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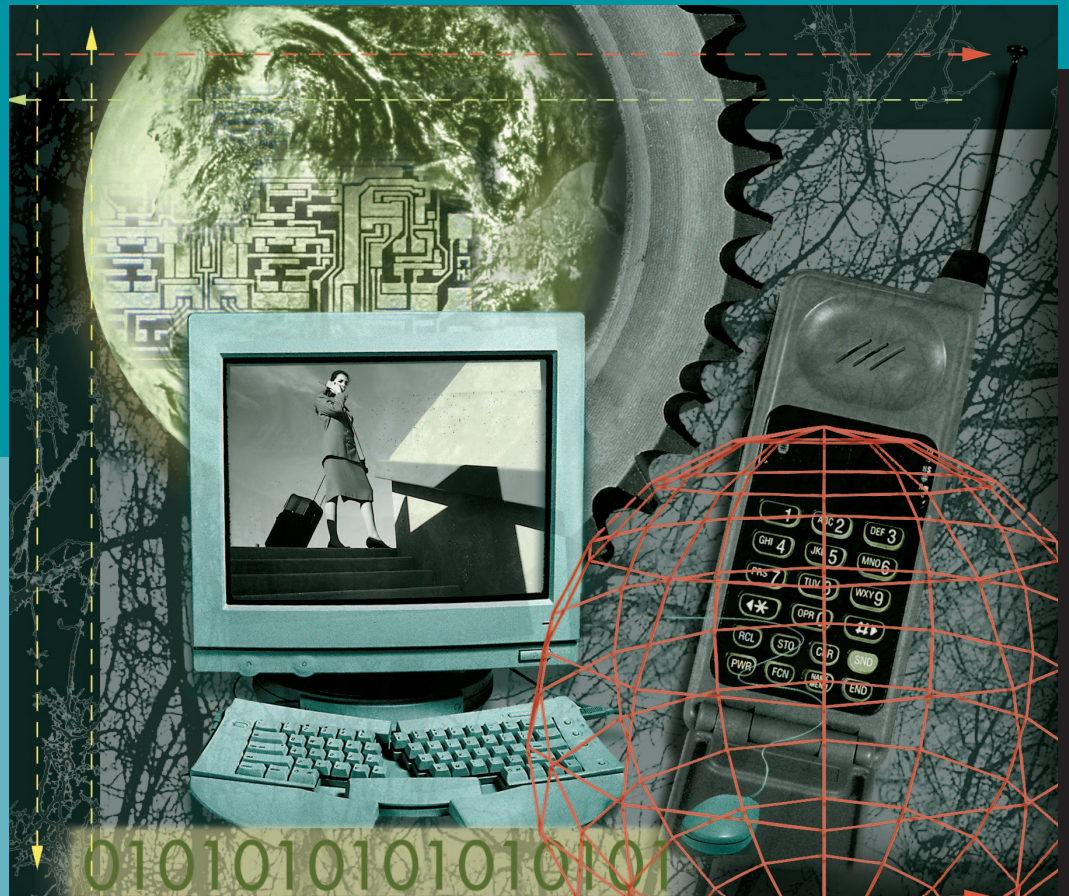
# Information Technology

## Economic Development

### *The New Foundation*

**Craig Moore**

The University of Massachusetts  
Donahue Institute





# Information Technology

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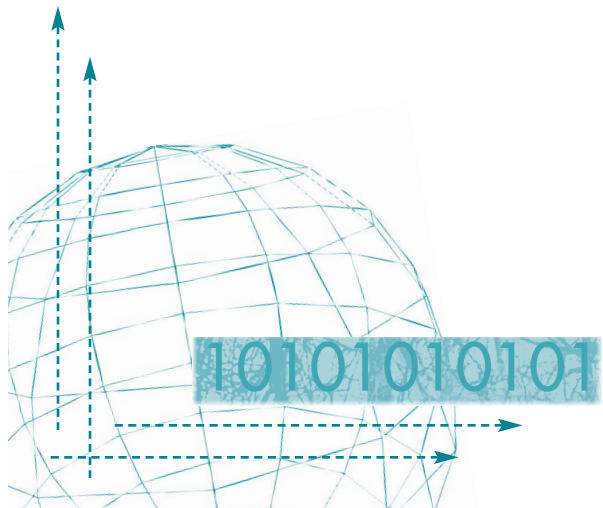
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# The New Foundation

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**O**UR NATION'S DEVELOPMENT has been characterized by massive public investment. We spend hundreds of billions of dollars each year expanding and improving networks of railroads, canals, highways and bridges, pipelines, airports and public utilities. No one has to look beyond the central artery in Boston to grasp the scope of this phenomenon. We depend on these vital links to communicate, govern and trade. While moving products from the farm or factory to the market has always been the lifeblood of economic growth, moving information, money, and ideas has become essential to successfully compete in the modern global economy.

We are spending an increasingly large portion of our incomes on services rather than products. Most of these services involve information, our appetite for which is growing at a geometric rate. The development of computers and high-speed digital telecommunications has made it possible to tap into a vast worldwide reservoir of knowledge in seconds and to gather new information about events almost as they happen.

The Commonwealth is a world leader in the innovation and entrepreneurship that drive this industry; much of the technology at the heart of the information age — including the Internet — originated here. Our economy has shifted away from defense research and production to computer networks, software, and telecommunications. The economic recovery of the early 1990s was driven largely by the information technology sector and by service sectors that rely heavily on IT, such as financial management, health care and education. The future clearly rests with the expansion of information-based activities.

