FILE COPY

New England Economic Review

Federal Reserve Bank of Boston

Nov./Dec. 1994

Norman S. Fieleke — *Is Global Competition Making the Poor Even Poorer?*

Alan Clayton-Matthews, Yolanda K. Kodrzycki, and Daniel Swaine — *Indexes of Economic Indicators: What Can They Tell Us about the New England Economy?*

Richard J. DeKaser and Jane Sneddon Little — *Explaining New England's Export Performance: 1987 to 1993*

President
Cathy E. Minehan

Senior Vice President and Director of Research
Lynn E. Browne

Research Department:
Banking Studies
Eric S. Rosengren, Vice President
Joe Peek
Robert Tannenwald

Financial Markets
Richard W. Kopcke, Vice President
Stephen R. Blough
Katerina Simons

International
Norman S. Fieleke, Vice President

Open Economy Macroeconomics
Stephen K. McNees, Vice President
Jeffrey C. Fuhrer, Assistant Vice President
Jane Sneddon Little
Geoffrey M. B. Tootell, Assistant Vice President

Regional
Katharine L. Bradbury, Assistant Vice President
Yolanda K. Kodrzycki
Christopher J. Mayer

The **New England Economic Review** is produced in the Research Department and is edited by Joan T. Poskanzer. Heather Schofield coordinates the design and production. The views expressed are those of the individual authors, and do not necessarily reflect official positions of the Federal Reserve Bank of Boston or the Federal Reserve System. The authors will be glad to receive comments on their articles. The Review is available without charge. Requests to be placed on the mailing list or for additional copies should be sent to the Research Library–D, Federal Reserve Bank of Boston, P.O. Box 2076, Boston, MA 02106-2076. Articles may be reprinted if the source is credited. Please send copies of the reprinted materials to the editor.

Contents

Is Global Competition Making the Poor Even Poorer?

Norman S. Fieleke

In recent years, average real wages have fallen, while the distribution of income has become less equal. This applies not just to the United States, but to a number of countries. At the same time, "globalization" has intensified, as national economies have become more closely connected through increased international commerce. Has globalization depressed wages and exacerbated inequality?

To address this issue, this article first presents some summary data on globalization and income distribution. Consideration is then given to various explanations of increasing income inequality. The author concludes that convincing evidence has not yet been marshaled to support the hypothesis that increased globalization has contributed substantially to greater inequality, although globalization remains suspect. He ends the article with some recommendations for policy. 3

Indexes of Economic Indicators: What Can They Tell Us about the New England Economy?

Alan Clayton-Matthews, Yolanda K. Kodrzycki, and Daniel Swaine

This article explores the development of composite coincident indexes summarizing the condition of the economy of New England and its six states. The authors conclude that continued attempts to construct coincident economic indexes at the regional level are worthwhile, for several reasons.

A widely accepted and used index for the region does not exist, although recent advances in statistical methodologies make such indexes possible and practical. Second, the indexes presented are in accord with what knowledgeable observers believe about the New England economy and are less noisy than the observable data from which they are generated. Their timeliness may at least partially fill the information gap created by the lag in regional statistics, especially with regard to personal income and gross state product. Finally, a methodology similar to the one employed in this paper could be used in the development of additional indexes of regional activity that could help in either analyzing current conditions or making forecasts. 17

Contents

Explaining New England's Export Performance: 1987 to 1993

Richard J. DeKaser and Jane Sneddon Little

The recession of the early 1990s hit New England much harder than the nation. Presumably, thus, New England firms are highly motivated to seek rapidly growing markets wherever they may be—including overseas. During the 1990–91 downturn, real net exports cut the depth of the U.S. recession by half. Looking ahead, moreover, recent forecasts by the International Monetary Fund suggest that world growth will outpace U.S. growth in 1995. Despite New Englanders' obvious incentive to explore burgeoning foreign markets, however, the best available data indicate that the region underperformed the nation in terms of export growth from 1987 to 1993.

This article explores the reasons for the region's below-average merchandise export growth and concludes that it largely reflects the relative importance of the regional computer industry and its recent structural problems, not a pervasive "exporting problem." Also contributing are New England exporters' traditional ties to markets in mature industrial countries, such as Atlantic Rim countries, which suffered severe recessions from 1990 to 1993. As the authors point out, however, merchandise exports represent only one route to foreign consumers. New Englanders are also reaching vibrant foreign markets, such as Asia or Latin America, through exports of services and through sales made by foreign affiliates of New England firms. The ongoing restructuring of the regional economy suggests that these alternative paths are likely to become increasingly important over time. 43

Is Global Competition Making the Poor Even Poorer?

Norman S. Fieleke

Vice President and Economist, Federal Reserve Bank of Boston. *Rachel Cononi provided valuable research assistance.*

In recent years a number of economic phenomena have caused dismay, but one in particular seems to justify for economics its hoary reputation as "the dismal science": average real wages have fallen, while the distribution of income has become less equal. This applies not just to the United States, but to a number of countries. At the same time, "globalization" has intensified, as national economies have become more closely connected, or integrated, through increased international commerce.

The correlation between rising income inequality and globalization has inspired suggestions that globalization may have depressed wages and exacerbated inequality, making the poor even poorer. For example, in mid-1993 the head of the U.S. Council of Economic Advisers declared, "Globalization has depressed the wage growth of low-wage workers. It's been a reason for the increasing wage gap between high-wage and low-wage workers" (quoted in Greenhouse 1993).

In addition, during the debate preceding congressional endorsement of the North American Free Trade Agreement, U.S. opponents of the Agreement alleged that free trade between the United States and Mexico would impoverish many low-income workers in the United States, but leave the well-to-do untouched. As Representative David Bonior put it, "Whose side are you on? . . . Are you on the side of the Fortune 500? Or are you on the side of the unfortunate 500,000 who will lose their jobs if NAFTA passes? . . . It's not fair to ask American workers to compete against Mexican workers who earn $1 an hour or less" (quoted in Rosenbaum 1993).

Paradoxically, similar concerns existed within Mexico. In the state of Chiapas, one reported cause of the rebellion was fear among peasants that NAFTA would depress their low farming incomes even further. This anxiety is understandable. Rising income inequality has not been limited to the United States, or even to the wealthiest countries; the gap between the rich and the poor has widened in at least some of the

countries with appreciably lower incomes, including Mexico.[1] Is it possible that globalization has generated greater inequality within the poorer as well as the richer countries?

To address these issues, this article first presents some summary data on globalization and income distribution. Consideration is then given to various explanations of increasing income inequality, including globalization. The primary purpose is to present a concise summary and evaluation of published research into this complex issue, although new ground is also broken. Some recommendations for policy conclude the article. Many countries are included in the analysis, with most attention given to the advanced industrial countries, especially the United States.

I. Globalization and Income Distribution: Some Summary Measures

Measuring the inequality between the incomes received by only two people is a simple matter (once income has been defined in a measurable way), but summarizing the inequality of the different incomes received by a large number of people is much more difficult. An informative summary measure must convey an impression of the dispersion of incomes, of the degree to which incomes vary across the population. For example, one might ascertain the level of income that is exceeded by all but 20 percent of the population, and also the higher level of income that is attained or exceeded by only 20 percent of the population. The ratio of the two income levels—of the top 20th percentile to the bottom 20th (or of the top quintile to the bottom quintile)—would be one index of inequality, or dispersion.

Alternatively, one might compute the percentage share of the population's total income that accrues to those in, say, the top 20 percent and the share accruing to those in the bottom 20 percent. Significant inequality would be present if the top 20 percent received substantially more, or the bottom 20 percent received substantially less, than 20 percent of the population's total income. Other measures could be, and are, employed.[2]

Although different researchers have used different measures of inequality, and of income, a common finding is that inequality has increased in recent years. Much of the research has focused on the United States. One such study, by Kevin Murphy and Finis Welch (1993), reports that hourly wage inequality among men in the United States increased continuously and smoothly from 1969 to 1990, the latest year covered by the study. Another, by Sheldon Danziger and Peter Gottschalk (1993, pp. 6 & 7), notes a rise in family income inequality over approximately the same period. For those who believe consumption to be a better measure of welfare than money income, David Cutler and Lawrence Katz (1992) report that changes in the distribution of consumption during the 1980s paralleled changes in the distribution of income.

Significant inequality exists between countries as well as within them.

A graphic representation of U.S. household experience is presented in Figure 1. For this chart, households were ranked from lowest income to highest and then divided into five groups of equal size. This procedure reveals that between 1967 and 1992 the share of total household income received by the top fifth of the households rose from 43.8 percent to 46.9 percent, while the shares received by the middle three-fifths and the bottom fifth fell from 52.3 percent to 49.4 percent and from 4.0 to 3.8 percent, respectively. Moreover, this trend has been more pronounced in the latter part of the period; in fact, the share of the bottom fifth rose slightly during the first 10 years.

Studies of foreign countries have also discovered a general tendency toward rising inequality.[3] One of the latest and most comprehensive analyses, published by the Organisation for Economic Cooperation and Development (1993), scrutinized data on workers' earnings for 17 OECD member countries and found increases in inequality in 12 of them during the 1980s. The increases were generally small, however, except in the United Kingdom and the United States. Only in Germany did inequality decline.

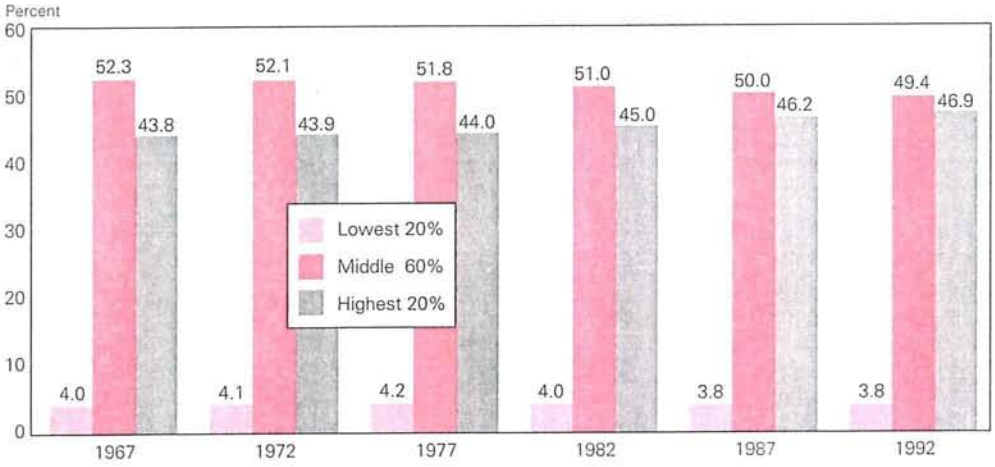
[1] See *Review of the Economic Situation in Mexico*, vol. LXX, no. 821 (April 1994), pp. 175–76.

[2] For a succinct discussion of methods of measuring inequality, see Organisation for Economic Cooperation and Development, *Employment Outlook July 1993* (Paris: OECD, 1993), pp. 179–81.

[3] See, for example, Blau and Kahn (1994), Katz, Loveman, and Blanchflower (1993), and Green, Coder, and Ryscavage (1992), as well as sources cited below.

Figure 1

Share of Aggregate U.S. Household Income, by Quintile: 1967 to 1992



Source: U.S. Bureau of the Census, *Money Income of Households, Families, and Persons in the United States: 1992*, p.xviii.

Some key findings of the OECD study are summarized in Figure 2, which relates to male workers, for whom the greatest number of countries report data. The underlying data are for deciles, with the first decile (D1) defined as the upper limit of the earnings of the bottom tenth of earners, the fifth decile (D5) as the earnings level on either side of which 50 percent of all earners lie, and the ninth decile (D9) as the lower limit of the earnings of the top tenth of earners.

As shown in this chart, during the 1980s the ratio of the ninth to the fifth decile rose in all of the 12 countries included except the Netherlands and Sweden, while the ratio of the first to the fifth decile fell in 8 of the countries.[4] By these measures, then, a general tendency toward greater inequality prevailed. A widespread tendency existed for the highest earners to earn more relative to those in the middle, accompanied by a somewhat less pervasive tendency for the lowest earners to earn less compared to those in the middle.

Of course, significant income inequality exists between countries as well as within them. In Figure 3, which summarizes data for 94 countries, it can be seen that 30 had a total output per capita of less than $2,000 in 1990, while at the opposite end of the spectrum a few enjoyed output per capita in excess of $20,000. Moreover, the degree of inequality in per capita GDP increased during the 1980s. From 1980 to 1990 the ratio of the top quintile to the bottom quintile among these countries rose from 9.9 to 12.3, and the coefficient of variation (another measure of dispersion) among the per capita GDPs rose from 88 to 98.

The general increase in inequality has occurred at a time of increasing globalization, or integration, of the world economy, as commerce between nations has grown more rapidly than world output. For example, between 1967 and 1993 the volume of world trade expanded at a compound annual rate of 5.3 percent, while world output grew at a rate of 3.4 percent.[5] And for many nations the value of their exports and imports has risen in relation to their total output.

This correlation between the increases in globalization and in inequality has fueled speculation that the former has contributed heavily to the latter. Is this speculation correct, or are factors other than globalization responsible?

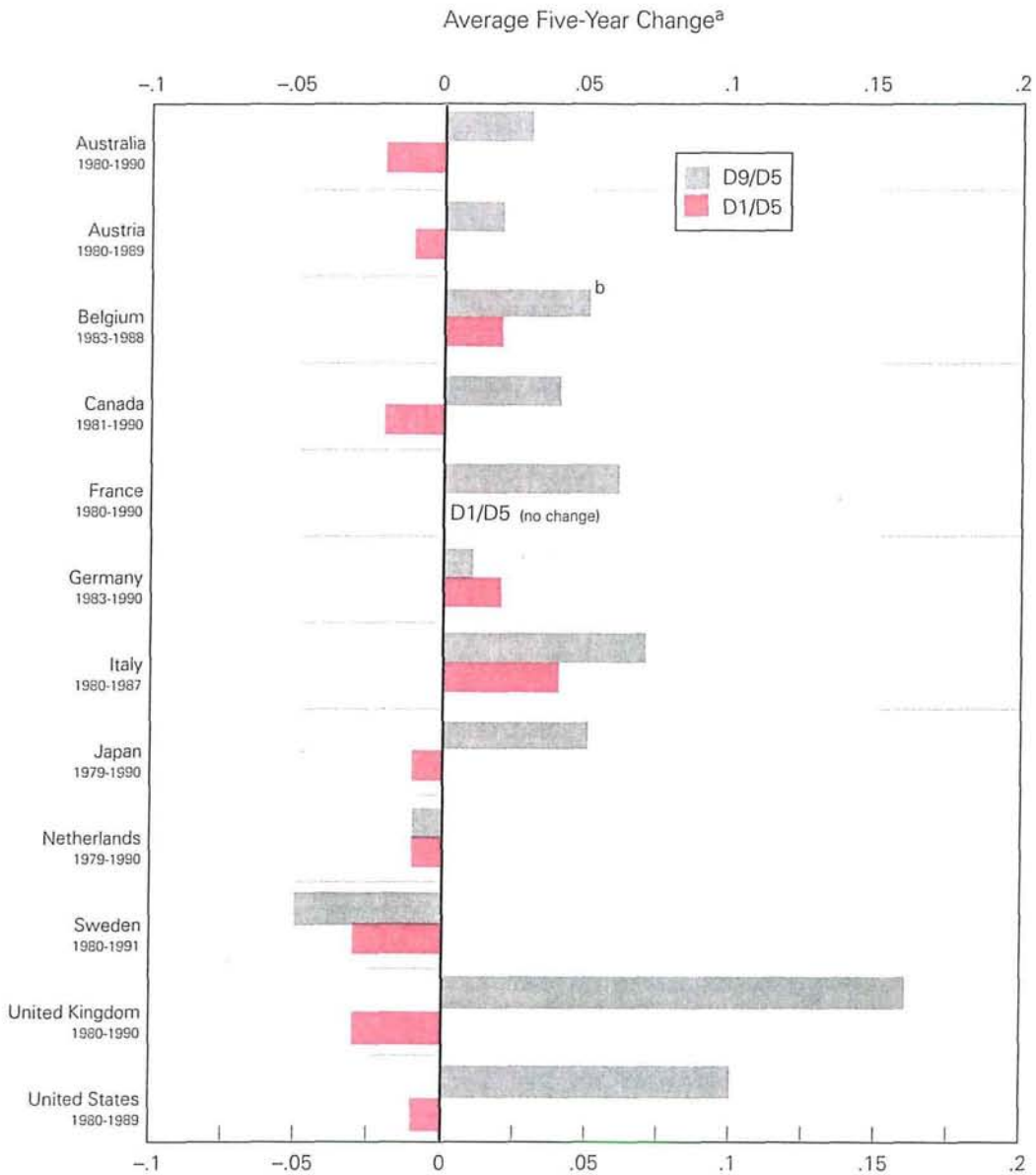
To explain changes in price, economists commonly invoke the law of supply and demand. The

[4] For Belgium, the eighth decile is used as a substitute for the ninth.

[5] International Monetary Fund, *World Economic Outlook*, various issues. Washington: IMF.

Figure 2

Changes in Ratios of Earnings Deciles for Men in the 1980s



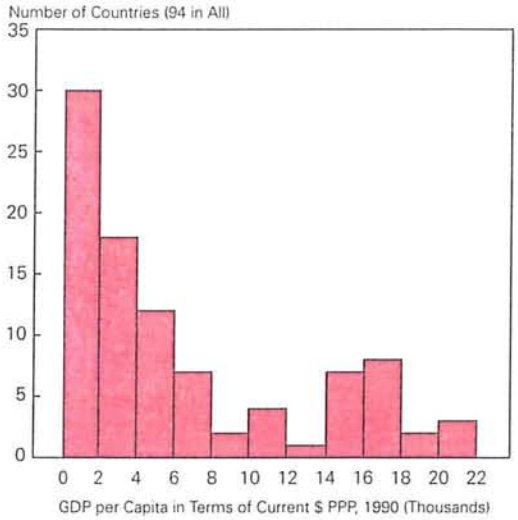
[a] Average annual arithmetic change in the ratios, over period shown, on a five-year basis.
b D8/D5.
Source: OECD, *Employment Outlook*, July 1993, Table 5.2, pp. 159-161.

price, or earnings, of labor is no exception. Thus, the following sections consider various factors, including globalization, that might have influenced the supply and demand for different categories of labor so as to generate significantly greater inequality. Because the relevant data for less-developed countries are very limited, most of the discussion relates to the advanced industrial nations.[6]

[6] Of the various sources tapped for this discussion, the most valuable was Organisation for Economic Cooperation and Development, *Employment Outlook July 1993*, pp. 157–77.

Figure 3

GDP per Capita in Terms of Current $ Purchasing Power Parity, 1990



Source: Summers, Robert and Alan Heston, *Penn World Table*, 1993.

II. Supply-Side Influences

Many factors can change the relative supply of different types of workers. Among the factors commonly deemed potentially most important are changes in the age and educational composition of the work force, including the effects of immigration, and changes in the organization, especially unionization, of the work force.

Immigration

An influx of skilled immigrants could lower the relative remuneration of skilled workers in a country, while an influx of unskilled could have the opposite effect. During the 1980s the great majority of the advanced industrial countries recorded net immigration. As the job-seekers among these immigrants usually competed for low-skilled, low-paying positions, the likely net impact was to contribute to the rise in inequality.

The size of the impact was probably small, however, with the possible exception of the United States. The United States experienced not only relatively sizable immigration, but also a substantial illegal component of generally unskilled and inexperienced job-seekers. While this influx surely operated to reduce the earnings of the less skilled relative to those of more skilled workers, the influx could hardly have been large enough to account for all, or even most, of the reduction that occurred (Bound and Johnson 1991, esp. pp. 83–84).

Other industrial countries generally absorbed comparatively fewer immigrants. Moreover, Italy, Portugal, and Spain, which absorbed relatively large numbers from less-developed countries, did not experience exceptional increases in earnings inequality. Thus, as the OECD study notes, immigration probably played a minor role in generating greater inequality within the industrial countries as a group.

Changes in Age Composition

During the early 1980s the populations of many industrial countries included relatively high numbers of 15- to 24-year-olds. Their entry into the work force could be expected to place downward pressure on the comparatively low pay typically received by young and inexperienced workers, thereby widening the degree of inequality. Indeed, the relative earnings of the young did decline during the decade in a number of these countries.

More than age may have been at work, however. As these "baby boomers" aged and the relative supply of 15- to 24-year-olds decreased during the latter 1980s, the comparative wage paid to these young workers might have been expected to recover. Noting that such wage recoveries were not universal and did not occur in the United States, analysts have suggested that it was relatively weak demand for less educated workers—including the typical young person—rather than mere inexperience, that may have depressed the comparative earnings of this age group.

Changes in Educational Composition

With regard to this matter of education: on the supply side, a marked rise occurred in the percentage of the work force with college education in industrial countries during the 1980s. As reported in Table 1, this rise ranged from roughly 2 to 6½ percentage points for the countries for which data are readily available. Other things equal, it would seem that the relative remuneration of these highly educated workers should have declined as their relative numbers grew.

That this decline did not generally ensue is obvious in Table 2, which includes the countries from

Table 1
Percentage of Work Force or Population with College Education

Country and Population Group	Year and Percent	
Australia: for full-time, full year	1981–82	1988–90
males in work force	9.1	13.4
France: for males over 15 years	1980	1989
of age	8.3	11.8
Germany: for working-age	1982	1989
population	7.4	9.4
Japan: for all employees	1979	1990
	17.9	22.5
Sweden: for total labor force	1980	1989
	16.6	23.1
United Kingdom: for total	1979	1989
population aged 16 to 60	12.0	18.3
United States: for total population	1979	1989
aged 18 to 64	16.6	21.5

Source: Organisation for Economic Cooperation and Development, *Employment Outlook July 1993* (Paris: OECD, 1993), p. 172.

Table 2
Change in Ratio of Earnings of College-Educated to Earnings of Less Educated, for Men

Country and Educational Groups	Initial Year and Ratio Value	Terminal Year and Ratio Value	Five-Year Annual Average Change in Ratio[a]
Australia: University/trade	1982:[b]	1990:[b]	+.03
Japan: College/upper high school	1979:1.26	1987:1.26	.00
Sweden: University/post-secondary	1981:1.16	1986:1.19	+.03
United Kingdom: University/no qualification	1980:1.53	1988:1.65	+.08
United States: College/high school	1979:1.37	1987:1.51	+.09

[a]Average annual arithmetic change in the ratios calculated on a five-year basis.
[b]Ratio values not supplied by OECD.
Source: Organisation for Economic Cooperation and Development, *Employment Outlook July 1993* (Paris: OECD, 1993), p. 171.

Table 1 for which earnings data by educational level could be obtained. In fact, increases rather than decreases were the rule. Among these five countries, the United States and the United Kingdom experienced the greatest increases in relative earnings of college-educated men, even though they also experienced substantial increases in their proportions of college-educated workers.

Again, it seems clear that demand as well as supply-side influences must be taken into account if the rise in inequality is to explained. First, however, one more supply-side factor will be considered.

Organization of the Work Force

Whether and how the work force organizes to bargain over the terms on which it supplies its labor could have a pronounced effect on the degree of earnings inequality. Thus, changes in the extent of unionization often receive attention in studies of changing inequality. As a general rule, countries with more highly unionized work forces exhibit lower degrees of inequality. Moreover, the widespread rise in inequality during the 1980s was accompanied by a fall in unionization rates in nearly all industrial countries, including the United States.

How much of the increased inequality should be attributed to diminished unionization is questionable, however. Diminished unionization may be not so much a cause of increased inequality as a consequence of other changes that not only reduced unionization rates but enhanced the bargaining power of skilled relative to unskilled workers more generally. These changes include the shift away from standardized production systems toward "non-standard" forms of work (a shift facilitated by more sophisticated computers), the shift of employment toward the service sector (with its smaller firms commonly not unionized), and the adoption by many governments of more conservative, freer-market policies.

