MASSACHUSETTS BENCHMARKS

The quarterly review of economic news & insight

winter 2001/2002 • volume five issue 1

- Economic Currents
- Massachusetts Current and Leading Indices
- Medical Devices: A Stronghold of the Commonwealth's Economy
- From the Field: Pioneer Valley Training and Retaining IT Talent

A PUBLICATION OF THE UNIVERSITY OF MASSACHUSETTS

IN COOPERATION WITH THE FEDERAL RESERVE BANK OF BOSTON

Massachusetts Benchmarks Editorial Policy

Massachusetts Benchmarks is a quarterly journal published by the University of Massachusetts in cooperation with the Federal Reserve Bank of Boston. It presents timely information concerning the performance of the Massachusetts economy, including periodic economic analysis of major geographic regions within the Commonwealth and an array of key industries that make up the economic base of the state. The journal provides commentary and interpretation of economic data aimed at business leaders, public policymakers, educational organizations, and the general public.

The editors of *Massachusetts Benchmarks* invite articles on topics of current interest from researchers on various aspects of the state economy, regional economic development, and key growth industries. The editors also welcome queries from academic or professional economists for future issues of the journal. Please send queries to Carolyn Dash Mailler at cmailler@donahue.umassp.edu with a brief biography and topical outline. Authors considered for *Massachusetts Benchmarks* will be furnished with writers' guidelines.

All submissions are subject to rigorous review by the Editorial Board or other referees. Manuscripts of accepted articles are expected to adhere to the guidelines. Final publication decision rests exclusively with the editors.

MASSACHUSETTS BENCHMARKS

winter 2001/2002

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This and past issues of *Massachusetts Benchmarks*, along with information about the Benchmarks Project, can be found on the Web at www.massbenchmarks.org.

President's Letter

The National Bureau of Economic Research recently confirmed what the authors of *Benchmarks* and other observers of the national and the Massachusetts economies have suspected for some time: We are in a recession.

The human costs and public policy consequences of this state of affairs are serious. Increasing numbers of Massachusetts families are facing layoffs, and our state government has had to cope with decreasing revenues.

Yet, even as we face these relatively short-term challenges, we must think ahead to the season of recovery. As public- and private-enterprise leaders, we must ensure that Massachusetts is strongly positioned to take advantage of all opportunities that will inevitably present themselves. This issue of *Massachusetts Benchmarks* highlights one of the Commonwealth's key innovative industries and reminds us that among our major long-term challenges is the retention of a highly skilled labor force.

In Economic Currents, UMass Boston Professor Alan Clayton-Matthews reports that the Massachusetts economy contracted throughout 2001 and forecasts that it will continue to shrink at a gradually diminishing rate through April 2002. While it is difficult to predict exactly what the Commonwealth's economic future holds, there is reason for hope.

In his article on medical devices, Dr. Clayton-Matthews profiles one of the Commonwealth's leading export industries and major employers. As his analysis makes clear, this industry has thrived in Massachusetts, due to the presence of our world-class teaching hospitals and research universities.

Finally, Elizabeth Williams and Youlanda Gibbons remind us that our institutions of higher education offer the best hope for producing talented workers who are committed to living and working in Massachusetts.

We hope you will find this issue both enriching and enlightening.

William M. Bulger
President
University of Massachusetts

EXCERPTS FROM THE BOARD

Is the economy poised to undergo a turnaround, or are we experiencing a pause with more of a downturn to come?

There is a mix of clear and confusing signals in the economic data, for both the state and the nation. What is clear is that we are currently in a recession and have been, in the estimation of the National Bureau of Economic Research, since March. The recession has been disproportionate in its impact, hitting some sectors considerably harder than others. Among the hard-hit sectors are manufacturing and related business services (such as temporary employment agencies), tourism, and transportation.

What is not so clear is where we are at the moment, how much more deeply the state and national economies may fall into recession, and what the timing and pace of the recovery will be. Regarding both the depth and the duration of the recession, the November employment report was sobering, with its significant uptick in the unemployment rate. The recent bankruptcy of Enron Corporation may yet have a wider impact on the economy. It is difficult to see where the recovery will come from, given the global nature of the slowdown.

On the other hand, a number of important economic indicators seem to have reached a plateau. Data measuring demand for computer and electronic products and semiconductors, the state withholding and sales tax base, and various indices measuring the stock market all seem to have leveled off. Lower energy prices are mimicking a tax cut for both businesses and households. Whether this means a recovery is approaching or that the recession has merely paused remains to be seen.

Even with the disruptions following September 11, the story of the recession remains much the same as it was before. That is, manufacturing and related industries have been hit hardest, and consumer spending has continued to buffer the contraction. Of course transportation and tourism have been added to the list of contracting industries since September, and the severity of the downturn has worsened. Still, any optimism about avoiding a more severe recession and the proximity of a recovery depend greatly on whether consumers continue to support the economy through their spending, and whether this spending will increase in the future. A federal economic stimulus package would be salutary but will be partially offset by cutbacks in state and local government expenditures. We will know much more about how the consumer is doing when the data from the holiday season are available.

When the recovery begins, the prospect is for mild rather than strong growth. A "new mood of caution" in all sectors will moderate any expansion.

Submitted December 11, 2001

Economic currents

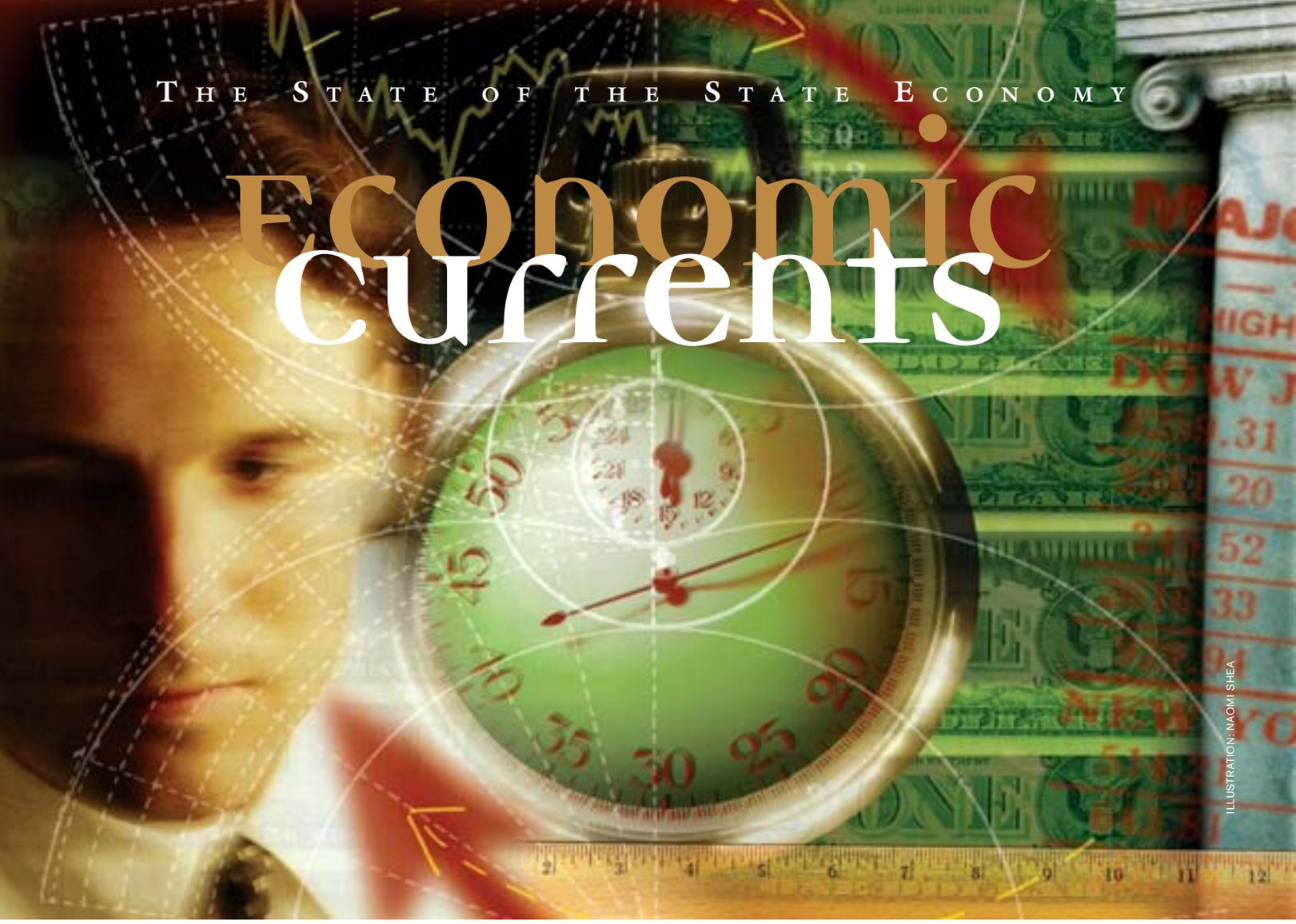


ILLUSTRATION: NAOMI SHEA

It all seems clear in hindsight: The national recession began last March and the state recession in December 2000. The difference in timing reflects the importance of technology production and the stock market to the Massachusetts economy.

ALAN CLAYTON-MATTHEWS

The National Bureau of Economic Research Business Cycle Dating Committee, the widely accepted umpire for the dating of economic turning points, set the turning point of the economy at March 2001, the peak payroll employment level. Real GDP did not decline until later in the third quarter. In Massachusetts, payroll employment peaked in June, later than in the United States as a whole. Even though employment peaked later in the state than in the nation, the recession began earlier, according to several other state-level indicators.

The three other components of the Massachusetts Current Economic Index, a proxy for real Massachusetts Gross State Product, peaked earlier. The unemployment rate reached its nadir of 2.3 percent in December 2000; the real withholding tax base peaked in September 2000, and the real sales tax base peaked in July 2000. The overall current index, a composite of these four indicators, peaked in December 2000. Furthermore, the Massachusetts Leading Economic Index first turned negative in November 2000 and remained negative for 10 of the next 12 months.

The state economy is still contracting, with sharp increases in layoffs, falling tax revenues, declining exports, and continuing declines in manufacturing production. So far, however, the recession has been mild. Though there are no clear signs that the bottom has been reached, there are several signs that the pace of contraction is slowing.

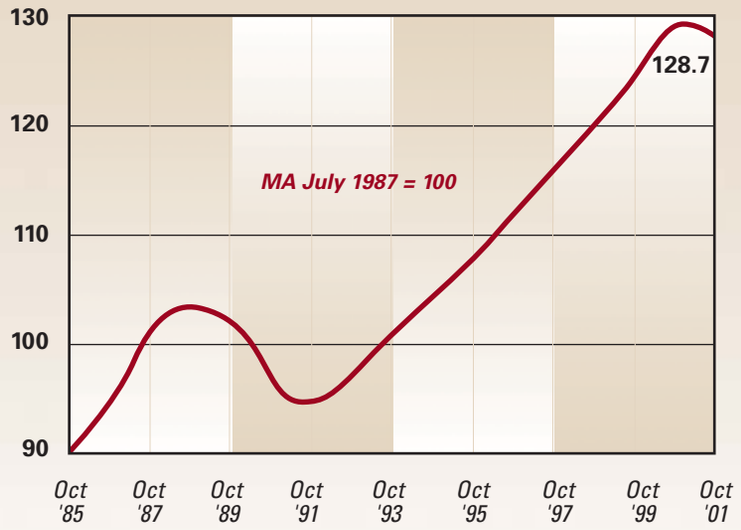
The Current and Leading Economic Indices for Massachusetts

The Massachusetts Current Economic Index for October was 128.7, down 1.1 percent from September (at annual rates), and down 0.7 percent from October of last year. The current index is normalized to 100 in July 1987, and is calibrated to grow at the same rate as the Massachusetts real gross state product over the 1978–1997 period.

The Massachusetts Leading Economic Index for October was -0.2 percent (negative 0.2 percent), and the three-month average for August through October was -0.6 percent (negative 0.6 percent). The leading index is a forecast of the growth in the current index over the next six months, expressed at an annual rate.