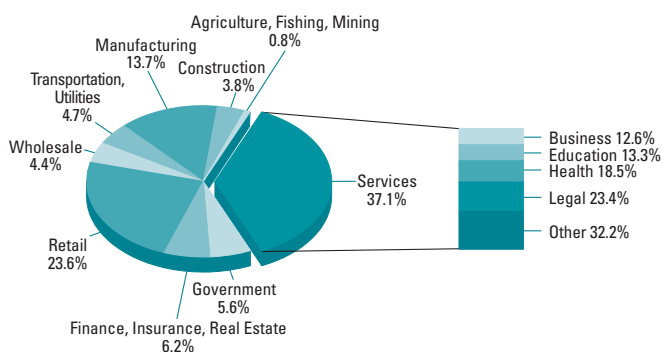
## The Massachusetts Economy

The Massachusetts economy, like the national economy, continues to shift away from its historical reliance on manufacturing to become a center of business and other services. This is an important backdrop against which we can view the rapid growth in the information technology sector. As Figure 1 illustrates, manufacturing in the Bay State accounts for less than 14 percent of employment, while the service sector has grown to over 37 percent. When finance, insurance and real estate (FIRE) is considered, this figure increases to more than 43 percent.<sup>1</sup>

Many of the major elements in the service sector rely on information technology. Financial, medical, educational, and government services are obvious examples of activities that rely more and more on communication networks, database access, and software to function. Advances in information technology have made many of these services more effective and supported their rapid expansion over the past decade.

Figure 1

The Massachusetts Economy — Employment in 1998

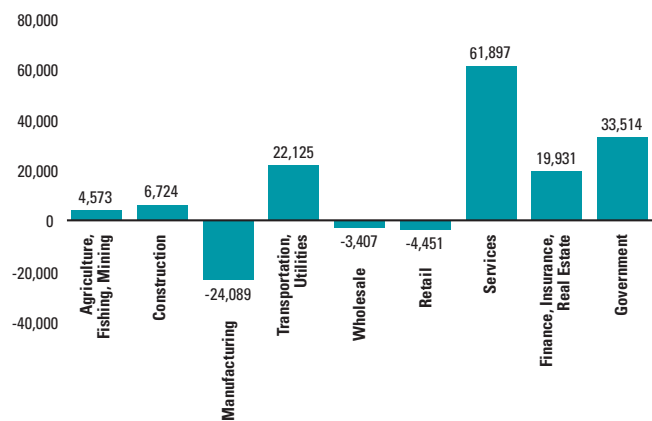


## Employment Growth, 1995 to 1998

The continued restructuring of the economy is further emphasized when one examines the changes in employment by major sector in Massachusetts during recent years. These changes are shown in Figure 2. While manufacturing lost more than 24,000 jobs, the service sector added over 61,000. When including FIRE, the total climbs to approximately

Figure 2

Massachusetts Employment Growth, Number of Jobs, 1995 to 1998



82,000 new employment opportunities. Transportation and utilities also show strong growth as a result of continued capital investment in telephone, cable, and wireless networks across the state.

The increase in government employment is due in large measure to increases in local public school districts responding to education reform. Efforts to equip our public schools with computers, networks, and Internet access is another key link to the IT sector.



## Defining the Information Technology Cluster

Information technology (IT) includes many elements. Starting with information itself as a product or service, we can add the communication network over which it is available; the hardware used to send, receive, and transmit it; the software that transforms and manages it; and the technical support to keep it going. While the IT cluster actually includes over 40 separate categories of products and services, it is simpler to think of it as hardware, software, communications services, support services and integrated systems or networks, as illustrated in Figure 3.

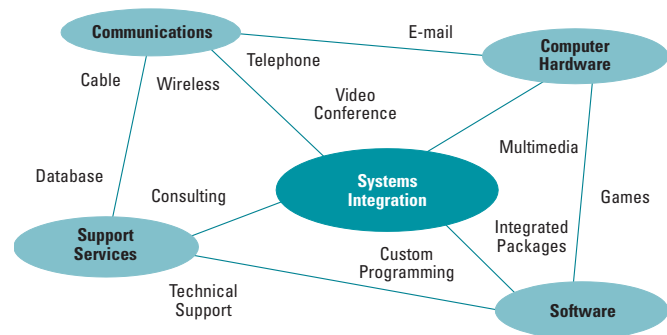
The main components of hardware are computer and communications equipment. Software can manage a network, enable you to “chat” with friends over the Internet, and support seemingly everything in between. Communications includes wireless technology (radio), local and long distance telephone services, cable networks, and other services, such as satellite access. Support services employ a vast army of technicians who do everything from installing products to troubleshooting over the telephone. Systems integration (or network technology) links people across organizations with local area networks (LANs) and over larger geographic areas with wide area networks (WANs), as well as in other ways. Companies combine hardware, software, technical support and consulting services in integrated product/service bundles. Many firms in the IT sector provide products or services that are variations on these themes, blurring the lines of distinction more and more all the time.

This analysis of the IT cluster, showing the size and relative change in employment and sales among its various elements, aggregates data provided for firms using the primary standard industrial classification (SIC) code they report. The data used are from Dun &

Bradstreet, and have the advantage of being very current and including many small companies. Other data sources, while more reliable in some ways, are based on employer tax records and miss the many small, non-traditional firms that tend to dominate software and support services.

**Figure 3**

### Information Technology Cluster



The percentage figures from Dun & Bradstreet are very reliable. The employment figures are useful, especially when doing comparisons across time. The sales figures are less reliable, because of double counting by resellers; there is no way to account for added value, as the special census of manufacturing does. All in all, the data and descriptions used provide a reasonably accurate picture of the IT cluster, the ways it is changing, and how important various elements of it are to the state’s economy.

## The Relative Size and Composition of the Information Technology Sector

The IT cluster presently employs approximately 169,000 people in Massachusetts. Figures 4 and 5 compare the composition of employment among the major IT sectors in Massachusetts and the United States. The greatest share of IT jobs in the state is in manufacturing, well above the national figure

shown in Figure 5. Within manufacturing, approximately one-third of the state's jobs are in computer hardware, one-quarter in communications equipment, and 20 percent in peripherals. The balance of employment is in telecommunications equipment and components. Wire and cable manufacturing comprise a very small segment.

Manufacturing, software and integrated systems employment is more concentrated in Massachusetts than in the rest of the country. Our employment in communications may seem low compared to the nation overall, but on a per capita basis, there is a higher-than-average use of communications services in the Bay State.

## An Overall Leader in Employment Growth

The information technology cluster is important not only for its absolute size but for its rate of growth. From 1995 to 1998, IT employment had a net increase of 24.5 percent, or 28,783 new jobs. Software accounted for 11,216 of these, growing 42.5 percent. Integrated systems companies added 11,386 new jobs and grew by 174.5 percent during the same period. The expanded demand for telephone and cable services brought 6,616 new jobs, a growth of 58.2 percent in the three-year period.

