"Whither New England?"

Stephen K. McNees and Geoffrey M. B. Tootell

Vice President and Economist, and Economist, respectively, at the Federal Reserve Bank of Boston. *The authors are indebted to Kim Gilbo, Jeff Liebman, and Adam Rosen for research assistance.*

The New England economy has undergone a striking change from the "miraculous" boom of the mid 1980s to a seemingly bottomless bust in the early 1990s. Were there advance warnings of this sea change? When will the decline end? How strong will the recovery be?

This article addresses these questions by attempting to identify precursors, or leading indicators, of economic activity in New England. It opens by seeking to distinguish between those variables that tend to lead economic activity in New England and those that do not. Because no single variable is likely to contain all information of predictive value, the article then explores alternative methods of combining several variables into an index or statistical "model" of New England economic activity. In the process of constructing these models, several issues arise: (1) the relative importance of regional and national indicators; (2) the relative importance of financial and nonfinancial indicators; (3) the relative importance of "actual" historical data and "expectational" or "forward-looking" data, such as forecasts; and (4) the relationship between in-sample "fit" and post-sample performance.

Given the multidimensional nature of the issues, the article constructs and tests several alternative models. Given the provisional, exploratory nature of the search, only time can tell which, if any, of these alternatives will prove successful in anticipating the future of the New England economy.

I. Measurement of Regional Economic Activity

The phrase "economic activity" could refer to the region's production, its income, or its employment. The only available measure of the region's production is the U.S. Bureau of Economic Analysis estimate of Gross State Product. While Gross State Product is invaluable for histor-

ical analysis of the region's productive activity, the fact that it has been estimated only on an annual basis severely limits its use for analyzing short-term developments. A more practical problem with using Gross State Product for current analysis and forecasting is its lack of timeliness—as of mid 1991, the latest available estimate of GSP was still for calendar year 1986.

State personal income is a more timely measure. It is estimated for each quarter and becomes available about four months after the quarter has ended. For example, the estimate of state personal income in 1990:IV was published on April 17, 1991. Personal income is a relatively good measure of a region's economic well-being but is not a particularly good measure of its economic activity, since it does not distinguish between income derived from economic activity within the region and that from outside the region. In addition, personal income is measured in current dollars. It is not clear what portion arises from price changes as opposed to changes in economic activity.

Relative to production and income, employment is a still more timely measure of regional economic activity, and the concept of employment is relatively easy to quantify. Employment is estimated regularly in two ways: on a household survey basis (EH), and on the basis of employers' payrolls (EP). Monthly estimates of household employment are available with only a one-month lag for the major industrial states like Massachusetts, while estimates of payroll employment carry a two-month lag for all New England states. For example, estimates of January household employment in Massachusetts and of December payroll employment for each New England state became available in early February. Given the difficulty of measuring the stock of capital and the flow of capital services, as well as the procyclical nature of labor productivity, employment is a relatively close proxy for economic activity. Thus, largely because of its availability and timeliness, but also because of its intrinsic importance, employment in New England will be used as the measure of its economic activity.

The main reason to focus on New England is not a conceptual one: that is the way most data are collected and analyzed.

A more difficult issue than measuring economic activity is the definition of a region. Geographic regions do not, in general, conform to either political jurisdictions or units of economic analysis. Economic theories have been established for individuals, firms, countries, and groups of countries, by location and even by geographic clustering or agglomeration. None of these concepts necessarily corresponds closely to the geographic regions defined by the Census Bureau. It would be tempting to hypothesize that factors of production, especially labor, are completely mobile within geographic regions, but relatively immobile across regions. Yet, it is not at all obvious that mobility is greater between southern Connecticut and northern Maine than between northern Maine and Canada or between southwestern New England and New York. The main reason to focus on New England is not a conceptual one; that is the way most data are collected and analyzed.

II. Why Is New England Distinctive?

On the most general level, the relationship between New England and the nation can be considered in two ways. On the one hand, New England can be viewed as a very small, totally open economy, having both a common currency and virtually no barriers to trade with other regions. New Englanders deal in national financial markets and face federal tax and expenditure programs. The United States economy is, in effect, a large common market. It would be surprising if any segment of a unified market were not ultimately driven by its "exports" to and "imports" from the rest of the country. In a fundamental sense, New England's economy is inextricably and closely tied to the United States.

On the other hand, the New England economy can be thought of as unique: it is geographically compact and relatively remote from other parts of the country; its climate and natural resource endowments are dissimilar to many other regions; in addition, because nearly one-half of its population is concentrated in Massachusetts and more than three-quarters in Massachusetts and Connecticut, the New England economy is subject to a relatively similar set of regulations and tax codes. Perhaps most impor-

Table 1
Percentage Composition of Regional Gross Product, 1986

Industry	New England	Southeast Seaboard	Midwest	Farm Belt	Southwest	Far West
Agriculture, Forestry, and Fisheries	.9	1.3	2.3	9.8	2.1	2.3
Mining	.1	.4	1.2	3.5	11.4	1.2
Durable Goods Manufacturing	16.2	8.2	15.4	8.1	7.1	11.8
Nondurable Goods Manufacturing	6.8	9.5	9.5	7.0	7.8	5.4
Transportation, Communications, and Utilities	7.4	9.3	9.6	10.7	10.6	8.5
Finance, Insurance, and Real Estate	18.0	17.9	15.9	16.6	13.8	17.1
Services	19.0	17.9	15.6	13.1	13.8	18.7
Government	9.7	13.3	10.3	11.2	12.0	12.4
Other	21.9	22.2	20.2	20.0	21.4	22.6

New England: ME, MA, RI, CT, VT, NH.
Southeast Seaboard: NY, NJ, DE, MD, DC, VA, NC, SC, GA, FL.
Midwest: PA, WV, KY, TN, AL, AR, MO, IL, WI, MN, MI, OH, IN.
Farm Belt: IA, KS, NE, CO, WY, ID, MT, ND, SD.
Southwest: MS, LA, TX, NM, OK, AK, HI.
Far West: UT, AZ, CA, NV, OR, WA.
Source: U.S. Bureau of Economic Analysis, Gross State Products computer tape, and authors' calculations.

tantly, New Englanders often think of themselves as a region. Given this perceived internal cohesion, it is not surprising to find that the New England economy is not always "in sync" with the country as a whole.

In fact, New England is not simply a miniature version of the country. As shown in Table 1, the region's industrial mix is quite distinctive. Of the nine industrial categories shown, New England ranked at either the high or the low extreme for seven, and is thus disproportionately affected by shifts among these categories. This idiosyncratic industrial structure creates the possibility that economic conditions in the United States and New England may diverge.

Nationally, movements away from full employment are the net result of supply and demand shocks to all of our industries. A region composed of an industrial mix or set of endowments different from the nation's is subject to a larger set of these employment disturbances. Supply and demand surprises that offset each other within the nation as a whole can have large effects on undiversified regions. Thus, the short-run disturbances that affect the endowments, firms, or industries of a region can cause dislocations in that area not experienced by the nation. It is these short-run employment dislocations that are examined in this paper; the potential sources for these swings in regional employment are briefly discussed in this section.

