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Defense Cutbacks and the New England Economy

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Defense is a regrettable expenditure. Like law enforcement and insurance, defense spending may be necessary but intrinsically it does not make us feel better off in the same way as, for example, housing, transportation services, and education. Thus the reductions in East-West tensions that enable us to allocate more dollars to items that directly improve living standards should be welcome.

Nevertheless, adjustment to a lower level of defense spending has costs. Reduced demand for defense services will cause disruptions for defense-oriented companies and their workers. Concern is especially high in New England, which is home to a disproportionate share of the nation's defense contractors.

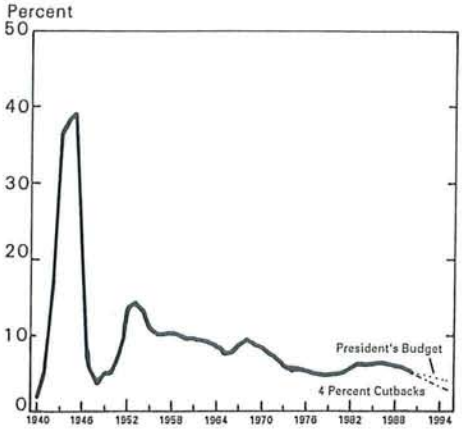
This article examines New England's economic costs from lower defense spending. Although the reduced expenditures on defense will have a noticeable negative effect on the region's output, this will not be as great as in past cutbacks. However, the coincidence of defense reductions with other economic problems in New England will tend to magnify the difficulty of adjustment. Section I measures the defense intensity of the national economy, and indicates the budgetary changes expected through the mid 1990s. Section II provides information on the role of defense in New England, and Section III estimates the impacts of defense cutbacks. The following two sections of the paper examine in more detail the effects of falling defense budgets on businesses doing work for the Defense Department and on their workers, as well as indicating possible roles for government. Section VI is a summary.

I. Defense in the National Economy

Between 1979 and 1986, national defense spending rose from 4.8 percent to 6.5 percent of GNP, a large increase in a peacetime economy. Since 1986, defense spending growth has slowed, and the defense share

Chart 1

Defense Spending as a Percentage of GNP, Fiscal Years 1940-95



Source: Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991*; Executive Office of the President, *Budget of the United States Government Fiscal Year 1991*; Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*; and *Economic Report of the President*, 1990.

of GNP fell to 5.9 percent in 1989. By the mid 1990s, assuming diminished international tensions, defense spending is expected to fall to its lowest share of the economy since the late 1940s, or perhaps even since before World War II. The further reduction in the defense intensity of our economy will pose new challenges for defense-oriented industries and their workers, as well as offering new opportunities for the government to finance other worthwhile activities, reduce its budget deficit, or lower taxes. However, the extent of these challenges and opportunities should not be exaggerated. Despite the buildup in the early 1980s, defense is a smaller share of our national economy than during most of the post-World War II period. Also, the reduction in defense spending will probably be small relative to those experienced after previous wars.

Historical Trends and Projections for the 1990s

The federal government spent about $300 billion for defense in fiscal year 1989. Adjusted for inflation, this was roughly the same as at the 1953 Korean War peak and the 1968 Vietnam War peak. But although the Carter-Reagan peacetime buildup left defense spending near these wartime highs in real dollars, the U.S. economy has grown significantly over the past forty years, and the 1980s defense budget was not as large a share of the nation's resources as at the other peaks. Furthermore, it was lower than in every single year from 1951 to 1972 (Chart 1). This previous reduction limits the problems and the possibilities associated with future defense cutbacks.

Under the President's proposal, the defense budget would grow only modestly (in nominal dollars), and it would fall from its recent share of 5.9 percent of GNP to 4.2 percent by fiscal year 1995 (Chart 1). Other participants in the national budgetary debate envision sharper cutbacks. If the nominal defense budget were reduced by 4 percent annually starting next year, an example considered in this article, defense would be 3.2 percent of GNP by fiscal year 1995.[1] These reductions from the 1986 peak, between 2.3 and 3.3 percentage points, would be far less than after World War II and the Korean War, and somewhat less than after the Vietnam War.[2]

Similarly, relative to the federal government budget, defense spending's 1980s peak of 28.1 percent in 1987 was well below the Korea and Vietnam peaks of 69.5 and 46.0 percent (Chart 2). So the prospect of a reduction to between 21.6 percent and 16.4 percent in fiscal year (FY) 1995 offers less of a "peace dividend" than after those wars.

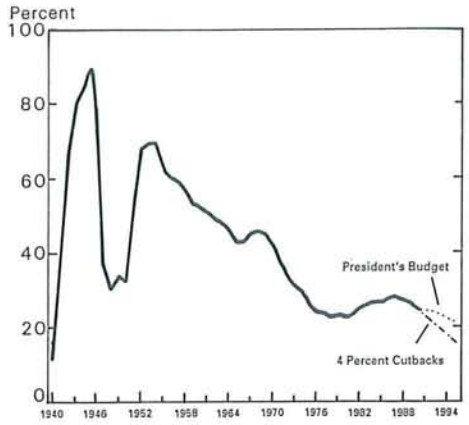
Composition of the Defense Budget

The largest components of recent military spending are operations and maintenance (29.5 percent in FY 1989), procurement (27.7 percent), and military personnel (27.4 percent). Research, development, testing, and evaluation (RDT&E) accounted for an additional 12.5 percent in FY 1989. The defense buildup of the 1980s consisted of increases in hard goods, services, and other items produced by private industry rather than growth of military personnel (Chart 3). Procurement spending more than doubled in constant dollars between the late 1970s and the late 1980s. Real RDT&E grew very rapidly (an annualized rate of 9.8 percent between 1979 and 1986), in order to support increasingly high-technology military hardware. RDT&E and operations are the only components of the defense budget that are significantly larger than they were three decades ago.

The composition of future defense budgets is highly uncertain. Under the President's budget for FY 1995, operations and maintenance would rise to 30.7 percent of total military spending authority,

Chart 2

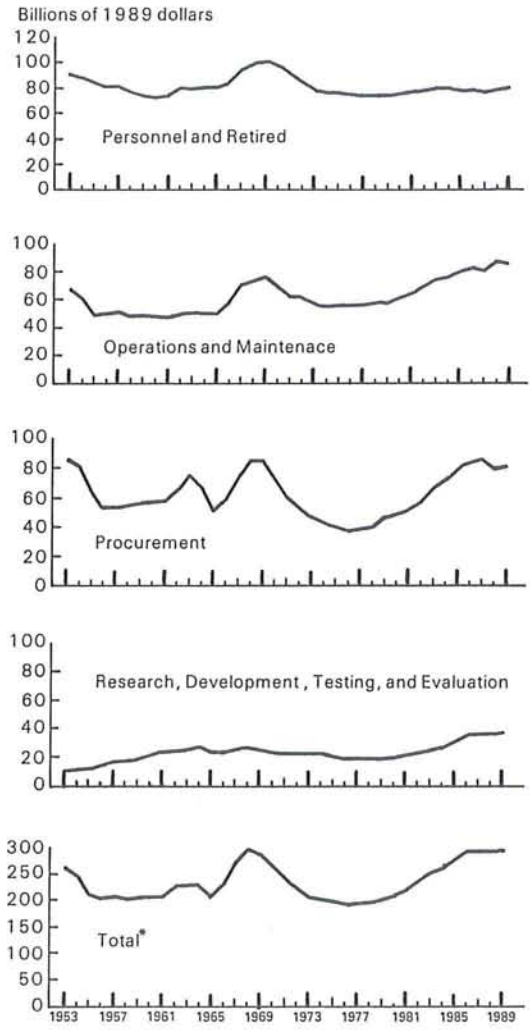
Defense Spending as a Percentage of Federal Government Outlays Fiscal Years 1940-95



Source: Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991*; Executive Office of the President, *Budget of the United States Government Fiscal Year 1991*; Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970.*

Chart 3

Components of the Military Budget, Fiscal Years 1953 to 1989



* Includes military construction, family housing, and other.

Source: Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991.*

procurement would drop to 26.1 percent, and the shares for other components including personnel and RDT&E would remain approximately constant. Current Congressional sentiment appears to favor sharper cutbacks in the defense budget, but priorities under such a plan have not yet been established (see U.S. Congressional Budget Office 1990b for further discussion). One scenario would emphasize readiness while deferring investment in more modern defense systems. Accordingly, procurement would be reduced sharply, while personnel and operations and maintenance would be reduced only modestly. Alternatively, the armed forces might accede to larger cutbacks in personnel in order to preserve spending on desired weapons systems.

The future role of RDT&E is especially uncertain. If Congress chooses to delay the introduction of new weapons systems, it might also postpone RDT&E. On the other hand, continued research and development might be preserved on the view that it is a useful hedge against future international threats, as well as a source of commercial spin-offs.

As an illustration of one possible alternative, this study considers aggregate nominal spending cuts of 4 percent a year starting in FY 1991. This hypothetical scenario includes a sharp reduction in procurement, a somewhat reduced share of the budget for RDT&E, and relatively modest reductions in personnel and operations and maintenance.

The analysis in this study highlights possible results for the mid 1990s rather than distinguishing

year-by-year patterns. (See Appendix Table 2 for detailed projections of FY 1995 budget authority). For both the President's plan and the 4 percent cutbacks plan, near-term reductions in spending are likely to be more modest than reductions in budget authority. This discrepancy is due to procurement authorized (but not yet paid for) in previous years' budgets (see Kaufmann and Korb 1989). Because of this pattern, the impacts of defense cutbacks are likely to show up earlier in contractors' orders than in their production activity.

II. Defense in the New England Economy

The pattern of the military buildup in the 1980s, as well as the pattern of cutbacks in the 1990s, suggests that New England might be particularly prone to economic disruptions from defense cutbacks. As a region, we receive a disproportionately high share of prime contract awards while having a relatively low share of military personnel.

Measures of Defense Intensity

Table 1 presents some key indicators of the defense intensity for the New England states. The first two columns indicate defense spending through prime contracts to private companies. Prime contract awards include budgetary items found under procurement, RDT&E, operations and maintenance, and some smaller categories such as military construction. From FY 1987 to 1989, Massachusetts received an average of $1405 per resident and Connecticut received $1651 per resident. These figures are roughly three times the national average of $514 per capita. Massachusetts and Connecticut also defied the prevailing pattern of declining prime contracts in FY 1989, as both states received large increases, even after adjusting for inflation (Chart 4). Still, contracts in both states are below their earlier peaks. The other New England states were below the national per capita average during the FY 1987 to 1989 period, and together accounted for only 11 percent of the region's total awards. As shown in column 2 of Table 1, prime contract awards for RDT&E accounted for about 16 percent of the total. Most of these went to Massachusetts, which had a per capita figure over four times the national average. Partly as a result of this high share of research, prime contract awards to Massachusetts grew very rapidly through the mid 1980s (Chart 4).

Prime contract awards are a somewhat imperfect measure of private sector production for the Defense Department. First, these data indicate when awards are made, but spending occurs with a lag. A more serious limitation is that, at best, prime contracts indicate the location of only the final stages of production, not work performed by subcontractors and other vendors. Producers of aircraft engines in Connecticut, for example, may purchase metals from other parts of the country. Computer services companies in Massachusetts may do work for defense contractors in other regions. The further down the chain of production, the more difficult it is to identify goods and services as defense-oriented, since they tend to resemble goods and services produced for other applications. Also, in some cases prime contract awards are listed by a company's primary facility rather than taking into account other locations for production work. An important example in New England is the exclusive allocation of General Dynamics/Electric Boat contracts to Groton, Connecticut, although additional work is performed at Quonset Point, Rhode Island. As a result of these measurement problems, no definitive data are to be found on shares of total state or regional private-sector output related to defense.

A simulation model developed at the Department of Defense estimates, however, that New England receives almost as large a share of total defense work as it does of prime contracts. In 1989, 9.9 percent of goods and services purchased directly by the Defense Department came from New England (column 4 of Table 1). The model assumes that these prime contractors purchase required services locally, but that they spread their purchases of goods across all states in proportion to where the goods are produced. Adding in these assumed indirect purchases, 9.1 percent of the nation's defense production came from New England (column 5).[3]

By contrast with procurement from the private sector, Defense Department spending on personnel in New England has been relatively small (column 3 of Table 1). Personnel spending relative to gross state product was substantially above the 1989 national average of 1.8 percent only in Maine (2.8 percent). In Connecticut, Massachusetts, and Vermont, military payrolls were less than 1 percent of gross state product.

Even after taking into account the region's low share of military payroll, a higher than average percentage of total goods and services produced in the New England states is related to defense. The De-

fense Department model estimates that this share in 1989 was 6.2 percent for New England, compared to 4.7 percent for the nation (column 6). In Connecticut, the estimated share was 7.5 percent and in Massachusetts, it was 6.0 percent.

Finally, for the nation as a whole, value added by defense formed 5.9 percent of GNP in 1989. If the national relationship between value added and defense production applies to the region, then the Defense Department model suggests that defense

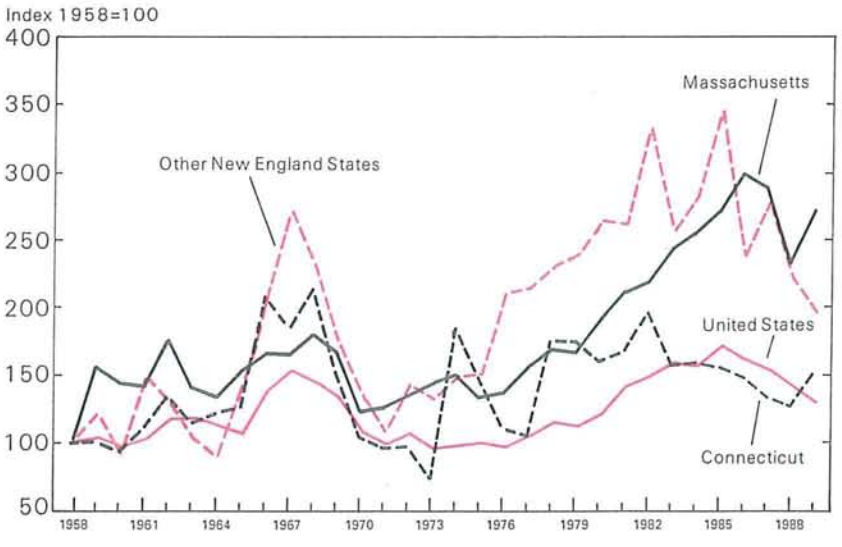
Table 1
Defense Indicators for New England and the Nation

	Prime Contract Awards per Capita, FY 1987–89 Average		Payroll as a Percent of Gross State Product, 1989[a]	Share of National Defense Purchases Excluding Pay, Estimate for 1989 (Percent)		Percent of Production Related to Defense, Estimate for 1989
	Total (1)	Research (2)	(3)	Direct (4)	Total (5)	(6)
Connecticut	$1651	$ 81	.6	3.5	3.2	7.5
Maine	$ 480	$ 5	2.8	.5	.5	5.8
Massachusetts	$1405	$364	.7	4.8	4.2	6.0
New Hampshire	$ 437	$ 51	1.2	.6	.6	5.2
Rhode Island	$ 446[b]	$ 29[b]	2.1	.3	.4	4.6
Vermont	$ 241	$ 30	.7	.2	.2	4.2
Total New England	$1176	$194	.9	9.9	9.1	6.2
Total United States	$ 514[c]	$ 89[c]	1.8	100.0	100.0	4.7

[a]1989 Gross State Product is estimated by assuming that GSP grew at the same rate as personal income between 1986 and 1989.
[b]Excludes General Dynamics, whose contracts are officially allocated to Connecticut.
[c]Excludes prime contracts not allocated to particular states.
Source: Columns 1 and 2: U.S. Department of Defense, (1990d) and U.S. Bureau of the Census (1989); column 3: U.S. Department of Defense (1990a) and U.S. Bureau of the Census (1989); columns 4,5,6: U.S. Department of Defense, (1989b).

Chart 4

Indexes of Real Prime Contract Awards, Fiscal Years 1958 to 1989



Source: Department of Defense, Directorate for Information, Operations and Reports, *Prime Contract Awards by Region and State*, various issues; and Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991*.

might account for about 8 percent of gross regional product in New England.[4]

These results indicate that New England's concern about the impact of defense cutbacks is quite appropriate, since defense is a larger share of the region's economy than it is of the national economy. On the other hand, the results should allay the fears of anyone who might have guessed that the fate of the defense industry is the dominant factor determining New England's future.

The Composition of Demand

The Defense Department's direct purchases from New England consist mostly of durable manufactured goods. Large corporations dominate these "hard goods" procurement programs. Among the region's major defense contractors, General Dynamics, manufacturer of submarines through its Electric Boat division, has large operations in both Connecticut and Rhode Island. Connecticut is also home to United Technologies, which manufactures aircraft engines at Pratt & Whitney and airframes at Sikorsky Helicopter, as well as to Kaman Aerospace. In Massachusetts, the largest defense industries are missiles (for example, Raytheon, General Electric, Textron Defense Systems, Draper Labs), aircraft engines (General Electric), and electronics and communications equipment (GTE and Raytheon). Raytheon also has defense-related electronics operations in Rhode Island. Because of MIT and the Mitre Corporation, Massachusetts is first in the nation for defense research dollars awarded to the nonprofit sector. Shipbuilding, represented by Bath Iron Works, is the predominant defense industry in Maine. Electronics and communication equipment account for the bulk of the prime contracts in New Hampshire (for example, Lockheed Sanders). Guns are the largest defense industry for Vermont (manufactured mostly at General Electric).

Many smaller companies in the region also receive defense contracts, especially for construction and other services. (Appendix Table 1 provides a detailed list of New England facilities receiving prime contract awards in FY 1987; this was the most recent disaggregated information available.) Looking also at indirect effects (that is, suppliers to prime contractors), business services, including repairs and maintenance of equipment and computer software development, are a significant component of defense purchases.

III. Defense Expenditure Cuts in New England

This section provides projections of prime contract awards to New England through the mid-1990s assuming enactment, in turn, of the President's budget and 4 percent annual cutbacks. These projections should be viewed as illustrative because they assume a continuation of past geographic patterns. For example, it is assumed that 15 percent of missiles procurement contracts will be awarded to New England companies, as in recent years. Alternatively, the Defense Department could choose to de-emphasize or cancel particular weapons systems that disproportionately affect certain regions of the country. Indeed, the larger the cutbacks in national defense, the more likely it is that entire systems would be eliminated. Also, because of changes in costs or technologies, New England suppliers may gain or lose market share relative to competitors elsewhere in the country.

With these caveats in mind, the results through 1995 indicate that the New England region as a whole will experience percentage cutbacks in prime contracts of about the same magnitude as the nation, using the FY 1987–89 average as the base. Cutbacks in Connecticut are projected to be more severe, while those for Massachusetts are projected to be milder. Given the heavy orientation toward defense in these states, these percentage reductions would amount to significant dollar losses.

The Effects of Defense Cutbacks on Prime Contracts

The projections entailed three major steps (see the Appendix for further details). First, budget authority assumptions were developed through FY 1995. The President's budget contains breakdowns for four major categories: operations and maintenance; procurement; research, development, testing, and evaluation; and military construction. For the 4 percent cutbacks plan, the assumptions for these categories are consistent with a policy of emphasizing readiness and deferring investment. Within procurement, assumptions were developed for six subtotals: aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other. These percentage allocations are the same for both scenarios, and are based on extrapolations of information found in the President's budget through FY 1991. The second step was to use these budget authority figures to project national prime contract awards, based on regression

Table 2
Department of Defense Prime Contract Awards, Actual FY 1987–89 and Projections for FY 1995
Millions of Dollars

		FY 1995		FY 1995 (FY 1989 Dollars)[b]		Compound Annual Real Rate of Change, FY 1987–89 Average to FY 1995[b]		Memo: Percent Change, FY 1988 to FY 1989[a]
	FY 1987–89 Average[a]	President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	
Hard Goods, Excluding RDT&E								
Aircraft	23,740	23,710	16,964	18,739	13,410	−4.5	−9.7	4.6
Missiles	13,890	14,892	9,159	11,770	7,240	−3.3	−10.9	2.2
Ships	11,620	10,374	8,066	8,199	6,376	−6.3	−10.1	−32.3
Weapons and Tracked Vehicles	5,380	5,084	4,047	4,018	3,199	−5.4	−9.0	−18.7
Ammunition	3,673	2,077	1,242	1,641	982	−13.2	−20.3	−12.2
Electronics	16,651	18,201	13,937	14,384	11,017	−3.1	−7.3	7.0
Total Hard Goods	74,954	74,338	53,415	58,750	42,225	−4.6	−9.7	−4.8
Construction	7,971	7,706	5,356	6,090	4,234	−5.0	−10.6	−7.4
Services and Other Non-RDT&E	21,535	25,792	21,234	20,384	16,786	−1.5	−4.7	−6.6
Research, Development, Testing, and Evaluation	21,856	23,486	17,798	18,561	14,070	−3.3	−7.7	−1.1
Total[c]	126,315	131,322	97,803	103,786	77,315	−3.8	−8.5	−4.7

[a]Not adjusted for inflation.
[b]Assuming an annual inflation rate of 4 percent from FY 1990 to FY 1995.
[c]Excludes prime contract awards not allocated to particular states.
Source: U.S. Department of Defense (1990d) and author's estimates (see the Appendix).

analysis for the 1980s. For example, aircraft prime contract awards (excluding research) were projected from the assumed budget authority for aircraft procurement. Finally, these national prime contracts were allocated to states according to their shares in the most recent three fiscal years.

Table 2 presents estimates of national prime contract awards by category, and Table 3 indicates the associated projections for New England. Under the President's proposal, total prime contract awards would increase at only a 0.6 percent rate through FY 1995. (In this section, rates of change are calculated using the average of FY 1987 to FY 1989 as the base period. Averaging reduces somewhat the problems associated with interpreting volatile historical data.) Contracts for aircraft and ammunition would decline. Contracts for ships and for weapons and tracked vehicles are also shown to decline, but these reductions are largely already complete, as a result of sharp cutbacks in FY 1989. Assuming an annual inflation rate of 4 percent, total prime contracts in constant dollars would decrease at a rate of 3.8 percent. No category would show a real increase, although reductions in services, electronics, RDT&E, and missiles would be relatively small compared to the other categories. The sharper cutbacks scenario would translate into a real rate of decline of 8.5 percent for total prime contracts, with even larger cuts for procurement of hard goods and construction. This budget would require allocating a greater share of the remaining resources to maintaining existing equipment, so contracts for services would decrease considerably less than average.

In New England, total prime contracts in constant dollars would decrease at an annual rate of 4.0 percent under the President's proposal. Under the alternative case, they would fall at a rate of 8.7 percent. These rates of reduction are similar to national averages. Thus, the projections assume that the unusually strong performances of Connecticut,

Table 3
New England Prime Contract Awards, Actual FY 1987–89 and Projections for FY 1995
Millions of Dollars

	FY 1987–89 Average[a]	FY 1995		FY 1995 (FY 1989 Dollars)[b]		Compound Annual Real Rate of Change, FY 1987–89 Average to FY 1995[b]		Memo: Percent Change, FY 1988 to FY 1989[a]
		President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	
Connecticut	5,341	5,202	3,878	4,111	3,064	−4.8	−9.4	23.8
Maine	573	531	411	420	325	−5.8	−9.7	−28.6
Massachusetts	8,218	8,738	6,392	6,906	5,052	−3.5	−8.4	21.4
New Hampshire	476	510	383	403	303	−3.3	−7.8	−0.6
Rhode Island	441	468	367	370	290	−3.5	−7.4	−2.7
Vermont	133	131	99	103	78	−4.7	−9.0	34.2
New England	15,182	15,580	11,530	12,313	9,112	−4.0	−8.7	19.0

[a]Not adjusted for inflation.
[b]Assuming an annual inflation rate of 4 percent from FY 1990 to FY 1995.
Source: U.S. Department of Defense, (1990d) and author's estimates (see the Appendix).

Massachusetts, and Vermont in FY 1989 were temporary aberrations. Contracts to these states are not expected to continue to rise sharply in the context of weakening defense orders nationwide.

Over the FY 1987–89 average to 1995 period, Connecticut is expected to fare substantially worse than the nation in percentage terms because of its reliance on aircraft and submarine contracts, while the decline in Massachusetts would be somewhat tempered by the comparatively gradual reductions expected for missiles, electronics, and research contracts. Given the high concentration of defense-related activity in these states, both these percentage changes would cause relatively large reductions in production. Maine is projected to suffer as a result of its reliance on shipbuilding, but much of this decline already took place in sharp cutbacks at Bath Iron Works since FY 1987. Vermont would be hard hit in percentage terms because of its high share of weapons production among prime contracts. This cutback would not have a large impact on the statewide economy, but might be a significant factor in the Burlington area, where the General Electric plant is located. New Hampshire and Rhode Island would also feel the effects of cutbacks in prime contracts, but less intensely because of their concentration in electronics. The results for Rhode Island should be interpreted with extreme caution because they implicitly omit activities of General Dynamics/Electric Boat. More generally, as noted above, prime contracts do not take into account the activity performed by subcontractors and other vendors. This may cause distortions in the results, especially for the smaller states.

The outcomes for particular contracts to particular companies potentially could cause a very large difference in the actual results. Contracts to most of the New England states are very highly concentrated in a few companies. For example, in FY 1989, the five largest recipient firms in Connecticut (United Technologies, General Dynamics, Textron, Kaman, and Analysis & Technology) received about 90 percent of prime contract awards. In Vermont, three-quarters of the total went to General Electric alone. The projections for Massachusetts may be subject to a smaller margin of error, because contracts are spread out over a relatively larger number of companies than is the case in the other New England states. But even in Massachusetts, higher contracts awarded to GTE more than accounted for the entire increase in FY 1989.