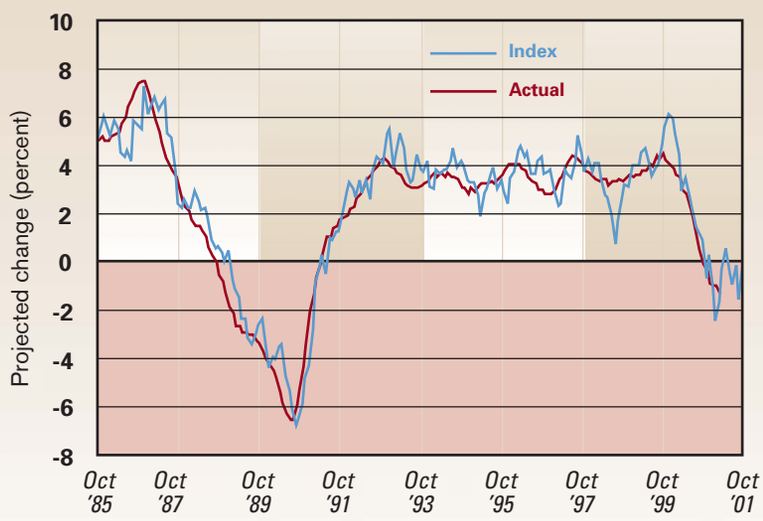
The negative shocks of the national and worldwide decline in investment spending for technology products, augmented by the economic disruptions related to the September 11 terrorist attacks, have gained momentum. Increased layoffs have deflated consumer confidence and non-automotive consumer spending. Though the economy is now officially in recession, however, some sectors are still holding up well, including residential real estate, hospitals, education, and management and consulting services. Aside from air transportation, related tourism sectors, and increased security costs in general, other impacts of the terrorist attacks on business activity in Massachusetts appear to have been temporary and short-lived. This still leaves the state in the midst of a mild recession—with no turnaround yet in sight—and the prospect that conditions are likely to deteriorate further over the winter and early spring.

Massachusetts Current Economic Index



Massachusetts Leading Economic Index

The leading index is the annualized, six-month projected change in the Massachusetts Current Economic Index.



Sources: The Conference Board; University of Massachusetts; Federal Reserve Bank of Boston

So Far, a Mild Recession Overall...

The NBER defines a recession as a general decline in business activity. In order for an episode to be classified as a recession, the decline must be diffuse (spread across many sectors), deep, and of significant duration. By these standards, the recession in Massachusetts has been mild so far. It has been concentrated primarily in manufacturing, related business services, wholesale trade, and transportation, but employment declines have spread to retail trade in the past several months. Construction and mutual funds, once rapid employment growth sectors, have essentially stopped hiring.

Outside of business services, employment in the large service sector continues to expand. Hospitals, private and public education, social services, and engineering and management services have all continued to increase employment near or above their average annual rates in the 1990s expansion. Commercial real estate is reeling with reduced rents and sharply higher vacancy rates, but residential real estate, aided by low mortgage rates, is still strong except at the very high end.

Because the recession has bypassed some major employment sectors, in the aggregate, it has not been deep. The unemployment rate is 4.2 percent, a level that until the last couple of years would have been considered full employment. According to the Current Economic Index, the Massachusetts economy has contracted at an annual rate of 1 percent since the peak in December 2000. The prospect, according to the Massachusetts Leading Economic Index, is for the rate of contraction to remain mild, and even decelerate. This mitigation of the rate of contraction is based on expansionary monetary policy, an improvement in stock market conditions, and some signs that consumers are willing to spend, as evidenced by strong automobile sales.

Duration, the third characteristic, is the big unknown. The Massachusetts Leading Economic Index is forecasting that the state's real gross state product will be lower in April 2002 than it was in October 2001. (The index's forecast horizon is sixth months.) This does not preclude a trough being reached in late winter or early spring, and it is consistent with the recession lasting throughout 2002.

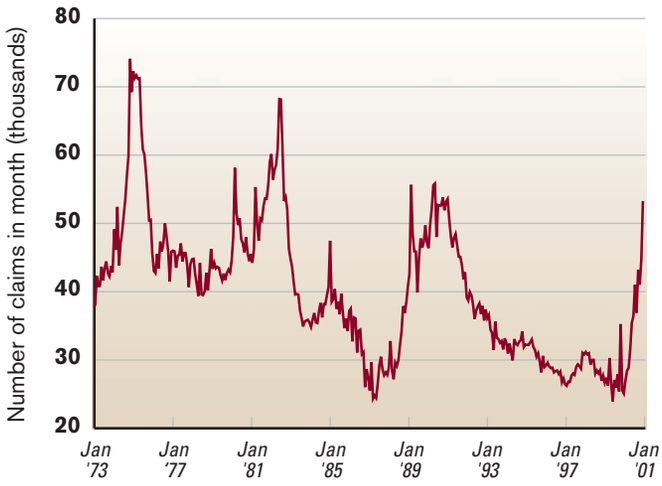
Some Sectors Have Been Hit Hard

This has been primarily a broad-based manufacturing recession. According to the payroll employment survey, Massachusetts lost 17,200 manufacturing jobs (3.9 percent) between December 2000 and October 2001 and an additional 9,000 jobs (3.1 percent) in business services, primarily in temporary and contract employment related to the production of technology products. Initial unemployment claims have soared in recent months, as a wave of earlier layoff announcements were realized. In the most recent month available, October, seasonally adjusted state initial claims topped 53,000, twice the level that prevailed at the beginning of the year. This nearly matches the peak month of initial claims in the last recession: 56,000.

Lost jobs in manufacturing and supporting services are those that generally pay much better than average. Laid-off workers are now finding it difficult to get new jobs, raising the risk that the losses will have a multiplier effect in reducing employment in other sectors, as these households cut back on spending.

As bad as the manufacturing decline has been in Massachusetts, it is not as severe as in the United States as a whole, if state payroll figures are accurate. Sector by sector, almost without exception, job losses have been proportionately smaller here than across the nation. For example, in electronic and electrical equipment, the state's largest manufacturing sector, 4.8 percent of jobs were lost in the year ending in October versus 11.2 percent nationally. In industrial machinery and equipment, our second-largest sector, Massachusetts lost 2.4 percent of jobs in the year ending in October versus 8.7 percent nationally. In manufacturing as

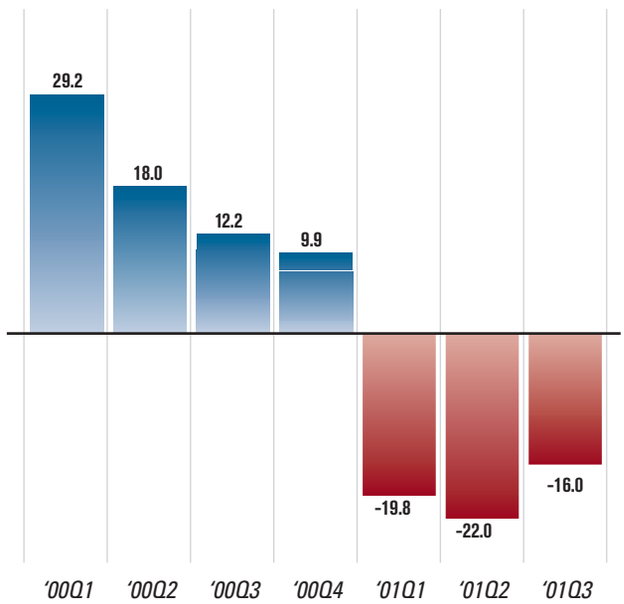
Initial Unemployment Claims, Massachusetts



Source: MA Division of Employment and Training

U.S. Investment in Information-Processing Equipment and Software

Data show nominal growth from prior quarter at an annualized percentage rate.



Sources: U.S. Bureau of Economic Analysis; NIPA accounts

a whole, 3.7 percent of jobs were lost in Massachusetts versus 5.9 percent in the United States. We do not know why Massachusetts has fared proportionately better. Indeed, an analysis of recent wage and salary trends suggests that the payroll survey may be undercounting state job losses, at least in the third quarter of 2001.

Massachusetts merchandise exports, dominated by the state's technology products, have plummeted during this recession. From their peak in November of 2000, the current dollar value of exports has fallen 30 percent to about the level that prevailed in 1998. The decline in U.S. merchandise exports, in contrast, has been only about half as severe.

Technology Production May Be Near the Bottom

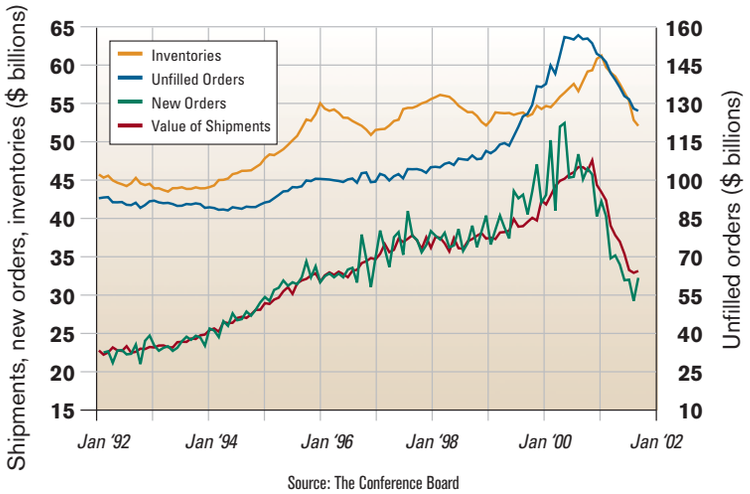
Employment and, for most products, production, has continued to decline. In the United States, investment spending (in nominal dollars) for information-processing equipment and software in the third quarter fell at an annual rate of 16 percent for the third consecutive quarter of double-digit declines.

Product markets for many technology goods may be at or near the bottom, a welcome development for Massachusetts companies. Much of the news for October is even positive. According to the Census Bureau's survey of manufacturing, new orders for computer and electronic products from plants in the United States was up in October to the highest level since June.

Except for a dip in September, the level of new orders has been stable after plummeting almost continuously for a year. The value of shipments in this industry actually rose for the first time since December 2000. Though shipments still exceed new orders, their levels are very close, and the backlog of unfilled orders could be large enough to sustain the volume of shipments if orders continue to improve. Inventories in this industry have fallen steadily and rapidly for the last eight months but are still high as a proportion of sales.

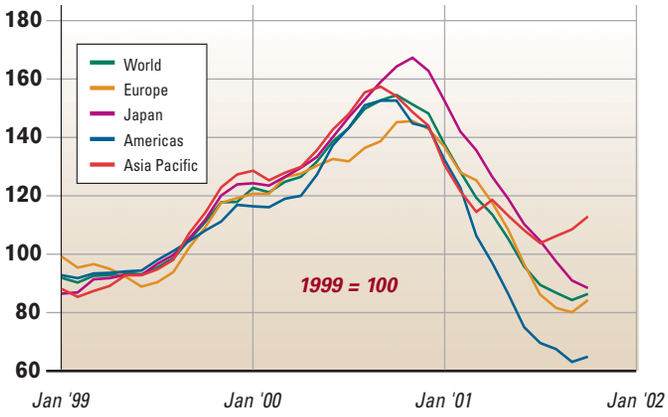
The semiconductor chip industry may have begun a turnaround in October. According to the Semiconductor Industry Association's survey, the dollar value of worldwide sales of computer chips— semiconductor billings—rose in October.

Computer and Electronic Products
United States



Source: The Conference Board

Semiconductor Billings
Sales of Computer Chips
3-month moving average



Source: Semiconductor Industry

This indicator is a three-month moving average, so the increase does not simply represent a rebound from September. All market areas were up except for Japan. The SIA reports an increase in demand for personal computers, cell phones, related communications products, and other consumer devices. They projected a turnaround and slow recovery for semiconductors beginning in the fourth quarter of 2001.

The recovery in the semiconductor equipment industry, another important sector for Massachusetts, will lag that in semiconductor chips. The latter industry has to expand first, before demand for chip-making machines returns. Excess capacity is a problem. Shipments fell 64 percent over the 12 months ending in October. The bottom may be near, though. The fall in orders for new equipment—bookings—appears to have hit bottom last April. If the semiconductor chip industry has actually begun its turnaround, demand for equipment should pick up, and the semiconductor equipment industry could be growing again in the first or second quarter of 2002.

