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New England Economic Review

Federal Reserve Bank of Boston

Nov./Dec. 1990

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How Diversified Is New England?

Eric S. Rosengren

Despite steady growth in the United States economy over the past eight years, several regions of the country have suffered severe economic slumps. Oil-producing and agricultural states in particular have experienced economic conditions that usually occur only during national recessions. Lack of diversity in the economies of these regions contributed to their economic problems.

Recently, it has been New England's turn; its economic performance has deteriorated significantly. This article examines the diversity of the New England economy. The author finds that New England has a diverse industrial base and that this should, in the absence of a major national downturn, help prevent a recession of the magnitude experienced earlier in farming and oil-producing states. 3

Does a Trend toward Early Retirement Create Problems for the Economy?

Gary Burtless and Alicia H. Munnell

Many politicians, gerontologists, and editorial writers have come to deplore the trend toward early retirement. This trend, which began after World War II and accelerated in the 1960s and 1970s, has led to a dramatic decline in work effort and earnings among the elderly. Opponents of early retirement believe that keeping people in the work force longer will raise the nation's output, reduce the costs of Social Security, and improve the well-being of older Americans.

This article takes a closer look at the economic arguments behind the widespread call for continued employment of older workers, particularly in view of the substantial aging of the population. The conclusion that emerges from the analysis is straightforward. Once social insurance costs are insulated from individual retirement decisions and individuals and their employers make their own provisions for support before the official Social Security retirement age, no strong economic reason exists to resist the trend toward early retirement, if that trend reflects the preference of the retiring individuals for more leisure and fewer goods. 17

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New England's Links to the World Economy

Jane Sneddon Little

"Openness" to international trade and investment encourages technology transfer and productivity growth. It may also provide a degree of stability in the face of national and regional business cycles. To assess New England's relative openness, this article surveys New England's links with the world economy: its trade in goods and services, its banking ties, its inbound and (to the extent possible) its outbound foreign direct investments.

The author finds evidence that New England's 1987–89 export growth has been slow, and that inbound foreign investment recently has played a below-average role in the regional economy, especially in the manufacturing sector. She suggests that the decline in the region's manufacturing may be adversely affecting its international trade and investment ties. New England remains one of the most open regions in the country, however, and opportunities abound for further expansion of its export activities. 33

On the Predictive Power of Interest Rates and Interest Rate Spreads

Ben S. Bernanke

Economists have long understood that financial market variables contain considerable information about the future of the economy. Recently a number of researchers have pointed out that interest rates and interest rate spreads—that is, differences between interest rates on alternative financial assets—can be effective predictors of the economy.

This finding raises a number of questions, possibly the most important being why interest rates and spreads predict the course of the economy so well. The author's tentative conclusion is that the spread between commercial paper and Treasury bill rates has historically been a good predictor because it combines information about both monetary and nonmonetary factors affecting the economy, and because it does this more accurately than alternative interest rate-based measures. 51

How Diversified Is New England?

Eric S. Rosengren

Assistant Vice President and Economist, Federal Reserve Bank of Boston.
Michael Thomas provided valuable research assistance.

Despite steady growth in the United States economy over the past eight years, several regions of the country have suffered severe economic slumps. Oil-producing and agricultural states in particular have experienced economic conditions that usually occur only during national recessions. Lack of diversity in the economies of these regions contributed to their economic problems.

While these regions were experiencing difficulties in the 1980s, the New England economy grew rapidly, spurred by growth in industries such as computers, financial services and defense. From 1984 to 1988 the unemployment rate in New England averaged only 3.9 percent, while the national average was 6.7 percent. Along with New England's growth in employment and personal income, the value of its real estate rose sharply, with the median house price doubling over the five-year period.

Recently, it has been New England's turn; its economic performance has deteriorated significantly. Employment growth has slowed, real estate values have dropped, and loan losses of banks and thrifts have risen. Whether these problems are an indication of more severe difficulties to come depends in part on the diversity of New England's economy.

Even a highly diversified economy will experience economic slowdowns during nationwide recessions. But regions that have highly specialized resources may face downturns for other reasons as well, such as a decline in demand for the products of industries concentrated there. If the shift in demand is long-lasting, a region may experience economic difficulties far longer than with a nationwide recession.

Analysis of a region's economic diversity requires more than a tallying of industrial concentration. Only 5 percent of Texas employment was directly involved in oil production, yet its importance to the Texas economy was far greater because other industries depended on the oil industry. Measures of diversification must capture not only

industrial fluctuations, but also whether these fluctuations are synchronized across industries. If they are, then a fall in employment in a major industry may depress the entire region. Conversely, if industrial declines are not correlated, a drop in employment in one industry may have relatively little effect on the region as a whole.

This article examines the diversity of the New England economy. The first section relates diversification to industrial composition and highlights those industries more concentrated in New England than in the nation. The second section examines the correlations of employment in New England industries with each other and with the same industries nationwide. The third section examines the industries responsible for most of the recent variations in New England employment. The article concludes that New England has a diverse industrial base, and that this should, in the absence of a major national downturn, help prevent a recession of the magnitude experienced earlier in farming and oil-producing states.

I. Measures of Regional Diversification and Industrial Mix

Definitions of regional diversification vary. Some measures assume that a diversified regional economy should have similar concentrations of employment in all industries. However, such a definition has several problems. First, it ignores the diversity within industry classifications. For example, "Industrial Machinery and Computer Equipment" includes such varied activities as manufacturing machine tools, computers, and farm machinery. Sales of these products depend on very different factors. Second, it ignores the interaction among industries. If service and retail industries depend on the health of local farming or mining, falling agricultural or mineral prices will reduce employment in these other sectors. However, if the products of the region's service industries are used nationwide, those industries will be less affected by slower employment growth in the regional economy.

This article uses a definition of diversification consistent with finance theory. In finance theory, a diversified portfolio of stocks has returns highly correlated with those on all existing assets. Ideally, to determine the degree of diversification provided by a portfolio of stocks, one would compare the movements in the return on the portfolio of stocks and the return on all assets. In practice, the return on all assets is difficult to measure, so the return on the portfolio would normally be compared to the return on a broad index of stocks.

Applying this definition of diversification to regional employment requires comparing the movements of employment in the region with those of the nation.[1] A diversified region is one that is unlikely to experience major or prolonged deviations in employment growth from that of the nation. However, the most diversified region may not be the region with the lowest employment variance. If the national economy is very volatile, an undiversified region may have lower employment variance if its employment is concentrated in industries that do well despite declines in the nation's employment.

Employment Composition of New England

The degree of diversification will be affected by a region's industrial mix. Industrial concentration does provide some indication of which industries may be responsible for major deviations in employment from that of the nation. A region with a mix of industry employment identical to that of the nation is not likely to experience major variations from national employment patterns. However, industrial concentration alone is not a good measure of diversification because it ignores co-movements in employment between industries in the region and between the region and the nation.

Industrial concentrations tend to vary across regions and states as each uses its comparative advantage. For example, a state such as Oklahoma, with only a few universities but with substantial oil reserves, does not have significant employment in high technology but has a large concentration of workers in the oil industry, while Massachusetts, with no oil but several major research universities, has the opposite employment composition.

Table 1 shows the twenty industries where New England's employment shares most diverge from the national average. The employment shares were calculated for sixty-seven industries, using the U.S. Bureau of Economic Analysis industrial classification,[2] with each industry ranked according to the absolute difference in employment share between New England and the United States for 1988. New England employment is underrepresented relative to the United States in natural resource industries and government and overrepresented in services and high technology.

Table 1
New England and United States Employment Shares
Percent

2-Digit Industry[a]	1975 NE Share	1975 US Share	1975 NE − US	1982 NE Share	1982 US Share	1982 NE − US	1988 NE Share	1988 US Share	1988 NE − US
Farming	1.02	4.06	−3.04	.86	3.22	−2.35	.64	2.47	−1.83
State and Local Government	11.80	12.59	−.79	10.05	11.56	−1.51	9.38	10.88	−1.50
Educational Services	2.86	1.37	1.48	2.87	1.38	1.49	2.88	1.43	1.46
Health Services	6.50	4.75	1.75	7.41	5.75	1.66	7.23	6.12	1.10
Electric and Electronic Equipment	2.84	1.76	1.08	3.23	1.81	1.42	2.61	1.58	1.03
Insurance Carriers	1.96	1.13	.83	2.04	1.14	.90	1.94	1.12	.82
Industrial Machinery and Computer Equipment	2.89	2.16	.73	3.07	2.03	1.04	2.42	1.60	.81
Military	2.11	2.73	−.62	1.51	2.32	−.82	1.32	2.09	−.77
Transportation Equipment except Motor Vehicles	1.90	.95	.95	1.96	.92	1.03	1.66	.91	.75
Federal Civilian Government	2.09	3.00	−.91	1.78	2.61	−.83	1.65	2.39	−.74
Instruments and Related Products	1.34	.56	.78	1.56	.64	.92	1.19	.56	.64
Mining	.08	.86	−.78	.11	1.20	−1.10	.10	.73	−.64
Food and Kindred Products	1.07	1.73	−.66	.86	1.47	−.62	.62	1.24	−.62
Motor Vehicles and Equipment	.13	.81	−.68	.12	.63	−.51	.09	.64	−.55
Miscellaneous Manufacturing Industries	1.32	.48	.84	1.12	.41	.71	.85	.35	.50
Trucking and Warehousing	1.10	1.45	−.34	.99	1.39	−.40	1.08	1.52	−.45
General Building Contractors	1.11	1.28	−.16	1.09	1.17	−.08	1.79	1.37	.42
Business Services	2.87	2.78	.09	4.63	4.20	.44	6.33	5.92	.41
Special Trade Contractors	2.62	2.68	−.05	2.65	2.77	−.12	3.72	3.33	.39
Social Services	.94	.79	.15	1.26	.99	.27	1.59	1.22	.37

[a]The industries where New England's shares diverge most from the national average

The five industries where New England is most underrepresented in employment shares relative to the United States are farming, state and local government, military, federal civilian government, and mining. The low employment shares in farming and mining are not unexpected, since New England has few mineral resources and its land is less suitable for agriculture than other parts of the country. More surprising is that New England has smaller shares of government workers, state, federal, and military, than the rest of the country.[3]

The five industries where New England has the largest shares of workers relative to the nation are educational services, health services, electrical and electronic equipment, insurance carriers, and industrial machinery and computer equipment. While New England is known for high-technology manufacturing, the most overrepresented industries are service industries. Health, education, and insurance comprise 12.1 percent of employment in New England, but only 8.7 percent in the United States.[4]

New England has always had a greater share of its employment in manufacturing than the country as a whole, 24 percent in 1975 compared to 19 percent nationwide. While United States employment in manufacturing declined to 15 percent by 1988, the relative decline was even greater in New England, where manufacturing dropped to 17 percent of total employment. This decline in the region's manufacturing employment has been widespread, affecting high-technology categories such as electric and electronic equipment, industrial machinery and computer equipment, and instruments and related products.

Eight of the ten industries where New England employment shares diverged the most from the United States in 1988 were also on the list in 1975. The industries themselves have changed, however. For

example, New England has maintained a much larger share of employment in industrial machinery and computers, but computers composed a much larger share of this category in 1988 than they did in 1975.

Business cycles also alter employment shares. Industries that are relatively insensitive to business cycles, such as educational and health services, have larger shares of employment during recessions; industries that are very cyclical, such as durable goods manufacturing, have smaller shares. Therefore during recessions such as the one occurring in 1982, noncyclical industries (cyclical industries) have larger (smaller) shares of employment than during periods of expansion.

Changes in Employment Concentration

Several recent studies have attempted to measure regional industrial concentration. While these measures of concentration are often interpreted as measures of diversification, they differ from the definition used in this paper because they measure similarities in concentration but do not capture the co-movement of employment in the region with that of the nation. Therefore, they should be referred to as measures of dissimilarity rather than measures of diversification. Perhaps the most common measure of dissimilarity is the "goodness-of-fit" index used by Conroy (1975) and Sherwood-Call (1988), which compares a region's distribution of employment to that of the United States.[5] A region whose employment share more closely resembles that of the United States over time is becoming less dissimilar, while a region whose employment share becomes less like that of the United States would be considered more dissimilar.

$$\text{(1)} \qquad GF = \sum_{i=1}^{67} \frac{(E_{NE_{it}} - E_{US_{it}})^2}{E_{US_{it}}}$$

where: $E_{NE_{it}}$ = employment share in New England for industry i in year t.
$E_{US_{it}}$ = employment share in the United States for industry i in year t.

In equation 1, if New England's employment shares are identical to the nation's employment shares, the numerator for each industry will be 0. If New England's employment shares differ from those of the United States, the difference is squared (which eliminates negative signs and weighs more heavily large differences in employment shares); each squared difference in employment share is then weighted by the nation's employment share for that industry.[6]

A second measure of regional dissimilarity is "employment entropy" originated by Theil (1972), a variant of which is used by Fomby and Hirschberg (1989) and Brewer (1985). The difference in entropy between the nation and a region is summarized in equation 2 and described in more detail in Appendix 1.

$$\text{(2)} \qquad ENT = \sum_{i=1}^{67} E_{NE_{it}} \ln\left(\frac{E_{NE_{it}}}{E_{US_{it}}}\right)$$

In equation 2, if New England's employment shares are identical to the nation's employment shares, the ratio for each industry is 1, the natural log of which equals 0. The log of the ratio is then multiplied by the employment share of the region. The greater the difference in employment shares, the larger the ratio, and the greater the value in ENT.

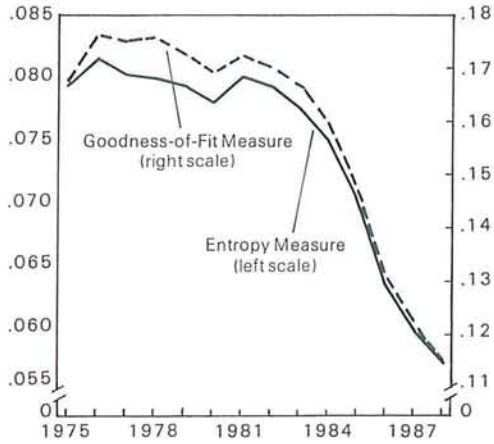
If the regional employment shares are identical to those nationwide, both GF and ENT equal 0. The more dissimilar the shares, the larger the values of GF and ENT. One would expect most regions of the country to diverge from national averages, since the composition of human and material endowments differs across regions.[7]

Figure 1 shows the two measures of dissimilarity for New England for the period 1975 to 1988. Both GF and ENT indicate that New England's industrial structure is becoming more like that of the nation. Both measures remained relatively stable between 1975 and 1982 and then dropped rapidly in the remainder of the 1980s. This convergence reflects the recent decline in New England's employment in manufacturing, particularly in high technology industries. The major industries of high technology manufacturing, industrial machinery and computer equipment, electrical and electronic equipment, and instruments, grew rapidly between 1975 and 1981, but have since shrunk. As a result, New England's share of employment in manufacturing is not as large relative to the nation's as it was in the beginning of the 1980s.

Several changes in the United States economy have also contributed to the convergence in employment shares. Industries with few employees in New England, such as farming and mining, now account for a much smaller proportion of employees nationwide than they did in 1982.

Figure 1

Employment Dissimilarity Index for New England 1975-88



The only New England industries whose employment shares became less like those of the United States in the 1980s were general building contractors and special trade contractors. While employment in these industries grew nationwide through 1988, it grew even faster in New England because of the real estate boom. The increased fraction of employment in construction made New England more vulnerable to the recent softening in the real estate market.

The individual New England states all follow a pattern similar to that of the region as a whole, with their industrial composition of employment converging toward the national averages. Every New England state is overrepresented in manufacturing and since 1982 has experienced sharper declines in manufacturing than the nation as a whole.

The severity of the difficulties created by recent employment declines in some high technology and other manufacturing industries as well as in construction depends at least in part on how other industries in the region fare. If employment in most industries depends on employment growth of the nation, and if national growth remains steady, the diversity of the region should prevent a sharp overall decline in employment. The next section considers which New England industries are most dependent on nationwide employment growth.

II. National Influences on Employment in New England

The previous section has shown that service industries such as insurance, health, and education and high-technology industries such as industrial machinery and computer equipment and electrical and electronic equipment are overrepresented in New England relative to employment patterns in the nation. This section will analyze how employment in each New England industry corresponds to that of the nation. Equation 3 was estimated for each of the sixty-seven New England industries:

$$EM_{it} = c_0 + c_1 EM_{US_t} + u_{it} \quad (3)$$

where: EM_{it} = percentage change in employment in New England industry i for time t.

EM_{USt} = percentage change in total employment for the United States for time t.

u_{it} = error in fitting the data.

The coefficient, c_1, measures the changes in industry i's employment relative to changes in total national employment. It does not measure the proportion of the variation in employment growth in an industry that is "explained" by the variation in employment growth in the same industry in the nation. In other words, c_1 does not describe how well the line fits the data. A measure of how well equation 3 "explains" employment growth in each industry is provided by R^2. R^2 is bounded by 0 and 1, with 1 indicating a perfect fit of the data and 0 indicating no fit of the data.

It is possible for an industry to have both a large coefficient c_1 and a small R^2.[8] For example, an industry may be sensitive to the national business cycle but competitors in a region may be highly sensitive to innovations by competitors in other regions of the country. If most of the variation in employment for a New England industry is due to shifts of business to competitors, an industry that is sensitive to the business cycle and thus has a large c_1 may nonetheless have a low R^2.

Table 2 lists the 67 industries by ascending order of c_1, showing the R^2 for each industry as well. Educational services, health services, and insurance carriers, three of the most overrepresented industries in New England, are among the industries whose employment growth corresponds least to that of national employment in the industry, as represented by a low R^2. In addition, the coefficient c_1 for those

Table 2
The National Economy's Effects on New England Industries

2-Digit Industry	c_1	R^2	2-Digit Industry	c_1	R^2
Forestry	−5.51	.41	Amusement and Recreation Services	1.00	.33
Heavy Construction Contractors	−2.16	.30	Paper and Allied Products	1.00	.37
Security and Commodity Brokers and Services	−1.10	.09	Auto Repair, Services, and Garages	1.06	.31
Motion Pictures	−.45	.01	Eating and Drinking Places	1.11	.47
Communications	−.28	.02	Automobile Dealers and Service Stations	1.11	.22
Mining	−.18	.00	Wholesale Trade	1.12	.59
Legal Services	−.08	.01	Rubber and Misc. Plastics Products	1.18	.20
Electric, Gas, and Sanitary Services	−.05	.00	Apparel and Accessory Stores	1.21	.47
Insurance Carriers	−.04	.00	Furniture and Home Furnishing Stores	1.23	.21
Educational Services	.03	.00	Other Transport[a]	1.32	.44
Health Services	.09	.02	Miscellaneous Repair Services	1.34	.26
Military	.11	.00	Special Trade Contractors	1.39	.18
Fisheries	.13	.00	Real Estate	1.40	.24
Banking and Credit Agencies	.16	.02	Building Materials and Garden Equip.	1.41	.34
Farming	.17	.00	Local and Interurban Passenger Transportation	1.41	.48
Food Stores	.19	.05	Museums, Botanical, Zoological Gardens	1.42	.50
Member Organizations	.22	.04	Fabricated Metal Products	1.60	.37
Private Households	.24	.01	Miscellaneous Services	1.65	.42
Chemicals and Allied Products	.26	.04	Instruments and Related Products	1.70	.27
Leather and Leather Products	.30	.00	Social Services	1.75	.29
Federal Civilian Government	.38	.11	Electric and Electronic Equipment	1.86	.22
Insurance Agents, Brokers, and Services	.48	.08	Textile Mill Products	1.89	.30
Food and Kindred Products	.49	.11	Trucking and Warehousing	1.96	.71
Printing and Publishing	.50	.39	Holding and Other Investment Cos.	2.12	.07
Business Services	.51	.11	Other Nondurable Goods[b]	2.18	.21
Personal Services	.54	.04	Misc. Manufacturing Industries	2.28	.63
Apparel and Other Textile Products	.56	.03	Industrial Machinery and Computer Equipment	2.71	.45
Miscellaneous Retail Stores	.64	.20	Transportation by Air	2.79	.55
Agricultural Services	.71	.12	Stone, Clay, and Glass Products	2.88	.74
Hotels and Other Lodging Places	.72	.20	Lumber and Wood Products	2.91	.65
Transportation Equipment except Motor Vehicles	.80	.17	Primary Metal Industries	2.94	.59
Combined Real Estate, Insurance, etc.	.85	.04	General Building Contractors	3.15	.34
State and Local Government	.88	.41	Other Durable Goods[c]	3.42	.60
General Merchandise Stores	.93	.24			

Note: c_1 is the coefficient measuring the change in the New England industry's employment relative to the change in total national employment. R^2 is a measure of how well a variation in employment growth in New England is "explained" by the national variation in the same industry.
[a] Includes Railroad Transportation, Water Transportation, Pipelines, and Transportation Services.
[b] Petroleum & Coal Products and Tobacco Manufacturing.
[c] Furniture & Fixtures and Motor Vehicles & Equipment.

industries is low, indicating that the growth of employment in those industries is not closely correlated to that of total employment in the nation.

The high technology industries have large values of c_1 but do not have particularly large values for R^2. Of all sixty-seven industries, the R^2 for industrial machinery and computer equipment is thirteenth largest (0.45), instruments is twenty-eighth largest (0.27), and electronic and electrical equipment is thirty-third largest (0.22). Changes in the growth rates in those industries do not correspond closely to national rates. These industries are nonetheless highly sensitive to changes in the nation's total employment. The coefficient c_1 is high for all three industries: 2.71 for industrial machinery and computers (seventh largest); 1.86 for electronic and electrical equipment (thirteenth largest); and 1.70 for instruments (fifteenth largest).

Correlation between Industries

While the service industries in New England are not highly correlated with employment in the nation, they may be sensitive to the local economy. Will these services maintain their employment growth, with several of our high technology industries experiencing falling employment? If many of the region's service industries market their products nationwide, the effect of falling employment in the high technology industries here is likely to be relatively modest. If, however, New England's service industries depend on local industries, employment in those industries would likely move together.

A statistical measure of the co-movement of two variables is provided by the correlation coefficient. The correlation coefficient is bounded between 1 and −1, with 1 showing a perfect positive linear relationship, −1 showing a perfect negative linear relationship, and 0 representing no linear relationship between the two variables.[9] If decreases in employment in one industry correspond to increases in employment in the other, the correlation coefficient is negative. If changes in employment tend to move together, the correlation coefficient is positive. Table 3 details the correlations between the service industries and the high technology industries in which New England has large employment shares relative to the United States. The most overrepresented service industries, education and health, have very low correlations with many of the manufacturing industries. For example, health services is negatively correlated with electrical and electronic equipment, general building contractors, and transportation equipment. The low and frequently negative correlations indicate that our most overrepresented service industries have relatively modest correlations with many of our high technology industries. If decreases in employment in high technology industries have little relationship to changes in employment in service industries, then their effect on overall New England employment is moderated.

How Diversified Is the Regional Economy?

Individual industry movements cannot measure a region's diversification, because increases in employment in one industry may be offset by decreases in other industries. To measure a region's diversification, it is necessary to compare the correlation between employment growth in New England and that of the nation. To measure the diversification of each of the nine census regions (here, New England) required estimating equation 4.

$$EM_{NE_t} = a_0 + a_1 EM_{US_t} + u_{NE_t} \quad (4)$$

where: EM_{NE_t} = growth in employment for New England during time t.
EM_{US_t} = growth in employment for the United States during time t.
u_{NE_t} = error in fitting the data.

The coefficient a_1 measures the correlation of the region's growth rate to that of the nation and is the slope of the line fit by equation 2. A coefficient of less than 1 would indicate that a fluctuation in the growth of national employment would correspond to fluctuations of a smaller magnitude in the region. A coefficient greater than 1 would indicate that national fluctuations would correspond to regional fluctuations of greater magnitude. R^2 measures how well changes in the growth rate of national employment correspond to changes in the growth rate of employment in a particular region.

A region with an economy identical to that of the

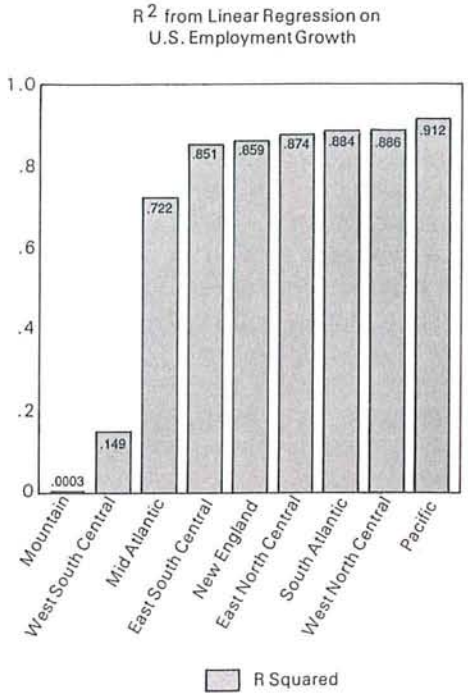
Table 3
Correlations between Industries Overrepresented in New England

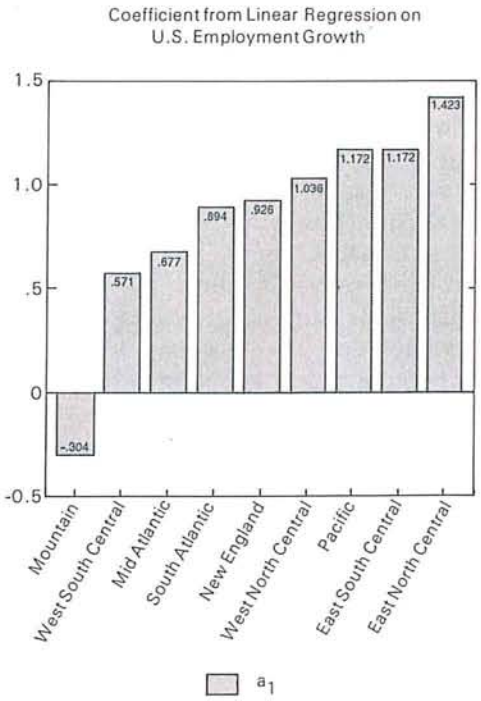
2-Digit Industry	Health Services	Educational Services	Business Services	Insurance Carriers
Electric and Electronic Equipment	−.59	.75	.81	−.39
Industrial Machinery and Computer Equipment	.34	.29	−.11	−.39
Transportation Equipment except Motor Vehicles	−.17	.01	.23	.62
Instruments and Related Products	.63	−.32	−.28	.14
General Building Contractors	−.46	.18	.58	.29
Miscellaneous Manufacturing Industries	.03	.54	.05	−.03

Figure 2

Figure 3

Comparison of Regional and National Growth Rates in Employment, 1976-88





nation would have an a_1 equal to 1 and a R^2 equal to 1. Otherwise, the region is likely to have a lower R^2, since changes in the growth of employment in the region would not correspond entirely to those in the nation.