However, more than imperfect regional diversification is required for a region to suffer fluctuations of employment away from its equilibrium path that are not experienced by the nation; imperfect labor mobility and some wage stickiness are also necessary. If wages and prices were perfectly flexible, and labor somewhat immobile, only real wages would fluctuate, not employment.[1] The differing economic performances in various areas of the country would be reflected in different gross outputs in these areas, but employment levels would remain unchanged.[2] Furthermore, if labor were completely mobile, while wages and prices were sticky, then the employment growth of any given area would not be a variable of economic concern, as decline in one area would be completely offset by growth in another; if oil reserves were depleted in Alaska and all the workers immediately shifted to other areas/firms/industries, output and employment in the geographical region known as Alaska would be affected but no unemployment or wasted resources would occur. Thus, only when some factor immobility is present do local disturbances cause the wasted resources that motivate examination of regional employment growth.[3] And the performance of the Southwest in the 1980s, and New England currently, reveals that the long-run factor mobility that exists in the United States can be too slow to prevent significant economic losses.

Given this labor immobility, diversification by industry and by firm is required to avoid regional employment movements away from equilibrium levels independent of the nation. A New England computer company whose product suddenly becomes obsolete is a good example of a firm-specific demand disturbance. Since the computer is rejected by consumers, the usual demand for this company's product would spill over to its competitors. This bad investment decision by the New England manufacturer would actually benefit the other companies in the industry. If every firm in the industry were located in New England, workers from one computer company would simply file over to the others, and regional employment would not be affected. If, on the other hand, the failing computer firm were the sole producer in the region, the other computer companies would not be there to hire the laid-off workers. However, even if New England is diversified as to computer firms, but disproportionately dependent on computer manufacturing, a decrease in the demand for computers as a whole would produce employment declines in New England relative to the nation. With some factor immobility, nondiversification either by firm or by industry can lead to divergences from the national performance.

New England will not remain permanently out of step with the rest of the nation.

Even when regions are diversified, the immobility of certain regional endowments can also cause regional performance to diverge from national conditions. Anything that affects the productivity of these region-specific factors of production will affect the economic performance of that area relative to the nation. The simplest example of such a disturbance is a local drought, where agricultural production and employment fall in the region but not in the rest of the country. Differences in regional endowments can also affect regional employment in the same way as undiversified industrial mix; the rise and fall in oil prices, and the ensuing effect on the economy of the Southwest, is an example of an endowment disturbance that resembles a demand shock on an undiversified region. Disturbances that affect the productive capacity of the region through shocks to the regional endowments can also cause divergent regional performance.

Finally, the national economy affects regional economic conditions even if the region is perfectly diversified. A national downturn will usually decrease the demand for many of a region's products. If the region were as diversified as the nation, the national decline would be emanating from many of the region's industries; if the region were not perfectly diversified, and if its industries were not directly responsible for the national decline, regional performance would be affected because income in its largest export market had declined. The only way a region can avoid a nationally driven downturn is if the industries in the area are acyclical; in this case, the national economy would not affect regional activity, but the firms in the area would still be susceptible to the forces specific to its firms, its industries, and its regional endowments, discussed above.[4] Thus, a nationally diversified region eliminates all regional employment movements not associated with national economic conditions, while a region immune to national shocks is prone to the more local sources of fluctuations.

In short, both national and regional factors can be expected to have an influence on New England's employment. Major swings in employment are dominated by national business cycles. Yet, because of the uniqueness of the region's industrial mix, the regional impact will not be a simple reflection of national trends. Similarly, the myriad of forces that affect the location of a firm or worker within the country will enter into regional, but not necessarily national, data. Any attempt to predict regional employment growth must include both national and regional variables in order to capture both sources of regional employment fluctuations.

III. Indicators of New England Employment

It is important to distinguish between the official Index of Leading Indicators of the U.S. economy and the broader definition of indicators used here. The official Index is designed to anticipate turning points in the national business cycle—peaks and troughs—as designated by the National Bureau of Economic Research. Its focus is binary—whether the economy is in an expansion phase or a contraction (recession) phase. In contrast, applied forecasting commonly uses the word "indicator" in a much broader sense:

any currently available information presumed to be associated with the future values of a variable of interest. Here, as is typically the case, the presumed relationship is not binary but a continuous, quantitative one with payroll employment in New England.

Any variable can serve as an indicator because no structural or causal relationship is implied. The only requirement for a successful indicator is that it be closely associated with the future values of the predicted variable. The relationship between an indicator and the predicted variable should also be fairly direct—if an indicator works only when embedded in a multivariate model or filtered with complex statistical techniques, it would seem as (more) appropriate to regard the model or the filter, rather than the indicator, as the predictor. The essence of the pure indicator approach is its simplicity: observing an indicator has clear, direct implications for the forecast.[5]

Table 2
Regional Indicators of Employment Growth in New England
Monthly Bivariate Regression Results, Sample Period 1983:02 to 1990:09

Indicator	Number of lags	Standard Error	$\bar{R}^2$	F-test Significance
1 CRNE	1 to 21	.0027376	.44	****
2 ICNE	0 to 15	.0027690	.43	****
3 CTNE	1 to 16	.0027732	.43	****
4 HWNE	1 to 17	.0028857	.38	****
5 RSNE	2 to 16	.0029094	.37	****
6 HSNE	1 to 19	.0029650	.35	****
7 EPNE	1 to 15	.0029690	.35	****
8 BPNE	1 to 23	.0029963	.33	***
9 BPSNE	1 to 21	.0030094	.33	***
10 ICENE	0 to 24	.0030159	.32	***
11 ICSNE	0 to 14	.0030936	.29	***
12 RURMA	0 to 23	.0031630	.26	***
13 CNNE	1 to 20	.0031859	.25	***
14 URMA	0 to 14	.0031859	.25	***
15 NBINE	2 to 16	.0033044	.19	***
16 ECNE	3 to 22	.0033985	.14	**
17 EHMA	0 to 10	.0034050	.14	**
18 RSNNE	2 to 13	.0034133	.13	**
19 EINE	3 to 22	.0034268	.13	**
20 LFMA	0 to 4	.0034492	.12	***
21 CPIB	1 to 24	.0034593	.11	*
22 AWHNE	1 to 14	.0035198	.08	*
23 PREB	0 to 0	.0036163	.03	**
24 TEMPB	0 to 4	.0036679	.00	*
25 ERNE	3 to 3	.0036878	-.01	*
26 AHENE	1 to 1	.0036890	-.01	*

****F-test significance is less than .0001.
*** F-test significance is between .0001 and .01.
** F-test significance is between .01 and .1.
* F-test significance is greater than .1.
Note: Column 3 represents monthly standard errors.
Definitions of the indicators may be found in Appendix Table A1.

Table 2 shows the results of regressing New England's monthly employment growth on lagged values of 25 potential regional indicators, defined in the Appendix to this article. The first lag is determined by data availability: each month, actual values of the financial variables and several labor market variables are known before that month's New England employment growth. For example, in the first week in February, when we learn New England's December employment, we already know what happened in January in the financial markets and the national employment situation, and we have some information on regional labor markets in January (initial claims, Massachusetts' unemployment rate, and employment measured on a household survey basis). Thus, this information can be used to predict New England employment in January, which will not be announced until early March. At the same time, most other indicators will be available only through December, and a few regional variables (for example, electricity use and new business incorporations) will be available only for still earlier months. Thus, depending on the timing of the availability of the indicator, it may be lagged not at all, or from one to three months.