Comparisons with the Post-Vietnam Era

Cutbacks in procurement after the Vietnam War had a very large impact on New England (Chart 4 and Table 4). In a five-year period, inflation-adjusted contracts to the region fell by half, a much greater drop than for the nation. Reduced orders for aircraft

caused especially large disruptions in Connecticut. Although Massachusetts did not experience as large a decline overall, the state suffered a 31 percent drop in prime contracts over an interval of just two years (FY 1968 to FY 1970). The current retrenchment will be much milder, for two reasons. First, the mix of production is much more favorable than in the earlier period. Relatively high concentration in areas such as electronics and research should prevent New England from experiencing percentage cutbacks in prime contracts that are more severe than the national average. Second, the reductions in the defense budget are now much more gradual, having started in the mid 1980s. So, for example, although *total* percentage cutbacks in New England under the 4 percent cutbacks plan might be comparable to those of the post Vietnam era, the *annual rate* of cutback would be only half as large. This fact allows defense contractors more time to consider pursuing alternative lines of business. It also means that laid-off workers have greater chances of being absorbed elsewhere in the economy.

The Effects of Cutbacks in Military Personnel

Prospective budgets also make reductions in military personnel. Assuming a 4 percent inflation rate, President Bush's proposal would cause an annualized real cutback of 2.8 percent. The assumptions under the alternative plan entail devoting a larger share of the defense budget to personnel. Nonetheless, it would result in a 5.9 percent rate of real cutback, which would exceed the 4.3 percent rate of reduction during the de-escalation of the Vietnam War (FY 1968 to FY 1974). In both cases, these decreases are still less than for contracts to private industry. Also, because of the relative dearth of young workers compared to the situation in the early 1970s, the U.S. economy now has less difficulty absorbing cutbacks in military personnel.

As noted above, of the New England states, only Maine and Rhode Island have above-average concentrations of defense personnel, and therefore would appear to be the most vulnerable to cutbacks in terms of potential economic damage. However, reductions in this category of the budget would probably involve closing particular military bases rather than making widespread cuts. Pease Air Force Base in New Hampshire is already slated to be closed, for example. Specific plans for shutting additional military bases are subject to Congressional approval, and have not been finalized. In an effort to save domestic jobs, Congress could possibly vote, for example, to close more bases abroad. For this reason, it is impossible to have confidence in any projection of the geographic allocation of personnel cutbacks.[5]

Total Effects and Macroeconomic Feedbacks

This section discusses aggregate economic impacts of defense cutbacks in New England. For the nation as a whole, the President would cut roughly $50 billion (FY 1989 dollars) from the defense budget by FY 1995. The sharper cutbacks proposal has over twice this reduction. As the section on defense intensity indicated, it is difficult to derive regional measures of total private defense-related activity solely from information on prime contract awards. Nevertheless, for policymaking purposes, a "ballpark" estimate is probably useful. A rough estimate of total impacts for New England might assign 2.5 percent of the military personnel cuts and 10 percent of the remaining cuts to the region. (This takes into account the data in Table 1, the estimates in Tables 2 and 3, and information on New England gross regional product relative to GNP.) These assumptions produce a total impact in New England of about $4.1 billion (FY 1989 dollars) from the President's budget and $9.6 billion (FY 1989 dollars) from the alternative

Table 4
Changes in Real Prime Contract Awards after the Vietnam War and Current Projections
Percent

		Current Projections FY 1985 to FY 1995[b]	
	Post Vietnam: FY 1968 to FY 1973[a]	President's Proposal	4 Percent Cutbacks Plan
Connecticut	−65	−35	−51
Massachusetts	−20[c]	−21	−42
Total New England	−47	−30	−48
United States	−34	−35	−51

[a]Actual peaks were: FY 1967 for the United States and FY 1968 for Connecticut, Massachusetts, and total New England. Actual troughs were: FY 1970 for Massachusetts and FY 1973 for Connecticut, total New England, and the United States.

[b]Actual peaks were: FY 1982 for Connecticut, FY 1985 for total New England and the United States, and FY 1986 for Massachusetts.

[c]Reduction between FY 1968 and the actual trough in FY 1970 was 31 percent.

Source: U.S. Department of Defense (1990b); U.S. Department of Defense (1990c); and author's estimates described in the Appendix.

budget. Relative to gross regional product in New England, these impacts are fairly moderate. (In 1986, the latest year available, gross regional product was $246 billion.)

Related industries would also be affected. For example, lower expenditures by defense employees would affect sales of consumer items. Macroeconometric models compute such multiplier effects to be between one and one-half and two times the direct impacts (U.S. Congressional Budget Office 1983). Even so, while the aggregate economic effects would be noticeable, they would not be out of line with the magnitude of shocks that the New England economy has felt with the usual ups and downs of business cycles. The timing of the cuts is particularly unfortunate, however, given the generally weaker economic growth that the region is experiencing compared to its performance in the 1980s.

According to mainstream macroeconomic theory (for example, Dornbusch and Fischer 1984), output does not remain permanently depressed when one component of aggregate demand is reduced. After a time, weaker demand, such as that generated by a reduction in defense spending, tends to lower prices. The near-term impact is a decline in output and employment, but eventually wage demands also fall in response to weak labor market conditions. The lower real cost of labor causes firms to hire more workers and expand production. Eventually (perhaps after three to seven years) national production is no lower than it would have been without the reduction in government spending.[6]

In the longer run, a decline in defense activity may even lead to higher national output if it is replaced by more productive activity. For example, it is widely felt that research and development in defense industries leads to some positive technological benefits for the economy at large, but that these spillovers are not as great as from other forms of industrial research. On the other hand, cutting defense expenditures does not guarantee productivity gains because many nondefense activities (whatever their other merits) could not be characterized as high technology. So the actual productivity gains depend very much on the new economic activity that replaces defense spending.[7]

Particular regions of the country might still suffer reductions in output for longer periods than the nation, depending on migration patterns caused by the initial downturn and the composition of new economic activity. For example, if new business opportunities were to develop faster in the rest of the country than in New England, professionals such as engineers and scientists might leave the region. Such a "brain drain" would hinder future expansion of technology-oriented businesses in the region. New business patterns depend partly on the federal government's allocation of the "peace dividend." Most alternatives would be significantly less targeted toward New England than defense spending has been. Nevertheless, some exceptions exist to this general rule. For example, for every dollar of defense-related research and development diverted to government-sponsored nondefense research and development, New England would expect to receive back about 60 cents. However, the region would probably recoup funds dollar for dollar if the additional resources were targeted toward health, transportation, or university-based research as opposed to agriculture or energy.[8]

IV. Consequences for Defense Contractors

The region's defense contractors vary widely in their reliance on defense. Table 5 provides information on the ratio of defense contracts as a percent of revenues for some of the largest recipient companies in New England. At one extreme, Bath Iron Works, General Dynamics, and Lockheed Sanders receive over three-quarters of their New England business from the Defense Department. Despite a long-term program of diversification, over half of Raytheon's business is still in defense. The shares for Colt Industries and United Technologies may seem surprisingly low, given their perceived association with defense work; both companies have diversified considerably into other lines of business. Some large computer companies including Digital and Wang receive business from the Defense Department, but these contracts amount to well under 10 percent of their overall revenues.

Some observers advocate widespread conversion of defense-related industrial facilities to nondefense applications (see, for example, the volume edited by Gordon and McFadden 1984). There are many cases of successful conversion of former military bases, involving joint planning by government and private industry, to uses such as industrial parks and commercial airports (see U.S. Department of Defense 1985). But most people would agree that our market-oriented economic system is not well suited to a similar process for adjustments for private industrial plants. In most cases, government cannot contribute

detailed knowledge about new products that businesses would need in a diversification effort. Business can obtain this information more effectively by developing it in-house, acquiring other companies, or purchasing consulting services.

Nevertheless, governments could provide other types of information. Advance notification of specific budget cuts by the Pentagon would help companies plan adjustment strategies. Also, both state and federal governments might serve as clearinghouses of information for contractors seeking new markets overseas or with other government agencies. For example, governments could identify how political and economic developments in other countries might increase demand for various goods and services produced in the United States, and they could explain the legal and other requirements for exporting. The expected cutbacks in defense should spur governments to survey the adequacy of their current informational services to business. Efforts in this area might be particularly helpful for the smaller companies involved in defense contracting. The actual choice of an adjustment strategy, however, should be left to the companies themselves.

Companies' responses to defense cutbacks are likely to vary from industry to industry. In the aircraft industry, companies already tend to produce for both defense and commercial markets. The need to modernize commercial airplanes as well as increased orders from abroad may provide some manufacturers with enough business to take up the slack left by defense. In shipbuilding and weapons production, other markets are very limited, so defense cutbacks will probably lead to decreased production at most facilities, and perhaps even some plant closings. In general, defense contractors that have produced a diversified mix of products in the past will benefit from the experience of marketing to customers outside of the defense area. They are likely to choose among a variety of options, including conversion, production cutbacks, and acquisitions of nondefense lines of business.

No matter how defense contractors adjust their production, it is likely that the new configuration will require a somewhat different mix of labor market skills. When defense-oriented companies have acquired nondefense businesses in the past, they still tended to lay off at least part of the work force in declining lines of business.[9] What amounts to a very successful adjustment by a company may look very different from the standpoint of its employees and the surrounding community. Income support for unemployed workers and assistance for finding new jobs are the topic for the next section. Community impacts are likely to be most severe in the case of a specialized defense plant operating in an area with little other industrialized activity. In these situations, the joint public-private planning process used in adjusting to base closings could be quite valuable.

Table 5
Defense as a Percent of New England Revenues for Selected Contractors

At least 75 percent	Bath Iron Works, General Dynamics, Lockheed Sanders
50 to 74 percent	Bolt Beranek & Newman,[a] Raytheon[b]
25 to 49 percent	Textron
10 to 24 percent	General Electric,[b] Kaman Corporation, United Technologies[b]
Less than 10 percent	Colt Industries,[b] Digital Equipment,[b] GTE,[c] RCA,[d] Wang Laboratories[d]

Note: Estimate provided by the company unless otherwise noted.
[a]Excluding subcontracts, Bolt Beranek & Newman would fall into the 25 to 49 percent category.
[b]Classification based on nationwide prime contract awards during U. S. government fiscal year 1988 relative to company's sales or revenues reported in Standard & Poor's (1989).
[c]Estimate provided by the company includes operations outside New England. Estimate for New England operations alone is not available, but would probably be considerably higher because the company estimates that over half its defense-related operations are headquartered in New England.
[d]Classification based on average of prime contract awards in New England during U.S. government fiscal years 1985, 1986, and 1987 relative to company's sales or revenues reported in Standard & Poor's (1989).
Source: U.S. Department of Defense, [1988]; Standard & Poor's (1989); and company representatives.

V. Consequences for Employment

Estimates of job losses associated with defense cutbacks vary widely. (For example, see Adams and Gold 1987 and The Massachusetts Jobs with Peace Campaign 1986). A compromise estimate might be 14,000 jobs at defense contractors and their suppliers per billion-dollar cutback. (See U.S. Congressional Budget Office 1983. This estimate does not include multiplier effects.) Thus, if defense spending is cut by $4.1 billion in New England under the President's budget, about 57,000 jobs would be lost in defense sectors by 1995. This is about 0.9 percent of the

current nonagricultural work force in the region. Using the assumption of a sharper cutback in defense yields a loss equal to about 134,000 jobs in the region, or about 2.0 percent of current employment.

Despite their differences, all analyses of job market effects agree that cutbacks (increases) in defense spending generate fewer job losses (gains) than most other forms of either public or private spending.[10] The lower jobs-per-dollar ratio is largely the result of defense-related industries paying higher wages. For example, a study of seven heavily defense-oriented industries in Massachusetts indicated that average annual wages in 1987 were 26 percent higher than in other manufacturing industries and 57 percent higher than in nonmanufacturing industries (Massachusetts Department of Employment and Training 1989a). By contrast with defense spending, when government or consumers cut their demand for production in sectors with lower wages or with a higher labor-to-capital ratio, more jobs are lost per dollar of spending reduction. In other words, defense cutbacks affect fewer jobs, but these are "better" jobs.

Defense workers are paid more than other workers because on average they are more highly educated and more skilled, and because, judging by their age distribution, they have more work experience. In the 1987 sample from Massachusetts, 33 percent of the defense workers were in the highly paid professional and technical category, including 15 percent engineers and 7 percent engineering and science technicians. In other manufacturing industries, only 14 percent of the workers were classified as professional or technical, and in nonmanufacturing, only 24 percent.[11]

Existing Programs to Assist Unemployed Workers

The distinctive characteristics of defense workers suggest that they may have different access to assistance when they become unemployed, and also that they have different needs from other workers. The evidence indicates that displaced defense workers on average have more access to income support programs than many other unemployed workers. However, unemployment benefits and job placement assistance vary widely from state to state, and from company to company. The prospect of layoffs in defense industries should prompt governments and companies to reexamine the adequacy of their programs in light of workers' needs and the programs available in other states.

The primary U.S. income support program is unemployment insurance.[12] Only about 30 percent of unemployed persons receive benefits, however, since new entrants into the labor force and people who leave their jobs voluntarily are not covered. But in the case of laid-off defense workers, almost all will be eligible. In New England, the maximum weekly unemployment benefit in 1989 ranged from $162 in New Hampshire to $382 in Massachusetts. Observed average weekly benefits were much more generous in Connecticut, Massachusetts, and Rhode Island than in the northern New England states (Table 6).

In the case of large plant closings (as opposed to layoffs of selected employees), federal law requires companies to give employees sixty days advance notice, enabling them to start looking for other jobs. State plant closing statutes provide additional benefits in some cases. Employers in Connecticut and Massachusetts must provide continued health benefits, while those in Maine must provide severance pay (Table 6). The remaining New England states have no plant closing statutes.

Table 6
State Programs to Assist Displaced Workers in New England

State	Unemployment Insurance: Maximum Weekly Benefit[a]	Unemployment Insurance: Average Weekly Benefit	Plant Closing Law
Connecticut	$284	$192	120 days' group health insurance[b]
Maine	$270	$148	Severance pay of one week for each year of service to employees who have been at the firm for three or more years.[b]
Massachusetts	$382	$211	90 days' group health insurance.
New Hampshire	$162	$124	—
Rhode Island	$300	$183	—
Vermont	$178	$137	—

[a]A maximum of 18 additional weeks of benefits is available to workers in state training programs beyond the maximum of 26 weeks (30 in Massachusetts).

[b]Covers businesses with at least 100 employees.

Source: U.S. Congressional Budget Office (1990a), state statutes, and conversations with state officials.

If previous data on layoffs of skilled workers are a useful guide, displaced defense workers are likely to require assistance in finding new positions. Historically, a substantial portion of experienced workers have remained without a job for long periods of time following layoffs. For example, of prime-age men (twenty-six to fifty-five years old) who lost their job over a year prior to being surveyed in January 1984, only 75 percent were working, 19 percent were unemployed, and 6 percent had dropped out of the labor force. The nonemployed proportions were even higher among older men and among women (Osterman 1988).

Defense companies can help to minimize the unemployment spells of their employees. For example, GTE laid off 2,000 workers in California over a two-year period in the early 1980s. By identifying openings at other company locations and with other area employers and by holding on-site job fairs and workshops on job search techniques, the GTE plant closed with 85 percent of its workers having found employment elsewhere (U.S. Department of Defense 1985).[13] This example demonstrates the possibility of advance planning to minimize unemployment spells, but does not control for general labor market conditions. However, an econometric study of layoffs in three aerospace companies (Boeing, Martin, and Republic) in the mid 1960s confirmed these results. After controlling for the general strength in the local labor market, it found that definite information regarding the chances of recall and organized information about other job possibilities significantly lowered the economic loss from unemployment (Fishman et al. 1968).

Some states provide reemployment assistance apart from funding company-specific programs. For example, the new Employment Express program in Massachusetts offers help to unemployed workers in targeting their job searches toward industries with growing demands for their skills.[14]

The federal government provides some reemployment support through Title III of the Job Training Partnership Act (JTPA) of 1982. (The President's budget for FY 1991 includes $400 million for this program.) Under JTPA, local councils composed of both private and public sector representatives devise programs aimed at persons who have been displaced from their jobs or are about to be laid off.[15] At least in the past, most of the New England experience has been with relatively low-skilled workers. For example, in Maine, workers laid off from the shoe industry have been one target group, and in Massachusetts, programs provided basic job skills to young people needed to fill jobs in the booming economy of the 1980s. But JTPA could also address the needs of defense workers because the program's design is very flexible. So far, the federal government does not appear to be considering increased funding for the program to address declining defense-related jobs.

Further Assistance for Defense Workers?

The prospect of layoffs in the defense industry has prompted a debate on special income maintenance and job search assistance for the workers affected. Advocates of targeted programs point out that society as a whole would benefit from the resources freed up as a result of reduced East-West tensions, and should therefore share this windfall to reduce the disproportionate costs borne by defense workers. These advocates also feel that the federal government encouraged these workers to develop specialties that are of limited use in nondefense sectors of the economy, and therefore has a particular obligation to assist them.

Opponents of specialized assistance present several counterarguments. First, if labor markets work efficiently, employees in industries with a high risk of demand reduction such as defense receive a risk premium in their salaries and therefore do not deserve further compensation when they become unemployed. Special treatment also may violate horizontal equity, if laid-off defense workers receive benefits in excess of those received by workers unemployed as a result of new federal legislation on, for example, environmental cleanup or product safety. Finally, in a society with competing demands on government resources, it is not obvious that defense workers should be singled out, given that other social needs were neglected during the recent defense buildup. Helping relatively well-to-do defense workers may be particularly unpalatable in the context of previous reductions in assistance to low-income persons, including welfare, housing grants, and health care.

The decision on whether to provide special assistance should also take into account the practical lessons from federal trade adjustment assistance. This program has been available since 1962 for workers in industries, geographic areas, or firms affected by import competition. For many years, the program emphasized income support, but more recently it has shifted more toward training and job search assistance. A major administrative difficulty of trade adjustment assistance has been certification of layoffs as

being trade-related, which has caused significant delays in awarding benefits. According to the review of this program by the Defense Department (1985), workers affected in the initial round of layoffs at their plant waited 488 days on average to receive an assistance check. Over half of all workers in the program were back at work before receiving aid. A separate adjustment program for defense workers would encounter this same problem because defense contractors also do nondefense work, and because workers in related industries would lose jobs as an indirect consequence of defense cutbacks. The need to certify eligibility for the program might severely reduce its effectiveness.

By contrast with specialized assistance, many company- and JTPA-funded programs have been implemented very quickly, and therefore appear to be more promising and less controversial vehicles for helping displaced defense workers.[16] Impending layoffs by defense contractors may justify spending part of the "peace dividend" to increase funding for Title III of JTPA.

Furthermore, because new job opportunities depend on patterns of growth, governments might usefully take into account the job skills of former defense workers when designing their industrial policies. For example, the federal government might increase its sponsorship of nondefense research and development or expand its tax incentives for private R&D. The general slowdown of economic activity in New England will make it harder for displaced defense workers to find jobs locally. But state government officials should emphasize the quality of this labor pool when trying to attract new manufacturing and high technology businesses.

VI. Summary and Conclusions

The shrinking of the national defense budget will continue to create a drag on the New England economy in coming years. For the nation, defense spending is currently just under 6 percent of GNP, and is expected to fall to between 3 percent and 4 percent of GNP by the mid 1990s. In New England, the current defense share of the economy is higher, perhaps about 8 percent, and is expected to fall by a somewhat greater proportion than in the nation because of the high share of expenditures on military procurement rather than personnel and other operating costs. Also, it is likely that the surge in prime contracts to New England in FY 1989 will be reversed in coming years. Under the scenarios examined, prime contracts to New England companies are projected to fall at real rates of between 4 percent and 9 percent annually between FY 1987–89 and the mid 1990s. Because Connecticut and Massachusetts typically receive about 90 percent of the region's prime contracts, most of the cutbacks will occur in these two states. By the mid 1990s, reductions in defense sector employment could total between 1 percent and 2 percent of the New England work force. For state economies, these projected slowdowns in defense-related activities are far from devastating, but they will feel burdensome in the context of simultaneous weakness in the real estate, financial services, and computer industries.

For individual companies, the damage imposed by defense cutbacks will vary widely, depending on how large a fraction of their business is related to defense, which specific defense systems are canceled, and other business prospects. Companies in the aircraft industry are expected to receive disproportionate defense-related cuts, but will probably successfully expand their nondefense work. Military orders for ships and submarines have already fallen considerably, and will result in lower production for contractors because they face limited alternative markets. Electronics companies will probably receive moderate-sized cutbacks in defense, and are often quite diversified already in their lines of business. Direct conversion of defense plants to nondefense work would not be desirable as a general policy. For many contractors, it may make more sense to scale down their level of operations at defense facilities. New production opportunities may have to come in other locations and other companies.

Displaced defense workers are a valuable resource. They have above-average skills and experience, and could make a significant contribution toward raising the productivity of our economy if they find good nondefense jobs. Evidence indicates, however, that mature workers find it difficult to find new employment following layoffs. This article suggests that companies and government can significantly minimize the costs of unemployment by helping to match displaced workers with job opportunities. Such a policy would be more equitable and effective if applied to all workers, and not just those directly affected by defense cutbacks. Finally, the availability of former defense workers is an advantage to businesses starting or expanding manufacturing and to high technology operations. To the extent possible, governments should encourage this type of business activity to assure future growth and job opportunities in the New England economy.

Appendix

Defense Contractors in New England

Appendix Table 1 lists New England facilities receiving at least $5 million in prime contracts from the Defense Department in FY 1987. These were the most recent data we were able to obtain on such a disaggregated basis. For each facility, the table also indicates the total value of awards between FY 1985 and FY 1987 and the major categories of goods and services purchased by the Defense Department. (It is possible that the table omits some relatively large defense contractors, if they happened to receive less than $5 million in orders during FY 1987.) All contracts awarded to General Dynamics are reported under Connecticut, despite the company's additional facilities at Quonset Point, Rhode Island. Submarine contracts to United Nuclear are not included in Appendix Table 1 because they are issued by the Department of Energy rather than the Defense Department. Additional details on defense-related activity in Connecticut may be found in Bean et al. (1986).

Methodology for Projecting Prime Contracts

The projections for prime contracts were based on the President's recently requested budget authority through FY 1995, and corresponding assumptions for a plan that would reduce spending by 4 percent a year starting in FY 1991. The relevant categories of budget authority were: operations and maintenance; procurement; research, development, testing and evaluation (RDT&E); and military construction (Appendix Table 2). The allocations in the latter plan were based on the flat defense spending plan in Kaufmann and Korb (1989). Within procurement, assumptions for six components (aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other) for each spending plan were developed from the President's detailed budget requests.

Since we had detailed plans on the composition of procurement budget authority only through FY 1991, we assumed that the composition of procurement would remain fixed thereafter at the estimated average for 1990 and 1991. Thus aircraft would continue to be 33.7 percent of procurement budget authority, missiles 18.8 percent, ships 13.8 percent, weapons and tracked vehicles 12.1 percent, ammunition 2.9 percent, and other 18.9 percent.

In order to develop a formula to translate budget authority into prime contracts, we estimated separate regressions of national prime contract awards on each non-personnel component of defense budget authority using 1980 to 1989 data. In addition to the six hard goods categories ("other" budget authority was allocated to electronics), we estimated regressions for total RDT&E, operations and maintenance, and construction. Thus we developed a formula for translating aircraft budget authority into non-RDT&E aircraft prime contract awards, missile budget authority into non-RDT&E missile prime contract awards, and so forth. Appendix Table 3 shows these estimates. In addition, a separate projection of prime contracts for petroleum was developed using assumptions for oil prices. Finally, the national forecasts make a partial adjustment for the estimation error in FY 1989.

To allocate the prime contract dollars among the New England states, we took the average prime contract awards for each state from 1987, 1988, and 1989. It was necessary to subtract out RDT&E because RDT&E is presented separately from procurement in the national budget. We subtracted out the RDT&E part of state prime contracts by first assuming that the state RDT&E percentage for each category (that is, the percentage of aircraft prime contracts dollars spent on RDT&E, the percentage of missile prime contract dollars spent on RDT&E, and so forth) was the same as the national percentage. We then scaled these components of RDT&E by a state-specific multiplicative factor so that their total matched the known figure for RDT&E for the state.

Finally we multiplied each state's percentage of the national total for each component by our national forecast for that component.