On the down side, computer manufacturing slowed, shedding 734 jobs (2.7 percent of its workforce). Communications hardware experienced an even stronger decline, losing 3,874 jobs, or 19.2 percent of its workforce.

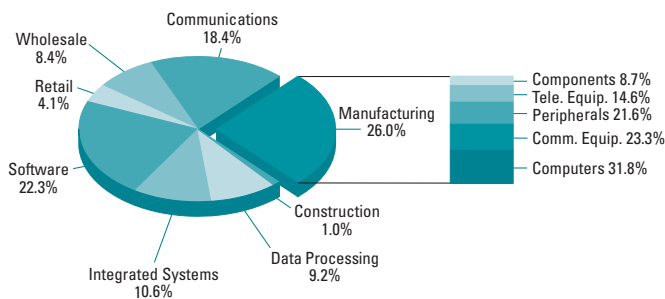
Overall, the IT cluster played a key role in employment growth, with software and integrated systems being the leading elements. This is important, considering how much of this employment growth is linked to sales outside the region.

There are, conservatively, about 100,000 jobs directly tied to equipment manufacturing, software, and systems integration that are primarily involved in selling their products outside of the state. To be sure, some of their products are consumed here, but some of the consulting and data services and other parts of the IT cluster also sell elsewhere. Figure 6 illustrates the concentration of jobs in various sectors that contribute to sales outside of the state.

IT sales in 1998 were about \$47.5 billion, comprising approximately 13 percent of all sales in the state economy. Nearly \$33.5 billion of these were primarily regional exports, an increase from \$28.8 billion in 1995. Many IT products and services tend to have high added

**Figure 4**

**Information Technology Employment — Massachusetts 1998**



**Figure 5**

**Information Technology Employment — United States 1998**

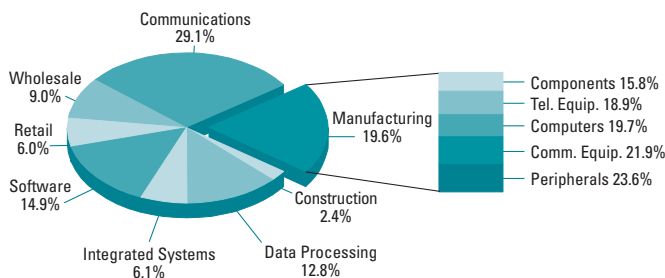
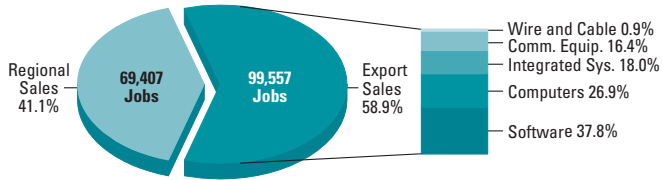


Figure 6

Regional Export Employment — Massachusetts 1998



value, very high short-term profits, and relatively short life spans, because of intense competition and rapid innovation.

### Software

Software firms are typically small and young. There are only four companies with more than 500 employees in the state; 59 percent have four or fewer employees. Between one-half and one-third of all software companies are less than three years old. Sales in 1998 were estimated at \$5.7 billion dollars, having grown by \$1.5 billion since 1995. These companies are involved in a wide variety of applications, from Internet security to network management. Some are software integrators that specialize in making existing software work together in solving complex systems problems. Software designers and engineers are in high demand across the nation, which creates a bottleneck to continued fast growth in this industry.

While Massachusetts is clearly a nationally recognized leader in software development, employment here has not grown as fast as it has in the nation. This is explained in part by the Commonwealth's strength early on. While national growth was 51.5 percent from 1995 to 1998, Bay State growth in this sector was 42.5 percent. As our talent became employed, it is likely that companies looked elsewhere for late bloomers in the pool. Some firms have contracted for programming services in Russia and India, for example, to tap cheap but talented human resources.

States that had little software activity only a few years ago are growing rapidly today. California has been a perennial leader, with more employment (134,419) and sales (\$24.3 billion) than any other state. Texas now ranks second in employment, with 56,778 employees, and third in sales, with \$7.8 billion. Massachusetts is third in employment (36,640) and number four in sales (\$5.7 billion). The state of Washington ranks fourth in employment with 34,708, but, thanks to Microsoft, number two in sales, with \$13.3 billion. Other leaders include New York, Florida, New Jersey, Virginia, and Illinois.

### Systems Integration

This element in the IT cluster is growing faster than any other part of the state economy, having increased 174 percent since 1995, compared to the nation's 52 percent. In 1998, about 25 percent of the companies were less than three years old, and only five companies had more than 500 employees.

Like software, this segment is made up of small, young businesses that are growing fast, and the two sectors are competing for the same employees. Sales in 1998 were approximately \$3.5 billion dollars, having increased by a meteoric 188.7 percent since 1995. Many of these firms are prime targets for acquisition, as they have developed new products that larger firms would like to add rather than develop internally.

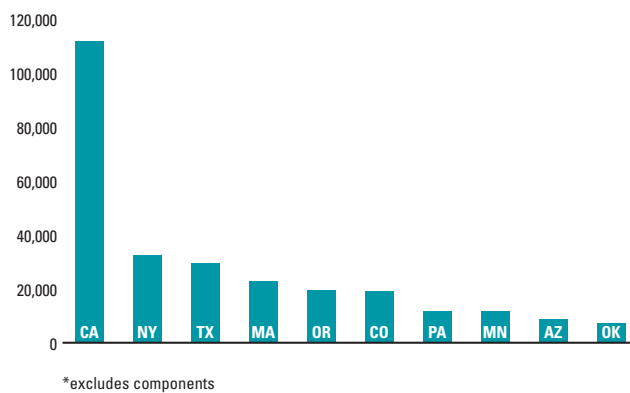
The national leader in absolute employment is California, with 46,259 jobs and sales of almost \$12.9 billion. Virginia is second in employment with 28,920 workers and third in sales with \$4.9 billion. Massachusetts is third with a workforce of 17,912, and fourth in sales, with \$3.5 billion. New York, while only sixth in employment, is tied with Virginia at number two in sales, with just under \$5 billion. Other leading states include Maryland, Texas, Illinois, Georgia and Pennsylvania.

