100th Congress
2d Session

JOINT COMMITTEE PRINT

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100-136

THE EFFECTS OF INDUSTRY EMPLOYMENT SHIFTS ON WAGE GROWTH: 1948-87

A STUDY

PREPARED FOR THE USE OF THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

AUGUST 1988

Printed for the use of the Joint Economic Committee

U.S. GOVERNMENT PRINTING OFFICE

89-562 WASHINGTON : 1988

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

JOINT ECONOMIC COMMITTEE

[Created pursuant to sec. 5(a) of Public Law 304, 79th Congress]

LETTER OF TRANSMITTAL

AUGUST 29, 1988.

To the Members of the Joint Economic Committee:

I am pleased to transmit to you a study entitled "The Effects of Industry Employment Shifts on Wage Growth: 1948-87." The study provides a systematic and comprehensive analysis of the effects on wage growth of employment shifts among industries, examining the wage and benefits characteristics of industries with expanding shares of employment and of those with declining employment shares. It was prepared by Dr. Robert M. Costrell of the University of Massachusetts.

Profound changes have taken place in the U.S. economy in recent years, with far-reaching implications both for the future role of the United States in the evolving international economic environment and for the standard of living at home. Dr. Costrell's study is designed to contribute to a better understanding of those changes, and I hope it will prove useful to you.

Sincerely,

PAUL S. SARBANES, *Chairman.*

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THE EFFECTS OF INDUSTRY EMPLOYMENT SHIFTS ON WAGE GROWTH: 1948-87

INTRODUCTION: EMPLOYMENT GAINS AND LOSSES, 1981-87

From 1981 to 1987, private nonfarm employment grew at an annual rate of 2.0 percent, slightly lower than the rate for the two prior decades. With some industries adding jobs and others losing jobs, there was a net expansion of 10.1 million jobs over the 6-year period.[1] A total of 12.7 million jobs was created in industries such as services and retail trade, most of which have relatively low wages and benefits. Meanwhile, jobs in other industries declined by 2.6 million, a rate faster than ever before. Industries with declining employment were largely in sectors of manufacturing and mining, which generally have higher pay than the service and retail trade sectors.

The purpose of this study is to analyze the effects of shifts in employment among industries on wage growth in the economy. The analysis adjusts the annual employment data on each industry for the effects of the business cycle and focuses on the shifts in employment shares among industries over the period 1948 to 1987. The study finds the 1981-87 period to be distinctive in several respects:

- Industries with expanding shares of employment paid an average of $10,404 less than industries whose employment shares were contracting. This pay gap is of unprecedented magnitude.
- The rate at which shares of employment have shifted among industries has accelerated from earlier periods by about one-third.
- Taken together, the combination of the rapid rate of industrial shift and the wide pay gap between industries with expanding employment shares and those with contracting shares has resulted in an unparalleled drag on wage growth. The shift from higher-paying to lower-paying industries has held back average compensation growth by about half a percentage point per year, offsetting half the real growth that might have occurred had employment shares remained constant. In dollar terms, this represents a drag of $113 in annual growth per employee, and $9.3 billion for the work force as a whole.

This study also examines the separate effects of industrial shift on wages and non-wage benefits; the difference between the workweeks and hourly wages of the expanding and contracting industries; the particularly adverse experience of production and non-supervisory workers; which specific expanding and contracting industries have played the greatest role in the shift effect on compensa-

[1] All figures in this study are based on annual averages. According to monthly data, from January 1981 to June 1988, private nonfarm employment grew by 13.9 million (seasonally adjusted) or 15.8 million (not seasonally adjusted).

tion growth; and provides some discussion of the possible causes of the unusual experience of the 1980's.

After an explanation of the technical background, the study goes on to discuss the findings outlined above. The Appendix provides a detailed explanation of the study's methodology, and a full presentation of the results from a variety of corroborating data sets.

Technical Background

This study examines the patterns of wages and benefits of jobs in contracting industries and in expanding industries. Note that the study's frame of reference is the share of jobs by industry. An industry is designated as a "contracting industry" even when the number of jobs in the industry is rising, if the number grows at a slower rate then the total number of jobs in the economy. As it turns out, this terminology is quite apt, since two-thirds of the industries with recent share declines actually did lose jobs between 1981 and 1987. Moreover, these industries accounted for 90 percent of the effects of recent industrial shift on wage growth.

The statistical technique described in the Appendix utilizes every year of available data, and adjusts for fluctuations in employment shares that are associated with the recessions and recoveries of the business cycle. This means that the results represent the underlying trends during different periods of the postwar economy. This technique is also used to determine which years were the turning points in the underlying evolution of industrial employment patterns.