III. The Role of Demand

As has been noted, the relative earnings of the college-educated rose during the 1980s even though they came to account for a larger proportion of the work force. This outcome implies that the demand for increases in the college-educated proportion may

have been growing faster than that proportion. Among the factors commonly suspected of generating this growth in demand are the business cycle, shifts in demand between industries, international trade, and technological progress.

The Business Cycle

Recessions might be expected to boost the relative earnings of skilled workers. The fact that the unskilled are more likely to be laid off seems to imply that the demand for their services weakens relative to that for skilled workers. Also, skilled workers may compete for jobs that in better times would be left to the unskilled, putting further downward pressure on the relative wages of the unskilled. During recoveries this process would reverse, and the relative earnings of the unskilled would tend to recover.

In general, earnings inequality rose, rather than declined, in industrial countries during the second half of the 1980s, even as unemployment rates declined.

While this process may be at work, the effects it might have generated have been outweighed by other influences. In general, earnings inequality rose, rather than declined, in industrial countries during the second half of the 1980s, even as unemployment rates declined. The United Kingdom and the United States stand out for marked increases in inequality during all phases of the economic cycles of the decade.

Shifts in Demand between Industries

Another factor that would operate to raise the relative earnings of skilled labor would be a shift in demand favoring relatively more employment in industries utilizing largely skilled labor and relatively less employment in other industries. In fact, shifts in employment between industries accounted for only a small part of the overall increase in relative earnings of skilled labor during the 1980s in virtually all of the countries for which data are readily available. Much more important was the increase in inequality *within* industries. Corresponding to this fact, the proportion of college-educated workers rose within all sectors of the economies of such countries.

Thus, shifts in employment from the manufacturing sector to the service sector—sometimes labeled "deindustrialization"—seem unlikely to account for the increase in inequality. Other explanations hold more promise.

International Trade: Preliminary Considerations

Both economic theory and common intuition suggest that trade with less-developed countries could lower the relative wages of the unskilled in industrial countries. The ratio of unskilled to skilled workers is lower in industrial than in less-developed countries, and the supply of goods produced by unskilled workers is also relatively smaller. Thus, other things equal, industrial countries demand products made with comparatively large inputs of unskilled labor from the less-developed countries, while the latter demand the products of skilled labor in exchange; and this pattern of reciprocal international demand operates to reduce the relative earnings of the unskilled in industrial countries and to raise them in the less-developed.

Persuasive as this argument may be, it rests on assumptions that may well be invalid. For example, it assumes that both the composition of demand for various goods and the techniques of production are the same (or inconsequentially different) in less-developed as in industrial countries. Even more extreme assumptions are required to support an argument that trade with less-developed countries reduces the *level* of the real wage, not just the *relative* wage, of the unskilled in industrial countries.

Aside from the theorizing, quantitative analyses of the impact of trade have yielded differing results. The weight of expert analysis has held that trade has had only a minor influence on income distribution, but this view is far from universal. The next sections consider the two most extensive—and conflicting—empirical studies of this issue.

An Argument That Trade Has Increased Inequality

In an imposing new book, Adrian Wood, a British economist, argues that trade with developing countries has significantly depressed the earnings of unskilled labor in the advanced countries. To begin with, Wood (1994) points out that the developing countries increased their exports of manufactures to

the advanced countries at a rapid rate—about 15 percent per year in real terms—between 1960 and 1990. (He might also have noted that manufactures from developing countries have comprised a rapidly growing share of all manufactured imports into developed market economies, rising from 4.8 percent of the total in 1970 to 8.6 percent in 1980 and 13.7 percent in 1990.)[7] This growth he attributes chiefly to a reduction in barriers to trade, including reductions in transportation and communication costs as well as in tariffs and other government restrictions.

A British economist argues that trade with developing countries has significantly depressed the earnings of unskilled labor in the advanced countries.

Almost without exception, previous analyses have found such trade to have little impact on labor markets in industrial countries. Wood asserts that these studies grossly underestimate the true impact, often because of a mistaken assumption about the labor content of goods imported by the advanced countries from developing countries. The studies commonly assume the labor content of these imports to be the same as the labor content of comparable categories of goods manufactured in the advanced countries. However, these supposedly comparable categories are seldom identical to the developing country goods, which have generally gone out of production in the advanced countries under competition from developing countries. Production of truly identical goods in the advanced countries would require much more unskilled labor than the comparable (but not at all identical) categories of goods that have survived the competition from developing countries. Thus, previous studies greatly underestimate the impact of goods from developing countries on relative wages in the advanced countries.

To avoid this alleged error, Wood calculates new estimates of the unskilled labor that would be needed in the advanced countries to duplicate and replace their manufactured imports from developing countries. The estimates are based on measures of labor input used in the developing countries, adjusted to reflect the effect on that labor input that would be exerted by differences in relative labor (and capital) prices between the advanced and developing countries. On the basis of these new estimates, the growth of trade in manufactured goods between the advanced and developing countries is said to have brought about a cumulative reduction in the demand for unskilled labor of about 9 million person-years in manufacturing in the advanced countries as of 1990.

Even this figure is claimed to be too low, however, on two counts. First, it fails to recognize that advanced country manufacturers, under competitive pressure from the developing countries, have made innovations that economize on unskilled labor. Such innovation is estimated to have diminished the demand for unskilled labor in advanced country manufacturing by roughly another 9 million person-years. Second, the figure should be enlarged to encompass the impact on the services industries in the advanced countries, both the industries that supply services to manufacturers there and face no international competition and also the services industries that face competition from the developing countries.

With these two corrections, the total reduction in demand for unskilled labor in the advanced countries is said to be roughly 36 million person-years, equivalent to a reduction in demand for unskilled relative to skilled labor of approximately 20 percent. Although this estimated shift in demand took place over three decades, it was concentrated in the 1980s. According to Wood, this shift was the main cause, on the demand side, of the increased inequality during the 1980s between the earnings of the skilled and the unskilled.

Central to Wood's analysis is his calculation of the labor content that would be required in the advanced countries to duplicate and replace the manufactured goods imported from the developing countries. The calculation assumes that the methods used to produce those goods in the developing countries are essentially the same as would be used in the advanced countries, the only difference being that developing country producers would use, say, eight hours of unskilled and two hours of skilled labor to manufacture a product that advanced country producers would make with, say, four hours of unskilled and three hours of skilled labor—the difference being attributable not to any difference in the technology

[7] See United Nations Conference on Trade and Development, *Handbook of International Trade and Development Statistics 1992* (New York: United Nations, 1993), p. 94.

used but to the relatively lower wage of unskilled labor in the developing countries.

However, it seems unlikely that the advanced countries use, or would use, the same technology as the developing countries to produce all, or even most, of the goods that are shipped from the developing to the advanced countries. For one thing, so much labor would be used in the advanced countries that the goods might well become prohibitively expensive.[8] In addition, research has discovered sizable and persistent gaps across even the advanced countries in both labor and total factor productivity by industry, a finding consistent with significant technological differences (Golub 1994, p. 289). Finally, it might be noted, the more closely the developing countries have in fact duplicated the technology of the advanced countries, the slimmer the grounds for classifying them in a lower stage of development and assuming that they have an abundance of unskilled workers.

A Contrary Analysis of the Impact of Trade

An alternative approach to analyzing the impact of international trade on inequality starts by examining the behavior of certain prices believed to be closely related to relative wages. As already noted, it seems that less-developed countries relatively well-endowed with unskilled labor should export manufactures made largely by such labor to the advanced countries, while the latter should export in return manufactured items made with comparatively greater inputs of skilled labor. As a consequence of such trade, in the advanced countries the price of goods with a comparatively large unskilled-labor content would tend to fall relative to the price of goods with a comparatively large skilled-labor content, and the relative wage of unskilled labor would also decline. By contrast, in the less-developed countries, such trade would tend to lower the relative price of goods with a comparatively large skilled-labor content, and thus to lower the relative wage of skilled labor. By this line of reasoning, if trade is to be held responsible for the decline in relative earnings of the unskilled in advanced countries, one should observe a decline in those countries in the relative prices of goods with comparatively large unskilled-labor content.

In fact, no such relative price decline is evident, at least for the United States, according to a recent analysis by Lawrence and Slaughter (1993). On the contrary, the relative price of traded goods produced with comparatively large inputs of unskilled labor rose slightly, rather than declined, in this country during the 1980s. By this test, then, international trade did not contribute to the rise in inequality.

A related test can also be performed. If trade had driven down the relative cost of employing unskilled labor, industries should have raised the ratio of unskilled labor to skilled labor that they employ, other things equal. It would be possible for all industries to make this shift, even though the labor force remained unchanged, by altering the proportions in which total output is divided among them. Industries employing comparatively large ratios of unskilled labor would contract their output under competition from similar industries in the less-developed countries, although the overall proportion of unskilled among the work force they retained would rise because of the relatively lower wage now paid such workers. Other industries would raise the ratio of their unskilled to skilled labor by absorbing the comparatively large numbers of unskilled workers released from the contracting industries.

Again, not this shift, but the opposite shift, was detected by Lawrence and Slaughter. Throughout U.S. manufacturing a pervasive decline has occurred in the ratio of unskilled to skilled labor. And again, international trade seems exonerated of the charge of generating greater inequality.

These findings are not conclusive, however. It is possible that trade with less-developed countries did tend to influence prices so as to generate greater inequality, but that this influence was offset by other forces. Lacking convincing evidence of such a phenomenon, many analysts speculate that technological change, rather than international trade, played the leading role—but not the sole role—in raising the relative earnings of those near the top of the earnings distribution.

Technological Change

Technological progress, or advances in know-how, can take various forms. If it raises the output of the typical skilled worker relative to that of the unskilled, the demand for skilled workers will grow compared to that for the unskilled, other things

[8] Richard N. Cooper, "Foreign Trade, Wages and Unemployment," unpublished paper, Harvard University, Cambridge, MA, July 1994. Cooper estimates that increased import competition from developing countries accounts for only 10 percent of the relative decline in wages of U.S. unskilled workers during the 1980s.

equal, thereby raising the relative earnings of the skilled.

Several pieces of evidence suggest that such "skill-biased" technological progress may well have taken place during the 1980s in the advanced countries. First, the relative earnings of the skilled rose even though the relative supply of these workers also grew. Second, the relative earnings of the skilled rose *within* virtually every industry. Finally, the relative earnings of highly educated workers and the share of highly educated workers as a percentage of total employment are highest in the most technologically advanced industries, such as those using sophisticated computers.

Many analysts speculate that technological change, rather than international trade, played the leading role—but not the sole role—in raising the relative earnings of those near the top of the earnings distribution.

One problem with this explanation of the increase in inequality is that in some countries inequality increased not only between groups of workers with different measured skill levels, but also among workers in the same skill groupings. It may well be, however, that the measured skill groupings are so broad as to conceal significant within-group skill differentials, and that the increased within-group inequality merely reflects the growth in relative demand for the more skilled at all levels.

Other problems in relying on technological change as the primary explanation are not so easily dismissed. For one thing, direct measures of technological change are not available to support the explanation; one must rely on indirect evidence. For another, the slow growth in productivity and real wages in many advanced countries during the 1980s somewhat undermines the hypothesis that technological progress has been a powerful force.

What does seem likely is that the same causal forces have been at work in many advanced countries, in view of the widespread nature of the increase in inequality. The cross-country experience with inequality is examined further in the next section.

IV. Casting a Wider Net: A Preliminary Investigation

The preceding discussion has focused on the advanced countries, primarily because much more of the relevant data are available for them than for the less-developed countries. Nonetheless, some useful data are available for the less-developed countries, and these data, together with data for the advanced countries, permit an examination of a much wider range of experience than that in the advanced countries alone. Casting the exploratory net over more countries may yield additional insight, even though the broader data base leaves much to be desired.

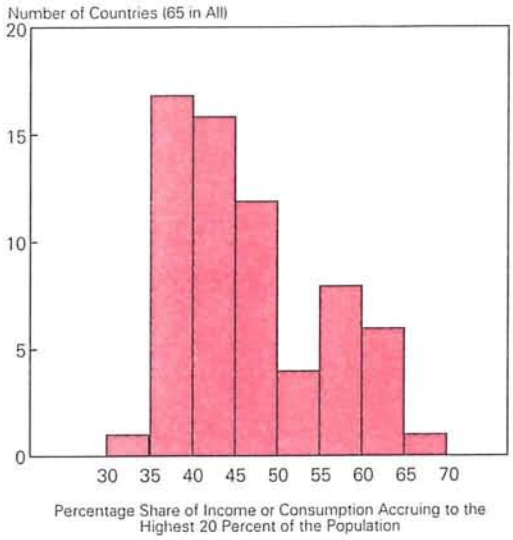
As stated at the beginning of this article, inequality can be measured in different ways. The measure that has been published and that will be used for the broad range of countries examined here is the percentage share of the population's total income or consumption expenditure accounted for by those in the highest 20 percent of income recipients or consumption spenders, on the one hand, and by those in the lowest 20 percent, on the other hand. Because this measure was not compiled for all countries in the same way or for the same year, only rough comparisions across countries can be made.

As can be seen in Figures 4 and 5, the 65 countries for which this measure is available have varied considerably in their degree of inequality. In a few countries, the top 20 percent of the population has received as much 60 to 70 percent of the total income or consumption, although the most typical proportions have been 35 to 45 percent. At the other extreme, in some countries the bottom 20 percent of the population has received as little as 1 to 3 percent of the total income or consumption, with the typical proportions ranging between 5 and 7 percent.

What accounts for this variation from one country to the next? The answer to this question should help us to discover what causes changes in inequality over time within individual countries. The preceding discussion has cited a number of influences, or variables, that could generate inequality. For some of these variables, lack of data prevents their inclusion in a comprehensive statistical analysis, but for a number of key variables the data are available for many countries. Specifically, in an attempt to explain some of the variation in inequality across countries,

Figure 4

Percentage Share of Income or Consumption Accruing to the Highest 20 Percent of the Population



Source: *World Development Report 1994*, World Bank (1994), Table 30.

the analysis undertaken in this section utilizes data for the age and educational composition of the population of each country, for the share of the country's output that consists of services, and for the extent of the country's integration into the world economy.

With respect to age, it is commonly assumed that a worker's earnings generally rise with age during his or her productive working lifetime, since age usually brings experience and seniority. But if experienced workers become relatively numerous, competition among them will tend to decrease the share of the total income accruing to the higher earners. Accordingly, this analysis posits that as the percentage of the population aged 40 to 64 rises, the share of the population's income accruing to the top 20 percent declines, other things equal.

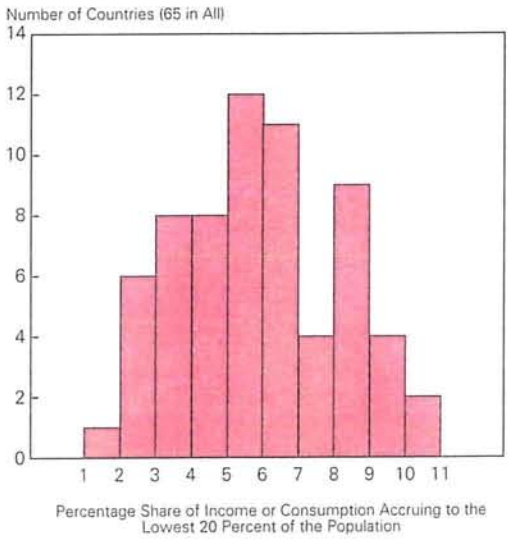
Similar reasoning applies to the relationship between the percentage of the labor force that is well-educated and the percentage of income that is received by the top quintile of the population. Thus, the latter percentage is expected to diminish as the well-educated become relatively more numerous, unless offsetting influences prevail. For the broad spectrum of countries being considered, a well-educated member of the labor force is here defined as a person aged 25 or older who has completed at least a secondary education.

It may be that a country's relative demand for skilled workers grows as the country concentrates more on the production of services and less on the production of goods. This is not to say that "deindustrialization" as such begets inequality, but that the transition to a more service-oriented economy is associated with a comparatively greater demand for many types of skilled labor. Thus, the present analysis examines whether the share of income received by the top 20 percent of the population tends to rise with the share of the country's output consisting of services.

Last but by no means least is the relationship between globalization and inequality. One measure of the degree to which a country has become "globalized" is the ratio of its international trade in goods and services to its total output. This ratio is a general index of the country's integration or interdependence with the world economy. The question addressed here is whether the share of income accruing to the

Figure 5

Percentage Share of Income or Consumption Accruing to the Lowest 20 Percent of the Population



Source: *World Development Report 1994*, World Bank (1994), Table 30.

top 20 percent of the population rises as this measure of globalization rises, other things equal.

The results of the analysis, which are reported in more detail in the appendix, reveal statistically significant relationships of the kind expected between the share of income or consumption accruing to the top 20 percent of the population, on the one hand, and the measures employed for age, education, and services, on the other hand, for the 48 countries that could be included.[9] From country to country, the income share going to the top quintile tends to fall as increases occur in the percentage of the population aged 40 to 64 and in the percentage of the population aged 25 or over with at least a secondary school education. Also, that income share tends to rise with the percentage of the country's gross domestic product that consists of services. However, no significant relationship was discovered between the income share of the top 20 percent and the degree of globalization.

Analysis reveals statistically significant relationships between the share of income or consumption accruing to the top 20 percent of the population and the age of the working population, the percentage that is well-educated, and the share of output consisting of services—but not the degree of globalization.

These results generally correspond with the views expressed in other studies of inequality. Like those studies, the analysis undertaken here is handicapped by the lack of a reliable measure of technological change, and would have to appeal to some unmeasured phenomenon such as technological change to explain the bulk of the variation observed in internal inequality across countries.

V. Conclusion

Within many countries, the incomes received by the inhabitants became less equal during the 1980s. Among the possible explanations, immigration flows and changes in the age composition of the population, and perhaps changes in the organization of the work force, seem to have influenced the supply of labor so as to engender higher inequality in at least some of the advanced countries. For most analysts, however, the key factor has been skill-biased technological change, which presumably has rapidly raised the relative demand for skilled labor.

Convincing evidence has not yet been marshaled to support the hypothesis that increased globalization has contributed substantially to greater inequality. But globalization remains suspect, and if it is believed to have this effect, what would be the proper policy response? It is easier to specify what should not be done than to specify what should be done.

Protectionist measures that would limit the degree of globalization, or of world economic integration, should be eschewed, because increasing integration surely benefits the world economy by introducing greater efficiency, thereby raising world output per capita. If increasing inequality is judged undesirable, measures should be considered to redistribute income with minimal impairment of incentives and efficiency. And if the relative demand for skilled labor is in truth rapidly increasing, that fact bolsters the case for enhancing the quality of education and specialized occupational training (understandably, a favorite recommendation of academic researchers).

Prudence would favor keeping an open mind on the question of what has produced the rising inequality observed in so many countries. Research into the issue has been largely probing, preliminary in nature, and definitive answers have yet to be discovered. As with many other complex social phenomena that economics tries to unravel, satisfactory explanations do not come easily.

[9] Simultaneity may be present, but probably not crucially, in the equation specified in the appendix.

Appendix

Following is the estimated regression equation discussed in the section entitled, "Casting a Wider Net: A Preliminary Investigation." Forty-eight countries were included in the estimation, with data primarily for the 1980s. T-statistics are in parentheses and, if starred, are significantly different from zero at the 0.05 level under the one-tail test appropriate for the hypotheses under consideration.

$$H20 = 53.35 - 0.90A - 0.20E + 0.27S + 0.03I; \ \bar{R}^2 = 0.46;$$
$$(7.89) \quad (-4.24)^* \quad (-1.74)^* \quad (1.94)^* \quad (0.52)$$

where

H20 = percentage share of income or consumption expenditures attributable to the highest 20 percent of the population;
A = percentage of population aged 40–64;
E = percentage of population aged 25 or over having completed secondary or higher education;
S = services production as a percentage of GDP; and
I = ½ (exports + imports) as a percentage of GDP, a measure of integration.

Sources of data:

H20: World Bank, *World Development Report 1994: Infrastructure for Development* (New York: Oxford University Press, 1994), Table 30: Income distribution and PPP estimates of GNP, pp. 220–21.

A: Bos, Eduard, My T.Vu, Ann Levin, and Rodolfo A. Bulatao, *World Population Projections 1992–93 Edition: Estimate and Projections with Related Demographic Statistics* (Baltimore: The Johns Hopkins University Press, 1992) (diskette).

E: Barro, Robert J. and Jong-Wha Lee, *International Comparisons of Educational Attainment*, NBER Working Paper No. 4349 (Cambridge, MA: NBER, July 1993) (diskette).

S: World Bank, *World Development Report* (New York: Oxford University Press, various years), Table 3: Structure of production.

I: International Monetary Fund, *International Financial Statistics* (Washington, D. C.: International Monetary Fund, December 1993); International Monetary Fund, *International Financial Statistics* from FAME database; and International Monetary Fund, *International Financial Statistics Yearbook 1993* (Washington, D. C.: International Monetary Fund, 1993).

References

Abraham, Katharine G. and Susan N. Houseman. 1993. "Earnings Inequality in Germany." National Bureau of Economic Research Working Paper no. 4541, November.

Atkinson, Anthony B., Lee Rainwater, and Timothy M. Smeeding. 1994. *Income Distribution in OECD Countries: The Evidence from the Luxembourg Income Study (LIS)*. Prepared for the American Economic Association, Boston, MA, January 5, 1994.

Barro, Robert J. and Jong-Wha Lee. 1993. "International Comparisons of Educational Attainment." National Bureau of Economic Research Working Paper no. 4349, July (diskette).

Bhagwati, Jagdish. 1994. "Free Trade: Old and New Challenges." *The Economic Journal*, March, pp. 231–46.

Blau, Francine D. and Lawrence M. Kahn. 1994. "International Differences in Male Wage Inequality: Institutions versus Market Forces." National Bureau of Economic Research Working Paper no. 4678, March.

Borjas, George J. and Valerie A. Ramey. 1993. "Foreign Competition, Market Power, and Wage Inequality: Theory and Evidence." National Bureau of Economic Research Working Paper no. 4556, December.

Bos, Eduard, My T. Vu, Ann Levin, and Rodolfo A. Bulatao. 1992. *World Population Projections 1992–93 Edition: Estimate and Projections with Related Demographic Statistics*. Baltimore: The Johns Hopkins University Press (diskette).

Bound, John and George Johnson. 1991. "Wages in the United States During the 1980s and Beyond." In M.H. Kosters, ed., *Workers and Their Wages*, pp. 77–106. Washington, D.C.: American Enterprise Institute.

Chen, Shaohua, Gaurav Datt, and Martin Ravallion. 1993. *Is Poverty Increasing in the Developing World?* WPS 1146 (June). Washington, D.C.: The World Bank, Policy Research Dissemination Center.

Cooper, Richard N. 1994. *Foreign Trade, Wages, and Unemployment*. Preliminary draft, Harvard University, Cambridge, MA, July.

Cutler, David M. and Lawrence F. Katz. 1992. "Rising Inequality? Changes in the Distribution of Income and Consumption in the 1980s." National Bureau of Economic Research Working Paper no. 3964, January.

Danziger, Sheldon and Peter Gottschalk, eds. 1993. *Uneven Tides: Rising Inequality in America*. New York: Russell Sage Foundation.

Davis, Steven J. 1992. "Cross-Country Patterns of Change in Relative Wages." In Olivier Jean Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual 1992*, pp. 239–300. Cambridge, MA: The MIT Press.

Gittleman, Maury. 1994. "Earnings in the 1980's: An Occupational Perspective." *Monthly Labor Review*, July, pp. 16–27.

Golub, Stephen S. 1994. "Comparative Advantage, Exchange Rates, and Sectoral Trade Balances of Major Industrial Countries." *International Monetary Fund Staff Papers*, vol. 41, no. 2 (June), pp. 286–313.

Gottschalk, Peter and Mary Joyce. 1992. *Is Earnings Inequality Also Rising in Other Industrialized Countries?* Working Paper No. 223 (October). Boston: Boston College Department of Economics.

"The Great Challenge: Growth with Equality." *Review of the Economic Situation of Mexico*, vol. LXX, no. 821 (April 1994).