The Role of Bonuses and Stock Options in Recent Wage Trends

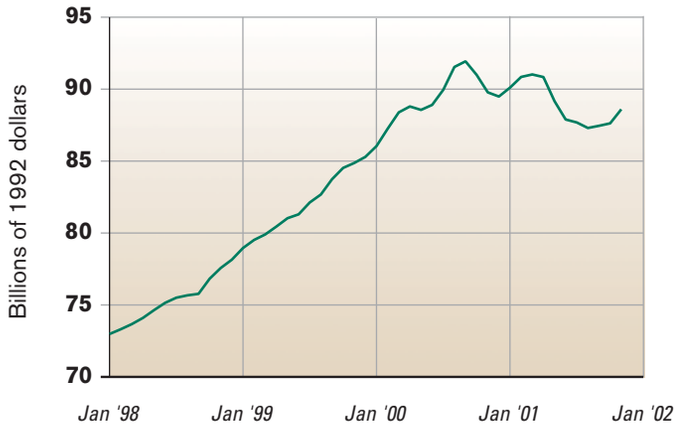
One distinguishing characteristic of the end of the Massachusetts expansion is the role played by bonuses and stock options in aggregate wage and salary income. These so-called lump-sum payments are counted as labor income in the reports that virtually all employers file with the Division of Employment and Training. They are also reflected in withholding taxes paid to the Department of Revenue. Understanding the magnitude and timing of these lump-sum payments is key to understanding why the tax-based indicators—and tax revenues—began to decline well before employment did. The real withholding tax base peaked in September 2000, and the real sales tax base peaked in July 2000. In contrast, payroll employment peaked in June 2001.

It is important to note that the figures presented here are estimates—lump-sum payments are not directly observed.[1] Furthermore, these estimates, based on state withholding taxes adjusted for changes in tax rates and base, probably understate their magnitude: they are derived from

observing the deviation of quarterly wages and salaries from an underlying trend of regular and usual wage and salary payments. That portion of lump-sum payments that, in the aggregate, are received each quarter get "lost" in the overall trend. Nevertheless, the pattern of boom-and-bust in 2000 and 2001 is revealed. The quarterly data reveal that lump-sum payments are concentrated in the fourth and first quarters of the year, so it makes sense to define an annual "bonus season" accordingly.

Some portion of these deviations is due to seasonal or irregular deviations in employment, so these are netted out. (Typically, employment is above trend in the fourth quarter, as trade employment gears up for the holiday shopping season, and is below trend in the first quarter, a slow season for construction.) Counting the remaining deviations as lump-sum payments shows that they began to accelerate in the 1999 season. In this season, comprising the fourth quarter of 1998 and first quarter of 1999, such payments totaled $6.5 billion, significantly higher than the levels of $5.3 billion in the 1998 season and $5.8 billion in 1997. In the 2000 season, lump-sum payments reached $9.8 billion. What is even more significant is that lump-sum payments continued into the second and third quarters of 2000, amounting to an additional $3.1 billion. These probably represent additional realized stock options over and above the usual amount received each quarter.

MA Real Withholding Tax Base



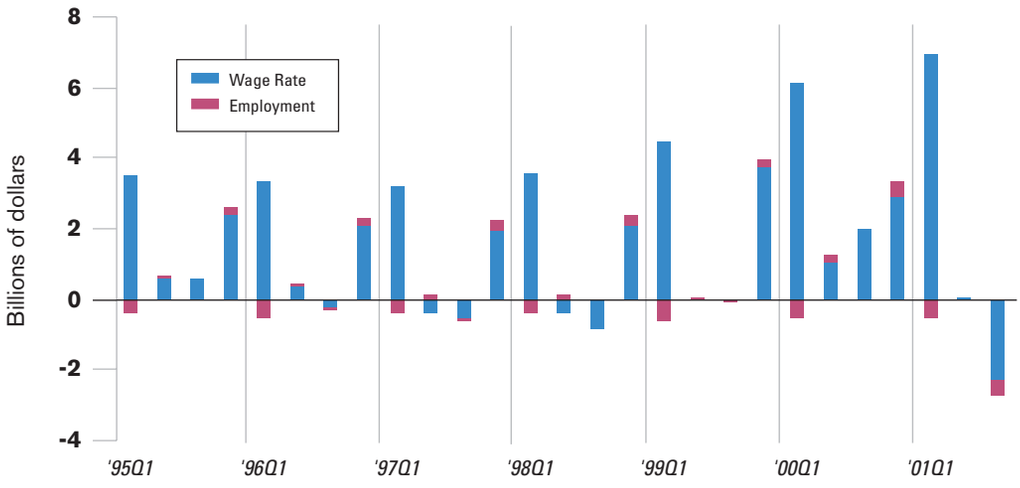
Source: MA Department of Revenue; author's calculations

The NASDAQ stock index peaked in March 2000, and there was probably a rush to "cash in" on these options as the market declined over the remainder of the year. All told, lump-sum payments are estimated to have been $12.9 billion in this four-quarter period. This is substantial, representing 8.6 percent of total wage and salary disbursements paid during this time and an average of $3,900 dollars for each of the state's 3.3 million workers. This is many times the size of last summer's federal income tax rebate of $300 for single filers and $600 for joint filers. (Only a fraction of workers, of course, shared in the $12.9 billion.) These extraordinary receipts of income and withholding tax revenues accounted for the peak of the real withholding tax base in September of 2000.

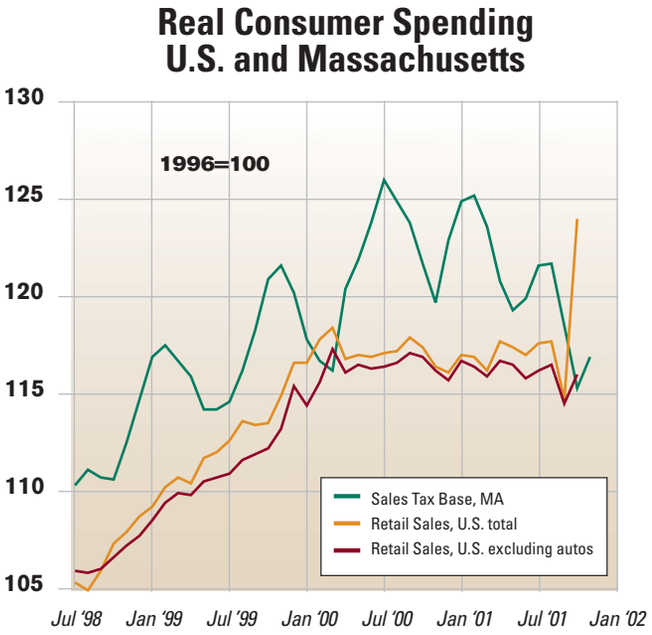
The 2001 bonus season was also quite strong, with lump-sum payments totaling $9.8 billion. However, wage and salary payments in the third quarter of 2001 were $2.4 billion below trend. Accounting for this decline is puzzling. The decline in payroll employment below trend in this quarter accounts for only $400 million, assuming that job-losers earned the average wage. Since employment losses were concentrated in manufacturing, which pays higher-than-average wages, $500 million might be a better estimate for the portion due to employment declines. The remaining discrepancy also does not appear to be due to the September 11 terrorist attacks, as the strongest month of that quarter for withholding taxes was September. The remaining deviation might reflect two things. The first is a reduction in compensation for workers, or a freezing of compensation (the trend rate of compensation grew at an average annual rate of 6.4 percent from 1995 through the third quarter of 2001). The second is an undercount of job losses by the payroll survey. The payroll survey has a tendency to undercount job losses at the beginning of a downturn and to undercount job gains at the beginning of an upturn. The extent of error in the payroll survey will be known several months from now when the census of employer wage reports for this period becomes available.

The end-of-2001 bonus season was almost certainly much leaner than in recent years, due to declines in the two main sources of bonuses and stock options: business profits and the stock market. For example, profits in the equity funds at Fidelity derive from management fees that are a fixed percentage of assets under management. Changes in the volume of assets under management are directly proportional to both stock prices and net inflows. On net, as-

Deviation of Total Wages and Salaries from Trend, by Source



Sources: MA Department of Revenue; Division of Employment and Training; author's calculations



Sources: U.S. Census Bureau; MA Department of Revenue; author's calculations

sets have declined substantially. An analysis in the *Boston Globe* on September 30, 2001, estimated on information through August, suggested that revenues from management fees for stock and bond funds could decline by $1 billion for the year at Fidelity alone, which would have directly decreased bonuses at year's end.

These patterns in aggregate wages and salaries inclusive of lump-sum payments are helpful in explaining recent trends in consumption as proxied by state sales tax revenues and the real sales tax base, as well as differences in the patterns of consumer spending between the state and nation. In the United States, real retail sales (exclusive of automobiles) stopped growing in March of 2000.

The peak in Massachusetts appears to have come later, in July 2000, just a few months after the peak of NASDAQ and the huge bonus season of 1999–2000. The importance of these lump-sum payments in Massachusetts also may explain why consumer spending in the state grew faster than nationally in the late 1990s. Since these peaks in consumer spending in 2000, real U.S. retail sales have remained essentially flat, while they declined in Massachusetts. This is consistent with declining lump-sum payments, wages and salaries, and the poor prospects for the 2002 bonus season. That the peak in Massachusetts consumer spending preceded that of wages and salaries also makes sense if the peak in the latter was due to a "cashing in" of stock options in anticipation of further declines in stock markets.

Will Growth Return in the Spring?

Because the signals of continuing weakness and nascent recovery are mixed, it is difficult to predict when the recession will end and the recovery will begin. The economy seems to be teetering on the brink of bottoming out or falling to new lows. Consumer spending will determine which way the balance tips. If the wave of layoffs in manufacturing and related sectors is near the end, then households' balance sheets may remain in good enough shape to keep consumer spending from ratcheting down.

Another factor in consumer confidence and spending is the progress in the war on terrorism. So far, things appear to be going well. Despite this, the Conference Board's consumer confidence index for the United States was down in November; for New England, it was down sharply. If this downturn reflects the effect of job losses rather than news (which improved on the whole after the survey was taken), then the recession could lengthen.

Outside of the concern with employment and its effect on consumer spending, there is much to be optimistic about. Aggressive monetary policy by the Fed and an expected fiscal stimulus from the federal government are having positive impacts on financial markets, business outlooks, and residential real estate markets. Stock markets have rebounded from their lows since September 11 and have recovered to their August levels. A wave of refinancing made possible by low mortgage rates has improved households' financial positions. Falling oil and energy prices are also easing burdens on pocketbooks and ledgers. Finally, the markets for some key technology products appear to be close to turning around.

A recent forecast by the New England Economic Project projects that the recession in Massachusetts will end in the second quarter of 2002 and the number of jobs will begin increasing again in the third quarter. At the time the forecast was released, it was easy to imagine how conditions could turn out to be worse than those on which the forecast was based, and difficult to see how they could be better. As of this writing, the negative risks appear to have abated significantly, except for the continuing uncertainties about consumer spending. After the holiday shopping season and the bonus season are accounted for, these uncertainties should be largely resolved.