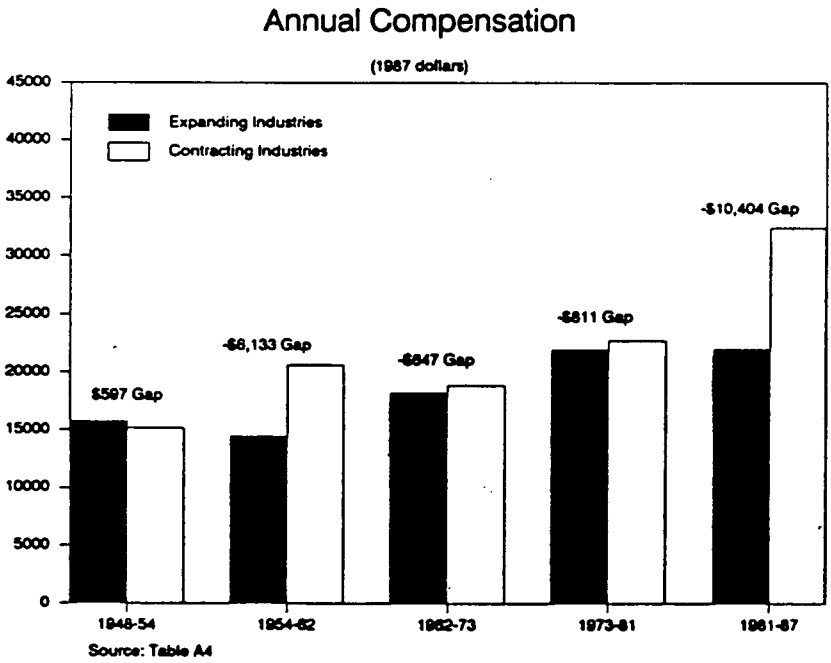
Although this statistical analysis does not reveal the causes of the shifts in employment patterns, it is noteworthy that the analysis found the two most recent turning points to be 1973 and 1981. Those were points at which many economists believe that major changes in the general economic environment occurred. In 1973, energy prices jumped, an event which affected the fortunes of many industries over several years. Energy-producing industries gained, while energy-consuming industries lost. Since 1981, U.S. employment patterns have been influenced by a different set of events. The emerging trade deficits began to affect many trade-sensitive manufacturing industries. Also, energy prices fell, reversing many of the developments of the seventies. It is possible that an analysis of this sort a few years hence will discern another turning point around 1987, if recent trade gains continue, and if energy prices start rising again.

The Appendix discusses the four sets of wage and employment data analyzed and reported in the tables found there. The main results discussed in this study derive from the most comprehensive source of compensation and employment data by industry covering the postwar period, produced by the Bureau of Economic Analysis (BEA) for the National Income and Product Accounts (NIPA). This study analyzes their data on wages and non-wage benefits for the 58 industries covering the nonfarm private economy. The study also makes use of data from the Bureau of Labor Statistics (BLS) Office of Productivity and Technology (OPT). These data provide more reliable measures of hourly compensation and workweeks, although they provide much less industry detail (12 sectors). Very de-

tailed data are provided by the BLS Current Establishment Survey (CES), dividing the nonfarm private economy into 323 industries. These data, however, only cover wages (not health and other benefits) of production and non-supervisory workers (about 81 percent of the total). Also, this data set only goes back to 1972. Analyses of these data sets and also the ES–202 data from the BLS Employment and Wages program yielded consistent results and are fully reported in the Appendix.

Pay Gap Reaches $10,404 for 1981–87 Period

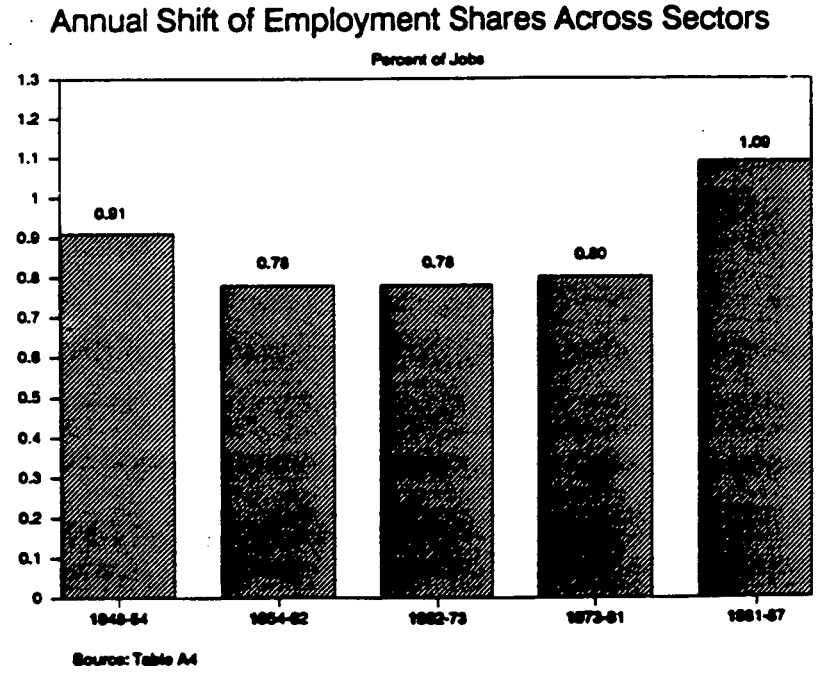
During the years 1981–87, the pay gap between jobs in contracting industries and jobs in expanding industries reached its widest level ever. Over that period, jobs in expanding sectors paid an average of $21,983 per year ($19,154 in wages and salaries, plus $2,829 in health, pension, and other benefits, including employer contributions to Social Security). At the same time, jobs in contracting sectors paid an average of $32,387 ($26,193 in wages and $6,194 in benefits), leaving a gap of $10,404 per year.[2] The pay gap in the eighties between expanding and contracting industries was more than 10 times as large as during the sixties and seventies.