Green, Gordon, John Coder, and Paul Ryscavage. 1992. "International Comparisons of Earnings Inequality for Men in the 1980s." *Review of Income and Wealth*, series 38, no. 1 (March), pp. 1–15.

Greenhouse, Steven. 1993. "Facing Up to Global Joblessness." *The New York Times*, July 10.

International Monetary Fund. 1993. *International Financial Statistics*, vol. XLVI, no. 12 (December).

———. 1993. *International Financial Statistics Yearbook 1993*. Washington, D.C.: International Monetary Fund.

———. Various issues. *World Economic Outlook*. Washington, D.C.: International Monetary Fund.

Jones, Ronald W. and Peter B. Kenen, eds. 1984. *Handbook of International Economics, Volume I*. New York: Elsevier Science Publishers B.V.

Katz, Lawrence F., Gary W. Loveman, and David G. Blanchflower. 1993. *A Comparison of Changes in the Structure of Wages in Four OECD Countries*. Paper prepared for the National Bureau of Economic Research Comparative Labor Markets Project Conference on "Differences and Changes in Wage Structures," Cambridge, MA, July 23–24, 1992 (revised, January).

Katz, Lawrence F. and Kevin M. Murphy. 1992. "Changes in Relative Wages, 1963–1987: Supply and Demand Factors." *The Quarterly Journal of Economics*, vol. CVII, issue 1 (February), pp. 35–78.

Lawrence, Robert Z. 1994. *The Impact of Trade on OECD Labor Markets*. Occasional Papers no. 45. Washington, D.C.: Group of Thirty.

Lawrence, Robert Z. and Matthew J. Slaughter. 1993. "International Trade and American Wages in the 1980s: Giant Sucking Sound or Small Hiccup?" *Brookings Papers on Economic Activity: Microeconomics 2*, pp. 161–226.

Levy, Frank and Richard J. Murnane. 1992. "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations." *Journal of Economic Literature*, vol. XXX, September, pp. 1333–81.

Murphy, Kevin M. and Finis Welch. 1993. "Lessons from Empirical Labor Economics: 1972–92: Inequality and Relative Wages." *AEA Papers and Proceedings*, vol. 83, no. 2 (May), pp. 104–109.

Organisation for Economic Cooperation and Development. 1993. *Employment Outlook*, July, pp. 157–84.

Rosenbaum, David E. 1993. "Clinton Musters a Majority for Trade Pact in the House After a Long Hunt for Votes." *The New York Times*, November 18.

Sachs, Jeffrey D. and Howard J. Schatz. 1994. "Trade and Jobs in U.S. Manufacturing." *Brookings Papers on Economic Activity, 1*, pp. 1–69.

Sass, Steven. 1994. "See Dick Earn. Earn, Dick, Earn." *Federal Reserve Bank of Boston Regional Review*, vol. 4, no. 3 (Summer), pp. 13–19.

Stolper, Wolfgang F., and Paul A. Samuelson. 1941. "Protection and Real Wages." *Review of Economic Studies*, vol. IX, November, pp. 58–73.

United Nations Conference on Trade and Development. 1993. *Handbook of International Trade and Development Statistics 1992*. New York: United Nations.

U.S. Bureau of the Census. 1993. *Money Income of Households, Families, and Persons in the United States: 1992*. Current Population Reports, Consumer Income, series P60–184. Washington, D.C.: U.S. Government Printing Office.

Wood, Adrian. 1994. *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World*. New York: Oxford University Press.

World Bank. 1994. *World Development Report 1994: Infrastructure for Development*. New York: Oxford University Press.

World Bank. Various Years. *World Development Report*. New York: Oxford University Press.

Indexes of Economic Indicators: What Can They Tell Us about the New England Economy?

Alan Clayton-Matthews, Yolanda K. Kodrzycki, and Daniel Swaine

Clayton-Matthews and Swaine are Economists with the Massachusetts Department of Revenue and Kodrzycki is a Senior Economist at the Federal Reserve Bank of Boston. *The authors are grateful to Stephen Blough, Katharine Bradbury, Theodore Crone, Stephen McNees, and James Stock for helpful discussions, and to colleagues at the New England Economic Project for the original impetus to pursue this research. Able research assistance was provided by James Andelman, Bruno Berszoner, Leo Hsu, and—in earlier stages—David Mann and Thomas Miles.*

Each month, the Boston Federal Reserve publication *New England Economic Indicators* reaches about 6,000 subscribers. Many of these readers undoubtedly want to know: "How is the New England economy doing?" In response, *Indicators* offers a comprehensive compilation of timely data. Yet no one of these indicators can possibly provide an overall assessment of the New England economy. Nor can any other individual piece of information offered by other regional or state agencies.

This article explores the development of composite coincident indexes summarizing the condition of the economy of New England and its six states. While composite indexes have long been used to analyze the national economy, they may be needed even more for regions because of the lack of current comprehensive measures of state activity, as well as the frequent lack of clarity in indicators that are available. The article discusses two approaches to constructing composite indexes, the traditional averaging method used by the U.S. Department of Commerce and a latent variable method advanced by two academic researchers, James Stock and Mark Watson, and recently applied to states in a study conducted at the Federal Reserve Bank of Philadelphia. A general model for deriving a coincident economic index is described, along with its relationship to the Stock-Watson and Philadelphia Fed research. The Philadelphia Fed specification is then applied to the New England states in order to measure how regional business cycles have compared with national cycles. In addition, an alternative composite coincident index is constructed for Massachusetts, using as inputs newly developed data based on state tax collections, which have the advantage of being quite timely and not subject to revisions (in contrast to more commonly used indicators).

I. Motivations

Composite indexes of U.S. economic indicators have a long history. Originally developed a half century ago by researchers at the National Bureau of Economic Research, a private organization, such indexes are now issued monthly by the U.S. Department of Commerce. The government's index of leading indicators gets widespread attention when it is released. Less noticed, but released just as frequently, are the index of coincident indicators, which measures the current state of the national economy, and the index of lagging indicators.

Composite indexes are attractive because of their simplicity and compactness. Interest in economic trends is widespread, but most people have neither the time nor the inclination to try to interpret each individual piece of economic data that becomes available. Furthermore, even for professional observers of the macroeconomy, individual indicators may be problematic. Any particular economic series may give an ambiguous signal, or it may contradict another piece of data.

National composite indexes (and individual indicators) may be misleading for regions because regional business cycles do not parallel national cycles exactly. For example, the strongest recoveries from the early 1980s recessions occurred on the East and West Coasts, and several interior states lost employment or showed virtually no gain in employment for several years after the national economy had picked up (Bradbury and Kodrzycki 1992). By contrast, in the upturn from the most recent national recession of 1990–91, it is widely acknowledged that the New England states and California were laggards. New England also headed into that recession well before the nation.

Composite indexes of coincident indicators may be particularly valuable for regional analysis because other available data are limited. For one thing, frequent and timely information on overall economic activity is lacking for states. As noted by others (see especially McNees and Tootell 1991 and Crone 1994), gross state product (GSP) is issued only annually, with a long lag. Data for 1991, for example, were made available in August 1994. State personal income scores higher (but not high) in terms of availability. It is issued quarterly, about four months after the end of the quarter. In addition, personal income may be problematic as an indicator of state economic activity because it includes income that a state's residents earn from assets located elsewhere and from transfer payments (such as Social Security and unemployment benefits).[1] Employment is undoubtedly the best commonly available current measure of state economic activity. Data are issued monthly, with a lag of only one or two months. Economic activity is measured only imperfectly by employment, however. For one thing, output changes with no change in labor demand as productivity varies over time and over the business cycle. Furthermore, the demand for labor can vary without a resulting change in the number of people who are employed. For example, given labor costs that depend more on the number of workers than the length of the workweek (such as training costs, unemployment insurance taxes, or requirements for employer provision of employee health insurance coverage, as exist in some states), employers may find implementation of longer work hours for existing staff to be a less expensive means of increasing production than additional hiring.

Employment is undoubtedly the best commonly available current measure of state economic activity, but it measures only imperfectly.

A second reason for the potential attractiveness of composite indexes at the regional level is that individual economic indicators tend to be quite noisy. Month-to-month volatility is a by-product of the inherently small state samples for indicators that are obtained as part of a national survey, as well as the limited resources of state governments for supplemental data-gathering efforts. For example, initial payroll employment statistics are obtained from a survey of selected business establishments and then revised annually to reflect information obtained through the unemployment insurance program (which covers almost all employers). The March 1994

[1] The quarterly personal income data separately identify wages and salaries earned in-state. But in-state business and investment income cannot be extracted from the remaining amount of personal income, as further breakdowns are available only annually at best. To the extent that economic activity is taken to mean consumption rather than income from current production, however, it may be argued that (unadjusted) personal income is an appropriate indicator.

benchmark revisions moved the reported recent cyclical trough for New England employment by close to two years, from August 1993 to December 1991. As another example, the measured monthly unemployment rate for the New England states has jumped by at least half a percentage point between three times (in Connecticut and Rhode Island) and eight times (in Massachusetts) during the past three years.[2] During the same period, the national unemployment rate never showed a change of this magnitude in a single month.

Despite the potential usefulness of developing composite indexes to supplement other data, state governments do not routinely issue such information. Furthermore, only scattered efforts along these lines have appeared on the part of other researchers.

II. Methodology

Traditional indexes of economic indicators are weighted averages of the economic indicators used to construct the index, with the weights chosen by judgment. Notwithstanding many complications and refinements, the Commerce Department composite coincident index exemplifies this traditional approach (Green and Beckman 1992 and 1993). Similar indexes for California and Texas have also been developed (California Department of Finance 1976 and Philips 1990), and nine composite regional performance measures are issued regularly by the Conference Board.[3]

National indexes of economic indicators have long been scrutinized both for their accuracy and for their conceptual validity. While different authors have reached varied conclusions regarding the empirical qualities of composite indexes, a consensus has developed that the traditional method is based neither on appropriate statistical methodology nor on an explicit economic theory (see Koopmans 1947, Auerbach 1982, de Leeuw 1991).

The more recent conceptual foundation of a composite economic index is the Sargent-Sims (1977) single index model of the economy. The key idea is that the current state of the economy is unobservable but may be detected by finding the co-movement in a selected set of observable economic indicators. The remaining movement in each economic indicator represents its idiosyncratic component—that is, the part unrelated to the state of the economy.[4]

Stock and Watson developed a methodology to estimate models based on the Sargent-Sims concept and used this methodology to derive new national composite economic indexes. Specifically, Stock and Watson (1989, 1992) set out to provide a more solid statistical foundation for the composite coincident index released by the Department of Commerce, using the technique developed in their 1988 article. Even though Stock and Watson's estimated weights for individual indicators differ somewhat from those used to form the Department of Commerce series, the correlation between the two indexes is 0.936 and they appear to move quite closely over individual business cycles. Stock and Watson (1993) went on to develop an alternative leading index.[5]

Traditional indexes of economic indicators are weighted averages of the indicators used to construct the index, with the weights chosen by judgment.

Crone (1994) applied the Stock-Watson methodology to the states in the Philadelphia Federal Reserve District. He attempted to find the closest pos-

[2] The Massachusetts sample for computing the unemployment rate is about 2,300 households. In the other New England states, samples of only about 500 to 600 are used, but the survey results are supplemented by econometric estimates in order to smooth the results.

[3] Dua and Miller (1994) recently used a similar methodology to develop coincident and leading indexes of employment for Connecticut. For an alternative, econometric study of regional employment, see McNees and Tootell (1991).

[4] Any given economic indicator may move independently of the state of the economy for a variety of reasons. Typical explanations for short-term movements include measurement error, fluctuations in the weather, the timing of holidays, the occurrence of labor strikes, or political developments. Indicators may follow different patterns over longer periods of time, for example, if some are sensitive to demographic trends, while others reflect the procedures for conducting monetary policy.

[5] It may be argued that although the Stock-Watson leading index is based on a more rigorous view of the relationship between a composite index and the state of the economy than is true of the Commerce Department measure, Stock and Watson's choices of underlying leading indicators are not any more rooted in economic theory (in the sense of de Leeuw 1991). Empirically, the inability of their revised leading indicator model to predict the 1990–91 recession was attributable in great part to the choice of indicators, especially the inclusion of financial variables. The Stock-Watson composite coincident index is less controversial, as it uses data series similar to those in the Commerce Department index. Indeed, its performance in the most recent business cycle appears to have spurred revision of the Commerce Department index of coincident indicators (Green and Beckman 1993).

sible state analogues to the four indicators used in the Commerce Department's national index: the number of jobs in nonagricultural establishments, inflation-adjusted manufacturing and trade sales, inflation-adjusted personal income less transfer payments, and an index of industrial production. State establishment employment and real retail sales come reasonably close to the first two national data concepts. Lacking state counterparts for the remaining components of the national index, Crone substituted average weekly hours in manufacturing and the unemployment rate in the state models. When Crone had combined these four variables in a national model, they came fairly close to reproducing the Commerce Department index. The state indexes produced by this approach indicated that recessions have generally occurred in the mid-Atlantic states at times of national recession, but that their duration often was different.[6]

The more recent concept of an economic index holds that the current state of the economy may be detected by finding the co-movement in a selected set of observable economic indicators.

Conceptually, the Stock-Watson and Crone indexes differ somewhat from the Sargent-Sims single index representing the state of the economy. Stock and Watson observed that the variables entering the Commerce Department coincident economic index are not cointegrated. In non-technical terms, this means that the series do not share a common long-run trend and therefore they can move arbitrarily far apart.[7] By differencing the variables in the model, Stock and Watson were able to derive an index that captures the common high-frequency (that is, purely cyclical) movement in the data.

Since the work of Nelson and Plosser (1982), it is commonly acknowledged that most economic time series appear to be subject to (semi-) permanent as well as temporary shocks. For example, business "cycles" can be influenced by lingering effects from shifts in productivity that occurred much earlier (and that show up also in a trend that varies over time), as well as by purely cyclical disturbances.[8] As noted by Stock and Watson (1988), economic indicators will share a common stochastic trend—and therefore can be used to form a single economic index that captures this newer, hybrid view of business cycles—only if they are cointegrated.

Empirically, it is possible that composite indexes may yield similar estimates of turning points in the economy, regardless of the underlying concept of the relationship between trends and cycles. But generating a model using data that are cointegrated with each other and with an overall measure of economic activity (such as gross domestic product or gross state product) has one clear advantage: In this case, the movement of the economic index over longer time horizons can be interpreted as the rate of growth in the economy, and it can reliably be used to compare the state of the economy for two dates that are relatively far apart—such as successive business cycle peaks or troughs.[9] Therefore, all else equal, it is preferable to use cointegrated data in forming a composite index.[10]

III. Modeling the State of the Economy

This section addresses modeling and estimation issues in the development of economic indexes. Readers interested only in empirical results may wish to skip to Section IV.

[6] Pennsylvania suffered longer recessions than the nation, for example, and New Jersey had relatively severe downturns around the time of the national recessions of 1973–75 and 1990–91, but relatively modest downturns in the early 1980s.

[7] For further discussion of cointegration, see Engle and Granger (1987), Dickey, Jansen, and Thorton (1991) and Hamilton (1994, Chapter 19). For an example applying this concept to an analysis of consumption behavior, see Fuhrer (1992). Cointegrated series individually are nonstationary (that is, they contain a trend), but a linear combination of them is stationary (trendless).

[8] Mathematically, the economy is represented by a difference stationary process—that is, a combination of a stationary stochastic process and a nonstationary stochastic process (see Beveridge and Nelson 1981). Only if the errors in the stationary stochastic process are independent of the errors in the stochastic trend can it be maintained that the economy can be described in terms of a distinct long-run secular trend and a short-run cycle. The empirical findings of Nelson and Plosser (1982) are at odds with this latter representation.

[9] The Commerce Department deals with this issue by mechanically constraining the resulting composite index to match the long-term growth rate of real GDP; a corrected version of this procedure is reported in Green and Beckman (1993). While this adjustment results in an appropriate overall trend, it may not capture accurately the trend within subintervals.

[10] Other considerations include the timeliness and volatility of the data.

The following is a general model of the state of the economy and its influence on individual economic indicators (see Stock and Watson 1992, p. 66):

$$X_t = BC_t + \gamma_0 + \gamma_1 t + \mu_t \quad (1)$$

$$\phi(L)C_t = \delta + \eta_t \quad (2)$$

where **t** is a time trend, X_t is an n-vector of observable time series, C_t is a k-vector of unobservable common components, **B** is an n×k array of coefficients (also called factor loadings) on the common components, $(\gamma_0 + \gamma_1 t)$ is a non-stochastic trend, $\phi(L)$ is a lag polynomial matrix, δ is a k×1 vector of non-stochastic drifts of the common components, and μ_t and η_t are stochastic processes of dimensions n×1 and k×1, respectively.

For the purpose of constructing an economic index, only the special case in which the model reduces to the Sargent-Sims single index formulation is of interest—that is, where k=1 and only one common component is present. (The term "common component" is used as a synonym for terms such as "common factor," "common trend," and "common stochastic trend" that may describe co-movement among individual economic time series.) For this special case, the common component is interpreted as representing the state of the economy. Then equation (1) implies that each economic indicator is composed of three parts: the state of the economy, multiplied by the appropriate coefficient; a deterministic trend (possibly zero); and a stochastic process that gives each series its own idiosyncratic character.[11] Equation (2) describes the "law of motion" of the economy.[12] Because the state of the economy is described by an autoregressive process, random shocks can have persistent effects.

When the observable series are stationary stochastic processes, the general model can be directly applied in estimation. Many general economic indicators exhibit a trend, however. For nonstationary data, with the nonstationarity entering through the common component, the data are said to be cointegrated in the Engle and Granger (1987) sense.[13] For this case, the data are cointegrated of order (1,1) with (n−1) cointegrating vectors. In other words, the data are tied together in (n−1) dimensions by linear relationships that prevent the series from wandering far apart. They can drift in one direction only—that indicated by the common component. If the common component is also cointegrated with a measure of aggregate economic activity, then one can be confident it represents the state of the economy. Under these conditions, the model may be estimated as indicated by equations (1) and (2), with the addition of a specification for the error processes (and taking into account the revisions in dimensionality when k=1, as indicated in footnotes 10 and 11).

When the underlying series are nonstationary, but the state of the economy cannot be regarded as the only possible source of nonstationarity (that is, the data are not cointegrated), then the model is differenced for purposes of estimation. This is the specification used in both the Stock-Watson and the Philadelphia Federal Reserve studies. If we assume that the idiosyncratic errors (μ_t) result from long-term secular processes that are different for each series—because the data are not cointegrated—then these errors can be assumed to be independent of the shocks to the state of the economy. Thus, C_t would represent only the common cyclical movement in the data. Its turning points can provide evidence on the timing of business cycles, but its long-run movements will not be meaningful (since the underlying data are not cointegrated).

Alternative econometric techniques can be used to solve for the unobserved state of the economy. These methods essentially are derived from factor analysis, which is used heavily in the behavioral sciences (see the box).

Estimating the Philadelphia Federal Reserve Specification

As noted, four indicators underlie the index specified in the Philadelphia Federal Reserve study by Crone: payroll employment, real retail sales, average weekly hours of manufacturing production workers, and the unemployment rate. (See the Appendix for a further description of the data.) These series were found not to be cointegrated for the New England states; this is not surprising, given that employment and sales have a positive trend while average weekly hours and the unemployment rate are trendless. Thus, as is appropriate with noncointegrated inputs, the series are differenced. (For employment, retail sales, and hours, the data are

[11] In the case of k=1, the common component appears in equation (1) as a scalar (rather than a vector), and its coefficient B is an nx1 vector (rather than a matrix).

[12] With k=1, the common component, the drift, and the error term all become scalars, and $\phi(L)$ a vector.

[13] In other words, the common component is a unit root process; in equation (2) (as revised for k=1) the lag polynomial vector $\phi(L)$ has a unit root.

Solving Unobservable Variable Time-Series Models

Dynamic factor analysis and the Kalman filter involve different algorithmic methods to estimate models that are intimately related.[14] As Engle and Watson (1981) and Watson and Engle (1983) point out, a wide spectrum of factor analysis models are special cases of the so-called state-space model, which means that the Kalman filter can be used to estimate the unobserved factors. Indeed, the equation system (1)–(2) belongs to the family of dynamic factor models presented in Harvey (1989, p. 450), as well as those in Stock and Watson (1992), which are solved by means of the Kalman filter.

Factor analysis starts by identifying the common unobservable component (or "factor") that explains the largest share of the variance in the chosen set of observable indicators. The analysis proceeds by searching sequentially for additional common factors that are uncorrelated with the previously identified common factors and that explain the largest share of the remaining variance in the observed indicators. The procedure ends when it is determined that the last common factor contributes little to explaining movement in the indicators. The factor analysis technique was used originally in non-economic applications, in which multiple common components existed. In some other applications, including this article, only one common component exists. Also, although classical factor analysis has been concerned primarily with cross-section data, the same framework can be applied to time series data as well—hence the designation "dynamic factor analysis."

With nonstationary time series data, a direct correspondence exists between factors and the common trends of cointegration. When the data are cointegrated, the number of factors that are nonstationary and the number of common trends are identical. Additional factors may be present, but they would be stationary; furthermore, they likely would explain only a relatively small proportion of the variance in the data.

The Kalman filter finds the unobservable variable(s) (and the associated coefficient estimates) that minimize the difference between the actual and fitted values of the observed indicators. The method starts by assuming a value for the unobserved variable(s) in the initial period and it sequentially produces optimal estimates for subsequent periods, using information for previous periods. If a model such as depicted in equations (1)–(2) has error terms that are not serially correlated, then these equations correspond directly to the measurement and transition equations, respectively, that constitute the so-called state-space framework of the Kalman filter. If they are serially correlated, then the equations must be transformed appropriately. For examples of transformations, see Stock and Watson (1992), Harvey (1981, 1989), Hamilton (1994), Engle and Watson (1981), and Watson and Engle (1983).

The factor analysis and Kalman filter techniques both determine common components of arbitrary scale. Thus, after the common component has been determined, it may be convenient to rescale the results.

expressed in logarithms prior to differencing.) Each differenced series is normalized by subtracting its mean and dividing the result by its standard deviation, so that the mean of each series is zero and its standard deviation is unity.

The state of the economy is posited to be reflected contemporaneously in the first three series, but to affect the unemployment rate with lags of one to three months in addition to entering the equation currently. In the equation for the law of motion for the economy, the drift parameter is set equal to zero. The resulting equations are as follows:

$$\Delta X_{it} = \beta_i \Delta C_t + \varepsilon_{it} \quad i = 1, 2, 3 \tag{3}$$

$$\Delta X_{4t} = \beta_{40}\Delta C_t + \beta_{41}\Delta C_{t-1} + \beta_{42}\Delta C_{t-2} + \beta_{43}\Delta C_{t-3} + \varepsilon_{4t}$$

$$\Delta C_t = v_t . \tag{4}$$

The stationary stochastic terms are modeled as second-order autoregressive processes, and an identification restriction is imposed on the variance of the error term in the equation for v_t:

[14] For a description of factor analysis, see Gorsuch (1974) and Joreskog (1967). The Kalman filter is described in Anderson and Moore (1979, Chapter 3), Harvey (1981, Chapter 4), and Hamilton (1994, Chapter 13).

$$\varepsilon_{it} = r_{i1}\varepsilon_{i,t-1} + r_{i2}\varepsilon_{i,t-2} + e_{it} \quad i = 1, 2, 3, 4$$

$$v_t = r_1 v_{t-1} + r_2 v_{t-2} + e_t$$

$$\text{var}(e_i) = \sigma_i^2$$

$$\text{var}(e) = 1.$$

The terms e_{it} and e_t are independent white-noise processes.

The estimates are obtained by transforming the model into state-space form, and obtaining maximum likelihood estimates of the parameters by using the Kalman filter to evaluate the likelihood function (see the box on "Solving Unobservable Variable Time-Series Models"). The indexes are estimated for the period April 1969 to August 1994. Parameter estimates are reported in Appendix Table 1. The final indexes are adjusted to reflect trends in gross state product, which was not done in the Philadelphia Federal Reserve study, but is in keeping with the U.S. Commerce Department methodology.[15] The results are described in Section IV.