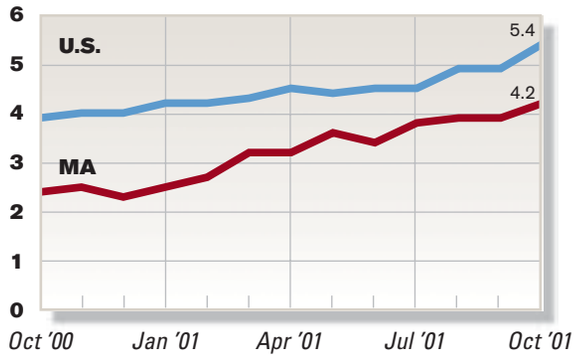
Submitted December 6, 2001

1 A quarterly wage and salary series is derived from withholding tax revenues adjusted for rate and base changes, and exemptions. Quarterly payroll employment data are from the monthly payroll survey. Both wages and employment are not seasonally adjusted. The logarithm of each series is regressed on a time trend, a dummy for the fourth quarter, and a dummy for the first quarter. The time period of the analysis is 1995Q1 to 2001Q3. Trends of each are defined as the fitted regression line with the fourth- and first-quarter dummies set to zero. The total deviation of wages and salaries is the difference between the actual estimated wages and salaries and the regression trend. The portion of the total deviation due to the deviation of employment from trend is the employment deviation times the trend value of average wages per worker. The remainder of the deviation is an estimate of lump-sum payments. The trend rate of average wages per worker is the difference between the trend rates of wages and salaries and employment. The annual estimated trend rates of growth are 8.6 percent for wages and salaries, 2.1 percent for employment, and 6.4 percent for wages per worker.

Alan Clayton-Matthews is an assistant professor and the director of quantitative methods in the Public Policy Program at the University of Massachusetts Boston. He is also president of the New England Economic Project.

The Measure of Massachusetts

Unemployment Rates



State Labor Force and Employment

State Income and Prices

	Period	Value	Change from Year Earlier (%)
Labor Force *(household-based)*	10/01	3,369,700	3.3
Employment *(establishment-based)*	10/01	3,229,600	1.5
Manufacturing		420,100	-3.7
Services		1,240,100	1.6
Monthly Initial Unemployment Claims	11/01	51,479	84.3
Income	'01 Q1		
Personal Income ($M)		250,759	6.4
Real Personal Income ($M 1982–84)		142,720	3.0
Boston Consumer Price Index	7/01	192.1	4.9
MA House Price Index	'01 Q2	169.5	14.9
MA New House Permits *(monthly avg.)*	8/00-7/01	1,411.5	-6.5

Regional Employment

	Employment		Unemployment Rate	
	10/01	Change from Year Earlier (%)	10/01	10/00
Central				
Fitchburg-Leominster PMSA	65,967	2.1	5.1	3.0
Worcester, MA-CT PMSA (MA only)	239,639	1.1	4.3	2.3
Cape and Islands				
Barnstable-Yarmouth MSA	74,722	1.9	2.6	2.1
Cape Cod, Vineyard, Nantucket SDA	121,631	1.6	2.6	2.1
Boston Metro				
Boston, MA-NH PMSA (MA only)	799,088	3.0	3.6	1.9
Northeast				
Lowell, MA-NH PMSA (MA only)	166,208	2.0	4.8	2.0
Lawrence, MA-NH PMSA (MA only)	127,813	1.7	6.1	3.1
Southeast				
Brockton PMSA	129,094	1.7	3.9	2.4
New Bedford PMSA	77,777	2.0	5.0	4.1
Providence-Fall River-Warwick, RI-MA MSA (MA only)	113,961	1.3	3.9	2.6
Pioneer Valley				
Greenfield LMA	32,880	1.3	2.5	1.9
Springfield MSA	278,439	2.6	3.5	2.5
Berkshire				
North Adams LMA	12,474	1.5	3.0	2.5
Pittsfield MSA	37,824	1.7	3.3	2.7

The University of Massachusetts Economic Benchmarks

	Oct. '01	Oct. '00
Current Economic Index	128.7	129.5
Leading Economic Index	-0.2%	0.9%

The Massachusetts Current Economic Index for October was 128.7, down 1.1 percent from September (at annual rates) and down 0.7 percent from October of last year. The current index is normalized to 100 in July 1987 and calibrated to grow at the same rate as the real gross state product over the 1978-1997 period.

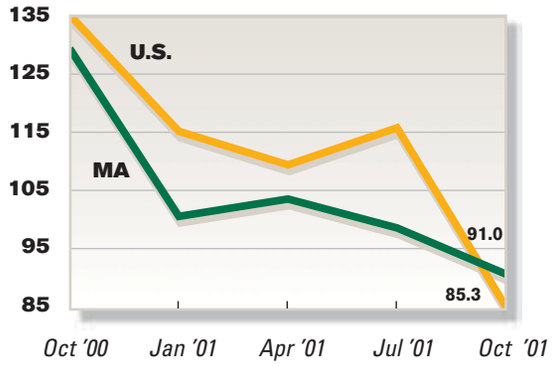
The Massachusetts Leading Economic Index for October was -0.2 percent, and the three-month average for September through October was -0.6 percent. The leading index is a forecast of the growth in the current index over the next six months, expressed at an annual rate. Thus, it indicates that the economy is expected to contract at an annual rate of 0.2 percent over the next six months.

Although the economy is now officially in recession, some sectors are still holding up well, including residential real estate, hospitals, education, and management and consulting services.

Consumer Confidence U.S. and Massachusetts

QUARTERLY DATA

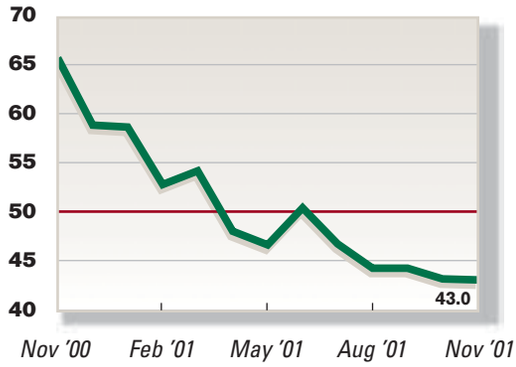
The trends rather than the levels of these indices should be compared, due to different base points.



Business Confidence in Massachusetts

MONTHLY DATA

Employers have generally positive views on current and prospective business conditions when the index is above 50.

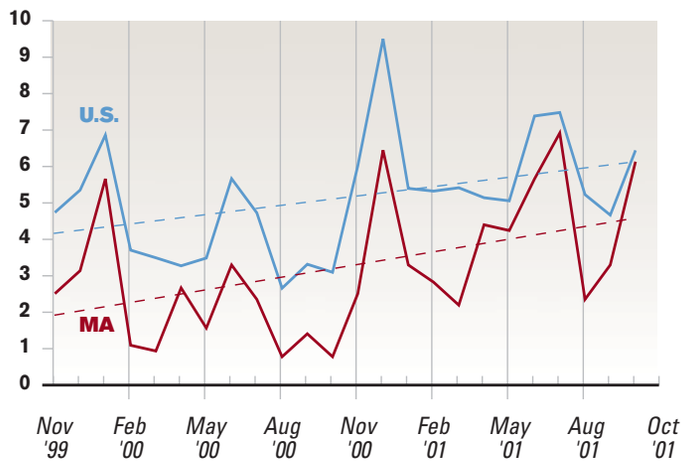


Mass Layoff Events, Massachusetts

Monthly mass layoff events are layoffs involving establishments that have at least 50 initial claims for unemployment insurance filed against them during a five-week period. The two sets of data have been normalized by population to allow comparison between the state and national numbers. The trend level of mass layoffs in Massachusetts has been lower than for the nation as a whole. In the current recession, Massachusetts has been hit harder than the nation as a whole, with an average 256 percent increase in layoffs over the same period in 2000 in comparison to an average increase of 151 percent for the nation. It is also clear that there is a seasonal aspect to layoffs with peak months in December/January, July, and October.

Sources: U.S. Bureau of Labor Statistics; U.S. Census Bureau

Mass Layoffs per Million Population for Nov. 1999 to Oct. 2001



Sources: Associated Industries of Massachusetts; The Conference Board; Mass Insight/New England Economic Project; Fannie Mae and Freddie Mac; Massachusetts Division of Employment and Training; U.S. Department of Commerce; U.S. Bureau of Economic Analysis; U.S. Bureau of Labor Statistics; University of Massachusetts

ILLUSTRATION: NAOMI SHEA

Medical Devices

A Stronghold of the Commonwealth's Economy

Alan Clayton-Matthews

We benefit from medical devices throughout our lives: Prenatal development is monitored by ultrasound devices, sports injuries are diagnosed with magnetic resonance imaging and fixed with arthroscopic tools, and heart blockages are cleared with angioplasties and drug-coated stents. Devices include the simple and mundane—eyeglasses and thermometers—and stretch to the boundaries of technology—laser scalpels, needles embedded with microprocessors, MRI machines, and artificial hearts. All are products of the medical device industry. Massachusetts is one of the nation's leading states in medical device development and production.

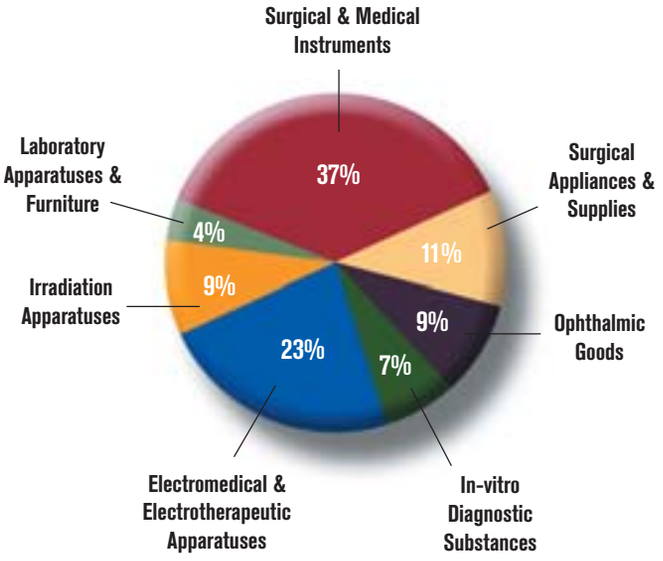
Medical devices have drastically reduced the invasiveness of surgical procedures, shortened recovery times, and lowered medical costs. This trend is continuing at a rapid pace, aided by advances in electronics and biotechnology. To aid diabetics, for example, internal pumps under development will monitor and deliver insulin; they are the closest thing yet to an artificial pancreas. Medical devices and biotechnology developments are becoming increasingly complementary over time, as devices of increasing sophistication and miniaturization are used to deliver new pharmaceutical and biotechnological products. In the future, "nano" may be used to deliver biological agents directly to cancer cells.

The field of medical devices is the larger part of a medical science sector that supports the health services sector. According to statistics from the 1997 Economic Census,[1] the medical science sector in Massachusetts was composed of three industry groups:

- the medical device industry, which consisted of 264 manufacturing establishments with 20,756 employees, a payroll of $989 million, and shipments of $4.0 billion;
- pharmaceuticals, which consisted of 57 manufacturing establishments with 5,612 employees, a payroll of $270 million, and shipments of $1.8 billion; and
- biotechnology, which consisted of 282 research establishments with 9,311 employees, a payroll of $589 million, and shipments of $1.5 billion.

Altogether, the Commonwealth's medical science sector consisted of 603 establishments with 35,679 workers, a payroll of over $1.8 billion, and shipments of $7.3 billion. This sector is therefore larger than several key high-technology sectors, including computers and office equipment, and electronic components, which had employment levels of 25,600 and 31,000, respectively.

Medical Devices Employment in Massachusetts, 1997



Source: U.S. Bureau of the Census, 1997 Economic Census

Massachusetts Medical Devices in a National Context

Using four measures of economic size and impact from the 1997 Economic Census—value of shipments, employment, payroll, and value added (labor plus overhead)—expressed in both absolute size and per capita terms, Minnesota and Massachusetts lead the nation in the production of medical devices. Though Massachusetts does not rank first on any of the eight criteria, it ranks high on all.

In terms of population and overall economic activity, California, Illinois, New York, and Florida are far larger than either Massachusetts or Minnesota, so their higher rankings on measures of absolute size do not indicate a higher concentration of medical device manufacturing. To rank states in terms of concentration of medical device activity, per capita comparisons are appropriate.

One way to combine these ranking criteria into a single comparison measure is to assign a rank score to each and form states' total scores as the sum of their rank scores on each category.[2] Using this simple scheme, Minnesota and Massachusetts rank first and second, respectively, on the four per capita measures and tie for third on the four absolute size criteria.