[2] All dollar figures in this study have been adjusted for inflation to represent constant 1987 dollars, using the implicit consumption deflator from the gross national product (GNP) accounts. The results are even more striking with a less refined analysis based on employment levels, rather than shares, which considers data only for the turning point years and does not adjust for the business cycle. In that case, the 1981–87 pay gap is even wider—$12,798.

Acceleration of Industrial Shift

Over the period 1981–87, contracting industries also lost their share of jobs at an unprecedented rate. From 1954–81, employment shares shifted across sectors at a rate of 0.79 percentage points per year. Since 1981, this has risen by a third, to 1.09 points per year.[3] Specifically, the growth in retail trade and business services accelerated, as did the decline of many industries in durable manufacturing. Also, in the 1980's, nonelectrical machinery and mining (especially oil and gas) lost more than three times the employment shares which these industries had gained in the 1970's.



$9.3 Billion Drag on Annual Pay Growth

When higher-paying industries' share of jobs declines, the result is a drag on average and total pay growth in the economy. The significance of the recent rapid shift in jobs from higher-paying to lower-paying industries can be seen by comparing actual wage gains to wage gains which might have occurred had industry employment shares remained constant.

If each industry had maintained its employment share over the 1981–87 period, while paying the compensation it actually did pay, then average compensation per worker would have grown 1.01 per-

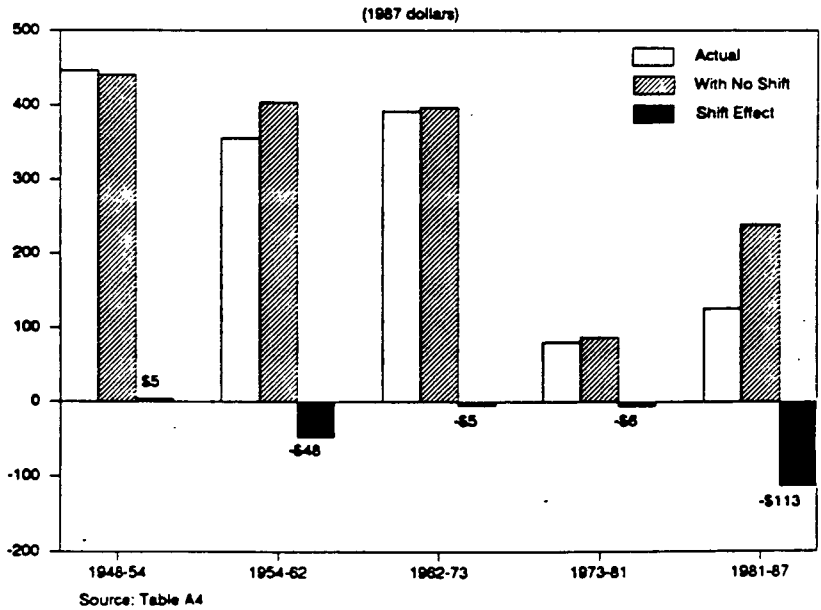
[3] The measured rate of shift differs by data set, increasing with the level of industrial detail, but all data sets show an acceleration. It should also be noted that the 0.91 shift during the 1948–54 period was from lower-paying to higher-paying industries, unlike more recent shifts (see the previous graph).

cent annually. In fact, however, average compensation rose only 0.53 percent. The 0.48 percent difference between the actual gains and the hypothetical gains represents the "shift effect"—the impact on average compensation growth of employment shares shifting out of higher-paying industries into lower-paying industries. This shift effect has been the most unfavorable of the postwar period. It has retarded the recovery of real wage growth from the slowdown of the seventies.

In dollar terms, average compensation would have grown $239 per year, with no employment shift, but the shift effect offset $113 of it. This unprecedented drag on average compensation growth is the consequence of (1) the extraordinarily wide compensation gap of $10,404, and (2) the rapid rate of industrial shift.[4] After 6 years, this shift effect amounts to $678 on annual compensation.

Taken over the entire work force, these figures represent a $9.3 billion annual drag on total compensation growth, rising after 6 years to a $55 billion shift effect on annual compensation.