The last lag for each potential indicator, as well as the ranking of the indicators, was selected to minimize the standard error of the regression. The start and end of the distributed lag for each indicator are shown in the second column and the standard error in the third column of the table.

Of the 26 regional indicators, six predicted payroll employment in New England (EPNE) better than its own recent history: three were measures of construction activity, the value of residential (CRNE) and total (CTNE) construction contracts and house sales (HSNE); two were measures of labor market conditions, initial claims for unemployment insurance (ICNE) and help wanted advertising (HWNE); the other relatively good indicator was retail sales (RSNE).

At the other extreme, several regional indicators were not very reliable: electricity sales, whether commercial (ECNE), industrial (EINE), or residential (ERNE), did not fare well; retail sales of nondurable goods (RSNNE) was far inferior to total retail sales;

neither the Boston Consumer Price Index (CPIB) nor average hourly earnings of manufacturing workers (AHENE) performed well. Somewhat surprisingly, Massachusetts employment data, as measured on a household basis (EHMA) or by the size of its labor force (LFMA), both available a month *before* data on New England employment measured on a payroll basis, and even average weekly hours (AWHNE), a leading indicator on a national basis, were not good predictors. Not at all surprisingly, the two "ringers" included to test whether this method would reject them were poor indicators—the deviations of Boston's temperature (TEMPB) and its precipitation (PREB) from normal.

Between these extremes, several indicators enjoyed a moderate success. These included building permits, both total (BPNE) and for single-family units (BPSNE); the Conference Board's indexes of New England consumer sentiment (ICSNE) and consumer expectations (ICENE); the Massachusetts unemployment rate (URMA) and the ratio of Massachusetts unemployment to the national rate (RURMA); the value of nonresidential construction contracts (CNNE); and the volume of new business incorporations (NBINE).

Table 3 replicates Table 2 over a longer sample period and includes national as well as regional indicators. Five of the top ten indicators are national and are measures of the labor market: payroll employment (EP), the unemployment rate (UR), help wanted advertising (HW), civilian household employment (EH), and average weekly hours (AWH). The top 20 indicators include six additional national variables. Two are financial variables: the spread between the rates on six-month commercial paper and Treasury bills (SPRED6), and the slope of the yield curve between 10-year and 1-year Treasury securities (TILT101). One is a labor market measure, initial claims for unemployment insurance (IC); and the other three are manufacturers' new orders for consumer goods and materials industries (NOC); building permits (BP); and personal consumption expenditures (PCE). Thus, the top 20 indicators of monthly employment in New England include nine regional variables, four components of the Index of Leading Indicators and two components of the NBER's Experimental Index of Leading Indicators, plus five national variables not included in any of the standard leading indicator indexes.

Among the less successful national indicators were (1) the Index of Leading Indicators (ILI) and several of its components—the real money supply

Table 3
Regional and National Indicators of Employment Growth in New England
Monthly Bivariate Regression Results, Sample Period 1976:02 to 1990:09

	Indicator	Number of lags	Standard Error	$\bar{R}^2$	F-test Significance
1	EP	0 to 5	.0031485	.34	****
2	HWNE	1 to 13	.0032997	.28	****
3	CRNE	1 to 22	.0033097	.27	****
4	EPNE	1 to 15	.0033303	.26	****
5	UR	0 to 23	.0033571	.25	****
6	HW	1 to 14	.0033665	.25	****
7	EH	0 to 7	.0034017	.23	****
8	CTNE	1 to 23	.0034280	.22	****
9	AWH	0 to 23	.0034405	.21	****
10	HSNE	1 to 24	.0034461	.21	****
11	IC	0 to 23	.0034539	.21	****
12	NOC	1 to 22	.0034789	.20	****
13	ICNE	0 to 20	.0034883	.19	****
14	BPNE	1 to 24	.0034926	.19	***
15	BPSNE	1 to 24	.0035054	.18	***
16	SPRED6	0 to 13	.0035348	.17	****
17	URMA	0 to 10	.0035429	.17	****
18	TILT101	0 to 18	.0035431	.17	***
19	BP	1 to 24	.0035554	.16	***
20	PCE	1 to 5	.0035618	.16	****
21	M2	0 to 22	.0035621	.16	***
22	SLACK	0 to 4	.0035843	.15	****
23	DTILT101	0 to 18	.0036113	.13	***
24	ILI	1 to 23	.0036159	.13	***
25	SM	1 to 24	.0036291	.13	***
26	RFF	0 to 20	.0036464	.12	***
27	BV	2 to 24	.0036470	.12	***
28	IIP	1 to 3	.0036572	.11	****
29	LF	0 to 16	.0036648	.11	***
30	RURMA	0 to 21	.0036696	.11	**
31	MTS	2 to 13	.0036829	.10	***
32	VP	1 to 23	.0036903	.10	**
33	SLOPE1OFF	0 to 8	.0036912	.10	***
34	LFMA	0 to 17	.0037097	.09	**
35	PILT	1 to 4	.0037131	.08	***
36	COPE	1 to 12	.0037178	.08	***
37	UOD	1 to 21	.0037499	.07	**
38	DDEFAULT	0 to 14	.0037531	.07	**
39	DEFAULT	0 to 5	.0037603	.06	**
40	YD	1 to 12	.0037691	.06	**
41	AWHNE	1 to 24	.0037804	.05	*
42	DSPRED6	0 to 13	.0037816	.05	**
43	CNNE	1 to 18	.0038019	.04	*
44	AHENE	1 to 10	.0038412	.02	*
45	PREB	0 to 0	.0038570	.01	**
46	DSLOPE10FF	0 to 24	.0038696	.01	*
47	SP	0 to 1	.0038840	.00	*
48	AHE	0 to 3	.0038885	.00	*
49	TEMPB	0 to 0	.0038910	.00	*

****F-test significance is less than .0001.
*** F-test significance is between .0001 and .01.
** F-test significance is equal to .01 or between .01 and .1.
* F-test significance is greater than .1.

Note: Mnemonics ending in NE, MA or B indicate that the variable is a measure for New England, Massachusetts or Boston respectively. Column 3 represents monthly standard errors. Definitions of the indicators may be found in Appendix Table A1.

(M2), sensitive material prices (SM), contracts and orders for plant and equipment (COPE), vendor performance (VP), unfilled orders for durable goods (UOD), and stock prices as measured by the S&P500 (SP); (2) the components of the index of coincident indicators except for payroll employment—personal income less transfer payments (PILT), the index of industrial production (IIP), and manufacturing and trade sales (MTS); (3) financial market indicators—the first difference of the slope of the yield curve between 10-year and 1-year Treasury Securities (DTILT101), the federal funds rate (RFF), the spread between 10-year Treasuries and the federal funds rate (SLOPE10FF), the difference between AAA and Baa rated corporate bonds (DEFAULT), the first difference of DEFAULT (DDEFAULT), the first difference of the spread between the rates on six-month commercial paper and Treasury bills (DSPRED6), and the first difference of SLOPE10FF (DSLOPE10FF); and (4) several miscellaneous potential indicators—the change in book value of manufacturing and trade inventories (BV), the civilian labor force (LF), persons working part-time for economic reasons (SLACK), disposable personal income (YD), and average hourly earnings (AHE).