Figure 2 shows the value of R^2 for each of the nine census regions.[10] Over 80 percent of the fluctuations of the rate of growth in New England correspond to fluctuations in the nation. New England has the median R^2. Only the growth rates of employment in the Mountain and West South Central regions do not correspond reasonably well to that in the nation.

Figure 3 shows a_1 estimated from equation 4 for each of the regions. A value of 1 would indicate that fluctuations in the growth rate of employment in a region correspond to similar fluctuations in the nation. New England again has the median value. The East North Central region, which has an R^2 similar to that of New England, is much more responsive to national trends, with a coefficient close to 1.5. The Mountain and West South Central regions again show little correlation with the nation.

The estimates of equation 4 for New England indicate that changes in the growth rate of employment in New England are positively correlated with those of the nation and that the relative magnitudes of these changes are similar. In contrast, the growth rates of employment in the Mountain and West South Central regions are not correlated closely with the growth rate of employment in the nation. It appears that New England is not likely to experience declines in employment growth of the magnitude experienced in the Southwest unless the nation experiences substantial declines in employment growth.

III. Analysis of Employment Variance in New England

The previous section established that New England employment moves closely with that of the nation, despite major differences across industries. This section shows how the industries fit together by calculating each industry's contribution to the vari-

ance of employment in New England. The interactions among a region's industries may be described in a manner analogous to the descriptions of interactions among a portfolio of stocks. Portfolio variance of employment is a statistical measure of the influence of industrial mix on the total variance of employment in a region. The formula for portfolio variance (PV) is summarized in equation 5.

$$(5) \qquad PV = \sum_{j=1}^{67} w_j^2 VAR_j + \sum_{i=1}^{67} \sum_{\substack{j=1 \\ j \neq i}}^{67} w_i w_j COV_{ij}$$

where: VAR_j = variance in industry j,
COV_{ij} = covariance between industry i and industry j, and
w_i = the proportion of total employment in industry i.

The double sum includes all possible permutations of two industries except where i = j.

The portfolio variance of employment is the sum of all the variances of employment for each of the industries plus the sum of the covariances of employment between each of the industries, with both terms weighted by each industry's share of total employment. Each industry's variance measures the fluctuation in employment in that industry. The greater the fluctuation in employment, the greater the variance of the industry and the greater the portfolio variance, holding all other things constant.

Industry covariances are an important component of portfolio variance, measuring the fluctuation of employment in one industry relative to another. If decreases in employment in one industry usually correspond with increases in employment in another industry, the covariance between those industries is negative, and this tends to reduce the portfolio variance below the sum of the individual industry variances.

The variances and covariances are weighted by each industry's contribution to overall employment. Following the work of Conroy (1975), Brewer (1985), Sherwood-Call (1990) and Gruben and Phillips (1989), the weights are calculated on a "long-run" basis. The calculation of variances, covariances, and weights is described in more detail in Appendix 2. Summing the 67 × 67 matrix of weighted variances and covariances of employment by industry equals the variance of total employment in New England.

The main advantage of examining the portfolio variance is that each industry's contribution to overall variance can be calculated. Table 4 lists each industry's contribution to the portfolio variance (beta) and each industry's weight (percent of total employment) in the portfolio. Beta is similar to the beta used in finance studies and its calculation is also described in more detail in Appendix 2. Beta for industry i is the weighted sum of the variance of employment in industry i and the sum of the covariances between industry i and the other sixty-six industries in the portfolio. If beta is greater than 1, the industry increases portfolio variance; if beta is less than 1, it decreases portfolio variance.

Table 4 lists each New England industry sorted by beta in ascending order, and gives the weight of each industry in the New England "portfolio." An industry's contribution to portfolio variance will depend both on the size of its beta and the size of the industry as measured by its weight. Health services, the second largest industry in the region, has a negative beta. The other two service industries among the ten largest industries are business services, with a beta of 0.47, and education, with a beta of −0.25. Insurance carriers, the thirteenth largest industry, has a beta of 0.17. The three service industries most overrepresented in New England employment share relative to the United States—health, education, and insurance carriers—all have large weights and low betas.

The industries with both large betas and large weights tend to be manufacturing or those related to real estate. Industrial machinery and computer equipment, real estate, and special trade contractors all have employment shares of over 2 percent and betas substantially greater than 1. As shown in the previous section, these industries are all quite sensitive to the business cycle.

Among the dozen other largest industries in New England, state and local government and wholesale trade both have betas greater than one, while miscellaneous retail stores and electric and electronic equipment have betas of less than one. While these industries are important because of their employment size, their betas are not in the largest or smallest 25 percent of the sample.

Table 5 lists the ten New England industries whose employment shares grew the most between 1975 and 1988, along with their betas. These industries split evenly between those with betas greater than one and those with betas less than one. The fastest-growing industry, business services, includes such firms as management consulting and computer services. Business services has a beta of 0.47, indicat-

Table 4

Contributions of New England Industries to Portfolio Variance

2-Digit Industry	Beta	Weight (%)	2-Digit Industry	Beta	Weight (%)
Forestry	−6.98	.03	Personal Services	.99	1.64
Heavy Construction Contractors	−2.71	.48	Rubber and Misc. Plastic Products	1.06	.95
Communications	−.61	1.07	Agricultural Services	1.17	.54
Security and Commodity Brokers and Services	−.30	.29	Auto Repair, Services, and Garages	1.22	.80
Chemicals and Allied Products	−.26	.65	Wholesale Trade	1.30	4.77
Educational Services	−.25	2.82	State and Local Government	1.35	10.26
Leather and Leather Products	−.14	.73	Apparel and Accessory Stores	1.35	1.06
Apparel and Other Textile Products	−.10	.88	Amusement and Recreation Services	1.37	.99
Health Services	−.07	7.00	Museums, Botanical, Zoological Gardens	1.41	.07
Motion Pictures	−.05	.16	Fabricated Metal Products	1.41	1.92
Mining	.02	.09	Other Nondurable Goods[b]	1.47	.04
Food Stores	.14	2.79	Miscellaneous Repair Services	1.59	.44
Electric, Gas, and Sanitary Services	.15	.69	Local and Interurban Passenger Transportation	1.65	.48
Military	.17	1.57	Miscellaneous Services	1.65	1.81
Insurance Carriers	.17	1.96	Combined Real Estate, Insurance, etc.	1.66	.05
Legal Services	.18	.84	Automobile Dealers and Service Stations	1.67	1.71
Private Households	.34	1.06	Farming	1.68	.87
Member Organizations	.36	1.32	Real Estate	1.72	2.05
Business Services	.47	4.65	Furniture and Home Furnishing Stores	1.95	.65
Banking and Credit Agencies	.56	1.89	Special Trade Contractors	2.01	2.89
Printing and Publishing	.57	1.45	Trucking and Warehousing	2.06	1.05
Miscellaneous Retail Stores	.58	2.92	Textile Mill Products	2.10	.81
Electric and Electronic Equipment	.67	3.11	Building Materials and Garden Equip.	2.13	.61
Fisheries	.67	.24	Social Services	2.20	1.30
Federal Civilian Government	.75	1.79	Industrial Machinery and Computer Equipment	2.36	2.89
Hotels and Other Lodging Places	.76	1.00	Misc. Manufacturing Industries	2.58	1.14
Insurance Agents, Brokers, and Services	.80	.63	Primary Metal Industries	2.88	.65
Transportation Equipment except Motor Vehicles	.80	1.88	Stone, Clay, and Glass Products	3.10	.46
Other Transportation[a]	.81	.50	Lumber and Wood Products	3.15	.59
Paper and Allied Products	.84	.97	Holding and other Investment Cos.	3.18	.26
Food and Kindred Products	.88	.84	Transportation by Air	3.27	.21
General Merchandise Stores	.88	1.92	Other Durable Goods[c]	3.36	.42
Instruments and Related Products	.88	1.41	General Building Contractors	3.84	1.32
Eating and Drinking Places	.94	4.66			

Note: Beta measures the contribution to portfolio variance and is described in appendix 2. Weight represents the percent of total New England employment.

[a] Includes Railroad Transportation, Water Transportation, Pipelines, and Transportation Services.

[b] Petroleum & Coal Products and Tobacco Manufacturing.

[c] Furniture & Fixtures and Motor Vehicles & Equipment.

Table 5

The Fastest-Growing New England Industries and Their Betas

2-Digit Industry	1975 Employment Share (Percent)	1988 Employment Share (Percent)	1975–88 Growth in Employment Share (Percentage Points)	Beta
Business Services	2.87	6.33	3.46	.47
Special Trade Contractors	2.62	3.72	1.10	2.01
Real Estate	1.54	2.57	1.03	1.72
Miscellaneous Services	1.41	2.16	.75	1.65
Eating and Drinking Places	4.08	4.82	.74	.94
Health Services	6.50	7.23	.73	−.07
General Building Contractors	1.11	1.79	.68	3.84
Social Services	.94	1.59	.65	2.20
Personal Services	1.53	1.93	.41	.99
Banking and Credit Agencies	1.74	2.12	.38	.56

ing that it reduced overall portfolio variance. Both business services and health services have grown fast, have large weights, and are among the twenty industries with the lowest betas. Three of the fastest-growing industries that increased portfolio variance were primarily tied to the real estate boom, special trade contractors, general building contractors, and real estate.

Analysis of the portfolio variance of New England employment is relatively encouraging. Many of the service industries in which the region is overrepresented and which employ a large percentage of the work force, such as insurance carriers, health, and education, have low betas and are not particularly sensitive to changes in employment in high technology industries. While the industries tied to real estate grew rapidly through 1988 and have large betas, many other fast-growing industries such as business services and health services decrease portfolio variance.

IV. Conclusion

New England is known for manufacturing, and particularly its high technology industries. Employment in some of these industries has declined since the mid 1980s and may decline further, as a result of cuts in defense spending and competition from firms outside the region. The extent of the difficulties in these industries will depend on how quickly they produce new products and how much demand for high technology products increases with changes occurring in the rest of the world. While problems in these industries may restrain employment growth in New England, the slowdown is not likely to be as severe as that experienced in the 1980s by regions dependent on natural resources. The major reason for this optimism is the greater diversity in the New England economy.

While New England has a larger share of its work force in manufacturing than the rest of the country, it is also overrepresented in many service industries such as educational services, health services, and insurance carriers. These industries contribute little to portfolio variance in total employment, are relatively uncorrelated to high technology industries, and are not particularly sensitive to movements in the national economy.

New England is likely to benefit from future national trends. The service sector has been growing rapidly nationwide and New England is no exception. Health and business services have been among the fastest growing industries in the region and they tend to reduce the variance of employment. New England should be well positioned to apply high technology innovations to service industries.

Unlike resource-dependent regions, the New England economy closely tracks the national economy. This will provide vital support to the New England economy while high technology industries adapt to changes in their markets. New England's close relationship to the nation also means, however, that a national recession would cause significant problems for its economy, which has already experienced considerable slowing in employment growth.

Appendix 1: Entropy as a Measure of Dissimilarity

The measure of entropy used in previous studies such as Kort (1981), is summarized in equation 1A.

$$\text{(1A)} \qquad ENT = \sum E_{NE_{it}} \ln\left(\frac{1}{E_{NE_{it}}}\right)$$

where: ENT = entropy measure, and
$E_{NE_{it}}$ = New England employment share of industry i.

If New England had only one industry, ENT would be zero. If employment is equally divided among n industries, ENT reaches a maximum value of ln(n). Use of entropy as a measure of diversification has been criticized by Conroy (1975) and Wasylenko and Erickson (1978) because industrial classifications are arbitrary, making particularly tenuous any assumption that diversification is synonymous with equal distribution of employment across industries. This article uses a variant of the entropy measure summarized in text equation 2. Rather than assuming a diversified region would have equal distribution of employment across industries, it assumes that a diversified region would have the same industrial composition as the United States. It therefore uses the same underlying assumption about diversification as the goodness of fit test. Both the entropy measure and the goodness of fit measure compare industrial composition of a region to that of the country, but do not measure diversification in a way consistent with finance theory.

Appendix 2: Portfolio Variance

The relative variance of employment in New England is

$$\text{(2A)} \qquad PV = \frac{1}{N-2}\sum_{t-1}^{N}\left[\frac{Y_t - \hat{Y}_t}{Y_t^*}\right]^2$$

where: N is the number of observations,
Y represents the total employment in period t,
$\hat{Y}_t$ represents the predicted level of total employment for period t based on a quadratic time trend equation estimated by ordinary least squares regression, and
Y* represents the arithmetic mean of the total employment time series.

The variance of employment can be disaggregated so that each industry's contribution to portfolio variance can be established. New England has 67 industries. For each industry it is necessary to calculate the variance of that industry's employment and the 66 covariances with the other industries. The 67 × 67 elements of the variance-covariance matrix can be calculated from equation (3A).

$$\text{(3A)} \qquad \sigma_{ij} = \frac{1}{N-2}\sum_{t-1}^{N}\left[\frac{Y_{it} - \hat{Y}_{it}}{y_i^*}\ \frac{Y_{jt} - \hat{Y}_{jt}}{y_j^*}\right]$$

where: Y_{it} and Y_{jt} represent the observed levels of employment in industries i and j, respectively, during period t,
$\hat{Y}_{it}$ and $\hat{Y}_{jt}$ represent the predicted levels of employment in industries i and j, respectively, for period t based on a quadratic time trend equation estimated separately for each industry by ordinary least squares regression, and
Y_i^* and Y_j^* represent the arithmetic means of the individual industry employment time series.

The covariance is a measure of the degree of association between employment in industries i and j. The covariance is positive if deviations of y_i and y_j from their respective expected values tend to have the same sign, and it is negative if the deviations tend to have opposite signs. If no correlation is found between deviations in employment in the two industries, the covariance is zero.

The weighted sum of the 67 × 67 components of the matrix is called the employment portfolio variance, computed in equation (4A).

$$\text{(4A)} \qquad PV = \sum_{j=1}^{67} \omega_j^2 VAR_j + \sum_{i=1}^{67}\sum_{\substack{j=1\\ j\neq i}} \omega_i\, \omega_j\, COV_{ij}$$

where: ω_i and ω_j represent the mean employment share of industries i and j, that is, y_i/Y and y_j/Y respectively.

By summing all the weighted elements of the variance-covariance matrix we achieve the same portfolio variance as calculated in equation (2A) on total employment. The advantage of equation (4A) is that it is possible to see each industry's contribution to the portfolio variance.

The contribution of a particular industry to the total portfolio variance is the sum of the industry's variance and the 66 covariances with other industries. In other words, it is the weighted sum of the column for industry j of the 67 × 67 variance covariance matrix. By comparing industry j's contribution to portfolio variance to total portfolio variance, we get beta.

$$\text{(5A)} \qquad B = \omega_j^2 VAR_j + \sum_{i=1}^{66} \omega_i\, \omega_j\, COV_{ij}$$

The sum of all the industry betas equals 1. Thus, an individual industry with a value of beta equal to or greater than 1 increases the portfolio variance, and an industry with a value of beta less than 1 reduces portfolio variance.

[1] Ideally we would compare employment in the region with that of the world, but because of measurement problems we instead compare New England employment to that of the nation.

[2] This article used U.S. Bureau of Economic Analysis (BEA) industrial classifications, which are based on the U.S. Bureau of Labor Statistics (BLS) 2-digit SIC code industrial classifications for 1972. Three of the industries are a combination of several BLS industries: "other nondurable goods" combines petroleum and coal products, and tobacco; "other transportation" includes railroad, water, pipelines, and transportation services; "other durable goods" combines furniture and fixtures, and motor vehicle equipment. The employment numbers used by the BEA make some adjustments to BLS employment numbers, such as including college students and proprietors and partners.

[3] A comparison of federal government workers by region will be distorted by the very large concentration of federal government workers in the greater Washington, D.C. area, resulting in all other areas appearing to be underrepresented. However, in 1988 civilian government workers were 1.98 percent of all employees in the United States excluding Maryland, Virginia, and the District of Columbia, compared to only 1.65 percent in New England.

[4] Note that substitution can occur between public and private employment. In a region with many private hospitals and private colleges, the government may decide to provide fewer public hospitals and public colleges.

[5] Fomby and Hirschberg (1989) use a slightly different goodness-of-fit test. Rather than assuming the theoretical distribution is U.S. employment shares, their test assumes the theoretical distribution is U.S. employment shares excluding the region under consideration, here New England. We also calculated the Fomby and Hirschberg (1989) goodness-of-fit measure for New England, which generated a curve with the same shape as the one shown in Figure 1.

[6] Consider the following employment in industries A and B.

	Region 1	Region 2	Region 3	Nation
A	25	50	25	100
B	25	25	50	100
Total	50	75	75	200

The employment shares are:

Industry	Region 1	Region 2	Region 3	Nation
A	.50	.67	.33	.50
B	.50	.33	.67	.50

GF and ENT are:

	Region 1	Region 2	Region 3
GF	0	.12	.12
ENT	0	.06	.06

[7] GF and ENT use employment shares of the United States in the denominator of equations 1 and 2. This is appropriate when comparing a region to the United States; over time, however, cross-regional comparisons can be misleading because the measures are not symmetric. Thus, differences in industries where the United States has smaller shares result in a larger effect on the measures than in industries where the United States has larger shares.

[8] R^2 is the explained sum of squared residuals divided by the total sum of squared residuals. It can be written as

$$R^2 = \alpha_1^2\left(\frac{S_x^2}{S_y^2}\right)$$

where: α_1 is the estimated slope coefficient,
S_x^2 is the sample variance of the independent variable
S_y^2 is the sample variance of the dependent variable.

Therefore, even if α_1 is large, R^2 will be low if the S_x^2 is small relative to S_y^2.

[9] Correlation coefficients are calculated as the covariance between industry i and industry j divided by the standard deviation of industry i times the standard deviation of industry j. The standard deviations and the covariances are calculated from the variance-covariance matrix used in calculating portfolio variance, so they are all corrected for time. Note that a 0 correlation implies no linear relationship but a relationship may exist; for example, the data may fit a curve rather than a line.

[10] The nine census regions include the following states: New England: CT, ME, MA, NH, RI, VT. Mid Atlantic: NJ, NY, PA. South Atlantic: DE, D.C., FL, GA, MD, NC, SC, VA, WV. East North Central: IL, IN, MI, OH, WI. East South Central: AL, KY, MS, TN. West North Central: IA, KS, MN, MO, NE, ND, SD. West South Central: AR, LA, OK, TX. Mountain: AZ, CO, ID, MT, NM, NV, UT, WY. Pacific: AK, CA, HI, OR, WA.

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Does a Trend toward Early Retirement Create Problems for the Economy?

Gary Burtless and Alicia H. Munnell

Senior Fellow, The Brookings Institution, and Senior Vice President and Director of Research, Federal Reserve Bank of Boston. *This article will also appear in the proceedings of the second annual conference of the National Academy of Social Insurance,* Retirement and Public Policy, *1990, Kendall/Hunt Publishing Co., Ames, Iowa.*

Many politicians, gerontologists, and editorial writers have come to deplore the trend toward early retirement. This trend, which began after World War II and accelerated in the 1960s and 1970s, has led to a dramatic decline in work effort and earnings among the elderly. Opponents of earlier retirement believe that keeping people in the work force longer will raise the nation's output, reduce the costs of Social Security, and improve the well-being of older Americans. In contrast, the groups most directly affected by retirement patterns—employers, labor unions, and especially older workers themselves—show little interest in reversing recent retirement trends. Personnel practices in most large firms tend to encourage rather than discourage early exit from the work force. Labor unions generally favor these practices. And older workers often seem eager to seize the opportunity to retire early when it is offered to them.

The concern about the trend toward early retirement has taken on increased urgency in the face of the projected slow growth of the labor force in the 1990s and a sharp increase in the size of the elderly population when the baby boom generation retires after the turn of the century.[1] Advocates of delayed retirement worry about the costs of supporting a large retired population after 2010 and view the 1990s as an opportunity to head off unbearable financial burdens. The next decade may be a period when the attitudes of employers and the elderly change and their interests coincide. The slowdown in the influx of new workers may make employers more eager to eliminate early retirement incentives and develop flexible job options to hold on to the skilled older worker. Improved job prospects for the elderly may make them more eager to work.

This article takes a closer look at the economic arguments behind the widespread call for the continued employment of older workers, particularly in view of the substantial aging of the population. It begins with a discussion of the implications of early retirement in an

economy without social insurance, and then looks at an economy with a social insurance system. The second section delineates the extent to which in the United States the costs of the Social Security program are insulated from reductions in the retirement age. The third section explores the effects of early retirement on economic performance outside Social Security and then highlights possible ways in which real world outcomes may deviate from the theoretical optimum.

The conclusion that emerges from the analysis is straightforward. Once social insurance costs are insulated from individual retirement decisions and individuals and their employers make their own provisions for support before the official Social Security retirement age, no strong economic reason exists to resist the trend toward early retirement, if that trend reflects the preference of the retiring individuals for more leisure and fewer goods. As noted, this conclusion rests solely on an analysis of the impact of the early retirement trend on national output and retirement programs, and does not incorporate consideration of any potential beneficial effects that continued employment might have on the health or psychological well-being of older workers themselves.

The next decade may be a period when the attitudes of employers and the elderly change and their interests coincide.

The Concern about the Increasing Costs of Early Retirement

The argument for keeping people in the work force is simple and appealing. The United States, like many other industrialized countries, is experiencing an aging of its population, as a result of a sharp decline in the fertility rate and improvement in life expectancy. Population aging increases the number of elderly, mostly retired, people who rely on Social Security as their primary source of income. Social Security payments, which are financed mainly by current payroll tax payments, involve the transfer of national product from the working population to the nonworking population. With an aging population, the cost of supporting older people will increase sharply as a relatively smaller working population must support a relatively larger retired elderly population. The burden of support is exacerbated by the increasing trend towards early retirement, since the aged must be supported for a longer period and out of a smaller pie due to the decline in the number of productive workers.

Much of the above is true. The population is aging and the proportion of those sixty-five and over is expected to increase substantially. The intermediate projections prepared by the Social Security Administration show the elderly population (sixty-five and over) as a percentage of the working-age population (twenty to sixty-five) doubling from its present level of 20 percent to 40 percent in 2035, where projections show it will remain. The reason for this increase is a drop in the total fertility rate from a postwar peak of 3.7 children per woman in the late 1950s to an ultimate rate of 1.9 children per woman. At the same time that fewer babies are being born, older people are living for a longer time. Life expectancies at age sixty-five, which were thirteen years for men and sixteen years for women in 1960, are now fifteen and nineteen years, respectively, and are projected to be seventeen and twenty-one years in 2035.

An Economy without Social Insurance

In thinking about the burdens placed on active workers by a growing retired population, it is useful to consider a simple baseline case of an economy without social insurance. The following analysis, which is based on a highly stylized version of reality, is designed to highlight the difference between a world without and with a social insurance system.

Suppose the population consists of workers and retirees of different ages who each expect to live exactly T years. People begin work at birth, earn E dollars per year while at work, and retire at age R. This leaves workers T − R years in which to enjoy leisure, during which time they earn no wages. In the absence of a social insurance system and without interest on savings, an individual's lifetime income (Y) is

$$Y = RE, \tag{1}$$

or the product of years at work and wage earnings per year.

Workers wishing to avoid starvation during their retirement will save during their working years.[2] Under a common assumption adopted here, they will save and dissave exactly enough each year so their annual consumption, C, is identical in each year of their life span, including periods at work and in retirement:

$$C = \frac{RE}{T}. \tag{2}$$

This consumption pattern implies that annual savings while at work will be (3)

$$S = E - \frac{RE}{T} = \frac{T - R}{T} E. \tag{3}$$

Individuals prefer more consumption to less, holding the retirement age constant, and prefer additional years in retirement to fewer years, holding annual consumption levels constant. This assumption yields a utility function defined in terms of C and R:

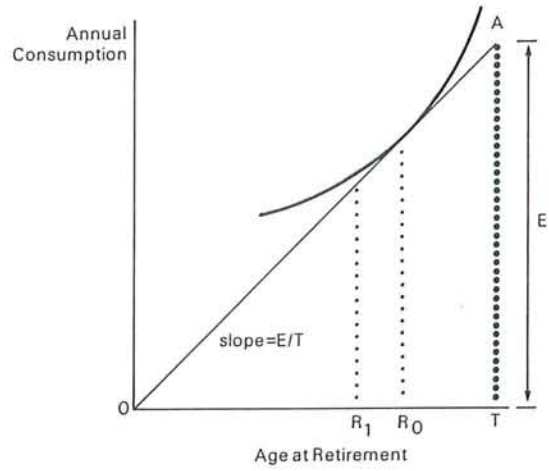
$$U = U(C,R), \tag{4}$$

where $dU/dC > 0$ and $dU/dR < 0$. The problem for the worker is to select consumption and a retirement age in such a way as to maximize utility, subject to the budget constraint and the assumption of smoothed consumption. This choice is graphically represented in Figure 1, which shows the worker's annual consumption level on the vertical axis and the retirement age on the horizontal axis. The straight line OA represents the budget constraint. It has a slope equal to E/T, which is the amount of extra yearly consumption the worker can enjoy by postponing retirement one additional year. In the figure, the highest level of satisfaction is attained when the chosen retirement age is R_0.

This model can illustrate how workers and the economy are affected when the population ages. First, assume that people live exactly fifty years and typically retire when they reach age forty (that is, T = 50 and R = 40). If they earn $10,000 a year while at work, they must set aside $2,000 a year while working in order to maintain a constant consumption level of $8,000 throughout their lives. In assessing the impact of population aging on these outcomes, it is important to remember that the population could grow older for one of two reasons: the rate of population increase might slow, thereby reducing the fraction of people who are young, or life expectancy might rise, increasing the proportion of people who are old.

Figure 1

Trade-off between Annual Consumption and Age at Retirement



Suppose initially the number of people born doubles every decade. For every person aged forty to forty-nine, two are aged thirty to thirty-nine, four aged twenty to twenty-nine, eight aged ten to nineteen, and sixteen under age ten. A little arithmetic shows that when the population rises this fast, the ratio of retired people (forty and older) to workers (people under forty) is 1 to 30. Only about 3 percent of national consumption is received by the elderly; nearly 97 percent is received by workers. If population growth slows down, a much higher fraction of consumption will go to the retired elderly. For example, if the population is constant in size, so the number of people born in each decade is the same, the retiree-worker ratio will be 1 to 4. Fully one-fifth of national consumption will be enjoyed by the retired population. While the rise in the fraction of consumption going to the elderly might seem alarming, it has no unpleasant consequences for the working population. Workers continue to earn $10,000 a year, saving $2,000 for their old age and consuming $8,000, just as they did when the population was rising rapidly. The aging of the population places no extra burden on individual workers. To be sure, the fraction of national consumption going to the retired

elderly could be reduced if the average age at retirement rose. Were the retirement age to rise from forty to forty-five, the share of consumption received by retirees would drop from 20 percent to just 10 percent, the share received by current workers would increase, and national income would rise 12.5 percent. But workers would not necessarily be any happier, because they would be forced under this arrangement to accept more consumption and less retirement leisure than they would have chosen if left to their own devices.