## Equipment Manufacturing

While equipment manufacturing in computers and communications sectors has been declining, Massachusetts is strong in both of these sectors. Figures 7 and 8 illustrate how the Commonwealth stacks up against other states.

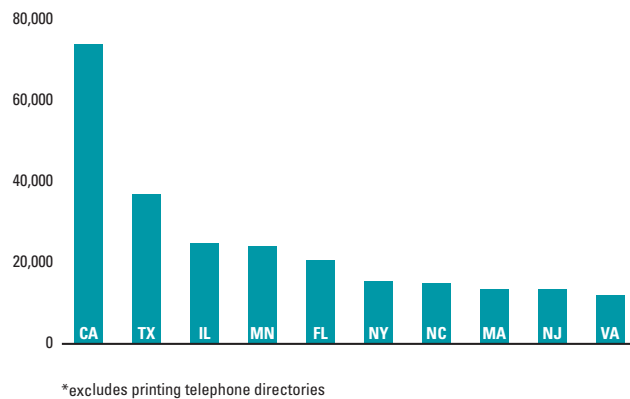
**Figure 7**

### State Comparisons — Computer Equipment Employment, Number of Jobs, 1998\*



**Figure 8**

### State Comparisons — Communications Equipment Employment, Number of Jobs, 1998\*



## State and National Growth in Information Technology

Economists view the relative performance of a regional economy through a shift-share analysis. This compares the rate of change in employment within each sector of the national economy with the rate of change in the state economy. Industries growing at the same rate in a state as in the nation appear along a 45-degree line (see Figure 9). Points above the line indicate faster growth in the state, and points below the line, slower growth. Points falling below the horizontal axis (e.g., wholesale trade) indicate growth in national employment while there is actually a decrease in state employment. If the state is growing in an industry that is experiencing a decline nationally, the point falls to the left of the vertical axis. Industries that are declining in both the nation and the state (e.g., communications hardware) fall to the left of the vertical axis and below the horizontal axis, where both rates are negative.

In Massachusetts, the networking or systems integration segment of the IT cluster is growing at a much faster rate than in the nation as a whole. The graph's broken vertical axis is necessary to accommodate the explosive 174 percent rate of growth in jobs in Massachusetts, while the nation posted an impressive, but more modest, rate of 52 percent over the same period.

The state's communications sector also grew at a faster rate than did the nation's, indicating that, for a state with a relatively small population, we have invested more heavily than have other states in communications infrastructure during this period. This very positive factor supports continued economic growth, particularly in the IT sector.

While continuing to grow at a very healthy rate, software employment grew more slowly here than in other states. This is not surprising, as

Massachusetts has a larger base and would have to add very large absolute numbers of jobs to keep up with states that are just taking off in this fast-paced industry. Small software businesses have the advantage of being inexpensive to start, while offering great opportunities for growth and profit.

Computer hardware continues to decline in both the nation and the Commonwealth, as more and more production shifts overseas. Mass production of computer equipment and telecommunications components can be done in highly automated facilities with cheap foreign labor, making competition very difficult for domestic manufacturers.

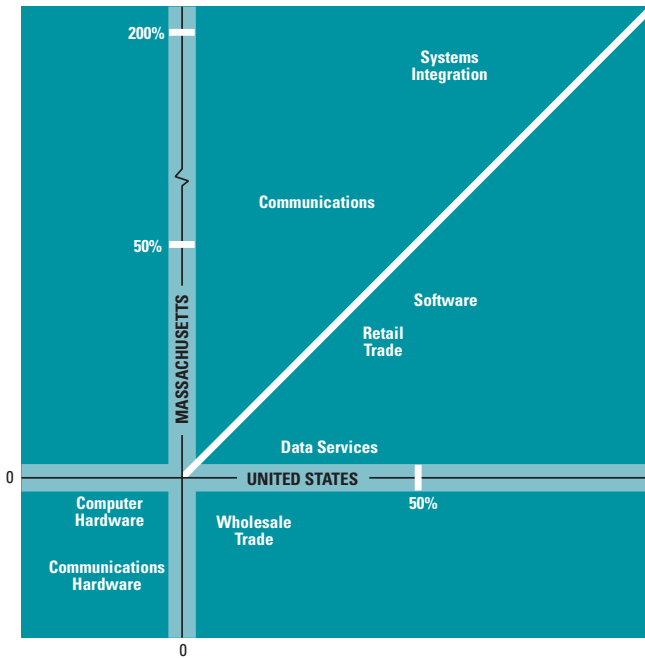
demand and increased overseas manufacturing operations.

Communications hardware was likewise in the red, with a 3.6 percent decline in the industry nationally and a 19.2 percent fall in the state since 1995. This shows real overall weakness in this sector, though radio and TV communications equipment increased by 2,297 jobs, offsetting some of the loss in other areas.

Wholesale trade in IT products increased by 11.9 percent across the country, while it fell by 5.1 percent here. Retail employment nationally experienced a rise of 40.2 percent, while Massachusetts employment increased by 34.7 percent.