Appendix Table 1

Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Connecticut		
General Dynamics Corporation (Groton)	$ 4,691.9	Ships
United Technologies Corporation (Stratford)	3,479.0	Airframes and spares; other aircraft equipment
United Technologies Corporation (East Hartford)	2,565.1	Aircraft engines and spares
Avco Corporation[b] (Stratford)	1,760.1	Combat vehicles
Norden Systems, Inc. (Norwalk)	360.8	Electronics and communication equipment; missile and space systems
Kaman Aerospace Corporation (Bloomfield)	328.4	Airframes and spares
United Technologies Corporation (Windsor Locks)	318.5	Other aircraft equipment; airframes and spares; ships
Colt Industries, Inc. (Hartford)	175.4	Weapons
Purdy Corporation (Manchester)	67.7	Aircraft engines and spares; airframes and spares
Analysis & Technology, Inc. (North Stonington)	66.6	Services
Colt Industries (West Hartford)	62.1	Aircraft engines and spares
United Technologies Corporation (Southington)	57.3	Aircraft engines and spares
Dataproducts New England (Wallingford)	55.5	Electronics and communication equipment
Electro-Methods, Inc. (South Windsor)	50.4	Aircraft engines and spares
Condec Corporation (Waterbury)	43.5	All other supplies and equipment; non-combat vehicles
Raymond Engineering, Inc. (Middletown)	39.2	Electronics and communication equipment
Analysis & Technology, Inc. (New London)	34.4	Services
United Technologies Corporation (Shelton)	29.6	Airframes and spares
Perkin-Elmer Corporation (Danbury)	27.1	Electronics and communication equipment; weapons
Kaman Corporation (Bloomfield)	21.8	Weapons
The Torrington Company (New Britain)	21.8	All other supplies and equipment; aircraft engines and spares; other aircraft equipment
J.T. Slocomb Company (South Glastonbury)	20.7	Aircraft engines and spares
Howmet Turbine Components, Inc. (Winsted)	19.8	Aircraft engines and spares
Sonalysts, Inc. (Waterford)	19.3	Services
Dynamic Controls Corporation (South Windsor)	19.1	Other aircraft equipment; weapons
Treadwell Corporation (Thomaston)	18.7	Ships
Yale University (New Haven)	18.4	Services
J.S. Nasin Company (Groton)	18.3	Construction
AIW-Alton Iron Works, Inc. (Windsor)	16.8	Other aircraft equipment; airframes and spares; all other supplies and equipment; electronics and communication equipment
The Boeing Company (Stratford)	10.2	Other aircraft equipment
Arnold M. Diamond Company (Stratford)	9.2	Construction
Tech Systems Corporation (Thomaston)	8.7	Ships; electronics and communication equipment
Delta Industries (East Granby)	8.4	Aircraft engines and spares
La Pointe Industries, Inc. (Somers)	7.8	Electronics and communication equipment
Carlin Contractors Company, Inc. (Groton)	6.0	Construction
Total	$14,453.1	
Maine		
Bath Iron Works Corporation (Bath)	$ 1,975.5	Ships
Maremont Corporation (Saco)	101.6	Weapons
Fiber Materials, Inc. (Biddeford)	24.3	Missile and space systems
Total	$ 2,101.4	

Appendix Table 1 continued

Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Massachusetts		
General Electric Company (Lynn)	$3,712.7	Aircraft engines and spares
Raytheon Company (Andover)	3,177.2	Missile and space systems
GTE Government Systems (Needham)	1,636.3	Electronics and communication equipment
General Electric Company (Pittsfield)	1,433.2	Missile and space systems; combat vehicles
Raytheon Company (Lowell)	1,388.3	Missile and space systems
Raytheon Company (Bedford)	1,301.1	Missile and space systems
Massachusetts Institute of Technology (Lexington)	1,018.9	Services
Raytheon Company (Wayland)	977.0	Missile and space systems; electronics and communication equipment
Avco Corporation[b] (Wilmington)	921.0	Missile and space systems
The Mitre Corporation (Bedford)	907.1	Services
Charles Stark Draper Laboratories (Cambridge)	802.7	Missile and space systems
Raytheon Company (Marlborough)	557.2	Electronics and communication equipment
Raytheon Company (Sudbury)	392.5	Missile and space systems
Raytheon Company (West Andover)	307.0	Missile and space systems
RCA Corporation (Burlington)	267.5	Electronics and communication equipment; combat vehicles
GTE Products Corporation (Needham)	246.7	Electronics and communication equipment
Bolt Beranek & Newman, Inc. (Cambridge)	219.0	Services
Chamberlain Manufacturing (New Bedford)	199.1	Ammunition
GTE Products Corporation (Westborough)	182.5	Missile and space systems
Braintree Maritime Corporation (Quincy)	168.1	Ships
Dynamics Research Corporation (Wilmington)	164.3	Services; missile and space systems
Northrop Corporation (Norwood)	162.9	Missile and space systems
Wang Laboratories, Inc. (Lowell)	150.7	Electronics and communication equipment
Raytheon Company (Waltham)	128.1	Electronics and communication equipment; missile and space systems
Massachusetts Institute of Technology (Cambridge)	123.7	Services
General Electric Company (Fitchburg)	105.1	Ships
General Ship Corporation (Boston)	101.3	Ships
Sippican, Inc. (Marion)	99.8	Electronics and communication equipment
General Electric Company (Wilmington)	98.9	Other aircraft equipment; aircraft engines and spares
Honeywell, Inc. (Lexington)	96.2	Photographic supplies and equipment; electronics and communication equipment
The Analytic Sciences Corporation (Reading)	88.9	All other supplies and equipment; services; ships
Varian Associates, Inc. (Beverly)	74.7	Electronics and communication equipment
Avco Corporation[b] (Everett)	71.4	Weapons
Kollmorgen Corporation (Northampton)	70.1	Electronics and communication equipment; weapons
Raytheon Company (Marlborough)	64.7	Electronics and communication equipment
Analytical Systems Engineering (Burlington)	63.1	Services
Computervision Corporation (Bedford)	58.0	Electronics and communication equipment
GTE Products Corporation (Billerica)	55.9	Electronics and communication equipment
Nuclear Metals, Inc. (Concord)	49.0	Ammunition
Itek Corporation (Lexington)	42.2	Electronics and communication equipment
Woods Hole Oceanographic Institute (Woods Hole)	40.2	Services
TRW, Inc. (Boston)	34.9	All other supplies and equipment
Softech, Inc. (Waltham)	34.2	Electronics and communication equipment
Digital Equipment Corporation (Maynard)	32.7	Electronics and communication equipment

Appendix Table 1 continued

Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Arthur D. Little, Inc. (Cambridge)	$ 32.2	Services; missile and space systems
Computer Technology (Burlington)	28.4	Electronics and communication equipment
Spears Associates, Inc. (Norwood)	28.2	Electronics and communication equipment; services; ships
Belcher New England, Inc. (Revere)	25.5	All other supplies and equipment
BBN Communications Corporation (Cambridge)	24.5	Electronics and communication equipment
Raytheon Service Company (Burlington)	26.7	Electronics and communication equipment; services; ships
All others (33 companies)	455.5	
Total	$22,477.2	
New Hampshire		
Sanders Associates, Inc.[c] (Nashua)	$ 869.5	Electronics and communication equipment
Sequa Corporation (Merrimack)	91.3	Missiles and space systems; other aircraft equipment
Digital Equipment Corporation (Salem)	53.5	Electronics and communication equipment
Sanders Associates, Inc.[c] (Hudson)	28.1	Electronics and communication equipment
Simplex Wire & Cable Co. (Portsmouth)	23.3	Electronics and communication equipment
New Hampshire Ball Bearing (Laconia)	17.4	Aircraft engines and spares; airframes and spares
Norden Systems, Inc. (Merrimack)	16.0	Missile and space systems
Granite State Machine Company (Manchester)	13.8	Electronics and communication equipment
MPB Corporation (Lebanon)	13.4	Aircraft engines and spares; all other supplies and equipment
Harvey Construction Company (Portsmouth)	9.2	Construction
Total	$ 1,135.5	
Rhode Island		
Raytheon Company (Portsmouth)	$ 501.6	Electronics and communication equipment
Mine Safety Appls. Company (Esmond)	59.6	Textiles, clothing, and equipage
Blue Cross & Blue Shield (Providence)	41.1	Services
CFS Aircargo, Inc. (Providence)	38.5	Services
Syscon Corporation (Newport)	24.6	Services
Purvis Systems, Inc. (Newport)	17.8	Services
McLaughlin Research Corp. (Middletown)	16.8	Services; electronics and communication equipment
Aquidneck Systems International (Middletown)	16.7	Services; electronics and communication equipment
PCC Technical Industries (Newport)	11.7	Services
Gilbane Building Company (Newport)	8.1	Construction
The Worcester Company, Inc. (North Providence)	7.7	Textiles, clothing, and equipage
A. F. Lusi Construction, Inc. (Newport)	6.9	Construction
Digital Equipment Corporation (Naval Underwater)	6.0	All other supplies and equipment
Louis Berger International (Newport)	5.6	Construction
Total	$ 762.7	
Vermont		
General Electric Company (Burlington)	$ 305.7	Weapons; other aircraft equipment
Simmonds Precision Products (Vergennes)	32.0	Other aircraft equipment; airframes and spares
Joslyn Defense Systems (Shelburne)	6.7	Airframes and spares
Total	$ 344.3	

[a]Totaling at least two-thirds of prime contract awards FY 1985-87.
[b]Merged into Textron in 1985.
[c]Renamed Lockheed Sanders in 1990.
Source: U.S. Department of Defense [1988].

Appendix Table 2

Department of Defense Military Budget Authority, Actual FY 1989 and Proposed FY 1990 and FY 1995

	Billions of Dollars				Billions of FY 1989 Dollars[a]				Percent of Total Military Budget Authority		
			FY 1995		FY 1995		Compound Annual Real Growth Rate FY 1989 to 1995			FY 1995	
	FY 1989	FY 1990	President's Proposal	Nominal Cutbacks	President's Proposal	Nominal Cutbacks	President's Proposal	Nominal Cutbacks	FY 1989	President's Proposal	Nominal Cutbacks
Military Personnel	78.5	78.5	83.9	69.1	66.3	54.6	−2.8	−5.9	27.0	26.9	29.1
Operations and Maintenance	86.2	86.8	95.6	77.6	75.6	61.3	−2.2	−5.5	29.6	30.7	32.7
Procurement	79.4	82.6	81.5	55.8	64.4	44.1	−3.4	−9.3	27.3	26.1	23.5
Research, Development, Testing, and Evaluation	37.5	36.8	40.1	29.0	31.7	22.9	−2.8	−7.9	12.9	12.9	12.2
Military Construction	5.7	5.3	5.9	3.7	4.6	2.9	−3.5	−10.6	2.0	1.9	1.6
Family Housing	3.3	3.2	3.7	2.3	2.9	1.8	−2.1	−9.4	1.1	1.2	1.0
Other	0.2	−1.8	1.1	0.1	0.9	0.1	28.0	−14.3	0.1	0.4	0.0
Total Military Budget Authority	290.8	291.4	311.8	237.6	246.4	187.8	−2.7	−7.0	100.0	100.0	100.0
Addenda											
Other Defense-Related Activities	8.7	10.3	13.9	10.7							
Total National Defense Budget Authority	299.6	301.6	325.7	248.3							
Outlays:											
Total Military Budget	294.9	286.8	304.8	228.1							
Other Defense-Related Activities	8.7	9.6	13.7	10.3							
Total National Defense	303.6	296.3	318.6	238.4							

[a]Assuming an annual inflation rate of 4 percent.

Source: Executive Office of the President of the United States (1990) and author's estimates.

Appendix Table 3

Regression Results for Translating Budget Authority into Prime Contract Awards

Dependent Variable (Prime Contract Awards)[a]	Independent Variable (Budget Authority) Coefficient[b]	Constant	Adjusted R^2	Durbin-Watson Statistic
(1) Aircraft	.78	3.17	.96	1.60
	(.05)	(1.48)		
(2) Missiles and Space Systems	.88	.98	.93	1.33
	(.08)	(.96)		
(3) Ships	.65	3.01	.71	1.76
	(.14)	(1.52)		
(4) Weapons and Tank-automotive	.34	2.89	.33	.47
	(.14)	(1.44)		
(5) Ammunition	1.37	0.08	.85	1.75
	(.19)	(.47)		
(6) Electronics and Communication Equipment	.85	4.43	.83	2.62
	(.13)	(1.58)		
(7) Operations and Maintenance (Excluding Petroleum)	.21	1.49	.84	1.51
	(.03)	(2.16)		
(8) Research, Development Testing, and Evaluation	.51	3.17	.95	1.40
	(.04)	(1.09)		
(9) Construction	1.11	1.46	.64	1.31
	(.27)	(1.29)		

[a]In regressions (1) to (6), as well as (9), the dependent variable is non-RDT&E prime contract awards for the listed category. In regression (7), the dependent variable is the sum of prime contracts for nondurables and services excluding construction and petroleum. Petroleum contracts were forecasted separately using assumptions about oil prices.

[b]In regressions (1) to (6), the independent variables are estimated procurement budget authority for aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other, respectively. For regressions (7) to (9), the independent variables are budget authority for operations and maintenance, RDT&E, and construction, respectively.

Note: Equations were estimated using annual data for 1980 to 1989. Numbers in parentheses are standard errors.

Source: Executive Office of the President of the United States, (1990a); U.S. Department of Defense (1990d); and U.S. Department of Defense (1990b).

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[1] The example of 4 percent cutbacks in defense outlays corresponds to an extrapolation of the Frank-Boxer proposal reported in Kaplan (1990), but also resembles several more recent Congressional suggestions. The ratios of defense spending to GNP and the total federal spending use the projections of GNP and spending from the President's budget.

[2] The ratio of defense spending to GNP fell by over 35 percentage points between 1945 and 1948, about 7 percentage points between 1953 and 1965, and about 5 percentage points between 1968 and 1978 (Chart 1).

[3] For FY 1979, the Defense Department compiled information on the location of work performed by subcontractors in connection with large prime contract awards (U.S. Department of Defense 1980). The results have been used by some analysts to suggest that Massachusetts retains very little defense activity after adjusting for flows of subcontracts across states. However, the data in the study seem flawed, because prime contractors in Massachusetts (as well as Minnesota, Vermont, and Wyoming) reported distributing subcontracts in excess of the prime contracts they received. Another source of information is a survey of shipments to government agencies, last published for 1983 and since discontinued (U.S. Bureau of the Census 1985). In this survey, New England firms accounted for 10.8 percent of total shipments to the federal government, largely under prime contracts to the Defense Department, and 16.6 percent indirectly through subcontracts. For Massachusetts, the fractions were 4.8 percent and 5.3 percent, respectively. For Connecticut, they were 3.3 percent and 9.4 percent. In general, estimates for the New England region as a whole are probably more accurate than estimates for individual states.

[4] Total output consists of output produced to satisfy final demand plus output for other industries. Total output may also be expressed as the sum of value added (equal to gross national product for the nation) plus purchased inputs. The calculation of defense as a share of value added (or gross regional product) for New England is subject to great uncertainty because there is no direct information on value added by New England firms as opposed to their purchases of goods and services from other parts of the country.

[5] The figures on personnel spending as a share of the economy (Table 1) might serve as a guide to maximum effects. These numbers should be reduced by about 20 percent in Connecticut, Maine, Massachusetts, and Rhode Island—and about 40 percent in New Hampshire and Vermont—to account for the portion of pay going to retirees. Retirement pay could be cut, for example, by scaling back cost-of-living adjustments, but such a policy would not disrupt individual state economies to the same degree as base closings would. Other categories of the military budget also include a payroll component. A substantial share of the operations and maintenance budget goes to pay civilian Defense Department employees (in addition to private contractors). In FY 1988, civilian pay relative to total Defense Department payroll was 50 percent in Maine, 43 percent in Massachusetts, 37 percent in Rhode Island, 26 percent in both Connecticut and Vermont, and 17 percent in New Hampshire.

[6] The composition of output does change. In the case where lower government expenditures reduce the deficit, production of investment and export goods would probably increase.

[7] International comparisons among industrialized nations suggest that defense spending and productivity growth are negatively related, but time series analysis within countries indicates that, at least through the 1970s, slowing productivity growth has coincided with a decline in the share of output devoted to defense (U.S. Congressional Budget Office 1983). Individual econometric studies obtain various results. Deutsch and Schopp (1987) found that the share of government-sponsored research and development devoted to the military had a negative effect on productivity growth in the United States and Canada, but an insignificant effect in France, Germany, Japan, and the Netherlands. Alexander [1989] found that growth in military expenditures had a positive effect, but military purchases of capital goods as a share of manufacturing output a negative effect, on productivity growth in the United States. Together, the net impact of the military role was very slightly positive for the period 1951 to 1982. Adams and Gold (1987), Rosenberg (1987), and Weston and Gummett (1987) provide useful surveys of this literature.

[8] In fiscal year 1987, New England received 9.7 percent of the federal government's overall research and development spending. The region received 14.4 percent of R&D spending by the Department of Transportation, 11.8 percent by the Department of Health and Human Resources, 11.3 percent by the Department of Defense, and 10.8 percent by the National Science Foundation. Of the national total for R&D, 64.9 percent was administered by the Defense Department. Of the remainder, the largest amounts were spent by the Department of Health and Human Services, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation (National Science Foundation 1988).

[9] For examples of previous case studies in Massachusetts and the nation, see Massachusetts Department of Employment and Training (1989b).

[10] A study by Employment Research Associates (Anderson, Frisch, and Oden 1986) found that the military buildup between 1981 and 1985 cost the nation over a million jobs, compared to the number that would have been generated by an equivalent increase in nondefense private and public spending.

[11] Thirty-four percent of the defense workers in this sample were college graduates, compared to 26 percent in other manufacturing and 29 percent in nonmanufacturing. The fraction of young workers (15–24 years) in defense was only one-half that in other manufacturing and one-third that in nonmanufacturing. Also, defense-oriented industries may be able to afford paying higher wages because they can pass on these costs to the Pentagon more readily than industries serving the private sector. Another factor explaining earnings differences may be that two-thirds of the Massachusetts manufacturing jobs (including defense-related) were held by men, whereas nonmanufacturing jobs were held by approximately equal numbers of men and women. Holding constant education, skill level, and occupation, women may be paid less than men because they tend to have less experience and work fewer hours, or because they face discrimination.

[12] Unemployment insurance is financed by federal and state payroll taxes and covers 97 percent of all wage and salary workers. The goal of UI is to replace about half of the recipient's pretax income (up to a limit) until he/she finds a new job or reaches the maximum duration of 26 weeks (30 weeks in Massachusetts). In addition, extended benefits go into effect automatically if the state's unemployment rate reaches a certain threshold, and Congress also enacted special extended benefits during the last two major national recessions. By federal law, employers must allow laid-off workers formerly covered by group health insurance to continue to purchase this insurance at the group rate for a period of up to eighteen months, or until they find a new job. This provision allows significant saving compared to purchasing health insurance on one's own. Massachusetts is planning to implement universal health insurance by 1992, but this program may be endangered by the state's fiscal crisis.

[13] Closer to home, General Electric (with the assistance of state and federal government) set up a center in Lynn, Massachusetts that provided information and training for its displaced workers. Within two years, about three-quarters of the workers found jobs paying at least 92 percent of their former wage (Victor 1990). This example indicates a slower response than in the GTE case.

[14] The state unemployment offices also provide telephones and personal computers for the use of workers in their job search. In addition, the agency holds job fairs and prepares resume books of available workers for potential employers.

[15] Three-quarters of JTPA is in the form of matching block grants to states, and the remainder is allocated at the discretion of the Secretary of Labor.

[16] Under a proposal in President Bush's budget, trade adjustment assistance would cease to exist as a separate category, but would be merged into Title III of JTPA.

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The Changing Fortunes of American Families in the 1980s

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After the recessions of 1980 and 1981–82, family income in the United States expanded through most of the 1980s. The decade brought gains in living standards to most families, but these gains were not distributed evenly. While high-income families enjoyed above-average gains, the incomes of low-income families declined; the rich grew richer but the poor grew poorer. This paper examines shifts in the sources of family income and family work patterns between 1979 and 1988 in order to address the question: Why were the period's income gains so unevenly distributed?

The first section of the article describes the changes that occurred in the distribution of family income in the 1980s, and how the decade's income gains were apportioned among various family types defined along such dimensions as age of head, headship type, presence of children, and education of head. Low-income families in general, and some types of low-income families in particular, did not share fully in the decade's income gains. Several hypotheses to explain such changes in the income distribution are then discussed.

Part II examines sources of family income, focusing on growing inequality in the distribution of earned income among nonelderly families during the 1980s. This growing earnings inequality was reinforced by changes in the distribution of interest and dividend income. Earnings grew faster for families with high incomes than for those with low incomes because both men's and women's earnings became more unequal. High-income men's earnings rose, while lower-income men's earnings fell; wives' labor force participation increased faster at the upper end of the family income distribution. Not surprisingly, the types of families left behind in the earnings-driven income growth of the 1980s were those with limited access to the labor market.

I. Income Trends in the 1980s

The 1980 and 1981–82 recessions battered family incomes in the United States. As Chart 1 shows, the dip in real incomes was much deeper than those associated with the 1970 and 1973–75 recessions. But income grew steeply after the twin recessions of the early 1980s, and median family income in 1987 was 3 percent higher than the previous peak level attained in 1979.[1] Median family income fell, very slightly, in 1988.

Not everyone's income rose in tandem in the 1980s. Table 1 shows that average family income rose 8.3 percent between 1979 and 1988.[2] But the average income of families in the lowest quintile (one-fifth of all families) declined steeply in the first part of the decade and recovered only slightly in the second part. The average income of families in the top two quintiles increased in both periods. As Table 1 shows, over the entire period, the lowest quintile's income fell, while higher-income families' income grew, and the richest quintile's income grew the most.[3]

Note that these data involve comparisons over time of snapshot cross-sections, not a panel study that actually tracks the income changes of specific families. The data for the lowest quintile report the average income of the 12 million families with the lowest incomes in 1979 and another group of 13 million families with the lowest incomes in 1988. Table 1 shows, therefore, that members of the group in 1988 had lower incomes than members of the 1979 group, not that incomes fell between 1979 and 1988 for the individual families in either group.

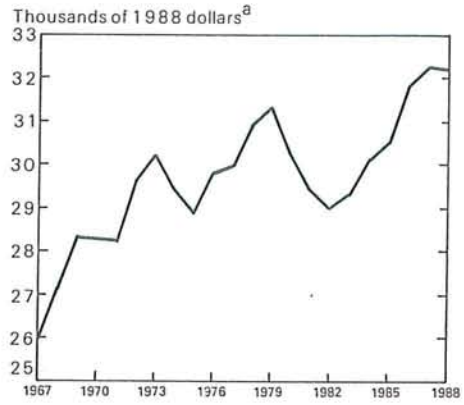
Table 1
Average Family Incomes

Quintile	1979	1984	1988	Percent Change 1979–88
First (poorest)	$ 9,350	$ 8,300	$ 8,850	−5.4
Second	20,650	19,450	20,700	.4
Third	31,150	30,100	32,250	3.5
Fourth	42,900	43,050	46,300	7.9
Fifth (richest)	70,950	75,900	81,400	14.7
All	35,000	33,350	37,900	8.3
Number of families (000)	59,550	62,706	65,837	10.6

Note: Average income is measured in constant 1988 dollars, as defined by the CPI-U-X1, and rounded to nearest $50.
Source: Author's calculations based on U.S. Bureau of the Census, Current Population Survey (March), 1980, 1985, 1989, machine-readable data files.

Chart 1

Median Family Income, 1967 to 1988



[a] Using CPI-U-X1.

Source: U.S. Bureau of the Census, "Money Income and Poverty Status in the United States: 1988" (Advance Data from the March 1989 Current Population Survey), *Current Population Reports*, Series P-60, No. 166 (Washington, D.C.: Government Printing Office, October 1989), Table B, as corrected in personal communication.

Who Gained and Who Lost?

Even though they do not track individual families, these data clearly indicate that the general boost in income was not spread evenly. Furthermore, families with certain characteristics lost ground relative to others.[4]

Younger families fell behind. The youngest and oldest families have the lowest incomes, on average. During the 1980s, the fortunes of the youngest and oldest families moved in opposite directions.

Elderly families' average incomes rose. They moved in greater numbers into higher quintiles, having started the period heavily concentrated in the lowest quintile (Table 2).[5] Despite these substantial gains, the elderly remained a relatively low-income group.

By contrast to the improving situation of elderly families, young families were under increasing pressure. In 1979, about two-fifths of families with head under age twenty-five were in the lowest quintile of nonelderly families.[6] By 1988, almost half of young

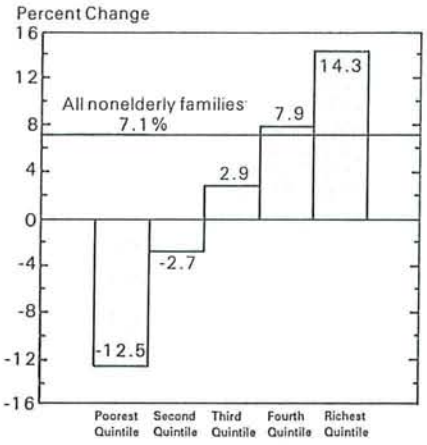
Table 2
Incomes of Elderly Families

Quintile	Percentage of Elderly Families in Each Family Income Quintile 1979	1988
First (poorest)	41.6	30.1
Second	28.4	30.3
Third	14.0	18.2
Fourth	8.7	11.4
Fifth (richest)	7.4	10.0
Total	100.0	100.0
Number of families (000)	8,996	10,626
Average Income	$23,400	$28,550

Note: Elderly families are headed by someone age 65 or older. Average income is measured in constant 1988 dollars, as defined by the CPI-U-X1, and rounded to nearest $50.
Source: See Table 1.

Chart 2

Change in Average Family Income by Quintile, 1979-88
(Nonelderly Families)



families had low incomes. Part of this deterioration is attributable to a changing mix of family types among the young: the proportion of young families that were headed by women with no husband present grew, and female-headed families typically have low incomes. But shifting composition is not the full explanation, for all types of young families—husband-wife as well as others—moved into lower quintiles.

The elderly are excluded from the remainder of the analysis in this article because elderly heads and their spouses are generally retired from the labor force and rely mostly on retirement income sources. This exclusion focuses the remaining discussion on factors related to the labor market and shifts in income sources other than pensions and Social Security. Table 3 repeats for nonelderly families the income distribution-related data that were reported in Table 1 for all families.

Table 3
Average Incomes of Nonelderly Families

Quintile	1979	1984	1988	Percent Change 1979–88
First (poorest)	$10,450	$ 8,450	$ 9,150	−12.5
Second	23,300	21,150	22,650	−2.7
Third	33,600	32,050	34,600	2.9
Fourth	45,000	44,950	48,550	7.9
Fifth (richest)	72,950	77,550	83,400	14.3
All	37,050	36,800	39,700	7.1
Number of families (000)	50,554	52,900	55,211	9.2

Note: Average income is measured in constant 1988 dollars, as defined by the CPI-U-X1, and rounded to nearest $50. Nonelderly families are headed by someone under age 65.
Source: See Table 1.