Table 4 covers the same indicators and sample period as Table 3 with all information measured on a quarterly rather than a monthly frequency. This allows the addition of several variables that are available only on a quarterly basis as well as forecasts of three quarterly variables. Ideally, forecasts of New England employment (EPNE) would have been used. Unfortunately, only forecasts of national variables were available—specifically, the one-quarter ahead forecasts of U.S. payroll employment (FEP), of employment based on the household survey (FEH), and of real GNP (FRGNP) were examined.

While Table 4 broadly reflects Table 3, the quarterly results differ from the monthly in several aspects. The most striking is the decline in the rank of several national labor market indicators: EP, which was highest ranked on Table 3, declines to 28th on Table 4; UR falls from 5th to 23rd; AWH drops from 9th to 21st; and IC from 11th to 22nd. All these monthly indicators apparently benefited from their timeliness, since each was available before New England employment for the same month. This advantage of timeliness is apparently sharply reduced when the data are smoothed by measuring at quarterly frequencies.

The second difference is that the forecasts were among the best indicators. All three "expectational"

Table 4
Regional and National Indicators Of Employment Growth in New England
Quarterly Bivariate Regression Results, Sample Period 1976:II to 1990:III

	Indicator	Number of lags	Standard Error	$\bar{R}^2$	F-test Significance
1	HWNE	1 to 4	.0044460	.65	****
2	CRNE	1 to 7	.0048839	.58	****
3	HW	1 to 1	.0052232	.52	****
4	EPNE	1 to 8	.0052791	.51	****
5	HSNE	1 to 8	.0054647	.48	****
6	RURMA	1 to 7	.0055854	.45	****
7	URMA	1 to 3	.0055990	.45	****
8	BPNE	1 to 7	.0056531	.44	****
9	ICNE	1 to 6	.0056674	.44	****
10	BPSNE	1 to 8	.0058570	.40	****
11	FEP	0 to 0	.0059070	.39	****
12	CTNE	1 to 6	.0059088	.39	****
13	FEH	0 to 0	.0059342	.38	****
14	PCE	1 to 5	.0059546	.38	****
15	ILI	1 to 8	.0059565	.38	****
16	EH	1 to 4	.0060520	.36	****
17	BP	1 to 8	.0060761	.35	***
18	FRGNP	0 to 0	.0061452	.34	****
19	MTS	1 to 3	.0061505	.34	****
20	SPRED6	1 to 3	.0061641	.33	****
21	AWH	1 to 7	.0061945	.33	***
22	IC	1 to 7	.0062882	.31	***
23	UR	1 to 2	.0063089	.30	****
24	M2	1 to 8	.0063431	.30	***
25	BV	1 to 8	.0063619	.29	***
26	VP	1 to 8	.0065152	.26	***
27	NOC	1 to 5	.0065152	.26	***
28	EP	1 to 8	.0065195	.26	***
29	SLACK	1 to 1	.0065346	.25	****
30	SLOPE1OFF	1 to 3	.0065413	.25	***
31	TILT101	1 to 2	.0065733	.24	***
32	RGNP	1 to 3	.0065970	.24	***
33	IIP	1 to 3	.0066324	.23	***
34	PILT	1 to 1	.0066758	.22	***
35	RFF	1 to 7	.0068184	.19	**
36	YPNE	2 to 8	.0068597	.18	**
37	DDEFAULT	1 to 5	.0068969	.17	**
38	DEFAULT	1 to 6	.0069217	.16	**
39	UOD	1 to 8	.0069353	.16	**
40	COPE	1 to 6	.0069505	.15	**
41	CNNE	1 to 8	.0069895	.14	**
42	YD	1 to 4	.0070240	.14	**
43	DTILT101	1 to 8	.0070720	.12	**
44	SM	1 to 1	.0070901	.12	***
45	AWHNE	1 to 7	.0071690	.10	**
46	LFMA	1 to 5	.0072311	.08	**
47	LF	1 to 1	.0072320	.08	**
48	AHENE	1 to 3	.0073801	.05	*
49	AHE	1 to 8	.0073808	.05	*
50	ICS	1 to 2	.0074464	.03	*
51	DSPRED6	1 to 3	.0074896	.02	*
52	DSLOPE10FF	1 to 8	.0074922	.02	*
53	SP	1 to 1	.0076177	−.02	*
54	TEMPB	1 to 1	.0076193	−.02	*
55	PREB	1 to 1	.0076219	−.02	*

****F-test significance is less than .0001.
*** F-test significance is between .0001 and .01.
** F-test significance is between .01 and .1.
* F-test significance is greater than .1.

Note: Mnemonics ending in NE, MA or B indicate that the variable is a measure for New England, Massachusetts or Boston respectively. Column 3 represents quarterly standard errors. Definitions of the indicators may be found in Appendix Table A1.

variables were among the eight best national indicators and 18 best overall indicators, even though none are designed to predict New England's employment. A final notable difference is that the composite Index of Leading Indicators (ILI) is a superior quarterly indicator to any of its components.

In broad terms, the problem is not a lack of good indicators but rather that dozens of plausible candidates can be found. Numerous indicators show a high, significant correlation with employment in New England (EPNE), but even the best indicator is far from perfect. The multiplicity of good but not perfect indicators raises the question of whether a composite index or multivariate model would be an even better precursor of employment growth in New England. This is the focus of the following section.

IV. Building Multivariate Models of New England Employment

The previous section of this article analyzed the relationship between New England employment growth and individual indicators, using several different information sets. This section explores the relationship between the region's employment growth and many variables simultaneously. The value of the various information categories is also examined further; the performance of regional, national, and expectational sets of variables are all compared to the predictive power of simple lagged values of the dependent variable. This analysis allows an exploration of the source of the predictive power of these variables. Thus, a model will be constructed for each data set, and the in-sample performance of each model will be compared.

The statistical gains from using multivariate rather than bivariate analysis could be important. First, many variables may appear to lead the growth in New England employment simply because they are correlated with other, "true" leaders. For example, using bivariate analysis, residential construction seems to lead employment growth, but when both building permits and construction contracts are included in the analysis, the construction variable becomes unimportant. Residential construction has no marginal predictive power once building permits are taken into account. Conversely, a variable may prove to be more important once other variables are accounted for, as it picks up "partial" elements of employment that others do not capture. Furthermore, a multivariate study allows the relative importance, or the weight, of each indicator to be determined by the regression analysis.

The multivariate approach, however, has several drawbacks. The models created here are not structural models but statistical ones. Interpretation of the coefficients as structural parameters should be avoided. Furthermore, this analysis runs the risk of "over-fitting." As we have seen, candidates for inclusion in a model are numerous, each with its own distributed lag. At the same time, the available sample size for many variables is relatively short. This poses a dilemma: the better the sample period is "mined," the fewer the degrees of freedom to estimate the coefficients, and the less reliable these estimates become. Because of this danger, the next section contains out-of-sample tests; the remainder of this section concentrates on in-sample performance.