The situation is slightly different when the population is aging as a result of increased life expectancy. Suppose life spans rise by one-fifth, jumping from fifty to sixty years. To maintain similar levels of annual consumption, workers must delay their retirements. If they wish to continue consuming $8,000 each year, equation (2) shows that their retirement age must also rise by one-fifth, from forty to forty-eight. Of course, some workers might prefer instead to maintain their retirement age at forty and cut their annual consumption to $6,667. Critics of early retirement may deplore this decision, but it has no adverse consequences on other workers. The burden of longer retirement, in the form of reduced annual consumption, is borne entirely by the individual workers who choose to spend more of their lives outside the work force.

The same conclusion follows if, even in the absence of greater longevity, some workers should plan to retire before reaching the average retirement age, retiring at age R_1 rather than R_0 in Figure 1. This trend toward early retirement affects the consumption levels and saving behavior of workers who exit the labor market early, but it does not impose any cost on workers who continue to retire at the normal job-leaving age. If early retirees derive satisfaction from additional leisure that offsets their loss of utility from forgone consumption, and if they provide for their own retirement through reduced consumption while at work, politicians, editorial writers, and others favoring late retirement have no legitimate reason to question their decision to retire early.

In an economy without social insurance, early retirement would have no adverse consequences on other workers.

In the absence of social insurance, it is hard to understand, within the confines of this simple model, why workers should be concerned about the retirement behavior of other workers. The retirement decisions of others, who have provided for their own retirement, in no way impinge upon the ability of an individual worker to earn wages and to spend those earnings in an optimal way over the life cycle.[3] The introduction of a social insurance system, however, can theoretically link one worker's lifetime consumption directly or indirectly to the retirement behavior of others.

An Economy with Social Insurance

In its simplest form, a social insurance system consists of a tax formula, a payment formula (including retirement ages and other eligibility factors), and an overall budget constraint that ties annual or future outlays in the system to past, current, and future revenue. In the U.S. system, revenues are obtained largely through a proportional tax, t, on earnings up to a maximum taxable amount.[4] The current tax for Old-Age, Survivors, and Disability Insurance is 12.4 percent on earnings up to $53,400 (1991 estimate) a year; the rate for Hospital Insurance is 2.9 percent on earnings up to the same limit.

Retirement pensions are payable to eligible workers who have attained age sixty-two and who have substantially withdrawn from active labor force participation. Full benefits are payable to all participants at age seventy regardless of their labor force activity. Old-age benefits are calculated under a complicated formula that depends on a worker's year of birth, current and prior taxable earnings, age at retirement, and number of eligible dependents. For simplicity, assume that the annual benefit payment, P, is determined solely by the worker's average earnings (E) and retirement age (R):

$$P = P(E,R), \tag{5}$$

with $dP/dE > 0$ and $dP/dR > 0$.

Annual spending in the United States Social Security system cannot exceed annual revenues plus the amount of reserves held in the trust fund. If spending threatens to exceed that threshold, Congress would be forced to appropriate funds from the Treasury or, more likely, raise the payroll tax rate (t) or trim the average payment (P). Even though the

system is now scheduled to accumulate substantial reserves in order to offset the rising costs associated with the retirement of the baby boom generation, the pay-as-you-go model is a useful approach for calculating the current costs of the program.

If the system were financed on a strict pay-as-you-go (or current cost) basis, the tax rate would be set each year so that total revenues were just equal to total benefit payments in that year. Revenues from the payroll tax depend on the tax rate (t), the number of workers in covered employment in that year (W), and the average annual taxable earnings per worker (E). Outlays are the product of the number of beneficiaries (B) and the average payment per beneficiary (P). If revenues are exactly equal to outlays,

$$(t)(W)(E) = (B)(P), \tag{6}$$

and the pay-as-you-go cost of financing the program is

$$t = P/E \times B/W. \tag{7}$$

Thus, the annual cost is the ratio of the average benefit to average earnings times the ratio of beneficiaries to workers. Assuming that the benefit to earnings ratio holds steady at 0.35, the current cost for beneficiary-to-worker ratios of 0.2, 0.3, 0.4, and 0.5 would be 7, 10.5, 14, and 17.5 percent of taxable payrolls, respectively.

For any given set of demographic factors, the ultimate costs will also depend crucially on the labor force participation of the population. A trend towards early retirement would both reduce the number of workers and increase the number of beneficiaries. For example, defining the working population as people aged twenty to sixty-four and the retired population as people aged sixty-five and over, the ratio of beneficiaries to workers in 2035 would be 0.40. If benefits were made available at age sixty and all workers retired at that age, the ratio increases to 0.55; if all workers received benefits upon retiring at age fifty-five, the ratio of beneficiaries to workers in this simple example becomes 0.75. The current costs of the program under these assumptions would be 14 percent, 19 percent, and 26 percent of taxable payrolls, respectively.

To understand the nature of the potential burden on individual workers created by the introduction of a social security system, it is helpful to define "burden" with some care. One definition of the net social security burden (SSB) is the difference between what individuals pay in tax contributions and the amount they receive in the form of retirement benefits.[5] This is somewhat different from the definition of burden typically used by journalists, which refers only to the tax rate paid by current workers and disregards the benefits workers will eventually receive when they retire. Assuming interest to be zero, the net social security burden for an individual is shown by the following equation:

$$\begin{aligned} SSB &= tRE - (T - 40)P, \text{ if } R < 40; \text{ and} \\ &= tRE - (T - R)P, \text{ if } R \geq 40, \end{aligned} \tag{8}$$

where forty is the earliest age at which benefits can be claimed.[6] Lifetime taxes are equal to the tax rate (t) times lifetime earnings (RE), and lifetime benefits are annual benefit payments (P) times the number of years collecting benefits (T − 40 or T − R, whichever is smaller). If benefits exceed taxes, the system yields net benefits to the worker and the net burden is negative; if taxes exceed benefits, the net burden is positive and the sum of the worker's benefits is less than his lifetime contributions.

To see whether workers are likely to be burdened by the system, the expression for the tax rate (t) shown in equation (7), can be substituted into equation (8). When the average retirement age is at least forty (the early retirement age), the net social security burden (SSB) is:

$$\begin{aligned} SSB &= R\frac{P}{E}\frac{B}{W}E - (T - R)P \\ &= R\frac{PB}{W} - (T - R)P. \end{aligned} \tag{9}$$

Holding the payment level and average retirement age constant, the effects of population aging on the net social security burden are immediately evident. If the population is growing very fast, the ratio of beneficiaries to active workers (B/W) will be low. Consequently, lifetime taxes will be low and the net social security burden will be negative, meaning that workers receive more in benefits than they have contributed. On the other hand, with slow population growth (and the same retirement age), a smaller proportion of the population will be at work, resulting in higher lifetime tax contributions. Under those circumstances, workers are more likely to be burdened by the system.

The fact that the net burden of social security varies with the ratio of beneficiaries to workers means that, once social insurance is introduced, workers' lifetime incomes and consumption are affected by the retirement decisions of other workers.[7] If workers decide to retire at age forty rather than forty-eight, they will have to pay higher social insurance taxes to finance a longer period of benefit payments. Even those workers who wish to work until age forty-eight will face the higher tax rate, possibly reducing their lifetime consumption below the amount they could obtain without social insurance.[8] For this reason, workers who wish to retire near the very end of life might legitimately object to a system providing generous retirement benefits for early retirement.

Once social insurance costs are insulated and individuals make their own provisions for support, no strong economic reason exists to resist the trend toward early retirement.

A social security program can, however, incorporate some mechanisms that partially protect it against the adverse effects of early retirement. One protection is an early retirement age. For example, workers cannot claim benefits until reaching a minimum age—age forty in equation (9)—thus limiting the maximum lifetime benefit to (T − 40)P. Workers retiring before that age do not obtain any extra benefits, though they pay lower lifetime taxes than workers who retire later.

An additional protection is tying the annual payment (P) to the worker's lifetime earnings history and age at retirement. For a worker who retires past the early retirement age, this means that the net social security burden is

$$(10) \quad SSB = tRE - (T - R)\,P(E,R), \text{ if } R \geq 40,$$

and the *change* in social security burden as retirement is delayed one year is

$$(11) \quad \frac{dSSB}{dR} = tE + P(E,R) - (T - R)\frac{dP\,(E,R)}{dR}.$$

Each of the terms in (11) has a straightforward interpretation. When retirement is delayed a year, the worker pays one more year's taxes, tE, and loses one year's benefits, P(E,R). As an offset, however, the worker gains additional benefits over the remainder of his lifetime, (T − R) dP/dR. For a worker retiring *before* the early retirement age, the change in social security burden from delaying retirement is

$$(11') \quad \frac{dSSB}{dR} = tE - (T - 40)\frac{dP(E,R)}{dR}.$$

The main difference between (11) and (11′) is that a worker retiring before the early retirement age does not give up a year's social security benefits when retirement is delayed a year. In either case, the change in the net social security burden can be positive or negative, depending on the nature of the benefit formula, P(E,R).

Equations (11) and (11′) suggest that early retirement provisions and the nature of the pension formula are mechanisms for controlling the extent to which the choice of retirement age of one worker affects the welfare of other workers. The degree to which this occurs under the U.S. Social Security system is an empirical question, and one addressed in the next section. One important conclusion, however, can be stated immediately: tax rates in a pay-as-you-go social security system may be raised or lowered by a trend toward early retirement, depending on the exact benefit formula linking pensions to past earnings and work experience.

The Extent to Which the Current U.S. Social Security System Is Insulated from Changes in Retirement Patterns

While the generalization is correct that the costs of a social insurance system depend on the working habits of the covered population, the United States Social Security program has provisions that influence the extent to which long-run benefit costs are affected by the retirement decisions of individual workers. The benefit provisions consist of two elements: a formula for the basic yearly pension (also known as the "primary insurance amount" or PIA) and an actuarial adjustment that reduces or raises the basic pension depending on whether benefits are claimed before or after the normal retirement age. Together these two elements determine the relationship between age at retirement and Social Security costs.

Actuarial Adjustments

Regardless of the age when an individual withdraws from the labor force, no retirement benefits are payable under the Social Security program before age sixty-two and full benefits are not payable until age sixty-five. Because benefits are actuarially reduced for retirement between ages sixty-two and sixty-five (5/9 of 1 percent for each month of retirement before age sixty-five, which amounts to 20 percent at age sixty-two), lifetime benefit costs are not affected by the worker's choice of retirement within this range. Table 1 shows that 75 percent of men and 81 percent of women opt for benefits before age sixty-five. Indeed, the majority of workers of both sexes opt for benefits as soon as they become available. Since annual payments are actuarially reduced, the selection of this option has only a slight impact on lifetime benefits or costs.[9]

Table 1
Initial Benefit Awards and Average Benefit Amounts, by Age at Award and Sex, 1988

	Men		Women	
Age at Award	Percent of All Awards	Average Benefit	Percent of All Awards	Average Benefit
62	55	$546	65	$339
63	9	618	8	409
64	11	667	8	447
65 and over	25	694	19	496

Source: U.S. Department of Health and Human Services, Social Security Administration, *Social Security Bulletin, Annual Statistical Supplement, 1989*, Tables 6.B1 and 6.B2, pp. 252-253.

Workers who claim benefits after the normal retirement age are penalized under the current provisions, however. The delayed retirement credit for waiting to claim benefits past age sixty-five is now just 3 percent a year, which is far too low to compensate a worker fairly for the loss of one year's benefits. The formula gives smaller lifetime payments to workers who retire after sixty-five than it does to those retiring at age sixty-five or earlier.

The delayed retirement credit, which amounted to only 1 percent per year for those attaining age sixty-five before 1982, is scheduled to reach 8 percent in 2008. Since this eventual amount is very close to a fair actuarial adjustment (9 or 10 percent), the system will gain little, if anything, from individuals postponing retirement beyond the normal retirement age (Myers 1985, p. 95).

The preceding discussion has focused on the sensitivity of Social Security costs to deviations in retirement patterns from the normal retirement age, now sixty-five. This still leaves the question of changes in the normal retirement age itself, and whether the trend toward early retirement precludes extending the age at which persons are eligible for full benefits. The answer, at least for the United States, is that actual and legislated retirement ages are perfectly capable of moving in opposite directions. Despite a sharp decline in the labor force participation of men fifty-five and over during the 1970s (Table 2), Congress decided in 1983 to advance the normal retirement age as a method of eliminating the long-run deficit in Social Security. As a result of the 1983 Social Security Amendments, the age at which full benefits are payable will be extended gradually to sixty-six by 2009, then to sixty-seven by 2027. People can still elect early retirement at sixty-two, but benefits paid to early retirees will be reduced 25 percent in 2009 and 30 percent by 2027, as compared to the current reduction of 20 percent. This will ensure that system costs remain unaffected by individual decisions to retire at sixty-two rather than sixty-seven. The delayed retirement credit, which will be fully phased in by 2008, will also hold costs more or less constant for retirements between the ages of sixty-seven and seventy.

Table 2
Labor Force Participation Rates by Age and Sex, 1973, 1978, 1983, 1988

	1973	1978	1983	1988
Men				
50–54	91.6	89.7	89.1	88.4
55–59	86.2	82.9	80.7	79.3
60–61	78.0	73.0	69.7	67.0
62–64	62.6	54.2	47.1	45.4
65–69	34.2	30.1	26.1	25.8
70+	15.7	14.2	12.2	10.9
Women				
50–54	53.2	54.5	58.5	64.8
55–59	47.4	48.6	48.8	53.3
60–61	41.3	39.7	40.5	41.7
62–64	29.2	28.5	29.1	28.5
65–69	16.0	14.9	14.7	15.4
70+	5.3	4.8	4.5	4.4

Source: U.S. Bureau of Labor Statistics, unpublished tabulations from Current Population Survey.

Primary Insurance Amount

Far more complicated than the actuarial adjustment for delayed retirement is the formula for the basic pension amount, or PIA. At a particular point in time, a worker's PIA is based on his average indexed monthly earnings (AIME) in employment covered by Social Security. For workers reaching sixty-two after 1990, the computation is based on the worker's average earnings in the thirty-five years of highest earnings after 1950 up to age sixty-two or the age when benefits are first claimed, whichever occurs later. The formula is also explicitly redistributive, so that workers with lower average lifetime earnings are provided with a PIA that represents a higher percentage of their past earnings.

Two features of the PIA formula link a worker's retirement age and the level of the basic pension. The first is the number of years used to calculate average earnings. People who have worked fewer than thirty-five years can always raise their basic pensions by working an additional year. This is as true for someone age sixty-seven as it is for someone age fifty-five. After working thirty-five years, however, workers gain little from an additional year of employment, particularly if their current (indexed) wage is similar to the lowest (indexed) wage in their previous earnings history. In the thirty-sixth year of a career, a worker is obligated to pay the same Social Security tax paid in the thirty-fifth year, yet the thirty-sixth year of work contributes very little to a higher basic pension amount or PIA. This provision should constitute an inducement for workers to retire after thirty-five years in the work force.

A second important feature of the PIA formula is the explicit provision to redistribute in favor of workers with low lifetime earnings. This aspect of the formula carries a price for both high-wage and average-wage workers who wish to delay retirement. Because the formula treats low earnings so favorably, it does not generously reward marginal gains in average earnings, even if they arise because a worker has decided to refrain from early retirement. Thus, average-wage or high-wage workers who work one additional year may find they receive less in future benefits than they give up in current Social Security taxes as a result of the extra work. (In terms of equations (11) and (11′), dSSB/dR is positive.) Even if the Social Security system *on average* imposes no net burden on average-wage and high-wage workers late in their careers, *on the margin* these workers may receive a smaller net transfer from Social Security as they postpone their retirement one additional year.

In short, the thirty-five-year averaging provision and the progressivity of the benefit formula are mechanisms through which workers could potentially influence their net burden under Social Security. By altering their retirement age, workers can improve the relationship between their lifetime taxes and benefits and thereby increase the net costs that they impose on other workers. Higher costs would translate into a higher tax rate and lower lifetime consumption for those covered by the system.

Payroll and Income Tax Revenues

In addition to affecting the benefit payments received by retired Americans, early retirement also affects Social Security and personal income tax revenues. The issue is the size of the revenue loss resulting from labor force withdrawal prior to age sixty-five. In 1988, 2.5 million retired workers between sixty-two and sixty-four were receiving benefits. If all those people had been working and earning the average reported taxable amount of $16,450, total Old-Age, Survivors, and Disability Insurance payroll revenues and personal income tax receipts would each have been roughly $5 billion higher. The additional payroll tax revenues would have allowed a 0.2 percentage point reduction in the combined employer-employee payroll tax. While this effect and the additional income tax receipts are not trivial, they hardly seem large enough to serve as the motivation for a call to reverse the trend toward early retirement.

Overall Assessment

The cost of benefit payments in the United States Social Security system is substantially, though not fully, protected against a continued trend toward early retirement. By establishing age sixty-two as the age of eligibility for first benefits, reducing benefits on an actuarially fair basis for retirement before the normal retirement age of sixty-five, and increasing benefits by what will be approximately an actuarially fair delayed retirement credit for work between sixty-five and seventy, system costs are insulated from individual decisions about when to withdraw from the labor force. Moreover, Congress appears not to be constrained by actual retirement patterns when setting the age of eligibility for full benefits, as indicated by the retirement age reform in the 1983 Amendments.

The impact on future Social Security revenues posed by the trend to early retirement is a somewhat different story. Payroll and income tax receipts are lost when people stop working, before or after the normal retirement age. At the moment, the revenue loss is not large enough to justify the call for reversing the trend toward early retirement. In the future, however, the loss will become more significant, as the share of the potential work force past the age of fifty rises.

The current Social Security benefit formula provides little inducement for many workers in their fifties to remain at work. To insulate the Social Security system against the adverse effects of early retirement, it might eventually be desirable to raise the incentive for postponing retirement or, alternatively, raise the penalty for very early retirement. One simple way to accomplish this is to increase the number of years of employment that are counted in determining a worker's average lifetime earnings.

At the moment, however, the economic justification for this kind of reform does not seem compelling. To the extent that people worry about the heavy economic burden arising from early retirement, an explanation must be sought outside of its impact on the Social Security program.

Early Retirement and Economic Performance outside Social Security

Many people concerned about the economic implications of the trend toward early retirement are not worried solely about the financial condition of the Social Security program; rather they are disturbed about the implications for broader measures of economic performance. Some indexes of performance would undoubtedly suffer if the early retirement trend continues. National output would be lowered by the reduction in the number of active workers and, as noted earlier, the share of national consumption going to the retired elderly would rise. The issue is whether these outcomes should cause concern.

Most economists would argue that the sense of loss and alarm stems from a failure to attach any value to leisure in the measured statistics. In the absence of any distortions created by taxes, transfers, or government regulations, virtually all economists concede that workers who value leisure more than the going wage will not and should not consent to remain employed. They are content to give up wage income for time off. National output will be lowered by the reduction in their hours, but this decline simply measures the goods that they are willing to forgo in order to enjoy more leisure, which they value just as highly as the goods and services they give up.

Absent economic distortions, workers still in the labor force should be in no way adversely affected by the lack of participation by those who value leisure. Workers are earning a wage that compensates them for their loss of free time, and their wage equals the value of goods and services that will be available for them to consume. Per capita output reported in traditional terms will be lower than if everyone worked, but this has no significance except to myopic consumers of economic statistics. The well-being of the nation is the sum of the well-being of its citizens, not the sum of goods and services that happen to circulate in the market. If leisure, which contributes to individual well-being, were properly valued in national income statistics, it would be clear that early retirement can contribute to an improved allocation of resources.

Most economists would argue that the sense of loss and alarm stems from a failure to attach any value to leisure in the measured statistics.

The question is: Does this basic economic model tell the whole story? Do instances occur where the decision not to work makes retirees less well-off than they could have been? Or does early retirement adversely affect those who remain in the labor force or future generations of workers? Several factors complicate the analysis, particularly lack of information about retirement needs and the stability of retirement income on the part of retirees, and the extent to which retirees create burdens for other members of society. An intergenerational issue also arises. Even though the current generation is happy to forgo goods and services for leisure, the next generation may find itself with a smaller capital stock than it would have desired. In sum, three different groups could be adversely affected by a trend toward early retirement: the early retirees themselves, workers

who remain actively employed, and future workers. This section examines each of these groups.

Early Retirees

Those who decide to withdraw from the labor force will fare less well than a simple model of perfect competition would indicate if their withdrawal is in any sense involuntary or if they incorrectly forecast their retirement needs or the adequacy of their retirement income.

Possibility of involuntary retirement. Except in a handful of occupations, involuntary retirement is no longer possible in the sense that people are forced out by explicit mandatory retirement provisions. Indeed even when mandatory retirement rules existed, only a small percentage of people were actually affected by these provisions (Schulz 1988, Figure 3–5, p. 85). Despite the lack of bite in companies' mandatory retirement policies and the continued move toward early retirement, Congress passed legislation in the 1970s that allowed workers to extend their work life. The bill amending the Age Discrimination in Employment Act, which swept through Congress in 1977 with only a sprinkling of dissenting votes, extended protection against age discrimination to nonfederal employees up to age sixty-nine and eliminated the upper limit entirely for most federal workers. In October 1986, the Age Discrimination in Employment Act was amended again. The new provisions now prohibit the termination of employment on the basis of age at any age.

Retirement of an unemployed older worker could still be involuntary, however, if the price of hiring an older worker were artificially inflated; that is, if the total compensation costs faced by the firm exceeded the wage for which older employees were willing to work. Such a situation could occur if pension and health care costs increase sharply with age and these additional costs were not shifted back to the employee in the form of lower cash wages.

The relationship between pension costs and age depends critically on the nature of the retirement plan. The cost of Social Security, which is financed by a flat payroll tax on earnings, does not increase with the age of the worker. In the case of supplementary private plans, the relationship between cost and age hinges on whether benefits are provided under a defined benefit or a defined contribution plan. The defined benefit plan is the traditional pension plan and continues to be the dominant form. Under such a plan, the worker is promised a specified benefit at retirement, based on earnings and years of service. In contrast, benefit levels under a defined contribution plan are based solely on the value of the individual worker's account at the time of retirement. This value is determined by the amount contributed to the account by the employer and/or the employee and any accrued earnings on the amounts invested.

Whereas the cost to an employer of funding a defined contribution plan remains constant, generally as a percent of earnings, over the life of the employee, the cost of funding a defined benefit plan increases dramatically with the age of the employee under most funding schemes. Cost methods based on projected benefits assume that the cost of the pension for a given year is equal to the present discounted value of benefits attributable to service during that year. The closer the worker is to retirement, the larger the required contribution since the amount will be discounted over fewer years.

The trend toward early retirement probably reflects the genuine preferences of older individuals rather than simply a new distortion in the price system.

Health care expenses also increase with age, and this increase is reflected in employers' costs for health insurance. Although individual employee premiums and employer contributions per employee do not vary with the age of the worker, an employer's total cost for health insurance is directly affected by the age composition of its work force. Large employers that self-insure can see the evidence directly, and smaller employers that insure through one of the major carriers are made acutely aware of the influence of age on costs when they receive their experience-rated premium increases. This phenomenon, which has always existed, has taken on increased importance in light of the extraordinary surge in health care costs for everyone in the 1970s and 1980s.

The sharp increase in costs for older workers of employer-provided fringe benefits—primarily pensions and health insurance—need not necessarily translate into greater total compensation costs faced by the employer. It would be possible to keep older

workers' total compensation in line with that of younger employees through a decline in their cash wages. This has not happened, however, and several explanations are possible.

One likely hypothesis is that such an effort would be strongly resisted by labor unions, which simply would not be able to accept a situation where older workers, doing the same job as their younger counterparts, received less cash wages. Alternatively, Lazear (1986) argues that the wage profile is actually tipped in the other direction, with older workers being paid more than their marginal product in an effort to keep them motivated as they approach retirement. Finally, a reduction in cash wages to compensate for the increase in fringe benefit costs may well not be legal under the Age Discrimination in Employment Act, even if it were viewed as desirable by older workers themselves.

Each of the factors just mentioned can explain why older workers have difficulty finding a job they wish to hold at a wage employers are willing to pay. None of them satisfactorily explains why it has become *harder* to find a reasonably well-paid job over the past two decades. Laws on age discrimination in setting wages, fringe benefits, and other conditions of employment have made it more costly to hire older workers, to be sure, but they have also made it more difficult to fire and to refrain overtly from hiring them. The views of labor unions are of interest, but the influence of unions in the workplace has steadily diminished.

It seems unlikely that the rise in early retirement can be fully explained by a rise in demand-side barriers against hiring older workers. The high total compensation of employed older workers and the high compensation requirements of older workers who seek employment can be interpreted as evidence that these groups have good income opportunities outside the job market. Many older people would honestly like to continue working, but, unlike younger workers today or older workers in the 1950s and 1960s, they have reliable sources of income outside of employment. Thus, the trend toward early retirement probably reflects the genuine preferences of older individuals rather than simply a new distortion in the price system.

Inadequate knowledge. An entirely sanguine conclusion about the economic implications of the trend toward early retirement presupposes full knowledge about all options on the part of the people making decisions. In the case of deciding whether or not to withdraw from the labor force, this assumption presumes workers' knowledge of their income needs during retirement and a complete understanding of the capacity of their public and private pensions to satisfy those needs over a period as long as several decades.

On the needs side, the assumption of ability to forecast seems fairly reasonable. People have a good idea of the money required to maintain their living standard before retirement and can probably be expected to make a reasonable forecast for the next ten or twenty years. The exception, of course, is health care. Even here Medicare after age sixty-five can protect retirees from most contingencies, although the possibility of developing a chronic condition that requires long-term care stands out as a major risk against which almost no one is protected. For the most part, however, assessing income needs in retirement seems like a manageable task.[10]

On the income side also, benefits received under Social Security are quite predictable. These amounts are directly related to earnings and, once awarded, are adjusted annually to keep pace with changes in the consumer price index. This ensures that Social Security benefits retain their purchasing power over the worker's retirement. The economic well-being of retirees relative to workers will decline somewhat over time, since those employed will see their earnings increase to reflect productivity improvements as well as price increases. This effect is quite modest, however. With annual productivity growth of 1.5 percent, a retirement benefit initially equal to one-half the average wage will decline to 40 percent of the average wage by the end of 15 years.

While Social Security benefits are fully adjusted for inflation, the maximum amount payable under this program for a person retiring at age sixty-five in 1989 was only $10,788 for a single person and $16,176 for a couple. This means that many middle-income and upper-income people receive a significant portion of their retirement income from supplementary public and private pension plans that are paid in nominal dollars. Even if inflation rates stay at modest levels, the purchasing power of benefits fixed in nominal terms will erode and retirees' standards of living will decline noticeably. When persistent inflation is combined with the trend toward early retirement and increased longevity, the value of an unindexed pension decreases significantly (Table 3). Employers and plan sponsors have been aware of the erosive impact of inflation and have periodically adjusted benefits in response to rising prices. The problem is that these adjustments generally account

Table 3
Purchasing Power of $100 of Fixed Pension Benefits under Various Rates of Inflation

Number of Years after Retirement	Annual Rate of Inflation 4%	8%	12%
5	$82	$68	$57
10	68	46	32
15	56	32	18
20	46	22	10

Source: Authors' calculations.

for only a small portion of the change in consumer prices.