The general patterns of income change are quite similar, although the decline in income of the poorest quintile is much sharper when the elderly are excluded. (See Chart 2.) By 1988, the richest quintile received 9.1 dollars of income per dollar received by the lowest quintile, up from a ratio of 7.0 to 1 in 1979.

Husband-wife families and childless families pulled ahead. Husband-wife and female-headed families (no husband present) made slight gains in the 1980s, and the relative position of male-headed families (no wife present) worsened. (Compare columns 2 to 4 and 6 to 8 in Table 4.) Thus, the sizable income gap between husband-wife families and other families increased. Families without children also gained relative to families with children, regardless of headship type. The fraction of childless families in the lowest quintile declined and in the highest quintile rose during the 1980s, while families with children slipped slightly.

The education gap widened. The payoff to higher education increased in the 1980s. Several analysts have noted a growing gap between the average wages of college-educated workers and high school graduates (Levy 1989; Blackburn, Bloom, and Freeman 1990). Families in which the head did not complete high school were much more likely to be in the poorest quintile in 1988 than in 1979. High school graduates with no college were somewhat more likely to be in the poorest quintile and much less likely to be in the richest quintile.

Stratification increased along demographic lines. These data show a consistent pattern of growing intergroup disparities in the 1980s: husband-wife families pulled further ahead of one-head families, families with children lost ground to childless families, and more strongly, the young fell further behind older families and the income gap between families with less-educated and more-educated heads expanded. In general, the family types that slipped down the income scale were those that already tended to have lower incomes. Not only did these families become more concentrated at the bottom of the income distribution, but in addition, the average income at the bottom declined.

Potential Sources of Change in the Income Distribution

Several hypotheses about what might account for these income patterns are described below. A number of studies have highlighted changes in the distribution of individual earnings, particularly increasing inequality in the earnings of male workers (Henle and Ryscavage 1980, Lawrence 1984, Bluestone and Harrison 1986, Burtless 1990). Aside from Levy (1989) and Rose and Fasenfest (1988), researchers have not examined changes in other income sources, however, or the relationship between changes in individual earnings and the distribution of family incomes.

Shifting mix of income sources. If the mix of income sources received by families with different characteristics or income levels differs, then some family types or income levels will gain or lose relative to others as sources grow at different rates. For example, when interest rates rise, higher-income families would benefit disproportionately, since they hold most interest-earning assets. Similarly, low-income families would lose ground and family income inequality would increase if transfers aimed at reducing poverty declined.

Changing composition of families. A number of hypotheses about the changing distribution of family income relate to shifts in the mix of families. For example, husband-wife families have higher incomes, in general, than families with no spouse present, as Table 4 showed. Thus as the husband-wife fraction of all families declines, the number of families with low incomes should increase. Similarly, since incomes vary by age and education, the aging of the baby boom and rising educational attainment among family heads would shift the distribution of family income.[7]

By the same token, changes in the work patterns of family heads or spouses would change the family income distribution. The declining labor force participation of men, for example, would be expected to increase the fraction of families that have low incomes, while the increasing labor force participation of wives would boost family income. And the shift of national economic activity from the manufacturing sector of the economy to the service-producing sector may increase inequality by replacing "healthy" middle-class manufacturing production jobs for male family heads with an uneven mix of many low-wage jobs and a few high-wage professionals.

Family work patterns and changing incomes within groups. Another set of hypotheses relates to shifts in the shape of the income distribution for specific types of families. For example, a rise in women's labor force participation would add to family income inequality if it were concentrated among families with high-wage husbands or high incomes from other sources. Even if participation increases were similar across all family income levels, the resulting income gains would be greater at the upper end of the distribution if the working wives of high-income men earned more than the working wives of low-income men. Such changes would be more complicated than the shifts in mix described in the previous section.

Similarly, different income groups might experience different changes in income. When the distribution of individual earnings becomes more unequal (as others have found), this would be likely to translate into a more unequal distribution of family income. If the earnings of low-wage workers rise more slowly than those of high-wage workers, the same will be true of the incomes of low-income families as opposed to high-income families, unless family work patterns counteract the obvious association between individual earnings and family income.

Changes in earnings over the business cycle. The distribution of individual earnings generally becomes

Table 4
Income and Demographic Characteristics of Nonelderly Families
Percent

Family Type	1979 Percent of nonelderly families (1)	1979 Percentage in Poorest Quintile (2)	1979 Percentage in Middle Three Quintiles (3)	1979 Percentage in Richest Quintile (4)	1988 Percent of nonelderly families (5)	1988 Percentage in Poorest Quintile (6)	1988 Percentage in Middle Three Quintiles (7)	1988 Percentage in Richest Quintile (8)
All nonelderly families	100.0	20.0	60.0	20.0	100.0	20.0	60.0	20.0
Age of head								
Under 25	7.5	40.8	57.3	1.9	5.4	48.8	48.3	2.9
25–34	28.1	22.4	66.1	11.5	27.3	24.8	64.0	11.1
35–44	24.2	16.3	60.6	23.1	29.5	15.7	61.0	23.4
45–54	21.3	14.6	54.7	30.7	20.5	13.6	56.4	30.0
55–64	18.9	18.9	57.2	23.8	17.2	18.4	59.5	22.1
Headship								
Husband-wife	82.5	13.1	63.7	23.2	78.6	11.9	63.9	24.2
Female head, NSP	14.7	57.3	40.1	2.7	17.0	54.8	41.6	3.6
Male head, NSP	2.8	27.9	56.5	15.6	4.4	29.1	60.1	10.8
Presence of children								
Fam. with children	63.0	22.8	59.5	17.1	60.9	23.9	59.4	16.7
Fam. w/no children	37.0	15.2	60.9	23.9	39.1	13.9	60.8	25.2
Education of head (age 25 and over)								
Not finished high school	24.1	36.4	55.3	8.3	17.6	43.0	51.7	5.3
Finished high school, no college	31.4	18.8	65.6	15.6	33.1	20.9	66.7	12.4
Some college, not finished	17.7	14.5	65.3	20.2	20.4	14.5	66.5	19.0
Finished college	19.2	5.7	51.2	43.1	23.4	5.2	50.5	44.4

Notes: Nonelderly families are headed by someone under age 65. NSP = no spouse present
Source: See Table 1.

more unequal during economic downturns for two reasons. First, rising unemployment in recessions is not spread evenly across all workers (Clark and Summers 1979, Lerman, Moss and Barnow 1978). When the unemployment rate rises, a small percentage of workers experience unemployment and substantial earnings losses, and other workers' earnings are affected only indirectly by slack in the labor market. Second, wages at the low end of the distribution are thought to be more flexible in a downward direction than those of high-wage workers. However, when one earner in a family becomes unemployed, loses overtime, or faces lower wages, the increase in inequality during recessions will be less for family incomes than for individual earnings if other members of the family respond by seeking work. If, on the other hand, multiple earners within a family are likely to be similarly affected by an economic slowdown, perhaps because they all work in the same sector of the economy, then family earnings inequality will follow individual earnings inequality.

The next section of the article evaluates these hypotheses. First are the hypotheses relating to the shifting mix of income sources, followed by shifting demographic mix. The other hypotheses relate to family work patterns.

II. Sources of Income, Especially Earnings

Wages and salaries account for over four-fifths of the income of nonelderly families, with another 6 to 7 percent contributed by other earnings, including income from self-employment. Interest and dividends

Table 5
Average Income from Each Source, by Quintile, Nonelderly Families

Year and Source of Income	All Families: Average Income	All Families: Percent of Total	Poorest Quintile	Middle Three Quintiles	Richest Quintile
1979					
Wages and salaries	$30,400	82.0	$ 6,550	$29,050	$58,350
Other earnings	2,750	7.4	550	1,950	7,250
Interest and dividends	1,400	3.8	200	750	4,550
Retirement income	1,400	3.8	1,350	1,250	1,850
Transfers	1,100	3.0	1,750	950	950
Total	37,050	100.0	10,450	34,000	72,950
1984					
Wages and salaries	30,150	81.9	5,050	27,800	62,400
Other earnings	2,300	6.3	300	1,650	6,400
Interest and dividends	1,850	5.0	200	1,000	6,100
Retirement income	1,400	3.8	1,100	1,400	1,800
Transfers	1,050	2.9	1,750	900	900
Total	36,800	100.0	8,450	32,750	77,550
1988					
Wages and salaries	32,600	82.2	5,600	29,850	67,750
Other earnings	2,700	6.8	500	1,950	7,050
Interest and dividends	1,650	4.2	200	950	5,300
Retirement income	1,550	3.9	1,200	1,450	2,200
Transfers	1,100	2.8	1,600	1,000	1,000
Total	39,700	100.0	9,150	35,250	83,400

Income sources defined as follows:
Wages and salaries—wage and salary earnings
Other earnings—all earned income except wages and salaries, including self-employment income
Interest and dividends—interest, dividends, and net rental income
Retirement income—social security, SSI, and private, military, and government pensions
Transfers—public assistance, welfare, veterans' payments, and child support

Notes: Parts may not sum to totals because of rounding. Nonelderly families are headed by someone under age 65. Incomes are in constant 1988 dollars, as defined by CPI-U-X1, and rounded to nearest $50.
Source: See Table 1.

(including net rental income), retirement income, and transfers round out the family income total.[8] (See Table 5. To interpret the figures shown in the table, it is important to note that they are averages for all nonelderly families, including families with zero income from a specific source. For example, about 30 percent of nonelderly families had some transfer income; these families typically received $3,700 from this source in 1988, while the other 70 percent received none.)

Over the weak 1979–84 period, the average income of nonelderly families declined slightly in constant dollars, with moderate declines in wages and salaries and transfers, and a more sizable falloff in the fairly small "other earnings" category, partially offset by a small increase in average retirement income and substantial growth in the interest and dividend category. In the expansionary years from 1984 through 1988, income increased from all sources except interest and dividends.[9]

For families of all income levels, the bulk of income comes from earnings. Low-income families, however, receive relatively less income from earnings than families with higher incomes. They also receive less income from interest and dividends, but more income, even in dollar terms, from transfers (Table 5). Interest and dividends account for a much greater fraction of the highest quintile's income than that of families with lower incomes.

The Shifting Mix of Income Sources

One hypothesis offered earlier was that changes in the income distribution might reflect the mix of income sources obtained by each income group or family type. For example, since low-income families rely on transfers for a larger share of income, they would be hardest hit by a general cutback in transfer income, other things equal. Transfer income did grow relatively slowly in the 1980s and the poor were affected adversely more than others. Dividends and interest grew rapidly and the richest quintile benefited more than others.

However, differences in the mix of income sources played only a very small role in the shifts in the income distribution. Instead, almost all sources of income grew fastest for families at the top and slowest for families at the bottom of the distribution. Similarly, the mix of income sources tapped by young families would have implied below-average income growth in the 1980s, but not the sizable decline they actually experienced. Most sources, and especially wages and salaries, grew more slowly (or declined faster) for the young than for older families. Thus the mix of income sources for different income levels or family types does not explain how their total incomes moved in the 1980s.

Overall, an increasingly unequal distribution of earned income across families was responsible for most of the increase in inequality in the distribution of family income during the 1980s. Wages and salaries fell for the poorest quintile and rose rapidly for the richest quintile. These percentage changes were more extreme than were the changes in total income, indicating that the inequality of wage and salary income across families increased more than the inequality of total income in the 1980s. (The same was true for interest and dividend income, although on a much smaller scale.) Some of the disequalizing change in average wage and salary income resulted from changes in the fraction of families with no earners (that is, with zero wage and salary income). The fraction of bottom-quintile families with no wage and salary income rose, while the fraction of top-quintile families without earners fell. After looking at shifts in demographic mix, subsequent sections of the paper examine the changes in family work patterns that underlie the shifts in earnings.

Shifting Mix of Families

A shift-share analysis can be used to quantify the effects of the changing mix of families on the overall income distribution. The analysis divides the total change in the median income (or other percentile) into two parts: that attributable to changes in the mix of families across various groups and that attributable to changes in income patterns within each group. The appendix describes the procedure in detail. Demographic changes provide examples of how the procedure works; the analysis then turns to changes in family labor market characteristics. Table 6 reports the results of the calculations.

Table 6
Contributions of Changes in Demographic Mix and Labor Market Characteristics to Income Shifts, 1979–88

	Percentage Change in		
	Top of Poorest Quintile	Median Income	Bottom of Richest Quintile
Total Actual Change, 1979–88	−7.3	3.1	10.3
Estimated Change Attributable to Shifts in			
Age of Head	2.0	1.3	.8
Headship	−3.9	−1.8	−1.2
Education of head	5.8	3.5	3.0
Labor Force Participation			
Primary Male	−2.7	−1.4	−.9
Wife	2.1	1.3	.7
Female Head	.2	*	*
Unemployment 1979–84			
Primary Male	−1.5	−1.0	−.8
Primary Female	−.1	−.1	−.1
Unemployment 1984–88			
Primary Male	1.6	1.0	.6
Primary Female	2.1	1.1	.7
Industry Mix			
Primary Male	−.5	−.2	*
Primary Female	*	.2	.2
Part-Time Status			
Primary Male	.2	.1	.1
Primary Female	.1	.1	.1
Sum of Estimated Effects of Shifts in Mix	5.4	4.1	3.2

Notes: Top of poorest quintile and bottom of richest quintile are 20th and 80th percentiles, respectively. Median income is 50th percentile. * = less than 0.5 in absolute value. These estimates ignore some interaction among changes analyzed and therefore are not strictly additive. Primary male is a husband in a husband-wife family or a male head of family with no wife present. Primary female is a wife in a husband-wife family or a female head of family with no husband present.

Source: Author's calculations based on distribution of income within groups in 1979. See Table 1 for data sources and see text and Appendix for explanation of calculations.

Table 7
Labor Force Participation Rates of the Nonelderly
Percent

	1979	1984	1988
Percent of husband-wife families with wife in the labor force	65.7	69.2	72.9
Poorest Quintile	45.8	48.7	48.5
Middle Three Quintiles	67.4	70.3	74.1
Richest Quintile	72.2	77.3	81.8
Percent of female-headed families, NSP, with head in the labor force	75.2	75.0	76.4
Poorest Quintile	64.1	61.0	63.5
Middle Three Quintiles	90.0	90.9	92.3
Richest Quintile	89.5	91.1	88.4
Percent of husband-wife or male-headed, NSP, families with husband or head in the labor force	94.0	92.8	91.0
Poorest Quintile	79.2	76.8	73.1
Middle Three Quintiles	95.5	94.3	92.0
Richest Quintile	98.5	97.9	97.9

Notes: These labor force participation rates are higher than those usually published because they count as participants individuals who worked or looked for work at any time during a calendar year rather than on a single survey date. Nonelderly families are headed by someone under age 65. NSP = no spouse present
Source: See Table 1.

Demographic changes. Educational attainment rose in the 1980s. Among nonelderly family heads age 25 and older, the fraction who had not finished high school declined substantially and the fraction with high school and college increased. (Compare the "education" entries in columns 1 and 5 of Table 4.) Since more education leads to higher income, this shift contributed to an upward shift in the family income distribution. The shift-share technique calculates how much median family income would have risen solely because of rising educational attainment by (1) holding constant (at 1979 levels) the distribution of college-educated families across the income spectrum, and similarly the distribution of income for each of the other education groups, but (2) shifting the mix of educational attainments from that in 1979 to that in 1988. Since the 1988 mix includes more highly educated families, it results in a higher median income than in 1979. How much higher—3.5 percent, as shown in Table 6—provides a measure of how much the shifting mix of heads' educational levels contributed to the overall increase in median family income between 1979 and 1988.

To get an indication of how the shifting education mix affected overall income inequality, the shift-share technique is used in a similar way to calculate the effects on the 20th percentile (the top income in the poorest quintile) and the 80th percentile (the bottom income in the richest quintile). Just like average income in the two quintiles, the top income in the poorest quintile fell during the 1980s and the bottom income in the richest quintile rose quite a bit. Because high school dropouts are concentrated at the bottom of the income distribution and the 1988 mix has markedly fewer of them, the shift-share calculation indicates that the shifting education mix would have led to a substantial rise in the poorest quintile's income. Similarly, because college-educated families are concentrated in the richest quintile, rising educational attainment contributed to the increase in top-quintile incomes. A comparison of these calculated shifts with the actual changes indicates that the rise in educational attainment of the 1980s more than accounts for the rise in median family income (other factors partially offset this rise, as will be shown below) and accounts for part of the increase in top-quintile income, but does not explain the decline in income of the lowest quintile.

Similar calculations indicate that the aging of the baby boom would have raised family incomes, other things equal. This is the case because middle-aged families have higher incomes than the young, and the aging of the baby boom in the 1980s reduced the under-twenty-five fraction and increased the fraction of families with head aged thirty-five to forty-four. By the same token, the declining fraction of husband-wife families and increase in families headed by a male or female with no spouse present shifted the family income distribution downward.[10] Both of these shifts, however, had smaller effects than rising educational attainment.

Shift-share calculations are next reported for shifts in the mix of families along labor market-related dimensions. In the discussion that follows, the term "primary male" is defined as a husband in a husband-wife family or a male family head with no wife present, and a "primary female" is a wife in a husband-wife family or a female family head with no husband present.[11]

Labor force participation. Men's labor force participation rates have fallen in recent decades while women's have risen. About 91 percent of nonelderly

Table 8

Income and Labor Market Characteristics of Nonelderly Families

Family Type	1979 Percent of nonelderly families (1)	1979 Percentage in Poorest Quintile (2)	1979 Percentage in Middle Three Quintiles (3)	1979 Percentage in Richest Quintile (4)	1988 Percent of nonelderly families (5)	1988 Percentage in Poorest Quintile (6)	1988 Percentage in Middle Three Quintiles (7)	1988 Percentage in Richest Quintile (8)
All nonelderly families	100.0	20.0	60.0	20.0	100.0	20.0	60.0	20.0
Labor force status								
Primary males								
Not in labor force	5.1	46.9	47.2	5.9	7.5	38.3	56.2	5.5
In labor force	80.1	11.4	64.5	24.1	75.5	10.3	64.4	25.2
Wives in husband-wife families								
Not in labor force	28.3	20.6	60.5	18.8	21.3	22.7	61.1	16.2
In labor force	54.1	9.1	65.3	25.5	57.3	8.0	64.9	27.1
Female heads of families								
Not in labor force	3.7	82.8	16.1	1.1	4.0	84.7	13.6	1.8
In labor force	11.1	48.8	48.0	3.2	13.0	45.5	50.3	4.2
Unemployment								
Primary male unemployed	7.8	30.2	62.6	7.2	7.8	30.5	60.9	8.6
Short Spell	4.8	22.4	69.0	8.6	4.5	22.0	67.9	10.2
Long Spell	3.0	42.7	52.3	5.0	3.3	42.4	51.4	6.4
Primary male in labor force, and not unemployed	72.3	9.4	64.7	25.9	67.6	8.0	64.9	27.2
Primary female unemployed	9.3	31.5	59.1	9.5	7.9	35.1	56.2	8.7
Primary female in labor force, and not unemployed	55.9	13.3	62.9	23.8	62.3	12.3	63.0	24.7
Industry Mix								
Primary Male Worked	79.9	11.2	64.6	24.2	75.0	10.0	64.6	25.3
In manufacturing	23.0	7.4	68.7	24.0	18.9	5.9	69.0	25.1
In nonmanufacturing	56.8	12.8	62.9	24.2	56.1	11.4	63.2	25.4
Primary Female Worked	63.6	15.0	62.8	22.1	69.1	14.0	62.8	23.2
In manufacturing	11.1	15.0	67.2	17.7	9.9	15.6	65.6	18.8
In manufacturing	52.5	15.0	61.9	23.1	59.2	13.8	62.3	23.9
Weekly Hours of Work								
Primary Male Worked	79.9	11.2	64.6	24.2	75.0	10.0	64.6	25.3
Less than 35 hours	4.0	33.4	57.6	9.0	3.6	35.8	52.8	11.3
35 hours or more	75.9	10.1	65.0	25.0	71.4	8.7	65.2	26.0
Primary Female Worked	63.6	15.0	62.8	22.1	69.1	14.0	62.8	23.2
Less than 35 hours	18.7	17.5	62.9	19.6	19.4	18.1	62.5	19.4
35 hours or more	44.9	14.0	62.8	23.2	49.7	12.5	62.9	24.7

Notes: Nonelderly families are headed by someone under age 65. People in the labor force were working and/or looking for work during the year. Unemployed people were laid off or looking for work for more than one week in the year. A long unemployment spell is defined as lasting 14 or more weeks. "Worked" refers to a person who held a job for one week or longer during the year. Primary male is a husband in a husband-wife family or male head of family with no wife present. Primary female is a wife in a husband-wife family or female head of family with no husband present.

Source: See Table 1.

primary males participated in the labor force in 1988, down from 94 percent in 1980.[12] (See Table 7.) By contrast, 73 percent of wives in nonelderly husband-wife families were in the labor force in 1988, up from 66 percent in 1979. Female heads of families with no husband present have historically had higher participation rates (75 percent in 1979) than wives, but their participation barely increased in the 1980s.

Having a primary male in the labor force significantly increases family income. As Table 8 indicates,

Table 9
Unemployment Rates of Nonelderly Family Members
Percent

	1979	1984	1988
Primary Males	9.7	12.5	10.4
Poorest Quintile	25.7	36.3	30.6
Middle Three Quintiles	9.4	11.8	9.8
Richest Quintile	2.9	3.5	3.5
Primary Females	14.3	14.6	11.3
Wives	13.1	13.2	10.0
Of Not-Unemployed Men	11.8	11.3	8.4
Of Unemployed Men	25.0	26.0	21.7
Of Men Not in Labor Force	12.7	13.4	14.5
Female Heads (No Husband Present)	19.8	21.0	16.8
Addendum: Long Unemployment Spells as Percent of All Spells			
Primary Males	38.5	51.9	42.2
Primary Females	33.3	40.8	38.2

Notes: These unemployment rates refer to any spell of unemployment in a calendar year and therefore are higher than standard unemployment rates that refer to a single date. Unemployment rate is ratio of unemployed persons to persons in the labor force in the calendar year. Unemployed were laid off or looking for work one week or longer. Labor force participants worked or looked for work in the year. "Not-unemployed" were employed part or all of the year and were not unemployed during the year. Primary males are husbands or male heads with no wife present; primary females are wives or female heads with no husband present. Long unemployment spell defined as 14 or more weeks.
Source: See Table 1.

almost one-quarter of families with a primary male in the labor force were in the richest income quintile in 1979, while almost one-half of those with a primary male *not* in the labor force were in the poorest quintile. So the decline in male labor force participation that occurred in the 1980s would have reduced family incomes, especially at the low end, other things equal (Table 6). Conversely, because having a wife in the labor force augments a family's income, the shift of wives into the labor force was responsible for raising family incomes. The increasing labor force participation of wives would have raised incomes at the bottom of the distribution more than at the top, because husband-wife families with working wives are relatively rare in the poorest quintile.[13]

Rising unemployment. In any year, a spell of unemployment, especially for the primary male, sizably increases the odds that a family will have low income (Table 8). The rise in nonelderly primary men's unemployment rates[14] from 1979 to 1984, as shown in Table 9, was responsible for part of the decline in family incomes in the period. But these changes were reversed as unemployment fell from 1984 to 1988. Women's unemployment rates are typically higher than men's and less cyclical. As Table 9 shows, for wives, unemployment had almost come back down to 1979 levels by 1984, and then fell still further in the continuing expansion. For the 1980s as a whole, these changes in female unemployment contributed to the increase in family income.

Fewer manufacturing jobs. The primary male was working in manufacturing[15] in over one-fifth of nonelderly families in 1979, and these families were better off, on average, than the families in which the primary male worked in nonmanufacturing. As Table 8 shows, having a primary male working in manufacturing kept most families out of the lowest quintile.[16] Manufacturing did not provide similarly "good" jobs to women workers in 1979, however. Families with the primary female working in manufacturing were not as well off as those with the primary female working in nonmanufacturing, on average. (This was the case despite the fact that wives with manufacturing jobs were more likely to have husbands with manufacturing jobs than were wives with nonmanufacturing jobs.)

The shift from manufacturing to nonmanufacturing jobs for primary males that occurred between 1979 and 1988 accounts for a small decline in family income, concentrated at the bottom of the income distribution. The shift for primary females accounts for an even smaller increase in family income both at the median and in the top quintile. Thus the declining importance of manufacturing caused incomes to fall and to become more unequal, but only very modestly.[17]

Declining part-time work. Part-time workers generally earn considerably less in a year than full-time workers. As Table 8 shows, one-third of families with the primary male working part-time were in the poorest quintile in 1979, compared with only 10 percent of the families of men working full-time, and similarly, many more of the full-time than the part-time group were in the richest quintile.[18] Among working primary males and females, the fraction working part-time fell slightly in the 1980s, and this contributed modestly to the increase in family incomes (Table 6).[19]

Combined effects of shifting composition. The sum of the calculated effects of demographic and work-related shifts in the mix of families is somewhat larger than the change in median family income that actually occurred in the 1980s (Table 6).[20] Thus these shifts roughly explain the 3.1 percent rise in the

median real family income. In addition, the shifts give a slightly smaller boost to income at the high end of the distribution, but this accounts for only a small part of the actual increase. And the shifts should have led to a sizable increase in incomes at the bottom of the distribution, other things equal, while incomes at the bottom actually fell. These discrepancies imply that the increase in inequality of family income that occurred in the 1980s is attributable to something other than the shifting mix of family types along the demographic and work-related dimensions examined here.