Annual Compensation Growth Per Employee



Source: Table A4

Non-Wage Benefits

A separate examination of the non-wage benefits portion of compensation reveals an even more striking pay gap and shift effect.[5] Contracting industries paid health, pension, and other benefits of

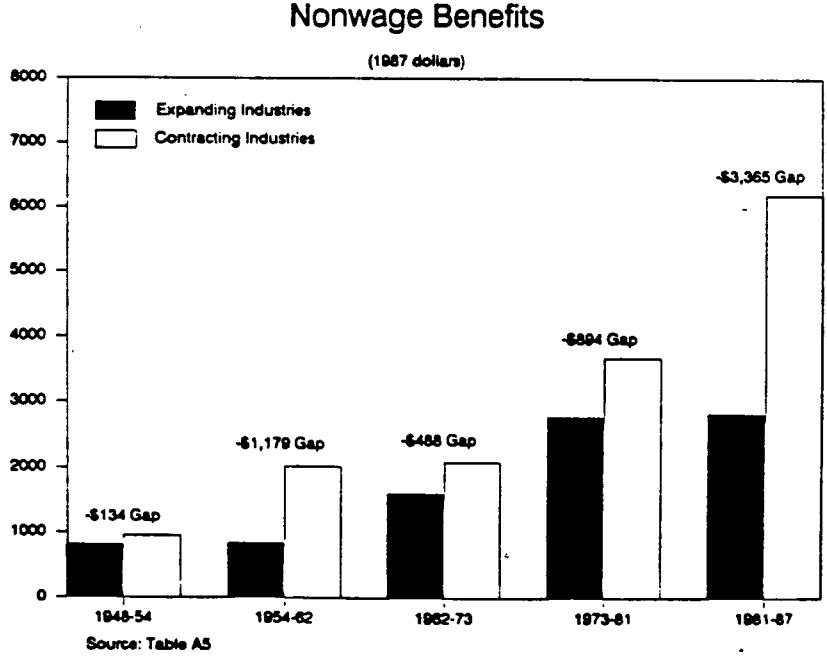
[4] It is the product of the two: $10,404 x 1.09 percent = $113.

[5] Wages and salaries alone, which constitute 84 percent of compensation, have a pattern more similar to that of compensation as a whole.

$6,194 per employee—more than twice the $2,829 in benefits paid by expanding industries.

The gap is even more remarkable for employer contributions to private health and pension plans, excluding legally mandated employment contributions to Social Security. Employer contributions to private plans were almost three times as high in the contracting industries ($3,816) as compared to the expanding industries ($1,310).[6]

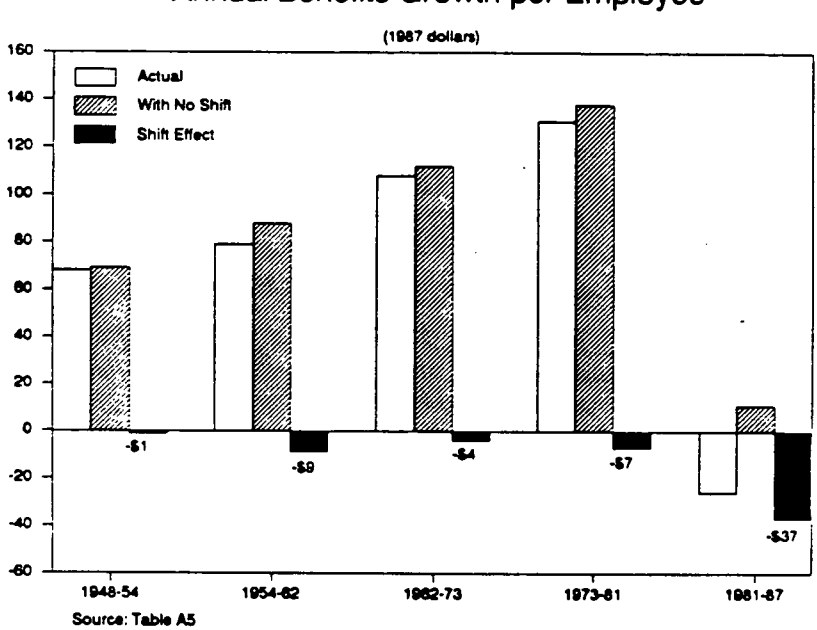
The benefits gap of $3,365 (in employer contributions to both private and public plans, shown below) accounts for one-third the compensation gap of $10,404, while the remainder is the wage and salary gap of $7,040. Since benefits generally constitute only one-sixth of compensation, this represents a disproportionate role in the compensation gap, and the consequent shift effects on compensation growth.



As a result of industrial shift, average benefits declined 0.69 percent annually over the period 1981–87. That is, the shift effect of −0.98 percent swamped the growth of +0.29 percent that might have occurred had employment shares remained constant.[7]

[6] This breakdown into private and public insurance is based on 11-sector NIPA data. The two gaps taken together were quite close to that estimated from the 58-industry data.

[7] The calculated decline in annual benefits understates the actual decline, since health costs rose more rapidly than the consumption deflator used in these calculations. Specifically, the non-shift component of benefits growth is overstated (it may well be negative), since that is the only component that is affected by the deflator.