**Figure 9**

**Relative Change in IT Employment — 1995 to 1998**



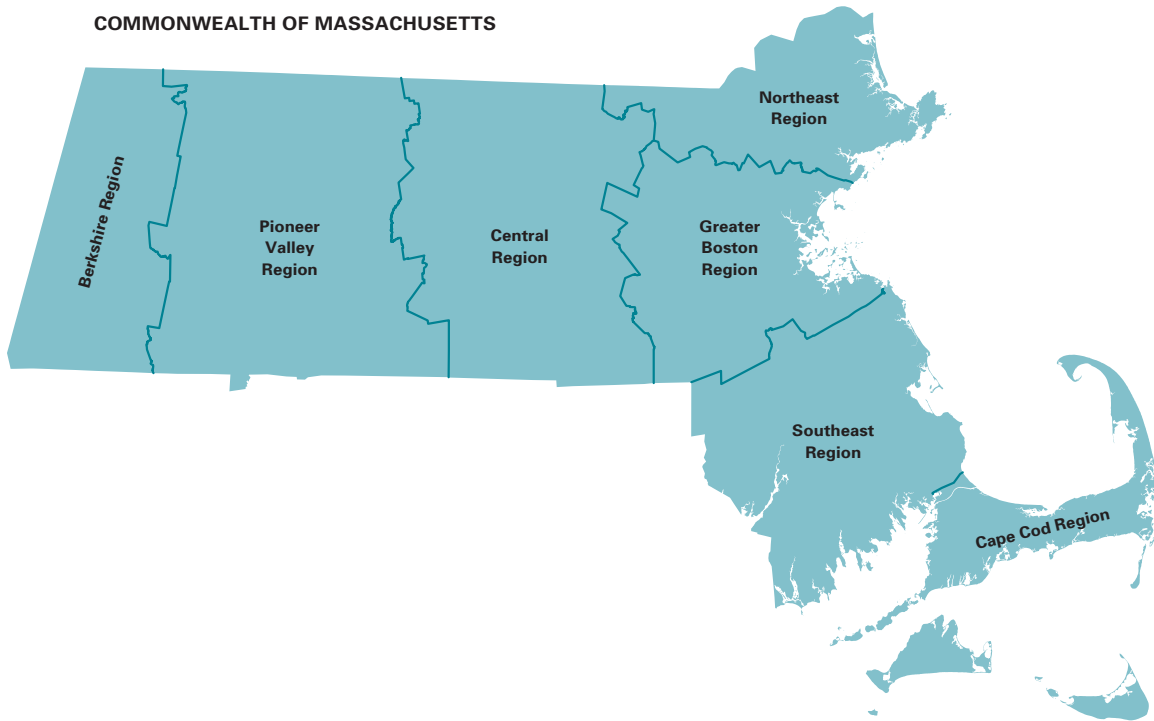
From 1995 to 1998, employment in this area fell by 1.5 percent nationally, while it declined by 2.7 percent in Massachusetts. Though the industry has been declining overall, there has been growth in peripheral equipment, helping to offset the loss of jobs. It is likely to remain weak, however, in view of reduced foreign

In the Bay State, non-hardware communications employment outpaced the nation with a 58.2 percent increase since 1995. It grew by only 22.4 percent across the country. This supports the belief that the per capita use of communications in our state economy is higher than in other states.

Data services include a variety of activities, from data preparation and processing to information retrieval and facilities management. Employment in this sector grew by 24.7 percent nationally during recent years, while increasing only 2.6 percent in Massachusetts. Most of this work is related to the size and composition of the economy. Being a smaller state, more advanced in the use of IT, one wouldn't expect as much growth here as in other regions.

The systems integration sector in the Bay State is a leader in the nation. This mixture of computer hardware, communications hardware and software, network management software, consulting services, and technical support embodies all of the IT cluster. Firms in this category are often referred to as software or telecommunications companies.

COMMONWEALTH OF MASSACHUSETTS



## Regional Aspects of the Information Technology Sector

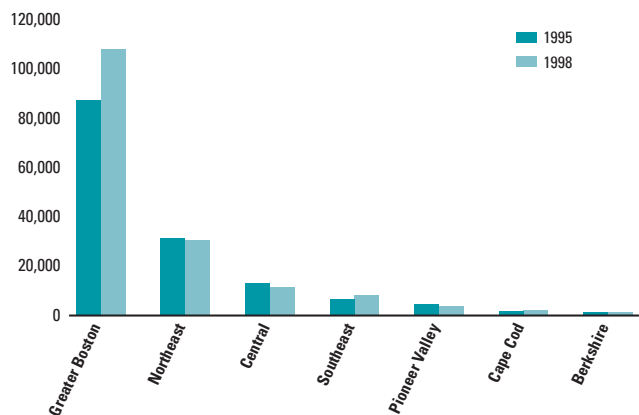
The rapid growth in information technology sectors is like a wave radiating out from the Greater Boston region. It is flowing along the corridors of transportation and trade, seeking the best available facilities and the most talented pool of labor. It seems to wash right over some smaller or older communities, and it hasn't had a major impact on the most distant regions yet. Everyone is trying to catch that wave of prosperity and opportunity pushed along by software, systems integration and other information technology services.

Figure 10, showing total IT employment in each of the seven regions across the state, provides some perspective. The Greater Boston region dominates the state, with over 108,000 people employed in information technology. The adjacent Northeast region follows, with 30,821 jobs. Central Massachusetts adds

11,507; the Southeast region, 8,339; the Pioneer Valley, 3,295; Cape Cod, 1,727; and the Berkshire region, 734. On the face of it, the geographic pattern supports the wave metaphor. But while this general view may be useful, there are many differences among regions' performances with respect to the various IT clusters. Those differences include some interesting surprises.

Figure 10

Regional Change in IT Employment — 1995 to 1998



## GREATER BOSTON REGION

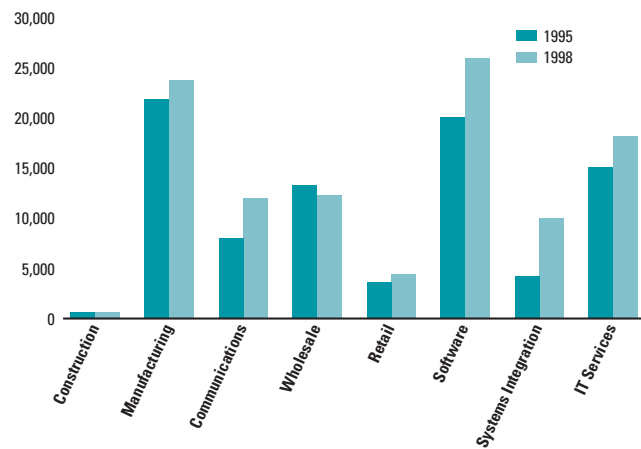
Boston is at the heart of the IT revolution in Massachusetts. Total employment grew from 87,400 to more than 108,000 from 1995 to 1998, and sales boomed from \$27.6 billion to \$36.8 billion. There were nearly 400 new companies. While manufacturing employment was slipping in many other regions, in Boston it grew, if only slightly, from 22,043 to 23,921.