Estimating a Revised Specification for Massachusetts

The alternative model for Massachusetts builds upon the Philadelphia Federal Reserve specification in two important ways. First, it adds two series related to tax revenues: the withholding tax base for the state personal income tax and the base of the state sales tax. (Some advantages of using the income and sales tax data are described at the beginning of Section IV, and additional details regarding the construction of the data are provided in the Appendix.) Second, the alternative model exploits the cointegration properties of three series: the two tax bases and retail sales. Using Johansen's procedure to test for cointegration (see the Appendix for results and discussion), these three series were found to be cointegrated with one common component.[16] The advantage that cointegration gives to the specification is that these series need not be differenced. Their common component informs the estimation procedure of the level of the underlying index, so that comparisons of the level of the index are meaningful over long periods of time.[17]

The data for employment, weekly hours, and the unemployment rate were prepared as in the Philadelphia specification above—that is, log-differenced (differenced in the case of the unemployment rate) and normalized, so that the mean of each series is zero and its standard deviation is unity. The data for the tax bases and retail sales were each deflated and expressed in logarithms, and then normalized by subtracting the mean and dividing the result by the standard deviation, so that the mean of each series is zero and its standard deviation is unity.

The model takes the following form:

$$(5) \quad X_{it} = \beta_i C_t + \mu_{it} \quad i = 1, 2, 3$$

$$\Delta X_{it} = \beta_i \Delta C_t - \gamma_i \delta + \mu_{it} \quad i = 4, 5$$

$$\Delta X_{6t} = \beta_{60}\Delta C_t + \beta_{61}\Delta C_{t-1} + \beta_{62}\Delta C_{t-2} + \beta_{63}\Delta C_{t-3} - \gamma_6\delta + \mu_{6t}$$

$$(6) \quad C_t = C_{t-1} + \Delta C_t$$

$$\Delta C_t = r_1\Delta C_{t-1} + r_2\Delta C_{t-2} + \delta + e_t$$

where

$$\mu_{it} = r_{i1}\mu_{i,t-1} + r_{i2}\mu_{i,t-2} + e_{it} \quad i = 1, \ldots, 6$$

$$\gamma_i = \beta_i/(1 - r_1 - r_2) \quad i = 4, 5$$

$$\gamma_6 = (\beta_{60} + \beta_{61} + \beta_{62} + \beta_{63})/(1 - r_1 - r_2)$$

and the terms e_{it} and e_t are independent white-noise processes. Subscripts i = 1 to 3 refer to the cointegrated series (the two tax bases and retail sales), i = 4 and 5 refer to employment and hours, and i = 6 refers to the unemployment rate.

The state of the economy, C_t, reflects both the stochastic and non-stochastic (δ) trends of the economy embodied in the three cointegrated series, as well as the common cyclical components measured by all six series. In the equations describing the withholding tax base, the sales tax base, and retail sales, both the observed data and the unobserved state of the economy enter in levels. The specifications for employment, weekly hours, and the unemployment rate are as in the Philadelphia model, with the exception of the addition of the $\gamma_i\delta$ terms, which ensure that the expectations of their respective equations are zero, as required by the normalizations of the three series. The state of the economy is modeled as an integrated, autoregressive moving average pro-

[15] As noted in footnote 9, the Commerce Department coincident index incorporates the trend in gross domestic product. Owing to a lack of recent data on gross state product, the New England trends are based on calculations through 1991.

[16] Even though it has an upward trend over time, payroll employment was found not to be cointegrated with the tax and retail sales series (or with measures of state production and income).

[17] A number of other variables also were tested (but rejected) for potential use in a coincident index, on the basis of their current availability or their relationship to broad measures of economic activity.

cess with drift; the remaining stochastic terms are modeled as second-order autoregressive processes.

In order to identify the model the factor loading on the withholding tax base, β_1, is constrained to unity. The model is put into state-space form, and maximum likelihood estimates of the parameters are obtained using the Kalman filter. The model is estimated for the period April 1969 to August 1994, and the parameter estimates are found in Appendix Table 1.[18] The trend in gross state product is used to adjust the index.

IV. Estimated Results: Coincident Indexes for the New England States

The New England indexes are based on the same underlying indicators as in the Philadelphia Federal Reserve study, with one exception. Retail sales data are available only for Massachusetts and the New England total. For the remaining states, the indexes are therefore based only on employment, hours, and the unemployment rate.[19] The Massachusetts and New England indexes are estimated with and without retail sales. The third version of the Massachusetts index includes three variables that are cointegrated with each other and with state income and output: constant-dollar values for the withholding tax base for the state personal income tax, the base of the state sales tax, and retail sales (as well as employment, hours, and the unemployment rate).[20]

The two tax indicators for Massachusetts were developed specifically for this study, and they have several appealing characteristics. Tax collection data are released monthly in a timely manner, within days of the end of the month.[21] The lag between the economic activity reflected in taxes and the time the taxes are collected is short. For example, large companies that remit withholding taxes weekly within days of the end of the pay period account for about 85 percent of total revenues from withholding. Medium-sized employers pay taxes in the following month. Large retail stores, telecommunications companies, and utilities—accounting for approximately 70 percent of total tax receipts—pay sales taxes in the same month in which the transactions occur. The bulk of the remaining sales tax revenues comes from taxpayers that pay monthly, for transactions in the previous month.[22] The bases of the Massachusetts personal income and sales taxes are broad enough to encompass a large proportion of income and spending. This means that the tax data are likely to be cointegrated with other income-based economic measures. The data are not based on a sample; they are derived from the full population of taxpayers. Finally, and in part reflecting the lack of sampling, revisions to tax collection data are insignificant.

Tax bases are constructed from revenue data by adjusting for law changes in the base and rates. The bases are then seasonally adjusted and, because they are noisy, smoothed with a filter (see the Appendix).

The tax indicators for Massachusetts have several appealing characteristics: They are timely, they are broad-based, they are derived from a full population of taxpayers, and revisions are insignificant.

The lack of comparable tax data for other states (as well as the lack of retail sales information) prevented the estimation of a similar alternative model for the remaining New England states. For one thing, some of these states do not have broad-based taxes that would reflect general economic conditions.[23] Furthermore, for those states with broad-based taxes,

[18] The sales tax base was omitted in estimating the index for the period March 1976 to October 1977, because the series was suspect during this time. See the Appendix for further discussion.

[19] Crone faced the same constraint in developing a composite index for Delaware.

[20] Another version of the Massachusetts index was calculated using only the three cointegrated series. The results were similar to those of the six-series index at low frequencies. However, excluding employment, hours, and the unemployment rate resulted in disagreement with other composite indexes in the timing of turning points. It also resulted in more frequent instances of false recessionary and expansionary signals.

[21] The fact that tax receipts must be deflated by a price index for use in the model makes these series somewhat less timely than this statement implies. However, the need for deflation is common to most data that are likely candidates for use in an economic index. Also, because tax receipts are far more variable than price indexes, a reasonable current estimate of real tax receipts may be obtained by forming a forecast of prices.

[22] Smaller employers and retail establishments pay quarterly and account for approximately 1 percent of withholding taxes on wages and 10 percent of sales taxes.

[23] The most extreme case is New Hampshire, which has neither a general income tax nor a general sales tax; Connecticut enacted a general income tax only recently.

estimates of the revenue effects of law changes either are not publicly available or are available only over a relatively short time period.[24] Finally, sometimes the structure of a tax is too complicated or too subject to change to permit outside researchers to obtain reliable estimates of the revenue effects of law changes, even when the state government has published helpful data.[25] Thus, although tax revenue data are potentially quite valuable for studying the state of the economy, their use poses greater challenges for the analyst than other indicators that may be used without adjustment.

For both the tax-based and the non-tax-based indexes, the long-run trends are constrained to be the same as the trend in gross state product. This procedure raises the computed trend growth rates of the indexes. The upward adjustment is not surprising in the case of the Philadelphia Federal Reserve specification, as two of the underlying indicators (hours and unemployment) do not have a positive trend and employment has a trend that is noticeably below that of gross state product. The upward adjustment is somewhat surprising for the tax-based index, since it uses series that are cointegrated with gross state product. Although an argument could be made for not constraining the trend in the case of the alternative Massachusetts index, the outcome has some intuitive appeal and it may be compared more directly to the results of the other specifications.

Results

Figure 1 shows the resulting coincident indexes for New England and each state. Table 1 indicates the computed regional peaks and troughs in comparison with those of the national economy as determined by the National Bureau of Economic Research, as well as the peak-to-trough changes in the regional indexes.[26,27] For New England and Massachusetts, separate results are shown for the four-variable ("A") and three-variable (without retail sales; "B") models, although their turning points usually are identical. The alternative Massachusetts index, using tax data, is shown as variant "C."[28]

The most recent recession in New England was much more prolonged than the national recession. The New England indexes reached their maximum in December 1988, nineteen months ahead of the national peak, and their minimum in July 1991, four months behind the national trough. Indexes for the individual states indicate recessions lasting from fourteen months longer than the national recession in Maine to twenty-nine months longer in Connecticut and Massachusetts (in the C specification).

This most recent regional downturn was also severe in terms of the peak-to-trough decline in the value of the index. The declines in state indexes ranged from 6.1 percent in Maine to 19.4 percent in Rhode Island. By contrast, the national index declined only 2.4 percent according to the Commerce Department specification and 3.1 percent according to the Philadelphia Fed specification (see Appendix Table 4).

---

[24] The Center for the Study of the States has issued quarterly estimates of state tax revenues, adjusted for law changes. However, for now these data are not usable in a model because they exist for only four years. Also, they were designed principally to detect differences across states rather than as time series for individual states.

[25] For example, the state of Connecticut issues a tax expenditure budget containing estimated annual revenue effects of law changes. In the case of the state sales tax, very large law changes took place in the early 1990s, a period of substantial changes in economic conditions. To our knowledge, the available tax expenditure estimates have not been verified in light of actual experience. Thus, any attempt to allocate a portion of the revenue change at that time to tax law changes, and the remainder to changes in the economy, is necessarily subject to considerable uncertainty. In the case of Massachusetts, the structure of the state sales tax has remained relatively stable; also, it is simpler than Connecticut's in that all covered items are subject to a single rate.

[26] Estimation of a national index using the Philadelphia Fed specification (and constrained to have the same trend from 1969 to 1994 as gross domestic product) generally gives business cycle turning points similar to those indicated by the National Bureau of Economic Research and the Commerce Department Composite Index of Coincident Indicators. See Appendix Table 4. The exceptions are that the 1973–75 national recession does not start until early 1974, and the most recent national recession, officially deemed to have ended in March 1991, lasts until early 1992 using the Philadelphia Fed specification.

[27] The peaks and troughs for New England and each state are given by the local maxima and minima, respectively, in the index. In some cases, they may be imprecise because the economy was relatively flat for an extended period around the time of the turning point. For this reason, the charts in Figure 1 can be helpful in assessing particular cycles.

[28] Both the Philadelphia Federal Reserve and the tax-based models appear to produce reasonable estimates. For one thing, estimated multipliers (that is, the computed change in the composite economic index for a given change in an observed indicator) are all of the correct sign. They also confirm that no single series dominates any of the composite indexes. Another specification check involved comparing the in-sample forecast errors for the observable indicators with errors from univariate models. Second-order autoregressive models produced larger errors than the Philadelphia Federal Reserve and tax-based specifications in 83 percent of the cases, which implies that the estimated state of the economy usually adds information not contained in each series' own history. However, in 51 percent of the cases, the best univariate model—among those with a first or second order autoregressive term and a first or second order moving average term—outperformed the multivariate model. This result suggests that a richer parameterization of the errors in the Stock-Watson-type models often could improve their in-sample performance. Results of the specification tests are available from the authors upon request.

Table 1
Comparison of New England and National Business Cycles

	Regional/State Cycles and Difference from National (Number of Months)			
	New England-A	New England-B	Connecticut	Maine
National Peaks				
December 1969	Feb 70(−2)	Jul 69(+5)	Mar 70(−3)	Apr 70(−4)
November 1973	Jul 74(−8)	Jul 74(−8)	Oct 74(−11)	Aug 74(−9)
January 1980	Feb 80(−1)	Feb 80(−1)	Apr 80(−3)	Mar 80(−2)
July 1981	Apr 81(+3)	Apr 81(+3)	Nov 81(−4)	Jul 81(0)
July 1990	Dec 88(+19)	Dec 88(+19)	Mar 89(+16)	Mar 90(+4)
National Troughs				
November 1970	Jun 71(−7)	Jun 71(−7)	Jun 71(−7)	Sep 71(−10)
March 1975	Jun 75(−3)	Jun 75(−3)	Sep 75(−6)	Apr 75(−1)
July 1980	Jul 80(0)	Jul 80(0)	Aug 80(−1)	Jul 80(0)
November 1982	Oct 82(+1)	Oct 82(+1)	Jun 82(+5)	Mar 82(+8)
March 1991	Jul 91(−4)	Jul 91(−4)	Apr 92(−13)	Jan 92(−10)
Length of Contraction				
Dec 69–Nov 70: 11 months	16(+5)	23(+12)	15(+4)	17(+6)
Nov 73–Mar 75: 16 months	11(−5)	11(−5)	11(−5)	8(−8)
Jan 80–Jul 80: 6 months	5(−1)	5(−1)	4(−2)	4(−2)
Jul 81–Nov 82: 16 months	18(+2)	18(+2)	7(−9)	8(−8)
Jul 90–Mar 91: 8 months	31(+23)	31(+23)	37(+29)	22(+14)
Percent Change in Index Peak to Trough[a]				
1969–70	−5.9	−7.0	−5.0	−2.6
1973–75	−8.6	−9.8	−5.5	−4.9
1980	−3.1	−3.6	−1.0	−1.8
1981–82	−3.1	−3.8	−0.6	−1.5
1990–91	−12.7	−14.2	−8.7	−6.1

Note: Columns labeled "A" use the specification in equations (3) and (4), estimated using employment, retail sales, average weekly hours, and the unemployment rate. Columns labeled "B" and those without a letter use only three variables, omitting retail sales. Massachusetts-C is based on equations (5) and (6), estimated using the withholding base for the state personal income tax, the base for the state sales tax, employment, retail sales, average weekly hours, and the unemployment rate. The "+" sign is used to denote leads, and the "−" sign lags, relative to national turning points.

[a]Dates refer to years of national peaks and troughs, but percent changes are based on regional/state peaks and troughs.

Source: Authors' calculations.

Prior to the 1990–91 recession, the timing of regional and national recessions was more similar, though not identical. In most cases, Connecticut and New Hampshire appear to have been relatively late in entering recessions. The Philadelphia Fed specification (but not the C specification) indicates that Massachusetts typically was relatively early in starting recovery. Patterns for the remaining states were more mixed.

The 1973–75 downturn in New England was unusually steep. Although the overall drop in economic activity was not as large as during the recession of the late 1980s to early 1990s, the earlier recession produced a sharper rate of decline (measured as the percent change in the index divided by the length of the downturn). Furthermore, the overall declines in Rhode Island and Massachusetts (16.3 and between 8.5 and 11.7 percent, respectively) were very large. The economies of several New England states also experienced considerable deterioration around the time of the 1969–70 recession. Not all recessions were unusually severe in New England, however. Most notably, Connecticut and New Hampshire showed very little decline during the national recessions of the early 1980s.

Discussion of Alternative Specifications and Alternative Indicators

Comparisons of the Massachusetts specifications suggest that composite indexes are sensitive to the choice of underlying indicators. While the two non-

Table 1 continued

Comparison of New England and National Business Cycles

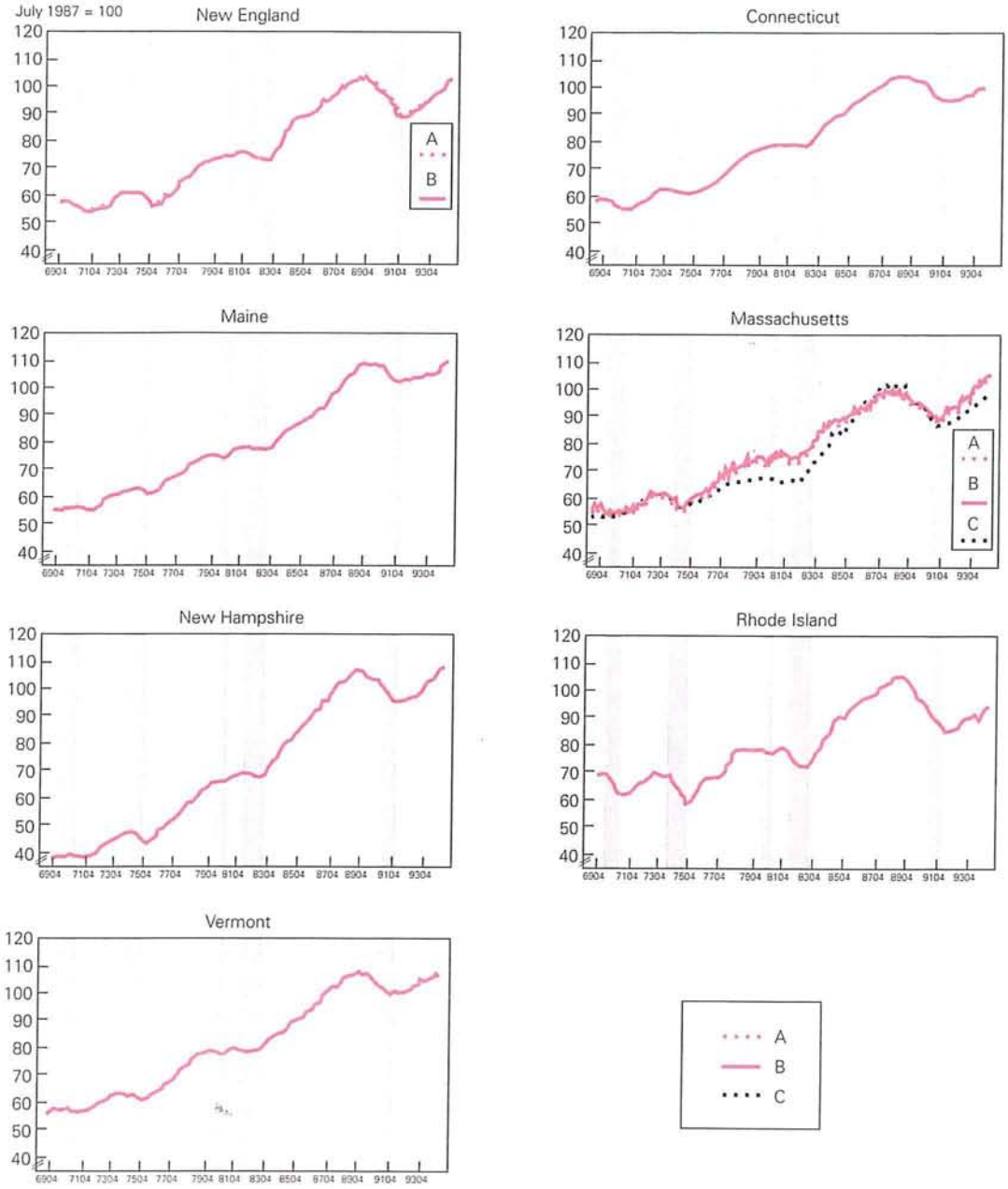
Regional/State Cycles and Difference from National (Number of Months)					
Massachusetts-A	Massachusetts-B	Massachusetts-C	New Hampshire	Rhode Island	Vermont
Jul 69(+5)	Jul 69(+5)	May 70(−6)	Jul 70(−7)	Jun 69(+6)	Mar 70(−3)
Jul 74(−8)	Jul 74(−8)	Sep 73(+2)	Jun 74(−7)	Jun 74(−7)	Aug 73(+2)
Feb 80(−1)	Feb 80(−1)	Feb 80(−1)	Mar 80(−2)	Apr 80(−3)	Dec 79(+1)
Apr 81(+3)	Apr 81(+3)	Apr 81(+3)	Oct 81(−4)	Apr 81(+3)	Aug 81(−1)
Jul 88(+24)	Mar 88(+28)	Apr 88(+27)	Mar 89(+16)	Feb 89(+13)	Jun 89(+13)
Aug 70(+3)	Aug 70(+3)	Dec 70(−1)	Apr 71(−5)	Jun 71(−7)	Jun 71(−7)
Apr 75(−1)	Apr 75(−1)	May 75(−2)	May 75(−2)	Jun 75(−1)	Jul 75(−3)
Jun 80(+1)	Jun 80(+1)	Sep 80(−2)	Sep 80(−2)	Sep 80(−2)	Jul 80(0)
Jan 82(+10)	Jan 82(+10)	Nov 81(+12)	Jun 82(+5)	Dec 82(−1)	Apr 82(+7)
Feb 91(+1)	Feb 91(+1)	May 91(−2)	Aug 91(−5)	Dec 91(−9)	Jul 91(−3)
13(+2)	13(+2)	7(−4)	9(−2)	24(+13)	15(+4)
9(−7)	9(−7)	20(+4)	11(−5)	12(−4)	23(+7)
4(−2)	4(−2)	7(+1)	6(0)	5(−1)	7(+1)
9(−7)	9(−7)	7(−9)	8(−8)	20(+4)	8(−8)
31(+23)	35(+27)	37(+29)	29(+21)	34(+26)	25(+17)
−4.5	−5.6	−2.1	−3.2	−8.9	−3.1
−8.5	−9.8	−11.7	−6.2	−16.3	−4.4
−4.1	−4.2	−3.2	−0.8	−2.0	−1.9
−3.7	−4.3	−1.7	−1.8	−10.4	−2.3
−11.8	−11.9	−15.3	−10.8	−19.4	−7.6

tax-based indexes (that is, Massachusetts "A" and "B") almost always produce the same business cycle turning points, their estimates of the length of downturns differ by more than three months from the tax-based Massachusetts "C" in the first two of the five recessions (1969–70 and 1973–75). All three specifications are reasonably consistent in ranking recessions as to their severity. The recession of the early 1990s was the most serious, followed by the 1973–75 recession, and the 1981–82 downturn was the mildest (or nearly so for the B specification). The tax- and non-tax-based indexes disagree about the severity of the 1969–70 recession, however, perhaps because of the relative unreliability of the tax data in the early years of the sample. (See the Appendix for a description of the data.) The indexes also give somewhat different indications of how the current state of the Massachusetts economy compares with its late 1980s peak. The non-tax-based indexes were approximately 4 to 5 percent above their previous peak as of August 1994, while the tax-based index remains shy of its previous peak. This discrepancy can be traced largely to a single indicator, the average workweek in manufacturing, which was not particularly short during the recession, and which recently has been substantially longer than at the 1988 peak.[29] Hours worked carries more weight in the A and B versions than in the C version of the index.

[29] Employment, retail sales, the unemployment rate, and the income and sales tax bases are all currently weaker than they were in the late 1980s. The indicated strength of the indexes in 1994 is largely a by-product of the trending procedure used.