Thus, people who retire early and for whom private pension income constitutes a sizable portion of their retirement income take a serious risk that inflation will erode their financial security. In this way, the retirees themselves may end up significantly less well off than anticipated at the time of retirement.

Current Workers

A second group that could be adversely affected by the trend toward early retirement are those people who remain in the labor force. The major perceived threat is that those who stop working hurl themselves on the employed for support. Two pieces of evidence indicate that this does not happen. Moreover, those who are left in the labor force may actually gain by having more capital per capita to work with and by facing reduced competition from older workers who block promotion possibilities.

Income sources of early retirees. Although good data are not readily available with which to identify the income sources of early retirees, two pieces of information indicate that these individuals are supporting themselves. First, except in the case of the disabled, public programs provide almost no funds to individuals aged fifty-five to sixty-two. Second, the receipt of pension income has increased substantially for this group.

As noted earlier, Social Security retirement benefits are not available before age sixty-two, regardless

Table 4
Pension Recipients by Sex and Age, 1973, 1978, 1983 and 1987
Numbers in Millions

Sex and Age	Pension Recipients 1973 Number	1973 Percent[a]	1978 Number	1978 Percent[a]	1983 Number	1983 Percent[a]	1987 Number	1987 Percent[a]	Percentage Change[b] 1973–87
Total:									
50–54	.3	2.7	.5	3.9	.5	4.8	.6	5.6	107.4
55–61	.8	6.0	1.4	9.2	1.9	11.8	2.3	14.9	148.3
62–64	.6	12.3	1.1	19.4	1.4	23.3	1.6	25.5	107.3
65 and over	3.7	19.6	5.7	24.5	7.7	29.1	9.3	32.5	65.8
Men:									
50–54	.2	4.6	.4	6.2	.4	7.0	.4	8.4	82.6
55–61	.5	8.2	1.0	14.1	1.3	16.9	1.5	21.0	156.1
62–64	.4	16.4	.7	27.1	.9	32.6	1.1	36.0	119.5
65 and over	2.3	29.6	3.4	35.3	4.5	42.1	5.4	45.7	54.7
Women:									
50–54	.1	1.0	.1	1.9	.2	2.7	.2	3.0	200.0
55–61	.3	4.0	.4	4.8	.6	7.4	.7	9.3	132.5
62–64	.2	8.8	.4	12.7	.5	15.3	.6	16.4	86.4
65 and over	1.4	12.5	2.3	17.0	3.1	20.0	3.9	23.2	85.6

[a]Pension recipients as a percentage of total population in age group.
[b]Percentage change in the proportion of sex-age group receiving pension.
Source: U.S. General Accounting Office. 1986. *Retirement before Age 65: Trends, Costs, and National Issues.* July. Washington, D.C.: General Accounting Office, Table 2.1, p. 22; U.S. Department of Commerce, Current Population Survey, March 1988, machine readable data.

of when an individual withdraws from the labor force. The other major sources of government support (except for food stamps) are also generally not available, since they are means-tested programs aimed at targeted groups of people. For example, Aid to Families with Dependent Children is designed for poor families with children under age sixteen; the Supplemental Security Income program is targeted on those over age sixty-five and the blind and disabled. In short, few direct government subsidies are provided for the nondisabled in the early retirement age group.

On the other hand, the receipt of pension income increased markedly between 1973 and 1987, the period when the trend toward early retirement accelerated. In 1987, 21 percent of men age fifty-five to sixty-one were receiving benefits (Table 4). Roughly half of these pensions were provided by private employers, 20 percent were from the military, and the remainder from the federal government or the states. Most of the people age fifty-five to sixty-one receiving pensions, particularly nonmilitary pensions, were out of the labor force; only 40 percent of men and 32 percent of women receiving civilian pensions described themselves as labor force participants (Table 5). Although this evidence is by no means conclusive, it does appear that those people receiving pensions are the ones not participating in the labor force, and that pension income, not the public dole, is the means by which early retirees support themselves.

The discussion so far implies that reliance on pension benefits is nearly identical to reliance on one's own saving. This is not quite correct. Saving through employer-sponsored pension plans is subsidized under the federal income tax, and this fact has implications for government revenues and tax rates.[11] Those who receive a portion of their compensation in deferred pension benefits pay less tax over their lifetime than those who receive all their compensation in wages. By allowing the deferral of taxes until retirement, compensation in the form of pension contributions offers three advantages over compensation in the form of wages. First, the full dollar of contribution without any reduction for income tax is available for investment during the employee's working years. This contrasts with the situation in which a dollar is paid in wages and the employee has only the after-tax dollar to invest. Second, no tax is currently paid on the investment income from accumulated assets, whereas interest earned by the employee on ordinary savings is subject to tax as income accrues.

Table 5
Labor Force Participation Rates for Pension Recipients and Nonrecipients by Sex and Age, March 1988

Sex and Age	Pension Recipients			Nonrecipients
	Total	Civilian	Military	
Men:				
50–54	67.6	51.3	83.9	90.8
55–61	44.6	39.9	64.4	83.7
62–64	23.1	20.6	38.2	59.8
65 and over	10.7	10.4	16.4	21.3
Women:				
50–54	59.3	58.7	[a]	63.8
55–61	32.7	32.2	[a]	50.5
62–64	19.8	19.8	[a]	29.9
65 and over	6.8	6.9	2.2	8.4

[a]Base population less than 75,000.
Source: U.S. Department of Commerce, *Current Population Survey*, March 1988, machine readable data.

Finally, when benefits are distributed in retirement, they are likely to be taxed at a lower marginal rate than if they had been taxed when they accrued.

The tax-deferred status of supplementary pension benefits causes a loss to the Treasury of significant revenues. Although the precise amount of the revenue loss is subject to considerable controversy, the total is undoubtedly quite large. For example, the U.S. Office of Management and Budget estimates that the revenue loss for 1990 (on a cash flow basis) is roughly $49 billion (1989, Table 6.1, p. 6–43). While only half the work force is covered by a supplementary pension plan, all taxpayers must pay higher taxes to make up for the forgone revenues. Thus the growing reliance of early retirees on supplementary pension benefits increases the tax burden on workers without pension coverage.

On the other hand, all workers reap the economic advantages from having fewer people, particularly fewer senior people, in the labor force. Economic theory indicates that output per worker will vary with the amount of capital each worker has available to work with. In the 1970s, for example, a slowdown in the rate of growth in the capital-labor ratio, associated with the entry of the baby boom generation into the labor force, contributed to the slowdown in productivity and wage growth. An alternative and somewhat more complicated version

of the same idea is the argument by Easterlin (1980) that young workers in small cohorts fare much better in the job market than those in large ones.

The history of retirement as an institution also underscores the advantages seen by both business and labor in getting older workers out of the labor force (Graebner 1980). Retirement has been supported by both groups as a means of replacing expensive older workers with cheaper younger ones, of opening up promotion opportunities, and of controlling unemployment by retiring older workers to create places for younger ones.

On balance, then, those who remain in the labor force probably gain from the trend towards early retirement. They are not asked to support substantially those who retire, and the early retirement of older workers probably increases the real wage earned by those who remain.

The Next Generation

The next generation is linked in two ways to the retirement decisions of today's older employees. First, they are providing Social Security benefits far in excess of anything that could be justified on the basis of the contributions of the current elderly. Second, a question arises whether the decision to withdraw early means that less saving occurs than if everyone stayed in the labor force until age sixty-five.

Intergenerational transfers. Although it is difficult to decide precisely how to interpret the information, it is important to remember that those currently retiring will receive Social Security benefits that greatly exceed their contributions into the system and any reasonable rate of return. In terms of the simple model discussed earlier, this group has experienced a shift in its budget constraint because of an intergenerational wealth transfer. This increase in wealth has allowed those currently over age fifty (as well as all preceding cohorts since the introduction of the program) to purchase more leisure as well as other goods than they would have been able to buy based solely on their own earnings.

The alternative to providing extraordinarily high rates of return to these older workers would be simply to reduce the benefits payable under the program. This would presumably not only reduce the income of those affected, but also alter some labor force participation decisions. Both developments would have ramifications that offset any immediate perceived gain. To the extent that benefit levels fell below acceptable standards, society would probably compensate with the introduction of some additional means-tested benefits that would require additional outlays on the part of the federal government. To the extent that older workers decided to continue working, their participation would preclude some of the benefits accruing to today's workers, described above.

Moreover, the issue of intergenerational transfers is one that is close to disappearing in the wake of the maturation of the Social Security system. While earlier generations received very high returns on their combined employee-employer contributions and today's older workers continue to receive a subsidy, new entrants into the work force will receive benefits that are roughly equal to their and their employers' contributions plus a real rate of return of about 2 percent. Hence, whatever the implications of existing intergenerational transfers, these transfers will become irrelevant in less than a generation.

Saving. A question can also be asked about whether the trend toward early retirement has any impact on national saving and capital formation. The answer in this case seems straightforward.

A trend toward early retirement would be expected to increase national saving, since people who retire early are forced to save at a higher rate over a shorter working life in order to finance a longer period in retirement. Even if each individual were a perfect life-cycle saver with zero net saving over her or his lifetime, with a growing population aggregate saving would increase because the number of savers would outnumber the dissavers. Similarly, if incomes were rising, the amount saved by workers would exceed that dissaved by retirees. Since historically both the population and real per capita income have tended to increase each year, theory would suggest that the trend toward early retirement would have increased the rate of saving in the economy.

At the moment, those who retire early do not appear to impose any burden on society at large.

The saving issue, however, may be one where the real world differs from the theory. The evidence indicates that many people do not reach the end of

their lives with zero assets, but die with some resources remaining. Hence lifetime saving for many individuals is probably positive, rather than zero. The likelihood of using up resources, however, is probably greater for those who retire early than for those who retire at age sixty-five or later. The reason for this is that the value of private pension benefits declines sharply over time, since they are not indexed for inflation. This erosion is generally not foreseen, and indeed is not knowable in that it depends on the performance of the broader economy. The longer people are retired, the greater the likelihood of pension benefits becoming inadequate for their needs and the more likely they will have to draw down accumulated assets. By reducing the amount of assets remaining at the end of life, early retirement may somewhat reduce national saving.

Conclusion

Based on economic factors alone, the widespread concern over the trend toward early retirement seems unwarranted. The trend has thus far been confined largely to American men. Women are actually more likely to work between the ages of fifty and sixty-four than they were in the past. The employment gains of women have offset a large share of the employment losses among men of the same age. Of course, the U.S. population is aging, and this must eventually raise the proportion of national consumption going to the retired elderly, regardless of retirement patterns. This fact by itself should hardly be alarming, however. In a world where workers save for their own retirement, the growing claim of the retired elderly on national consumption places no extra burden on workers.

The aging of the population imposes burdens on future generations of workers when those workers are asked to bear a substantial part of the cost of financing retirees' consumption, for example, through means-tested programs or a social insurance system. Because of the demographic structure of the United States, the consumption claims of the retired elderly will grow, whether or not a trend to earlier retirement occurs. An important question, however, is whether a trend toward early retirement will impose heavier burdens on future workers than they would have otherwise experienced. The answer to this question depends critically on the specific tax and benefit provisions of the social insurance system under consideration.

The United States Social Security system is largely protected from any increase in costs arising from retirement before age sixty-five. No benefits are payable until age sixty-two, and benefits are actuarially reduced between ages sixty-two and sixty-five. The basic pension formula, by not generously rewarding employment beyond thirty-five years, may allow individuals to control somewhat their net burden under the system, and thereby affect system costs. But this feature of the formula could be easily modified. In 1983 Congress showed that it is willing to raise the reward for delayed retirement and reduce the reward for early retirement if that is necessary to protect the integrity of the program.

If workers choose to retire at younger ages in spite of the financial penalty for early retirement, it is unclear why other workers should object. At the moment, those who retire early do not appear to impose any burden on society at large; they seem to be supporting themselves with accumulated assets and supplementary public and private pensions. Those left in the work force probably gain on balance from the earlier withdrawal of older workers. The early retirement trend does reduce income and payroll tax revenues somewhat, and national saving may be slightly lower. But it would be difficult to argue for reversing the trend on the basis of these secondary effects. If a strong case can be made against early withdrawal from the labor force, it must rest more on arguments about the physical and psychological well-being of early retirees themselves.

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[1] The flavor of this debate is suggested by titles of some recent articles in the popular press: "The Coming Conflict as We Soak the Young to Enrich the Old," *The Washington Post*, January 5, 1986, pp. D1, D4; "Our Idle Retirees Drag Down the Economy," *The New York Times*, October 18, 1988, p. A31; and "Aging America: They've Got to Eat, So Let Them Work," *The Economist*, September 16, 1989, pp. 27–34.

[2] This simple model treats annual earnings E as if they were given and unaffected by the level of national saving. Thus, the only economic variable affected by decisions to retire is the number of years worked, and hence the product of years worked and E. In a closed economy, of course, the aggregate of individual retirement decisions determines aggregate saving, the capital-labor ratio, and hence E. In an open economy, however, the retirement decisions in one country would have little effect on that nation's capital stock since the stock of capital is determined by worldwide interest rates.

[3] In a model where the level of saving influences the average wage rate, E, a trend toward early retirement can affect the earnings and consumption of late retirees, though the effects are ambiguous (see below).

[4] A small amount of revenue is also raised through income taxes assessed against Social Security benefits paid to high-income recipients. The revenue raised is so small it will be disregarded here.

[5] This should not be interpreted to imply that the welfare gains from a social insurance system are limited to the pure financial advantages that participants under the system enjoy. Even if workers on average pay more in taxes than they receive in benefits, they may still enjoy welfare gains. For example, U.S. Social Security provides insurance against the uncertainty of the duration of life spans, T, and some protection against the uncertainty of future prices and rates of return. Nonetheless, the strictly financial aspects of the program are important and worth considering.

[6] The early retirement age in the U.S. system is sixty-two, which is about forty years after workers typically enter the work force.

[7] Although the ratio of beneficiaries to workers has risen over much of the past half century, no retiring cohort up to now has paid more in Social Security taxes than it has gotten back in Social Security benefits; the net burden of the program has been negative. Individually, members of past retiree cohorts are better off than they would have been if they had saved for their own retirement. Future cohorts may not be so lucky. Under recent projections future retirees will receive Social Security benefits equal roughly to their tax contributions plus a real return of about 2 percent.

[8] This will depend on the rate of population growth among other factors.

[9] Lifetime benefits can rise slightly as a result of the early retirement option if workers with short life expectancies choose to claim benefits at age sixty-two, while workers with longer life expectancies continue to retire at sixty-five.

[10] While couples may be capable of anticipating their retirement needs as a unit, many old workers make poor provision for their surviving dependents. The death of a retired husband very frequently leads to the poverty of the surviving spouse, even if the couple was not poor when the husband was alive (see Auerbach and Kotlikoff 1987, and Hurd and Wise 1989). The high poverty rate of aged widows is a strong challenge to the economic assumption that workers plan carefully and conserve their resources prudently for the likely contingencies of old age.

[11] It is important to note here that the tax preference for pensions is conferred on *all* pension plans and does not of itself constitute an incentive to retire early. A pension plan might encourage early or late retirement, depending upon the provisions of the plan. The tax preference only offers an inducement to establish a pension plan.

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New England's Links to the World Economy

> Boston State House is the hub of the solar system. You couldn't pry that out of a Boston man, if you had the tire of all creation straightened out for a crowbar.
>
> Oliver Wendell Holmes,
> *The Autocrat of the Breakfast Table*

Have New Englanders' horizons expanded since Oliver Wendell Holmes accused Bostonians of regarding their state house as the "hub of the solar system?"[1] At least the region's business managers are now more apt to view Boston as just one of many nodes on a geodesic dome, an intricate web of fibre optic cables and jet flight paths. This article examines a few of this structure's members: New England's trade and investment links with the world economy. How extensive and pervasive are they? How does New England compare with other parts of the country in terms of its "openness" to (dependence on) international trade and investment? What difference does "openness" make to a region's economic well-being?

This article argues that openness is beneficial because it encourages technology transfer and productivity growth. For a region like New England with few natural resources but its human skills, keeping up with the technological Joneses can be crucially important. In addition, openness may provide a degree of stability in the face of regional and national business cycles, an advantage that could also prove relevant to New England as the region experiences a period of comparatively slow growth.

To assess New England's relative openness, the article surveys New England's links with the world economy: its trade in goods and services, its banking ties, its inbound and (to the extent possible) its outbound foreign direct investments. This survey reveals that during the mid-1980s New England was one of the more open regions in the nation. Its manufacturing work force was highly dependent on exports and relied

Jane Sneddon Little

Economist, Federal Reserve Bank of Boston. *The author is grateful to Lawrence D. Herman and Chérie Renée Miot for valuable research assistance.*

on imported inputs to an above-average extent. While still small, international trade in services was growing rapidly, and exporting service industries were relatively important in the region.

Limited evidence suggests that New England firms also had an above-average readiness to make foreign investments, a tendency likely to encourage a two-way exchange of goods and ideas. By contrast, inbound foreign investment played a below-average role in the regional economy, especially in the manufacturing sector. Although New England continued to attract a disproportionately large share of foreign high-tech investments, its advantage in this regard appears to be dwindling. Along with evidence that New England's recent export growth has been relatively slow, this development suggests that the decline in the region's manufacturing base may be adversely affecting its international trade and investment ties. This erosion does not augur well for New England's continued leadership of innovative industries. However, exporting to expanding foreign markets offers a way—possibly *the* most promising way over the short term—of stabilizing the local manufacturing base. The article concludes with some policy implications that follow from these observations.

I. The Benefits of Openness . . . and Some Costs

A country or region is defined as open to trade when its exports plus imports loom large compared to its gross product. Similarly, it is open to international investment if a large share of its output or employment is linked to the activities of multinational corporations. Economists are accumulating evidence that technical progress is faster in countries that are open to international trade and investment.[2]

How do foreign firms penetrating the U.S. market encourage technology transfer? Foreigners exporting to or investing in this country force U.S. competitors to acquire new, more productive technologies and management systems. The workers and managers employed by foreign investors also absorb new ideas, skills and procedures that they can carry with them to other firms at a later date. In addition, suppliers frequently develop cooperative relationships with foreign investors and learn to meet their technical requirements.

Foreign affiliates or joint ventures of U.S. companies also represent channels through which foreign innovations are absorbed. In addition, such ventures are able to locate or develop reliable sources of inexpensive foreign inputs. Such inputs may be crucial to meeting worldwide competition successfully. U.S. firms investing abroad may also stimulate U.S. exports by providing better marketing and servicing facilities or, being rooted on foreign soil, by qualifying for foreign government contracts. Currently, with U.S. demand expanding slowly, and demand in Europe and Japan growing relatively fast, many New England firms are acutely aware of the earnings benefits of a foreign sales base. Foreign sales provide some stability in the face of domestic business cycles. Foreign production facilities also provide some insulation from currency fluctuations.

Technical progress is faster in countries that are open to international trade and investment.

Studies finding that openness to international trade and investment spurs productivity growth generally deal with nations. Nevertheless, in a country as big as the United States, regions do differ in their dependence on exports or the importance of foreign investment. While some benefits from technology transfer undoubtedly disperse to other parts of the country, others may adhere to the region where the multinational is located. Skills acquired by a local firm's work force or spin-offs established in its vicinity may remain relatively concentrated, for instance. For a region like New England that "lives by its wits" because it has few natural resources, the consequences of openness may be particularly important.

Although economists may point to the many benefits of openness, members of the business community are acutely aware of its costs and feel threatened by them. Because openness forces technology transfers largely by increasing competition, some firms and their employees suffer in its wake. Some firms may close or may abandon certain markets; others will arm themselves with more productive equipment that requires fewer or different workers. Still others will seek to cut costs by using imported inputs; the short-run impact will be a decline in the

demand for local products. Furthermore, while many studies suggest that foreign direct investment can stimulate exports, some foreign production clearly replaces them. For example, many New England firms report that they make 40 to 50 percent of their sales overseas but export very little because they serve foreign markets primarily from their overseas subsidiaries. Most likely, the net impact of foreign direct investment on exports varies over time and by industry.

Although openness involves both costs and benefits, regions that trade ideas and skills for resources have little choice but to embrace it with enthusiasm. By adopting a thoroughly global outlook, a region's leaders can maximize the benefits of openness; a half-hearted approach may maximize its costs.

II. New England's Trade in Goods and Services

The following section describes New England's international trade links as a first step in assessing the region's relative openness. The section starts by discussing the region's overall trade orientation. It then briefly explores the general role of imports in the New England economy. A more specific review of the region's merchandise exports follows. Finally, the section surveys fragmentary information on the region's services trade.

Orientation

As the seafarers' collections at the Peabody Museum in Salem attest, New Englanders have a long tradition of reaping the opportunities inherent in foreign trade. According to the latest data (based on manufactured exports in 1986), New England remains the most export-dependent region in the nation (Table 1). In Connecticut and Massachusetts (the first and third ranked states in the country) 79 and 68 out of every 1,000 private sector workers were employed in export-related jobs. The U.S. average was 53. All the New England states except Maine have above-average export dependence.

The region's reliance on exports reflects its industry mix: it has an above-average concentration of employment in electrical equipment, nonelectrical machinery, and instruments, three of the four industries with the highest fractions of export-related employment. In Massachusetts, New Hampshire and Vermont, moreover, this export-dependence also reflects above-average export activity within individual industries. In a majority of industries for which data are available, these three states had above-average export-related employment.

Export dependence does not necessarily imply export orientation, however. Export dependence varies with the share of industry (or regional) output that is exported either directly or indirectly as part of another product. Export orientation reflects the balance between direct exports and competing imports. For example, among manufacturing industries, primary metals is one of the most export-dependent industries, with 23 percent of industry employment related to exports in 1986. Nevertheless, most (87 percent) of this employment reflects metals used in other directly exported products rather than direct exports of steel or aluminum. Indeed, as the voluntary export restraint program for steel attests, the primary metals industry is more accurately characterized as import-competing than as export-oriented.

Table 2 shows the U.S. regions' overall trade orientation. In the table U.S. manufacturing industries are grouped according to the ratio of exports plus imports to industry shipments in 1986. Where exports plus imports represented more than 15 percent of total shipments, the industry is considered a

Table 1
Total Employment Related to Manufactured Exports as a Share of Private Sector Employment, 1986
Percent

New England	6.8
Mid Atlantic	5.4
East North Central	6.2
West North Central	5.0
South Atlantic	4.3
East South Central	4.7
West South Central	2.6
Mountain	3.9
Pacific	6.0
United States	5.3

Definition of regions: New England (NE) = CT, ME, MA, NH, RI, VT; Mid Atlantic (MAT) = NJ, NY, PA; East North Central (ENC) = IL, IN, MI, OH, WI; West North Central (WNC) = IA, KS, MN, MO, NE, ND, SD; South Atlantic (SAT) = DE, FL, GA, MD, NC, SC, VA, WV; East South Central (ESC) = AL, KY, MS, TN; West South Central (WSC) = AR, LA, OK, TX; Mountain (MT) = AZ, CO, ID, MT, NV, NM, UT, WY; Pacific (PAC) = AK, CA, HI, OR, WA.

Source: U.S. Bureau of the Census, *Exports from Manufacturing Establishments: 1985 and 1986*, Analytical Report Series (AR86-1), Table 2a, January 1989.

Table 2

Percentage of Regional Manufacturing Employment in the Export-Oriented, Two-Way, Import-Vulnerable and Nontraded Goods Industries, 1987

	PAC	NE	MT	ESC	MAT	ENC	WSC	WNC	SAT	US
Traded Goods Industries	69.02	66.85	64.91	61.64	61.49	61.30	60.91	55.84	52.62	61.12
Export-Oriented	21.75	19.27	21.51	9.69	13.10	8.68	16.46	14.27	13.02	14.15
Chemicals	2.96	3.30	3.29	5.14	7.98	4.88	7.43	4.13	6.82	5.41
Office and Computing Machines	4.38	5.91	7.86	1.00	2.44	.67	2.12	3.64	1.49	2.55
Other Transportation Equipment	14.40	10.06	10.35	3.56	2.68	3.12	6.91	6.50	4.71	6.19
Two-Way	31.69	32.57	31.27	19.09	25.72	24.87	25.04	25.38	19.08	25.41
Other Machinery except Electrical	4.86	7.99	5.12	6.41	7.36	13.26	8.46	10.68	4.66	8.08
Electronic Components and Accessories	6.27	6.13	8.91	.74	3.14	1.45	4.54	2.52	1.97	3.31
Instruments	5.02	6.85	5.92	1.18	6.01	2.24	1.96	4.05	1.49	3.57
Lumber	6.63	2.51	7.18	6.23	1.76	2.26	4.75	3.02	4.82	3.91
Other Electric and Electronic Equipment	8.90	9.09	4.14	4.53	7.45	5.65	5.33	5.11	6.14	6.53
Import-Vulnerable	15.59	15.01	12.14	32.86	22.67	27.75	19.40	16.19	20.52	21.57
Apparel	5.21	3.07	2.50	13.80	8.65	1.60	5.55	2.80	8.82	5.77
Leather	.29	2.03	.33	.80	.99	.43	.86	1.43	.29	.71
Primary Metals	2.33	2.74	2.50	4.42	4.50	6.72	2.79	2.23	2.47	3.86
Misc. Manufacturing	1.68	4.48	2.61	1.83	2.97	1.53	1.40	1.70	1.04	1.96
Household Appliances, Radio and TV Receiving Equipment	.77	.54	.55	2.98	.55	1.99	.77	1.17	.61	1.14
Petroleum	1.15	.15	.71	.64	.90	.64	3.67	.52	.21	.88
Motor Vehicles and Equipment	1.57	.66	1.26	3.68	2.19	12.53	2.39	4.41	2.26	4.51
Furniture	2.58	1.34	1.68	4.70	1.91	2.30	1.98	1.94	4.82	2.72
Nontraded Goods Industries	30.98	33.15	35.09	38.36	38.51	38.70	39.09	44.16	47.38	38.88
Printing	7.11	7.92	10.54	5.17	10.63	7.14	7.32	10.47	6.74	7.88
Food	9.23	3.70	11.74	8.44	7.35	7.14	12.12	15.33	8.15	8.58
Tobacco	0	.04	0	.61	.09	0	0	0	1.37	.29
Fabricated Metals	5.90	7.82	4.82	6.66	6.89	11.35	7.67	7.23	4.41	7.39
Stone, Clay and Glass	2.42	1.82	4.36	2.83	3.48	2.85	4.33	2.70	3.50	3.07
Textiles	.72	3.01	.21	5.49	2.50	.31	.38	.20	15.75	3.79
Rubber and Plastics	3.07	4.46	2.62	5.10	3.72	6.22	3.86	4.00	3.95	4.36
Paper	2.53	4.39	.79	4.06	3.83	3.69	3.40	4.22	3.51	3.52

Source: U.S. Bureau of Labor Statistics, ES202 release for 1987.

traded-goods industry. The traded-goods industries are then divided into export-oriented industries (if exports were greater than imports), import-vulnerable (if imports were at least three times greater than exports) and two-way-trade-oriented (if imports exceeded but were less than three times exports). These criteria clearly reflect the United States' current sizable trade deficit.