Rankings of Top Five Medical Device States by Production Characteristic

Absolute Size					Per Capita			
Value of Shipments	Employment	Payroll	Value Added	RANK	Value of Shipments	Employment	Payroll	Value Added
CA	CA	CA	CA	1	MN	MN	MN	MN
IL	IL	IL	IL	2	CT	UT	**MA**	CT
MA	NY	**MA**	MN	3	**MA**	**MA**	UT	**MA**
MN	MN	MN	**MA**	4	UT	CT	IL	UT
FL	**MA**	NY	FL	5	NE	IL	CT	NE

Sources: U.S. Bureau of the Census, 1997 Economic Census

Combining all eight criteria, Massachusetts ranks second behind Minnesota and ahead of California, Illinois, Connecticut, and Utah. The thrust of these rankings is confirmed by conversations with industry executives in the Commonwealth. Minnesota and Massachusetts have similar agglomeration economies, with a favorable mix of higher education, as well as medical and high-tech industries.

Why be concerned about how Massachusetts ranks in measures of medical device production relative to other states? The one-word answer is "exports." Over half the output of the Commonwealth's medical device industry is exported to other states or countries.[3] Because revenues from exports are ultimately received by Massachusetts workers and suppliers of capital to the state's medical device companies, industries that export support the state economy's health and growth. Given the agglomeration economies that are favorable to production of medical devices—that is, the state's concentration in higher education, teaching hospitals, precision production, and electronics—Massachusetts would be expected to rank high on measures of relative production volume, and it does.

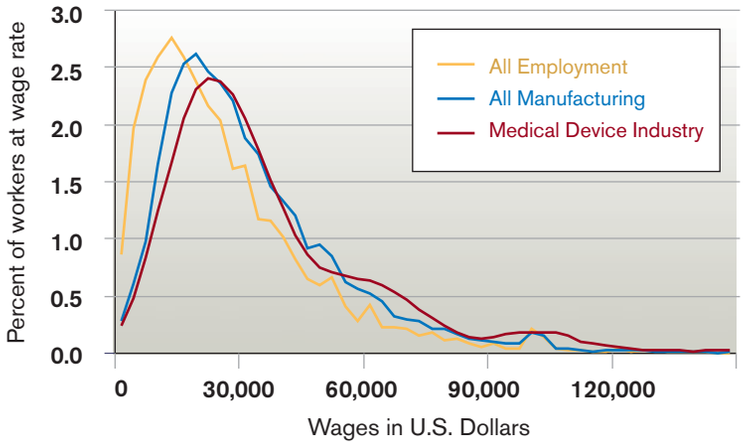
Basic Characteristics of the Massachusetts and U.S. Medical Device Industry

Number and size of establishments. According to the 1997 Economic Census, there were 264 manufacturing establishments in the state's medical device industry. These companies employed 20,800 workers, or 3.39 of every thousand residents. Nationally, there were 335,800 employees in 1997, or 1.26 per thousand residents. The industry is thus 2.7 times as concentrated in Massachusetts as in the nation overall. The value of shipments from the state's manufacturing facilities totaled $4.0 billion, with a payroll in 1997 of $1.0 billion.

Aggregate sales are dominated by a handful of large companies. In a 2000 *Boston Business Journal* survey of the largest 25 medical device employers in Massachusetts, 1999 sales ranged from $2.8 billion for Boston Scientific Corporation, the largest company, to $2.5 million for UroMed Corporation, the 24th-ranked company in terms of sales.

As of 1998, there were just over two dozen Massachusetts-headquartered, publicly held medical companies, with $3.2 billion in sales. Though the vast majority of companies are privately held and small by comparison (approximately half these manufacturing establishments were small, employing fewer than 20 employees), they are critically important to the vitality and technological advancement of this industry. One indicator is the scale of venture capital funding, which is targeted to small start-ups. Over the four quarters ending in the third quarter of 2000, venture capital funding received by the state's medical device firms totaled $314 million.[4] To illustrate its magnitude, this investment is roughly equal to the total research and development spending of the 26 Massachusetts-headquartered, publicly held medical device companies in 1997 and is nearly twice the amount spent in 1997 on capital expenditures for all medical device manufacturing establishments in the state.

U.S. Annual Wage Distribution for All Employment, All Manufacturing, and Medical Device Industry

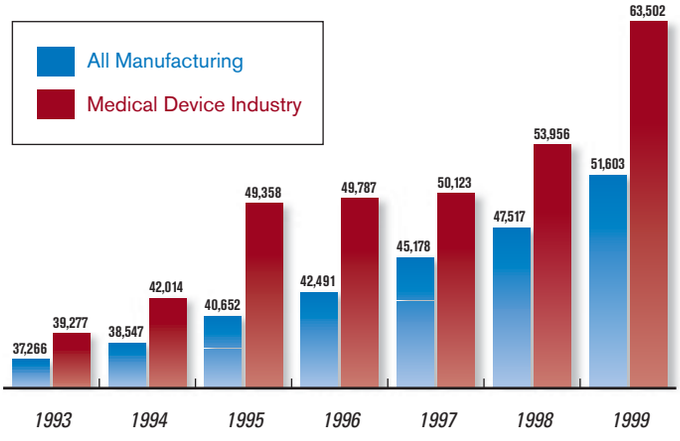


Source: U.S. Bureau of the Census, Current Population Survey 1994-1998

Industrial composition. In Massachusetts, surgical and medical instruments is the largest industry in the medical device sector, with 37 percent of medical device employment. The next largest, with 23 percent of employment, is electromedical and electrotherapeutic apparatuses. In contrast, these two industries comprise 31 percent and 16 percent of national medical device employment, respectively. The relative concentration of these two industries in Massachusetts reflects the state's comparative specialization in precision specialty production and electronics.

The distribution of employment in Massachusetts among the other medical device industries is 11 percent in surgical appliances and supplies, 9 percent in irradiation

Massachusetts Annual Wages in Medical Devices and Manufacturing



Source: Massachusetts Division of Employment and Training, ES-202

apparatuses, 9 percent in ophthalmic goods, 7 percent in in-vitro diagnostic substances, and 4 percent in laboratory apparatuses and furniture. Relative to the nation as a whole, Massachusetts has a higher proportion of its employment in irradiation apparatuses and a lower proportion in surgical appliances and supplies and in-vitro diagnostic substances.

Employment wages, salaries, and benefits. Not surprisingly, wages and salaries in medical devices are higher than in manufacturing and in the economy as a whole. Median annual wages of medical device workers were $30,000 during 1994–1998, according to the CPS, versus $28,000 in manufacturing and $21,243 for all workers.[5]

Even though manufacturing workers on the whole have a lower level of education than all workers, they are generally paid better, which is true at every level of educational attainment. For college-educated medical device workers, this premium is even greater. A medical device worker with an associate's degree earned an average annual salary of $41,145 in 1994–1998, versus $36,916 in all manufacturing and $30,470 in all jobs. A medical device worker with a bachelor's degree earned, on average, $66,292 per year versus $54,012 in all manufacturing and $44,307 in all jobs; a medical device worker with a professional or graduate degree earned an average of $85,101 per year versus $77,477 in all manufacturing and $70,704 in all jobs. These premiums probably reflect the value of specific job training for those with a high school education or less and higher market valuations for degrees related to medical device research and development for those with a college education. One in 20 medical device workers earned more than $100,000 annually in the1994–1998 period.

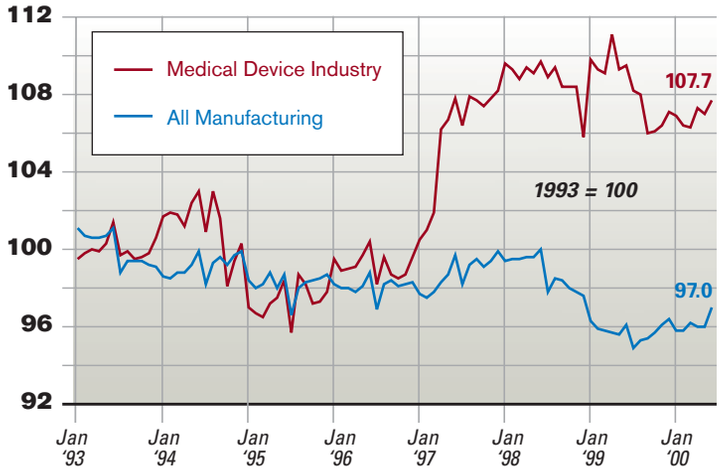
Current and Future Trends

The Commonwealth's medical device industry is expanding rapidly. Employment, wages, productivity, and foreign exports have grown faster than the state's manufacturing sector as a whole, and medical device wages and foreign exports have been growing faster in Massachusetts than in the nation.

Employment. Since 1993, medical device employment in Massachusetts has been up and down, but with an upward trend.[6] In 1993 and 1994, there were about 16,000 jobs in the medical device industry. During the national and regional slowdown in 1995, employment declined to 15,500. In 1997, it rose sharply and has since been in the 17,000 to 17,500 range. The strength of the industry is apparent when compared with overall trends in Massachusetts manufacturing employment. In 1997, aggregate manufacturing employment rose, but it didn't keep up with medical instruments.

Between January 1997 and June 1998, the date of the most recent peak in statewide manufacturing employment, total manufacturing jobs expanded by 2.4 percent, whereas

Massachusetts Employment Indices



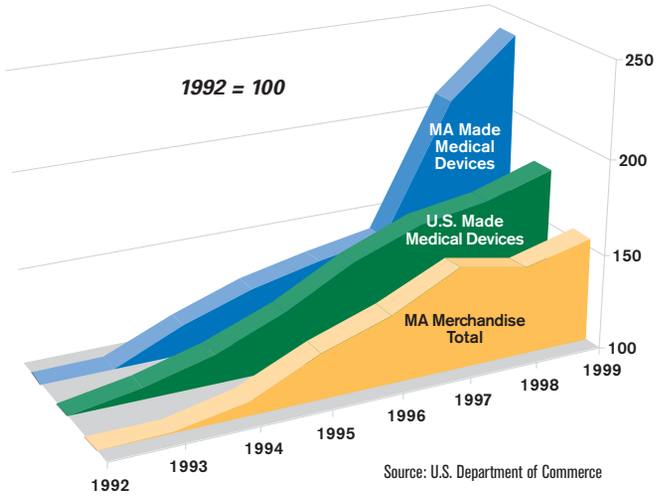
Source: Massachusetts Division of Employment and Training, ES-202

medical device jobs increased 9.1 percent. Then the effects of the Asian financial crisis were felt. Statewide manufacturing employment fell sharply through June 1999 and has remained roughly level since then. In June 2000, overall manufacturing employment was 2.9 percent below its June 1998 peak. The fall in medical device employment, however, was less severe. As of June 2000, employment was only 1.8 percent lower than in June 1998.

Medical device employment trends in Massachusetts and in the United States were similar from 1997 to 1999. Annual average employment grew by 2.6 percent in Massachusetts and by 3.0 percent in the nation as a whole.

Exports. In Massachusetts, the growth in medical device exports to foreign countries has been rapid. Europe has been the chief destination of exports, with demand driven by high incomes relative to most of the rest of the world, but growth in East Asia is accelerating from a much smaller per capita base. As incomes rise in East Asia in the long run, the market should expand dramatically.

Exports to Foreign Countries Indices of Growth



Source: U.S. Department of Commerce

Venture capital. By financing the development of new technologies in start-up firms, venture capital funding plays a crucial role in the growth of the medical device industry. In the four-quarter period ending in September 2000, Massachusetts firms received a total of $314 million in venture capital financing.[7]

The medical device sector competes with other technology-related sectors for venture capital funding, principally information technology (IT) and biotechnology. The total supply of venture capital funds depends in part on investors' perceptions of the likelihood of successful "liquidity events," such as initial public offerings (IPOs) or acquisitions in which investors recoup their initial outlay plus a substantial profit.

Nationally, the medical device industry received 2.3 percent of all venture capital funding in the four-quarter period ending in September 2000. The share of all venture capital funds going to medical device companies is roughly equivalent to that received by biotechnology firms, but well below that received by firms in the IT sector. The relative unattractiveness of medical device companies compared with IT is largely due to the longer time to a liquidity event, especially an IPO outcome; FDA approval to market a device, and Health Care and Financing Administration (HCFA) reimbursement approval needed to make the device profitable are time-consuming processes. The medical device industry compares favorably with biotechnology on this score, especially if a device can be registered with the FDA as a 510(k) device, which can usually be brought to market quickly, without the need for clinical trials.