Both software and systems integration showed remarkable increases in sales and employment. There were almost 12,000 new jobs in these two sectors. IT services added nearly 3,000 more. Other sectors were flat or showed smaller amounts of growth.

On top of all this, there is the strength of other sectors that rely on IT services — financial management, health systems, higher educa-

Figure 11

Greater Boston Region IT Employment — 1995 and 1998



tion, and a wide variety of business services. Boston reaps the benefits of being a purveyor of all of these.

## NORTHEAST REGION

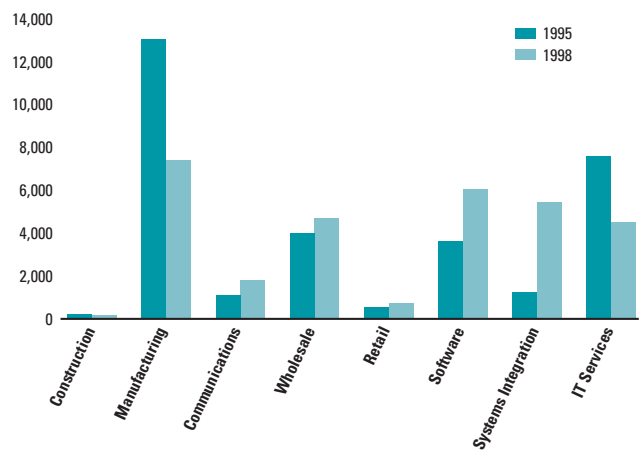
The Northeast region is showing a significant decline in the manufacturing sector. Between 1995 and 1998, jobs fell from over 13,000 to about 7,400. Equally impressive was the growth in software and systems integration, which was almost enough to offset the loss. There is clearly some major restructuring going on in this region.

There has also been an increase in the number of IT services firms over the past three years, from 248 to 342. Sales have increased, but employment has fallen from 7,585 to 4,522. The answer may lie in smaller, more efficient companies.

With over 30,000 workers in the IT cluster, development of the workforce and of quality

Figure 12

Northeast Region IT Employment — 1995 and 1998



telecommunications services will be important for continued restructuring.

## CENTRAL REGION

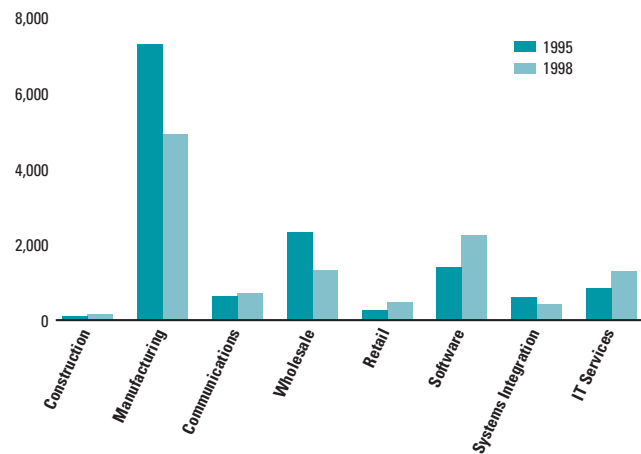
Central Massachusetts has experienced a decline in total IT employment since 1995. There were more firms and increased sales (from \$1,408 million to \$1,827 million), but manufacturing employment in the sector fell significantly, from 7,266 to 4,891.

Growth was significant in software, retail trade and IT services. While this region seems to be next in line for the wave of IT expansion, there has not yet been a major impact. Current employment is only about 11,500, and there is no sign of rapid expansion within the IT sector itself.

While direct activity in the IT cluster may not be growing as fast as expected, biotechnology and healthcare are booming. This sector is a major user of telecommunications, database technology, software, and other IT services. The expertise that might typically go directly

Figure 13

Central Region IT Employment — 1995 and 1998



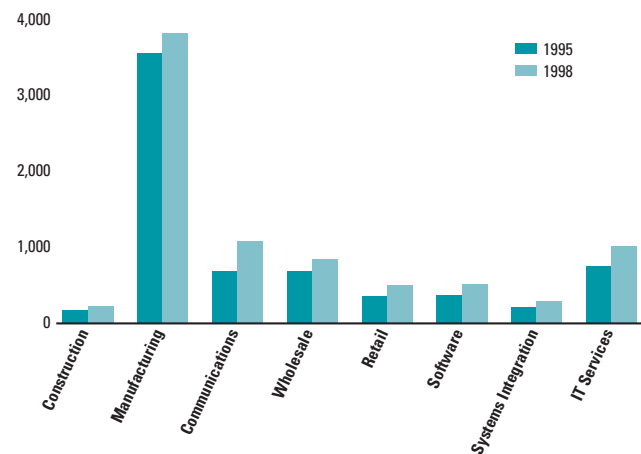
into IT in other regions is probably being attracted into the rapid growth in medical technology and research here.

## SOUTHEAST REGION

The IT wave has hit the Southeast and is starting to have a very positive impact. The region, while small in its IT base, showed growth in every sector. Total employment increased from 6,827 in 1995 to 8,339 in 1998, with a pattern of almost perfectly balanced growth across the board. The number of new companies suggests that some people who are tired of the Boston bustle are setting up shop south of the city.

Figure 14

Southeast Region IT Employment — 1995 and 1998





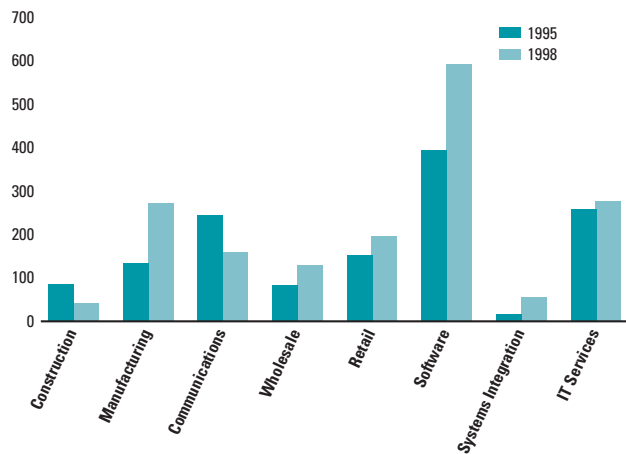
## CAPE COD REGION

The Cape Cod region has only about 1,727 IT employees, an increase from 1,373 in 1995. The largest and fastest-growing sector is software, with almost 600 employees. Manufacturing, while small, did grow from 135 to 272 jobs. While trimming the number of companies from 17 to 10, sales increased almost threefold.