The differences in the data sets occur over several dimensions: regional and national, actual and forward-looking, and financial and nonfinancial. New England employment growth is estimated as functions of the variables in these information sets available at the time the prediction would be made. For example, the estimate of the employment growth in the second quarter of 1991 would use all information released as of the first week in May. The importance of the increased timeliness of the financial variables is examined by separating each series into the chronological quarterly lag, and a monthly (April) update; this is one way to observe whether the explanatory power of these financial variables derives from long lags or their relative timeliness. Along the geographic dimension, the regional information set contains less timely data than the national information; one might, therefore, expect the national model to perform better in sample. On the other hand, to the extent that regional employment diverges from the national performance, the regional information should conform more closely to the variable of interest. Finally, the expectational information set is forward-looking, whereas the variables in the other models are all historical, or predetermined; thus, the value of judgment can be explored. Breaking up the information sets allows an exploration of the importance of these dimensions.

The construction of each model began with the bivariate analysis in the previous section. The potential indicators having the strongest bivariate relationship with regional employment growth were first combined to form a base model. All the remaining variables were then added to the base equation, one at a time. The most significant added variable was

Table 5
Multivariate Models of New England Employment
Sample Period: 1976:I to 1988:IV

The Models	SER
I. Autoregressive:	
EPNE = C + EPNE(1–8)	2.1576
II. Regional:	
EPNE = C + EPNE(1–3) + ICNE (1–3) + CNNE(1–3) + HWNE(1)	1.4599
III. National:	
EPNE = C + EPNE(1–3) + DSLOPE1OFF(1–3) + HW(1–2) + COPE(1–3) + MTRD	1.4517
IV. Expectational:	
EPNE = C + EPNE(1–7) + FEP	1.6924
V. All Information Sets:	
(A) EPNE = C + EPNE(1–4) + HW(1–5) + COPE(1–5) + DDEFAULT(1–2) + HWNE(1–8) + MTRD + FEP + ILI(1–4) + BP(1–3)	.71674
(B) EPNE = C + EPNE(1–4) + HW(1–3) + COPE(1–3) + DDEFAULT(1–3) + ILI(1–4) + SLACK(1–4) + CNNE(1–4) + DSLOPE1OFF(1–3) + AWHNE(1–2) + RGNP(1–2) + FEP	.56451

The numbers in parentheses are the lags of each variable used in the equation.

then included in the fundamental equation in the next round. This procedure was then repeated with the new base model. This process continued until no more variables could be added to the base equation, and all the included variables were significant. One drawback to this methodology is that the final model may be dependent on both the original base equation used and the order of acceptance of the added variables. For this reason, several different routes to arrive at the final equation were taken; the final equation in each information set turned out to be fairly robust to different routes.

Table 5 contains the models identified for each information set. The standard error of each regression (SER), in annualized rates, is given alongside the variables in each equation. The simple autoregressive model in equation I, using only the lags of New England employment growth, provides a convenient standard of comparison. A large body of previous research suggests that an autoregressive model is a reasonably high standard for comparison in this type of analysis, as it is known to produce relatively accurate one-period-ahead forecasts (Zellner and Palm 1974). The number of lags of each independent variable included in this and the other models was determined using Akaike's Information Criterion.[6] This method of selection tends to keep the lag length short and, thus, helps prevent the over-fitting to which this statistical method is prone.

The second equation in Table 5 gives the in-sample performance based solely on the regional information set. In addition to lags of the dependent variable, labor market and construction variables are important.[7] Initial claims for unemployment insurance (ICNE) and help wanted advertising (HWNE) are two labor market series often promoted as leading indicators of employment; both variables gain from timeliness—claims are available weekly and firms advertise a job opening *before* they fill it. The construction variable (CNNE) is also a traditional candidate for a leading indicator. The value of new construction contracts is similar to building permits, but it gives a dollar value to future work. As with building permits, the signing of the contract should portend future employment increases in the construction sector.

What is surprising about the equation is not the variables included, but rather the variables that are missing. The regional indicators do not closely resemble the components of the national Index of Leading Indicators. Good reasons can be found for this discrepancy. First, national leading indicators attempt to predict turning points of the business cycle, not employment growth. Employment is only one of several elements of the national coincident series. Furthermore, many of the data available at the national level are not available at the regional level and certainly not in a timely manner. What, for example, is the regional money supply? Also, many of the regional counterparts to the national Index that are available did not perform well. Building permits and average workweek, both contained in the national Index, do not help explain future regional employment growth; their failure could be due to the different dependent variable they are attempting to predict on the regional level. Even with this parsimonious equation, however, the standard error of the fitted regional model is two-thirds of the standard error of the autoregressive equation.

The national data set suggests how strongly the regional economy has been linked to the economic performance of the rest of the country. Labor market variables are prominently represented in the national equation, as they are in the regional model. U.S. help

wanted advertising and the most recent monthly trade component of the national payroll employment figures are both important for explaining New England employment growth. Use of the monthly number brings more timeliness to the quarterly data even though its contribution is, in general, small. The importance of the rate of growth in contracts for plant and equipment (COPE) is not surprising, as it is a component of the national Index of Leading Indicators.

As with the regional model, what is most surprising about the national model is the indicators that do not enter the equation. The financial variables examined by Friedman and Kuttner (1990) and Stock and Watson (1989) did not perform as well as they have on national variables, although DSLOPE10FF does seem to help predict New England employment growth performance. Again, note that the increased timeliness of these financial series was not important, as the current monthly update did not enter the national equation. The standard error of the national equation is only slightly lower than its regional counterpart but 33 percent lower than the baseline autoregressive equation, suggesting the strength of the linkage between the national economy and New England's.

A perfect indicator of New England employment would, of course, be a "rational," efficient forecast of the region's employment. Unfortunately, that ideal indicator does not exist. The few documented forecasts that could be found were available only on an irregular basis. Cursory examination suggested these limited forecasts did not encompass all available information with predictive content. Forecasts of national data are regularly available and, as revealed earlier, highly correlated with employment growth in New England. As expected, the forecast of national payroll employment was the best predictor of New England employment. Forecasts of national household employment and real GNP had no independent explanatory power once that forecast was included. The expectational equation, however, does not fit as well as the regional or national equations, although it does outperform the autoregressive equation. Part of the failure of the expectational equation relative to its competition is due to the difference between the forecasted variable, national employment growth, and the dependent variable, New England employment growth. The link between national and regional employment movements is not a perfect one, and the correspondence between New England employment growth and real GNP is even weaker. The expectational variables could efficiently use all relevant information, but since the target is different, this test would not reveal that efficiency.

The best model is likely to combine the information from all sets. Building such a model raises several important questions. Are the other data sets proxies for the regional data, or do they play some independent role in predicting New England employment? What is the predictive power of traditional indicators once forward-looking expectational variables are added to the model?