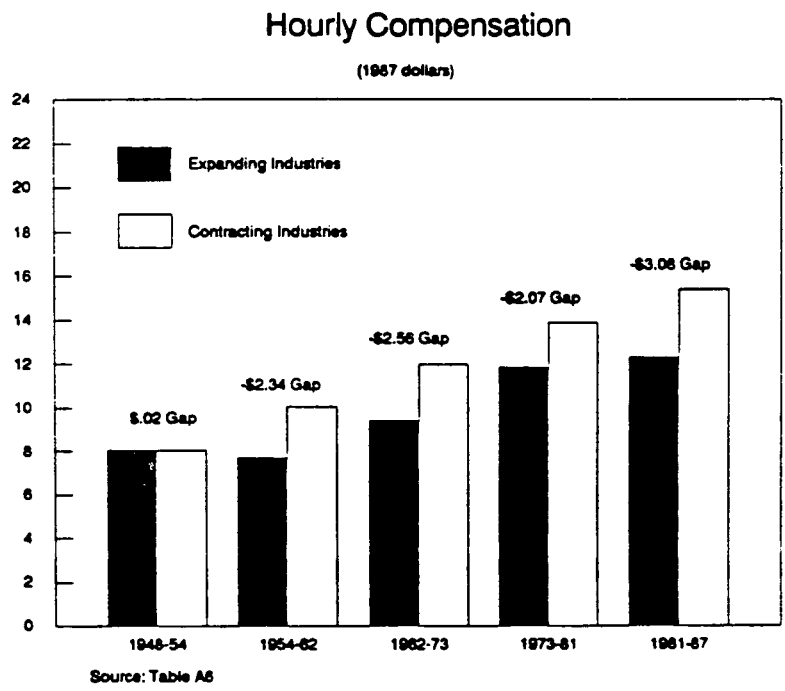


In dollar terms, the shift effect on annual growth of benefits has been −$37 per employee. Again, this accounts for one-third of the shift effect on average compensation growth (−$113), which is disproportionate to its share of compensation. All the other measures of the shift effect presented earlier (the economy-wide effect, etc.) also break down in these proportions.

Hourly Compensation and Weekly Hours

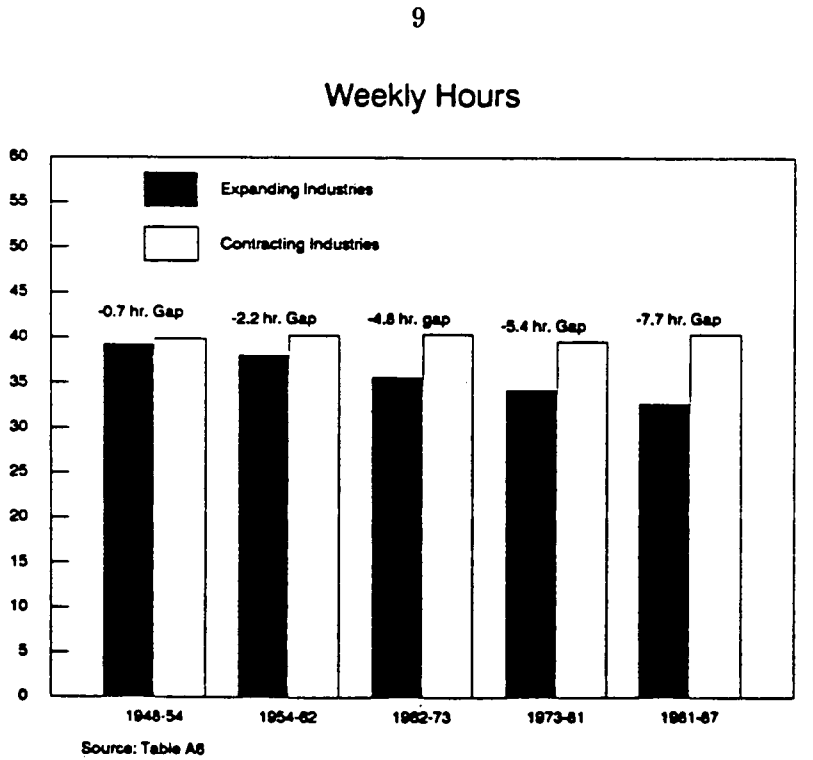
The unprecedented compensation gap is due to both lower hourly compensation and shorter average workweeks in the expanding industries. Results from a comparable data set [8] indicate that hourly compensation in the expanding sectors has lagged behind that of the contracting sectors by $3.08 since 1981. This is a somewhat wider gap than has previously been observed, and accounts for a bit over half the annual compensation gap.

[8] The BLS OPT data set provides hourly data based on the establishment survey, which is somewhere more reliable than the household survey on which the BEA NIPA bases its estimates of full-time equivalent (FTE) employees. Analysis based on the BEA FTE data attributes far more of the compensation gap to the gap in compensation/FTE, and far less to the difference in weekly hours. See the Appendix for details.



A bit less than half of the annual compensation gap is due to the gap in weekly hours. Average weekly hours in the expanding sectors have fallen to 32.7 hours, some 7.7 hours less than in the contracting sectors. This is also a wider gap than in previous periods.