Will Cape Cod and the islands become places where software engineers telecommute from their sailboats? Some people think so. While it is doubtful that this region will ever become a major IT center, it should continue to enjoy modest growth from software and network companies, as the industry seems drawn in its direction.

Figure 15

Cape Cod Region IT Employment — 1995 and 1998



## PIONEER VALLEY REGION

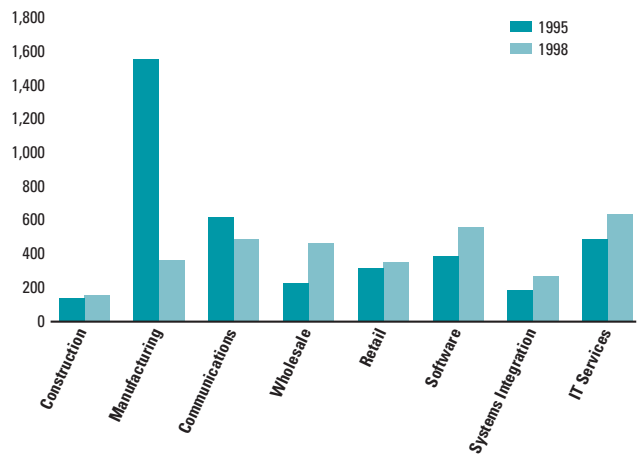
Like Central Massachusetts, the Pioneer Valley experienced a decline in IT employment between 1995 and 1998. The number of manufacturing firms grew from 12 to 19, and sales increased from \$33 million to nearly \$49 million. Employment, however, fell from 1557 to 363.<sup>2</sup> This indicates that near-term growth in the number of manufacturing jobs in computer and communications equipment is unlikely.

Nearly every other sector of the cluster showed significant growth. Software, systems integration, and IT services were all very strong. The number of new software companies grew from 67 to 107, and employment jumped from 390 to 561. IT services added nearly 150 jobs — from 490 to 637 — with companies like JavaNet leading the way.

This region has excellent telecommunications access. It also has access to major markets and is a natural crossroads for travel and communications. Though other regions have similar advantages, the Pioneer Valley's lower costs should attract more than IT companies. It

Figure 16

Pioneer Valley Region IT Employment — 1995 and 1998



is also an excellent location for companies that depend on good telecommunications services.

The region's strong base of higher education is likely to continue to spawn new ventures in software and systems integration. If the Valley increases the supply of people with the right mix of technical skills, it will undoubtedly attract growing IT-oriented businesses.

## BERKSHIRE REGION

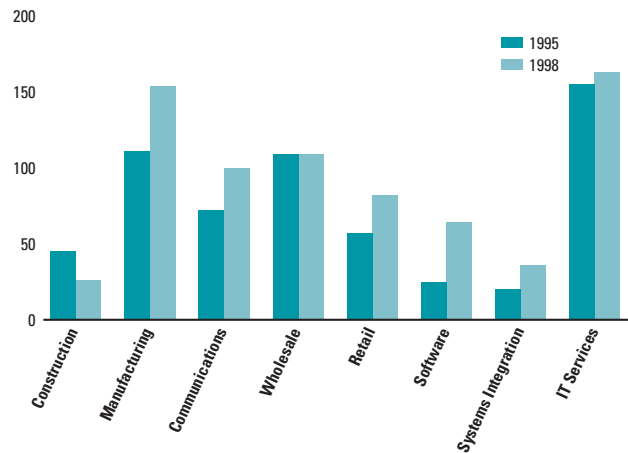
Its distance from Boston, along with its low population, place the Berkshire region at a disadvantage for economic growth in the IT sector. In spite of this, the region has been showing promise. Total IT employment is up nearly 24 percent, from 594 in 1995 to 734 in 1998. Surprisingly, the manufacturing component of the cluster is growing significantly, along with software, systems integration, retail trade, and communications. As the infrastructure is upgraded, even more rapid growth is expected in IT services and software.

There is potential for continued growth in manufacturing, as low-cost space becomes available at the General Electric facilities in Pittsfield. There are resident workers with experience, skill, and the willingness to work at a lower wage than are people who have to shoulder the higher costs of living in urban areas. While manufacturing in general is flat or in a long-term decline, this region may buck the trend because of its cost advantages.

The IT sector in the Berkshire region may never grow to the extent that it might in a

Figure 17

Berkshire Region IT Employment — 1995 and 1998



more urban region, but it is very well suited for integrating the area's skilled designers and artists with the training that is linked to multimedia software and graphics. There is real opportunity for the cultural assets in this rural setting to attract young, talented people looking for an alternative lifestyle and natural surroundings with many of the cultural advantages of a metropolitan area.

## General Regional Patterns

One of the important trends in information technology is the rapid growth and expansion of the software and systems integration sectors. As more and more people discover that they can write computer programs, the software industry will continue to take hold in increasingly remote places. Many regions across the state will benefit from this trend. Areas with colleges and universities are likely to do especially well.

Manufacturing employment seems to be flat at best, even in this fast-growing industry. It is continuing to decline in most of the regions, though the jobs that are lost seem to be replaced with other IT jobs. This restructuring has to raise concerns about retraining and changes in our basic approach to education in public schools. The rapid growth in business and IT-related services makes this a priority.

For most regions, IT investment and growth will be influenced to a large degree by a number of factors:

- The availability of high quality telecommunications services at a reasonable cost;
- The availability of a well-trained and talented labor force;
- Area colleges or universities offering IT training and programs;
- The availability of venture capital;
- Local governments that are fiscally sound and well managed;
- A competitive local tax structure and regulatory process.