The results of these tests are given in equations V (A) and V (B). The national variables tend to dominate the equations. In equation V (A), lags of New England employment and help wanted advertising are the only regional variables that survive. National help wanted also remains in the equation. The importance of the national series relative to their regional counterparts is vividly illustrated when examining building permit data, where national building permits strongly dominate the best regional building permit variable, both in sample and out of sample.

The best model is likely to combine the information from all sets of variables.

This result seems surprising, as one might expect the national variable to serve at best as a proxy for its regional analog. One reason this national variable dominates may be that it is measured more precisely. Furthermore, national building permits represent the demand not just for construction workers but for all laborers who produce construction materials, wherever these materials are used. The construction supplies business could easily be more important for a region's employment than the construction of housing as such. Therefore, on a more fundamental level no reason exists to believe that a regional variable must outperform its national counterpart.

Equation (B) in section V of Table 5 reports an alternative full information set model to Equation (A). Equation (B) is meant to exemplify a difficult problem. This model is derived from a different baseline equation and a different ordering of the selection of the variables added to the baseline. It is a sign of the robustness of (A) that (B) contains most of its varia-

bles; only regional help wanted, national building permits, and the monthly trade component of payroll employment have been dropped. Equation (B), however, includes two more indicators than equation (A); by adding even more variables, the ability of the equation to fit in sample is improved; its standard error is lower than that of Equation (A). The problem of over-fitting in sample will be examined in the next section, where out-of-sample tests will reveal whether the additional variables really help predict employment growth. Equations V (A) and (B) highlight the difficulties encountered with too many possible indicators and not enough data; at some stage judgment must be used. By reporting two of these models, one basis for such judgments is revealed.

Equations V (A) and (B) contain other important implications. The expectational variable remains in both models. Forecasts of national employment growth provide information beyond the information contained in the "actual" indicator variables, although the forecasts do not replace the more traditional indicators. These "judgment" or forecasting models contain useful information on future employment growth. Furthermore, a financial variable, DDEFAULT, survives in both full information equations. Again, however, the timeliness of the financial data is not important for the prediction of regional employment, as the financial variables' quarterly lags, not their monthly updates, are significant.

The in-sample performance of the full information sets is far superior to their competitors. The standard error in V (A) and (B) is one-half that of their closest rival, the national equation, and about one-fourth that of the autoregressive equation. Based solely on this information, equation V (A) or (B) should be used to predict future employment growth in New England. The standard error, however, only reveals how well the equation has done in the sample period, not how well it will forecast. The best in-sample equation is not necessarily the best predictor out of sample. One reason for this result is possible over-fitting of the data. Because so many variables were examined, the possibility is high of finding a series that moved with future employment growth only by chance over that sample period, where no stable relationship exists. Over a different sample, or outside of that sample, a series may have absolutely no relationship to the dependent variable. One way to test for this over-fitting is to see how the equations perform out of sample. Thus, the performance of each equation in out-of-sample forecasting is examined in the next section.

V. Post-Sample Performance

The previous section identified models based on four different information sets as well as two "global" models based on all information sets combined. Because all the models included lagged values of employment in New England (EPNE), all models will by construction fit the sample period at least as well as model I, the autogressive model. Similarly, the global models, V (A) and V (B), must necessarily fit the sample data at least as well as the single information set models. The information about how well the models fit the sample data describes how the models were created and how their coefficients were estimated, but does not provide much assurance about how well the models would perform in "real time" outside the fit period.

To get some idea of their predictive properties, the models, which had been fit to the 1976:I–1988:IV period, were used to estimate how they would have performed over the period from 1987:I to 1991:I. The two-year overlap represents a compromise between the desire for more degrees of freedom in the fit period and the desire to observe a longer, "post-sample" performance period.[8] Thus, all models were reestimated each quarter, using only information available prior to the forecasts, to simulate what their forecasts would have been if they had been used to forecast the past four years.

Table 6 provides various summary error statistics for each of the models described in Table 5. Column 1 shows the root mean squared error (RMSE) of each model; Column 2 gives the ratio of each model's RMSE to that of equation I, the autogressive model used as a standard of comparison. Column 3 provides the ratio of the post-sample RMSE to the in-sample SER, to gauge the relationship between forecast accuracy and fit. Columns 4 and 5 present information for the mean absolute errors (MAE), which do not penalize large errors disproportionately. Column 6 gives the mean error, predicted less actual employment growth, to measure the bias in the models' forecasts.

Not surprisingly, all of the models tend to overestimate employment growth in the last four years. As seen in column 6, the overestimation is by far the worst for models III and IV, which contain no regional indicators. The overestimation is fairly small for the global models, well below that of the autogressive standard of comparison.

The purely regional model II shows relatively little tendency to overestimate but also was not

Table 6
Post-Sample Performance of the Multivariate Models, 1987:I to 1991:I

Equation	RMSE (1)	$\frac{RMSE_i}{RMSE(I)}$ (2)	$\frac{RMSE}{SER}$ (3)	MAE (4)	$\frac{MAE_i}{MAE(I)}$ (5)	MEAN (6)
I	1.94	1.00	.90	1.74	1.00	1.08
	(2.13)	(1.00)	(.99)	(1.60)	(1.00)	(1.01)
II	1.80	.93	1.23	1.48	.85	.33
	(2.18)	(1.02)	(1.57)	(1.68)	(1.05)	(.42)
III	1.86	.96	1.28	1.50	.86	1.0
	(1.92)	(.90)	(1.68)	(1.51)	(.94)	(1.23)
IV	2.62	1.35	1.55	2.12	1.22	1.75
	(2.62)	(1.23)	(1.59)	(1.94)	(1.20)	(1.76)
V (A)	2.42	1.25	3.38	1.84	1.06	.96
	(1.55)	(.73)	(2.82)	(1.17)	(.73)	(.80)
(B)	1.59	.82	2.82	1.30	.75	.19
	(1.43)	(.67)	(2.97)	(1.07)	(.67)	(.25)

Numbers in parentheses are the summary error statistics compared to the pre-benchmark revisions of 1989–90.
RMSE is the root mean squared error and MAE is the mean absolute error. Columns (2) and (5) compare the forecast error of the given equation relative to equation I.

particularly accurate. Indeed, over this test period, neither the regional information set alone nor the national information set alone could significantly improve upon the simple, autoregressive model's forecasts. The model containing the national employment forecast alone was distinctly inferior to the autoregressive standard of comparison. This suggests that using *only* regional information or *only* national information may not improve upon a fairly simple autogressive model forecast.

The global models are more difficult to evaluate. Taken at face value, model V (A) was somewhat inferior to the autoregressive model and model V (B) somewhat superior. Although the superiority could have been overstated by the partial overlap of the fit and test periods, the performance out of sample of the global (B) model relative to the autoregressive in the 1989:I–1991:I period is identical to that in Table 6. Model (B) does well out of sample; unfortunately, model (A) completely falls apart, reducing the faith one can put in these models.

On the other hand, both of the global models clearly outperformed the autoregressive model in predicting New England employment growth, as measured prior to the March 1991 rebenchmarking of the 1989 and 1990 data (Cronkhite 1989). It is important to recall that the 1990 data are subject to further revision in 1992. How that revision affects these results remains to be seen. In addition, some forecast users care less about the ultimate revised estimate than they do about the earlier estimates. These forecast users could be particularly impressed by the performance of "global" models. The lesson to them seems clear—neither a simple autoregressive model nor a combination of that model with a single information set (regional or national indicators) seems sufficient to generate the best forecast. Apparently, all types of information must be combined to make the best forecast.