Some of the shorter hours in the expanding sectors reflect shorter full-time workweeks in these sectors. Much of this represents the loss of overtime work that had been available in manufacturing. Some of the shorter hours also reflect part-time work which constitutes a higher proportion of employment in these sectors than in the contracting sectors. According to the household survey, this holds both for voluntary and involuntary part-time.



Production Workers

The effect of industrial shift has been particularly adverse for the 81 percent of employees classified as production workers.[9] Because of this shift effect, their real wages continued to fall over the most recent period.

Highly detailed BLS data indicate that, over the period 1981–86, the wage and salary gap for production workers reached $7,004. In conjunction with a rapid rate of industrial shift, this resulted in an adverse effect on wage growth of −0.61 percent per year. This effect is substantially larger than the comparable shift effect on wage growth of all workers (not including benefits), found from the BEA NIPA data of −0.38.[10]

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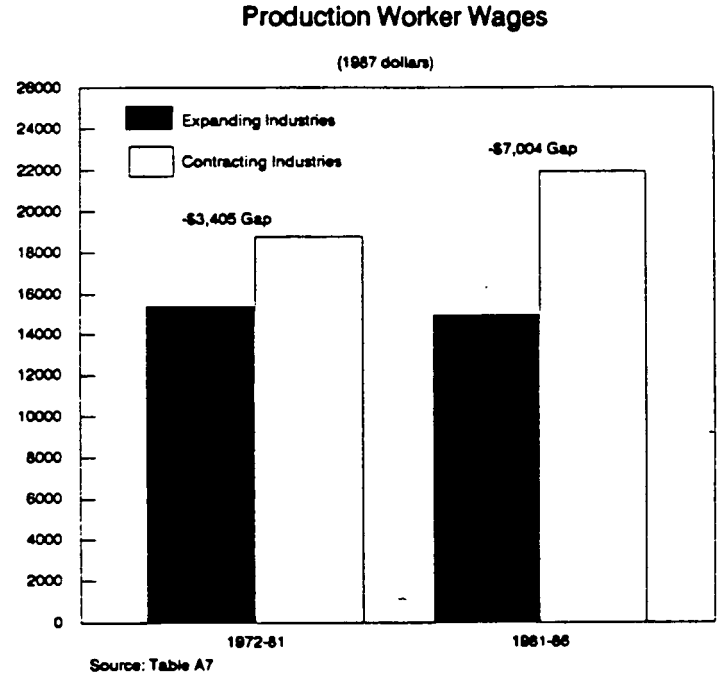
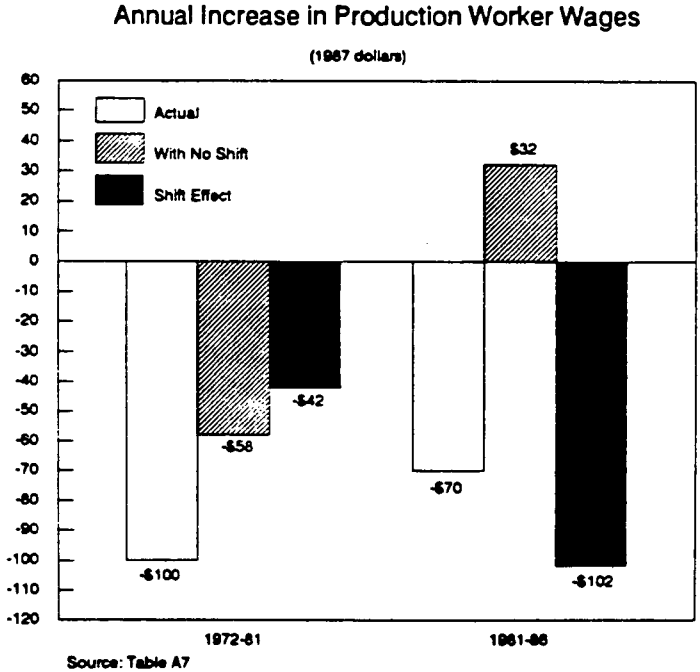
[9] This section is based on published and unpublished BLS data from the CES at the three-digit level for 323 industries. This level of detail is highly desirable, but unfortunately these data only go back to 1972, and the 1987 data were not available to the author while this study was under preparation. Also, the CES data does not cover non-wage benefits and only provide wage data for production workers.

[10] The most accurate comparison with the BEA wage data is found by aggregating the CES data to the same BEA industries, and restricting to the same time periods. On this basis, the shift effect on production worker wage growth comes to −0.57 percent, compared with −0.45 percent on the BEA data for all workers. The Appendix investigates occupational shift from production to nonproduction jobs, and integrates it with the analysis of industrial shift. It is found that the shift from production to nonproduction jobs has been small, especially in recent years, and has been quantitatively outweighed by adverse industrial shifts. Among nonproduction workers alone, industrial shift has been mixed, with growth in some higher-paying industries, such as security and commodity brokers, roughly balancing the growth in other lower-paying nonproduction jobs. The Appendix also investigates industrial shift by sex, and shows that it has been less adverse for females than for males.



