photographic Services Photographic Equipment and Supplies Radio, TV, Publisher Representatives Printing Services Printing Inputs Paper Products Specialty Paper Products Inked Paper and Ribbons Office Equipment and Supplies
Analytical Instruments Laboratory Instruments Optical Instruments Process Instruments Search and Navigation Equipment Electronic Components	Distribution Services Merchandise Wholesaling Apparel and Accessories Wholesaling Catalog and Mail-order Food Products Wholesaling Farm Material and Supplies Wholesaling Transportation Vehicle and Equipment Distribution	Hospitality and Tourism Tourism Attractions Tourism Related Services Water Passenger Transportation Accommodations and Related Services Boat Related Services Ground Transportation	Plastics Plastic Materials and Resins Plastic Products Paint and Allied Products Synthetic Rubber	Sporting, Recreational and Children's Goods Sporting and Athletic Goods Games, Toys, and Children's Vehicles Motorcycles and Bicycles
Apparel Men's Clothing Women's and Children's Clothing Hosiery and Other Garments Accessories Knitting and Finishing Mills	Education and Knowledge Creation Educational Institutions Research Organizations Educational Facilities Patent Owners and Lessors Supplies	Information Technology Computers Electronic Components and Assemblies Peripherals Software Communications Services	Power Generation and Transmission Electric Services Turbines and Turbine Generators Transformers Porcelain, Carbon and Graphite Components Electronic Capacitors	Textiles Fabric Mills Specialty Fabric Mills Specialty Fabric Processing Textile Machinery Yarn and Thread Mills Carpets and Rugs Wool Mills Fibers Finishing Plants Specialty Apparel Components Women's and Children's Underwear Tire Cord and Fabrics
Automotive Motor Vehicles Automotive Parts Automotive Components Forgings and Stampings Flat Glass Production Equipment Small Vehicles and Trailers	Entertainment Video Production and Distribution Recorded Products Entertainment Equipment Entertainment Related Services Entertainment Venues	Jewelry and Precious Metals Jewelry and Precious Metal Products Costume Jewelry Cutlery Collectibles	Prefabricated Enclosures Recreational Vehicles and Parts Mobile Homes Trucks and Trailers Caskets Elevator and Moving Stairways Office Furniture Household Refrigerators and Freezers Aluminum Processing	Tobacco Cigarettes Other Tobacco Products Tobacco Processing Specialty Packaging
Biopharmaceuticals Biopharmaceutical Products Health and Beauty Products Containers	Financial Services Depository Institutions Securities Brokers, Dealers and Exchanges Insurance Products Health Plans Risk Capital Providers Investment Funds Real Estate Investment Trusts Passenger Car Leasing	Leather and Related Products Leather products Fur Goods Coated Fabrics Related Products Accessories	Lighting and Electrical Equipment Lighting Fixtures Electric Lamps Batteries Switchgear Electrical Parts Metal Parts	Transportation and Logistics Air Transportation Bus Transportation Marine Transportation Ship Building Transportation Arrangement and Warehousing Trucking Terminal Airports Bus Terminals
Building Fixtures, Equipment and Services Plumbing Products Drapery Hardware Fabricated Materials Heating and Lighting Furniture and Fittings Clay and Vitreous Products Floor Coverings Steam and Air-conditioning Stone and Tile Work Wood Cabinets, Fixtures and Other Products Concrete, Gypsum and Other Building Products	Fishing and Fishing Products Fish Products Fishing and Hunting Processed Seafoods	Medical Devices Surgical Instrument and Supplies Dental Instrument and Supplies Ophthalmic Goods Medical Equipment Diagnostic Substances Biological Products		
Business Services Management Consulting Online Information Services Computer Services Computer Programming Photocopying Marketing Related Services Professional Organizations and Services Engineering Services Laundry Services Facilities Support Services	Footwear Footwear Specialty Footwear Footwear Parts			
	Forest Products Paper Products Paper Mills Paper Industries Machinery Prefabricated Wood Buildings Wood Partitions and Fixtures			

See <http://www.isc.hbs.edu/cmp/help.html> for Excel listing.

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

About This Report

This report was prepared in conjunction with Prof. Michael E. Porter's presentation before the National Governors Association Winter Meeting on February 26, 2011. It draws on data and analysis from the *Cluster Mapping Project* and other sources at the Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director. Additional information may be found at the website of the Institute for Strategy and Competitiveness, www.isc.hbs.edu. None of this information may be duplicated, disseminated or copied without express written consent from the Institute for Strategy and Competitiveness.

This report is available electronically at <http://www.isc.hbs.edu/stateprofiles.htm>.