Some areas of the state continue to stress quality of life over economic growth. In these communities, IT may offer an alternative to traditional industrial or office park development. Many professionals in the IT cluster work at home and telecommute, rather than spend time at an office. This provides employment opportunities and income without the impact of commercial development.

In other regions, the information revolution will mean new large company facilities for research and development, production, and management. Commercial expansion will mean more employment and income in the community and the need to expand public facilities and services. Many communities welcome this growth and will actively compete to attract the continuing tide of IT investment.

## Challenges and Opportunities

Overall employment for the state grew 4.3 percent between 1995 and 1998. Overall sales increased by 17 percent. Employment in the state's IT cluster over the same period increased 24.5 percent and sales, 10 percent.

Nationally, the industry grew by 24.7 percent, but the composition of growth was not the same as it was in the Commonwealth. National IT employment expanded faster in wholesale and retail trade, communications, and construction. It was slightly higher in software and about the same in other areas. Systems integration was much faster in this state, offsetting slower growth in other parts of the industry. The Bay State's net growth was almost equal to that of the nation.

What is a reasonable expectation about future IT growth in the Commonwealth? It is amazing that a state with such a small population continues to be ranked among the top producers in all segments of the IT cluster. Our high technology orientation and research strengths seem to give us the edge over larger states. Venture capital continues to fund the wellspring of new ideas and products. But Massachusetts is virtually at full capacity; we may have reached the limits of our "resident" productivity. Any growth in employment will have to come from an increased workforce with highly educated and well-trained individuals.

Like other industries that were spawned in Massachusetts, growth spreads beyond our

borders as knowledge disseminates and barriers fall. Any of the highly successful, newly created “.com” companies, such as E-Bay, Amazon, or E-Trade, could have originated here. Likewise, Tripod, which was launched in Williamstown, could have started almost anywhere else. Internet commerce, while still in its infancy, will provide many new jobs in the future, and Massachusetts should be at the forefront of that activity. This industry is very mobile, and maintaining leadership will require special efforts.

### **Technical Education and Training**

The most important resource in this industry is human creativity. The demand for people with computer science, electrical engineering, software, and communications training is very high. While engineers and computer science graduates are very important, many of the technical occupations in the IT cluster require only two years of training beyond high school. Others could be accomplished with a technical high school curriculum focused on applied math and science, communication skills, and effective school-to-work programs. Without a serious effort to expand the supply of people with training for this industry, it cannot continue to grow as it has in Massachusetts. Neither will the other key growth industries that depend on employees with many of the same IT talents. Where will they come from?

There is a reservoir of women who left professional careers to raise their children. During their years at home, the technical world changed dramatically, leaving many reluctant to reenter the workforce. If IT skills-training programs were made available over the Internet or elsewhere, these women might be encouraged to enter high-demand occupations. We can use technology itself for new initiatives that will expand our workforce in the IT sector.

As certain industries downsize, other workers become available. In a classic example of

retraining, a production supervisor who had been “downsized” from a bottling plant took a year off to update her computer skills. She got a job as a programmer/systems analyst. The salary in her new job is almost as high as in her previous position and, unlike the stagnant salary she left behind, is expected to rise rapidly during the next few years. Though taking a year out to retrain cost her most of her savings, it was a sacrifice that she will recover from quickly. This type of retraining can be encouraged through retraining loans, tax incentives, and other programs.

As the Commonwealth’s population continues to decline and our workforce ages, the shortage of skilled workers may well become a crisis. Headhunters in the IT industry are increasingly focused on foreign workers who speak English and have good computer skills. This accelerates a brain drain from countries that need skilled workers to develop, and it does little to increase the prosperity of our own citizens.

We must create retraining initiatives, innovative education programs at all levels, retention of our best graduates, and collaboration between educational institutions and companies in this industry. A continued emphasis on higher standards in K-12 is essential, as are new curricula — geared toward lower achievers — that focus on real-world problem solving rather than abstract thinking.

### **Telecommunications Infrastructure**

Another major factor in influencing growth and investment in this sector is the availability of top-quality telecommunications services — low-cost service with very high band width. The recent efforts of businesses to acquire these services in Berkshire County underscores the importance that this industry places on network access.

Cape Cod is another region that is frequently mentioned as needing modern telecommunications services. The Commonwealth has

supported these efforts, along with the Massachusetts Information Turnpike Initiative that provides a fiber optic spine across the Bay State. Every effort must be made to extend services across the state at a reasonable cost. Deregulation has not yet been successfully carried out in this or most other states; more efforts must be made to ensure full access and effective competition.

Convergence is not just a buzzword anymore. Telecommunications integration is a reality. Networks of various sizes and types will continue to use a variety of services and may be linked by very different means. No one approach is likely to dominate the industry in the near term, and advances in technology keep providing more and better alternatives for both home users and businesses. Continued competition is vital. Effective regulation is essential to assure that Massachusetts customers have access to the best and broadest set of services across the state. This is an area where the Department of Public Utilities must be proactive, not merely a forum to settle disputes.

### **Other Factors**

While workforce and infrastructure concerns top the list of industry executives, there are other important factors. These include the continued availability of venture capital, a strong flow of research and development money from the government, competitive business taxes and regulatory process, a fiscally stable government, a reasonable cost of living, and a physical environment that people find attractive.

Among these, the high cost of housing in the eastern part of the state is seen as a serious impediment to attracting people from other parts of the country. Traffic problems and airport access are also favorite themes. Not unique to the IT cluster, these problems are part of a general concern in the business community about the competitiveness of Massachusetts.

The information technology cluster continues to be a key sector in the Massachusetts economy. While manufacturing in this industry is lagging, software and systems integration are soaring. These two sectors of the industry are critical to the future prosperity of the Commonwealth, not just for their direct benefits, but for the extraordinary access they provide to other key clusters in the state. Information is the new foundation of our economy, and the technology used to gather, manage, distribute and communicate it is the key to our future.

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### **ENDNOTES**

1. Numbers in this study reflect second-quarter 1995 and second-quarter 1998 Dun & Bradstreet data. (This information has not been deseasonalized.)

Since the completion of this study, more recent data have become available. Taking these data into account does not change the overall conclusions of the study.

2. This significant decrease may, in part, reflect a reclassification of firm activity, rather than an actual decrease in employment.