In dollar terms, the shift effect for production workers since 1981 constituted a $102 annual drag on real wage growth (compared with $77 for all workers, according to the BEA data). Indeed, if employment shares had remained constant, real wages might have resumed positive growth since 1981, since real wages grew $32 per year within industries. However, the exceedingly strong shift effect overwhelmed this modest rise, and resulted in average wages falling by $70 per year.



Again, a bit less than half the wage gap and shift effect is due to shorter hours in the expanding sectors (32.9 hours) as compared to the contracting sectors (39.1 hours). The rest of it is due to lower hourly wages, $8.48 compared to $10.62. This hourly wage gap of $2.14 is about two-thirds of the hourly compensation gap found from the BLS OPT data, and is consistent with the BEA NIPA finding that the wage and salary gap constitute two-thirds of the compensation gap. This suggests that the hourly benefits gap is about $1.

Industries With Greatest Role in Shift Effect on Wage Growth

It is helpful to examine which industries contributed most to the recent adverse shift effect. Table 1 provides this information, both from the viewpoint of the contracting industries and of the expanding industries. The top half of Table 1, based on the BEA data, lists the 11 most important contracting industries in order of their contribution to the adverse shift effect. Fully half the shift effect originates in the decline of trade-sensitive durable goods manufacturing industries, such as primary metals (especially steel) and nonelectrical machinery. Energy-related industries, such as oil and gas extraction, coal mining, and petroleum refining, have also played a major role. Further detail is found in the top half of Table 2, based on BLS CES data on wages only (not benefits) of production and non-supervisory workers, over the period 1981–86. Clearly a

broad variety of higher-wage manufacturing industries contracted over this period.[11]

The corollary to the adverse industrial shift effect is the expansion of lower-paid industries. The bottom half of Table 1 shows that these are primarily retail and service industries. Further detail from Table 2 indicates that a quarter of the adverse shift effect involved the expansion of eating and drinking establishments. Among business services, the most important expansion occurred in personnel supply services (primarily temporary help).

There have, of course, been some exceptions to the pattern of contracting industries with higher pay and expanding industries with lower pay. For the period 1981–87, the most significant contracting industries with lower pay were the apparel and textile industries, and private household services. The most significant expanding sector with higher pay was the brokerage industry, at least until October 1987. These favorable shifts, which are included in the total shift effect, were relatively minor and were outweighed by the adverse job shifts discussed above.

TABLE 1: CONTRACTING AND EXPANDING INDUSTRIES, 1981–87

[In percent and 1987 dollars]

		Contribution to shift effect	Average compensation	Change in	
				Employee share	Employment, thousands
Contracting industries:					
1. Primary metal industries	DUR	17.7	$38,994	−0.71	−395
2. Machinery, except electrical	DUR	17.4	34,032	−0.98	−486
3. Railroad transportation	TRN	10.4	46,365	−0.29	−178
4. Oil and gas extraction	MNG	7.2	39,717	−0.28	−301
5. Chemicals and allied products	NDR	6.8	39,293	−0.27	−91
6. Telephone and telegraph	CMN	6.6	40,693	−0.24	−135
7. Fabricated metal products	DUR	6.3	30,348	−0.51	−192
8. Coal mining	MNG	5.3	44,382	−0.16	−76
9. Motor vehicles and equipment	DUR	5.2	44,549	−0.16	61
10. Petroleum and coal products	NDR	4.4	57,695	−0.08	−49
11. Electrical and electronic equipment	DUR	3.7	31,329	−0.27	−24
Expanding industries:					
1. Retail trade	RTL	39.2	13,605	1.42	3398
2. Business services	SVC	31.6	20,996	1.89	2019
3. Health services	SVC	10.2	23,262	0.76	1287
4. Hotels and lodging places	SVC	6.9	14,614	0.26	345
5. Educational services	SVC	5.9	16,191	0.25	287
6. Personal services	SVC	5.1	13,200	0.18	242
7. Credit agencies other than banks	FIR	3.2	24,189	0.27	316

Column 1 lists the industries of the nonfarm private economy, with contracting (top half) or expanding (bottom half) cyclically-controlled employment shares. They are listed in order of their contribution to the shift effect.

Column 2 indicates the industry's 1-digit sector: Mining (MNG), Construction (CNS), Durables Manufacturing (DUR), Nondurables Manufacturing (NDR), Transportation (TRN), Communications (CMN), Retail Trade (RTL), Finance/Insurance/Real Estate (FIR), and Services (SVC).

Column 3 gives the portion of the shift effect on compensation growth accounted for by the decline (top half) or rise (bottom half) of employment share in that industry. If all contracting and expanding industries had been listed, both the top and bottom halves of this column would each sum to 100.

Column 4 gives the simple average over the period of constant dollar compensation, including employer-paid benefits, as well as wages and salaries. Implicit consumption deflator is used.

Column 5 gives the cyclically-adjusted change in employment share, over the six-year period. If all industries had been listed, the top column sum, divided by 6, would be −1.09, and the bottom would be +1.09, the annual rate of industrial shift.