Massachusetts receives roughly 10 percent of the total supply of venture capital funds for medical devices in the United States, though the amount can vary markedly in the short run. For the four-quarter period ending in September 2000, the state received 19.5 percent of all U.S. venture capital funding for medical devices. That figure is inflated by the remarkably successful first quarter of 2000, when Massachusetts medical device companies received $163.3 million, nearly half of the U.S. total. In the next two quarters, Massachusetts companies received $30.9 million and $46.2 million, representing 9.2 percent and 8.7 percent of the U.S. total.

In the amount of venture capital funding it receives, how does Massachusetts fare relative to other areas? In terms of the share of national venture capital financing, the state does well. Its share of national venture capital funding for medical devices (roughly 10 percent) exceeds what would be expected, based on medical device industry measures, such as the share of national shipments, value added, or employment of 6 to 7 percent. On the other hand, venture capital funding is concentrated in a handful of regions, including Silicon Valley, New England, San Diego, the Midwest, and the Southeast. Though New England and Massachusetts typically rank second or third, Massachusetts falls far behind Silicon Valley in the share of funds it receives.

The competition for venture capital funds is, in part, affected by the size and risk of the expected return. By their nature, venture capital investments are risky. The expectation is that many—if not most—ventures will fail to be profitable, but those that are will compensate. Relative to biotechnology, medical devices are perceived to be less risky, but successes are perceived to be less profitable.

The risk advantage derives from the small probability, in pharmaceuticals, of discovering a safe and effective drug relative to the probability, in medical devices, of developing a safe and effective instrument. On the other hand, the payoff for a successful drug is enormous relative to the payoff for a successful device, because once the drug or device is approved for marketing, the marginal costs of producing a drug are typically very small relative to those of producing a medical device.

Massachusetts public policy should focus on providing quality public education, lowering the cost of living, promoting Massachusetts as a place to do business, and developing an information-sharing liaison with the industry.

The Role of Hospitals and Universities

Teaching hospitals and universities play an arguably more important role in the growth of the medical device sector than venture capital does.[8] More research is done in these institutions than in private industry, often resulting in the licensing of technology to medical device firms and occasionally in the formation of start-up companies or joint ventures with existing companies. Massachusetts hospitals and universities license and form ventures with companies around the world, but roughly 30 percent to 40 percent of the deals are with in-state partners.

Though aggregate figures for the effect on the medical device industry are not available, the order of magnitude can be inferred from a couple of examples. The University of Massachusetts receives approximately $200 million in research money annually, more than half of which goes to the UMass Medical Center. The university's Office of Commercial Ventures and Intellectual Property had license revenues of $12.4 million in FY 2001. Such revenues have been rising at double-digit rates annually since the office was started in 1995. Roughly three-quarters of these revenues are medical related, and more than 10 percent are due directly to medical devices.

Universities attribute the rapid growth in the licensing of sponsored research to the Bayh-Dole Act, passed in the 1980s. This legislation allows universities to own the intellectual property created by faculty and research personnel. Other countries are beginning to emulate this model, an indication of the policy's success in increasing the volume of university-sponsored research.

In another example, Massachusetts General Hospital conducts $250 million in research annually, with a significant portion related to medical device research in lasers, imaging devices, and other radiology applications. Much of this research is performed in the hospital's Center for Minimally Invasive Technologies. Medical device-related licensing revenues are running at about $2 million per year. The role of such research in other teaching hospitals is similar, though the scale is less than at Mass General or Brigham and Women's. These two rank first and second, respectively, in the volume of research performed by Massachusetts hospitals.

Conclusion

Massachusetts medical devices form the largest part of the state's vibrant medical science sector, which also includes pharmaceuticals and biotechnology. Massachusetts is one of the leading states in the production of medical devices, providing good jobs that employ high-paid scientists, engineers, and production workers. Through its economic links with electronics, metal and plastics manufacturers, hospitals, and financial institutions, the medical device sector comprises an important part of the state's high-technology economic base.

The long-term outlook for the sector is one of continued growth, supported by growing worldwide demand for health services, and the state's comparative advantage in the development of new technologies. In order to ensure the future success of the medical device sector—and the state's economy as a whole—Massachusetts public policy should focus on providing quality public education, lowering the cost of living (especially housing costs), promoting Massachusetts as a place to do business, and developing an information-sharing liaison with the industry.

1 Department of Commerce, 2000

2 For each criterion, first place was assigned five points; second four points; and so on through one point for fifth place.

3 According to the Regional Economic Models Inc.'s Massachusetts economic accounts for 1998, exports of the medical device industry (SICs 384 and 385) were estimated to be 1,441 million ($92) and output was estimated to be 2,784 million ($92), for an export-to-output ratio of .5176. Here, exports refer to sales to the rest of the United States and the world.

4 PriceWaterhouseCoopers, 2000

5 Annual wages are calculated as follows: For each sample individual, the CPS reports earnings in the prior year from the primary employer (i.e., the employer for whom the individual worked the longest in the prior year), as well as weeks worked last year and number of employers in the prior year. (If the person worked for two or more employers concurrently, only one employer is counted.) For purposes of calculating annual wages, the sample was restricted to those individuals who worked for a single employer in the prior year. Annual earnings were calculated as earnings received from the primary employer divided by weeks worked times 52.

6 The sources of information for this section are the state and national data from the "covered" payroll employment series, ES-202 (Division of Employment and Training, 1993–2001, and the U.S. Bureau of Labor Statistics, 2001). The ES-202 provides a time series of employment and wages from 1993 to 1999 for Massachusetts and from 1997 to 1999 for the United States as a whole for the medical device sector, defined as SICs 384 and 385.

7 The data on venture capital in this section are from quarterly surveys on venture capital investments (PriceWaterhouseCoopers, 2000).

8 The sources of information for this section are interviews with executives from medical device companies or related businesses.

Alan Clayton-Matthews is an assistant professor and the director of quantitative methods in the Public Policy Program at the University of Massachusetts Boston. He is also president of the New England Economic Project.

ILLUSTRATION: NAOMI SHEA

PIONEER VALLEY: Training and Retaining IT Talent

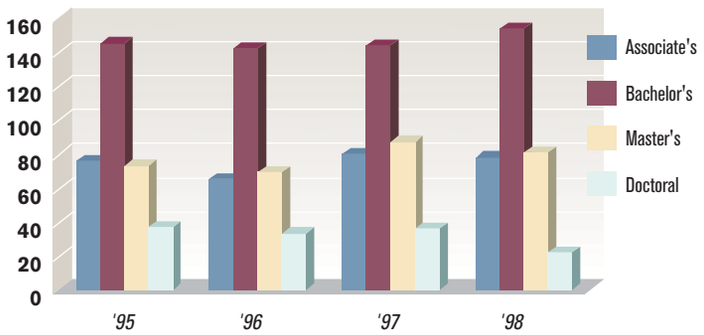
ELIZABETH WILLIAMS AND YOULANDA GIBBONS

Successful growth of the Pioneer Valley's information technology industry hinges, in part, on the availability of skilled workers. Regional planners, industry leaders, and higher education administrators have been looking at ways to tie together the skills and career interests of emerging college graduates with the needs of area business and industry. A coordinated effort could have favorable outcomes for institutions and industry alike.

The high cost of living in Massachusetts has discouraged in-migration. Because of this, it has been suggested that state policy should focus on ways to "grow" our resident population into a more skilled workforce.[1] The success of such a strategy is dependent on a system of education and training that is both effective and well attuned to the needs of business and industry across the Commonwealth.

One of the fastest-growing and most promising sectors of the state economy is the information technology (IT) sector. At the present time, only a fraction of the state's IT jobs are located in the Pioneer Valley: 5.7 percent of computer support specialists, 2 percent of computer programmers, and .7 percent of software engineers are accounted for in the Springfield MSA.[2] A primary goal of the Pioneer Valley Planning Commission's Plan for Progress[3] is to boost the regional economy by encouraging graduates of area educational institutions to seek employment locally. Another key goal is to attract IT firms to the region by providing a skilled workforce.

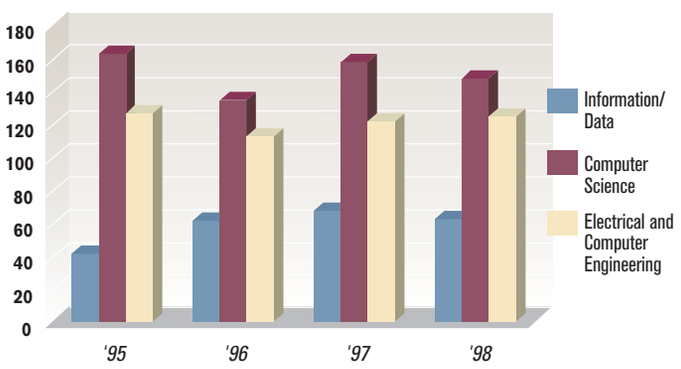
Number of IT Degrees Awarded at Pioneer Valley Institutions



Source: Authors' study

Recognizing the important role of western Massachusetts colleges and the University of Massachusetts as suppliers of a well-trained IT workforce, the Plan for Progress Higher Education and Workforce Development Strategy Teams sought a better understanding of graduating college seniors' employment interests and expectations. The University of Massachusetts responded to this need for information by conducting a survey of graduating IT students in the region's colleges and universities.[4] The teams anticipated that data describing the new IT talent pool would be useful to the region's employers and help attract IT firms considering locating in the Pioneer Valley.[5]

Degrees Awarded at Pioneer Valley Institutions by IT Field



Source: Authors' study

Institutional Offerings in IT-Related Fields

Advocates of the baccalaureate contend that programs leading to IT-related degrees provide the best foundation skills necessary to succeed in the ever-changing world of work: problem-solving, communication skills, and, above all, the ability to acquire knowledge. However, the importance of having a bachelor's degree in computer science, as opposed to any other area, is a subject of debate. Though some companies prefer graduates with computer science degrees, there are successful IT professionals from all disciplines. Of the respondents to the 1998 *InfoWorld* Compensation Survey who indicated they had bachelor's degrees, only 26 percent held degrees in computer science. Other respondents held degrees in business (19 percent) and the humanities (15 percent).[6]

According to the National Center for Education Statistics, the number of students earning bachelor's degrees in computer science declined during the 1990s. In contrast, the number of graduate degrees in this field increased. The Massachusetts Board of Higher Education "Review of Computer and Information Science Technology Programs Report" indicates that over a ten-year period, Massachusetts also experienced a decline in the number of bachelor's degrees in computer science and engineering. The number of graduate degrees in both of these areas continues to rise.

Two-year or associate's degrees in computer information systems, data processing, and computer systems engineering are granted by community colleges whose primary focus is to serve local communities. Four-year bachelor's degrees are granted in computer studies, computer science, and electrical and computer engineering. Master's and doctoral degrees are offered in computer science, management information systems, and electrical and computer engineering.

Business and industry leaders agree that community colleges can adapt more quickly than four-year colleges to meet the needs of business and industry. Though associate's degree programs do teach foundation skills, students with these degrees may sacrifice depth of knowledge for current technical skills, making it easier for them to obtain employment but harder to develop the knowledge and skills needed to reach their ultimate career goals.[7]

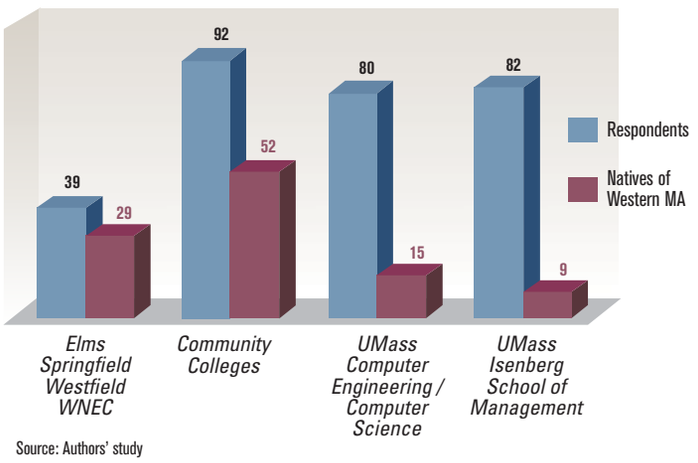
The Emerging IT Talent Pool

Demographics. The IT talent pool emerging from the region' colleges and the University of Massachusetts can be

characterized demographically as disproportionately male and predominantly white. Nearly 40 percent of the IT students scheduled to graduate from western Massachusetts colleges in spring 2000 were natives of the area, whereas approximately one-quarter were natives of eastern Massachusetts and one-tenth were natives of central Massachusetts. The remaining 25 percent were from out of state. Given the locally oriented educational mission of community colleges, it is not surprising that western Massachusetts natives comprise a substantially larger proportion of the region's two-year degree recipients than its four-year degree recipients (57 percent vs. 31 percent).