VI. New England Employment in Perspective

New England's employment experience measured relative to the nation's is depicted in Figure 1. The past 40 years can be divided into three different periods: (1) a period of slow, but steady decline; (2) a period of gains, or at least stability, with respect to the rest of the nation; and (3) the recent sharp decline.

From 1950 to 1975, New England's employment slowly but steadily declined from 7.4 percent of U.S. employment to 6.0 percent. From 1971 through 1989, New England's employment fluctuated between 6.0

and 6.3 percent of national employment. From one perspective, this period could be viewed as one in which New England employment simply reflected the nation's. Yet, behind this apparent stability, the New England economy had clearly gone out of sync with the rest of the country. The region's unemployment rate fell from almost 30 percent *above* the national average in 1973 (6.1 percent versus 4.8 percent) to nearly 50 percent *below* the national average in 1987 (3.3 percent versus 6.2 percent). Thus, the similarity between the region's and the nation's employment growth was based on a trend that obviously could not be sustained and almost certainly would eventually be reversed. Although it was difficult to predict exactly when the trend would end, New England clearly could not perpetually gain relative to the rest of the nation and was extremely unlikely to sustain an unemployment rate of 3 percent, only one-half the national average.

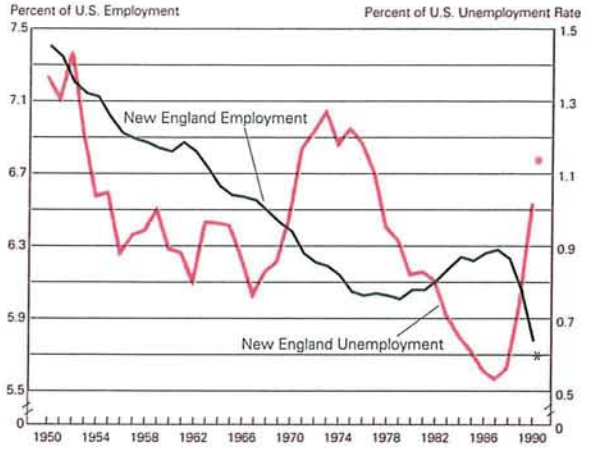
After several years with an unemployment rate below 4 percent, by 1988 labor scarcity and costs in New England had risen at the same time that national employment was accelerating. By 1989, when national employment growth slowed, New England's employment growth had turned negative. Still, it was possible to regard this period as simply a restoration of a more normal relationship between the regional and national unemployment rates, as the region's unemployment rate remained below the national average until mid-1990.

By early 1991, it became clear that the new trend of New England's employment falling behind that of the nation would not end once a more "normal" (long-run equilibrium) unemployment relationship was restored. Just as the extended period of outpacing the rest of the nation fed on itself and overshot the region's productive capacity, the period of reversal was feeding on itself and overshooting any conception of a "normal" role for the region.

Figure 1

New England Employment and Unemployment Rate

(as a percentage of the United States)



* = value in 1991:I.

From this perspective, it is easy to see why 1971–87 indicators of New England employment had difficulty anticipating what would happen in 1988–90. New England's employment growth, which had simply mimicked the nation's for more than a decade, suddenly appeared to have come "unhinged" from the nation's.

As shown on Table 7, New England employment growth had been at least as highly correlated with the past growth of national employment as with its own past values. This relative correlation pattern held for the past 40 years as well as in each decade. In contrast, over the past five years, 1986–90, this structure has broken down. (See row 6 in table 7.) Recent employment in New England is virtually uncorrelated with national employment growth but closely related to its own recent behavior.

This historical review suggests a broad outline of the prospects for employment in New England. In the very short term, the employment losses that have already occurred are feeding on themselves, estab-

Table 7

New England Employment Growth

Correlation Coefficients

	(t-1)		(t-2)	
Sample Period	National	Regional	National	Regional
1950:I–90:IV	.54	.43	.26	.16
1950:I–59:IV	.56	.29	.23	.12
1960:I–69:IV	.46	.32	.23	−.14
1970:I–79:IV	.61	.57	.39	.20
1980:I–89:IV	.49	.50	.19	.16
1986:I–90:IV	.29	.89	.07	.79

lishing a downward momentum that is difficult to reverse quickly. Even if a national recovery starts in mid 1991, as is widely expected, employment growth in New England seems likely to continue to decline.

The gap between New England and the nation cannot continue to grow indefinitely, however. When the nation returns to high employment levels or perhaps even labor scarcity, due to slower increases in population and female participation, the availability of labor in New England will both attract new jobs and slow the growth of the New England labor force. New England will not remain permanently out of step with the rest of the nation.

The exact timing of these changes is, of course, highly uncertain. All of the models developed here indicate the decline is not yet over—employment will fall again in the second quarter. Yet, under the assumption that the recession ends soon, these models do suggest that employment will decline less than 1 percent from mid 1991 to mid 1992, a rate far more moderate than the 3 percent rate of decline in the last two years. Assuming a sustained national expansion, New England employment can be expected to start to grow again before mid 1992.

VII. Summary

This article has investigated various precursors of economic activity in New England. It opened by arguing that employment is the best measure of the region's economy. Timeliness of data was the primary practical consideration, but employment is also intrinsically important as it is closely tied to the region's well-being.

It next examined the definition of a geographic region, noting that it corresponds to neither a political nor a traditional economic unit of analysis. The analogy with a country in international economics is flawed because all resources are interregionally mobile in the long run. The concept of a region is based on a temporary immobility of labor. Because of this immobility and the absence of perfect price flexibility, a region is subject to both region-specific and national cyclical forces. A region's economy floats on the national sea while being buffeted by local tides and winds.

The article then examined numerous individual data series to assess their value as indicators of future employment growth in New England. Over a fairly short, recent period, the best monthly indicators seem to be the measures of the value of residential (or total) construction contracts as well as labor market data such as initial claims and help wanted advertising. Over a somewhat longer time period, several measures of national employment conditions—payroll employment, unemployment, help wanted advertising, average weekly hours, and initial claims—seemed as valuable monthly indicators as the strictly regional series. Perhaps surprisingly, few of the financial market indicators that have become so popular as national indicators fared well for regional employment.

The success of the national labor market indicators stems partly from their timeliness—they are the first nonfinancial indicators to become available. This inference is supported by examining quarterly indicators of New England employment, as timeliness is less crucial for smoothed, lower-frequency data. The best quarterly indicators were primarily those derived from regional labor market data (help wanted advertising, lagged employment, the New England unemployment rate relative to the national rate, the Massachusetts unemployment rate, and initial claims) and regional construction data (on construction, home sales, and building permits). The only top indicators from the national data set were help wanted advertising and forecasts of next quarter's national employment growth.

The article next considered how these indicators could best be combined in a multivariate index or model. The procedure followed was to separate the data series into several distinct information sets: regional, national, expectational, and "global" (that is, all information sets combined). An autoregressive model was developed as a standard of comparison to judge the contribution of the various information sets.