According to Table 2, after the Pacific, New England is the most open region in the nation. Its manufacturing work force has a well-above-average dependence on the export-oriented industries (chemicals, office and computing machines, and transportation other than autos). New England is also the region most dependent on industries where two-way trade is important. Two-way trade arises in imperfectly competitive industries to take advantage of economies of large-scale production and specialization. A significant part is likely to take place intrafirm when producers purchase inputs from abroad or

rationalize production among countries. Finally, Table 2 also indicates that New England's manufacturing employment is one of the least import-vulnerable in the nation. While leather and miscellaneous manufactures continue to play an above-average (but diminished) role in New England, apparel does not. Competition has been driving this once important regional industry south, west and abroad for decades now. By contrast, the other major import-competing industries, motor vehicles and primary metals, have never been prominent in the region.

Imports

Imports mean "competition" first and foremost to many U.S. firms and their employees; however, as Table 2 established, the industries most vulnerable to import competition do not currently play a major role in New England. Less obviously, imports also serve an important role in the U.S. economy as components in domestically produced goods. Indeed, the share of imported inputs in total inputs seemingly grew significantly in the early 1980s as the huge dollar appreciation forced U.S. firms to seek low-cost components offshore. Estimates based on data from input-output accounts indicate that the ratio of imported manufactured inputs to total manufactured inputs rose from 9 percent to 15 percent between 1977 and 1985. Accordingly, certain industries and regions may be particularly dependent on imports rather than vulnerable to them.

Table 3
Weighted Average[a] Share of Manufactured Imported Inputs[b] in Total Manufactured Inputs[b], by Region, 1985
Percent

	Weighted Average Share
New England	14.1
Middle Atlantic	13.9
East North Central	14.3
West North Central	14.0
South Atlantic	13.0
East South Central	14.0
West South Central	13.8
Mountain	13.7
Pacific	13.9

[a]Weighted by 1986 employment.
[b]Plus noncomparable imports.
Source: US Bureau of Labor Statistics 1986 ES202 release, U.S. Bureau of Economic Analysis, "Annual Input-Output Accounts of the U.S. Economy 1985," *Survey of Current Business*, January 1990.

The available state import data provide little satisfactory information about the products' ultimate destination. Nevertheless, input-output tables developed by the U.S. Department of Commerce permit estimating the role of manufactured imported inputs in each manufacturing industry. The role of imported inputs in each region can then be estimated by calculating an average ratio of imported to total manufactured inputs, with the industry ratios weighted by their shares of regional manufacturing employment.[3]

Table 3 displays the results of this procedure. According to these estimates, the regions vary remarkably little in their use of manufactured imported inputs. Nevertheless, New England and the East North Central are the two regions where manufacturers appear most reliant on imported inputs. By contrast, the South Atlantic appears least dependent on imports. These results are consistent with the fact that industries where two-way trade prevails are important in New England while industries producing nontraded goods predominate in the South Atlantic.

The results shown in Table 3 are likely to underestimate New England's dependence on imports because they take no account of regional differences in a given industry's use of imported components. New England's coastal and border position suggests that the region's manufacturers may be more likely to use imported inputs than their counterparts in other parts of the country. In addition, New England's limited resource base also implies above-average dependence on imported raw materials. For instance, New England accounts for a disproportionately large share of U.S. imports of petroleum, natural gas and electric power. Finally, New England firms appear to be relatively active in establishing foreign affiliates, as will be discussed in a later section. Such investments would alert parent firms to good foreign sources and encourage intrafirm trade. In other words, the numbers hint and common sense suggests that New England is relatively open to the use of imports even if it is no longer particularly vulnerable to import competition.

Exports

The data in Tables 1 and 2 established that New England is both export-dependent and export-ori-

ented. This section will describe the commodity breakdown and geography of New England's merchandise exports. It will also discuss the implication of recent export trends.

What does the "land of the bean and the cod" export currently? Some cod, not very many beans, and primarily sophisticated machinery, aircraft equipment and instruments. Leather and paper products also loom large in Maine, miscellaneous manufactures and textiles in Rhode Island, and food and fabricated metals in Vermont.

The two primary sources of information on state exports confirm this general impression. The two series, both compiled by the Census Bureau, differ, however. The first (used above in the discussion of export-dependent employment) is titled "Exports from Manufacturing Establishments." It is based on export figures reported by manufacturers, with residual exports from wholesalers, export agents and so forth allocated according to state share of U.S. industry employment. This source probably provides the best available data on the states where production of manufactured exports occurs. The data appear with a considerable lag, however, (the latest are for 1986) and do not provide information on nonmanufactured exports or on export destinations.

A second, relatively new and more current series includes nonmanufactured exports and export destination. The data in this report, "U.S. Exports by State of Origin of Movement," indicate the state where the product began its foreign journey as reported by the exporter (wholesaler, broker, manufacturer). This "origin" may be the production site, assembly point, warehouse, location of wholesaler or port of exit. This new series suggests that the value of manufactured products exported from the New England states is significantly less (perhaps one-third less) than the value of manufactured exports produced in New England as shown in the "Exports from Manufacturing Establishments." Because they provide a view of New England's export markets and recent (albeit short) export trends, the rest of this section will focus on the data in the new series.

According to this new Origin-of-Movement data,[4] five industries—industrial machinery and computer equipment, electronic and electric equipment, instruments, transportation equipment (largely aircraft related) and chemicals—accounted for over three-fourths of the region's exports in 1988 (Table 4). The instruments and industrial machinery and computer industries were roughly twice as important in regional as in national exports. As a supplement to the published data, conversations with New England exporters indicate that specialized, even made-to-order, capital goods and defense-related products form an important part of the region's export base. Since demand for this type of product is not very price sensitive, a significant portion of New England exports reflects foreign growth rates and government procurement policies rather than exchange rate movements. While currency movements remain important for many other New England products, the region may well be less sensitive to exchange rate developments than other parts of the country.

New England's primary export markets are Canada, the United Kingdom, Japan and Germany, as

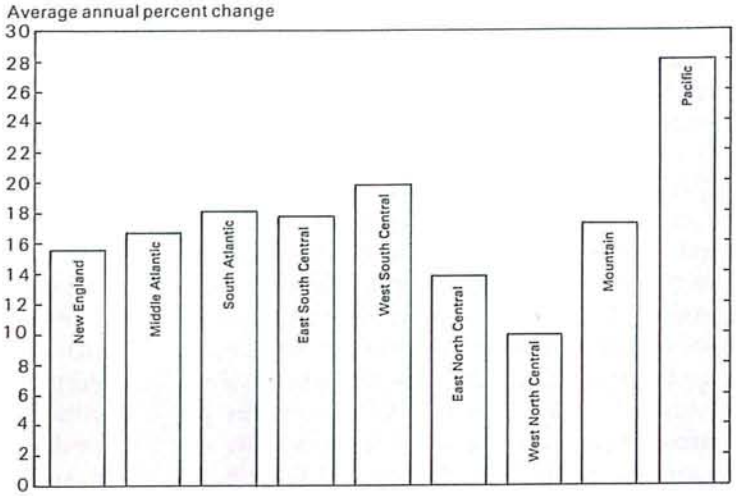
Table 4
Industry Composition of New England and U.S. Exports, 1988
Percent

	N.E.	U.S.
Total, All Industries	100.0	100.0
Industrial Machinery, Computer Equipment	35.3	18.2
Electronic, Electric Equip. exc. Computer	13.1	10.2
Instruments and Related Products	13.0	5.6
Transportation Equipment	11.1	17.7
Chemicals and Allied Products	4.4	10.9
Paper and Allied Products	3.0	2.4
Fabricated Metal Products	2.4	2.5
Scrap and Waste	2.3	1.4
Primary Metal Industries	2.2	4.0
Rubber and Misc. Plastics Products	1.9	1.7
Food and Kindred Products	1.9	5.4
Misc. Manufacturing Industries	1.6	1.4
Leather and Leather Products	1.3	.3
Used or Second-hand Merchandise	.9	.6
Textile Mill Products	.9	.8
Lumber and Wood Products	.9	1.8
Special Classification Provisions	.8	1.3
Stone, Clay, and Glass Products	.7	.8
Printing and Publishing	.7	.6
Agricultural Production—Livestock	.4	.4
Apparel and Other Textile Products	.4	.7
Agricultural Production—Crops	.4	7.1
Nonmetallic Minerals, except Fuels	.3	.4
Furniture and Fixtures	.1	.3
Petroleum and Coal Products	.1	1.2
Metal Mining	.1	.3
Bituminous Coal and Lignite Mining	.1	1.3

Source: Massachusetts Institute for Social and Economic Research, The State Data Center, University of Massachusetts, Amherst, based on U.S. Bureau of the Census, *U.S. Exports by State of Origin of Movement, 1988.*

Chart 1

Merchandise Export Growth by Region, 1987-89



Source: U.S. Bureau of the Census data, adjusted by Massachusetts Institute for Social and Economic Research, University of Massachusetts.

Table 5 shows. These four countries account for over 50 percent of the total. Compared with the nation, New Englanders are more dependent on exports to European countries, about equally dependent on exports to neighboring Canada, and less dependent on Mexico and the Latin American countries. Surprisingly, perhaps, New England exports about hold their own in sales to Japan, Australia, Hong Kong and Singapore (but not to Korea and Taiwan). Although the Japanese market is hard to penetrate, New Englanders have had some success with products embodying unique technology or with products sold through joint ventures with Japanese companies.

The relationship between the origin of movement and the production of exports will not become clear until several years of overlap between the two series have accumulated. Nevertheless, the new data presumably provide some clues concerning export performance. If so, the trend should cause New Englanders concern, because for the (very short) period for which these data are available, New England exports have been growing more slowly than those in the nation. Indeed, as shown in Chart 1, New England had the third slowest export growth in the country from 1987 to 1989.

Table 5

New England's 15 Major Foreign Markets, as Measured by Export Share, 1988

Percent

	New England	United States
Canada	20.0	19.5
United Kingdom	12.3	5.9
Japan	12.1	12.1
Federal Republic of Germany	6.6	4.6
Netherlands	4.8	3.2
France	4.3	3.2
Australia	3.4	2.2
Ireland (except Northern Ireland)	2.9	.7
Italy	2.8	2.2
China, (Taiwan)	2.4	3.9
Korea, Republic of	2.3	3.6
Belgium	2.2	2.3
Singapore	2.2	1.8
Mexico	2.0	6.6
Hong Kong	1.9	1.9
Total Shown	82.2	73.9

Source: Mass. Institute for Social and Economic Research, The State Data Center.

What explains New England's relatively weak export performance? The region's industry mix could provide a partial explanation. Because New England exports are not very price sensitive, they may not have benefited from the post-1985 dollar depreciation as exports from other regions have. Nevertheless, Data Resources, Inc. has developed data indicating that even when industry mix is taken into account New England's export growth did not match its potential, as measured by national performance, over this period (Walls 1990). Alternatively, market mix may have contributed to the region's relatively weak export growth, because New England firms send a well-below-average share of their exports to Mexico, Taiwan and Korea, three important markets where U.S. exports grew particularly rapidly over this period. Moreover, among the four regions with the slowest export growth rates, three—the East North Central, New England and the Mid Atlantic—have an above-average readiness to establish foreign affiliates, as will be discussed in a later section. Accordingly, overseas production at foreign affiliates may have reduced exports from these regions to an above-average extent.[5]

Nevertheless, as the bar graph shows, the regions with the most rapid export growth are generally Sunbelt areas. Recently, these regions have been gaining while New England has been losing manufacturing employment share. Unless New England regains its attractiveness as a manufacturing site, it may lose its export business and reduce its ability to weather periods of slow domestic growth by increasing foreign sales.

Indeed, with current softness in defense, computers, real estate and finance—the major sectors propelling the New England economy over the past decade—rapidly expanding foreign countries may provide the most promising markets for many New England firms. Although the region has been the most export-dependent in the country, New England manufacturers appear to have ample scope for further increasing exports. Three firms appear to supply half of all Massachusetts merchandise exports; twelve firms account for 80 percent (Franko 1990). If Massachusetts is representative, not very many New Englanders have expanded their horizons very far.

For starters, New England should be in a good position to benefit from the European Community's 1992 initiative and the opening of markets in Eastern Europe. After all, as Tables 4 and 5 show, the region's primary exports are capital goods, its primary markets are European, and some European countries are enjoying a capital spending boom. The New England states are also in a good geographic position to benefit from export opportunities in neighboring Canada as the U.S.–Canada Free Trade Agreement reduces trade barriers over the next decade.

Services Trade

In addition to its $319 billion in merchandise exports, the United States sold $62 billion in travel, passenger transportation and other private services in 1988. Although only one-fifth the value of merchandise exports, service exports have grown faster than goods trade in recent years. For instance, travel receipts rose 64 percent from 1984 to 1988, compared with 45 percent for merchandise trade. While several breaks in the series (reflecting improved coverage) make a proper comparison impossible, "other private services" seem to have grown several times faster than merchandise exports during the 1980s. Regional information is available for a few categories of private service exports.

Travel. The Boston Marathon, the Head of the Charles Regatta, even a trip through Harvard or Copley Square on a summer morning have become international events, as more and more foreign travelers are finding it possible to visit the United States. According to a U.S. Travel and Tourism Administration (USTTA) survey, foreign travelers spent $29.9 billion in the United States in 1988 (plus another $8.9 billion for passenger services provided by U.S. companies).

The USTTA's latest regional data (for 1985–86) indicate that foreigners spent 4.7 percent of their U.S. travel expenditures (or $1.4 billion) in New England. By comparison, New England earned 5.6 percent of domestic tourism expenditures and contained 5.3 percent of the U.S. population at that time. Massachusetts ranked sixth in foreign travel receipts in 1985–86, after California, Florida, New York, Hawaii and Texas. Beautiful as Cape Cod and the Berkshires are, fascinating as the Freedom Trail, it would probably not be realistic to expect Massachusetts to outshine those other five states. Because New England earns a larger share of domestic than of foreign travel expenditures, some observers worry that New England may not be attracting its "fair share" of foreign tourists and urge greater efforts to entice them. While additional promotion aimed at international tourists might well prove productive, it is worth remembering that foreign travel spending amounts to less than 10 percent of domestic tourism expenditures.

Table 6
Selected Services Share of Total Private Sector Employment, for 1988
Percent

	NE	MAT	ENC	WNC	SAT	ESC	WSC	MT	PAC	NE/US[a]
Higher Education	1.9	1.4	.6	.8	.6	.5	.5	.3	.7	14.7
Insurance	3.4	2.7	2.3	2.6	1.9	1.7	2.1	1.8	2.1	9.6
Financial Services	3.5	4.8	3.0	3.0	3.0	2.7	3.1	3.2	3.4	6.4
Business Services	5.2	5.9	4.9	4.5	5.6	4.0	5.1	5.1	5.8	6.3
Accounting, Auditing and Bookkeeping	.5	.6	.6	.5	.4	.3	.5	.6	.7	6.0
Advertising	.2	.4	.3	.2	.1	.1	.2	.2	.3	4.5
Computer and Data Processing	1.0	.8	.6	.6	.9	.4	.7	.7	.9	8.1
Engineering, Architectural Construction and Mining	6.9	6.3	5.5	5.9	9.2	7.7	9.5	9.2	7.0	6.0
Legal Services	.9	1.2	.8	.8	.8	.6	1.0	1.0	1.1	6.2
Management and PR	.8	.6	.2	.6	.6	.3	.5	.5	.7	7.0
Medical Services	9.0	8.9	8.7	9.5	6.9	7.9	8.2	7.5	7.1	7.2
R&D, Commercial Testing	.3	.3	.2	.1	.2	.3	.2	.7	.4	5.8
All Selected Services										7.0
All Private Sector										6.5

[a]New England's share of U.S. employment.
Source: U.S. Bureau of Labor Statistics, 1988 ES202 release.

Other Private Services. Table 6 provides employment data for the service industries included in the Commerce Department's recent efforts to improve its trade statistics. As the data show, a majority of these industries play a larger role in New England than in the national economy. The New England work force is more dependent than that of any other region on higher education, insurance, computer and data processing, and management consulting and public relations, and is second most dependent on financial services (after the Mid Atlantic) and on medical services (after the West North Central). Accordingly, private service exports should have particular importance for this region.

U.S. exports of "other private services" amounted to $24.3 billion in 1988. In the absence of any information on regional service exports, allocating these export earnings by regional share of U.S. industry employment suggests that New England could claim $1.7 billion (or 7 percent). (See the box for additional information on exports of educational, medical, and insurance services.)

While foreign trade remains a peripheral activity for several service industries, service exports are growing fast and have already reached significance in travel, education and computer software. Given New England's relatively heavy dependence on these service industries, the region has an important stake in the successful outcome of the current General Agreement on Tariffs and Trade (GATT) negotiations on services trade and investment.

Banking Links

A region's banks provide key links to the world economy: they facilitate trade and investment by providing finance and knowledge to local companies and to foreign firms entering the region. Although a few New England banks have been active overseas for generations, Boston's development as an international banking center has undoubtedly been curbed by its proximity to New York. Large regional corporations can easily turn to the major money center banks in New York to handle their international banking needs. Similarly, Boston has relatively few foreign banking facilities,[6] in part because these institutions have found they can serve New England from New York, which many have chosen as their "home state."

Nevertheless, by some measures banks in the Boston Federal Reserve district, which covers New England except for Fairfield County, appear to be as open to international business as their counterparts in the Chicago and San Francisco districts, the two

Private Service Exports

Education is the one industry for which a good deal of detailed information on private service exports is available at the regional level. According to the Institute of International Education (1989), New England attracted 8 percent of all foreign students and 17 percent of foreign students attending private institutions in 1988–89. These figures are slightly greater than the region's shares of employment in all and in private institutions. Moreover, the region leads the nation in foreign students to total students in higher education, as Table 7 shows. With almost 20,000 foreign students from 163 countries, Massachusetts ranked fourth in absolute terms after California, New York and Texas. In all of New England, 29,000 foreign students spent $329 million in 1988–89, according to estimates by the Institute of International Education. The region's share of the foreign student pool has been increasing, in part because New England schools appeal to Europeans and European representation has been growing. New England also attracts close to the national average share of students from the Pacific area, the largest group; it is less popular with students from Latin America, the Middle East (mostly Iran) and Africa, regions with declining shares of the student population.

Educating foreign students is probably an investment in the region's future. These visitors provide U.S. students with a world view and future business contacts. A few may eventually return to New England as foreign investors, lured by impressions gained in their undergraduate years. If some students stay, they enhance the region's supply of skilled labor. In the past, immigrants have made many significant contributions to U.S. technological advancement.

Within the business services industry, New England computer software companies also appear to benefit importantly from foreign sales. Among 800 Massachusetts software companies listed in *The Complete Guide to the Massachusetts Software Industry*, over half have foreign distribution and one-fourth offer foreign language versions of their products. Of those providing foreign sales data, one-fourth estimate that foreign sales are greater than 30 percent of total sales (Massachusetts Computer Software Council, 1989, p. 58).

From time to time, royalty and other famous foreigners travel great distances to seek help from New England's prestigious teaching hospitals. Accordingly, one might suspect that the region earns more than its proportional share of medical service export receipts. Support for this hypothesis is not readily available, but other data indicate that hospitals still have something in common with barber shops—their services are largely directed to local populations and are not widely traded. Only 0.1 percent of all patients treated in Massachusetts hospitals in 1989 were foreigners. Moreover, at several of the area's well-known teaching hospitals, foreigners accounted for a mere 1 percent or less of the patients treated on an inpatient basis in that year.

The U.S. insurance industry also remains largely closed to trade. Insurance industry export receipts equaled 0.7 percent of life insurance company premiums (life, annuity and health) in 1988. Including other types of insurance premia in the comparison would reduce the ratio even further. (The asset links were somewhat stronger, with foreign securities accounting for 3.5 percent of total life insurance company assets in 1988.) Apparently, foreign insurance companies have been more active in the United States than U.S. companies abroad: insurance is one of the few private services where U.S. payments exceed receipts—in part because of barriers to entry into foreign insurance markets.

other regions that have developed as second-tier international banking centers. Table 8 provides several measures of domestic bank involvement in international activities. In column 1, total acceptances and commercial letters of credit plus commercial and industrial loans to foreigners as a share of commercial bank assets serve as a proxy for bank involvement in trade finance.[7] The ratio of foreign assets to total bank assets, shown in column 2, measures the role of international lending more broadly. According to the data in these first two columns, banks in the New York and San Francisco Federal Reserve districts are way ahead of all the others in involvement in international activities. Next most active were banks in the

Table 7
Foreign Students as a Share of Total Students in Higher Education, by Region
Percent

New England	4.6
Mid Atlantic	4.0
East North Central	3.3
West North Central	3.5
South Atlantic	3.5
East South Central	2.3
West South Central	4.2
Mountain	3.7
Pacific[a]	4.3
United States	3.9

[a]Excluding Hawaii and Alaska.
Sources: Brizius & Foster, *State Policy Databook 1989*, Table G-36 and Institute of International Education, *Open Doors 1988–1989*, Table 5-5.

Chicago and Boston districts. Nevertheless, compared to national average figures, the ratio of Boston district trade finance to regional exports was below average in 1989. This result may suggest that New England exporters are turning to banks outside of the district to finance their international trade. It has also been posited,[8] however, that New England's high-tech exporters tend to sell "open book," in effect providing their customers with short-term credit themselves. In addition, intra-firm trade is largely company-financed, and many New England firms export through their foreign subsidiaries.

Columns 3 and 4 of table 8 provide measures of bank dependence on income from foreign operations. Column 3 shows non-interest income from international operations in relation to total non-interest income. Non-interest income from international activities includes foreign exchange earnings and fees related to letters of credit, mergers and acquisitions, and private banking, money transfer and custodial services. For example, one Boston bank has developed a specialty in providing safekeeping services for the mutual fund industry, which requires income collection, settlement, cash management and portfolio information on a global basis. This bank also provides worldwide custodial services for corporate and other pension funds. Column 4 relates net interest income from international operations to total net interest income. Together columns 3 and 4 indicate that banks in the Boston, Chicago and San Francisco districts are similarly dependent on international operations. Currently, moreover, the Boston district is one of the few where international operations are

Table 8
Selected Bank Performance Ratios for All U.S. Commercial Banks, Fully Consolidated, by Federal Reserve District, for the Fourth Quarter of 1989
Percent

District	Total Acceptance and Commercial Letters of Credit plus C&I Loans to Foreigners/Total Assets (1)	Foreign Assets/ Total Assets (2)	Non-interest Income from International Operations/Total Non-interest Income (3)	Net Interest Income from International Operations/Total Net Interest Income (4)
Boston	2.2	1.6	8.2	4.3
New York	9.3	10.9	39.4	20.4
Philadelphia	.8	.7	1.5	−1.2
Cleveland	1.3	1.0	2.3	1.5
Richmond	.6	.4	1.9	.2
Atlanta	.6	.2	.8	.1
Chicago	2.1	1.8	7.3	2.4
St. Louis	.9	.1	.1	.0
Minneapolis	.7	.1	1.1	.3
Kansas City	.7	.1	.2	−.0
Dallas	1.0	.7	.2	.4
San Francisco	4.6	4.4	9.7	3.0
U.S. Total	3.5	3.7	14.2	5.0

Source: Call report data from the Board of Governors of the Federal Reserve System.

providing a significant positive contribution to return on assets. This outcome reflects the Boston banks' decision to write off their loans to heavily indebted developing countries relatively early—in 1987 and 1988, whereas banks in Chicago, San Francisco and New York continued to make large charge-offs of LDC loans in 1989. The regional banks have had more flexibility in this regard than have the major money center banks that were more heavily encumbered by their LDC loans.

III. New England's Investment Links

The article now turns to New England's direct investment links to the world economy. These investment transactions provide important channels for the international dispersion of technology. By diversifying a firm's market and production base, they also help to stabilize earnings in the face of national business cycles and exchange rate swings. Because the Commerce Department publishes no state data related to U.S. investment abroad, the section on outbound investment is very brief. A more detailed review of the changing role of inbound foreign direct investment in New England follows.

New England's Direct Investment Abroad

Table 9 presents regional data on the number of firms with foreign operations in relation to private sector employment. The company data are from the *Directory of American Firms Operating in Foreign Countries*, which covers approximately 3,000 firms and is based on annual reports and survey responses. The data presented here do not reflect either the size or the number of the firm's foreign facilities—just the fact that foreign operations exist. The intent was to find a simple indicator of regional differences in business readiness to invest abroad—an indicator of "openness to outbound foreign investment."[9]

As Table 9 shows, New England firms are active foreign investors. According to our measure of openness to outbound investment, New England ranked second in the nation after the Mid Atlantic states. As outlined above, these foreign investments enhance the New England firms' ability to promote U.S. exports through improved marketing and servicing facilities. These affiliates also provide, or can scout about to locate, offshore sources of inexpensive inputs. With a foot in foreign markets, they can stabilize company earnings over national business cycles and exchange rate swings. And, finally, these overseas outposts observe and absorb foreign innovations. In a highly competitive world these many advantages are crucial to New England firms' continued viability and probably more than compensate for the inevitability that some overseas production substitutes for New England exports.

Table 9
U.S. Firms Operating in Foreign Countries in Relation to Private Nonfarm Employment, by Region, 1987

Region	Number of Firms	Firms Per Million Employed
New England	314	46.1
Middle Atlantic	952	56.7
East North Central	681	38.0
West North Central	136	17.6
South Atlantic	195	10.6
East South Central	49	8.5
West South Central	201	19.5
Mountain	59	10.8
Pacific	382	23.3
TOTAL	2969	28.1

Source: World Trade Academy Press, *Directory of American Firms Operating in Foreign Countries*, vol. 1, 1987, and U.S. Bureau of Economic Analysis, 1969–1988 BE 55 release.

Foreign Direct Investment in New England

Recent Japanese purchases of Tiffany and Company, Rockefeller Center, and Columbia Pictures raised eyebrows all across the nation. After all, these companies represent some of the country's crown jewels, and what could be closer to America's heart than its motion picture industry? New England institutions acquired by foreigners in recent years include the *Boston Herald*, Lafayette Place, and Jordan Marsh.[10] Accordingly, foreign ownership of these and other New England assets has produced a similar sense of disquiet at the regional level. Because Americans' fears that foreigners are acquiring control of the U.S. economy have been thoroughly addressed elsewhere (for example, Harris 1989; Rosengren 1988; Little 1988), the following discussion will focus more narrowly on concerns about the local impact of foreign investments.