Employment expectations and interests. Students majoring in IT fields are well attuned to the demand for their specialized skills. Their employment interests and expectations tend to be shaped by national and state trends. Anecdotal accounts suggest that prospective employees have specific expectations and interests regarding location of employment, salary, and other factors.

Respondent Demographics by Institution Type



Source: Authors' study

With regard to location, interest in working in western Massachusetts was highest among students who had grown up in the region and lowest among eastern Massachusetts natives. Among those attending community colleges, 88 percent expressed some level of interest in remaining in western Massachusetts for employment. Interest in working in eastern or central Massachusetts was highest among eastern Massachusetts natives and lowest among western Massachusetts natives.

Students enrolled in four-year colleges expect higher salaries in their first IT jobs than do students enrolled in two-year colleges. Among four-year degree recipients in the study, the mean expected annual salary was $42,676; among two-year degree recipients, it was $35,680. Less than 1 percent of students anticipated earning an initial salary of $60,000 or more.

Students rated the importance of five different factors in making a decision to accept an employment offer. Opportunities for career development and quality of life were rated "very important" by substantially larger proportions of students than were salary level or cost of living. Nevertheless, all five factors were rated "very important" or "somewhat important" by more than 90 percent of the respondents.

An overwhelming majority of students anticipate that they will *need* (88 percent) and *receive* (93 percent) on-the-job training after entrance into the IT workforce. This finding suggests that soon-to-be graduates recognize the ever-changing nature of IT work and expect to acquire new knowledge and skills subsequent to graduating from college.

Linking Prospective Employees and Employers

Employer needs. Analyses of data collected by the Bureau of Labor Statistics suggest there will be enormous growth in three IT occupations: systems analysts, computer scientists and engineers, and computer programmers. The BLS estimates that between 1996 and 2006, the United States will require more than 1.3 million new IT workers in these areas. Approximately 137,000 workers per year will be needed to fill *newly* created jobs. Specifically, it is estimated that 1,134,000 IT jobs will result from current workers leaving these occupations and 244,000 vacancies will occur due to retirements.[8]

Of the three occupations, systems analysts will be in greatest demand. The number of jobs is projected to double from 506,000 in 1996 to 1,025,000 in 2006. This compares to a projected increase of 14 percent for *all* IT occupations. The number of computer scientists and engineers is expected to grow by 114 percent, from 427,000 to 912,000 during the same period, whereas the number of computer programmer positions is expected to grow at a comparatively slower rate of 23 percent, expanding from 567,000 in 1996 to 697,000.

In contrast to the national picture, the 1999 Massachusetts Technology Collaborative Workforce Needs Survey reports that the greatest need for IT workers in the Commonwealth is in the area of skilled production. This points to the need for a different focus on training in the state, if a "native" workforce is a priority.

Information sources for students. For soon-to-be graduates interested in employment, gathering information about prospective employers is crucial. Which information sources are most widely used by students to find IT employment opportunities? Data suggest that "word-of-mouth" is the most popular, followed by company Web sites. Newspapers and employment agencies were the least utilized sources.

University students are more likely than students from other four-year colleges or from community colleges to report job fairs as good sources of information: Three-fourths of the university students surveyed reported learning of IT employment opportunities this way. These students were also more likely than students at other schools to indicate

Can we keep IT graduates in the Pioneer Valley?

Who wants to work in western Massachusetts?

• Survey respondents from UMass were less than half as likely as other students to seek employment in western Massachusetts.

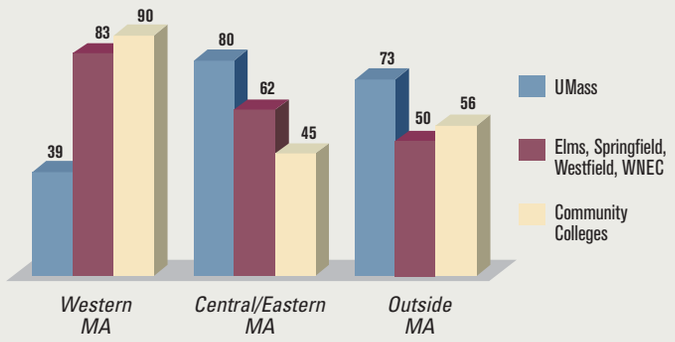
• University students were geared toward employment opportunities elsewhere in the state, as well as outside of Massachusetts.

• Overall, western Massachusetts ranked highest—but only marginally—as the preferred place to work.

Recommendations: Match training at local colleges and the University of Massachusetts with the needs of local employers. Include more local recruiters at job fairs, heavily utilized by university students.

Interest in Working in Each Geographic Area

Percentage of Respondents Choosing "Very Interested" or "Somewhat Interested"



How do students learn about employment opportunities?

• For UMass students, job fairs were the most important source of information. Nearly 80 percent reported having received information this way.

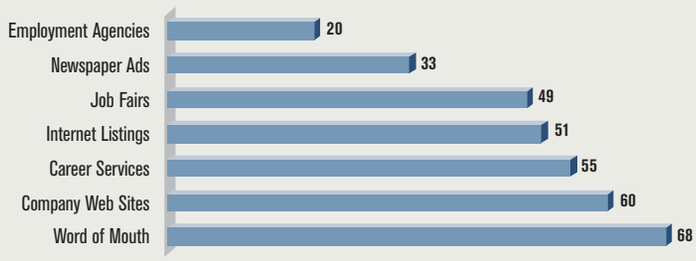
• Less than 30 percent of the respondents from the other colleges surveyed looked to job fairs for employment information.

• Company Web sites and word of mouth were the most useful sources of information about employment.

Recommendations: Develop job fairs at colleges and community colleges. Include local recruiters. Match recruiting organizations to student skills.

Most Useful Sources of Information About Job Opportunities

Percent of Respondents Utilizing Each



What factors make job offers attractive?

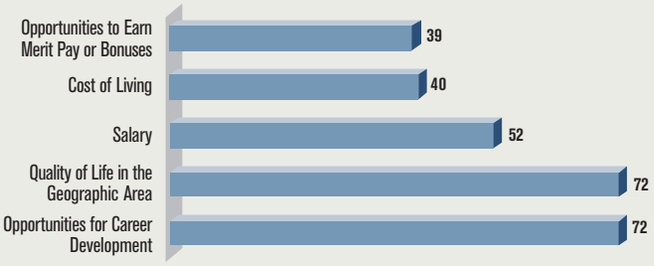
• Opportunities for career development and quality of life in a geographic area were the factors rated highest by all students, followed by salary level.

• Approximately two-thirds of community college students rated the cost of living in a geographic area as "very important," compared to just one-quarter of university students.

Recommendations: Develop and emphasize career advancement opportunities. Include career development information on Web sites and in recruitment literature and interviews. Offer competitive salaries to qualified applicants. Emphasize benefits of life in the Pioneer Valley region: affordability, cultural richness, continuing education, access to New York and Boston, open space and natural beauty.

Influential Factors Associated with Accepting Employment

Percent of Respondents Choosing "Very Important"



Source: Authors' Study

Information Technology Job Opportunities in the Pioneer Valley

	MA	Pioneer Valley	Pioneer Valley Share (percent)
Population	**6,349,097**	**695,368**	**11.0**
Computer Science Jobs	61,290	808	1.3
Electrical and Computer Engineering Jobs	84,640	1,121	1.3
Information/Data Jobs	12,349	252	2.0
Total Information Technology Jobs	**158,279**	**2,181**	**1.4**

Sources: Authors' study; iMarket; U.S. Census Bureau, 2000 Census

that their institution's career services office was useful as a source of information.

Forty-eight percent of students reported having been pursued by prospective employers. Students enrolled in four-year colleges were twice as likely as students at two-year colleges to have had job prospects (57 percent vs. 27 percent). Also, students who had completed IT internships or co-ops were twice as likely to indicate that a company had expressed interest in them (62 percent vs. 32 percent).

Among community college students who had been pursued, an overwhelming majority (82 percent) reported that western Massachusetts companies had expressed interest in them. In contrast, only 42 percent of students enrolled in four-year colleges had been pursued by a western Massachusetts company. Only 20 percent of Greenfield Community College students reported having been pursued by an IT employer, a substantially lower proportion than at any other college.

Findings and Recommendations

A number of the IT students emerging from the region's educational institutions are interested in being employed in western Massachusetts. (Interest is high among community college students, who are often locals, but not among natives of eastern Massachusetts attending four-year institutions.) If western Massachusetts intends to capture more four-year degree recipients, efforts should be made to inform students about the comparative advantages of living in the region *and* to provide training to address local needs.

Educators must work more closely with business and industry leaders to ensure that curricula reflect the skill areas most in demand by employers. Internship and co-op arrangements between businesses and educational institutions have proven especially valuable. Local IT professionals lecturing on college campuses, and companies making resources and facilities, such as state-of-the-art computers and laboratories, accessible to students ultimately benefit all participants.

Across all groups, students reported that word-of-mouth, company Web sites, and career services departments are principal sources of job information. For UMass students, however, job fairs are most important. Consequently, local employers seeking UMass graduates would benefit by participating in job fairs at the university. Overall, IT students lack knowledge about job opportunities in the Commonwealth. Addressing this issue would be a logical next step for educational institutions and the industry.

The majority of students across all groups expect on-the-job-training. IT employers are encouraged to invest in training programs in order to attract and retain highly productive and skilled workers.

If western Massachusetts is to be successful in "growing its own" IT workforce, it is vital for regional IT companies to establish and maintain links with area colleges and the university. By creating collaborative and cooperative relationships with faculty and university leaders, the region's IT employers may more effectively meet their employment needs and remain competitive in the industry.

1 Excerpts from the Board, *Massachusetts Benchmarks*, Winter 2000, p.5.

2 1999 Occupational Employment Statistics available from the Bureau of Labor Statistics (http://www.bls.gov/oes/1999/oes_ma.htm).

3 See Pioneer Valley Planning Commission's "Plan for Progress," 1994.

4 Two *Benchmarks* regions: Pioneer Valley and Berkshires, are represented in this study.

5 In order to gather the desired information, the University of Massachusetts Amherst Office of the Deputy Chancellor, under the direction of the Plan for Progress, collaborated with the Student Affairs Research, Information and Systems office (SARIS) in surveying 302 students with IT-related majors (e.g., computer science, electrical and computer engineering, computer information systems, management, etc.) graduating in May 2000 from UMass Amherst and the Pioneer Valley's other colleges and community colleges. We describe the personal characteristics, skills, and employment interests of the 221 students who expressed an intention to be employed in the IT field upon graduating in May 2000. Detailed methodological information can be found in "Western Massachusetts Institutions of Higher Education as Suppliers of the Information Technology Labor Force: A Survey of the Class of 2000," a report prepared for the Pioneer Valley Planning Commission's "Plan for Progress Higher Education and Workforce Development Strategy Teams," by Youlanda Gibbons and Elizabeth A. Williams.

6 *InfoWorld*, 1998.

7 Ibid.

8 Bureau of Labor Statistics, 1997.

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The complete SARIS study can be accessed on the Web at: www-saris.admin.umass.edu/saris/pp_home.html

Would long-term economic stress across the state cause an exodus among our best-educated workers? There may be cause for concern.