Changing Work Patterns and Earnings

The calculations of the effect of shifting composition above are based upon the 1979 distribution of income for families with each characteristic. But the shape of the distribution changed between 1979 and 1988 for each group. For example, a noticeable fraction (over 3 percent) of families headed by women in the labor force (no spouse present) moved out of the poorest quintile, and smaller fractions of families with working wives or working primary males also moved out and up (comparing columns 2 and 6 in Table 8). This section of the paper examines hypotheses regarding changes in incomes within groups defined in terms of labor market characteristics of family members.[21]

The importance of family members' work patterns and changes in those patterns in determining family income is starkly demonstrated in Table 10. The first four columns of the first row of the table, for example, report the income of the average nonelderly family in 1979, the family's income from earnings, and average family earnings of the primary male and primary female. Included in these averages are families without a primary male or female or with a nonearning primary male or female. The next five columns report the fraction of families with some

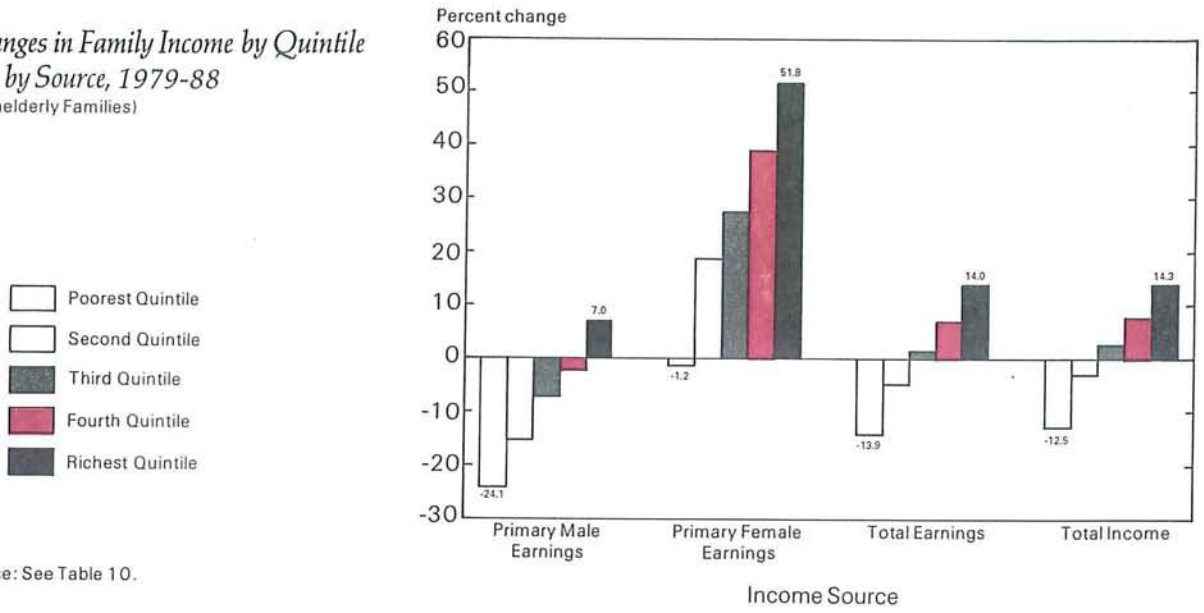
Table 10
Earnings of Family Members (Nonelderly Families)

Year and Family Type	Average Total Family Income (1)	Average Family Earnings			Percent of Families with Earnings of:			Average Earnings for Those with Earnings	
		Total (2)	Primary Male (3)	Primary Female (4)	Primary Male (5)	Primary Female (6)	Other Member (7)	Primary Male (8)	Primary Female (9)
1979 All Families	$37,050	$33,150	$23,200	$ 7,250	80	63	27	$29,000	$11,550
Poorest Quintile	10,450	7,100	3,900	2,700	45	47	15	8,600	5,750
Middle Three Quintiles	33,950	31,000	21,850	7,100	86	66	25	25,400	10,800
Richest Quintile	72,950	65,600	46,550	12,250	96	69	46	48,250	17,650
Husband-Wife Families	40,500	37,150	27,400	7,100	94	63	25	29,200	11,200
Female-Headed Families	18,650	13,450	0	9,600	0	72	39	na	13,350
1984 All Families	36,800	32,450	21,750	8,200	77	65	27	28,350	12,650
Poorest Quintile	8,450	5,350	2,600	2,350	40	44	15	6,400	5,300
Middle Three Quintiles	32,750	29,450	19,600	7,900	83	68	26	23,700	11,550
Richest Quintile	77,550	68,800	47,650	15,000	95	75	43	49,950	20,100
Husband-Wife Families	40,900	37,050	26,250	8,300	92	67	24	28,550	12,400
Female-Headed Families	17,950	13,350	0	9,700	0	70	38	na	13,850
1988 All Families	39,700	35,300	22,800	9,800	76	69	27	29,850	14,250
Poorest Quintile	9,150	6,100	2,950	2,650	39	48	16	7,550	5,500
Middle Three Quintiles	35,250	31,850	20,400	9,250	83	72	26	24,700	12,850
Richest Quintile	83,400	74,800	49,800	18,550	95	80	40	52,250	23,300
Husband-Wife Families	44,550	40,450	27,900	10,150	92	72	23	30,200	14,150
Female-Headed Families	19,250	14,950	0	10,750	0	73	38	na	14,700

Note: Nonelderly families are headed by someone under age 65. Primary male is husband or male head (no wife present); primary female is wife or female head (no husband present); other member is any other family member. All incomes are in constant 1988 dollars, as defined by CPI-U-X1, and rounded to nearest $50. Female-headed families have no husband present. na = not applicable.
Source: See Table 1.

Chart 3

Changes in Family Income by Quintile and by Source, 1979-88
(Nonelderly Families)



Source: See Table 10.

(nonzero) earnings from each family member and the average earnings of those primary males and primary females who had some earnings.

For those with earnings, earnings were much higher for primary males and females in high-income families than in lower-income families (columns 8 and 9). Also, a greater fraction of high-income families had primary males, primary females, and other family members with earnings (columns 3 to 5). By the same token, female-headed families' incomes averaged less than half those of husband-wife families because they lacked a husband's typical earnings. And these disparities increased during the 1980s.

For nonelderly primary males with earnings, average earnings rose modestly in real terms during the 1980s (column 8 of Table 10). But these changes were very uneven.[22] Earnings actually fell 12 percent for working primary males in the poorest (family income) quintile while rising 8 percent for those at the top. In addition, the fraction of nonelderly families with some primary male earnings declined sharply (6 percentage points) for the poorest quintile but only slightly for the highest. Thus, low-income families received substantially less income in the form of primary male earnings in 1988 than in 1979 for two reasons: (1) a smaller fraction of these families included a working primary male and (2) primary male earnings were lower. The first group of bars in Chart 3 shows the sharp drop in primary male earnings for the poorest quintile and earnings growth for the richest.

The average family's income from the earnings of a primary female rose dramatically in the 1980s—by about 35 percent. This increase reflects both the changes in labor force participation noted earlier (which show up as changes in column 6 of Table 10) and changes in annual earnings per worker (column 9), which result from changes in unemployment, industry, hours worked and other factors. These changes, like those for men, were quite uneven, as the second group of bars in Chart 3 shows. Families in the highest quintile enjoyed a 52 percent gain in primary female earnings because earnings per worker rose 32 percent and the proportion of families with working women rose 11 percentage points. Meanwhile, the lowest quintile's fraction of families with a primary female worker rose only 1 percentage point, and earnings per worker declined.

In sum, a loss of primary male earnings accounted for most of the income losses of the poorest quintile. Increases in the earnings of both primary males and primary females, but especially the latter, were responsible for most of the richest quintile's income gains. The combined effect was to increase the inequality of the family income distribution, pulling down the lowest quintile and pushing up the top.

These percentage changes in average family earnings by quintile were larger than the corresponding percentage changes in primary male earnings per worker, indicating that the increase in family income inequality was not just attributable to the increased inequality of male earnings. Differential changes in male and female participation and female earnings per worker also contributed.[23]

Earnings Changes over the Business Cycle

Without more detailed analysis and data for a recession year, this article can only hint at possible conclusions regarding cyclical changes in inequality.[24] The 1984 data in Table 10 show the uneven impact of a weak economy. Low-income families experienced sizable declines in male and female earnings from 1979 to 1984. These changes in earnings may reflect the uneven impact of changing unemployment shown in Table 9. Unemployment rates for primary males rose for all income groups between 1979 and 1984, but rose the most for the poorest quintile. These patterns of income loss and unemployment are consistent with the hypothesis that unemployment and wage rate adjustments in a weak economy are focused at the lower end of the income distribution.

While unemployment is more prevalent among women who head families with no husband present than among wives, it is higher still among the subset of wives married to unemployed men (Table 9). This positive association between husbands' and wives' employment/unemployment experience may be attributable to previously nonworking wives' attempts to find jobs when their husbands lose theirs or to a positive association between spouses' industry of employment increasing the odds of simultaneous layoffs. For whatever reason, it implies that family incomes will not necessarily move more smoothly over the business cycle than do individual earnings.

In the 1980s, almost all sources of income grew fastest for families at the top and slowest for families at the bottom of the income distribution.

III. Summary and Conclusions

Most families made significant income gains in the 1980s as the national economy expanded. Some families, however, did not participate fully in the general growth. In the early part of the decade, job-related earnings weakened for low-income families more than for those with higher incomes, and interest and dividend income expanded faster for high-income families than for those lower on the income scale. As the expansion progressed in the latter half of the decade, families at all income levels made gains, but the poor did not recover to their previous position. Average income of nonelderly families in the two lowest income quintiles declined over the 1979–88 period, while higher-income families enjoyed income growth. As a result, the family income distribution became more unequal. Why did the bottom of the income distribution fail to keep pace?

Losing ground were young families, families with key workers unemployed, and those with poorly educated family heads. The biggest gainers were families with jobs, preferably full-time, the more the better, and especially in manufacturing. Also gaining were families with no children, husband-wife families, and highly educated families.

A critical thread in these lists is employment. As the economy expanded, families without workers were not carried along. Earnings comprise the bulk of family income, but the importance of employment does not simply reflect burgeoning earned income and a corresponding increase in family income for those with a high share of income from earnings.[25] First, earnings grew faster than average for earners in high-income families. This was especially true of primary female earnings. Second, families with two earners made faster gains than families with one (or none), and high-income families had more earners than families with lower incomes. Third, increases in work effort during the decade seem to have been a key factor. Changes in labor force participation were not proportional to rates of labor force participation at the beginning of the period. Labor force participation rates of wives in low-income families were moderately higher in 1988 than in 1979, but wives' participation rates for high-income families in 1988 were much higher than in 1979 (recall Table 7). Similarly, female-headed families made more modest income gains than husband-wife families because the labor force participation rates of wives rose much faster than participation rates of female heads.

Increased family work effort, of course, clouds the translation of family income into family well-being. But if slow productivity growth continues to keep a lid on real wage growth and the wage distribution continues to become more unequal, a critical question for family income prospects may be how much more women's labor force participation rates can or will rise.

A notable exception to the importance of employment was the elderly, who are generally retired from the labor market, but who moved up the income ladder in striking fashion in the 1980s. They benefited from continuing federal policies aimed at maintaining their living standards and also from holding savings, the returns on which grew apace in the decade.[26] By contrast, non-retirement transfer income declined over the period for low-income families.

The employment link sheds little light on why families without children would move ahead, except perhaps that they have more time available for market work, or why the young fared so poorly. The young, it turns out, experienced a sizable decline in labor force participation rates in the 1980s. Studies that have found early labor market experience to be a critical determinant of lifetime job prospects certainly heighten concern about the currently young cohort's future.[27]

In summary, for all families combined and for most types of families, the rich got richer and the poor got poorer. The shift was especially pronounced for family heads with high educational attainment as compared to low. While reinforced marginally by changes in the distribution of interest and dividends, the increase in inequality was largely attributable to changes in family earnings—the earnings of high-income families rose while the earnings of low-income families declined. High-income families' earnings rose because of steep increases in the labor force participation of wives as well as growth in earnings per worker, whether male or female. Low-income families experienced declines in primary male earnings. Thus the families that benefited most from the good times of the 1980s were those with the most earners and the most highly paid earners. A corollary is that families with less access to the rewards of market work (with the exception of the elderly) fell behind.

Appendix: Measuring the Effects of Economic and Demographic Shifts on the Distribution of Family Income

This study uses a simple shift-share analysis to break down the total 1979–88 change in the distribution of family income into two parts: 1) the change attributable to shifts in the work patterns or demographic composition of families and 2) the change attributable to shifts in the distribution of income within each economic or demographic group. The data used in the analysis are drawn from the Current Population Survey, March 1980, March 1985, and March 1989 (machine readable data files), and report incomes for 1979, 1984, and 1988; income data are inflated to 1988 dollars using the CPI-U-X1. Incomes are grouped into 18 $5,000 intervals ranging from "under $5,000" to "$85,000 or more." Several demographic or labor force groupings are analyzed; for example, headship type, age of head, and primary male's labor force status. If a_{ijt} is the fraction of families in demographic group i that have incomes in class j in year t, and S_{it} is the fraction of all families in demographic group i in year t, then

$$\sum_j a_{ijt} = 1 \text{ for all i in year t, and}$$

$$\sum_i S_{it} = 1 \text{ in year t.}$$

The 20th and 80th percentiles and the median income can be estimated using linear interpolation within the income class that includes 20th, 50th or 80th percentile; such estimates do not differ substantially from those obtained directly from the data and provide the appropriate baseline for comparisons with those derived (as described below) from distributions projected using the shift-share technique.

The overall distribution of families across income classes in year t can be calculated as the weighted average of the income distributions of the demographic groups that comprise the whole. Thus the fraction of all families that have incomes in class j in year t, b_{jt}, is equal to

$$b_{jt} = \sum_i a_{ijt} * S_{it}.$$

To calculate what the overall distribution of families across income classes would be in 1979 if the 1988 demographic mix already held, the 1988 shares of each group (the S_is) are applied to the 1979 income distribution for each group (the a_{ij}s). Thus

$$b_{jx} = \sum_i a_{ij79} * S_{i88}.$$

The corresponding percentile income cutoffs can be estimated from this distribution by linear interpolation as described above. These cutoffs can then be compared to the cutoffs based on the actual 1979 and 1988 distribution. The difference between the medians and other percentiles calculated using b_{jx} and b_{j79} is said to be attributable to the change in shares, and is reported in Table 6. The difference between b_{jx} and b_{j88} is attributable to shifts in the income distributions within demographic or labor market groups.

Table A shows the actual percentile cutoffs for the nonelderly family income distribution in 1979 and 1988.

Table A
Income Percentiles for Nonelderly Families

Year	Percentile 20th	50th	80th	Ratio 80th:20th
1979	17,700	33,565	52,560	2.97
1988	16,410	34,610	58,000	3.53

Notes: Percentiles rounded to nearest $5. Incomes in constant 1988 dollars, as defined by the CPI-U-X1.
Source: See Table 1.

[1] The income data reported in this article have been translated into 1988 dollars using the CPI-U-X1, an experimental Consumer Price Index developed by the Bureau of Labor Statistics (BLS). The CPI-U-X1 consistently uses the rental equivalence approach to measuring shelter services that was incorporated into the official Consumer Price Index for All Urban Consumers (CPI-U) beginning in 1983. The BLS and Census Bureau recommend the CPI-U-X1 for analysis that needs a consistent treatment of housing costs in the years before and after 1983. The CPI-U-X1 registers less inflation during the 1980s than the CPI-U; hence the real growth in median family income just reported (3 percent) is greater than would be calculated with the CPI-U (1 percent).

[2] Because the gains were greatest at the top of the distribution, the growth in average income is considerably greater than the growth in the median (3.0 percent); the median is less sensitive to changes in the extremes of the distribution. The ceilings on income reported by the Current Population Survey also rose over the period, but imposing the lowest ceilings consistently over all years does not appreciably affect these averages.

[3] The income measure reported by the Bureau of the Census reflects all cash income before taxes and other deductions. It includes the income sources listed in Table 5 but not capital gains, other one-time payments, or noncash income such as Medicaid and employer-provided health benefits. Thus the measured distribution of income differs from the distribution of total income after taxes, fringes, and transfers. The U.S. Congressional Budget Office (1987) argued that taxes, on net, became slightly less progressive between 1977 and 1988. Low-income families' tax burdens crept up in the early part of the decade and then were reduced by the Tax Reform Act of 1986; social security taxes (which take a greater share of low-earner wages than high) rose. Capital gains augmented family incomes much more at the top than at the bottom of the distribution, and tax changes are unlikely to have fully offset the increase. Thus the difference between the rate of decline for the poorest quintile and the rate of increase for the richest might have been even greater if all after-tax income were included.

[4] Several studies have documented that the recent increases in inequality have been accompanied by greater stratification of the income distribution, in the sense that the overlap between the income distributions of various demographic groups has declined (U.S. Congressional Budget Office 1988, Michel 1989, Rauch 1989, Levy 1989, Lerman and Salzman 1990).

[5] Note that many elderly people live alone. Elderly families, included in this analysis, comprised only 54 percent of elderly households in 1979, 1984 and 1988.

[6] Demographic characteristics actually refer to March of the survey years (that is, 1980, 1985, 1989), while income is for the year before (1979, 1984, 1988). However, industry, unemployment, part-time status, and labor force participation refer to the same year as income. The article uses the income year as shorthand (and to avoid confusion) even when referring to demographic mix. The data cited in the text regarding the distribution of young families across quintiles are reported in Table 4.

[7] An earlier article in this *Review* examined changes in the distribution of family incomes between 1973 and 1984 (Bradbury 1986), focusing on the effects of changes in the demographic composition of American families.

[8] While most retirement income goes to the elderly, nonelderly families can also be recipients. For example, Social Security pays survivors' benefits to non-retirees.

[9] Improvements in the Census Bureau's data processing methods, rather than real growth, may be responsible for most of the measured increase in transfers. Beginning with the March 1989 survey (used in this article for data on 1988 incomes), the Census Bureau increased the number and detail of income categories imputed because of missing data. They also reprocessed the previous year's data with the new methods to gauge the impact of the new processing procedures. They report that the new methods increased their estimate of total income by less than 1 percent, but increased unearned income by almost 3 percent (U.S. Bureau of the Census 1989, Table D and pp. 14–17). Increases (attributable to reprocessing) in types of income falling into the transfer income category ranged from 0.7 percent for "AFDC and other public assistance" through 2.5 percent for "veterans' payments, unemployment and workers' compensations" to 9.1 percent for "child support, alimony, anything else." (Reprocessing also raised their estimates of interest and dividend income by 4 to 5 percent.) Over the 1979–1987 period (for which data processing methods were not changed), average transfer income for all families fell 8.5 percent, a stark contrast with the 1979–1988 increase of 0.2 percent.

[10] The income distribution for male-headed families (no wife present) looks similar to that of husband-wife families with wife not in the labor force. The distribution for female-headed families (no husband present) is centered at a considerably lower income level.

[11] The Census Bureau leaves the designation of family head up to the respondent of the Current Population Survey. Thus in a husband-wife family, either the husband or the wife may be designated the head. Because male wages have behaved differently from female wages and female labor force participation rates have risen so dramatically, the "primary male" and "primary female" labels seem more useful for this analysis than the Census' labels, "head" (of either gender) and "spouse."

[12] The data cited here include men and women in the military as part of the employed labor force. These labor force participation rates are higher than those usually published because they count as participants those who worked or looked for work at any time during the calendar year rather than on a specific survey date.

[13] That is, working wives move families into the middle quintiles as well as into the richest quintile.

[14] The unemployment rate used here is defined as the ratio of unemployed persons to persons in the labor force in the calendar year. Unemployed persons were laid off or looking for work one week or longer (they may have been working and/or out of the labor force for part of the year as well). Labor force participants worked or looked for work part or all of the year. Since the data refer to any spell of employment in a calendar year, they yield higher unemployment rates than the standard measure that refers to a specific date.

[15] "Industry" refers to an individual's longest job in the year.

[16] The income distribution for families with primary male in nonmanufacturing shown in Table 8 is not inconsistent with the stereotype cited earlier—that nonmanufacturing consists of lots of low-wage retail and service jobs and a few high-paid professionals. In 1979, for example, the fraction of families with primary male in nonmanufacturing in the highest quintile was actually slightly higher than that of manufacturing families, but the fraction in the lowest quintile was considerably higher.

[17] A more detailed industrial breakdown might yield different results, but the income distribution differences between manufac-

turing and nonmanufacturing for primary males are clear in Table 8, yet the shift that results is quite small.

[18] The same pattern holds true for primary females working part-time as compared to full-time, but because women are often the secondary earner in a family, the differences are much less pronounced. Part-time workers are defined as those working less than 35 hours in a typical week during the year.

[19] While the fraction fell, the number of part-time workers actually rose over the period because women are much more likely than men to work part-time and women's labor force participation rose so much. The labor force participation effects in Table 6 reflect the 1979 part-time/full-time mix for men and women.

[20] The effects shown in Table 6 are not strictly additive because each calculation does not hold constant all the factors considered in the other calculations.

[21] Another example of shifting returns is the expanding earnings gap between college graduates and high school dropouts described earlier. Why the payoff to education rose so sharply in the 1980s remains an interesting puzzle.

[22] Other researchers have pointed out that the distribution of men's earnings became more unequal in the 1980s (Levy 1989, Burtless 1990).

[23] Thus, despite the fact noted earlier that wives' earnings reduce family income inequality in any one year, these *changes* in wives' earnings added to family income inequality in the 1980s by stretching the top of the distribution.

[24] Income inequality typically increases during economic downturns and decreases as the economy expands, but a number of analysts have found that inequality has not declined noticeably during the expansion of the mid to late 1980s (Burtless 1990, Danziger, Gottschalk and Smolensky 1989, Levy 1989).

[25] Data cited earlier indicate that earned income grew somewhat more slowly than other sources in the 1980s, and in any case, the incomes of various groups did not generally grow in proportion to their mix of income sources.

[26] The growth in retirement income mostly reflected the indexation of Social Security to the Consumer Price Index (CPI-U). During the late 1970s and early 1980s, the CPI-U rose faster than wages, raising the incomes of the elderly relative to those of workers. Because the CPI-U rose faster than the CPI-U-X1 used here to convert nominal incomes to constant 1988 dollars, this indexation is measured as real income growth.

[27] Most of the 1979–88 increase in the number of young family heads not in the labor force is accounted for by heads not working or not looking for work because they are caring for other family members. The remainder of the increase is young family heads who are not in the labor force because they are attending school. The latter group presumably has much better future job prospects than the former.

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Man vs. Model? The Role of Judgment in Forecasting

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Vice President and Economist, Federal Reserve Bank of Boston. *The author is indebted to the modelers for graciously providing the history of their forecasts. He also thanks James Clark for valued research assistance. This article will also appear in the* International Journal of Forecasting*'s special issue on macroeconomics.*

Two apparently conflicting themes have developed on the role of judgment in forecasting. On the one hand, the literature from the field of psychology is replete with studies in which individuals' biases, prejudices, unfounded optimism, and undue conservatism undermine the accuracy of their predictions. Some interpret this evidence of fallibility as indicating that any form of subjective adjustment is "unscientific," and bound to impair predictive accuracy. Their counsel is "Don't trust your common sense" (Armstrong 1985, p. 86).

In contrast, economists commonly postulate the economic "rationality" of the individual. Many argue that much of psychologists' evidence has been gathered in unrealistic, "artificial" environments in which the participants were untrained and lacked incentives to do their best. In addition, they point to evidence showing that predictive accuracy in macroeconomics derives mainly from individuals' adjustments to their models (Evans, Haitovsky, and Treyz 1972; Haitovsky and Treyz 1972). Critics of large-scale macromodels take the fact that the models are adjusted as prima facie evidence that the models are "incredible" and "provide no useful information" (Sims 1980, p. 3 and Lucas 1976, p. 20). Many model builders themselves insist that their models are fragile and unsuitable for use without "tender loving care." Thus, at least in macroeconomics, it is uncommon for forecasters to attribute their forecasting errors to their own judgment in order to exonerate their models.

The primary purpose of this article is to review some recent evidence on the value of judgmental adjustments in macroeconomic forecast accuracy. With the notable exception of Wallis's (1989, pp. 52–55) studies of macroeconometric models of the United Kingdom, much of the evidence on which the conventional impression rests was gathered more than two decades ago and based on a fairly small sample of models very different from the current generation. Are judgmental adjustments still required to keep macromodels within reasonable

bounds? Or, as psychologists suggest, do forecasters exaggerate the value of their intuitive insights, undervaluing the importance of their models?

Those who characterize judgment as "bad" and concurrently observe that models are even less accurate without adjustments often draw the cynical conclusion that because nothing works, all models are "bad" and anyone's forecast is as good as anyone else's. This article concludes that such a view misinterprets the evidence from both psychology and economics. The fallacy follows from thinking of either judgment or models in absolute terms as "good" or "bad." What psychologists have demonstrated is that models, even highly imperfect ones, are more accurate than "pure," unreasoned expertise or global intuition. The moral to be drawn is that some systematic procedure, or "model," helps to integrate disparate information. What macroeconomic forecasting evidence suggests is that those who do use models, as opposed to pure intuition or expertise, are also often aware of some of the limitations of applying their models in practice. More often than not, model builders can adapt their models to bring them closer to actual outcomes. The best forecasts are made, not by abandoning models or by abandoning judgment, but by blending both sources of information. The observed mixture does not appear to be the optimal blend, however.

I. Adjusted versus Unadjusted Macroforecasts

The most prominent macroeconomic forecasts are generated by forecasters who adjust their purely mechanical model simulations in an attempt to improve their accuracy. The practice of adjusting models has been severely criticized on both theoretical and empirical grounds, with the main inference drawn that the underlying models are so unreliable that any success achieved in forecast accuracy must derive from the personal insights of the forecaster who adjusts the model.