Figure 1

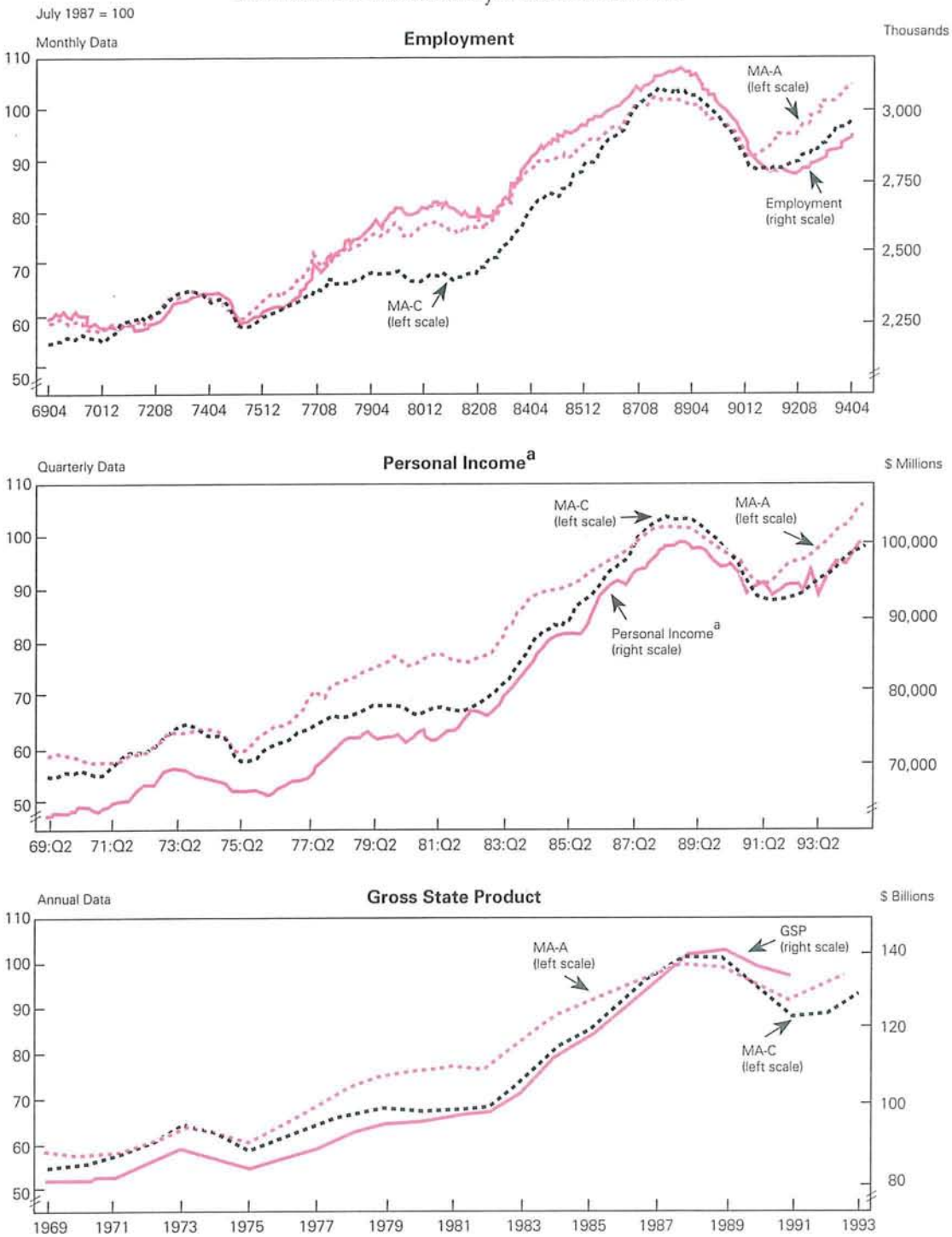
Coincident Economic Indexes for New England



Note: Series labeled "A" use the specification in equations (3) and (4), estimated using employment, retail sales, average weekly hours, and the unemployment rate. Graphs labeled "B" and those without a letter use only three variables, omitting retail sales. Massachusetts "C" is based on equations (5) and (6), estimated using the withholding base for the state personal income tax, the base for the state sales tax, employment, retail sales, average weekly hours, and the unemployment rate.
Shaded regions represent national recessions.
Source: Authors' calculations.

Figure 2

Alternative Indicators for Massachusetts



[a]Deflated by Boston CPI.
Source: Authors' calculations.

Table 2

Comparison of Massachusetts Business Cycles as Measured by Employment, Personal Income, Gross State Product, and Coincident Economic Indexes

I. Employment (Monthly Data)

Peaks			Troughs		
Employment	Index A	Index C	Employment	Index A	Index C
October 1969	Jul 69(+3)	May 70(−7)	January 1972	Aug 70(+17)	Dec 70(+13)
July 1974	Jul 74(0)	Sep 73(+10)	June 1975	Apr 75(+2)	May 75(+1)
February 1980	Feb 80(0)	Feb 80(0)	July 1980	Jun 80(+1)	Sep 80(−2)
April 1981	Apr 81(0)	Apr 81(0)	October 1982	Jan 82(+9)	Nov 81(+11)
December 1988	Jul 88(+5)	Apr 88(+8)	August 1992	Feb 91(+18)	May 91(+15)

II. Personal Income (Quarterly Data)

Peaks			Troughs		
Personal Income	Index A	Index C	Personal Income	Index A	Index C
Q2 1970	Q3 69(+3)	Q2 70(0)	Q4 1970	Q3 70(+1)	Q4 70(0)
Q2 1973	Q3 74(−5)	Q3 73(−1)	Q1 1976	Q2 75(+3)	Q2 75(+3)
Q1 1979	Q1 80(−4)	Q1 80(−4)	Q2 1980	Q2 80(0)	Q3 80(−1)
Q4 1980	Q2 81(−2)	Q2 81(−2)	Q1 1981	Q1 82(−4)	Q4 81(−3)
Q4 1988	Q3 88(+1)	Q2 88(+2)	Q3 1991[a]	Q1 91(+2)	Q2 91(+1)

III. Gross State Product (Annual Data)

Peaks			Troughs		
GSP	Index A	Index C	GSP	Index A	Index C
1973	1973	1973	1975	1975	1975
1989	1988	1988	1991	1991	1991

Note: Numbers in parentheses refer to differences between the coincident economic indexes and employment or personal income. Personal income is deflated by the Boston CPI.

[a]Abstracts from a tax-law-induced decline in the first quarter of 1993.

Source: Authors' calculations.

Other commonly used single-series indicators of the regional economy also are not uniform in their assessment of business cycles. Table 2 and Figure 2 compare three alternative indicators of the Massachusetts economy—payroll employment, personal income deflated by the consumer price index for Boston, and real gross state product—with each other and with the Massachusetts "A" and "C" indexes. Because it is measured only annually, gross state product fell only in the two most severe recessions—in the mid 1970s and the late 1980s to early 1990s. Massachusetts employment and personal income declined during all five recessionary periods. However, they indicate the same turning point only once—a peak in the fourth quarter of 1988. Employment peaked later than personal income in three of the four remaining cycles, and reached its trough later in three out of the five cycles. The composite "A" and "C" indexes tend to lead employment, but their turning points with respect to personal income are more varied. In general, however, the composite indexes are more "cyclical" than employment and personal income, in that the indexes show larger percentage declines during recessions. This property may be helpful in distinguishing true downturns from routine fluctuations.

Despite their various differences, the composite indexes for the New England states would have signalled by sometime in 1991 that a regional recovery had begun, in contrast to more gloomy assessments that resulted from relying on employment as the single best indicator of the economy. This is because the indexes for the two largest states in the region, Massachusetts and Connecticut, turned up earlier than the employment data did. The three indexes for Massachusetts show a pickup no later

Table 2 continued

Comparison of Massachusetts Business Cycles as Measured by Employment, Personal Income, Gross State Product, and Coincident Economic Indexes

Length of Contraction (Months)			Percent Change, Peak to Trough		
Employment	Index A	Index C	Employment	Index A	Index C
27	13(−14)	7(−20)	−3.0	−4.5	−2.1
11	9(−2)	20(+9)	−4.7	−8.5	−11.7
5	4(−1)	7(+2)	−0.9	−4.1	−3.2
18	9(−9)	7(−11)	−1.9	−3.7	−1.7
44	31(−13)	37(−7)	−11.5	−11.8	−15.3

Length of Contraction (Quarters)			Percent Change, Peak to Trough		
Personal Income	Index A	Index C	Personal Income	Index A	Index C
2	4(+2)	1(−1)	−1.1	−3.5	−1.3
11	3(−8)	7(−4)	−5.4	−7.2	−10.9
5	1(−4)	6(+1)	−1.6	−2.5	−2.7
1	3(+2)	2(+1)	−1.9	−2.4	−1.3
11	10(−1)	14(+3)	−7.4	−10.9	−14.8

Length of Contraction (Years)			Percent Change, Peak to Trough		
GSP	Index A	Index C	GSP	Index A	Index C
2	2	2	−5.0	−4.6	−8.9
2	3	3	−5.1	−9.7	−14.3

than spring of 1991, while employment did not hit bottom until August 1992.[30] The Connecticut index began to recover in spring 1992, whereas employment continued to decline for the remainder of the year.[31]

In summary, then, even after certain economic indicators have been selected from among the many candidates, and after a specification has been chosen, it is impossible to conclude that the constructed economic index is *the* best measure of the state of the economy. This is because alternative composite indexes are not entirely consistent in dating contractions (and, by extension, expansions). Furthermore, officially recognized state business cycle reference dates do not exist for states, and even in retrospect they could not be determined straightforwardly from available indicators such as gross state product, personal income, and employment. At least for states, composite economic indexes are instructive rather than definitive.

Consistency of Composite Indexes

Another issue is the internal consistency of composite indexes with respect to recessionary and ex-

[30] As indicated in Table 2, Massachusetts real personal income hit bottom in the third quarter of 1991. Because of lags in the release of personal income figures, an upturn would not have been noticed until mid-1992.

[31] The comparisons cited in the text on the timing of the recovery are not totally fair, as they cite employment data (and estimated composite indexes) after the benchmark revisions of March 1994, rather than the unrevised employment data for 1991 to 1993. However, our preliminary calculations of composite indexes using pre-benchmark data also indicated that a recovery started prior to a pickup in the employment numbers. Furthermore, the Massachusetts-C version of the composite index relies relatively less on employment data and is therefore much less prone to revision than versions A and B.

Table 3
False Signals from Composite Coincident Indexes

	False Recessionary Signals					
Year	Maine	Massachusetts-A	Massachusetts-B	Massachusetts-C	Rhode Island	Vermont
1970	—	(Oct–Dec)	(Oct–Dec)	—	—	—
1973	—	—	—	—	May–Aug	—
1974	—	—	(Feb–Apr)	—	—	—
1977	—	Aug–Oct	Aug–Oct	—	—	—
1979	—	—	—	Jul–Oct	—	—
1982	(Oct–Dec)	—	—	—	—	Oct–Jan 83
1989	(Jul–Oct)[a]	—	—	—	—	—
1993	—	—	Oct–Dec	—	Oct–Jan 94	—
	False Expansionary Signals					
	Maine	Massachusetts-A	Massachusetts-B	Massachusetts-C	Rhode Island	Vermont
1970	Sep–Nov	—	—	—	—	—
1974	—	—	—	(Jun–Aug)	—	Apr–Jun

Note: Parentheses around dates indicate cases where the designation of a signal as false is questionable, because of evidence either on the national business cycle or, in the case of Massachusetts, the designation of the period as a recession or expansion according to an alternative composite index. The indexes for the New England total, Connecticut, and New Hampshire gave no false signals.

[a]Although the decline during this period is inconsistent with subsequent movement in the Maine index, it is consistent with recessionary readings for all of the other New England states.

Source: Authors' calculations.

pansionary signals. Table 3 indicates false signals, where a false recessionary (expansionary) signal is defined as at least three consecutive declines (increases) in the index during a period of expansion (recession). Parentheses around dates indicate periods when the direction of the index was inconsistent with its own dating of business cycles, but consistent with the dates for national business cycles or with alternative state indexes. In other words, for these periods, the signals provided by the index could be justified.

Composite indexes are quite reliable during recessions. They misleadingly increased three times in a row during recessions only in two instances (1970 for Maine and 1974 for Vermont).

Recessionary signals during expansions are more common. Composite indexes falsely indicated recessions in mid-1973 and late 1993 for Rhode Island and late 1982 for Vermont. For Massachusetts, both the A and B indexes declined in mid-1977, and the B index also declined in late 1993. The Massachusetts-C index decreased for four consecutive months in 1979.[32]

Timely Release of Composite Indexes

In light of the potential value of composite coincident indexes for New England, but bearing in mind the ambiguous results as to which specification is best, the authors plan to calculate the various coincident indexes monthly, and to make them publicly available.[33] Such an experiment may shed additional light on the validity of regional composite indexes.

Most indicators are available within approximately one month of the end of the reference month (see Appendix Table 5 for the release dates for each series). The exception is retail sales, for which data are issued with a two-month delay. Retail sales is a component of the four-series indexes for Massachusetts and New England (Massachusetts-A and New England-A) and the tax-based index (Massachusetts-C).

The retail sales data add information to the composite indexes, despite their relatively late availability. A reasonable response may be to calculate Massachusetts and New England coincident indexes that include the retail sales component, but to base

[32] All these comparisons are based on examining currently available data, and do not take into account false readings based on preliminary data. We have not looked at the historical performance of coincident indexes based on unrevised data. A proper retrospective exercise would involve not just the retrieval of appropriate data, but also reestimation of coefficients.

[33] Tentative plans call for annual reestimation of the indexes using updated inputs, in conjunction with rebenchmarking to take into account release of annual data for gross state product.

the initial estimates of the indexes on a forecast of retail sales (for example, on the basis of a univariate autoregressive moving-average model, or using the Kalman filter forecast of the index and the estimated coefficients for the retail sales equation) rather than waiting for the retail sales data to be released. Similarly, since the Boston consumer price index (used to deflate the tax and retail sales data) is released only every other month, the initial calculation of the composite index may be speeded up by using a forecast of inflation.

It is impossible to conclude that one constructed economic index is the best measure of the state of the economy: At least for states, composite economic indexes are instructive rather than definitive.

V. Conclusions

What does this exercise teach about constructing regional economic indexes? Such indexes fall short of satisfying those who desire an irrefutable measure of the business cycle. Nonetheless the attempt to construct coincident economic indexes at the regional level is worthwhile, and will continue to be pursued by the authors—for several reasons.

First, despite the demand for such indexes, a widely accepted and widely used index for the region does not exist. Recent advances in statistical methodologies, as in the fields of common trends and cointegration, and innovative applications of these methods, as in the work by Stock and Watson, have made the estimation of such indexes possible and practical. Also, the use of regional tax revenue data as a source of information for such indexes appears to have been overlooked or underutilized. (On the other hand, the use of tax data necessitates detailed historical information on the revenue effects of changes in tax law. For this reason, this study was able to use tax indicators only for Massachusetts. Another limitation is that the revenue effects of future tax law changes may not be as accurately forecastable in "real time" as they are with historical hindsight.)

Second, the indexes presented here are in accord with what knowledgeable observers believe about the New England economy. The estimated turning points and the estimated recession severities seem reasonable. For example, the recession of the late 1980s to early 1990s was unusually long and deep; the mid-1970s recession also produced a sharp decline in economic activity. This implies that the basic premise of the models being used is correct—that a common state of the economy is reflected in each series individually.

Third, the indexes are less noisy than the observable data from which they are generated. This is a useful characteristic, since the alternative of no index requires subjectively balancing the idiosyncracies of several observable series or, what is worse, relying on a single data series as a proxy for the state of the economy simply because it is smooth.

Fourth, the indexes show that the current state and regional recoveries in New England began much earlier than was previously thought—especially before the dramatic upward revision in March 1994 of the establishment employment series. (In fact, even indexes that include the pre-revised establishment employment—not reported in this paper—show recoveries much earlier than conventional wisdom at that time suggested.)

Fifth, the timeliness of the indexes may at least partially fill the information gap created by the lag in regional statistics, especially with regard to personal income and gross state product. This characteristic of the indexes can aid regional forecasters. Since forecasters' projections generally "take off" from the most recently available data, the timeliness of the index provides a more accurate point of departure. Also, since the economy appears to have momentum, a good current economic indicator can help regional prognosticators more accurately predict the first derivative of short-run forecasts. Finally, a methodology similar to the one employed in this paper could be used in the development of additional indexes of regional activity that could help in either analyzing current conditions or making forecasts.

Appendix

Data Sources and Definitions

Except for gross state product and the tax revenue data, all series were obtained from the Federal Reserve Bank of Boston *New England Economic Indicators* data base, which can be accessed through the New England Electronic Economic Data Center at the University of Maine in Orono. *Payroll employment* estimates the number of full-time and part-time wage and salary workers on the payrolls of nonagricultural establishments, seasonally adjusted, in thousands (Source: U.S. Bureau of Labor Statistics). *Retail sales* estimates the operating receipts of stores primarily engaged in retail trade, seasonally adjusted, in millions of dollars (Source: U.S. Bureau of the Census; seasonal adjustments for New England and Massachusetts data by the Federal Reserve Bank of Boston). *Average weekly hours* refers to the average workweek for manufacturing production workers, seasonally adjusted (Source: U.S. Bureau of Labor Statistics; seasonal adjustments for the New England states by the Federal Reserve Bank of Boston). *The unemployment rate* equals the number unemployed (civilians who had no employment during the survey week, were available for work, except for temporary illness, and had made specific efforts to find employment sometime during the prior four weeks) as a percentage of the civilian labor force (all persons 16 years of age and older who are employed or available for employment, except armed services personnel), seasonally adjusted (Source: U.S. Bureau of Labor Statistics). *The consumer price index* for all urban consumers measures the average change in the prices paid by urban consumers for a fixed market basket of goods and services relative to the price of that basket during the 1982–84 period (Source: U.S. Bureau of Labor Statistics). Because data for Boston are available only every other month (every third month prior to 1978), missing observations were obtained through linear interpolation. *Gross state product* (GSP) is the state analogue to gross domestic product (Source: U.S. Bureau of Economic Analysis). Because of a change in the methodology to estimate implicit deflators, a consistent constant-dollar GSP series is available only back to 1977. Estimates for prior years were constructed using prior BEA estimates of inflation.

Conceptually, construction of a tax base from its revenue stream simply involves dividing revenues by the tax rate. If the base on which the tax is computed changes—owing, say, to a change in tax law—then a corresponding adjustment to the base must be made so that it is defined consistently over time. Otherwise, movement in the tax base would reflect the state of the law in addition to the state of the economy.

In practice, several complications usually arise: tax-law base changes may be difficult to measure; effective tax rates may differ from statutory tax rates (this is usually associated with simultaneous changes in statutory tax rates and tax base definitions); phase-in periods of varying duration often accompany rate or base changes; and changes in tax collection procedures and technology can affect the timing and month-to-month variation in revenue collections. In constructing historical income tax withholding and sales tax bases, the problems due to these complications are less severe in recent years, partly because improvements in revenue-collecting procedures and technology have made the data more reliable and less noisy, and partly because the revenue-collecting agency has better knowledge of the revenue impact of recent tax law changes.

The steps involved in constructing the withholding and sales tax bases are described briefly here. Details are available from the authors.

Withholding tax base. The statutory base is essentially wage and salary disbursements, less the value of personal and dependent exemptions claimed by workers on their withholding forms. These exemptions account for less than 10 percent of wage and salary disbursements. Since these exemptions have changed four times over the 1968–94 period, the tax base was adjusted to include all wage and salary disbursements. Although the per-person and per-dependent exemption levels are known, the actual number of exemptions claimed on withholding forms is not. Estimates of the average per-worker exemption amounts claimed during each of the five regimes were formed using information on withholding tax collections and rates, employment (as measured by the Massachusetts Department of Employment and Training), and wage and salary disbursements (as measured by the quarterly data of the U.S. Bureau of Economic Analysis).

An initial estimate of the tax base was formed by adjusting monthly collections for the number of tax-deposit days per month, constructing a few short phase-in periods, adding the estimates of the exempt portion of the base, and seasonally adjusting the result. Because the series was noisy, the filter $(1 + 2L + 2L^2 + L^3)/6$ was applied. This filter has been used extensively by the U.S. Commerce Department to smooth noisy series. Its characteristics are described in Stock and Watson (1989, p. 367).

The resulting series exhibited a marked difference in month-to-month variation pre- and post-FY 1978. Also, owing to a lack of adequate historical documentation on the revenue effects of some of the tax law changes pre-FY 1978, the data for this early time period were suspect. Since the data were cointegrated with the BEA measure of wage and salary disbursements (for the entire interval), the BEA series was used to proxy for the tax-based series during the pre-1978 time period.

Sales tax base. During the 1968–94 period, the sales tax has undergone only two major changes: a simultaneous rate and base change beginning in 1976, and a moderate expansion of the base in late 1990. Official analyses of the revenue impact of the 1990 base change were used to factor the 1968–90 base upward to be consistent with the current base definition. Historical estimates of the 1976 change were unavailable; therefore, estimates of the relationship between personal disposable income and sales tax collections were used to estimate an effective tax-rate change for this period.

The series was adjusted for the number of deposit days, seasonally adjusted, and filtered as above. The series is highly suspect between early 1976 and late 1977, perhaps because of a lengthy and complex phase-in period for changes in the tax law. Therefore, for this period the sales tax data were omitted and the index was estimated using only the remaining indicators.

Parameter Estimates

Parameter estimates for New England, each New England state, and the United States are displayed in Appendix Table 1.

Cointegration Tests

This section lists the integration and cointegration properties of the three series making up the Massachusetts-C index. Unit root tests are used to indicate whether a series is integrated—that is, whether it exhibits a trend. The multivariate equivalents provide evidence of cointegration.

Appendix Table 2 summarizes unit root properties based on Dickey-Fuller tests. For two of the series, the sales tax base and the withholding tax base, the Dickey-Fuller t-tests of a unit root cannot reject the null hypothesis of a unit root regardless of whether a deterministic trend is present. For retail sales, however, the t-test rejects the null hypothesis of a unit root for the residuals from a linear deterministic trend. For this series, we further investigate this hypothesis with an augmented Dickey-Fuller test, using the $T(\rho-1)$ test, which has greater power with a stationary alternative. The augmented Dickey-Fuller test fails to reject the null hypothesis of a unit root. For all series, the Dickey-Fuller and augmented Dickey-Fuller tests reject the null hypothesis of a unit root in the first differences of the series. We conclude that all three series are integrated of order one.

Appendix Table 3 lists the multivariate unit root tests based on the Johansen test (see Johansen 1988, 1991; Johansen and Juselius 1990; and Dickey, Jansen, and Thorton 1991 for descriptions of the tests). Regardless of whether constants are included in the auxiliary regressions, the combination of trace and maximal eigenvalue tests suggests that only one common unit root (one common stochastic trend) is present. Consequently, in extracting the unobservable component, we "de-mean" but do not detrend each of the series.

In tests between the index and gross state product, personal income, and wages and salaries, cointegration results proved to be marginal. The index (before constraining the trend to be the same as that of gross state product) was found to be cointegrated (at the 5 percent level) with gross state product, personal income, and wage and salary disbursements when paired with each series singly. When the four series were tested jointly, however, the hypothesis of a single common trend could not be accepted. When the four series were detrended, the hypothesis of a single common trend could be accepted, but this result leaves open the question of why the series have different nonstochastic trends. Extensive results are available from the authors upon request.

National Business Cycle Turning Points

Appendix Table 4 compares official business cycle turning points, as determined by the National Bureau of Economic Research, to turning points in the Commerce Department Composite Index of Coincident Indicators and in the Philadelphia Federal Reserve national index, adjusted to mirror the long-term trend in real gross domestic product. Appendix Table 5 lists the public release dates for selected economic indicators.