Without a rigorous theoretical or structural framework, model construction is subject to the problem of "over-fitting" or data mining. With this problem in mind, the models were fit to data through 1988 to reserve the more recent experience for post-sample evaluation of the models.

Post-sample evaluation suggested that none of the individual information sets—regional, national, or expectational—could add to the ability of the autoregressive model to predict the recent decline of employment in New England. When all information sets were combined, the results were mixed; the global models were better than the autogressive model at predicting the employment data prior to the rebenchmarking, but one model was slightly more accurate and another less accurate in predicting the latest available data.

Given the extreme conditions in the post-sample test period, these results offer some encouragement that a multivariate model based on all information sets can help to predict employment in New England. At the same time, a number of considerations—the shortness of the test period, the instabilities of the models' coefficients, the deterioration of the models relative to their in-sample fits, and the fact that only one of the two models could add much to the simple autoregressive model—all argue for caution in relying on these precise specifications.

A broader message does seem clear, however. Predicting employment in New England must rely on several types of information: the recent history of New England employment, regional indicators drawn from the construction and labor markets, national economic indicators, and forward-looking "expectational" variables. Each type of information provides a different insight into the myriad of forces affecting the New England economy.

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[1] This assumes, for ease of exposition, that workers' labor supply is completely inelastic.

[2] The assumption here is that industry shocks nationally net out to zero so that no national effects take place, only effects due to nondiversification.

[3] If capital is perfectly, instantaneously, mobile, even regionally fixed labor will always be fully employed. Furthermore, the more immobile these two factors of production, the more important are nontraded goods in the region.

[4] Note that the effect of the shocks discussed in this section may be amplified by the regional multipliers that result from the reaction of the nontraded goods sector. These regional multipliers are merely a reaction to these other shocks and derive from the assumption of factor immobility in the short run.

[5] See McNees (1989) for a more complete discussion of the indicator approach and its application to inflation forecasting.

[6] Specifically, Akaike (1973) suggests choosing the optimal lag length by minimizing

$$-2\ln(\text{maximum likelihood}) + 2(\text{number of lags}),$$

which penalizes the selection of longer lag lengths. In the autoregressive equation in Table 5, the optimal lag length selected is 8 quarters. The value of the criterion at 3 lags was almost identical, which explains why the bivariate work looks at 3 lags, for parsimony.

[7] Preliminary multivariate tests using regional consumer expectations show this variable has promise as a leading indicator of New England employment growth. Because this variable is only available over a short sample, multivariate analysis can only be preliminary. So far, however, it performs much less strongly than the bivariate analysis suggests.

[8] The basic rankings in Table 6 remain the same when the post-sample period is constrained to the 9 quarters not used in the model building, 1989:I–1991:I. This overlap is not affecting the results.

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Appendix Table A1

Employment Market Indicators

Regional	National	Variable Definition[a]
EPNE	EP	Payroll employment, nonagricultural establishments; percent change, annual rate.[b]
HWNE	HW	Index of help-wanted advertising in newspapers.
ICNE	IC	Average weekly initial claims for state unemployment insurance.[c]
URMA	UR	Civilian unemployment rate. Regional variable is for Massachusetts, both are first differences.
EHMA	EH	Civilian employment, household survey.
LFMA	LF	Civilian labor force, total.
AWHNE	AWH	Average weekly hours of production workers, manufacturing.[c]
AHENE	AHE	Average hourly earnings of production workers, manufacturing.
RURMA		Ratio of the civilian unemployment rate for Massachusetts to that of the United States, level.
	SLACK	Persons at work part-time for economic reasons, nonagricultural industries.
	MTRD	Trade component of national payroll employment for the month preceding the prediction.
Construction Market Indicators		
BPNE	BP	Index of housing authorized by local building permits, private.[c]
BPSNE		Housing permits authorized, single units.
HSNE		Total existing home sales, single-family, condo and co-op, thousands of units.
CTNE		Value of total construction contracts index, 1980 = 100.
CRNE		Value of residential construction contracts index, 1980 = 100.
CNNE		Value of nonresidential construction contracts index, 1980 = 100.
Miscellaneous Indicators		
	RGNP	Gross national product, 1982 dollars.
	PCE	Real personal consumption expenditures, total.
RSNE		Total retail sales index, 1980 = 100.
RSNNE		Retail sales index, nondurable goods, 1980 = 100.
CPIB		Consumer price index for Boston, 1982–1984 = 100.
PREB		Precipitation. Deviation from monthly mean of Boston, first difference.
TEMPB		Temperature. Deviation from monthly mean of Boston, first difference.
ECNE		Commercial electricity sales, millions of kilowatt-hours.
EINE		Industrial electricity sales, millions of kilowatt-hours.
ERNE		Residential electricity sales, millions of kilowatt-hours.
NBINE		New business incorporations.
YPNE		Personal income, 1982 dollars.
National Nonfinancial Indicators		
	ILI	Composite index of leading indicators (with trend adjustment).
	COPE	Contracts and orders for plant and equipment.[c]
	NOC	New orders (net) for consumer goods and materials, 1982 dollars.[c]
	VP	Vendor performance, companies receiving slower deliveries.[c]
	SM	Change in sensitive materials prices, smoothed.[c]
	IIP	Index of total industrial production.[b]
	YD	Disposable personal income, 1982 dollars.
	PILT	Personal income less transfer payments, 1982 dollars.[b]
	UOD	Change in manufacturers' unfilled orders, durables.[c]
	BV	Change in book value of manufacturing and trade inventories.
	MTS	Manufacturing and trade sales, 1982 dollars.[b]
Financial Variables		
	RFF	Effective rate on federal funds, level.
	M2	Money supply, M2 in 1982 dollars.[c]
	SP	Standard & Poor's Composite Stock Price Index, Common Stocks.[c]
	SPRED6	Yield on six-month commercial paper minus the yield on six-month Treasury securities, level.
	DSPRED6	First difference of SPRED6.
	TILT101	Yield on Treasury securities at a constant maturity of one year minus the yield on Treasury securities at a constant maturity of 10 years, level.
	DTILT101	First difference of TILT101.
	SLOPE10FF	Effective rate on federal funds minus the yield on Treasury securities at a constant maturity of 10 years, level.
	DSLOPE10FF	First difference of SLOPE10FF.
	DEFAULT	Yield on Moody's AAA corporate bonds minus the yield on Moody's Baa corporate bonds, level.
	DDEFAULT	First difference of DEFAULT.
Expectational Variables		
	FRGNP	Forecast of real GNP.
	FEP	Forecast of payroll employment.
	FEH	Forecast of household employment.
ICSNE	ICS	Index of consumer sentiment, University of Michigan survey, level.[c] Regional variable is the index of consumer confidence, Conference Board Survey, level.[c]
ICENE	ICE	Index of consumer expectations, University of Michigan Survey, level.[c] Regional variable is from Conference Board Survey, level.[c]

[a]Variables are annualized percent changes, unless otherwise indicated.

[b]Component of index of coincident indicators.

[c]Component of index of leading indicators.