One of the earliest empirical criticisms was Nelson's (1972) demonstration that a simple univariate time series or ARIMA model could produce more accurate one-quarter-ahead forecasts than the ex post simulations of a large-scale macroeconometric model. Nelson's conclusion was based on a fairly small sample collected more than twenty years ago. Since 1976, Nelson has used simple univariate equations to mechanically generate forecasts of nominal GNP and the GNP implicit price deflator (IPD) and thus, implicitly, real GNP. Nelson refers to these equations as the Benchmark (BMARK) model because they are intended to be used as a standard of comparison for assessing macroeconomic forecasts. In early 1988, Frederick Joutz of George Washington University extended the BMARK model and now issues regular forecasts of several more variables.

Table 1 compares the accuracy of the mechanically generated BMARK forecasts with the average of four prominent adjusted forecasts—those by Data Resources, Inc. (DRI), Georgia State University (GSU), the Research Seminar in Quantitative Economics at the University of Michigan (RSQE), and Wharton Econometric Forecasting Associates (WEFA). For all three variables and four horizons the BMARK forecast was less accurate. In fact, the BMARK forecast was always the least accurate of all the forecasters, with a single exception. The one-year-ahead forecasts of the implicit price deflator (IPD) showed BMARK to be virtually identical to two of the adjusted forecasts. Contrary to some previous evidence, the margin of superiority of the adjusted forecasts is greatest at the shortest horizon and decreases as the horizon lengthens. Moreover, the mechanically generated BMARK forecasts of IPD are nearly as accurate as the adjusted forecasts of a three-quarter horizon. Finally, note that these results pertain to cumulative changes and that BMARK fore-

Table 1
Evaluation of BMARK Model Forecasts against Four Adjusted Forecasts, by Variable and Forecast Horizon,[a] 1976:II–1989:IV

	Forecast Horizon (quarters)				Average for All
Variable	1	2	3	4	Horizons
Implicit GNP Price Deflator	86	92	96	94	92
Real GNP	78	84	85	88	84
GNP	74	80	85	90	82
All Variables	80	86	89	91	86

[a][(Mean RMSE/BMARK RMSE) * 100] where mean RMSE is the average of the RMSEs of the four adjusted forecasts: Data Resources, Inc. (DRI); Georgia State University (GSU); the Research Seminar in Quantitative Economics at the University of Michigan (RSQE); and Wharton Economic Forecasting Associates (WEFA).

Table 2
Evaluation of BVAR Model Forecasts against Four Adjusted Forecasts, by Variable and Forecast Horizon,[a] 1980:II–1989:IV

Variable	Forecast Horizons (quarters)								Average for All Horizons
	1	2	3	4	5	6	7	8	
Unemployment Rate	80	92	98	107	121	136	142	128	113
Real GNP	90	98	102	107	114	111	100	83	101
Money Supply, M1	99	102	102	99	98	97	97	95	98
Business Fixed Investment, Real	94	84	80	82	84	85	87	91	86
GNP	77	77	77	79	80	81	80	77	78
Treasury Bill Rate	81	85	80	79	78	75	74	74	78
Implicit GNP Price Deflator	84	64	56	51	48	44	46	47	55
All Variables	86	86	85	86	89	90	89	85	87

[a][(Mean RMSE/BVAR RMSE) * 100] where mean RMSE is the average of the RMSEs of the four adjusted forecasts: DRI, GSU, RSQE, and WEFA.

casts of quarterly changes are as accurate as other forecasts (Nelson 1984; McNees 1988).

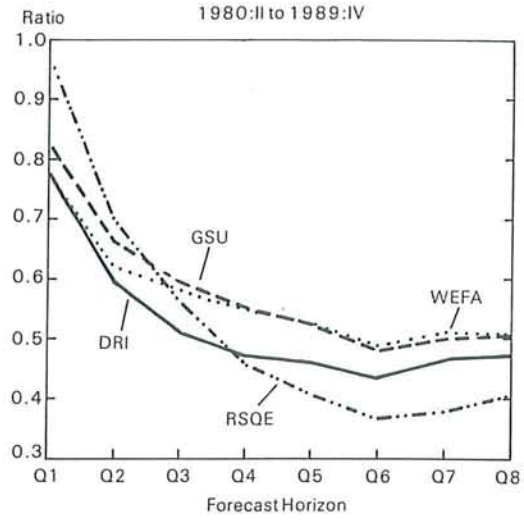
A decade ago, Litterman (1979) developed a six-variable statistical model, which he calls a Bayesian vector autoregression or BVAR model. He used the BVAR model to generate forecasts mechanically. Initially, the BVAR model produced relatively accurate forecasts of the severe recession of 1981–82 but highly inaccurate forecasts of the inflation rate (McNees 1986). In response to the poor inflation performance, the model was expanded to incorporate three additional variables hoped to contain predictive information on inflation (Litterman 1986). In August 1987, Sims (1989) modified the statistical procedures on which the model is based.

This evolution of the model illustrates why it is a mistake to think of a model used mechanically to forecast as "free of human judgment." On the contrary, the BVAR model embodies novel and sophisticated techniques that have evolved over nearly a decade. Nevertheless, the BVAR forecasts, as well as the BMARK forecasts, are as close examples of a "pure model" forecast as one is likely to see. In contrast to traditional macroeconometric models, they do not require an explicit set of external assumptions to generate their forecasts. (Indeed, it has been argued that a BVAR model is incapable of generating forecasts conditional on fixed assumptions about, for example, the future path of macroeconomic policy instruments.) It is the combination of not requiring explicit input assumptions and the modeler's refraining from adjusting the mechanically generated forecast that places the BVAR model forecasts at the "pure model/no judgment" end of the spectrum.

Table 2 contrasts the accuracy of the BVAR model forecasts with the average of the four adjusted forecasts. (The BVAR forecasts enjoy some advantage in that five of the more recent ones were made later in the quarter when more high-frequency and revised data were available. All other forecasts were issued soon after the release of the preliminary GNP data for the prior quarter.) For four of the seven variables examined, the BVAR forecasts are distinctly inferior to the others. This is particularly true of the forecasts of the rate of inflation as measured by the IPD. (See Chart 1.) The forecasts of the narrow definition of the money stock are roughly as accurate as the adjusted forecasts. For the other two variables, the relative performance of the BVAR model forecast depends on the forecast horizon. Chart 2 presents the ratios of the RMSEs of each of the four adjusted unemployment rate forecasts to the RMSE of the BVAR model. The BVAR model's one-quarter-ahead forecast of the unemployment rate is less accurate than the others but its five- through eight-quarter-ahead forecasts were the most accurate, often by a sizable margin. Chart 3 provides comparable information for the real GNP forecasts. For this variable, the BVAR forecasts were the most accurate, by small margins, for the four-quarter through six-quarter horizons, but the least accurate by fairly small margins for the shortest and longest forecast horizons. This result contrasts sharply with the superior performance of the BVAR model in the early 1980s. For the longer horizons, the BVAR model's real GNP forecasts were somewhat less accurate in the late 1980s than in the early 1980s.

Chart 1

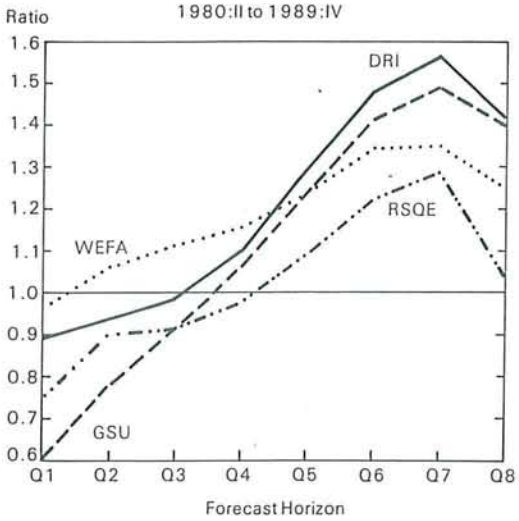
Implicit GNP Price Deflator: Ratio of RMSEs of Adjusted Forecasts to RMSEs of BVAR Forecasts



RMSE= Root mean squared error.

Chart 2

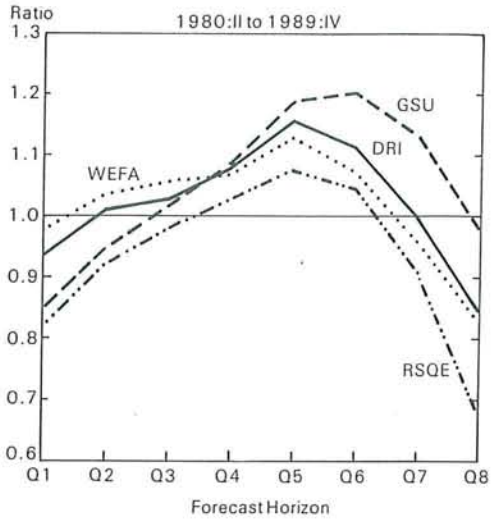
Unemployment Rate : Ratios of RMSEs of Adjusted Forecasts to RMSEs of BVAR Forecasts



RMSE = Root mean squared error.

Chart 3

Real GNP: Ratios of RMSEs of Adjusted Forecasts to RMSEs of BVAR Forecasts



RMSE = Root mean squared error.

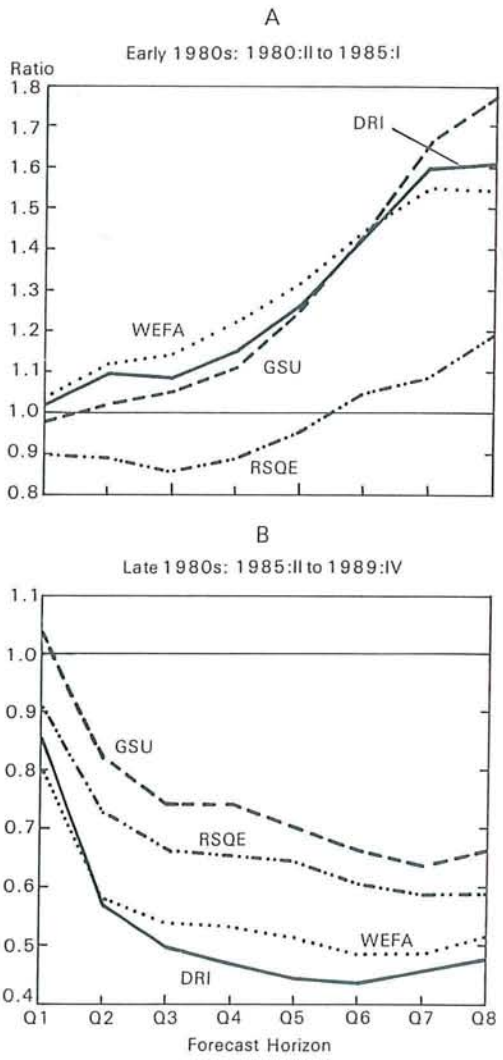
In sharp contrast, most other forecasters' real GNP forecasts have been far more reliable in the late 1980s than they were in the early 1980s.

The discrepancy between the relative accuracy of the BVAR model in the first and second halves of the 1980s is most clearly illustrated by its performance on business fixed investment measured in constant dollars. The top panel in Chart 4 shows that in the early 1980s the BVAR model's real capital spending forecasts were the most accurate by a sizable margin. In sharp contrast, its more recent forecasts have been the least accurate, also by a sizable margin. This clearly illustrates how the past, even when it appears fairly unambiguous, need not be a reliable guide to the future.

In 1983, Fair started to issue regular forecasts generated by his "structural" macroeconometric model. Unlike the statistical BMARK and BVAR models, Fair's model is based on an explicit theory of economic behavior. In addition, the model user must select specific assumptions about external conditions, such as fiscal policy and economic developments outside the United States, in order to generate a forecast. Unlike most other large-scale macroecono-

Chart 4

Business Fixed Investment: Ratios of RMSEs of Adjusted Forecasts to RMSEs of BVAR Forecasts



RMSE = Root mean squared error.

metric model users, Fair consistently refrains from adjusting his model's forecasts once he provides fairly mechanical assumptions about external variables. Thus, the Fair model represents minimal forecaster input from the user of a conditional, "structural" model.

Table 3 contrasts the forecast performance of the Fair model with the average of the adjusted forecasts of the four other models. The Fair model forecasts of three of the five variables examined—the Treasury bill rate, nominal GNP, and the unemployment rate—are distinctly less accurate than the other forecasts. Its relative performance for real GNP and inflation is more complicated to describe. The Fair inflation performance depends critically on the horizon of the forecast. As shown in Chart 5, Fair's one-quarter-ahead inflation forecast is nearly as accurate as those of three forecasters and more accurate than the fourth forecast. Four to eight quarters ahead, the accuracy of Fair's inflation forecasts is similar to two and inferior to two other forecasters. Only one forecaster clearly dominates Fair's inflation forecasts at all horizons.

Chart 6 shows that the relative accuracy of Fair's real GNP forecasts depends on the horizon as well as which individual forecaster is used for comparison. Specifically, the Fair model was uniformly more accurate than the GSU forecasts, especially at longer horizons, quite similar to the other three forecasters' up through six quarters, and more accurate at the longer horizons.

Overall, looking at all variables, it seems clear that the adjusted forecasts tend to be more accurate than those generated mechanically. There are, however, some significant exceptions to this generalization: for the longer horizons, the most accurate real GNP forecasts came from the Fair model and the most accurate unemployment rate forecasts were generated with the BVAR model. Even the simple, univariate BMARK model provides a fairly demanding standard of comparison, especially for IPD forecasts. Nevertheless, the historical record does suggest that adjusted forecasts are usually the most accurate, despite instances of success of mechanically generated forecasts.

II. Do Adjustments Improve Forecast Accuracy?

The preceding comparisons do not isolate the role of judgment per se because the forecasters who refrain from making adjustments use different models from those used by forecasters who do adjust their models. The general superiority, though not total dominance, of the adjusted forecasts could be due

Table 3

Evaluation of Fair Model Forecasts against Four Adjusted Forecasts, by Variable and Forecast Horizon,[a] 1983:II–1989:IV

Variable	Forecast Horizons (quarters)								Average for All Horizons
	1	2	3	4	5	6	7	8	
Real GNP	99	107	108	109	115	122	132	136	116
Implicit GNP Price Deflator	103	100	94	88	84	83	81	82	89
Unemployment Rate	68	76	74	74	76	80	90	97	79
GNP	89	86	79	73	68	66	64	64	74
Treasury Bill Rate	40	58	67	67	68	66	67	67	63
All Variables	80	85	85	82	82	84	86	89	84

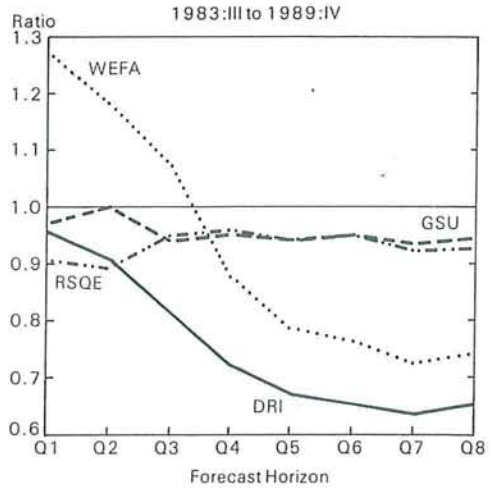
[a][(Mean RMSE/FAIR RMSE) * 100] where mean RMSE is the average of the RMSEs of the four adjusted forecasts: DRI, GSU, RSQE, and WEFA.

either to the adjustments *or* to the superiority of those models that were judgmentally adjusted. To distinguish between the two, one needs both adjusted and unadjusted forecasts from the *same* model. Typically, those who refrain from making adjustments do not accompany their mechanically generated forecast with their own judgment about where the model may go wrong and those who adjust their models do not also provide their model's "mechanical" forecast, prior to adjustment.

Fortunately, four prominent macroeconometric forecasters (not the same group considered above) who do adjust their models' forecasts have provided data on both their publicized (adjusted) and mechan-

Chart 5

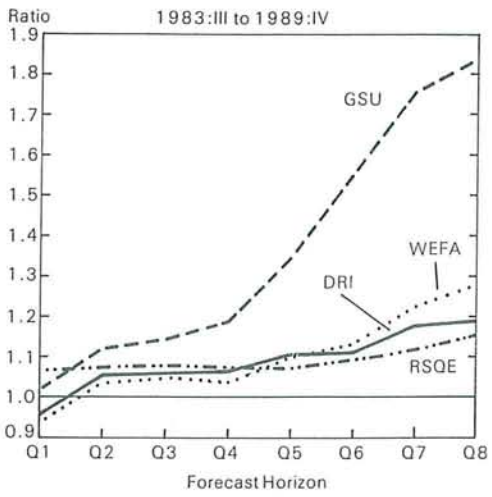
Implicit GNP Price Deflator: Ratios of RMSEs of Adjusted Forecasts to RMSEs of Fair Forecasts



RMSE = Root mean squared error.

Chart 6

Real GNP: Ratios of RMSEs of Adjusted Forecasts to RMSEs of Fair Forecasts



RMSE = Root mean squared error.

Table 4
Impact of Judgment on Forecasting Accuracy

	Forecast Horizon					
	One Quarter Ahead		Four Quarters Ahead		Eight Quarters Ahead	
	Judgment Improved (Percent) (1)	Lower RMSE (2)	Judgment Improved (Percent) (3)	Lower RMSE (4)	Judgment Improved (Percent) (5)	Lower RMSE (6)
Forecaster 1	68*	9 of 13	49	8 of 13	33	5 of 13
Forecaster 2	66*	15 of 19	62	16 of 19	65	15 of 19
Forecaster 3	62*	16 of 20	47	9 of 20	53	10 of 20
Forecaster 4	55	14 of 19	66	15 of 19	64	15 of 19
Short-term interest rates	90*	3 of 3	77	3 of 3	60	3 of 3
Long-term interest rates	78*	4 of 4	78	4 of 4	76	3 of 4
Federal deficit	76*	3 of 3	71	2 of 3	56	3 of 3
Consumer prices	76*	4 of 4	72	4 of 4	61	4 of 4
Corporate profits	74*	3 of 3	56	2 of 3	75	3 of 3
Nominal GNP	66*	4 of 4	47	2 of 4	65	2 of 4
Labor compensation	65*	2 of 3	52	2 of 3	58	1 of 3
Consumption	64*	2 of 4	50	2 of 4	60	3 of 4
Exports	63	2 of 2	47	1 of 2	30	1 of 2
Residential investment	63	4 of 4	72	4 of 4	60	4 of 4
State and local purchases	61	4 of 4	66	3 of 4	53	2 of 4
Unemployment rate	60	3 of 4	48	2 of 4	50	2 of 4
Business fixed investment	59	4 of 4	51	2 of 4	50	2 of 4
GNP implicit price deflator	59	2 of 4	72	4 of 4	85	4 of 4
Nominal net exports	57	2 of 3	57	3 of 3	50	2 of 3
Narrow money stock	56	1 of 2	58	2 of 2	50	2 of 2
Real GNP	55	3 of 4	50	1 of 4	50	1 of 4
Import price deflator	54	1 of 3	52	1 of 3	56	1 of 3
Productivity	53	2 of 2	59	2 of 2	57	1 of 2
Change in business inventories	46	1 of 4	40	2 of 4	48	1 of 4
Imports	36*	0 of 3	28	0 of 3	44	0 of 3
Total	62*	54 of 71	57	48 of 71	58	45 of 71

*Significantly different from 50 at 90 percent confidence level for one-quarter-ahead forecast. Because the four- and eight-quarter-ahead forecasts are not independent, no statistical test was applied. For each variable there are 11 to 13 one-quarter-ahead forecasts, 8 to 10 four-quarter-ahead forecasts and 4 to 6 eight-quarter-ahead forecasts.

ical (unadjusted) forecasts. (The mechanical forecasts were generated using a predetermined, fixed rule for taking account of recent residuals. Because these adjustment rules were not varied over time by the forecaster, it is appropriate to think of them not as an ad hoc adjustment but rather as part of the model.) The impact of their adjustments on the accuracy of their forecasts is described in this section.

It is important to emphasize that these data measure the importance of forecasters' adjustments of their models, not judgment in some absolute sense. Adjustments are most valuable when a forecaster is especially astute or a model especially poor. Adjustments can be harmful either when the adjuster has no information or when the model is quite reliable by itself. The results describe the net interaction between forecasters and models, roughly apportioning the forecast accuracy between the two factors.

The simplest way to measure the impact of adjustments on forecast accuracy is to count the number of times that adjusted forecasts were more accurate than those generated mechanically. Column 1 in Table 4 shows that 62 percent of all one-quarter-ahead forecasts were more accurate with adjustments. Because this is based on a large number (841) of observations, one can infer with a high level of confidence that the superiority of adjusted forecasts is significant in the statistical sense. The table shows

that the proportion of improvements ranged among forecasters from a low of 55 percent (which is not significantly different from 50 percent at a 90 percent level of confidence) by forecaster 4 to a high of 68 percent for forecaster 1. Although adjustments clearly help all forecasters on average, note that improvement is by no means assured. The table also shows, for all forecasters combined, the differences among variables. Adjustments improved 90 percent of the one-quarter-ahead forecasts of short-term interest rates. This nearly universal improvement may well reflect the fact that actual interest rate data are contemporaneously available while these models, like most macroeconometric forecasting models, are based on quarterly data. Of the variables where the adjusted forecasts were most often more accurate, several are available on at least a monthly basis.

Adjustments do not always enhance accuracy, however. Mechanically generated forecasts of the change in business inventories were usually better, and those of real imports significantly better, than the adjusted ones. Data for these two variables are not available on an accurate, current basis. Indeed, few reliable data on these variables are available when the preliminary GNP data are released. For these variables, forecasters would appear to do better to rely on their models until the "actual" data are released.

The frequency of release of actual data does not, of course, explain all of these results. Model adjustments improve forecasts of corporate profits even though the actual data only become available with a considerable lag. Similarly, even though preliminary money stock data are available weekly, the adjusted forecasts are closer to the final, actual figures only slightly more often than mechanically generated model forecasts. It is interesting also to observe that for several variables including, most notably, real GNP, mechanical forecasts are more accurate nearly as often as the publicized, "official" forecasts.

The assumptions behind the mechanical forecast, as well as the model itself, reflect the modeler's judgments.

A simple ordinal, better-or-worse comparison provides no indication of how much adjustments improve accuracy. Conceivably, model adjustments could frequently help a little but occasionally hurt a lot. Column 2 of Table 4 shows that this is not so. It compares the RMSEs of the adjusted and mechanical forecasts. (The same overall result holds for comparisons of the mean absolute forecast errors.) Of seventy-one forecaster/variable combinations, three-quarters of the RMSEs of the adjusted forecasts are lower. This same result holds across forecasters though not across variables. For eleven of the twenty-one variables studied, the RMSEs of the adjusted forecasts were uniformly smaller. For only three variables—real imports, the import price deflator, and the change in business inventories—were the mechanical forecasts more accurate for more than half of the forecasts.

The discussion so far has pertained solely to one-quarter-ahead forecasts. The remainder of Table 4 describes forecasts with longer horizons. Any conclusions drawn from them are necessarily even more tentative because they are based on fewer, overlapping (and therefore not independent) time periods. Specifically, the data were collected over a three-year period containing eleven to thirteen one-quarter-ahead observations, depending on the forecaster. Because the actual outcomes for the most recent forecasts of longer horizons are still unknown, there have been very few independent outcomes and little assurance that what has been observed so far will hold up in the future.

Taken at face value, this evidence shows adjustments are less helpful for the longer horizons than for the short horizon. Whether measured by the frequency of improvement or the relative size of RMSEs, this conclusion holds. For example, for eighteen of twenty-one variables the average RMSE of the adjusted forecast is lower than that of the mechanical one-quarter-ahead forecast. Of the four-quarter-ahead forecasts, the corresponding figure is fourteen of twenty-one, and the number falls to only eleven of twenty-one for the eight-quarter-ahead forecasts. Broadly speaking, forecasters would appear to have more "extra-model" information about the current quarter, including some high-frequency actual data, than they do about longer forecast horizons.

This general tendency can be attributed entirely to two (#1 and #3) of the four forecasters. For them, adjustments impaired forecast accuracy of their four-

and eight-quarter-ahead forecasts more frequently than it improved it. Nevertheless, the RMSEs were reduced by adjustments for about one-half of the variables. In contrast, the judgment of the other two forecasters (#2 and #4) improved their longer-term forecasts at least as often as it did their one-quarter-ahead forecasts. This suggests that different forecasters may attach differing importance to their short-term and long-term forecasts. Short-term forecasts are more important for trading financial assets or for those who judge a forecaster by his most recent forecast of the preliminary data. Longer-term forecasts are more important for longer-range planning, including macroeconomic policymaking.

The impact of model adjustments on a particular variable clearly tends to be uniform across horizons. The adjusted forecasts of short-term interest rates, consumer prices, and residential investment always had lower RMSEs than the mechanical forecasts. With a single exception in each case, the same holds true for long-term interest rates, corporate profits, and the federal government deficit. At the other extreme, adjustments always impaired forecasts of real imports and usually impaired forecasts of the change in business inventories.

For a few variables, however, the degree of improvement from adjustments depends heavily on the horizon of the forecast. Specifically, while the one-quarter-ahead forecasts of short-term interest rates and the federal deficit were improved most frequently, the improvement of their eight-quarter-ahead forecasts was only about as frequent as for other variables. Adjustments improved the one-quarter-ahead forecasts of exports and the GNP deflator about as often as they did all other variables. But, at an eight-quarter horizon, adjustments improved GNP deflator forecasts more often than any other variable (85 percent) while export forecasts were improved less often than any variable (only 30 percent). Forecasters have the ability to keep their models' long-run forecasts of the GNP deflator from running off track, but no such ability for forecasts of real exports.