Recently the University of Massachusetts Donahue Institute's UMass Poll asked 460 residents across the Commonwealth whether they would seriously consider moving out of Massachusetts if economic conditions worsened. Just over 19 percent responded "yes." Respondents were also asked whether they expected economic conditions in the Commonwealth to get better, get worse, or stay the same in the coming year. While overall respondents expressed optimism about the future prospects of the state economy, a closer look at the results reveals a more disturbing pattern.

A small but significant number of respondents reported both that they expect economic conditions to deteriorate over the next 12 months and that they would seriously consider leaving Massachusetts if conditions worsen. The demographic profile of those "ready-to-leave" should give business leaders and policymakers pause. These respondents were more likely to be younger (under 45 years old) and better educated (a four-year college degree or above).

While the poll's sample size prevents precise statistical conclusions from being drawn, this pattern was clear and pronounced. These findings are all the more troubling in light of the recently released Center for Labor Market Studies report that documents the substantial impact that recent layoffs have had on our best-educated and better-paid workers. If these very workers are the ones who will be required to fuel the Commonwealth's economic recovery, there is real cause for concern.

The margin of error is ± 5 percent.

The condition of the Massachusetts economy:

Excellent	2%
Very good	14%
Good	41%
Fair	34%
Poor	8%
Don't know/unsure	1%

Expectations for the state economy over the next 12 months:

Get better	37%
Get worse	33%
Remain the same	28%
Don't know/unsure	3%

Consider moving out of Massachusetts if economic conditions worsen:

Yes	19%
No	79%
Don't know/unsure	1%

Family's financial situation one year from now:

Better	29%
Worse	8%
About the same	62%
Don't know/unsure	2%

Effect of September 11 attacks on your decision to vacation in Massachusetts in 2002:

Less likely to stay	10%
More likely to stay	16%
Just as likely to stay	64%
Don't know/unsure	10%

Inadequate CPS Household Census Sampling Hurts Massachusetts

In this issue of *Massachusetts Benchmarks*, Excerpts from the Board highlights the mixed set of economic signals being received on the performance of the Massachusetts economy during the current national economic downturn. A set of very mixed and confusing signals is being generated by the state's labor force statistics system under the Local Area Unemployment Statistics program (LAUS). Perplexing findings on state labor force developments have been produced by the LAUS program over the past two years. These highly erratic changes in key labor force and employment estimates are creating severe difficulties in interpreting current labor market developments in Massachusetts.

During the economically prosperous and "super full employment" year of 2000, the LAUS estimates for Massachusetts indicated that the average size of the state's resident labor force declined from 3.278 million to 3.237 million, a drop of 41,000.[1] Full-employment labor market conditions typically attract more youth and adults into the labor force. Yet recently released findings of the Geographic Profile of Employment and Unemployment, based on CPS survey findings, indicate that the labor-force participation rate of Massachusetts adults fell from 68.7 percent to 67.4 percent between 1999 and 2000, a time of unprecedented employment opportunities. In more recent months—as the state has begun to shed jobs, worker dislocation has been growing, and unemployment has been rising rapidly—the LAUS system has indicated that the state's resident labor force has grown by leaps and bounds.

Our ability to track ongoing labor-force developments in Massachusetts was sharply curtailed in the mid-1990s when the U.S. Census Bureau substantially reduced the monthly sample of Massachusetts households included in the national CPS sample from nearly 2,300 to less than 1,200 as a result of cutbacks in the Census Bureau budget and in the Department of Labor. Recently the Census Bureau was provided additional resources by Congress to expand the national monthly sample of households in the survey to 60,000.[2] While most states received an increase in their samples, Massachusetts did not. As a consequence, there are fewer households interviewed per month in Massachusetts than in Maine and Vermont, two states with considerably smaller populations and resident labor forces.

What is needed to rectify this situation is a major expansion of the CPS household sample in our state, which will generate more reliable and comprehensive estimates of labor-force developments and problems. Such an expansion would yield valuable dividends in other information areas as well. Currently, our understanding of household and family income developments, changes in the real annual earnings of workers, and the poverty status of families and individuals is based on interviews with fewer than 1,200 households in the state during the March CPS survey.[3] An expansion of the survey to include 3,000 or more households in Massachusetts would facilitate our ability to assess changes in worker annual earnings, family incomes, and poverty problems over time and to identify progress in improving the economic living standards of key subgroups of workers and families in the Commonwealth.

1 Annual average estimates of the size of a state's resident labor force for the entire 1990s decade are available on the U.S. Bureau of Labor Statistics' Web site under the Geographic Profile of Employment and Unemployment. Findings for the 2000 Geographic Profile are just being released by the U.S. Bureau of Labor Statistics.

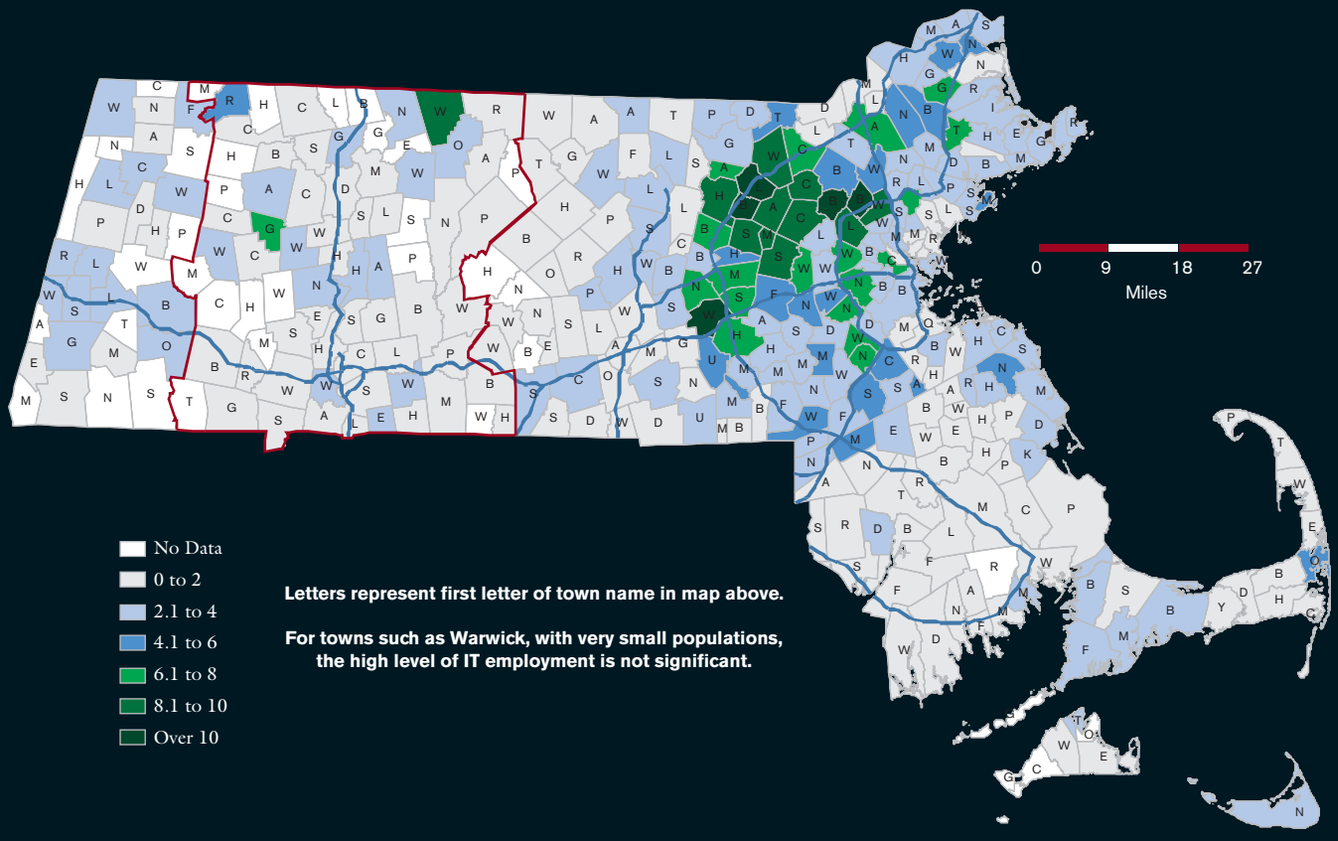
2 For a review of the recent CPS sample expansion by state, see Ryan T. Helwig, Randy Ilg, and Sandra L. Mason, "Expansion of the Current Population Survey Sample Effective July 2001," *Employment and Earnings*, August 2001, Washington, D.C., pp. 3-7.

3 On the recently released March 2001 CPS public use tapes, there were only 1,122 sample households for Massachusetts, of which 715, or 64 percent, were family households.

Andrew Sum
Paul Harrington
Center for Labor Market Studies
Northeastern University

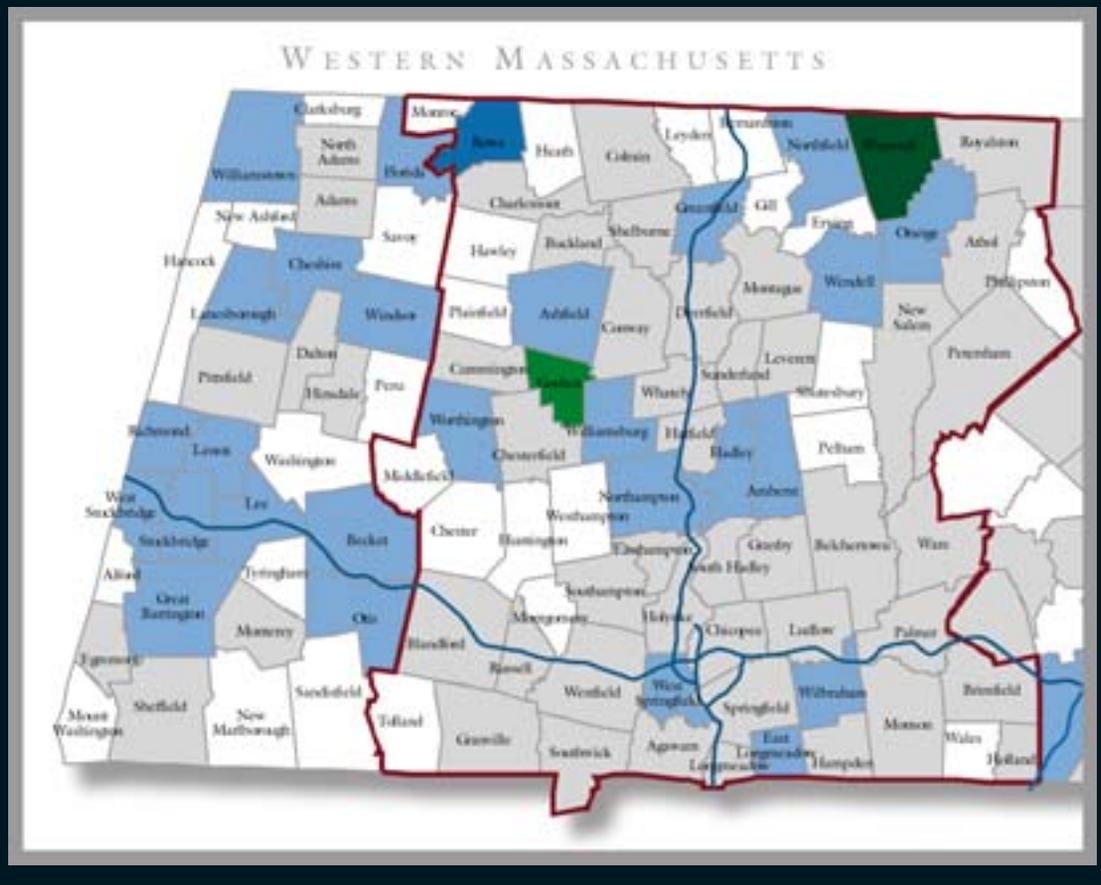
Information Technology Employees

per 1000 People of Working Age (18-65)



Letters represent first letter of town name in map above.

For towns such as Warwick, with very small populations, the high level of IT employment is not significant.



Sources: MA Division of Employment and Training and U.S. Bureau of the Census, Decennial Census

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