Appendix Table 1

Parameter Estimates

Standard Errors in Parentheses

New England—A

Parameter	Equation: Employment	Retail Sales	Hours	Unemployment Rate	v
β_i or β_{40}	.8144 (.0399)	.2281 (.0688)	.1286 (.0330)	−.2031 (.0569)	
β_{41}				−.1716 (.0591)	
β_{42}				−.0207 (.0605)	
β_{43}				−.7823 (.0598)	
r_{i1}	.4495 (.4515)	−.5292 (.0736)	−.5609 (.0533)	−.3126 (.0582)	
r_{i2}	.4745 (.4319)	−.2620 (.0738)	−.2587 (.0503)	−.2184 (.0588)	
σ_i	.1531 (.0727)	1.1406 (.0613)	.7351 (.0300)	.8829 (.0365)	
r_1					.1978 (.0710)
r_2					.3084 (.0685)

Connecticut

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.3885 (.0757)	.4825 (.0189)	−.4944 (.1230)	
β_{41}			.0079 (.1548)	
β_{42}			.3020 (.1697)	
β_{43}			−.1083 (.1174)	
r_{i1}	−.2923 (.0991)	−.5404 (.5292)	−.0229 (.8394)	
r_{i2}	.0343 (.0914)	−.2891 (.0500)	.1043 (.1457)	
σ_i	.6812 (.5129)	.7599 (.0309)	.7593 (.0906)	
r_1				.4557 (.1880)
r_2				.4179 (.1723)

New England—B

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.8127 (.0395)	.1313 (.0332)	−.1971 (.0568)	
β_{41}			−.1718 (.0590)	
β_{42}			−.0279 (.0604)	
β_{43}			−.0836 (.0594)	
r_{i1}	.4586 (.4592)	−.5628 (.0531)	−.3131 (.0588)	
r_{i2}	.4765 (.4424)	−.2603 (.0501)	−.2264 (.0592)	
σ_i	.1501 (.0684)	.7343 (.0299)	.8842 (.0366)	
r_1				.1875 (.0723)
r_2				.2985 (.0696)

Maine

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.5156 (.1402)	.0565 (.0282)	−.4518 (.1297)	
β_{41}			−.0243 (.1980)	
β_{42}			.1345 (.1146)	
β_{43}			−.0533 (.1000)	
r_{i1}	−.2636 (.1175)	−.5508 (.0535)	−.0905 (.0766)	
r_{i2}	−.2370 (.1577)	−.2392 (.0510)	.0706 (.0759)	
σ_i	.7287 (.1135)	.7624 (.0310)	.8438 (.0691)	
r_1				.2650 (.2830)
r_2				.4394 (.2231)

Appendix Table 1 (continued)

Parameter Estimates

Standard Errors in Parentheses

Massachusetts—A

Parameter	Equation: Employment	Retail Sales	Hours	Unemployment Rate	v
β_i or β_{40}	.8038 (.0534)	.3795 (.1119)	.1094 (.0410)	−.0876 (.0601)	
β_{41}				−.1251 (.0578)	
β_{42}				−.0367 (.0584)	
β_{43}				−.1486 (.0590)	
r_{i1}	.7225 (.7280)	−.5518 (.0756)	−.6147 (.0553)	−.2992 (.0613)	
r_{i2}	.1877 (.6753)	−.2913 (.0745)	−.2447 (.5237)	−.1095 (.0619)	
σ_i	.2331 (.1489)	1.1079 (.0619)	.7336 (.0307)	.9454 (.0396)	
r_1					−.1439 (.1023)
r_2					−.0047 (.0922)

Massachusetts—B

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.7903 (.0641)	.1114 (.0415)	−.0743 (.0638)	
β_{41}			−.1202 (.0595)	
β_{42}			−.0237 (.0606)	
β_{43}			−.1393 (.0606)	
r_{i1}	.3591 (.4972)	−.6010 (.0539)	−.2814 (.0625)	
r_{i2}	.5408 (.4701)	−.2345 (.0511)	−.0919 (.0633)	
σ_i	.2876 (.1124)	.7330 (.0298)	.9526 (.0400)	
r_1				−.1410 (.1129)
r_2				−.0198 (.1106)

Massachusetts—C

Parameter	Equation: Withholding Tax Base	Sales Tax Base	Retail Sales	Employment	Hours	Unemployment Rate	State (Transition)
β_i or β_{60}	1 (Restricted)	.9810 (.0292)	.9723 (.0467)	18.1142 (2.4072)	1.7159 (.8948)	45.0477 (82.0551)	
β_{61}						−38.9697 (186.2010)	
β_{62}						−65.0331 (154.6230)	
β_{63}						52.5934 (55.9688)	
r_{i1}	1.3734 (.0516)	1.0420 (.0464)	.6142 (.0581)	−.0262 (.0625)	−.6078 (.0537)	−.4791 (.1096)	
r_{i2}	−.4595 (.0515)	−.6737 (.0445)	.0292 (.0585)	.0960 (.0596)	−.2388 (.0510)	−.1405 (.0895)	
σ_i	.0551 (.0023)	.0875 (.0041)	.2294 (.0093)	.8693 (.0362)	.7393 (.0300)	.7907 (.0760)	.0057 (.0049)
δ							.0003 (.0003)
r_1							1.3955 (.4974)
r_2							−.4339 (.4647)

Appendix Table 1 (continued)

Parameter Estimates

Standard Errors in Parentheses

New Hampshire

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.2474 (.0871)	.0110 (.0090)	−.4521 (.1429)	
β_{41}			.5802 (.2672)	
β_{42}			−.5629 (.2961)	
β_{43}			.2919 (.1555)	
r_{i1}	−.1364 (.0914)	−.6550 (.0498)	.0367 (.1816)	
r_{i2}	−.1136 (.0757)	−.4378 (.0484)	.0716 (.0898)	
σ_i	.7343 (.0467)	.7394 (.0299)	.7655 (.0944)	
r_1				1.0987 (.2816)
r_2				−.1841 (.2566)

Vermont

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.4523 (.0888)	.0329 (.0245)	−.4777 (.1110)	
β_{41}			.0828 (.1433)	
β_{42}			.0248 (.1209)	
β_{43}			−.0755 (.0875)	
r_{i1}	−.3073 (.0885)	−.5913 (.0540)	.0501 (.0998)	
r_{i2}	−.1294 (.0797)	−.3019 (.0531)	.1333 (.0840)	
σ_i	.7649 (.0574)	.8089 (.0328)	.7976 (.0643)	
r_1				.3032 (.1405)
r_2				.4403 (.1358)

Rhode Island

Parameter	Equation: Employment	Hours	Unemployment Rate	v
β_i or β_{40}	.3382 (.0918)	.0317 (.0243)	−.5145 (.1524)	
β_{41}			.0644 (.2121)	
β_{42}			.0009 (.1657)	
β_{43}			.1289 (.1474)	
r_{i1}	−.1780 (.0956)	−.4275 (.0549)	−.2478 (.1501)	
r_{i2}	−.0584 (.0813)	−.2906 (.0552)	.1513 (.1101)	
σ_i	.8484 (.0541)	.9048 (.0366)	.7371 (.1022)	
r_1				.5929 (.3547)
r_2				.2003 (.3170)

United States

Parameter	Equation: Employment	Retail Sales	Hours	Unemployment Rate	v
β_i or β_{40}	.5694 (.0519)	.0745 (.0231)	.1107 (.0268)	−.3935 (.0615)	
β_{41}				−.3020 (.0761)	
β_{42}				.1514 (.0737)	
β_{43}				.1449 (.0636)	
r_{i1}	.0827 (.1717)	−.3076 (.0569)	−.5005 (.0573)	−.3895 (.1234)	
r_{i2}	−.0145 (.1683)	−.1672 (.0568)	−.1668 (.0571)	−.1170 (.1019)	
σ_i	.4778 (.0601)	.7407 (.0302)	.8729 (.0360)	.6696 (.0582)	
r_1					.3626 (.0849)
r_2					.4657 (.0830)

Appendix Table 2
Unit Root Properties

Variable	Dickey-Fuller T-Tests: No Trend	Dickey-Fuller T-Tests: With Trend	Augmented Dickey-Fuller T(ρ−1)-Tests: No Trend	Augmented Dickey-Fuller T(ρ−1)-Tests: With Trend
Levels				
Sales Tax Base	−1.716	−2.674	−1.849	−6.623
Retail Sales	−2.238	−3.469	−3.795	−10.726
Withholding Base	−.834	−1.239	−1.068	−4.153
First Differences				
Sales Tax Base	−10.606	−10.588	−244.847	−238.808
Retail Sales	−25.326	−25.286	−577.882	−577.965
Withholding Base	−10.663	−10.649	−317.771	−317.963
Critical Values (.05)	−2.880	−3.425	−14.000	−21.400

Appendix Table 3
Multivariate Unit Root Test Results

Hypothesis Null/Alternate	Johansen Cointegration Tests: With Constants	Critical Value (.05)	With Constants, No Trend	Critical Value (.05)	No Constants	Critical Value (.05)
Trace Tests						
At Least 1 Unit Root/ 0 Unit Roots	.160	3.962	2.840	8.083	1.224	3.840
At Least 2 Unit Roots/ 0 Unit Roots	18.656	15.197	29.653	17.844	52.271	12.530
Maximal Eigenvalue Tests						
2 Unit Roots/1 Unit Root	18.496	3.962	26.814	8.083	51.047	3.840
Trend Test						
No Trend/Trend	n.a.	n.a.	2.680	3.840	n.a.	n.a.

n.a. = not applicable.

Appendix Table 4
Comparison of Business Cycle Turning Points

(1) NBER Business Cycle Turning Points	(2) Commerce Department Coincident Index	(3) Coincident Index Using Philadelphia Federal Reserve Specification and GDP Trend	(4) Gross Domestic Product
Peak			
December 1969	October 1969	Same as (1)	Q3 1969
November 1973	Same as (1)	May 1974	Q4 1973
January 1980	Same as (1)	March 1980	Q1 1980
July 1981	August 1981	Same as (1)	Q3 1981
July 1990	June 1990	June 1990	Q2 1990
Trough			
November 1970	Same as (1)	Same as (1)	Q2 1970
March 1975	Same as (1)	June 1975	Q1 1975
July 1980	Same as (1)	Same as (1)	Q2 1980
November 1982	December 1982	December 1982	Q3 1982
March 1991	Same as (1)	February 1992	Q1 1991
Percent Change, Peak to Trough			
1969–70	−2.4	−2.6	−0.9
1973–75	−6.6	−5.2	−4.1
1980	−3.0	−2.2	−2.6
1981–82	−3.9	−5.4	−2.8
1990–91	−2.4	−3.1	−1.5

Source: National Bureau of Economic Research, U.S. Bureau of Economic Analysis, and authors' calculations.

Appendix Table 5
Public Release Dates for Economic Indicators

Indicator	Massachusetts	Other New England States	Indicator	Massachusetts	Other New England States
Payroll Employment	Last Wednesday of following month.[a]	Last Wednesday of following month.[a]	Withholding Tax Base	First week of following month.[c]	Not available.
Retail Sales	Between the 22nd and 29th day of second following month.[b]	Not available.	Sales Tax Base	First week of following month.[c]	Not available.
Average Workweek in Manufacturing	Last Wednesday of following month.	Last Wednesday of following month.	Consumer Price Index	Approximately one week after employment release; odd-numbered months only.[d]	Not available.
Unemployment Rate	First Friday of following month.[b]	Last Wednesday of following month.			

[a]Refers to release date by the U.S. Bureau of Labor Statistics. Data may be available approximately one week earlier from the state.
[b]Applies also to New England total.
[c]Refers to potential public release date; data currently not released.
[d]Refers to Boston CPI.
Source: Issuing agencies.

References

Anderson, Brian D.O. and John B. Moore. 1979. *Optimal Filtering*. Englewood Cliffs, NJ: Prentice Hall.

Auerbach, Alan J. 1982. "The Index of Leading Indicators: 'Measurement Without Theory,' Twenty-Five Years Later." *The Review of Economics and Statistics*, vol. 64, no. 4, pp. 598–95.

Beveridge, Stephen and Charles Nelson. 1981. "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the Business Cycle." *Journal of Monetary Economics*, vol. 1, no. 2 (March), pp. 151–74.

Bradbury, Katharine L. and Yolanda K. Kodrzycki. 1992. "What Past Recoveries Say about the Outlook for New England." *New England Economic Review*, September/October, pp. 15–31.

California Department of Finance. 1976. "California Index of Leading Indicators: Methodology." Sacramento, California.

Center for the Study of the States. *State Revenue Report*. Quarterly, May 1991–present. Albany, NY: Nelson A. Rockefeller Institute of Government.

Clayton-Matthews, Alan. 1994. *Kalman 3.0: A Manual*. Department of Revenue, The Commonwealth of Massachusetts, June 6.

Crone, Theodore M. 1994. "New Indexes Track the State of the States." Federal Reserve Bank of Philadelphia *Business Review*, January/February, pp. 19–31.

de Leeuw, Frank. 1991. "Toward a Theory of Leading Indicators." In Kajal Lahiri and Geoffrey H. Moore, eds. *Leading Indicators: New Approaches and Forecasting Records*. Cambridge: Cambridge University Press.

Dickey, David A., Dennis W. Jansen, and Daniel L. Thorton. 1991. "A Primer on Cointegration with an Application to Money and Income." Federal Reserve Bank of St. Louis *Review*, vol. 73, no. 2 (March/April), pp. 58–78.

Dua, Pami and Stephen M. Miller. 1994. "New Tools for Analyzing and Forecasting Connecticut Employment and Unemployment." University of Connecticut. October.

Engle, Robert F. and C.W.J. Granger. 1987. "Co-integration and Error Correction: Representation, Estimation, and Testing." *Econometrica*, vol. 55, no. 2 (March), pp. 251–76.

Engle, Robert F. and Mark Watson. 1981. "A One-Factor Multivariate Time Series Model of Metropolitan Wage Rates." *Journal of the American Statistical Association*, vol. 76, December, pp. 774–81.

Fuhrer, Jeffrey C. 1992. "Do Consumers Behave as the Life-Cycle/Permanent-Income Theory of Consumption Predicts?" *New England Economic Review*, September/October, pp. 3–14.

Gorsuch, S.A. 1974. *Factor Analysis*. Philadelphia: W.B. Saunders Company.

Green, George R. and Barry A. Beckman. 1992. "The Composite Index of Coincident Indicators and Alternative Coincident Indexes." U.S. Department of Commerce, *Survey of Current Business*, vol. 72, no. 6 (June), pp. 42–45.

———. 1993. "Business Cycle Indicators: Upcoming Revision of the Composite Indexes." *Survey of Current Business*, vol. 73, no. 10 (October), pp. 44–51.

Hamilton, James D. 1994. *Time Series Analysis*. Princeton, NJ: The Princeton University Press.

Harvey, A.C. 1981. *Time Series Models*. Oxford: Philip Allen Publishers Ltd.

———. 1989. *Forecasting Structural Time Series and the Kalman Filter*. Cambridge: Cambridge University Press.

Hertzberg, Marie P. and Barry A. Beckman. 1989. "Business Cycle Indicators: Revised Composite Indexes." *Survey of Current Business*, vol. 69, no. 1 (January), pp. 22–28.

Johansen, Soren. 1988. "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control*, vol. 12, pp. 231–54.

———. 1991. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models." *Econometrica*, vol. 59, no. 6 (November), pp. 1551–80.

Johansen, Soren and Katarina Juselius. 1990. "Maximum Likelihood Estimation and Inference on Cointegration—with Application to the Demand for Money." *Oxford Bulletin of Economics and Statistics*, vol. 52, no. 2, pp. 169–210.

Joreskog, K.G. 1967. "Some Contributions to Maximum Likelihood Factor Analysis." *Psychometrika*, vol. 32, no. 4 (December), pp. 443–82.

Koopmans, Tjalling C. 1947. "Measurement Without Theory." *The Review of Economics and Statistics*, vol. 29, pp. 161–72.

McNees, Stephen K. and Geoffrey M.B. Tootell. 1991. "'Whither New England?'." Federal Reserve Bank of Boston, *New England Economic Review*, July/August, pp. 11–26.

Nelson, Charles R. and Charles I. Plosser. 1982. "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications." *Journal of Monetary Economics*, vol. 10, no. 2 (September), pp. 129–62.

New England Economic Project. 1994. *Economic Outlook 1994–1998*. October.

Philips, Keith R. 1990. "The Texas Index of Leading Economic Indicators: A Revision and Further Evaluation." Federal Reserve Bank of Dallas, July, pp. 17–25.

Sargent, Thomas J. and Christopher A. Sims. 1977. "Business Cycle Modeling Without Pretending to Have Too Much *A Priori* Economic Theory." In Federal Reserve Bank of Minneapolis, *New Methods in Business Cycle Research: Proceedings from a Conference*. Minneapolis: Federal Reserve Bank of Minneapolis.

Stock, James H. and Mark W. Watson. 1988. "Testing for Common Trends." *Journal of the American Statistical Association*, vol. 83, no. 404, pp. 1097-1107.

———. 1989. "New Indexes of Coincident and Leading Economic Indicators." *NBER Macroeconomics Annual*, pp. 351–94.

———. 1992. "A Probability Model of the Coincident Economic Indicators." In Kajal Lahiri and Geoffrey H. Moore, eds., *Leading Economic Indicators: New Approaches and Forecasting Records*. Cambridge: Cambridge University Press.

———. 1993. "A Procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience." In James H. Stock and Mark W. Watson, eds., *Business Cycles, Indicators, and Forecasting*. Chicago and London: The University of Chicago Press.

Watson, Mark W. and Robert F. Engle. 1983. "Alternative Algorithms for the Estimation of Dynamic Factor, MIMIC, and Varying Coefficient Regression Models." *Journal of Econometrics*, vol. 23, August, pp. 385–400.

Communities & Banking

Communities & Banking

Updates

INVESTING IN THE INNER CITIES

Published quarterly, *Communities & Banking* explores viable roles for financial institutions in community economic development. The newsletter is produced by the Federal Reserve Bank of Boston's Public and Community Affairs Department. In the most recent issue, four Boston area experts discuss investing in the inner city. Also included are updates on recent developments in affordable housing and community development finance. The regular CRA Notes section suggests places to turn for additional reinvestment strategies, technical assistance, and fair lending tools.

For a copy of *Communities & Banking* or a free subscription, write to Sheryl Snowden, Public and Community Affairs, Federal Reserve Bank of Boston, P.O. Box 2076, Boston MA 02106-2076 or call (617) 973-3097. Those interested in having community development programs or projects described in *Communities & Banking* should contact the editor, Joel Werkema, at (617) 973-3390.

Explaining New England's Export Performance: 1987 to 1993

Richard J. DeKaser and Jane Sneddon Little

Senior Economists, Bank of Boston, and Federal Reserve Bank of Boston, respectively. *The authors would like to thank colleagues at the Federal Reserve Bank of Boston for helpful comments. In addition, they are most grateful to Rachel Deyette and Paula Fitzgibbon for valuable research assistance.*

The recession of the early 1990s hit New England much harder than the nation. Over the period covered by this study (1987 to 1993), New England's manufacturing employment fell 22 percent, as compared with a 5 percent decline for the nation; over the same period, total nonfarm jobs *grew* 8 percent nationally but *fell* 5 percent in the region. Although New England's manufacturing employment has stabilized recently, and the total number of nonfarm jobs has been rising for two years, both series remain well below their previous peaks. Presumably, thus, New England firms are highly motivated to seek rapidly growing markets wherever they may be—including overseas.

Exports have provided considerable support to the national economy in recent years. During the 1990–91 downturn, real net exports cut the depth of the U.S. recession by half. Looking ahead, moreover, recent forecasts by the International Monetary Fund suggest that world growth will outpace U.S. growth in 1995. U.S. GDP is projected to rise an inflation-adjusted 2.5 percent next year while, with the help of the dynamic developing countries, world growth is estimated to be 3.6 percent. Global trade is expected to grow even faster, at a 7 percent pace.

Despite New Englanders' obvious incentive to explore burgeoning foreign markets, however, the best available data indicate that the region underperformed the nation in terms of export growth from 1987 to 1993. How so? Indeed, the result seems surprising given the region's trading history and its traditional comparative advantage vis-à-vis the nation in the high-tech industries that dominate U.S. exports. This article explores the reasons for the region's below-average merchandise export growth and concludes that it largely reflects the relative importance of the regional computer industry and its recent structural problems. Also contributing are New England exporters' traditional ties to markets in mature industrial countries. As the authors point out, however, merchandise exports represent only one route to foreign consumers. New Englanders are also reaching vibrant foreign markets

through exports of services and through sales made by foreign affiliates of New England firms. Indeed, given the region's industrial structure, these alternative paths are likely to become increasingly important over time.

I. Exports: A Growth Market

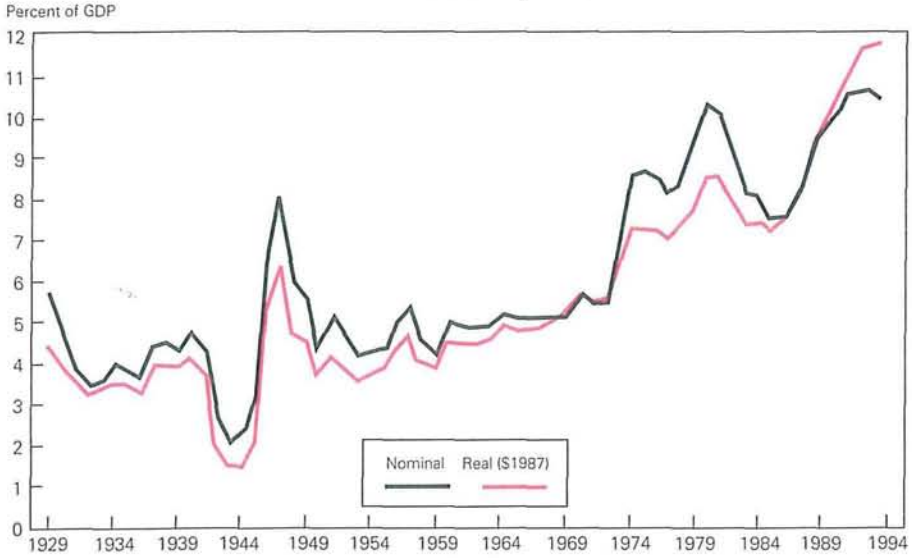
With the start of North American free trade in January 1994, the seemingly endless trade talks between the United States and Japan, and the fractious congressional debates over the recently negotiated amendments to the General Agreement on Tariffs and Trade, the impact of world trade on the U.S. economy has been in the forefront of the news for much of the last year. Not always well appreciated by the U.S. public, however, is the growing importance of exports in national output as advances in communications and transportation and reductions in trade and investment barriers have led to increasingly global markets. With the recovery of war-torn Europe and Japan, the start of European integration in 1957, and the decline of the overvalued dollar in the 1970s, total real exports grew from 4 percent of GDP in the early 1950s to almost 9 percent in 1980 (Figure 1). During the first half of the 1980s, a 50 percent appreciation of the dollar reversed this trend. Once the dollar retraced its steps, however, real exports renewed their climb, rising steadily in each of the last seven years to approach 12 percent of GDP in 1993. Simply put, exports have been a "growth market" for most of the postwar period.

The best available data indicate that New England underperformed the nation in terms of export growth from 1987 to 1993.

State and local economic development specialists clearly have noted these trends. According to a 1990 Government Accounting Office report, export promotion has eclipsed attracting foreign investment as a priority among state and local economic development officials. In New England, all six states have committed resources to export promotion initiatives; trade missions and educational programs are the supportive tactics most commonly used.

Figure 1

Total U.S. Exports



Source: U.S. Bureau of Economic Analysis.

Given the growing importance of exports nationally, as well as regional efforts to promote trade, the rest of this article explores why exports appear to have played a less dynamic role in the New England economy in recent years than they have for the country as a whole. The next two sections address some basic questions about New England's exports—what they are and where they go.

II. *What Are New England's Exports?*

That New England's exports differ from those in the national export basket reflects fundamental differences in the regional and national resource base. In general, the region's exports consist of fewer raw materials and derivative products than is the case for the nation as a whole (Table 1). For example, New England's agricultural exports account for just 2 percent of its total, while the national share of agricultural exports is nearly three times as high. Nationally, crops account for the great bulk of agricultural exports, but, in New England, fish are most important.[1]

Table 1
Exports by Industry: 1991 to 1993
Millions of dollars

Industry	United States Annual Average	United States Share of Total (%)	New England Annual Average	New England Share of Total (%)
Agriculture	26,299	5.9	504	2.1
Crops	22,205	5.0	128	.5
Livestock	909	.2	80	.3
Forestry	329	.1	19	.1
Fishing & Hunting	2,856	.6	277	1.2
Mining	6,882	1.5	106	.4
Metal Mining	1,079	.2	36	.2
Coal Mining	3,987	.9	36	.2
Oil & Gas	676	.2	2	0
Nonmetallic Minerals	1,140	.3	31	.1
Manufacturing	401,240	90.2	22,326	94.0
Food Products	20,419	4.6	303	1.3
Tobacco Products	4,468	1.0	1	0
Textile Products	4,791	1.1	336	1.4
Apparel	4,912	1.1	107	.5
Lumber & Wood	7,155	1.6	254	1.1
Furniture & Fixtures	2,661	.6	53	.2
Paper Products	10,044	2.3	630	2.7
Printing & Publishing	4,114	.9	277	1.2
Chemicals	43,958	9.9	1,304	5.5
Petroleum & Coal	6,708	1.5	93	.4
Rubber & Plastics	8,317	1.9	447	1.9
Leather Products	1,697	.4	320	1.3
Stone, Clay & Glass	3,999	.9	149	.6
Basic Metals	17,147	3.9	475	2.0
Fabricated Metals	13,823	3.1	1,080	4.5
Industrial Machinery	75,837	17.1	5,605	23.6
Electronic Equipment	55,083	12.4	5,182	21.8
Transportation Equip.	83,601	18.8	2,493	10.5
Instruments	24,997	5.6	2,782	11.7
Misc. Manufactures	7,512	1.7	436	1.8
Other	10,306	2.4	814	3.4

Source: U.S. Bureau of the Census and Massachusetts Institute for Social and Economic Research.