In this context, it may be worth stressing again that we are not dealing with "pure" judgment or "pure" models. These data measure the relative contribution of judgmental adjustments to mechanically generated, model-based forecasts. Just as the forecaster's adjustments may be influenced by the mechanical forecast, the assumptions behind the mechanical forecast, as well as the model itself, reflect the modeler's judgments.

III. Are Forecasters Too Timid or Too Aggressive? Actual and Optimal Adjustments

The fact that forecasts are usually more accurate when models are adjusted does not imply that the forecasts we see reflect an ideal blend between model and judgment. In some instances, larger adjustments would have improved accuracy even more, but the forecasters "underadjusted" their models. On other occasions, greater reliance on the model relative to the forecasters' own insights would have improved the accuracy of their forecasts; they "overadjusted" their models. This section documents whether forecasters are "too timid" or "too aggressive" about the value of their own adjustments of their models.

The impact of model adjustments can be summarized by the ratio of the adjustments to the error of the mechanically generated model forecast, which will here be called J.

In symbols,

$$(1)\quad J = \frac{\text{Published forecast} - \text{Mechanical forecast}}{\text{Actual outcome} - \text{Mechanical forecast}} = \frac{\text{Adjustment}}{\text{Mechanical forecast error}}$$

or, rearranging,

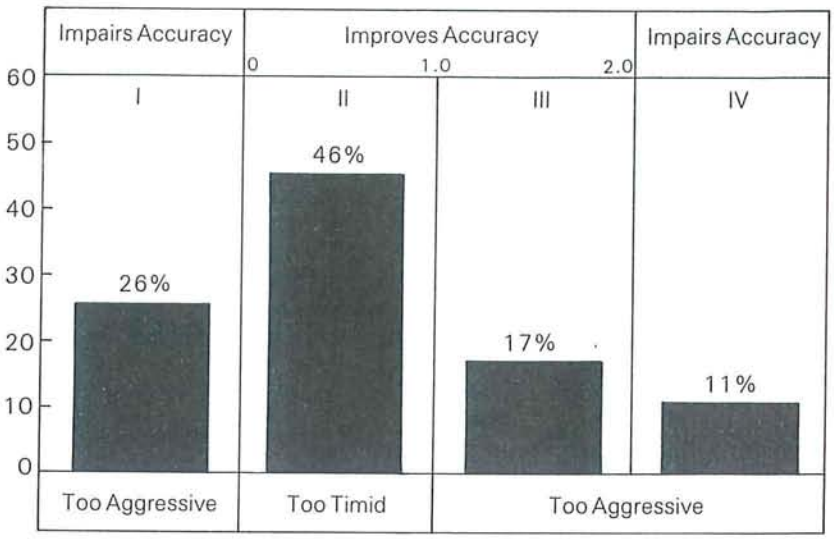
$$\text{Error of Published forecast} = (1 - J)\ \text{Error of mechanical forecast.}$$

Note that $J = 1$ when the adjustment exactly offsets the mechanical forecast error so that the published forecast is perfect. When $0 < J < 1$, the adjustment offsets part, but not all, of the mechanical error, so that the published forecast is more accurate than the mechanical forecast. In these cases, the forecaster was "too timid"; a larger adjustment would have enhanced accuracy. In all other cases, when $J < 0$ or $J > 1$, the forecaster was "too aggressive"; a larger adjustment would have impaired accuracy. When $1 < J < 2$ the adjustment more than offsets the "model error" but still improves upon the mechanical forecast. Thus, adjustments improve forecast accuracy when $0 < J < 2$.

When $J > 2$, the adjustment is in the correct direction but too large, rendering the published forecast error larger (and of opposite sign) than the mechanical forecast error. When J is negative, the adjustment is in the wrong direction, compounding the "pure model" error. Thus when J is either negative or exceeds 2, judgment impairs forecast accuracy.

Chart 7

Distribution of J for All One-Quarter-Ahead Forecasts



$$J = \frac{\text{Adjustment}}{\text{Mechanical Forecast Error}} = \frac{\text{Published Forecast} - \text{Mechanical Forecast}}{\text{Actual} - \text{Mechanical Forecast}}$$

Chart 7 presents a frequency distribution of the 841 Js of the one-quarter-ahead forecasts of all forecasters and all variables. Nearly two-thirds (63 percent) of the Js fall into the $0 < J < 2$ region, reflecting the fact that adjustments improved the forecasts more often than not. However, more than one-quarter of the adjustments were in the wrong direction and about one in ten were so large that they actually impaired the accuracy of the forecast. Less than half (46 percent) of the Js fall between 0 and 1, indicating forecasters are usually not "too timid" in adjusting their models.

The top panel of Table 5 summarizes the distribution of Js for each forecaster and three horizons. At each horizon, the forecasters as a group were "too aggressive." More often than not, a smaller adjustment would have improved accuracy more than the actual adjustment that was made. This tendency toward overly aggressive adjustments is mainly attributable to two of the four forecasters. It is clearly evident in forecaster 1, whose frequency rose from 63 percent at the one-quarter horizon to 75 percent at the eight-quarter horizon. Forecaster 3 also tended to

Table 5
Optimal Adjustments by Forecast Horizon

	Forecast Horizon (quarters)		
	1	4	8
	Too Aggressive (Percent of forecasts)		
Forecaster 1	63*	65	75
Forecaster 2	48	54	52
Forecaster 3	55	64	60
Forecaster 4	55	49	46
All	54*	57	55
	Optimal Weight > (<)1**		
Forecaster 1	3 (8)	1 (8)	2 (8)
Forecaster 2	3 (7)	2 (7)	5 (9)
Forecaster 3	5 (7)	2 (13)	2 (11)
Forecaster 4	2 (10)	9 (6)	8 (5)
All	13 (32)	14 (34)	17 (33)

*Significantly different from 50 at the 90 percent confidence level for one-quarter-ahead forecasts. The four- and eight-quarter ahead forecasts are not independent and no statistical test was applied. There are approximately 200 one-quarter-ahead forecasts, 150 four-quarter-ahead forecasts and 80 eight-quarter-ahead forecasts.

**Significantly different from 1 at the 50 percent confidence level. See Table 4 for total number of variables for each forecaster.

overadjust his model, with frequencies ranging from 55 percent to 64 percent. The other two forecasters do not exhibit a clear tendency to overadjust more frequently than they underadjust. Some forecasters clearly tend to be overly confident of the value of their own adjustments relative to their models.

The tendency to overadjust was most evident among the several variables where, as we have already seen, adjustments impaired accuracy. The clearest case (not shown in the table) was real imports, where adjustments were excessive in from 69 percent to 80 percent of the cases, depending on the horizon. Forecasters also tended to be overly aggressive in adjusting estimates of the change in business inventories and the import price deflator. The few counterexamples of underadjustment, or "timidity," were for corporate profits and the federal deficit one quarter ahead, and short-term interest rates at the longer horizons.

More often than not, forecasters could improve accuracy by placing less weight on their own adjustments relative to their mechanically generated model forecasts.

We have learned that forecasters' adjustments improve accuracy more than they impair accuracy but that their adjustments are too large more often than they are too small. We turn now to what an ideal adjustment would have been, or, more concretely, the optimal, fixed weight that the forecasters should have placed on adjustments in order to maximize the accuracy (based on a quadratic loss function) of their forecasts.

In symbols, we calculate the W that minimizes the expression

$$(\text{Mechanical forecast} - \text{Actual outcome} + W \cdot \text{Adjustment})^2.$$

A weight of 1 implies a perfect blend between model and adjustments. A weight greater than 1 implies that the forecasters were too timid, too "anchored" to their models, too skeptical about the predictive value of their own insights. In contrast, weights of less than 1 imply the forecasters were too aggressive, overadjusted their models, and had undue confidence in their own extra-model insights. A negative weight suggests the adjustments would have to be reversed in order to improve accuracy.

The optimal weights were calculated by regressing the error of the mechanical forecast on the forecaster's adjustment. (The following conclusions also hold when a constant is included in the regression.) A clear majority of these weights were less than 1, confirming the impression of overadjusting. Many of the estimated weights were, however, quite close to the ideal of 1. In order to allow for the imprecision in the estimation of the ideal weight, the bottom panel in Table 5 summarizes only those Ws that were statistically significantly different from 1 at a 50 percent level of confidence. The table again confirms the predominance of weights less than 1, showing that better forecasts would have been obtained by sticking closer to the model. At the one-quarter horizon, thirty-two weights were significantly less than 1 and only thirteen significantly more than 1. At the four-quarter horizon the proportion increases—thirty-four were less than 1 and fourteen greater than 1. The prevalence of overadjusting is overwhelming if one counts only those weights that are significantly different from 1 at a 90 percent level of confidence. More often than not, forecasters could improve accuracy by placing less weight on their own adjustments relative to their mechanically generated model forecasts.

IV. Conclusion

This article has argued that the man (or judgment) versus model dichotomy is a false one. The question is not whether human judgment is either always "good" or always "bad." Everyone is all too familiar with examples of each. The important questions are: Under what circumstances is judgment most likely to incorporate information with predictive value above and beyond that which has already been incorporated in a formal model? How can the imperfect information from judgment be combined with the imperfect information in models to maximize predictive accuracy? Models and judgment are not mutually exclusive, and can be complementary.

Social psychologists have carefully and extensively documented and replicated examples of the fallibility of judgment. Their findings recommend a

healthy skepticism toward those who offer forecasts based purely on experience or expertise with no explicit form of systematic reasoning or model. They do not, however, show that judgments are in some sense devoid of predictive content.

At the same time, the limitations of models of an entire economy seem so painfully obvious that it is difficult to imagine that anyone could seriously expect them to incorporate all information with predictive content. The economy is more or less continually buffeted by a variety of events if not entirely unique, at least without close historical precedent. Most recently, it has been drought, earthquake, freeze, and abnormal warming. A decade ago, rather than natural disasters it was strikes, oil shocks, and the phasing in and out of wage, price, and credit controls. At other times, institutional and regulatory changes have led to changes in the very definition of macroeconomic concepts. Such events have implications for the economic future, implications not well captured by standard models which, of necessity, describe the "normal," past behavior of the economy. The evidence presented here broadly confirms the conclusion that individuals adjust their models to compensate in part for their models' deficiencies, thereby improving the accuracy of their forecasts.

The fact that adjustments usually enhance forecast accuracy does not imply that the adjustments that are actually made are optimal for maximizing accuracy. At one extreme, the unadjusted forecasts of real imports were always more accurate, and those of the change in business inventories usually more accurate, than the widely publicized adjusted ones.

More generally, with the benefit of hindsight we can show that the adjustments that were made were typically too large. The prevailing tendency to place too much weight on the specific circumstances and too little on the model is what Kahneman and Tversky (1982, p. 416) have called "the major error of intuitive prediction." It is important to stress that this tendency has been observed in a highly realistic situation. In contrast to some of the previous experiments, all of the subjects were highly trained and informed, had a major incentive to do their best, could eventually learn the actual outcome, and were relatively immune from the treatment effects that contaminate the interpretation of many social science experiments.

While it would be a mistake to ask forecasters to refrain from adjusting their models, it is also a mistake to accept the adjustments that are made at face value, especially when the adjustments appear without any explanation of the reasoning behind them. On occasion, forecasters may have objectives other than simply maximizing the accuracy of their forecasts. This possibility strongly suggests that both forecasters and forecast users should be aware of the differences between their adjusted and unadjusted forecasts. The first step in learning how to extract the most predictive information from both model and forecaster is to be clear about how the two may differ.

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The Downturn in the New England Economy: What Lies Behind It?

Edward Moscovitch

President, Cape Ann Economics.

After a long period of vigorous growth—a period in which New England grew faster than the rest of the United States—employment in New England leveled off in 1989. This slowdown represents both a cyclical adjustment and a disturbing erosion in New England's competitive position.

To help clarify the causes of the downturn and the implications for the region's future development, this article develops a framework for analyzing regional economies, applies that framework to New England and other regions of interest, and examines New England's share of national markets in key industries.

New England's Economic Performance

A quick overview of New England's performance in recent years is provided by Chart 1, which shows New England employment in major sectors of the economy as shares of national totals. Back in the early 1970s, hardly anyone would have predicted that New England, with its cold winters, high energy costs, high taxes, and location far from Sunbelt markets would have grown as quickly as the rest of the country. Perhaps the most interesting finding in Chart 1, then, is that New England employment has stayed at approximately 6 percent of the U.S. total since 1973. Indeed, our share rose steadily from 1976 to 1987 before it reversed itself and fell in 1989.[1]

The central role of the region's durable goods manufacturing firms is underscored in the chart. Employment in this area rose from under 7.5 percent of the national total in 1973 to a peak of close to 9.0 percent in 1983; it has since fallen below 8.0 percent. This decline bodes ill for the long-term economic outlook and should be the single most important issue on New England's economic agenda.

It is not surprising that New England's nondurable goods sector,

which includes such traditional industries as shoes, textiles, and apparel, should represent a declining share of national employment. Even so, this sector followed a pattern somewhat similar to durables, with only a modest decline in the golden years from 1975 to 1984 and sharp losses thereafter.

Another important factor in New England's strong performance during most of the 1980s was the remarkable upsurge in the region's construction industry; employment rose from 4.6 percent of the national total in 1979 to a peak of 6.7 percent in 1988. Employment in finance, insurance and real estate also rose in relation to the national industry.

Even during the boom years of the 1980s, New England's rate of population growth was barely half that of the nation. With this low population gain, New England cannot support a large home-building sector, and its construction industry must in the long run form a smaller proportion of the regional economy than is true elsewhere. The high construction activity of recent years was clearly unsustainable; in retrospect, everyone should have seen the current slowdown coming.

The problems in manufacturing would ordinarily have led to a slowdown sometime after 1984. They were masked, however, by the gains in construction and related industries. When, in 1989, construction fell, total employment leveled off, New England's economic performance fell behind the rest of the country's, and the problems became apparent.

The subsequent analysis is centered on the key durable goods manufacturing industries and focuses on three periods:

1) 1975–80: In 1975 the New England and United States economies began a long period of expansion. Durable goods manufacturing employment grew even more rapidly in New England than the nation during this period, peaking in 1980.
2) 1980–84: New England durables employment recovered quickly from the 1982 recession; by 1984 it had essentially regained 1980 employment levels. During this period national durable goods employment fell sharply, so New England continued to gain share.
3) 1984–88:[2] From 1984 onward, New England's durable goods manufacturing employment fell by roughly 130,000 jobs, while national employment rose. The decline is a central focus of this article. Which industries within the region suffered the greatest losses? Which other regions of the country picked up the employment share lost here?

A Framework for Analyzing the New England Economy

This review of New England's recent economic performance is grounded in economic base theory and the central role of those industries that sell to customers outside the region.[3]

Economic Base Theory

It is helpful to think of the economy of a region as containing three sectors: the economic base, the domestic sector, and construction. The economic base consists of those activities that sell primarily to customers outside the region. In New England, the economic base includes almost all of the region's manufacturing, its insurance headquarters, its farms and fisheries, and its private schools, colleges and universities. These base industries can be identified with readily available economic data.

New England's base also includes hotels and restaurants that cater to nonresident tourists, wholesalers that supply stores outside the region, banks that lend to national customers, and software houses or business consultants selling in national markets. Unfortunately, these are not readily separated from banks serving retail markets or restaurants catering to neighborhood trade. For the purposes of this article, these hard-to-categorize sectors are referred to as the "semi-base."[4]

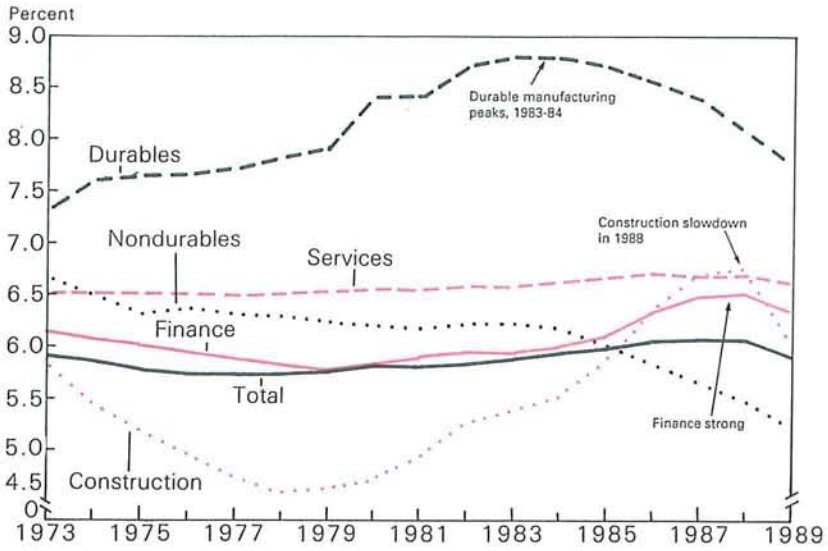
The domestic sector is composed of the businesses that serve primarily local markets—retail

As long as New Englanders spend a substantial portion of their income on goods produced outside the region, they must be successful in sales in national and world markets.

stores, insurance agents, barbershops, laundries, lawyers, and local government.[5] The growth of the domestic sector is driven by the economic base. New shopping centers and real estate agencies normally cannot be justified without higher total income in the region. Higher income is earned from increased sales

Chart 1

New England Employment as a Percentage of U.S. Employment by Major Industry Groupings



Source: See Table 1.

to out-of-region buyers. As long as New England residents spend a substantial portion of their income on food, automobiles, appliances, fuels, and clothing produced outside the region, they cannot expect to increase regional income and employment unless they are successful in national and world markets.

Construction is usually classified with the domestic sector. However, construction activity is financed in national capital markets and in a period of falling interest rates and looser credit, a region could experience a construction boom even if local income were not growing strongly. Conversely, high rates might trigger a decline even if the regional economy were sound. The investment decisions of federal, state and local governments or major companies in the region can also affect the level of construction apart from local economic conditions. For short-run analysis, then, the construction sector does not depend on the level of the local economy and can be grouped with the economic base. From one year to the next, total employment in a region depends on increases in construction and/or base sector activity and on the multiplier impact of these increases on total employment.

Over the longer run, of course, construction employment depends heavily on the health of the local economy and on long-term population growth. However favorable financing conditions might be, builders will not continue to put up houses that will not sell and office space that cannot be rented. For long-term analysis, the construction sector is not part of the economic base.

This distinction is critical to understanding the recent economic history of New England—a period in which the construction sector has grown out of proportion to the economic base. The inevitable end of a construction boom is one of the major factors behind New England's current downturn.

Regional economic studies frequently underestimate the impact of the construction cycle on regional economies because they ignore the service-producing industries that are closely linked to construction. This article tries to rectify the problem, by defining the construction sector to include not only the carpenters, electricians, and ironworkers directly employed in construction, but also real estate agents and people employed in selling furniture and building materials.

The relationship between a region's economic base and its total economy is commonly termed the multiplier. The income generated by new base sector jobs supports new retail stores, insurance agencies, laundries, and schoolteachers. The size of this multiplier depends on the ability of the region to meet its own demand for goods and services. In the long run, then, the study of a regional economy is essentially the study of the health of its economic base.

The Economic Base

Over a period of a few months, movements in a region's base will generally follow national cycles in those same industries. When computers, metalworking, insurance, and electronics slow nationally, growth in the New England components of those industries slows. For short-term forecasting, then, it is important to monitor national trends in a region's key industries.

Over the course of several years, however, regions can gain or lose share; employment, therefore, depends not only on national trends but also on the region's competitive position. Market share is a far more interesting issue for regional analysis than national production and employment trends. A region can do relatively little to influence the size of the national market. But, given a long enough time horizon, it can increase—or decrease—the share of national production that takes place within its boundaries.

Regional employment depends not only on national trends but also on the region's competitive position.

Region-to-region differences in energy and transportation costs, wages, taxes, health insurance, and workers' compensation influence the decisions of businesses to relocate or expand production facilities. Other factors also come into play: Where do business people like to live? Where can they easily recruit either assembly-line labor or skilled engineers and researchers? Where will they find government officials who will be helpful and cooperative on such matters as curb cuts, building permits, and environmental regulations? Where can they have ready access to current research results?

A region's share of national production and employment also depends on the success of the particular products and the business strategies of its companies. New England's share of the camera market, for example, depends on Polaroid's success in competing with Kodak. New England's share of the computer market rose in the 1970s when the minicomputers made by Digital, Data General, Wang, and Prime were taking market share from IBM's mainframes. New England's share of the computer market is falling today as personal computers displace the minis.

Over the very long run, the ability to develop new products and industries is critically important to a region like New England. As industries mature and their products standardize, production will gradually shift to suppliers in lower-cost regions and, increasingly, overseas. The region's textile and shoe industries have been in decline for over a generation, but the growth of computers, instruments, and other high tech manufactures in the late 1970s and early 1980s enabled the region to achieve remarkable prosperity. With the slump in computers and the inevitable defense cutbacks, New England may once again have to generate a new round of products or even new industries if it is to continue to prosper.

Chart 2 shows base, construction,[6] semi-base, and domestic employment in New England. A listing of the industries assigned to each category is found in the Appendix. Other analysts may differ somewhat on the assignment of particular industries, but the overall picture is unlikely to change very much. In 1975, the base represented 30 percent of total employment; the base plus the construction sector—the foundation for the short-term multiplier—accounted for 37 percent. By 1988, the base had fallen to 23 percent of total employment; construction had risen to 10 percent from 7 percent in 1975. The region's increased dependence on the semi-base industries is also illustrated in Chart 2. Over the entire period, the combination of base, semi-base and construction remained essentially the same fraction of employment, with a decreasing fraction of base jobs replaced by semi-base and, after 1980, by construction.

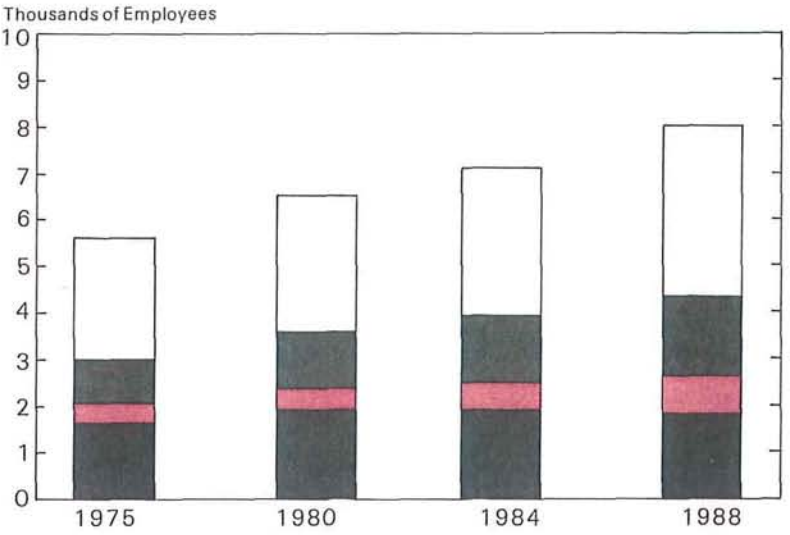
Regional Growth Patterns

This framework will now be used to analyze economic developments in New England. As shown in Chart 3, 1975–80 was a period of strong, balanced growth. Total and base employment grew at 3 percent per year, with the semi-base growing more quickly and construction and domestic employment somewhat more slowly.

From 1980 to 1984, a curious pattern developed: base employment began to fall while construction growth doubled to almost 6 percent a year. The imbalance worsened after 1984. Base employment was now falling more than 1 percent a year, while

Chart 2

New England Employment, by Sector



Note: See the Appendix for a listing of industries in each sector.

Source: See Table 1.

construction growth exceeded 8 percent a year. Domestic employment outgrew the economy as a whole. Each of the six New England states followed essentially the same growth pattern—rapid growth in the late 1970s, slower growth in the early 1980s as the economic base slowed down, and construction-led employment gains after 1984.