These highly visible transactions arouse concern

at the regional level in part because local businesses fear increased competition for markets and scarce resources. Although foreigners could generally be expected to compete via exports if not via local production, establishing a domestic presence may increase their competitiveness by permitting them to improve their marketing and servicing capabilities. (Many U.S. companies certainly adhere to this theory when investing abroad.) Of course, in many industries increased competition for market share is diffused across the entire continent. Competition in retailing is more localized, however; thus, regional retailers may worry that their foreign-owned competitors will have advantages like privileged access to capital. In addition, competition for scarce resources is most likely concentrated at the regional level; thus, indigenous firms also fear the impact of foreign investment on the prices or even the availability of labor, land, and electric power. After all, soaring real estate prices, labor shortages, and brownouts were a part of New England's very recent past.

Although workers, like other sellers of scarce resources, often benefit from foreign investment, employees at some firms sought by foreigners fear that the new parent will close down plants or lay off significant fractions of the work force. As a case in point, Norton Company employees vigorously opposed BTR PLC's recent hostile takeover effort because the British company was reported to have a "notorious" reputation for eliminating jobs "on all levels" (*American Banker*, April 26, 1990). These impressions may reflect the prominence of large foreign companies like Campeau, BAT Industries, Shamrock Holdings and Saint-Gobain in certain well-publicized contested tender offers, usually as the hostile suitor but occasionally as the White Knight. However, while layoffs and dismemberments do follow some foreign acquisitions, foreign investors actually appear less likely than their domestic counterparts to engage in divestitures—the sale of product lines, subsidiaries or divisions. Between 1986 and 1988, divestitures made up 40 percent of all U.S. merger and acquisition activity, but divestitures by foreign sellers amounted to only 13 to 19 percent of foreign acquisitions in that period (*Mergerstat* 1988).

Another fear particularly relevant to high-tech New England concerns the loss of U.S. technological advantages. Numerous sad stories describe U.S. innovations bought, borrowed, or stolen by foreign companies that developed the new technologies aggressively abroad and ultimately pushed U.S. producers completely out of the market. A well-known example involves the VCR technology first developed by Ampex but lost to Asian companies that now dominate the market.[11] Nevertheless, limiting foreign investment in U.S. high-tech industry is unlikely to limit or even slow the diffusion of U.S. technology. (The VCR technology transfer did not involve foreign investment, for instance.) Indeed, friendly mergers or joint ventures may represent one way of retaining some control over how and where the technology is developed.

In contrast to those U.S. managers and workers who see foreigners as competitors or unsympathetic employers, most state and local governments welcome foreign investment, particularly new establishments, and even spend resources to attract them. They view these investments as increasing capital spending, job opportunities and, eventually, local tax revenues. In addition, analysts favoring the U.S. traditional open door policy toward foreign direct investment believe these capital inflows are often accompanied by technology and management skills. Because foreign investors operate over long distances in an unfamiliar milieu, they must have compensating advantages to permit them to compete with domestic firms operating on their own turf. These advantages include company-owned technology, managerial skills, a well-known brand name, or favored access to resources, including capital.

Moreover, as foreign living standards and literacy rates have caught up with, or surpassed, those in the United States, an increasing share of the world's technological breakthroughs are being made abroad. A Nippon Steel Corporation–Inland Steel Industries joint venture in Indiana provides an example of technology imports linked to foreign direct investment. The new plant uses Japanese technology that reduces the time required for the cold rolled finishing process from ten days to less than one hour (*The New York Times*, April 25, 1990). In sum then, whether one fears or welcomes foreign direct investment, it has significant consequences at the regional level.

Foreign Direct Investment and New England Jobs

By 1988 New England had attracted more than 2,200 foreign-owned affiliates employing over 230,000 people. The employment impact of these affiliates was roughly similar to that of the industrial machinery and computer equipment industry, a major force in the region's economy. Because acquisitions account for over half the number and more than 80 percent of the value of foreign investments made

Table 10
Affiliate Employment by Nationality, 1988[P]
Percent

Country	New England	United States
All Countries	100.0	100.0
Canada	18.5	19.4
Europe	65.3	59.6
France	9.1	6.7
Germany	11.3	10.2
Netherlands	8.3	8.2
Switzerland	3.2	5.5
United Kingdom	24.4	20.0
Asia and Pacific	8.8	15.1
Japan	7.4	10.9
Australia	1.2	2.6
Latin America	2.5	3.1
Middle East	1.2	1.2
Africa	.3	.6

P = Preliminary
Source: US Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies: Preliminary 1988 Estimates*, July 1990.

nationally since 1985, not all of these jobs are new. Indeed, data gathered by the U.S. International Trade Administration indicate that acquisitions play a more prominent role in New England than in the nation.[12] Nevertheless, some share of the jobs associated with foreign acquisitions might well have vanished in the absence of the foreign investment. For example, some acquisitions involve company divisions that are relatively weak or are unrelated to the U.S. seller's new corporate strategy. Moreover, the infusion of capital, technology and management skills that often accompanies foreign investment may strengthen the acquired firms and bolster their employment levels.

In investment as in trade, New England leans toward Europe and Canada. As Table 10 shows, European investments accounted for over 60 percent of affiliate employment in 1988, with the United Kingdom alone making up 24 percent of the total. Canada, Germany, France, the Netherlands and Japan were all major players, with Japan in sixth place. New England is more dependent on European (especially U.K.) investors than is the nation; it is less dependent on Japan.

Table 11 provides data on the industrial character of New England's foreign investments and compares it with that of the United States. Manufacturing accounts for 47 percent and retailing for another fifth of affiliate employment in the region. As the table shows, the region's foreign investments are focused slightly less on manufacturing and more on retailing and insurance than are foreign investments in the rest of the nation. (Measured by employment, foreign real estate investments are much less important in New England than in the country as a whole.)

The industrial nature of New England's foreign investments has changed considerably since 1980 when manufacturing accounted for 59 percent of foreign affiliate employment in the region—versus 54 percent in the nation. The increased importance of retailing (and insurance) undoubtedly reflects the growing importance of retailing nationally plus New England's high per capita income. Four New England states have above-average per capita income, with Connecticut and Massachusetts ranked first and third in the nation in 1988. The declining importance of manufacturing, which was greater at the regional than at the national level, may mirror the impact of the "miracle" years that transformed New England

Table 11
Affiliate Employment by Industry, 1988[P]
Percent

Industry	New England	United States
All Industries	100.0	100.0
Petroleum	1.1	3.6
Manufacturing	46.6	47.9
Food and Kindred Products	4.2	4.6
Chemicals and Allied Products	7.0	10.3
Primary and Fabricated Metals	4.5	5.4
Machinery	12.4	11.1
Other Manufacturing	18.5	16.4
Wholesale Trade	6.5	9.0
Retail trade	21.7	18.5
Finance, except Banking	3.2	2.6
Insurance	4.2	2.8
Real Estate	.2	.9
Services	8.8	8.9
Other Industries	2.3	5.8

P = Preliminary
Source: U.S. Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies: Preliminary 1988 Estimates*, July 1990

from a relatively low-wage to a relatively high-wage region with labor shortages and rising real estate prices.

Foreign direct investment currently plays roughly the same role in the region's as in the nation's economy. Table 12 presents the share of affiliate jobs in total and in manufacturing employment in New England and the other regions. As the table indicates, the New England states tied for third place by the total employment measure, and ranked fifth, or somewhat below average, by the manufacturing yardstick. By these criteria, foreign investment was most significant in the Mid Atlantic and South Atlantic states.

In contrast with the present situation, in 1977 New England had an above-average dependence on foreign investors. This change in the relative importance of foreign direct investment in part reflects New England's success in achieving rapid employment growth over this period. Foreign affiliate employment actually grew faster in New England than in the nation from 1980 to 1988 (90.5 percent versus 81.0 percent); however, New England's total employment also grew faster than the nation's (26.1 percent versus 21.5 percent). Accordingly, despite New England's success in attracting affiliate jobs, the region's *relative* dependence on affiliate employment declined.

In the manufacturing sector, foreign investors probably helped to cushion the impact of the region's manufacturing decline. From 1980 to 1988 manufacturing employment fell faster in New England (−10.6 percent) than in the nation (−4.0 percent). These were the years when many New England manufacturers were shifting production—especially labor-intensive production—south and west as well as offshore in search of lower operating costs. During this period, employment at New England's newly established and acquired manufacturing affiliates grew—albeit more slowly (50.8 percent) than in the nation as a whole (59.8 percent). Accordingly, without the increase in affiliate manufacturing jobs that occurred over this period (assuming that a large share of these jobs might have vanished in the absence of the foreign investment), the region's manufacturing employment could have declined by as much as an additional 2.4 percent. Nevertheless, while foreign investors helped slow the region's sharp decline in manufacturing employment, they played a less positive role in New England than at the national level. Seemingly, foreign investors—like domestic investors—did not find New England a particularly attractive area for manufacturing in the late 1980s.

Table 12
Employment Share of U.S. Nonbank Affiliates of Foreign Firms by Region, 1988
Percent

	Total Nonbank Affiliate Employment/ Total Private Nonfarm Employment	Manufacturing Affiliate Employment/ Total Manufacturing Employment
New England	3.4	7.8
Middle Atlantic	4.1	10.1
East North Central	3.4	8.4
West North Central	2.2	6.7
South Atlantic	3.9	10.5
East South Central	3.3	8.3
West South Central	3.2	6.7
Mountain	2.3	7.2
Pacific	2.9	7.0
United States	3.4	8.8

Source: US Bureau of Economic Analysis, 1988 BE 55 release, and *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies: Preliminary 1988 Estimates*, June 1990.

New England and Technology Imports

As already mentioned, foreign investors must possess some company-specific advantage that permits them to compete with indigenous firms on home ground. Frequently that advantage is company-owned technology. Presumably, thus, foreign investments often introduce new technology or management procedures to a region. Knowledge of these innovations then spreads beyond the affiliate through the observation and movements of employees, partners, suppliers and competitors.

In addition to the technology and management skills that investors bring from abroad, they also conduct R&D activities in this country. The location of multinationals' R&D facilities has recently become a subject of international concern because the spin-offs from these innovative activities are thought to be greater than the spin-offs from assembly operations. The Commerce Department collects data on the U.S. affiliates' R&D expenditures by industry (but not by state).[13] Manufacturers account for almost 90 percent of affiliate R&D spending, with chemical and machinery firms providing three-quarters of the total.

New England undoubtedly benefits disproportionately from technology inflows because it has an

above-average share of high tech investment transactions. Nevertheless, the region appears to be losing its advantage in this regard. Even at the national level, the declining role of manufacturing in foreign direct investment may be weakening the ties between these investments and technology transfer. However, in contrast with the situation in the early 1980s, manufacturing now accounts for a smaller share of New England's foreign direct investment than it does nationwide. In particular, chemicals and machinery, the industries where affiliate R&D spending is concentrated, provide a smaller fraction of affiliate employment in New England than in the nation. Although New England continues to attract an above-average share of "high tech" foreign investments, including those in drugs, computers, communications equipment, electronics and most instruments, even there the region's advantage is dwindling. In the early 1980s, high tech industries accounted for 2 percent of the foreign transactions made in the nation, but for 20 percent of those made in New England. In 1987 and 1988 the figures were 9 percent for the United States and 14 percent for New England. (Of course, high tech foreign investors may also be most likely to absorb and export indigenous innovations from New England.)

In summary then, foreign direct investment has continued to gain importance in New England as in the nation. Foreign affiliates now provide 3.4 percent of the region's jobs—7.8 percent in the manufacturing sector, where they also own 10 percent of the gross book value of manufacturers' depreciable assets and make an estimated 9 percent of regional plant and equipment expenditures.[14] Contrary to the situation in the late 1970s, however, foreign investment now plays a more modest role in the region than in the nation, especially in manufacturing. Because New England continues to attract an above-average share of high tech investments, it may also benefit from an above-average share of technology imports. Manufacturing's declining role in regional foreign direct investment suggests, however, that New England may cease to be favored in this regard. Indeed, the nationwide shift away from manufacturing may reduce the technological benefits associated with foreign direct investment.

IV. Summary and Policy Implications

This article reviews New England's foreign trade and investment activities. According to the data it presents, New England is one of the most open regions in the country—highly dependent on exports, import-reliant rather than import-vulnerable, and two-way-trade oriented. Its business managers also appear to be active foreign investors. Conversely, inbound foreign direct investment provides a significant but below average share of regional employment. Despite the recent shift in the industrial composition of the region's foreign investments from manufacturing towards retailing, New England still attracts an above-average share of high tech foreign investment transactions. Accordingly, this investment undoubtedly serves as a leavening agent with more than proportionate benefits for the region.

With few resources but its people, New England prospers when it stands at the forefront of technological developments. Because international trade and investment foster the diffusion of technology and because technical innovation increasingly occurs abroad, these findings are generally auspicious.

For a region that depends on exports and uses imported inputs in its manufacturing processes, protectionist policies provide few benefits. Indeed, because they usually provoke retaliation, protectionist acts at the national level probably prove especially expensive for New England. Accordingly, continued progress in the current multilateral trade negotiations is important to the region. Given the potential significance of services exports and foreign investment activity for the region, New England also has a stake in current efforts to bring services and foreign investment under the auspices of the General Agreement on Tariffs and Trade. Finally, because of the potential spin-offs associated with inbound foreign direct investment, New Englanders should welcome foreign investors—without special favor, certainly, but also without suspicion and hostility.

Despite the encouraging nature of most of this article's findings, two provide cause for concern. First, the relatively slow growth in New England exports in recent years suggests that the decline of the region's manufacturing sector is undermining its export activity and, thus, its ability to stabilize earnings in periods of weak domestic demand. The second cause for concern is the shift in the industrial composition of inbound foreign direct investment from manufacturing to retailing and financial services—a shift greater at the regional than the national level. This development suggests that foreign manufacturers—like many of their domestic counterparts—do not find New England a particularly advantageous production site at the present time. The

shift does not augur well for New England's continued leadership of innovative industries.

The solutions? With continuing weakness in the sectors that usually drive the New England economy, expanding its export base provides one alternative for halting the decline in New England's manufacturing sector over the short run. Since remarkably few firms actually export, even in export-dependent New England, the scope for increased foreign sales seems considerable. In the longer run, New England must be made attractive to domestic manufacturers. What is good for the domestic goose would also be good for the foreign gander.

The role for policy-makers is probably somewhat limited. Many of New England's current disadvantages—its relatively high-cost land and labor, for instance—are undoubtedly the consequence of cyclical pressures: a period of less robust growth will allow prices for scarce resources to come closer to national averages. State governments do have a role, however; they must ensure that the available labor supply is skilled and that the region's infrastructure (especially as it concerns transportation and energy) is adequate. State governments must also deal with the fiscal consequences of supplying these necessities. In other words, Oliver Wendell Holmes may have been partially mistaken. While the tire of international commerce has pried (some) New Englanders' parochialism from them, their state houses remain important after all.

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[1] From *The Autocrat of the Breakfast Table I.* Seemingly, Holmes viewed parochialism as a common human foible, for he also wrote, "The axis of the earth sticks out visibly through the centre of each and every town and city." (*Ibid.*)

[2] For example, in a study of 19 industrial countries, Helliwell and Chung (1989) find that productivity growth has been faster in countries that have increased their openness to international trade. Similarly, Blomstrom and Wolff (1989) find that productivity growth is higher in Mexican industries with a greater presence of multinationals.

[3] The Commerce Department's input-output tables permit calculating the ratio of U.S. imports to U.S. output for 51 manufactured commodities. Assuming that the ratio of imports to total output applied to that part of each commodity used in the production of other goods yields estimates of the role of imported inputs in each manufacturing industry. Then weighted averages of the ratio of imported to total manufactured inputs can be estimated for each region with each industry's ratio weighted according to the industry's share of regional manufacturing employment.

If m_i = imports of manufacturing industry i
o_i = total commodity output of industry i
p_{ij} = inputs of industry i used in industry j
mp_j = imported inputs used in industry j
e_j = regional employment in manufacturing industry j
e = total manufacturing employment in the region
mu = regional weighted average ratio of imported manufactured inputs to total manufactured inputs
nk = noncomparable imported inputs,

then

$$mp_j = \frac{\sum_1^n \left[P_{ij} \cdot \frac{m_i}{o_i} \right] + nk}{\sum_1^n P_{ij} + nk} \quad \text{and}$$

$$mu = \sum_1^n \left[\frac{e_j}{e} \cdot mp_j \right].$$

[4] Raw data are provided by the U.S. Bureau of the Census. The data presented have been adjusted by the Massachusetts Institute for Social and Economic Research, University of Massachusetts at Amherst, to reduce reporting error.

[5] Here too, differences in the regions' geographic focus may have come into play. Many U.S. affiliates in Southeast Asia and Mexico were established relatively recently in the wake of the dollar appreciation of the early 1980s. They frequently provide low-cost assembly sites for products that contain U.S. components and that are destined for the United States or other industrial country markets. Accordingly, some of the recent growth in exports originating in Texas or the Pacific states may reflect this increased use of maquilladoras and their Southeast Asian equivalents. By contrast, U.S. affiliates in Europe are older, on average, and are more likely to be self-sustaining units serving host country markets. As already mentioned, exports originating in New England exhibit a European tilt.

[6] At the end of 1988, only twelve foreign banks had opened facilities in Boston, which ranked tenth after New York, Los Angeles, Chicago, San Francisco, Houston, Miami, Atlanta, Dallas, and Seattle.

[7] This measure is decidedly imperfect, however. According to national data, only half of all acceptances are related to international trade. Similarly, only a portion of all commercial letters of credit and of commercial and industrial loans to foreigners involve trade finance. Unfortunately, call report data do not permit segregating the trade-related share of these credits and commitments from the totals.

[8] By James Thornblade, Visiting Professor of International Economic Relations, Fletcher School of Law and Diplomacy.

[9] Since the data generally reflect the address of the corporate headquarters, they do not necessarily represent the region most affected by the firm's decision to invest abroad. For instance, production at an overseas facility may replace—or require—exports from a domestic plant located far from the corporate offices. For this reason the Commerce Department is reluctant to publish any state data related to U.S. direct investment abroad.

[10] Contrary to popular rumor (see Baker 1990), the Japanese did not buy the state of Massachusetts. A group of Japanese banks merely saved the Commonwealth some money when they permitted the state to borrow on the basis of their credit rating while the state's bond rating sank to the lowest level in the nation.

[11] Concerns about technology transfer are based on the proposition that economies of large-scale production or learning-by-doing may be very important in some industries. Accordingly, if a foreign company in such an industry buys/steals U.S. technology and develops it in a protected market with the help of foreign government subsidies, it may be extremely hard for U.S firms to catch up.

[12] According to the U.S. International Trade Administration's list of inbound foreign direct investment transactions in 1987 and 1988, acquisitions accounted for 40 percent of all transactions but for 60 percent of the investments made in New England.

[13] An exact comparison of U.S. affiliates' R&D efforts in relation to sales with those of their domestic counterparts is not possible because the R&D figures for domestic companies are presented in relation to sales of *companies conducting R&D* while the U.S. affiliate R&D expenditures must be related to *total industry sales*. The available data suggest that the R&D efforts of domestic and affiliate manufacturers are roughly similar but that the affiliates' efforts may be somewhat smaller. The Commerce Department does not publish data on the R&D expenditures of foreign affiliates of U.S. companies.

[14] Author's calculations.

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On the Predictive Power of Interest Rates and Interest Rate Spreads

Ben S. Bernanke

Professor of Economics and Public Affairs, Princeton University. This paper was written while the author was on leave at the Department of Economics, Massachusetts Institute of Technology, and the Federal Reserve Bank of Boston. *James Clark provided research assistance. Timothy Cook, Stephen McNees, and James Wilcox provided useful comments.*

Economists have long understood that financial market variables contain considerable information about the future of the economy. Stock prices, in particular, have always been a popular leading indicator. Recently, though, a number of researchers have pointed out that interest rates and interest rate spreads—that is, differences between interest rates on alternative financial assets—can be effective predictors of the economy.

Probably the most striking results along these lines have been obtained by Stock and Watson (1989), who examined the information contained in a wide variety of economic variables in an attempt to construct a new index of leading indicators. Stock and Watson found that two interest rate spreads—the difference between the six-month commercial paper rate and the six-month Treasury bill rate, and the difference between the ten-year and one-year Treasury bond rates—outperformed nearly every other variable as forecasters of the business cycle. The two Stock and Watson variables are not the only candidates that have been advanced, however: A number of alternative interest rates and spreads have been suggested by various authors, as will be discussed further below.

The finding that interest rates and spreads contain a great deal of information is interesting, but it raises a number of questions. Possibly the most important of these is the question of *why* interest rates and spreads predict the course of the economy so well. This article will try to make some progress on this issue.

To do this, a necessary first step is to determine which interest rate variable (or variables) is the most informative about the future course of the economy. Section I of this article runs a "horse race" between a number of suggested predictors, testing the ability of the alternative interest rate variables to predict nine different monthly measures of real macroeconomic activity as well as the inflation rate. While many interest rate variables have been excellent predictors of the economy during the

period considered, the best single variable is found to be the spread between the commercial paper rate and the Treasury bill rate—one of the two Stock and Watson variables.[1] An additional finding is that, unfortunately, the predictive power of this variable (as well as of the other interest rate variables) appears to have weakened in the last decade; this poses a potential problem for the use of this variable in the new index of leading indicators proposed by Stock and Watson.

Given the superiority of the commercial paper–Treasury bill spread documented in Section I, in Section II the focus is narrowed to inquire why this particular spread has historically been so informative about the economy. Two principal hypotheses are considered: The first is that the commercial paper–Treasury bill spread is informative because, as the difference between a risky return and a safe return on assets of the same maturity, it is a measure of perceived default risk. Suppose that, for whatever reason, investors expect the economy to turn down in the near future; because this will increase the riskiness of privately issued debt, the current spread between private and safe public debt will be bid up. The commercial paper–Treasury bill spread forecasts the future, according to this explanation, because it embodies whatever information the market may have about the likelihood of a recession.

The second hypothesis discussed here is that the commercial paper–Treasury bill spread predicts the economy because it measures the stance of monetary policy, which in turn is an important determinant of future economic activity. Two variants of the monetary policy hypothesis are considered, both of which require the assumption that commercial paper and Treasury bills are imperfect substitutes in the portfolios of investors. The general idea underlying both variants is that monetary policy affects the spread between commercial paper and Treasury bills by changing the composition of assets available in the economy; because of imperfect substitutability, interest rate spreads must adjust in order to make investors willing to hold the new mix of assets. A more detailed discussion of this hypothesis is deferred until Section II below.

It seems clear that the commercial paper–Treasury bill spread must reflect default risk to some degree (the first hypothesis), so much of Section II is devoted to asking whether the spread also measures the stance of monetary policy (the second hypothesis). Using several alternative measures of monetary policy, this study finds evidence that it does. Indeed, to a degree that perhaps is surprising, the commercial paper–Treasury bill spread seems more closely related to conventional indicators of monetary policy (such as the federal funds rate) than to alternative measures of default risk.

The paper's tentative conclusion—tentative, because of the surprisingly weak association of the spread with other measures of default risk—is that the spread between commercial paper and Treasury bill rates has historically been a good predictor because it combines information about both monetary and nonmonetary factors affecting the economy, and because it does this more accurately than alternative interest rate-based measures. However, because this spread has become over time a less perfect indicator of monetary policy, it may be a less useful predictor of economic fluctuations in the future.

The best single predictor among interest rate variables has been found to be the spread between the commercial paper rate and the Treasury bill rate.

I. A Comparison of the Predictive Power of Alternative Interest Rates and Spreads

This section will review some recent literature on the predictive power of interest rates and spreads. It will then compare the forecasting power of a number of the variables that have been suggested by various authors.

Much of the recent attention to the predictive power of interest rates can be traced back to a provocative 1980 paper by Christopher A. Sims. At the time, Sims was interested in interpreting his own earlier finding (1972) that the growth rate of the money stock helped forecast output; in particular, he wanted to know if this earlier finding could be taken as evidence that monetary policy can be used to affect the real economy. In the 1980 paper Sims showed, in a vector autoregression (VAR) system including post-

war data on industrial production, wholesale prices, and the M1 money stock, that M1 was an important predictor of production; indeed, in this VAR, disturbances to M1 were found to explain 37 percent of the forecast variance of industrial production at a horizon of 48 months. This predictive power for money was in line with the earlier results of Sims and others. However, in his paper Sims also showed that, when the commercial paper rate was added to the VAR, nearly all of money's predictive power for output was "absorbed" by the interest rate: In the expanded VAR, the commercial paper rate explained 30 percent of the forecast variance of industrial production at the 48-month horizon, while money accounted for only 4 percent. Similar results were later obtained, but for the Treasury bill rate rather than the commercial paper rate, by Litterman and Weiss (1985).

Both the levels and the spreads between interest rates can be extremely informative for forecasting the economy.

From the finding that money did not predict output when interest rates were also in the forecasting equations, both Sims and Litterman and Weiss concluded that monetary policy does not in fact affect real output. This interpretation was disputed by McCallum (1983), who pointed out that in practice interest rates might be a better indicator of monetary policy than money growth rates; hence the predictive power of interest rates was not necessarily evidence against the effectiveness of monetary policy. A paper by Bernanke and Blinder (1989) concurred with McCallum's view, pointing out that the federal funds rate—the interest rate most closely associated with monetary policy—was in fact unusually informative about the future of the real economy. Some evidence is presented here that bears on the debate about monetary policy in Section II; for the time being, it is enough to note that the literature following Sims' contribution demonstrated the forecasting power of several alternative interest rates.

The research that followed Sims suggested that it was the level of interest rates that was important for forecasting the economy. However, a number of papers written during the 1980s showed that spreads between different interest rates could also be extremely informative. For example, in a study of financial crises during the Great Depression, Bernanke (1983) showed that the spread between the rates on Baa-rated corporate bonds and Treasury bonds was a leading indicator of output during the interwar period. Estrella and Hardouvelis (1989) demonstrated the forecasting power of the difference between short-term and long-term Treasury rates; the "tilt" of the term structure, as this spread is sometimes referred to, is in fact a popular forecasting variable in financial circles, as Estrella and Hardouvelis mentioned. In their paper cited above, Bernanke and Blinder suggested that the spread between the federal funds rate and the long-term government bond rate—which they interpreted as an indicator of monetary policy—would be a useful predictor; similar conclusions were drawn by Laurent (1988; 1989). The high information content of the spread between the commercial paper rate and the T-bill rate was first documented in an important paper by Friedman and Kuttner (1989). Finally, as discussed in the introduction, Stock and Watson's comparison of a wide variety of potential leading indicators gave high marks to the commercial paper–Treasury bill spread and the spread between short-term and long-term Treasury rates (the tilt of the term structure).