Manufactured goods derived from raw materials also represent a relatively small share of New England's exports. Manufactured foods, tobacco, lumber, chemicals, petroleum products, and basic metals each account for an appreciably smaller proportion of New England exports than they do for the nation. Combined, these goods accounted for 23 percent of U.S. exports over the three-year period from 1991 to 1993, while the corresponding regional figure is much lower, at 10 percent.[2]

As a corollary to New England's resource base—with its relative scarcity of raw materials and abundance of skilled labor—an unusually large share of its exports are products requiring significant processing or "value added." Fabricated metal products, industrial machinery, electronic equipment, transportation

[1] Maine, Massachusetts and Rhode Island, which produce nearly all of the region's fishery exports, have an export concentration in fish equal to, or greater than, the nation as a whole. As for mining products, they account for a small 1.5 percent of the nation's merchandise exports, but their share of New England exports is even lower, at just 0.4 percent. New Hampshire and Vermont each export some nonmetallic minerals (presumably quarried stone, like granite), while much of the rest comes from Connecticut.

[2] By exception, large paper exports from mills in Maine and Massachusetts push the regional dependence on paper exports over the national average. Similarly, Maine and, to a lesser extent, Massachusetts have an above-average dependence on exports of leather products (including footwear).

equipment, and instruments account for 57 percent of national exports, while the corresponding figure for New England is 72 percent. Among these sectors, transportation equipment is the only one that looms more important in national than regional exports.

Exports have been a growth market for most of the postwar period.

Still, because Connecticut is a major producer of jet engines and other aviation equipment, transportation accounts for nearly one-third of Connecticut's exports—a figure well above the national average of 19 percent.

III. Where Do New England's Exports Go?

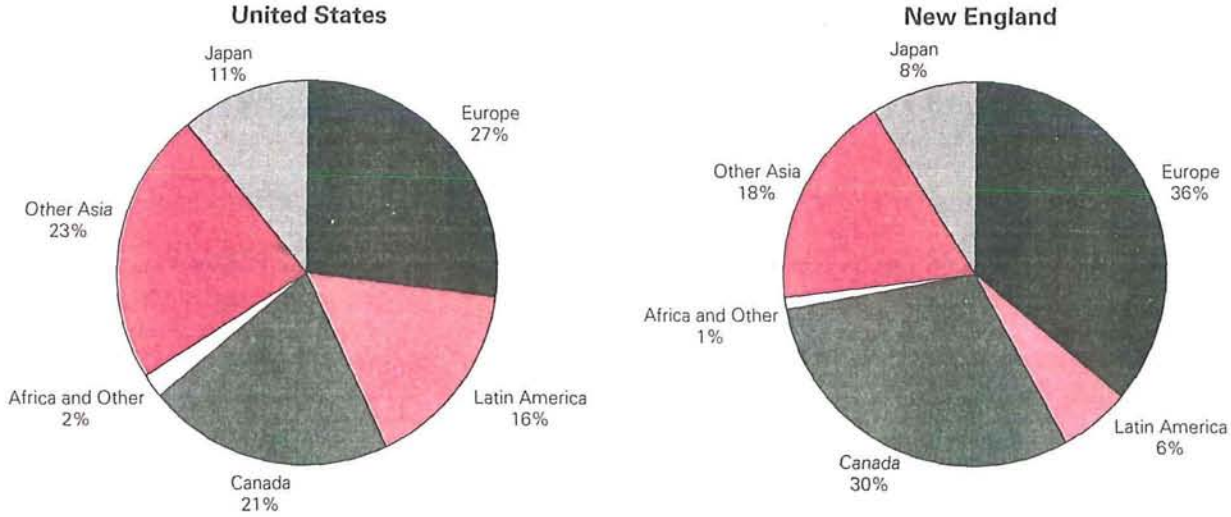
New England's exports also differ from the nation's in terms of destination or market mix. While Europe is a principal foreign market for both the region and the nation, New England's European trade ties are far stronger. Thirty-six percent of the region's exports went to Europe between 1991 and 1993, as compared with 27 percent for the nation (Figure 2). For both cyclical and secular reasons, however, Europe's relative importance as a foreign market has diminished recently. Its share of U.S. exports fell from 30 percent in the boom years of 1989 and 1990 to 26 percent in 1993, the trough of its recent recession. (Maps 1 and 2 show relative average annual U.S. export growth rates to this country's trading partners from 1987 to 1990 and 1990 to 1993.) For New England the decline in Europe's share has been even more dramatic—from 43 percent in 1987 and 1988 to 35 percent in 1993.

Canada is another very significant market for the country and the region but, again, New England has the greater dependence on trade with this neighbor. Canada accounts for 30 percent of New England's total exports, compared with just 21 percent for the nation. Nationally, Canada's market share has been quite stable, holding near 20 percent of total U.S. exports throughout the 1987–93 period. By contrast, Canada's share of New England exports rose sharply from 20 percent of total exports in 1988 to 31 percent in 1993.

That Canada has retained its share of U.S. exports and increased its share of New England sales is noteworthy in light of its relatively severe recent recession; real domestic demand in Canada showed

Figure 2

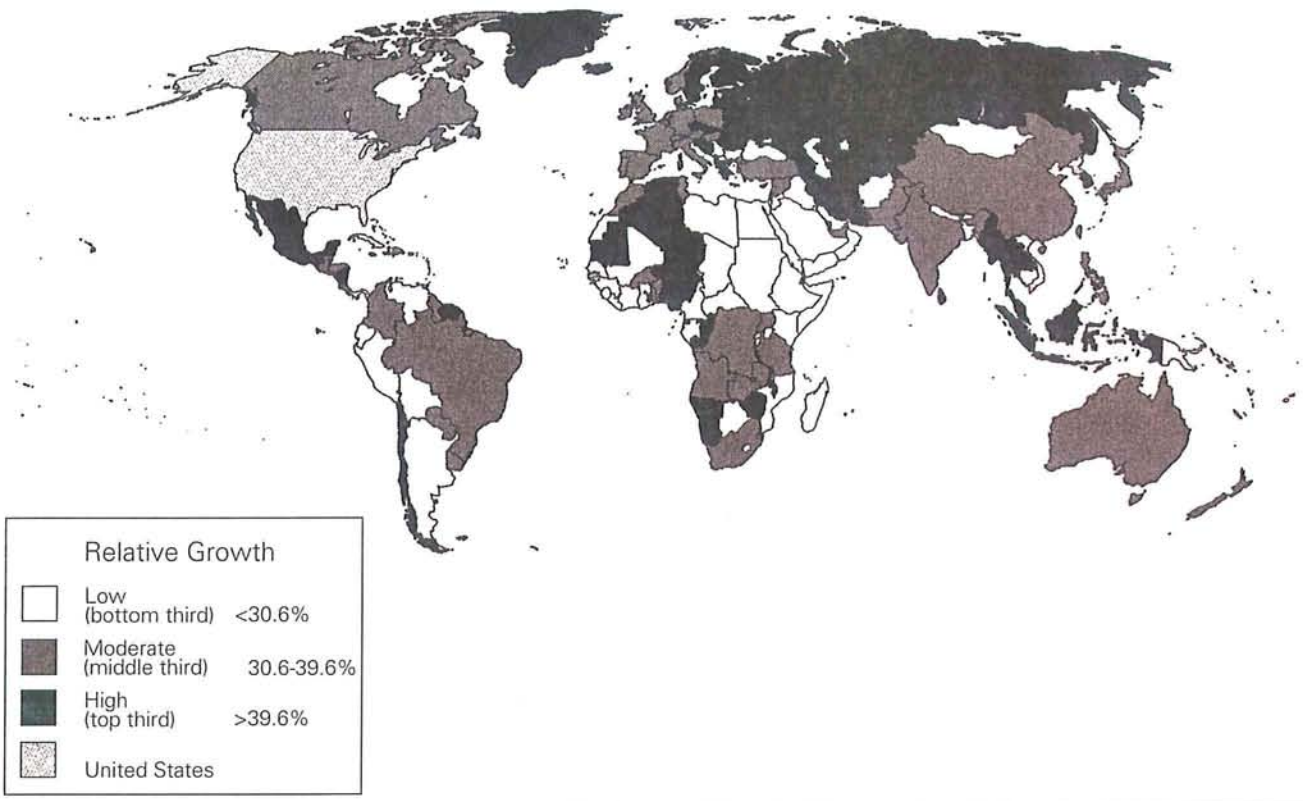
Export Destinations
Average Share, 1991 to 1993



Source: U.S. Bureau of the Census and Massachusetts Institute for Social and Economic Research.

Map 1

Growth in U.S. Exports
1987 to 1990



no net growth at all from 1989 to 1993. The Free Trade Agreement between Canada and the United States, which went into effect at the start of 1989, provides a likely explanation. Progressively liberalizing trade between the two countries, the Free Trade Agreement expanded access to the Canadian market while the market itself remained comparatively weak.[3] Recently, of course, Canada and the United States have enjoyed mutually reinforcing recoveries.

Beyond Canada and Europe, New England's market share is lower than the national average. As it turns out, the regions where New England has less exposure include some of the world's fastest growing export markets. Latin America, for example, has enjoyed an impressive economic resurgence in recent years, perhaps in part because it has embraced increasingly open trade policies. Tariff rates, which averaged over 50 percent in the mid 1980s, have fallen to less than 20 percent in most countries.[4] As a result, Latin America's share of U.S. exports rose from 14 percent in 1990 to 17 percent in 1993. While New England's dependence on Latin American sales has also grown, as of 1993, exports to Latin America still accounted for just 7 percent of the region's total.

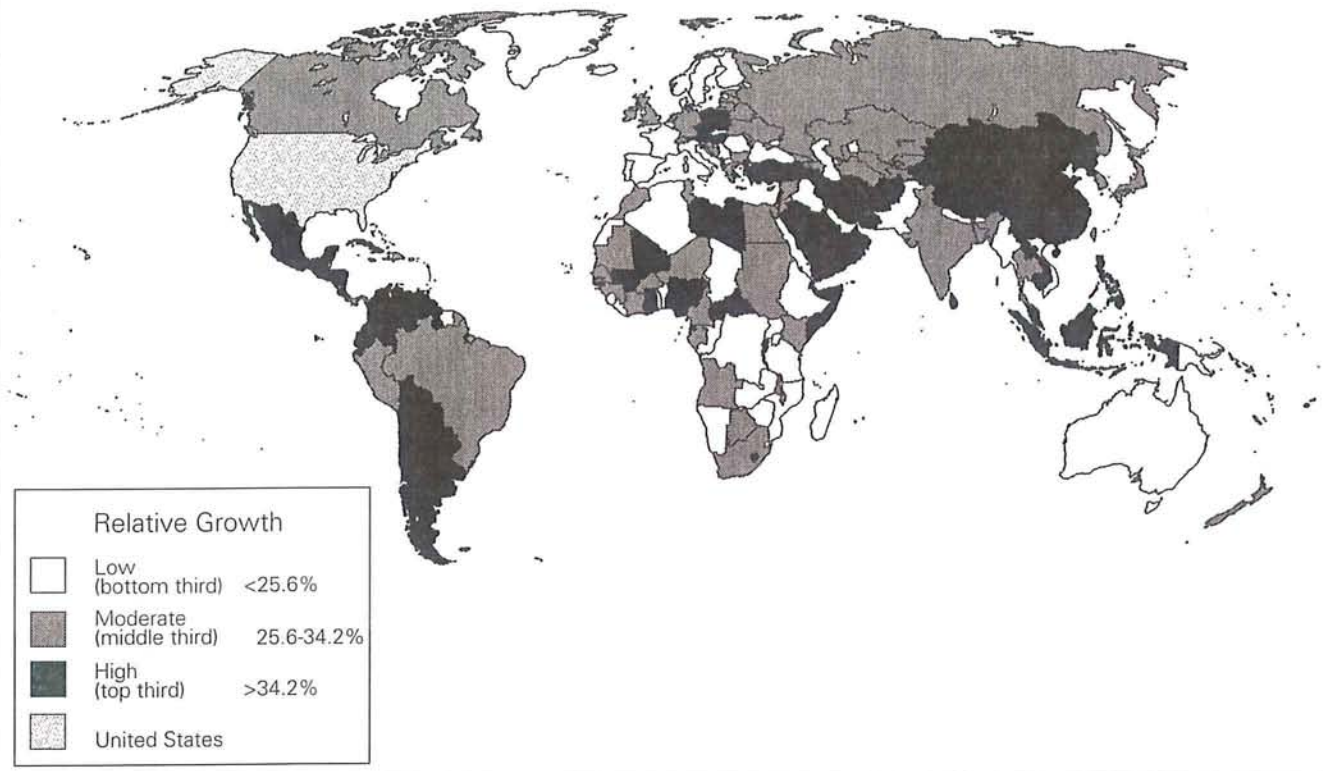
Like Latin America, the dynamic Asian econo-

[3] Although the New England states, like other border areas, stand to benefit disproportionately from free trade with Canada, a statistical change may also help to explain the sharp increase in Canada's share of New England exports over this period. In 1990 the Census Bureau began substituting Canadian import data for U.S. export data and eliminated the category "undocumented exports to Canada." Undocumented exports probably represented a larger share of exports to Canada from border areas than from more distant states; thus, the statistical change may account for part of the jump in Canada's share of New England exports.

[4] International Monetary Fund, Western Hemisphere Department, "Adjustment and Recovery in Latin America and the Caribbean," *World Economic Outlook*, May 1994, pages 93–98.

Map 2

Growth in U.S. Exports
1990 to 1993



mies represent another large and rapidly growing market for U.S. exports. This region has posted the world's fastest growth rates over the past decade while pursuing increasingly open trade and investment policies. By exception, Japan, like the other industrial countries, has been mired in a deep recession from which it is just beginning to emerge; thus, its share of U.S. exports has fallen from 13 percent in 1989 to 10 percent in 1993. Nevertheless, vigorously expanding Southeast Asian and Asian Communist countries have more than taken up the slack. Overall, Asia accounts for 33 percent of U.S. exports and 26 percent of those from New England.[5]

[5] Africa remains an export market of limited significance for the United States and New England. In both cases, South Korea represents a larger market than the entire continent of Africa.

IV. How Important Are Exports to New England's Economy?

While the question is simple enough, providing a complete answer is not. The difficulty stems from the fact that firms do not always know when their products are exported. Finished goods are frequently exported by an intermediary other than the producer. In addition, the firm's output may be used as an input into other merchandise eventually sold abroad. For the nation as a whole, the U.S. Bureau of the Census estimates that indirect exports associated with exports of manufactured goods amounted to about 60 percent of the value of those direct exports in 1989. Although Census attempts to allocate indirect exports to individual states on the basis of direct export and employment patterns, the process is complex and requires many assumptions. In addition,

these data on direct and indirect exports provide no information on destination and are available only with a three- or four-year lag.

Accordingly, this article uses another data set, the origin-of-movement data for direct merchandise exports. Although these data are relatively timely and include information on destination, they also have limitations. (See Box for further discussion of these limitations.) Nevertheless, using the origin-of-movement data as the best available indicator of recent state export activity suggests that direct exports account for a slightly smaller share of total New England output than they do nationally, although the shares have trended up in both cases (Table 2). Following the sharp dollar depreciation of 1985, U.S. exports increased from 5.4 percent of GDP in 1987 to 7.4 percent in recessionary 1991. In New England, similarly, exports rose from 5.2 percent of net output in 1987 to 6.9 percent in 1991. During 1993, when the United States was growing faster than most of its major trading partners, U.S. and New England exports fell back to 7.3 and 6.7 percent of output, respectively.[6]

Given the predominance of manufacturing in national and regional exports and the decline in New England's manufacturing employment, it is remarkable that New England has retained as large a share of U.S. export activity as it has.

While most New England states fit the regional pattern, Massachusetts and Vermont are exceptions. In these states, exports account for a greater share of net output than is the case nationally, as Table 2 shows. In Vermont, the export share was a well-above-average 22 percent of output in 1993. That state's unusual export-dependence is largely attributable to exports of electronic equipment to Canada. The IBM Corporation manufactures semiconductors in its Vermont facility and ships these components to Canada to be built into other products. Though IBM does not release precise figures on the magnitude of such shipments, it acknowledges that their value well exceeds $1 billion annually.[7] This cross-border activity underscores the importance of North American integration and, indeed, U.S. producers' ties to their foreign affiliates generally, in determining the nature and behavior of regional exports.

Table 3 provides data to illustrate these relationships. As column 1 shows, over one-third of U.S. exports to Canada and over one-fourth of U.S. exports to Mexico are shipments from U.S parents to their foreign affiliates. In both cases, over half of these intra-firm exports reflect the ongoing integration of North American auto production. In Mexico, another quarter of the affiliate trade involves electrical and electronics products. In combination with the figures in column 4, which show foreign affiliate sales to the United States as a share of total foreign affiliate sales, these data suggest that the activities of affiliates in Canada, Mexico, and some Southeast Asian countries, like Singapore and Malaysia, are often closely linked with U.S. production for U.S. markets; thus, U.S. exports to these countries reflect the strength of the U.S. economy as well as demand conditions overseas. By contrast, affiliates of U.S. companies in Europe, South America, and Japan are generally serving local or other foreign markets.

Given the predominance of manufacturing in national and regional exports and the relatively precipitous decline in New England's manufacturing employment (down 25 percent in the region between 1987 and 1993, compared with a 5 percent decline nationally), it is remarkable that New England has retained as large a share of U.S. export activity as it

[6] An alternative measure of New England's export dependence—export-related employment as a share of total private employment—suggests that exports provide above-average support for regional jobs. These figures, based on Census estimates of employment related to direct and indirect exports of manufactured products for 1989, show that 6.6 percent of New England's private employment was supported by manufactured exports, compared with 5.6 percent for the nation. According to these numbers, New England was one of the most export-dependent regions in the country, following closely behind the Pacific and the East North Central regions. These Census data also indicate that New England's export-related shipments as a share of total shipments were above the national average in a majority of the 2-digit industries for which regional data are available. A significant exception, given the industry's importance in U.S. and New England exports, was one 3-digit component, computers and office machinery.

[7] The dramatic rise in Vermont's exports over this period partly reflects the substitution of Canadian import records for U.S. export records and, thus, the elimination of "undocumented exports to Canada" in 1990. This change makes origin-of-movement export figures for 1987–89 not entirely comparable with those for the later years—particularly for states bordering Canada.

Limitations of Origin-of-Movement State Export Data

These origin-of-movement data on state exports are collected by the U.S. Bureau of the Census from shippers' export declarations, which ask for the "point of origin"—that is, the state where the product started its export journey. The instructions indicate that shippers may choose among the state where the product was produced or the location of a distributor, regional warehouse, cargo processing facility, or Foreign Trade Zone. For a multi-product shipment, the shipper may choose the state of origin of the product having the greatest value or, for a multi-product order, the state of consolidation. According to Census-ITA research, manufacturers, who export about two-thirds of U.S. manufactured exports directly, provide the state of production about 85 percent of the time; for the rest of their exports, they tend to give the location of the port through which the export left the country. Intermediaries, who handle the remaining one-third of U.S. manufactured exports and most exports of nonmanufactured merchandise, tend to give their own location or the location of the relevant port. As a result, these data tend to overstate exports from states like Texas, where a large number of intermediaries supply Mexican "maquiladora" plants with inputs from around the country. Similarly, the data tend to overstate exports from states with major ports—Louisiana, for instance, where a large volume of farm products shipped down the Mississippi start their journey overseas. Adding to these reporting weaknesses, roughly 15 percent of the shippers do not answer the state-of-origin question.

Partly as a result of these problems, in 1993 Census began publishing a new data set based on the shipper's own zip code. Compared with the origin-of-movement data, the zip-code-based data substantially reduce exports from border or port states like Texas, Louisiana, and New York while increasing exports from states like New Jersey, Pennsylvania, and Illinois. In New England, the zip-code data suggest that for the first half of 1994 Connecticut's exports were 67 percent greater than shown by the origin-of-movement data while Vermont's exports were 13 percent less; for the other states in the region the differences were generally small. All told, according to the zip-code data, New England accounted for 5.2 percent of U.S. merchandise exports in the first half of 1994 but for only 4.2 percent according to the origin-of-movement data. Even so, these new data do not allocate exports through intermediaries to the state of production, nor do they address the issue of indirect exports.

The table accompanying this box shows New England's share of U.S. exports according to the above measures in the latest year for which the data are available. Clearly, the origin-of-movement data tend to understate the region's share of U.S. exports compared with the other series.

An additional limitation to the origin-of-movement data is that they do not cover increasingly important service exports. Further, the industrial breakdown provided—at the 2-digit Standard Industrial Classification (SIC) code level—is too broad to permit a satisfactory adjustment for cross-state differences in export product mix. This problem is discussed more fully in the body of the article.

Alternative Measures of New England's Share of U.S. Merchandise Exports

Percent

1989	Direct Exports of Manufactures (AR89-1)	Origin-of-Movement, Manufactures	Origin-of-Movement, Total
	6.7	6.0	5.5
1994, 1st Half		**Origin-of-Movement, Total**	**Zip-Code Total**
		4.2	5.2

Sources: U.S. Bureau of the Census. Industry Division. *Exports from Manufacturing Establishments; 1988 and 1989*, Analytical Report Series (AR89–1), November 1992; Foreign Trade Division. *Origin of Movement of U.S. Exports by State*, 1987–93. Massachusetts Institute for Social and Economic Research tape (also available in the FT-900 release); Foreign Trade Division. "Exports of Goods by State Where the Exporter is Located," Exhibit 2, FT-900 Supplement, August 1994.

Table 2
Exports in Relation to Output
Millions of Dollars

	1987	1988	1989	1990	1991	1992	1993
United States							
Gross State Product	4,548,182	4,911,706	5,232,032	5,518,482	5,690,865	6,085,754	6,358,274
Merchandise Exports	246,437	312,060	348,127	392,975	421,853	447,471	464,858
Share of Total	5.4%	6.4%	6.7%	7.1%	7.4%	7.4%	7.3%
New England							
Gross State Product	277,750	303,694	319,944	327,043	331,974	349,856	363,990
Merchandise Exports	14,446	17,083	19,299	21,765	22,949	23,767	24,534
Share of Total	5.2%	5.6%	6.0%	6.7%	6.9%	6.8%	6.7%
Connecticut							
Gross State Product	79,234	86,429	91,292	94,329	96,384	100,704	103,757
Merchandise Exports	3,319	3,829	4,473	5,187	5,699	5,711	6,325
Share of Total	4.2%	4.4%	4.9%	5.5%	5.9%	5.7%	6.1%
Maine							
Gross State Product	18,993	20,895	22,415	23,007	23,241	24,341	25,179
Merchandise Exports	656	805	915	1,075	1,040	1,027	1,141
Share of Total	3.5%	3.9%	4.1%	4.7%	4.5%	4.2%	4.5%
Massachusetts							
Gross State Product	132,250	145,116	152,301	154,208	156,090	164,978	172,617
Merchandise Exports	8,349	9,692	10,472	11,587	11,891	12,158	12,195
Share of Total	6.3%	6.7%	6.9%	7.5%	7.6%	7.4%	7.1%
New Hampshire							
Gross State Product	20,760	22,444	23,170	23,616	24,404	25,990	27,122
Merchandise Exports	885	1,025	1,106	1,210	1,143	1,049	1,115
Share of Total	4.3%	4.6%	4.8%	5.1%	4.7%	4.0%	4.1%
Rhode Island							
Gross State Product	17,366	18,794	19,931	20,664	20,657	21,832	22,741
Merchandise Exports	506	560	650	756	784	1,004	1,025
Share of Total	2.9%	3.0%	3.3%	3.7%	3.8%	4.6%	4.5%
Vermont							
Gross State Product	9,147	10,016	10,835	11,219	11,198	12,011	12,575
Merchandise Exports	731	1,173	1,684	1,950	2,391	2,819	2,734
Share of Total	8.0%	11.7%	15.5%	17.4%	21.4%	23.5%	21.7%

Source: Gross state product data for 1987 through 1991 are from the U.S. Bureau of Economic Analysis. Estimated gross state product for 1992 and 1993 are authors' calculations, derived by ordinary least squares regression with industry earnings, by place of work, as the sole independent variable. (Regression results are available upon request.) Export values are from the U.S. Bureau of the Census and the Massachusetts Institute for Social and Economic Research.

has. In 1980, all of the New England states were among those most dependent on manufacturing employment.[8] By 1991, however, none of the New England states were in the top category. Over the period covered by this study, New England's share of total U.S. manufacturing employment fell from 7.2 to 5.9 percent. The decline in the region's share of production jobs was even sharper.[9] While part of this job loss was due to technological change and reflected productivity improvements, some jobs were shifted to other parts of the country and overseas, in part because average hourly earnings for the region's production workers continued above the national average. As a result, the manufacturing activities remaining in New England increasingly have focused on administration, service, and research and development functions. Accordingly, much of the final processing and export of goods produced by firms headquartered in New England is likely to occur

[8] That is, with 25 percent or more of total employment in manufacturing.