The extent to which New England's economy was out of balance is underscored by Chart 4, which shows the differences between New England and national growth rates. In the most recent time period, New England's construction sector was growing 5 percentage points faster than U.S. construction while its base sector was shrinking a percentage point

Chart 3

Annual Growth Rates, New England Employment

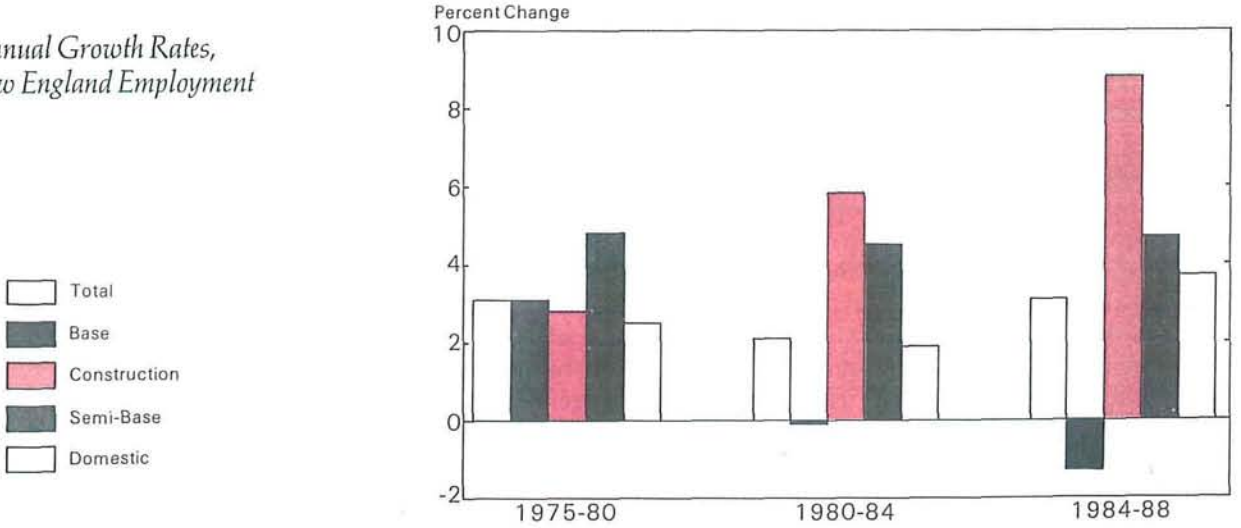
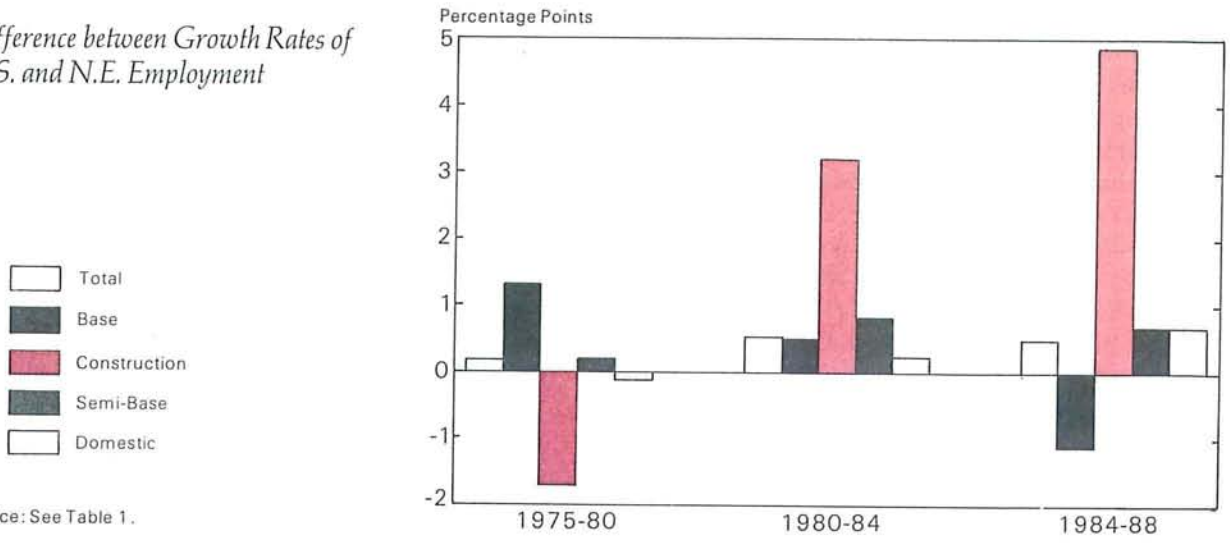


Chart 4

Difference between Growth Rates of U.S. and N.E. Employment



Source: See Table 1.

more. As the experience of recent months makes clear, builders will not continue to construct new units nor will bankers continue to finance them in the absence of adequate demand. Given the long slide in New England's economic base, the current decline in construction was inevitable.

It is tempting to hope that New England has become a "service economy," in which growth is led by a constantly expanding service sector and the economic base is no longer important. A glance at the experience of the Pacific and West South Central regions (Charts 5 and 6) suggests otherwise.[7] In the Pacific in the early 1980s and more strikingly in the West South Central region in the mid 1980s, a weakening in base employment was accompanied by a sharp reduction in the growth of domestic-sector and construction employment. These examples emphasize that strong growth in the service-producing industries of the domestic sector cannot continue in the face of a declining base. New England has been remarkable in that it sustained such strong construction and domestic activity for so long.

The continued high growth of New England's semi-base sector raises an interesting and important question. To the extent that this growth is serving national markets, it may well continue and would represent the only real strength in the short-term outlook for New England. On the other hand, if this new employment serves domestic markets, the semi-base (like construction) may have expanded beyond the capacity of the local market to support it and may well require a correction.

Shift-Share Analysis of the Economic Base

As can be seen from Chart 7, durable goods manufacturing represents approximately half of New England's base; it looms so large that its ups and downs dominate the movements of the total. Nondurables manufacturing represents a steadily shrinking portion of the base. The nonmanufacturing components of the base have grown just about as much as nondurable employment has shrunk. This growth has come mainly from education and to a lesser extent from insurance. The "other" category includes mining, farming, forestry, and fishing.

Traditional nondurables manufacturing (shoes, textiles, apparel) will probably continue its long decline. Meanwhile, the diminished number of college-age students probably means a temporary end to growth in higher education. Defense cutbacks assure a decline in military employment. Insurance, therefore, represents the only likely source of base sector growth other than durables, and by itself insurance is too small to have much impact. One is forced to

Employment Growth Rates

Chart 5 Pacific States

(California, Oregon ,Washington, Hawaii, Alaska)

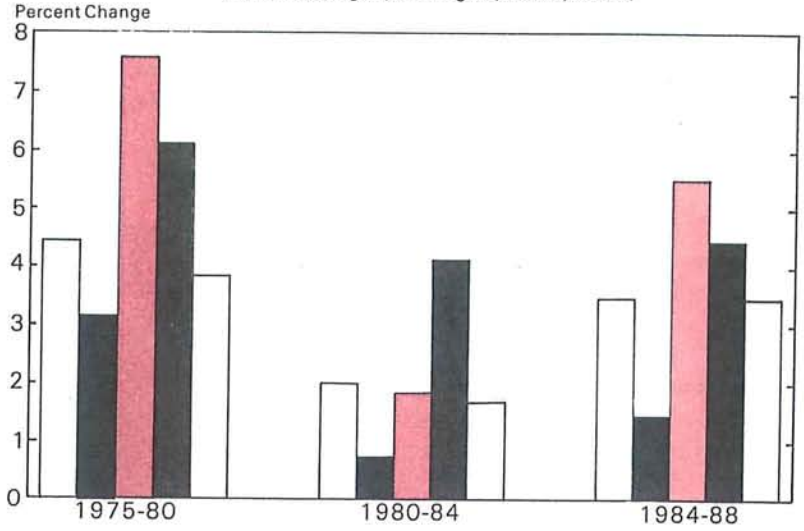
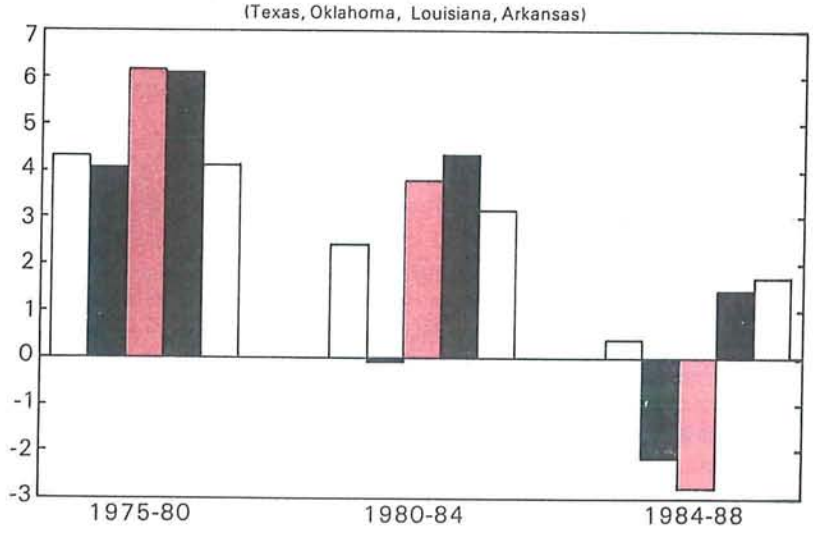


Chart 6 West South Central States

(Texas, Oklahoma, Louisiana, Arkansas)



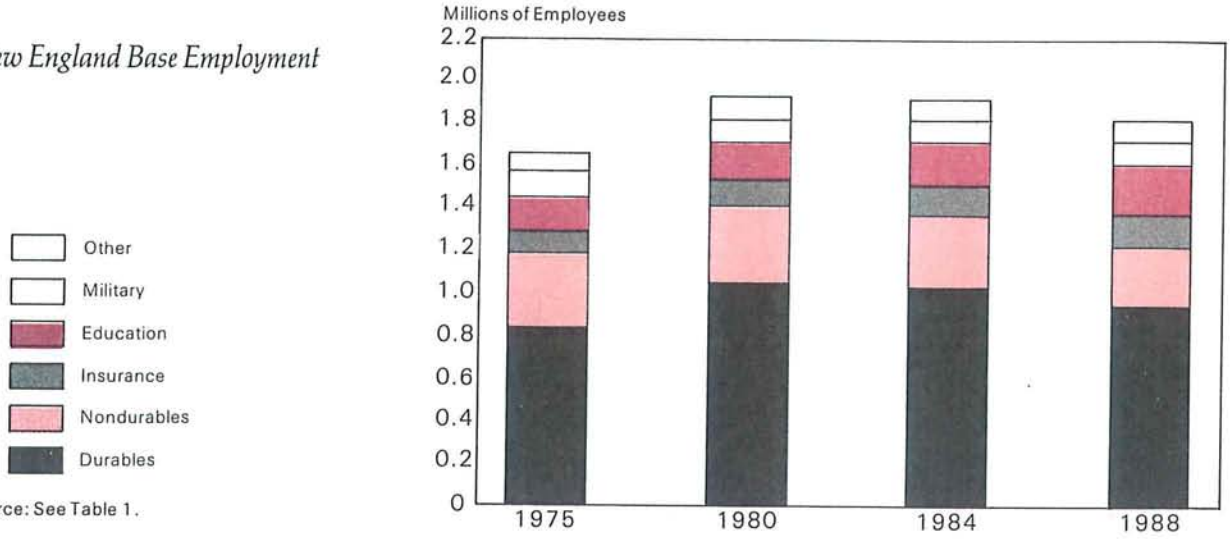
Source: See Table 1.

conclude that New England must therefore look to a revival of its existing durable goods manufacturing sector or to whole new industries (such as bio-tech or advanced plastics) if it is to have a healthy economy and sustainable growth.

New England's durable goods manufacturing sector has been losing employment since 1984. The reduction is attributable mainly to a deterioration of New England's competitive position rather than to national trends. This is demonstrated by shift-share

Chart 7

New England Base Employment



Source: See Table 1.

analysis, which looks at the national growth rate in each narrowly defined industry, applies this growth rate to New England's employment, and compares the estimated changes to actual employment changes in the region. For example, national employment in electrical equipment (appliances, telephone and other communications equipment, electronics and so forth) rose by 23.7 percent from 1975 to 1980. Had the New England industry grown at this same rate, 37,800 jobs would have been added in the region. This portion of New England's employment increase (its "share" gain) represents what would have occurred if the region had maintained a constant share of the U.S. industry. In fact, New England gained 54,500 jobs in electrical equipment. The additional 16,700 jobs represent a shift in employment from other regions into New England.

Shift-share analysis can help answer a critically important question—did New England's poor performance since 1984 in base industries, and in durable goods manufacturing in particular, occur because New England is overrepresented in slow growth industries? Or did it occur because, industry by industry, New England was losing ground to competitors elsewhere in the country?

1975 to 1980

During this period, national employment in base industries grew 9.2 percent. Had New England maintained a constant share in each of these industries (insurance, machinery, instruments, and so forth), its base employment would have grown 12 percent. That is, New England was heavily represented in high-growth industries; it had a favorable industrial mix. Its "share" employment gain would have been 199,000 jobs. In fact, New England base employment grew by 16.4 percent. The region enjoyed a "shift" of 73,000 jobs from other regions, for a total employment gain of 272,000 in its economic base. Thus, New England turned in a more favorable performance than the rest of the country both because it had a strong mix and because it gained share.

The favorable shift occurred across a broad range of base industries, as spelled out in Table 1. The base industries shown are those in which New England's employment in 1988 exceeded 50,000; they are listed in the order of their contribution to employment growth. Machinery (computers, machine tools, and industrial machinery) and electrical equipment accounted for over 110,000 new jobs, of which 40,000 appear to be a shift from other regions. A detailed

analysis of the sub-industries involved shows that New England's stronger-than-national performance occurred because the region's employment was concentrated in the rapidly growing computer and electronics sub-industries. In other words, using a finer industrial breakdown, somewhat more of New England's strong showing during this period would be attributed to its favorable mix and somewhat less to a gain in share.

Table 1
Shift-Share Analysis of New England's Economic Base, 1975–80

Industry	Employment Change 1975–80 (thousands of jobs) Shift	Share	Total
Machinery, except electrical	26.7	33.2	59.9
Electrical and electronic equipment	16.7	37.8	54.5
Transportation equipment (excluding motor vehicles)	3.1	22.3	25.4
Instruments and related products	1.9	21.8	23.7
Insurance carriers	.3	17.8	18.1
Fabricated metal products	3.6	13.5	17.1
Education (private)	−4.0	18.8	14.8
Farm	12.7	−1.8	10.9
Miscellaneous manufacturing	3.9	5.1	9.0
Paper	.0	4.8	4.8
Rubber and misc. plastics products	−9.5	13.0	3.5
Military employment	−4.8	−9.2	−14.0
Other	22.3	21.7	44.0
Total	72.9	198.9	271.8

Components may not sum to totals because of rounding.
Source: Author's calculations using computer tape supplied by the U.S. Bureau of Economic Analysis

New England gained another 100,000 jobs in transportation equipment except motor vehicles (aircraft, shipbuilding, and missiles), instruments, fabricated metals, education (private universities, colleges, and schools), and insurance. New England's performance in these industries reflected favorable national trends. In two industries—education and rubber and plastics—strong national growth allowed New England to post overall employment gains even though it lost share.

During this "golden age," New England enjoyed rapid growth because it increased or maintained share during a time of strong national growth and because its employment was concentrated in high-growth industries. Except for business services, the semi-base sectors during this period grew more slowly in New England than in the rest of the country.

1980 to 1984

Because the national economy weakened, New England's economic base was no longer growing in the early 1980s. New England would have lost 45,000 base sector jobs during this period, had its industries held a constant share of national employment. In addition, New England's competitive position was not quite as strong: its industries showed a favorable shift of 33,000 as compared to 73,000 in the earlier period (Table 2). This favorable shift was concentrated in electrical equipment. Positive shifts also resulted in employment increases in education and insur-

Table 2
Shift-Share Analysis of New England's Economic Base, 1980–84

Industry	Employment Change 1980–84 (thousands of jobs) Shift	Share	Total
Electrical and electronic equipment	27.1	10.9	38.0
Education (private)	7.1	23.1	30.2
Insurance carriers	8.2	2.0	10.2
Instruments and related products	2.1	.8	2.9
Transportation equipment (excluding motor vehicles)	10.1	−8.0	2.1
Rubber and misc. plastics products	−3.6	5.2	1.6
Military employment	−11.3	9.9	−1.5
Paper	−.7	−1.1	−1.8
Miscellaneous manufacturing	−3.4	−6.1	−9.5
Farm	−8.6	−4.3	−12.9
Machinery, except electrical	9.1	−26.0	−16.9
Fabricated metal products	−6.7	−13.6	−20.3
Other	3.6	−37.8	−34.8
Total	33.0	−45.0	−12.0

Source: See Table 1.

Table 3
Shift-Share Analysis of New England's Economic Base, 1984–88

Industry	Employment Change 1984–88 (thousands of jobs) Shift	Share	Total
Education (private)	1.2	24.8	26.0
Insurance carriers	−2.4	20.0	17.6
Military employment	−.7	3.3	2.6
Transportation equipment (excluding motor vehicles)	−21.3	20.8	−.5
Farm	1.1	−4.7	−3.6
Paper	−4.9	1.2	−3.7
Miscellaneous manufacturing	−4.7	−.7	−5.4
Instruments and related products	−9.4	3.3	−6.1
Rubber and misc. plastics products	−13.9	4.1	−9.8
Machinery, except electrical	−1.8	−9.5	−11.3
Fabricated metal products	−15.1	−2.3	−17.4
Electric and electronic equipment	−27.9	−14.9	−42.8
Other	−28.5	−12.1	−40.6
Total	−128.0	33.4	−94.6

Source: Table 1.

ance, and a small increase in the defense-oriented transportation equipment except motor vehicles. In nonelectrical machinery, the effect of declining national employment overwhelmed a positive shift, producing an overall decline.

In the semi-base, business services, hotels, banks, and wholesale trade experienced favorable shifts. Most domestic sector industries grew at or near national rates.

1984 to 1988

During this period, New England's base employment declined sharply. Had New England industries maintained share, the region would have gained 33,000 base jobs. Instead, New England lost 94,000 jobs. This implies an unfavorable shift of 128,000 jobs, almost 7 percent of base sector employment. New England's mix was slightly favorable during this period: while national base employment fell by 0.7 percent, New England's employment would have risen 1.7 percent had the region not lost market share. The erosion of New England's competitive position, then, is even greater than a simple comparison of national and regional growth rates would suggest. Details are provided in Table 3, which shows that the only significant employment gains during this period occurred in education and insurance. Even these changes were more the result of national trends than regional competitive strength.

The declines in such traditional industries as rubber and plastics and textiles, apparel, and leather (the last three all in the "other" category) are perhaps not surprising or even alarming. But instruments, transportation equipment, electrical equipment, and computers are the core of New England's high tech economy, and the region lost share in all of them. At the sub-industry level, New England lost share in electronics, shipbuilding, missiles, aircraft, metal-working machinery, industrial machinery, forgings, screw machinery, cutlery, engineering and scientific instruments and others. The breadth and consistency of the region's loss of share is striking.

The poor performance of the region's base during the 1984–88 period was masked by the spectacular surge in the construction sector. Construction proper, real estate, and associated retail sectors showed a favorable shift of 131,000 jobs in this period—almost exactly balancing the unfavorable shift in the economic base.

In the semi-base area, New England saw major favorable shifts in wholesale trade and banking. Developments in the past year, however, suggest that some of the banking increase was based on construction lending and therefore will not be sustained. Domestic employment in the period grew far more rapidly than national employment, with the biggest gains in local government, utilities, and a wide range of services.

The central problem facing New England is not construction but the loss of share in just about every one of our key base industries.

In the long run, the construction and domestic industries serve local markets and their growth depends upon the health of the economic base. How-

ever dramatic the construction decline and however large it looms in the short-term economic outlook, the central problem facing New England is not construction but the loss of share in just about every one of our key base industries.

Regional Competitors

As New England lost market share in the 1984–88 period, which regions gained? Some insights are provided by a quick look at New England's four largest durable goods manufacturing industries.

Fabricated Metals

The fabricated metals industry consists of firms stamping, forging, and drawing metal into parts for automobiles, appliances, computers, and other basic products. This industry also includes manufacturers of ball bearings, cutlery, hand tools, structural metal parts, valves, and plumbing fixtures. It covers the basic metalworking firms characteristic of many older industrial cities of New England. From 1980 to 1984, the national economy grew slowly and the dollar rose, inviting a flood of imports. National employment in fabricated metals fell by 2.4 percent a year; New England employment dropped 3.7 percent. After 1984, a falling dollar helped stem imports and national employment stabilized. New England employment, however, continued to fall at a rate of 3.7 percent. The South Atlantic states gained share during this period, as did some East North Central and West North Central states. The West South Central states lost share; spillovers from the oil industry undoubtedly played a role. The Mid Atlantic states lost share but employment did not fall as quickly as in New England.

Machinery, except Electrical

Statistics on employment lump computers together with machine tools, engines, bulldozers, and industrial machinery. New England has been a major manufacturer both of traditional industrial machinery and computers. National employment in this industry grew 3.8 percent per year from 1975 to 1980 and fell in the 1980s. New England gained share through 1984 and essentially held its own from 1984 to 1988. The only regions gaining significant market share in the 1984 to 1988 period were the South Atlantic and the East South Central.

Electrical Equipment

This industry encompasses electric generating equipment, appliances, communications equipment, semiconductors and other electronic components. National employment grew through 1984, then fell. New England grew substantially faster than the rest of the country during the growth years and fell substantially faster after 1984. During this later period, employment shifted to the Pacific, Mountain, South Atlantic, West North Central and West South Central regions.

Transportation Equipment except Motor Vehicles

This industry is dominated by aircraft and shipbuilding. National employment rose in the late 1970s, fell in the early 1980s, and began to rise again in 1984. New England employment remained essentially level from 1980 onwards. Thus, the region gained share from 1980 to 1984, then lost ground. As New England lost share, the South Atlantic, West South Central, Mountain, and Pacific states gained.

Some interesting patterns emerge from these data. The South Atlantic region gained share across all four industries. The Mountain states have also done well. Contrary to what might be expected, the East North Central states have held their own in recent years. Like New England, the Mid Atlantic states are losing share, but not so dramatically. After falling behind national growth in the early 1980s, the West South Central states around Texas and the West North Central states from Kansas to Minnesota have been gaining share in at least some of the four industries. This pattern of regional winners and losers suggests that the explanation for New England's problems is more complex than the old Sunbelt-Frostbelt dichotomy that emphasized cold winters, older factories and a location far away from the growth centers of the country.

Conclusions

New England's strong overall growth since 1984 has lacked a solid foundation. The momentum came from a dramatic but unsustainable surge in the construction industry. This surge masked a serious decline in the region's economic base, particularly its durable goods manufacturing industries. In 1989, this imbalance became painfully obvious. Construction

employment began to fall while the erosion in the economic base continued. The long boom came to an end, highlighting problems in the region's economic base going back at least five years.

While slower growth nationally in New England's base industries played a role in the decline, recent years have seen a major weakening in New England's competitive position. From 1984 to 1988, the region's loss of market share in base industries cost about 130,000 jobs. (Although the broad pattern is roughly similar for all of the New England states, the three northern states did not lose share at the rate of their southern neighbors.)

The regions that gained share across a range of key durables industries have been the South Atlantic and Mountain states. Over the last few years, New England has lost competitive position at a more rapid rate than any other region; the East North Central states around Chicago have actually held their own in fabricated metals and machinery.

This overview leaves unanswered the question of why New England's economic base has eroded. Although the problems of the region's computer companies have been widely publicized, the declines cut across the entire spectrum of manufacturing industries and cannot be explained by the special difficulties of one or two sectors.

High costs in the region are undoubtedly a major factor. In recent years, tight labor markets have pushed up wage rates and housing prices have skyrocketed, making it difficult to recruit professionals and managers from other parts of the country. Since most of New England's base firms compete with other national and international producers, they cannot easily pass on these higher costs and, consequently, give priority to expansion options outside the region.

To the extent that labor and housing costs lie behind the current decline, there is reason for optimism. Labor costs in New England were substantially below the national average in the early 1970s; today they are higher. The current slowdown has led to a break in housing prices and will undoubtedly bring labor costs close in line with those in other industrial states. When New England costs are competitive once again, normal growth could resume.

Unlike wages and housing, other regional costs are not self-correcting. New initiatives will be required to meet concerns about high rates for workers' compensation, health insurance, and unemployment insurance and about balancing the costs and benefits of environmental regulatory systems. The region is pushing up against the limits of its current electric generating capacity and in some of the states, poor roads and declining quality of public education are sources of concern as well.

Some of these problems are not new. They have been the subject of debate for the last fifteen years—even during periods of rapid growth. Nonetheless, if ongoing problems such as these underlie the current decline, there is less reason for optimism, since they will not be solved by a year or two of slow growth.

The more we understand about the causes of New England's current decline—particularly those factors that turned sour since the growth years of the late 1970s and early 1980s—the greater will be our ability to develop programs that will help New England's industries regain their competitive edge.

Appendix

New England Base, Semi-Base, Construction and Domestic Employment, 1988

Category	Employment (thousands)
Base	
Farm	51.7
Forestry and fisheries	19.0
Various mining	5.7
Manufacturing	1,396.9
excluding food	−49.7
excluding printing and publishing	−118.9
Holding and other investment companies	24.5
Insurance carriers	155.8
Education (private)	231.4
Military	105.9
	1,822.3
Semi-Base	
Food	49.7
Printing and publishing	118.9
Wholesale trade	393.7
Eating and drinking places	386.5
Banking and credit agencies	170.0
Hotels and other lodging places	91.6
Business services	507.7
	1,718.1
Construction	
Construction	477.2
Retail bldg. material and gardening equip.	57.3
Retail furniture and home furn. stores	60.4
Real estate	206.3
	801.2
Domestic	
Residual	3,684.3

Source: U.S. Bureau of Economic Analysis, computer tape, June 1989.

[1] The employment data for this article were supplied via computer tape by the U.S. Bureau of Economic Analysis (BEA). At the time this article was written, BEA employment data were not available for 1989. Estimates for 1989 were calculated by applying the percentage changes in employment as shown by the U.S Bureau of Labor Statistics 790 series to the 1988 BEA employment figures.

[2] Although Chart 1 shows employment through 1989, detailed information for the analysis which follows was available only through 1988.

[3] For a discussion of economic base theory, see, among others, Walter Isard, *Methods of Regional Analysis*, The M.I.T. Press, 1960, pp. 182–231.

[4] The semi-base is also defined here to include food processing and printing, two nondurable manufacturing industries that serve both local and out-of-region markets.

[5] It should be noted that some of the industries that have been included in the domestic sector do have customers outside the region. Examples include legal and health services. However, it was the author's judgment that these industries serve *primarily* customers within New England.

[6] In Chart 2 and throughout the rest of the article, the construction sector is expanded to include associated real estate and retail activities, as explained in the text.

[7] New England: CT, ME, MA, NH, RI, VT.
Mid Atlantic: NY, NJ, PA.
East North Central: IL, IN. MI, OH, WI.
West North Central: IA, KS, MN, MO, ND, NE, SD.
South Atlantic: DC, DE, FL, GA, MD, NC, SC, VA, WV.
East South Central: AL, KY, MS, TN.
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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