Table 1
Interest Rates and Spreads Used in This Study

Mnemonic	Definition
RAAA	Long-term corporate bond rate, Aaa credit rating
RBAA	Long-term corporate bond rate, Baa credit rating
RCP6MO	Commercial paper rate, highest quality, 6 months' maturity
RFF	Federal funds rate, overnight
RT3MO	Treasury bill rate, 3 months
RT6MO	Treasury bill rate, 6 months
RT1	Treasury bill rate, 1 year
RT10	Treasury bond rate, 10 years
SHORT	RCP6MO – RT6MO
LONG	RBAA – RT10
TILT	RT1 – RT10
FUNDS	RFF – RT10
DEFAULT	RBAA – RAAA

Table 2
The Information Content of Interest Rates

Predicted Variable	Interest Rates			
	RFF	RT3MO	RCP6MO	RT10
Industrial Production	.0000	.0000	.0000	.0021
	.0236	.0204	.0008	.0169
	.1227	.1084	.0163	.0828
Unemployment Rate	.0000	.0001	.0000	.0001
	.0089	.0220	.0043	.0113
	.0133	.2232	.1446	.1197
Capacity Utilization	.0000	.0000	.0000	.0001
	.0224	.0217	.0005	.0145
	.1012	.0921	.0085	.1080
Employment	.0000	.0000	.0000	.0079
	.0379	.0419	.0057	.0547
	.4147	.2843	.1497	.2240
Housing Starts	.0000	.0000	.0000	.0000
	.0000	.0001	.0000	.0006
	.0000	.0001	.0000	.0001
Retail Sales	.0001	.0157	.0017	.0795
	.0396	.7010	.3566	.6718
	.0019	.1383	.0464	.3168
Personal Income	.0005	.0109	.0007	.2211
	.0192	.1275	.0183	.2880
	.0107	.1439	.0148	.2173
Durables Orders	.0000	.0005	.0000	.0059
	.0038	.0720	.0189	.0329
	.0031	.0942	.0286	.0269
Consumption	.0000	.0000	.0000	.0001
	.0046	.0621	.0183	.1012
	.0000	.0000	.0000	.0003
Inflation	.0000	.0000	.0000	.0003
	.0000	.0000	.0000	.0001
	.0001	.0002	.0004	.0021

Note: For definitions of interest rate variables, see Table 1. Entries give the probability that the interest rate variable can be excluded from a prediction equation for the macro variable, for each of three specifications of the prediction equation. Data are monthly, 1961–89.

Comparisons of Univariate Forecasting Power

Given the variety of interest rate-based predictors that have been suggested, it is important to try to determine more precisely which of the candidate variables contain the most information. A preliminary examination of eight proposed forecasting variables, taken one at a time (that is, in univariate fashion), is reported in Tables 2 and 3. (Definitions of the alternative interest rates and spreads used in this paper are given in Table 1.) Four interest rates and four interest rate spreads are considered. The four interest rates include the federal funds rate (RFF), the three-month Treasury bill rate (RT3MO), and the six-month commercial paper rate (RCP6MO), all of which have been used in previous studies of the forecasting power of interest rates. The ten-year Treasury bond rate (RT10) is also brought in at this stage, both because Stock and Watson include the first difference of this variable in their experimental index of leading indicators and in order to have a representative long-term rate. The four interest rate spreads examined are 1) the commercial paper–Trea-

Table 3
The Information Content of Interest Rate Spreads

Predicted Variable	Interest Rate Spreads			
	SHORT	LONG	TILT	FUNDS
Industrial Production	.0000	.0000	.0000	.0000
	.0001	.0000	.0707	.3004
	.0014	.0012	.4144	.6166
Unemployment Rate	.0000	.0032	.0053	.0002
	.0003	.0008	.4488	.1443
	.0121	.0314	.6963	.0262
Capacity Utilization	.0000	.0000	.0001	.0001
	.0000	.0000	.0738	.1197
	.0003	.0032	.1378	.1063
Employment	.0000	.0000	.0001	.0002
	.0015	.0003	.3691	.5683
	.3816	.0511	.9062	.9818
Housing Starts	.0002	.0006	.0000	.0000
	.0261	.0300	.0000	.0004
	.0104	.0087	.0000	.0001
Retail Sales	.0012	.0199	.0000	.0000
	.2607	.3630	.2502	.0087
	.2026	.7911	.0087	.0002
Personal Income	.0000	.1117	.0015	.0001
	.0000	.0075	.0400	.0082
	.0000	.0461	.0964	.0138
Durables Orders	.0000	.0007	.0001	.0000
	.0060	.0018	.2673	.0467
	.0545	.0173	.3345	.0442
Consumption	.0000	.0348	.0000	.0000
	.0006	.1664	.0207	.0017
	.0002	.4888	.0000	.0000
Inflation	.1814	.0006	.0002	.0001
	.1305	.0006	.0000	.0000
	.2123	.0040	.0011	.0004

Note: For definitions of interest rate variables, see Table 1. For explanation of the table, see notes to Table 2 and text.

sury bill spread (at six months' maturity), called SHORT because Stock and Watson refer to it as the short-term public-private spread; 2) the spread between the long-term corporate bond rate (Baa rating) and the ten-year government bond rate, or LONG; 3) the difference between the one-year Treasury bill rate and the ten-year Treasury bond rate, called TILT because it measures the tilt of the term structure; and 4) the spread between the federal funds rate and the ten-year Treasury bond rate, referred to here as FUNDS.

The study examined the ability of each of the eight forecasting variables to predict ten macroeconomic variables (nine indicators of real activity, plus the CPI inflation rate); the chosen macro variables are listed down the left-hand side of Tables 2 and 3. The ten macroeconomic variables are essentially the same as those used by Bernanke and Blinder (1989), with the addition of nonagricultural employment and personal consumption expenditures; all of these variables are closely watched measures of the economy that also meet the criterion of being available on a monthly basis. The predictive power of the interest rate variables was tested for a number of different economic series, instead of just (say) industrial production, as a check on the robustness of the relationships found.[2]

The univariate forecasting power of the individual interest rates and spreads was evaluated as follows: For each macro variable and each interest rate variable (rate or spread), three in-sample, one-month-ahead prediction equations were estimated, using monthly data for 1961–89.[3] In the first of the three prediction equations, the macro variable being forecasted was regressed on a constant, a trend, six lags of itself, and six lags of the interest rate variable. The second prediction equation augmented the first equation by adding six lags of CPI inflation and six lags of real M2 growth to the right-hand side of the equation.[4] The third equation augmented the first equation by adding six lags of the growth rate of the index of leading indicators to the right-hand side.[5]

Given these estimated forecasting equations, each containing the interest rate variable and other predictors, the study then tested the hypothesis that all lags of the interest rate variable could be excluded from the equation (that is, that the interest rate variable had no marginal predictive power). The results are given in Table 2 (for interest rates) and Table 3 (for interest rate spreads). For each macro variable and each interest rate variable, the tables give three numbers; these correspond to the probability that the interest rate variable can be excluded from the first, second, or third prediction equation, respectively. Low values imply strong marginal predictive power; thus, a value of .0001 means that there is only one chance in 10,000 that the interest rate variable does not belong in that particular prediction equation.

The two tables show that interest rates and spreads clearly contain information about the future of the economy that is not included even in the index of leading indicators. For example, the federal funds rate (RFF in Table 2) predicts each of the macro variables at the .0001 level of significance when only lags of the forecasted variable are included; it predicts all of the macro variables at the .05 level or better when inflation and real money growth are added; and it predicts seven of the ten variables at close to the .01 level or better even in the presence of the index of leading indicators.

Interest rates and spreads clearly contain information about the future of the economy that is not included even in the index of leading indicators.

Which interest rate variables are the best predictors of the economy? Direct comparisons are undertaken in the next section. However, as a simple and informal way of quantifying the impressions given by the univariate results in Tables 2 and 3, "points" were assigned to each interest rate variable as follows: 5 points for each entry in Table 2 or 3 that is less than .001; 4 points for entries between .001 and .01; 3 points for entries between .01 and .05; 2 points for entries between .05 and .10; and 1 point for entries between .10 and .20. The scores arrived at in this way are as follows:

Federal funds rate (RFF)	118 points
3-month T-bill rate (RT3MO)	95 points
Commercial paper rate (RCP6MO)	119 points
10-year T-bond rate (RT10)	85 points
SHORT spread (RCP6MO − RT6MO)	109 points
LONG spread (RBAA − RT10)	105 points
TILT spread (RT1 − RT10)	89 points
FUNDS spread (RFF − RT10)	107 points

On a univariate basis, and by this informal scoring measure, the federal funds rate and the commercial paper rate do better than the Treasury bill rate and the long-term bond rate. Of the spreads, the TILT variable seems weaker than the others, which are more or less equal.

Multivariate Comparisons

All the interest rate variables considered here appear to have significant forecasting power. Is this because all interest rates capture basically the same information about the future? Or does each interest rate or spread have separate information about the evolution of the economy? To try to answer these questions, and to make more direct comparisons between the different interest rate variables, a multivariate analysis is necessary.

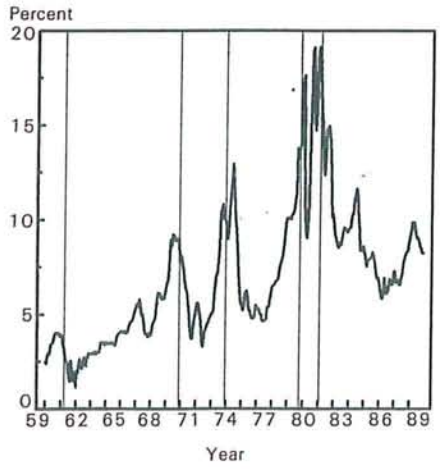
In the previous section, the federal funds rate and the commercial paper rate appeared to be better predictors than the Treasury bill rate and the long-term Treasury bond rate. Since this has also been indicated by previous research, the two Treasury rates were dropped from the comparison.[6] This leaves six interest rate variables to be compared—two interest rates and four interest rate spreads.[7] The historical behavior of these variables is shown in Figures 1 to 6; vertical lines in those figures indicate the dates of business cycle peaks.

To see which of these variables are the best predictors, and to try to determine the "dimensionality" of the information in interest rates, in-sample forecast equations were estimated for each of the macro variables. Each forecast equation contained a constant, a trend, six monthly lags of the forecasted variable, and six lags each of one to four interest rate variables. A forecasting equation containing k different interest rate variables on the right-hand side (along with the constant, trend, and lagged values of the dependent variable) will be referred to here as a model of size k.

All possible models of size k were estimated for each macro variable and for k = 1,2,3,4. With six interest variables, this meant that for each forecasted variable six models of size one were estimated, fifteen models of size two, twenty models of size three, and fifteen models of size four. The best-fitting (highest R^2) models for each forecasted variable and for each

Figure 1

Federal Funds Rate



Note: Vertical lines indicate business cycle peaks.

Figure 2

Six-Month Commercial Paper Rate

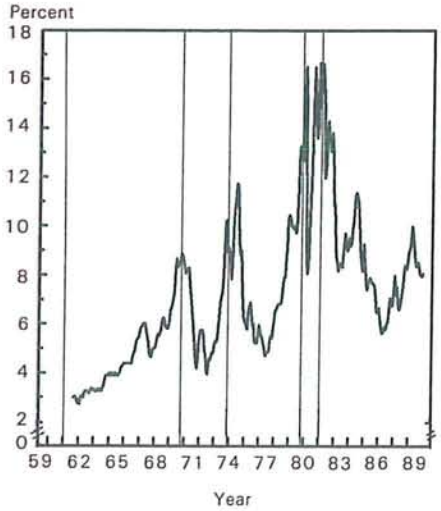


Figure 3

Commercial Paper Rate minus Treasury Bill Rate (SHORT)

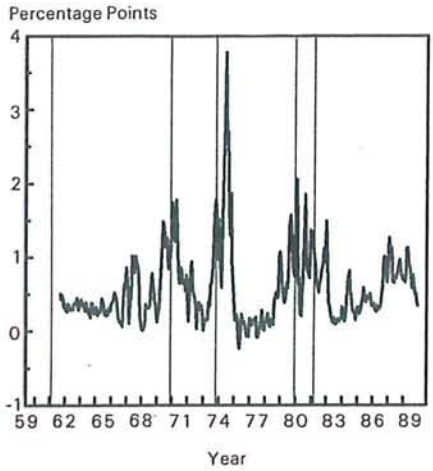


Figure 4

Baa Corporate Bond Rate minus 10-Year Treasury Bond Rate (LONG)

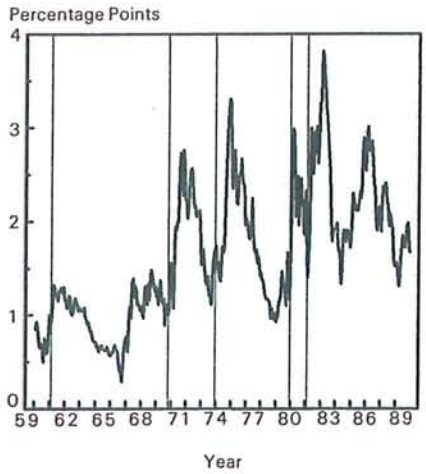


Figure 5

One-Year Treasury Bill Rate minus 10-Year Treasury Bond Rate (TILT)

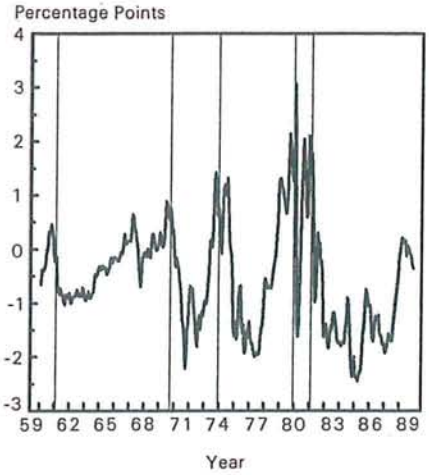
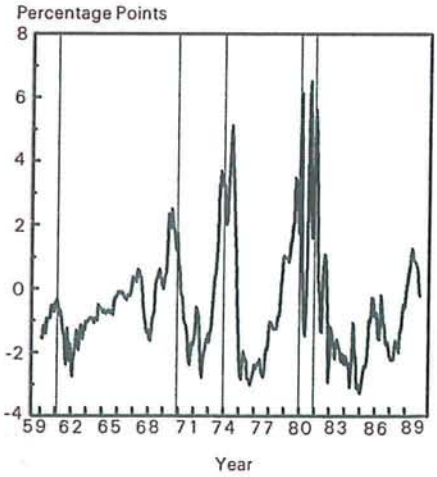


Figure 6

Federal Funds Rate minus 10-Year Treasury Bond Rate (FUNDS)



model size are listed in Table 4. The best overall fits (regardless of model size) are indicated by superscripts in the table: Superscript r indicates the model that fit best by the adjusted R^2 criterion, superscript a the model that is best by the Akaike information criterion, and superscript s the model that is best by the Schwarz criterion.[8]

Putting aside for a moment the question of which model size produces the overall best equations, consider first how the alternative interest rate variables compare in this head-to-head forecasting competition. Obviously, the answer depends on which macro variable is considered; but, generally, the SHORT variable—the spread between the commercial paper rate and the Treasury bill rate—appears to be the best predictor. When only one interest rate variable is allowed (that is, in the models of size one), SHORT gives the best fit in six of the ten cases; it also appears in seven of the best size two models.

To see the size of SHORT's advantage as a predictor, as before the results of Table 4 were summarized using an informal point system, with 5 points awarded to each interest rate or spread variable for each time it appears in the best size-one model; 3 points for each appearance in the best size-two model; 2 points for each time in the best size-three model; and 1 point for each appearance in the best size-four model. The point totals this time are:

Federal funds rate (RFF)	27 points
Commercial paper rate (RCP6MO)	35 points
SHORT spread (RCP6MO − RT6MO)	69 points
LONG spread (RBAA − RT10)	38 points
TILT spread (RT1 − RT10)	4 points
FUNDS spread (RFF − RT10)	37 points

These totals point to SHORT as the best overall of the six interest rate predictors; this is in line with the previous findings of Friedman and Kuttner (1989) and of Stock and Watson (1989). At the other end of the scale, TILT (the difference between the one-year T-bill rate and the ten-year Treasury bond rate) appears to add little when the other variables are included.[9] The other four interest rates and spreads embody intermediate amounts of independent information. Of these four, perhaps the most interesting is LONG, the spread between the Baa corporate bond rate and the long-term bond rate. LONG is not the best variable in any of the size-one models, but it appears in four of the size-two models, eight of the size-three models, and all ten of the size-four models.

Table 4
Best-Fitting Prediction Equations

Predicted Variable	Model Size (number of explanatory variables) 1	2	3	4
Industrial Production	SHORT^{s}	SHORT LONG	RCP6MO^{a} SHORT LONG	RCP6MO^{r} SHORT LONG FUNDS
Unemployment Rate	SHORT^{s}	SHORT LONG	RCP6MO LONG FUNDS	RCP6MO^{ar} SHORT LONG FUNDS
Capacity Utilization	SHORT^{s}	RCP6MO SHORT	RCP6MO^{a} SHORT LONG	RCP6MO^{r} SHORT LONG FUNDS
Employment	SHORT^{s}	RCP6MO SHORT	RCP6MO^{ar} SHORT LONG	RFF SHORT LONG TILT
Housing Starts	RCP6MO^{s}	RCP6MO FUNDS	RFF^{a} LONG FUNDS	RFF^{r} SHORT LONG FUNDS
Retail Sales	FUNDS^{sa}	LONG FUNDS	RFF^{r} LONG FUNDS	RFF RCP6MO LONG FUNDS
Personal Income	SHORT^{sa}	RCP6MO SHORT	RCP6MO^{r} SHORT TILT	RCP6MO SHORT LONG TILT
Durables Orders	SHORT^{s}	RFF SHORT	RFF^{a} SHORT LONG	RFF^{r} SHORT LONG FUNDS
Consumption	FUNDS^{s}	RFF SHORT	RFF LONG FUNDS	RFF^{ar} SHORT LONG FUNDS
Inflation	RFF^{s}	LONG FUNDS	RFF^{a} RCP6MO FUNDS	RFF^{r} RCP6MO LONG FUNDS

Note: For each macro variable, the table lists the interest rate variables included in the best prediction equation of the specified size. Data are monthly and cover 1961–89. All equations include a constant, a trend, and six monthly lags of the predicted variable. For definitions of interest rate variables, see Table 1.

^{s} Best model by Schwarz criterion.

^{a} Best model by Akaike criterion.

^{r} Best model by adjusted R^2 criterion.

Since the correlation of LONG with the other interest rate variables is low, it appears that this variable, while not containing the most "essential" information that is present in interest rates, does contain useful additional information.

The comparison just drawn among forecasting variables ignored the issue of the optimal size of the forecasting models (which is closely related to the issue of the "dimensionality" of the information in interest rates). Unfortunately, the conclusions on this count are somewhat ambiguous. Of the three criteria used to compare models of different sizes, the one that puts the stiffest penalty on extra parameters (the Schwarz criterion) always indicated that the model of size one was best, while the criterion with the smallest penalty on extra parameters (adjusted R^2) chose models of size three or (usually) size four. (See Table 4.) The Akaike criterion, which gives an intermediate penalty for increased model size, indicated in two cases that the best model was of size one but in the other eight cases that the best size was either three or four.

In many cases the models chosen by the stringent criteria are nested in the larger models chosen by the alternative criteria. When a larger model nests a smaller one, the hypothesis that the smaller model is to be preferred can be directly tested by testing the hypothesis that the additional forecasting variables can be excluded. These tests usually found that the larger model was statistically preferred at conventional significance levels. The fact that larger models are typically preferred is weak evidence for the view that interest rate variables contain several different types of independent information, which cannot be completely captured by using a single interest rate or spread in a forecasting equation.

Out-of-Sample Forecasting

While in-sample fit is one criterion for judging prediction equations, the ultimate test of an equation is the ability to forecast out of sample. Experiments along this line suggest that, unfortunately, the strong predictive power of interest rates that has been noted is most apparent for the period before (approximately) 1980; since that time the forecasting power of interest rates has deteriorated significantly.[10]

As a simple illustration of this point, results are shown here for only three key macro variables (industrial production, the unemployment rate, and inflation) and for models including only one interest rate variable. The study attempted to determine whether the use of an interest rate variable could improve out-of-sample forecasting for the key macro variables, *given* the inclusion in the equation of lagged values of the macro variable and of the index of leading indicators. In contrast to the prediction equations in the previous section, which focused on one-month-ahead forecasts, six-month-ahead forecast equations were considered.

For each of the three macro variables, prediction equations were estimated for samples beginning in January 1961 and ending in December of 1971, 1974, 1977, 1980, 1983, or 1986. The dependent variable in each case was the cumulative growth rate of the forecasted macro variable over the previous six months. Each prediction equation included a constant, a trend, and the seventh through twelfth lags of the monthly growth rate of the forecasted variable, of the growth rate of the index of leading indicators, and of one of the candidate interest rate variables. For each forecasted variable and sample period the prediction equation was chosen that fit best in sample. The "winning" interest rate variable in each case is shown in Table 5; just below the name of each interest rate variable is the probability that all lags of that variable could be excluded from the associated prediction equation.

Since 1980 the forecasting power of interest rates has deteriorated significantly.

Using the best prediction equations for each sample period, out-of-sample forecasts were made for each subsequent three-year period. The forecast periods were non-overlapping; so, for example, using the equation estimated through December 1971, forecasts were made of the six-month growth rates beginning in January or July of 1972, 1973, and 1974. The accuracy of these forecasts was compared to what could have been obtained if the interest rate variable had been omitted, and the forecasting equation had been estimated using only lagged values of the forecasted variable and the index of leading indicators. The second entry below each variable

Table 5
Marginal Forecasting Power of Interest Rates and Spreads for Industrial Production, the Unemployment Rate, and Inflation at Six-Month Horizons

	Forecasted Variable		
Period	Industrial Production	Unemployment Rate	Inflation
1972–74	SHORT	RFF	RFF
	(.0011)	(.0003)	(.0000)
	.7704	.8743	.8965
	.5997	.7542	.8538
1975–77	RCP6MO	SHORT	FUNDS
	(.0000)	(.0000)	(.0000)
	.8907	.6582	.5445
	.9532	.7497	.2150
1978–80	SHORT	SHORT	FUNDS
	(.0000)	(.0000)	(.0000)
	.7069	.7692	.6387
	.5372	.5435	.4169
1981–83	SHORT	SHORT	FUNDS
	(.0000)	(.0000)	(.0000)
	1.5456	1.3887	1.9002
	1.7403	1.9950	2.6509
1984–86	SHORT	SHORT	FUNDS
	(.0000)	(.0000)	(.0000)
	.9233	.6605	1.5382
	.6846	.6346	1.8680
1987–89	SHORT	SHORT	TILT
	(.0000)	(.0000)	(.0000)
	1.4480	1.2751	1.2782
	1.6922	1.4578	1.9667

Note: For each variable and forecasting period, the interest rate variable named is the one that fit best using data prior to the forecasting period. (Variable names are defined in Table 1.) The number in parentheses is the probability that all lags of the named interest rate variable could be excluded from the prediction equation. The next two numbers are the ratios of (respectively) the average absolute forecasting errors and the average squared forecasting errors between equations with and without the interest rate variable, as discussed in the text.

name in Table 5 gives the ratio of the average absolute forecasting error obtained when the interest rate variable is included to the average absolute error obtained without the interest rate variable. Similarly, the third entry below each variable name gives the ratio of average squared forecast errors. Entries of less than one indicate that using the interest rate variable improves the out-of-sample forecast, relative to an equation that uses only the lagged forecast variable and the index of leading indicators.

Table 5 shows that once again SHORT is the best interest rate variable for predicting real activity; thus, this finding appears to be independent of the forecast horizon. Although the spread between the Federal funds rate and the long-term bond rate (FUNDS) is best for forecasting the nominal variable (inflation), for the two real variables (industrial production and the unemployment rate), SHORT fits best in ten of twelve cases. Table 5 also shows that, up through 1980, the use of interest rate variables would have consistently improved out-of-sample forecasts.

After 1980, however, the story is different. Although the use of SHORT would have helped to forecast real variables in 1984–86, in 1981–83 and 1987–89 an equation using SHORT would have performed considerably worse. Further, the inflation prediction equation deteriorates in all sub-periods of the 1980s.

The "reason" for the poor performance of SHORT in the 1980s is that, first, this variable, like all interest rate variables, was very volatile in 1979–83 (compare Figure 3); although a severe recession occurred during this time, the real economy did not exhibit volatility proportional to that in interest rates. Second, SHORT rose in the last third of the 1980s, indicating (based on previous experience) that the economy should have gone into a mild recession, but no recession occurred. To understand at a deeper level why the forecasting power of SHORT has weakened, it is necessary to explain why this variable seemed to contain so much information in the first place.

II. Why Does the Commercial Paper–Treasury Bill Spread Predict the Economy?

The first main section of this article showed that, while many interest rates and spreads are informative about the economy, the best single interest rate indicator among those examined is probably the spread between the commercial paper rate and the Treasury bill rate, or SHORT. At this point the focus of the study narrows to consider specifically why this variable seems to contain so much information about the future of the economy. For concreteness the study focuses on SHORT, but much of the discussion to follow would apply to several of the other interest rate indicators as well.

As discussed in the introduction, the simplest explanation of why SHORT forecasts the economy is that it measures the amount of default risk perceived

by the market. As such, this spread may be useful because it summarizes available information about the likelihood of a recession.

A difficulty with this explanation is that SHORT would seem to be a poorer measure of general default risk than several other available interest rate spreads. Defaults on prime nonfinancial commercial paper are extremely rare (much too infrequent, it would seem, to plausibly account for the 300-basis-point swings in this spread that have been observed); if obtaining an objective measure of default risk were important, a variable such as the Baa corporate bond–Treasury bond spread ought to do a better job in forecasting than SHORT. Indeed, the correlation of SHORT with other indicators of default risk is remarkably low: For example, the correlation of monthly changes in SHORT with monthly changes in the spread between Baa corporate bonds and Treasury bonds (LONG) is just .09 over the 1961–89 period; when the Aaa rate is used instead of the Baa rate, the correlation is still .09, and when the Baa–Aaa rate differential is used, the correlation in changes with SHORT is less than .04. Van Horne (1979) has shown that the correlation between the commercial paper spread and the long-term corporate bond spread is low even when measured *company by company*.

Although the correlation of SHORT with other default measures is low, its correlation with various measures of monetary policy is higher.

Although the correlation of SHORT with other default measures is low, its correlation with various measures of monetary policy is higher; for example, the correlation of monthly changes in SHORT with monthly changes in the federal funds rate over 1961–89 is .46. While of course not necessarily proof of anything, this correlation does motivate consideration of the possibility that SHORT is a good forecaster because it contains information about monetary policy. This general proposition will be called the monetary policy hypothesis. Two different versions of this hypothesis will be considered; the common element of both, as mentioned in the introduction, is that it is assumed that commercial paper and Treasury bills are imperfect substitutes in investors' portfolios.