[9] Between 1987 and 1991 (the latest date for which regional data are available), employment of production workers fell by 11 percent nationally and by 19 percent in the region.

Table 3
U.S. Parent Exports to Foreign Affiliates as a Share of Total U.S. Merchandise Exports, Selected Countries, 1991[P]
Percent

Country	U.S. Parent Exports to Affiliates as a Share of Total U.S. Merchandise Exports to Country	Share of Parent-to-Affiliate Exports in: Transportation	Electric and Electronic Equipment	Memo: Sales to the U.S. as a Share of Total Affiliate Sales
Canada	38.2	56.4	3.5	24.5
Europe	25.7	3.2	5.3	4.0
Latin America	20.2	38.7	20.6	20.7
Mexico	26.9	51.7	25.8	25.8
Japan	16.5	.1	7.8	4.7
Malaysia	17.9	.0	75.8	27.0
Singapore	27.6	n.a.	26.4	24.7
Total	23.0	25.7	8.9	10.1

[P]These data, which are for U.S. nonbank parents and their majority-owned foreign affiliates, are preliminary.
Note: Parent exports may include exports of services.
Source: U.S. Bureau of Economic Analysis. *U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and Their Foreign Affiliates, Preliminary 1991 Estimates*, Washington, D.C.: U.S. Government Printing Office, July 1993; and "U.S. International Transactions, First Quarter 1994," Table 2, *Survey of Current Business*, June 1994, p. 102.

elsewhere. From this perspective, in other words, a region's relative export dependence or performance reflects the domestic competitiveness of the region's manufacturing sector.

As the regional economy shifts increasingly towards service activities, the failure of state export data to cover exports of services becomes more of a problem. Nationally, exports of services, which include travel, transportation, and business services like accounting, engineering, and data processing services, have been growing somewhat faster than merchandise exports. While merchandise exports rose 83 percent between 1987 and 1993, service exports grew 89 percent. "Other private services" (which is the largest component of services after travel and includes financial, telecommunications, and business, professional, and technical services) soared over 106 percent, while the royalties and license fees important to New England biotech companies, for instance, rose 93 percent. Because New England has a disproportionately large share of U.S. jobs in financial and business services (these sectors accounted for 38.0 percent of New England's nonagricultural employment in 1993, compared with 33.5 percent for the nation), it is almost certain that the region has produced a relatively large share of these service exports and is, thus, more dependent on overseas sales than the data on merchandise exports alone would suggest.

In addition, as mentioned above, exporting is not the only or even the widest avenue to foreign markets. Finding that foreign sales benefit from an on-the-spot ability to customize products and provide ongoing service support, U.S. firms increasingly are serving these markets from foreign affiliates. Indeed, as Table 4 shows, sales of goods by foreign affiliates of U.S. companies to unaffiliated customers were almost twice as large as total merchandise exports in 1991. Sales by European affiliates were roughly four times U.S. merchandise exports to Europe. Data on U.S. foreign direct investment abroad provide no information on the state where the U.S. parent is located, in large part because U.S. firms often have facilities in more than one state. Nevertheless, because New England has a disproportionately large share of U.S. employment in several industries where outbound foreign direct investment looms important (computers, electronics, and fabricated metals, for example), it seems plausible that New England firms have been particularly active foreign investors. In addition, New England has strong traditional trade and inbound investment ties with Europe, the site of over half of U.S. foreign direct investment assets (and over 40 percent of affiliate employment) in 1991. Altogether, thus, foreign sales are likely to be a great deal more important to New England firms than the state export data indicate.

With all of the above caveats in mind, the rest of

Table 4
Sales of Goods by Foreign Affiliates[a] of U.S. Firms to Unaffiliated Entities, by Location of Affiliate, and U.S. Merchandise Exports to the Same Country
Billions of Dollars

	1987			1991[P]		
	Affiliate[a] Sales (1)	U.S. Exports (2)	Ratio 1 ÷ 2	Affiliate[a] Sales (3)	U.S. Exports (4)	Ratio 3 ÷ 4
All Countries	542.1	250.2	2.2	798.7	416.9	1.9
Canada	91.0	62.0	1.5	115.0	85.9	1.3
Europe	309.0	70.9	4.4	479.4	121.6	3.9
Japan	31.0	27.6	1.1	47.7	47.2	1.0
Australia	21.2	5.3	4.0	29.9	8.3	3.6
Latin America & Other Western Hemisphere	47.9	34.9	1.4	63.7	63.3	1.0
Other Asia & Pacific	26.6	43.7	.6	52.1	81.2	.6

[a]Majority-owned nonbank foreign affiliates of nonbank U.S. parents. P = preliminary.
Source: U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and Their Foreign Affiliates, Revised 1987 Estimates* and *Preliminary 1991 Estimates*, July 1990 and July 1993; *Survey of Current Business*, June 1994.

this article will explore why New England's merchandise export performance has lagged the nation's. The analysis is based on the origin-of-movement data because they represent the best available indicators of recent export trends that include information on export destination.

V. How Rapidly Are New England's Exports Growing?

As mentioned above, merchandise exports account for a rising share of national output. But, over the period 1987 to 1993, New England's exports grew more slowly than the nation's except in 1989 (Figure 3). While national exports rose 89 percent, the region's exports grew just 70 percent.[10] Although the differences were small in some years (1990 and 1993), it seems somewhat curious that New England would consistently underperform the national rate of export growth, given its traditional dependence on trade. On the other hand, judging by employment trends, the region's manufacturing industries were generally in a state of relative decline vis-à-vis the national sector at this time.

This section sets out to "explain" the region's relatively lackluster export growth by focusing on two determinants of this performance—the region's export product mix and its market orientation. It asks two hypothetical questions: How rapidly would the region's exports have grown if exports of each product had increased at the national rate? and How rapidly would the region's exports have grown if exports of each product *to each destination* had grown at the national rate? The second step controls for differences in the region's and the nation's traditional geographic orientation or "market mix" as well as for differences in product mix. As it turns out, the residuals not explained by this estimating procedure point to the major reasons for the region's relatively slow export growth.

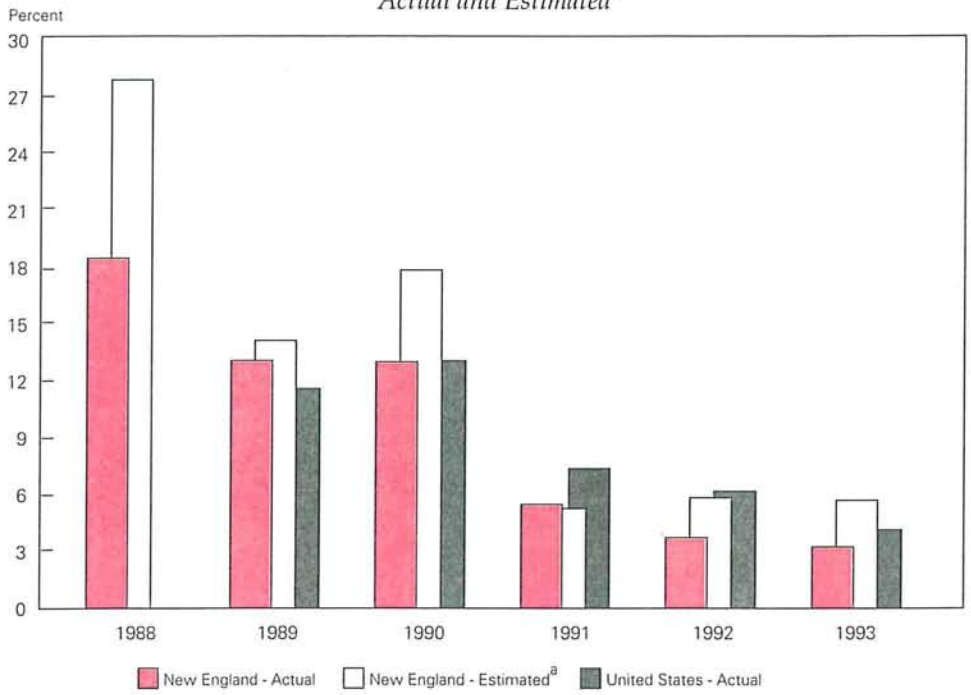
In the first step, total New England exports were estimated for each year from 1988 to 1993[11] assuming that regional exports perfectly tracked the national export performance of each product. For example, because national exports of paper products rose 4.4 percent between 1989 and 1990, New England's exports of paper products were also estimated to have grown by 4.4 percent, instead of by the 4.5 percent actually observed. Following the same procedure for all products, for each year, summing the estimated export values, and comparing the estimates with the export values actually observed indicates whether the

[10] Information for the first half of 1994 suggests that the discrepancy is continuing; national exports grew 7.1 percent on a year-over-year basis while the region's exports climbed just 2.8 percent.

[11] The analysis did not include 1994 because a full year's data were not available at the time of writing.

Figure 3

Export Growth in New England and the United States
Actual and Estimated[a]



[a]Adjusted to U.S. export mix and market orientation
Source: Massachusetts Institute for Social and Economic Research; authors' calculations.

region's export product mix explains its relatively disappointing export performance over time.[12]

To control for New England's above-average dependence on exports to relatively slow-growing regions like Europe and Canada, total New England exports were then estimated assuming that regional exports tracked national exports of each product to each destination in each year (step 2). For example, New England paper exports to France in 1992 were assumed to have grown at the same pace as U.S. paper exports to France in that year.

The results of this two-step process are shown in Table 5. Estimated exports (line 6) are obtained by adding the results of step 2, which controls for both product and market mix, to actual exports for the preceding year. The estimated growth in exports has two components: product gain and destination gain. The difference between the estimates made in step 1 (controlling for product mix alone) and actual exports equals the product gain, shown in line 3. The product gain measures the extra exports New England would have sold if exports of each New England product had grown at the national pace. Destination gain (line 4) is calculated as the difference between the estimates made in step 2 (controlling for product and destination mix) and in step 1 (controlling for product mix alone). The destination gain indicates whether New England has benefited or suffered from its traditional trade ties. Finally, the unexplained residual (line 7) is the difference between total estimated and actual exports. This residual reflects factors other than product mix and market mix that account for the difference between the regional and national export performance.

These calculations yield a striking conclusion. New England's export product mix and market orientation do not account for the region's subpar trade performance from 1987 to 1993. In fact, New England's export product- and market-mix should have

[12] Because the origin-of-movement data for state exports are only available at the 2-digit SIC code level, this study's adjustments for product mix are only partial. For example, employment data indicate that computer-related products account for a much larger share of SIC 35, industrial machinery, in New England than they do nationally. Similarly, aircraft looms much larger in transportation (SIC 37) in New England than in the national industry.

Table 5
Actual versus Estimated Exports from New England, 1987 to 1993
Millions of Dollars

	1987	1988	1989	1990	1991	1992	1993	Cumulative Change, 1987 to 1993
1) Actual Exports	14,446.4	17,083.5	19,299.0	21,765.3	22,949.0	23,767.2	24,534.4	+10,088.0
2) Actual Change		2,637.1	2,215.5	2,466.3	1,183.7	818.2	767.2	+10,088.0
3) Estimated Product Gain		4,186.5	1,950.4	2,610.2	1,637.1	1,516.9	1,495.5	+13,396.6
4) Estimated Destination Gain		−170.7	462.9	832.9	−494.7	−200.7	−169.3	+260.4
5) Total Estimated Gain		4,015.8	2,413.3	3,443.1	1,142.4	1,316.2	1,326.2	+13,657.0
6) Estimated Exports	14,446.4 (actual)	18,462.2	20,875.5	24,318.6	25,461.0	26,777.2	28,103.4	+13,657.0
7) Unexplained (1–6 or 2–5)		−1,378.8	−197.8	−976.8	41.4	−498.0	−559.0	−3,568.7

Source: Authors' calculations based on MISER data. See the text for details.

caused its export gains to exceed the nation's in five of the six years covered by the study, as shown in Figure 3. Over the entire period covered by this study, actual New England export growth exceeded the modeled result only in 1991.

Looking at the results in more detail indicates that, by and large, New England enjoys an attractive product mix and exports the type of U.S. goods increasingly in demand in foreign markets. The New England export growth implied by U.S. export growth for comparable 2-digit products exceeded actual export growth in every year from 1988 to 1993. For the entire period, the region's exports should have been $3.3 billion higher than they actually were if they had tracked national trends without regard for differences in market orientation.

However, performing the second step and controlling for the region's market orientation indicates that New England's geographic focus is sometimes disadvantageous. In 1989 and 1990, the region's export ties to Europe and Canada were beneficial, since those countries were approaching cyclical peaks and were investing heavily in American goods, like transportation and electronic equipment. But from 1991 to 1993, when restructuring Latin American economies and South East Asian countries were the nation's fastest growing foreign markets, New England was at a disadvantage. In those years, the region's market focus damped its export performance by an estimated $169 to $495 million per year.

All told, thus, the model estimates (by successively adding estimated export gains to estimated exports in each preceding year) that for the 1987–1993 period as a whole New England exports should have been $3.6 billion larger than they actually were, given the region's product mix and market orientation. In other words, unexplained factors reduced New England's export growth by $3.6 billion. What were these additional factors?

Examining the shift-share residuals for total exports, as well as for each industry, helps to answer this question.[13] For example, because the residuals were positive in a single year, 1991, the proposition that the region's below-average export growth reflects unusually limited access to trade finance seems unconvincing. Other research has shown that the region's "credit crunch" was most severe in 1991, the only year in which New England's export growth exceeded the modeled results.

In addition, negative residuals did not predominate across a wide range of product categories and showed no consistent trend over time. This result undermines the suggestion that New England is especially disadvantaged by a lack of public sector support for exports or that its cost environment is generally or increasingly debilitating. Although either explanation may apply to particular industries or

[13] A statistical supplement with actual and estimated exports, and residuals, for individual New England states and industries is available on request to Research Library–D, Federal Reserve Bank of Boston, P.O. Box 2076, Boston, MA 02106-2076.

states, the evidence does not support a broad-based deficiency.

Finally, it is noteworthy that, over time, one sector—industrial machinery—accounts for the bulk of the negative residuals. In fact, New England exports of this set of products fell well below the modeled results in each year and, for the entire 1987–93 period, this one industry's cumulative residual amounted to $3.5 billion, virtually all of the region's unexplained export shortfall for the years studied. While other industries, such as transportation equipment and instruments, also had substantial negative residuals (−$0.9 billion and −$0.5 billion, respectively), these residuals represent relatively small fractions of the total shortfall and were largely offset by positive residuals in industries like chemicals ($0.4 billion), fabricated metals ($0.4 billion) and electronic equipment ($0.2 billion). In other words, if it were not for the industrial machinery industry, New England export growth would have done a reasonably good job of tracking the nation's export performance.

By and large, New England enjoys an attractive product mix and exports the type of U.S. goods increasingly in demand in foreign markets.

One explanation for the industrial machinery sector's relatively poor performance may be the familiar misfortunes besetting the region's computer industry during this period; more powerful microprocessor-based personal computers and the trend towards open-architecture systems have both cut into the market share of the region's mini-computer makers. More generally, the level of industry detail available with the origin-of-movement export data (2-digit SIC codes) may simply be too broad to allow full adjustment for differences in product mix. For example, computers account for a major part of the industrial machinery industry in New England, but for a much smaller share of the national industry. Thus, using trends in U.S. exports of industrial machinery to estimate New England's industrial machinery exports (largely computers with falling prices) could greatly exaggerate the region's apparent export shortfall. Similar distortions could also contribute to the relatively large residuals found in the transportation and, to a lesser extent, the instruments industries. In the case of transportation equipment, for example, aircraft engines and parts dominate the regional industry whereas autos or complete aircraft loom larger elsewhere.

VI. Summary and Policy Implications

This article uses the best available state export data, the U.S. Census Bureau's origin-of-movement data provided through the Massachusetts Institute for Social and Economic Research, to explore the reasons for New England's below-average export performance from 1987 to 1993. En route, the article points out that the region's exports differ from the nation's because they comprise more highly processed merchandise and are disproportionately destined for European and Canadian markets.

Although New England's recent export growth has lagged the nation's, the shift-share analysis of product and market mix underlying this article indicates that the region has no pervasive "exporting problem." On the contrary, the region's apparent underperformance seems to be substantially attributable to a single industry, industrial machinery. Although the origin-of-movement data cannot support further conclusions, other data suggest that the region's relatively slow export growth largely relates to its above-average dependence on computers as well as to the specific challenges confronting the regional computer industry.[14] Otherwise, the region appears to enjoy a generally favorable export product mix, dominated by the high-tech capital equipment foreigners seek from the United States. The data provide no indication that the region suffers from peculiarly limited access to trade finance or that ongoing structural shifts from manufacturing production activities to services have pulled its export growth below average.

On the other hand, New England's traditional trade ties to Atlantic Rim countries did prove detrimental from 1991 to 1993. Europe and Canada, New England's major export markets, suffered severe recessions in those years, and the region's exports

[14] Another possible exception is the region's above-average dependence on aircraft engines and parts, rather than complete aircraft or autos, within the transportation industry.

suffered as a consequence. As of late 1994, however, recovery is well under way in these areas. Accordingly, New England's established market focus—rooted in geography and culture—should soon become less disadvantageous.

Nevertheless, Latin America and Asia will undoubtedly continue to gain importance as U.S. export markets, as these developing regions outpace growth in the mature industrial countries and become increasingly open to trade. Starting in early 1994, the North American Free Trade Agreement (NAFTA) gradually eliminates Mexican tariffs (presently averaging 10 percent) on U.S. products. Similarly, NAFTA provisions protecting U.S. intellectual property rights and a side agreement on enforcing Mexico's environmental laws enhance export opportunities for the U.S. software and environmental businesses, important in New England. Other Latin American and Asian countries are also committed to reducing barriers to international trade and investment and have made such policies a central aspect of their development strategies as their leaders have increasingly recognized that cutting trade barriers will improve their nation's productivity and living standards. Such policies led over 120 countries to the commitments embodied in the Uruguay Round amendments to the General Agreement on Tariffs and Trade (GATT), recently approved by the U.S. Congress.

Although the foregoing analysis suggests that New England exporters are generally aware of and responsive to global market trends, obtaining a good understanding of foreign markets requires timely and appropriate trade data. Given the growing importance of services in international trade, information on state service exports would be most welcome. In addition, the data on state merchandise exports by industry would be much more useful if transportation could be divided into autos and other transportation, and if computers and office equipment could be segregated from other industrial machinery.

In light of New England's traditional involvement in international trade and investment, it is somewhat reassuring to find that the region's recent export performance is probably akin to the national average, once remaining differences in product mix—particularly the relative importance of computers—are taken into account. Still, since the computer industry remains key to New England's industrial future, this result provides no grounds for complacence. Indeed, the fact that New England merchandise exports have not grown faster than the national average, given New Englanders' international sophistication, probably reflects the region's ongoing shift from manufacturing production activities to services. After all, relative merchandise export performance signals a region's competitiveness as a manufacturing production site. The ongoing restructuring of the regional economy suggests that New Englanders will increasingly serve global markets through exports of services and overseas investments. For this reason, the merchandise trade data discussed in this article provide only a partial picture of New England's involvement with the world economy.

Index—1994

Banking

The Fed Must Continue to Supervise Banks
Richard F. Syron
January/February 1994 p. 3

The Geographic Boundaries of New England's Middle-Lending Markets
Robert Tannenwald
September/October 1994 p. 45

A New Look at Reverse Mortgages: Potential Market and Institutional Constraints
Christopher J. Mayer and Katerina V. Simons
March/April 1994 p. 15

Safeguarding the Banking System in an Environment of Financial Cycles: An Overview
Richard E. Randall
March/April 1994, p. 3

International

50 Years after Bretton Woods: What Is the Future for the International Monetary System?
Rachel E. Cononi and Rebecca Hellerstein
July/August 1994 p. 65

International Capital Transactions: Should They Be Restricted?
Norman S. Fieleke
March/April 1994, p. 27

The International Monetary Fund 50 Years after Bretton Woods
Norman S. Fieleke
September/October 1994 p. 17

Is Global Competition Making the Poor Even Poorer?
Norman S. Fieleke
November/December 1994 p. 3

Macroeconomics and Monetary Policy

Diversity, Uncertainty, and Accuracy of Inflation Forecasts
Stephen K. McNees with Lauren K. Fine
July/August 1994 p. 33

Gifts for Home Purchase and Housing Market Behavior
Gary V. Engelhardt and Christopher J. Mayer
May/June 1994 p. 47

Goals, Guidelines, and Constraints Facing Monetary Policymakers: An Overview
Jeffrey C. Fuhrer
September/October 1994 p. 3

A Panel Study of Investment: Sales, Cash Flow, the Cost of Capital, and Leverage
Richard W. Kopcke with Mark M. Howrey
January/February 1994 p. 9

Restructuring, the NAIRU, and the Phillips Curve
Geoffrey M.B. Tootell
September/October 1994 p. 31

Yield Curve Forecasts of Inflation: A Cautionary Tale
Stephen R. Blough
May/June 1994 p. 3

Regional

A Decade of Boom and Bust in the Prices of Single-Family Homes: Boston and Los Angeles, 1983 to 1993
Karl E. Case and Robert J. Shiller
March/April 1994 p. 40

Explaining New England's Export Performance: 1987 to 1993
Richard J. DeKaser and Jane Sneddon Little
November/December 1994 p. 43

Indexes of Economic Indicators: What Can They Tell Us about the New England Economy?
Alan Clayton-Matthews, Yolanda K. Kodrzycki, and Daniel Swaine
November/December 1994 p. 17

Massachusetts' Tax Competitiveness
Robert Tannenwald
January/February 1994 p. 31

New England Job Changes during the Recession: The Role of Self-Employment
Katharine L. Bradbury
September/October 1994 p. 45

Privatization of Local Public Services: Lessons for New England
Yolanda K. Kodrzycki
May/June 1994 p. 31

The Regional Impact of Health Care Reform—with a Focus on New England
Jane Sneddon Little with Michael D. Jud
July/August 1994 p. 3

School District Spending and State Aid: Why Disparities Persist
Katharine L. Bradbury
January/February 1994 p. 50

Technology Life Cycles and State Economic Development Strategies
Patricia M. Flynn
May/June 1994 p. 17

Federal Reserve Bank of Boston
P.O. Box 2076
Boston, Massachusetts 02106-2076

Address Correction Requested

Bulk Rate
U.S. Postage
PAID
Richmond, VA
Permit No. 930