The first version of the monetary policy hypothesis might be called the "credit crunch" story, and is due principally to Cook (1981). Cook's argument is that, prior to institutional changes in 1978, monetary policy affected SHORT (and other money market spreads) by inducing disintermediation from the banking system. Because of deposit interest rate ceilings imposed by Regulation Q, during the latter part of the 1960s and in the 1970s monetary tightening and the associated increase in interest rates periodically led to large outflows of deposits from banks. Depositors were motivated to withdraw, of course, in order to obtain higher open-market yields. However, because private money market instruments such as commercial paper could be purchased only in large minimum denominations, during these episodes disintermediated deposits flowed primarily into T-bills. Cook argued that during these credit crunch episodes the large switches from deposits to T-bills in private portfolios lowered the yield on T-bills relative to commercial paper (and other money market instruments). Thus tight money was reflected in an increase in the commercial paper–Treasury bill spread. The increase in this spread during the credit crunches of 1966, 1969, and 1973–74 can easily be seen in Figure 3.[11]

Why didn't the increase in the spread cause banks or other investors not constrained by the minimum denomination restriction to sell off their Treasury bills and buy commercial paper, thus offsetting the switch by depositors? This did happen to some extent. But as Cook (1981) explains in detail, Treasury bills are valuable to banks and other investors for reasons beside their direct yield. For example, T-bills can be used for posting margin, for collateralizing overnight repurchase agreements, and for satisfying bank capital adequacy requirements; commercial paper generally cannot fulfill these functions. Thus, it is reasonable that the demand for Treasury bills will be less than perfectly elastic as the commercial paper–Treasury bill spread widens; that is, Treasury bills and commercial paper are imperfect substitutes.

Given Cook's explanation of why credit crunches caused the spread SHORT to increase, then as long as the monetary actions that caused the credit crunches also tended to induce recessions, SHORT should help predict the economy. A nice feature of this explana-

tion is that it suggests SHORT should no longer be strongly related to monetary policy after the institutional changes (such as the introduction of money market mutual funds and the removal of deposit rate ceilings) that eliminated credit crunches; this is consistent with the finding that SHORT is no longer a good predictor after 1980.

The credit crunch story implies that SHORT will be related to monetary policy only during periods when deposit rate ceilings are binding. An alternative form of the monetary hypothesis, which for lack of a better name will be called the "simple imperfect substitutability" hypothesis, suggests that SHORT will respond to monetary policy whenever the federal funds rate (or some other short-term interest rate) is used as an intermediate target.[12] This story goes as follows: Suppose that, in the process of tightening the stance of monetary policy, the Federal Reserve induces a rise in the federal funds rate. This directly increases the cost of funds to banks. However, banks have several principal alternatives to borrowing federal funds: 1) they can issue CDs or other managed liabilities; 2) they can sell some of their holdings of Treasury securities; or 3) they can cut back on credit to their loan customers (or raise loan interest rates).

If Treasury bills and other assets are imperfect substitutes, then either action (1) or action (3) by banks would tend to increase the open-market commercial paper rate relative to the Treasury bill rate. To sell additional CDs, the banks would have to raise the rate they offer on that instrument; since commercial paper is a very close substitute for CDs in investor portfolios, this would lead the commercial paper rate to rise as well.[13] If banks respond to the higher cost of funds instead by raising the cost of credit to business loan customers, firms that are able to do so will borrow directly from the public by issuing additional commercial paper; this too will raise the commercial paper rate.

If banks sell off Treasury securities (option 2), on the other hand, the tendency for the spread to increase will be arrested; however, following Cook's argument above, banks will not sell off their T-bills in response to a modest increase in the yield differential. Thus, an increased commercial paper–Treasury bill spread will be associated with tight monetary policy, which would help explain why this spread is a useful forecaster. The decline in SHORT's forecasting power after 1980 would in this case be explained by the observations that 1) because of changing Federal Reserve procedures, interest rates in general have been much less reliable indicators of monetary policy since the October 1979 policy shift; and 2) financial innovation, deregulation, and internationalization over the last decade may have increased the substitutability among alternative short-term assets. Another possibility is that monetary policy has simply been relatively less important in recent years.[14] Note that, relative to the credit crunch hypothesis, this alternative view would predict a more gradual reduction in the sensitivity of SHORT to monetary policy after 1978.

Like the credit crunch version of the monetary policy hypothesis, the simple imperfect substitutability version is sensitive to the possibility of investors in the economy, outside of banks, for whom commercial paper and Treasury bills are (nearly) perfect substitutes; if these investors exist, their arbitrage activity will cause the spread between these two assets to reflect only differences in after-tax expected yields. Rather than discuss in the abstract whether such arbitrage is likely to exist, however, some empirical evidence on the relationship of interest rate spreads to Fed policy will be reviewed.

The Response of Interest Rate Spreads to Changes in Monetary Policy

This study will now consider how some key interest rate spreads, including SHORT, respond to changes in monetary policy. As will be shown, the evidence is consistent with the general view that SHORT is if anything more closely related to indicators of monetary policy than to the economywide level of default risk. Precise dates of changes in monetary policy are, of course, not available. Instead, the study will rely on two very different efforts to measure shifts in Federal Reserve policy.

The first of these studies is by Romer and Romer (1989). By reading Federal Reserve records, they identified dates in the postwar era at which monetary policy shifted to a tighter, anti-inflationary mode. Four of these dates (December 1968, April 1974, August 1978, and October 1979) fall within the 1961–89 sample period. Table 6 shows the behavior of the federal funds rate (RFF), the commercial paper–Treasury bill spread (SHORT), the spread between Baa and Aaa corporate bond rates (here called DEFAULT), and the difference between the one-year and ten-year Treasury bond rates (TILT) for the period from two months before until twelve months after each Romer and Romer date. DEFAULT is introduced as a measure of the behavior of perceived default risk in the economy. DEFAULT is probably

Table 6

Behavior of the Federal Funds Rate and Interest Rate Spreads in the Periods around the Romer and Romer Dates[a]

Episode 1 (*December 1968)	RFF	SHORT	DEFAULT	TILT	Episode 2 (*April 1974)	RFF	SHORT	DEFAULT	TILT
1968 O	5.92	.39	.75	−.01	1974 F	8.97	.87	.68	−.08
N	5.81	.33	.82	.05	M	9.35	.59	.61	.55
D*	6.02	.12	.78	.16	A*	10.51	1.47	.62	1.11
1969 J	6.30	.25	.73	.30	M	11.31	2.22	.68	1.20
F	6.64	.32	.64	.22	J	11.93	2.84	.80	1.13
M	6.79	.66	.66	.04	J	12.92	3.78	.76	.99
A	7.41	.91	.65	.09	A	12.01	2.54	.77	1.32
M	8.67	1.20	.73	.10	S	11.34	2.70	.94	.83
J	8.90	1.48	.72	.47	O	10.06	1.62	1.21	.15
J	8.61	1.42	.76	.88	N	9.45	1.29	1.71	−.02
A	9.19	1.14	.89	.85	D	8.53	1.87	1.74	−.12
S	9.15	1.17	.91	.66	1975 J	7.13	.94	1.98	−.67
O	9.00	1.27	.89	.54	F	6.24	.71	2.03	−1.41
N	8.85	.84	.90	.75	M	5.54	.44	1.81	−1.62
D	8.97	.95	.93	.52	A	5.49	.15	1.63	−1.33

Episode 3 (*August 1978)	RFF	SHORT	DEFAULT	TILT	Episode 4 (*October 1979)	RFF	SHORT	DEFAULT	TILT
1978 J	7.60	.40	.84	−.37	1979 A	10.94	.90	1.12	.95
J	7.81	.47	.72	−.25	S	11.43	1.40	1.10	1.51
A*	8.04	.53	.79	−.10	O*	13.77	1.57	1.27	2.14
S	8.45	.45	.73	.22	N	13.18	1.44	1.23	1.74
O	8.96	.48	.70	.50	D	13.78	.96	1.32	1.59
N	9.76	.99	.80	1.20	1980 J	13.82	.82	1.33	1.26
D	10.03	1.07	.78	1.29	F	14.13	.74	1.19	1.51
1979 J	10.07	.85	.88	1.31	M	17.19	1.47	1.49	3.07
F	10.06	.60	.82	1.14	A	17.61	2.05	2.15	1.83
M	10.09	.49	.89	1.13	M	10.98	.64	2.18	−.79
A	10.01	.38	.95	.94	J	9.47	.73	2.13	−1.62
M	10.24	.44	.97	.87	J	9.03	.23	1.58	−1.60
J	10.29	.65	1.09	.66	A	9.61	.20	1.51	−.86
J	10.47	.58	1.09	.69	S	10.87	.47	1.68	.01
A	10.94	.90	1.12	.95	O	12.81	.69	1.92	.74

[a]The dates defining the four episodes were determined by Romer and Romer (1989) to be dates at which monetary policy was tightened in order to fight inflation. Variables names are defined in Table 1.

superior to LONG as a measure of default risk (although the two spreads are highly correlated), since changes in LONG may also be affected by changes in the value of the call option attached to most corporate bonds.[15]

The most important observation to make from Table 6 is that SHORT and DEFAULT respond rather differently to increasing monetary tightness, as measured by the Romer and Romer dating. Generally, SHORT rises and falls sympathetically with the federal funds rate RFF during the contractionary episodes; in this sense, its behavior is similar to the term structure spread TILT, which also moves with the funds rate. In contrast, DEFAULT typically responds only with a lag, usually not rising until after RFF and SHORT have fallen back.[16] This is a bit of evidence for the view that SHORT responds more to monetary policy than to changing perceptions of default risk. The fact that SHORT still appears to respond to the funds rate in 1979, when credit crunches were no longer a possibility, seems to favor the alternative "simple imperfect substitutability" version of the monetary policy hypothesis.[17]

The second study of monetary policy we utilize is

by Cook and Hahn (1989). Using *Wall Street Journal* reports, Cook and Hahn determined the dates of approximately 75 changes in the federal funds rate target that occurred between September 1974 and September 1979. (This period was chosen because, according to the authors, during this time the federal funds rate was a very precise indicator of monetary policy.) Using daily data, Cook and Hahn showed that changes in the federal funds target caused changes in Treasury bill and bond interest rates; this implies that the target changes conveyed new information and were not simply passive adjustments to the existing level of rates.

Table 7 reports the results of regressing changes in the federal funds rate (ΔRFF), the commercial paper–Treasury bill spread (ΔSHORT), the Baa bond–Aaa bond spread (ΔDEFAULT), and the term structure spread (ΔTILT) against changes in the federal funds target, as identified by Cook and Hahn. Since the federal funds rate did not seem always to respond contemporaneously to the target change (which implied that there may have been market uncertainty about the size and timing of the change), the study used weekly data and regressed changes in the interest rate variables against the current and lagged changes in the federal funds target.[18]

Table 7 shows that, first, the actual federal funds rate responded strongly to changes in the target during this period, with the coefficients over the week of the change and the subsequent week adding up approximately to one. The term structure variable also responded strongly to target changes, and with high statistical significance; this suggests that the tilt of the term structure is in fact largely driven by monetary policy. Most interesting, though, is that the responses of SHORT and DEFAULT to a change in the funds target are found to have been in opposite directions during this period; with a one-week lag, SHORT responded positively and with high statistical significance to an increase in the funds target, while DEFAULT, somewhat surprisingly, actually fell. (The decline in DEFAULT is small but statistically significant.) The rather different responses of these two variables are consistent with the previous observation, based on the Romer and Romer dates, that SHORT is more closely related to monetary policy indicators than to general default risk.

Table 7
Relation of Changes in Interest Rate Variables to Changes in the Federal Funds Target, 1974–79

Dependent Variable	Constant	ΔTARGET	$\Delta TARGET_{-1}$
ΔRFF	−.0063	.488	.668
	(.468)	(4.72)	(6.46)
ΔSHORT	−.0047	−.063	.252
	(.500)	(.863)	(3.45)
ΔDEFAULT	.0011	−.043	−.020
	(.616)	(3.04)	(1.45)
ΔTILT	−.0041	.322	.350
	(.689)	(6.87)	(7.48)

Note: Data are weekly and the sample period is September 1974 until September 1979. ΔTARGET and $\Delta TARGET_{-1}$ are the changes in the federal funds target, in the current and previous week respectively, as identified by Cook and Hahn (1989). Other variable names are defined in Table 1. t-statistics are in parentheses.

An Estimated Equation for the Commercial Paper–Treasury Bill Spread

To get at the determinants of SHORT more directly, this study specified and estimated some simple regressions in monthly data. A first consideration in modelling SHORT empirically is that some account must be taken of tax effects. Unlike commercial paper returns, Treasury bill yields are not taxable at the state and local levels. On this account, the before-tax yields to the two instruments must be related by RCP6MO = t RT6MO, where $t > 1$ is a factor measuring the tax advantage of T-bills. This relationship implies that RCP6MO−RT6MO = (t − 1) RT6MO; that is, the spread increases proportionally to the level of the bill yield. In contrast, the ratio RCP6MO/RT6MO = t should be independent of the level of bill yields. The study followed previous work and used as the dependent variable the ratio RCP6MO/RT6MO rather than the spread RCP6MO−RT6MO;[19] however, estimated equations using the spread as the dependent variable and including the Treasury bill yield on the right-hand side gave similar results.

The previous discussion suggests that the ratio RCP6MO/RT6MO should depend on perceived default risk and the stance of monetary policy. The Baa–Aaa spread (DEFAULT) was used as a measure of default risk and the federal funds–Treasury bond spread (FUNDS) as an indicator of monetary policy.[20] Regressions of RCP6MO/RT6MO against these two variables yielded significant coefficients with the right sign, but the equations exhibited high serial correla-

tion. After correction for first-order serial correlation, the results were:

1) for January 1961 to June 1978 (the "credit crunch" period):

$$\text{RCP6MO/RT6MO} = \underset{(46.8)}{1.10} + \underset{(0.87)}{.0215}\ \text{DEFAULT} + \underset{(6.49)}{.0347}\ \text{FUNDS}$$

$$\text{rho} = .84 \qquad R^2 = .743$$

2) and for August 1978 to December 1989:

$$\text{RCP6MO/RT6MO} = \underset{(51.9)}{1.06} + \underset{(0.66)}{.0077}\ \text{DEFAULT} + \underset{(4.02)}{.0084}\ \text{FUNDS}$$

$$\text{rho} = .84 \qquad R^2 = .709$$

where rho is the estimated first-order serial correlation coefficient and t-statistics are in parentheses.[21]

These results show that the ratio of commercial paper and Treasury bill yields is positively related to default risk, as the theory suggests, but that the relationship is rather weak.[22] The relationship to monetary policy, as measured by FUNDS, is statistically much stronger, and in the earlier period is economically significant as well. (For example, if the Treasury bill rate is 6 percent, and the federal funds rate spread rises by 1 percentage point, the equation for the earlier period implies an increase in the commercial paper–Treasury bill spread of about 21 basis points.) In contrast, after 1978 the effect of the federal funds rate spread on the commercial paper–Treasury bill spread is only about one-fourth as large as before.

That the relationship of SHORT to monetary policy weakens but does not disappear after 1978 is more consistent with the simple imperfect substitutes version of the monetary hypothesis than with the credit crunch version. In order to make a more direct comparison of the two versions of the monetary hypothesis, the study examined the effects of adding to the equation for RCP6MO/RT6MO a variable equal to the spread between the six-month Treasury bill rate and the deposit rate ceiling imposed by Regulation Q, whenever that difference was positive.[23] This new variable, called CRUNCH, is supposed to capture episodes of disintermediation.

When CRUNCH and DEFAULT were included together in the equation for RCP6MO/RT6MO, for the sample period January 1961–June 1978, CRUNCH entered significantly and with the right sign in the ordinary least squares (OLS) estimates. However, with correction for serial correlation, CRUNCH entered with the wrong sign. When both CRUNCH and FUNDS were included in the equation, with correction made for serial correlation, the result was

$$\text{RCP6MO/RT6MO} = \underset{(42.2)}{1.15} + \underset{(0.43)}{.0112}\ \text{DEFAULT} + \underset{(8.24)}{.0499}\ \text{FUNDS} - \underset{(5.86)}{.0539}\ \text{CRUNCH}$$

$$\text{rho} = .82 \qquad R^2 = .779.$$

In this equation FUNDS enters much as before but CRUNCH has the wrong sign. Although these results should be taken only as suggestive, they do tend to support the simple imperfect substitutes version of the monetary hypothesis over the credit crunch version.

The Information Content of SHORT

At this point, it is appropriate to return to the question of why SHORT is such a good predictor. Some part of the reason appears to be that this spread combines information about both monetary policy (and the state of the money market) and expected default risk.[24] As a test of this answer, one more experiment was run: prediction equations were estimated for each of the ten macro variables used in Section I, over the entire sample period 1961–89. Each equation included a constant, a trend, six lags of the forecasted variable, six lags of DEFAULT (as a measure of default risk), six lags of FUNDS (as a measure of monetary policy), and six lags of SHORT. If SHORT is a good forecaster because it contains information about both default risk and monetary policy, in the presence of DEFAULT and FUNDS its predictive power should be much weakened.

The results are in Table 8. For each prediction equation the probabilities are given 1) that *both* DEFAULT and FUNDS should be excluded from the equation (leaving only SHORT) and 2) that SHORT should be excluded from the equation. The results are

Table 8
The Marginal Forecasting Power of the Commercial Paper Rate–Treasury Bill Rate Spread in Equations Containing Alternative Variables

	Marginal Significance Levels	
Forecasted Variable	H_0: All lags of FUNDS, DEFAULT equal zero	H_0: All lags of SHORT equal zero
Industrial Production	.0000	.0004
Unemployment Rate	.0048	.0133
Capacity Utilization	.0001	.0076
Employment	.0007	.2615
Housing Starts	.0000	.0022
Retail Sales	.0080	.9680
Personal Income	.2534	.0171
Durables Orders	.0156	.0530
Consumption	.0002	.0959
Inflation	.0000	.1211

Note: Entries are the probabilities that the given set of forecasting variables can be excluded from a prediction equation that includes six lags each of the forecasted variable, FUNDS, DEFAULT, and SHORT. The data are monthly and the sample period is 1961–89. Variable names are defined in Table 1.

mildly supportive of the view that information about default and monetary policy is important for forecasting: In nine of the ten cases, the probability that both DEFAULT and FUNDS can be excluded from the equation is lower than the probability that SHORT can be excluded. On the other hand, SHORT retains significance at conventional levels in a number of the equations, despite the presence of the other two variables. It must be either that SHORT somehow measures default risk and monetary policy more accurately than do DEFAULT and FUNDS, or that this variable also contains other kinds of information.[25]

III. Conclusion

This paper began by comparing the predictive power of a number of different interest rates and spreads. While several of these variables were found to contain a great deal of information about the future evolution of the economy, the spread between the commercial paper rate and the Treasury bill rate appears to be the best predictor—although this predictive power has weakened recently.

Some progress was made toward explaining why this interest rate spread is so informative. Besides containing information about default risk, which is the natural first hypothesis, this spread seems also to be a measure of monetary policy. (Indeed, if anything, the relationship between the commercial paper–Treasury bill spread and monetary policy has historically been more clearcut than the spread's relationship with default risk.) The commercial paper–Treasury bill spread predicts well because it registers developments in both the nonmonetary and monetary sectors of the economy.

At least two possible explanations can be offered as to why the predictive power of the commercial paper–Treasury bill spread was lower in the 1980s than previously. First, a number of changes in Federal Reserve operating procedures during the decade reduced the reliability of interest rates in general as indicators of the stance of monetary policy. Second, financial innovation, deregulation, and international integration may have increased the substitutability among various money market instruments; all else equal, this would act to reduce the sensitivity of interest rate spreads to monetary policy.

Whether the commercial paper–Treasury bill spread will be as useful a predictor in the future as it was in the past depends very much on which of the two explanations just given is the more important. If the first is correct, then to the extent that the Federal Reserve returns to its earlier emphasis on interest rates as targets or indicators, the predictive power of the spread (and of other interest rate variables) should return. If the second explanation is the right one, and commercial paper and Treasury bills have become effectively perfect substitutes, then the spread should not be a useful predictor in the future. Unfortunately, it is too soon to tell which of these explanations should be given the greater weight.

Data Appendix

All the data used are from Data Resources, Inc. Variable definitions and DRI code names are listed below:

Monthly Variables

Industrial production index – total (JQIND)
Unemployment rate – civilian (RUC)
Capacity utilization – manufacturing – total (UCAPFRBM)
Employed persons – nonagricultural establishments (EEA)
Housing starts – private, including farms (HUSTS)
Retail sales – 1982 dollars (STR82)
Personal income – 1982 dollars (YP82)
New orders, manufacturing durables goods – 1982 dollars (OMD82)
Personal consumption expenditures (C)
Consumer price index (CPIU)
M2 money supply (MNY2)
Leading indicators – composite index (JLEAD)
Effective rate on federal funds (RMFEDFUNDNS)
Average market yield on 3-month government bills (RMGBS3NS) and 6-month government bills (RMGBS6NS)
Rate on prime commercial paper – 6 months (RMCML6NS)
Rate on prime certificates of deposit, secondary market – 6 months (RMCD6SECNS)
Yield on Treasury securities at constant maturity of 1 year (RMGFCM@1NS) and 10 years (RMGFCM@10NS)
Yield on Moody's Aaa corporate bonds (RMMBCAAANS) and Baa corporate bonds (RMMBCBAANS)

Weekly Variables

Federal funds rate – effective (FFYW)
Commercial paper rate, industrial – 6 months (FIP180YW)
Treasury bill rate – 6 months (FBL6YW)
Treasury bond rate, constant maturities – 1 year (FCN1YYW) and 10 years (FCN10YYW)
Seasoned corporate bond rate (Moody's Baa and Aaa), weekly averages of daily figures (CAVBAA and CAVAAA)

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[1] Actually, the predictive power of this particular spread was first noticed not by Stock and Watson but by Benjamin Friedman and Kenneth Kuttner, as discussed below.

[2] Obviously the ten macroeconomic variables are not independent, since they are all related to the aggregate business cycle; thus, one should not overstate the advantage of looking at a number of different variables. On the other hand, the ten variables do reflect different measurement techniques, different sectors, and different cyclical dynamics; thus a finding that an interest rate variable predicts many of the macro variables is less likely to be spurious than a finding that an interest rate variable predicts a single macro variable.

[3] The start date is determined by data availability. Using one-month rather than longer forecasting horizons gets at the main issue of information content while avoiding technical problems arising from overlapping forecast errors. Some evidence from six-month-ahead forecasts presented below suggests that the main results are robust to the choice of forecast horizon.

[4] Stock and Watson (1989) used a similar procedure. Only real money growth was added in the prediction equation for inflation, since lags of inflation were already included in the first equation. Deflation of M2 was by the CPI.

[5] This is the traditional index, not to be confused with the Stock and Watson experimental index. The traditional index of leading indicators is a weighted average of twelve macroeconomic time series that have been found historically to be quite useful for forecasting real activity. The available leading indicator series includes revisions that were not available at the time of actual forecasts; since interest rates are rarely revised, this introduces a bias against finding marginal predictive power for interest rate variables.

[6] The short-term Treasury rate is still implicitly included, since it is a linear combination of the commercial paper rate and the commercial paper rate–Treasury bill spread.

[7] The spread between short-term and long-term Treasury bonds (TILT) was retained, even though it did relatively poorly in the univariate comparison, because it has been strongly advocated as a forecasting variable.

[8] See, for example, Priestly (1981, pp. 372–6). The best equation by each of these criteria is the one that minimizes the log of the sum of squared residuals plus a penalty term that is increasing in the number of right-hand side variables. The Schwarz criterion assesses the heaviest penalty for adding extra independent variables, the adjusted R^2 criterion the lightest.

[9] This poor showing for TILT was not due to the inclusion in the analysis of another term structure variable, the spread between the federal funds rate and the long-term bond rate (FUNDS). Exclusion of FUNDS from the analysis gave approximately the same results for TILT.

[10] This is also true in sample. For example, if the prediction equations reported in Tables 2 to 4 are re-estimated for 1961–79, the results remain strong; if they are re-estimated for 1980–89, there is a substantial reduction in fit.

[11] It is also the case that credit crunches, because they reduced the funds available for bank lending, led to large increases in the issuance of commercial paper by nonfinancial firms. This would also tend to raise the yield on commercial paper relative to Treasury securities. See Rowe (1986).

[12] For a formal model related to the following discussion, see Judd and Scadding (1981).

[13] The correlation of monthly changes in the commercial paper–Treasury bill spread and the CD–Treasury bill spread is .88 over 1970–89, the period for which data were available.

[14] It may be that monetary policy has appeared less important in recent years because the Federal Reserve has acted aggressively to forestall any increase in inflationary expectations; with inflation under control, there has been no need for the Fed to administer the strong contractionary medicine (with the resulting effects on real activity) that it did in some previous episodes. The author thanks Timothy Cook for this suggestion.

[15] The author thanks Richard Kopcke for pointing this out.

[16] For a similar result, compare the cyclical behavior of the federal funds rate, the commercial paper–Treasury spread, and the spread between Baa and government bonds (an alternative default

measure) in Figures 1, 3, and 4. RFF and SHORT tend to lead the cycle, while LONG clearly lags. It is odd, though, that changes in default premia appear to be forecastable, since if true this would imply potential profit opportunities.

[17] A caveat is that, because of tax considerations, SHORT should respond to the level of interest rates in general. This is analyzed further below.

[18] Reported results are for the whole sample, which contains many weeks in which the change in the federal funds target was zero. Regressions restricted to weeks of non-zero change in targets gave essentially the same results.

[19] See Cook and Lawler (1983).

[20] The spread variable FUNDS was used rather than the federal funds rate itself in order to avoid attributing to monetary policy possible effects (such as tax effects) arising from changes in the general level of nominal interest rates. However, for the record, replacing FUNDS with the federal funds rate RFF led to essentially the same results.

[21] The relatively high serial correlation suggested the alternative of doing the estimation in first differences. This gave about the same results as in the reported equations.

[22] Higher t-statistics for DEFAULT were obtained in the alternative specification with SHORT on the left-hand side and the level of the Treasury bill rate on the right-hand side.

[23] The ceiling rate used was the one corresponding to time deposits of six months to one year.

[24] The reader will have noticed that, based on the statistical evidence reported, the relationship of SHORT to default risk looks rather weak. That conclusion should not be pushed too far: during some periods, such as 1970 (following the Penn Central bankruptcy) and the spring and summer of 1982 (following the collapse of Drysdale Securities and Penn Square), SHORT seems to have responded strongly to fears about possible defaults.

[25] Also considered was the question of whether SHORT remains informative when the CD–Treasury bill spread is included in the forecasting equations; under the imperfect substitutes story, the two spreads should contain similar information. In this case SHORT can almost always be excluded. These two spreads move so similarly that it does not appear to matter which one is used for forecasting.

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