Column 6 is the simple difference between employment in 1987 and 1981.

Source: BEA NIPA Tables 6.4B and 6.6B.

[11] The decline of railroad transportation, while important, is the continuation of a long-run phenomenon, unlike the other shifts. The contraction of telephone communication over this period appears to be due to special factors unrelated to trade or energy.

TABLE 2: CONTRACTING AND EXPANDING INDUSTRIES, DETAILED, 1981–86

[In percent and 1987 dollars]

		Contribution to shift effect	Average wage	Change in	
				Employee share	Employment, thousands
Contracting industries:					
1. Blast furnaces and basic steel	DUR	11.0	$31,184	−0.35	−182
2. Railroad transportation	TRN	10.8	31,922	−0.32	−155
3. Telephone communications	CMN	6.9	27,379	−0.29	−128
4. Other heavy construction	CNS	6.5	28,792	−0.24	−95
5. Oil and gas services	MNG	5.1	26,087	−0.24	−186
6. Construction and related machinery	DUR	4.6	25,197	−0.23	−126
7. Bituminous coal and lignite	MNG	4.0	33,438	−0.11	−41
8. Aircraft and parts	DUR	2.5	29,153	−0.09	−12
9. Metalworking machinery	DUR	2.3	24,538	−0.12	−45
10. Petroleum refining	NDR	2.0	36,480	−0.05	−26
11. Iron and steel foundries	DUR	2.0	23,460	−0.12	−57
12. General industrial machinery	DUR	1.7	23,014	−0.11	−47
13. Farm and garden machinery	DUR	1.6	23,219	−0.10	−44
14. Ship and boat building and repairs	DUR	1.6	23,804	−0.09	−40
15. Primary nonferrous metals	DUR	1.5	32,299	−0.05	−25
16. Fabricated structural metal products	DUR	1.5	20,745	−0.13	−38
17. Engines and turbines	DUR	1.4	29,300	−0.05	−22
18. Nonferrous rolling and drawing mills	DUR	1.4	26,409	−0.06	−22
19. Tires and inner tubes	NDR	1.3	31,250	−0.04	−12
20. Metal forgings and stampings	DUR	1.2	26,182	−0.06	−9
Expanding industries:					
1. Eating and drinking places	RTL	24.2	6,469	0.80	969
2. Personnel supply services	SVC	10.8	11,379	0.53	399
3. Other business services	SVC	5.6	16,174	0.50	419
4. Hotels, motels and tourist courts	SVC	5.3	9,711	0.22	229
5. Grocery stores	RTL	4.8	13,635	0.30	351
6. Services to buildings	SVC	4.0	9,846	0.17	151
7. Nursing and personal care facilities	SVC	3.8	9,637	0.16	198
8. Outpatient and other health services	SVC	3.4	15,661	0.28	196
9. Offices of physicians	SVC	3.1	13,525	0.19	177
10. Miscellaneous personal services	SVC	2.3	7,571	0.08	66
11. Miscellaneous shopping goods stores	RTL	2.1	9,291	0.08	105
12. Individual and family services	SVC	2.1	9,813	0.09	72
13. Radio, TV and music stores	RTL	2.0	13,282	0.12	92
14. Offices of dentists	SVC	1.9	12,146	0.10	89
15. Retail stores, nec	RTL	1.9	11,240	0.09	72
16. Residential care	SVC	1.8	10,305	0.08	76
17. Colleges and universities	SVC	1.8	15,887	0.15	167
18. Savings and loan associations	FIR	1.8	13,105	0.10	88
19. Elementary and secondary schools	SVC	1.6	10,820	0.07	51
20. Offices of other health practitioners	SVC	1.6	11,265	0.07	59

See Table 1 for explanation of columns. In addition to finer detail, results differ from Table 1 in coverage: production and nonsupervisory workers only; wages only (not benefits); and 1981–86 only.

Source: Published and unpublished data from BLS Current Establishment Survey.

Slow Output Growth in Higher-Paying, Contracting Industries

Although employment shares have been shifting from manufacturing to services over the entire postwar period, the pace has accelerated since 1981. The traditional explanation of this long-term trend has been that productivity growth in manufacturing typically exceeds that in services. With the shares of final demand supplied by manufacturing and services historically fairly stable, the productivity gap has implied a falling share of factory employment.

While this productivity gap continues to explain much of the employment shift, the question arises concerning the acceleration of that shift since 1981.

Many observers believe that the acceleration has been largely attributable to the emergency of large trade deficits in manufactured goods, which in turn has been related to the large fiscal deficits. Indeed, it is certainly suggestive that, in this statistical procedure, the data have singled out 1981 for the break in trend.

It is worth examining trends in output and labor productivity at a more disaggregated level. The top half of Table 3 presents cyclically adjusted estimates of the output growth, relative to total output, of the most relevant industries (drawn from Table 1). Most of the contracting higher-paying industries have recently suffered slower output growth than the economy as a whole, and slower than the expanding lower-paying industries.[12]

On the other hand, the bottom half of Table 3 shows that the productivity gap persists between the contracting higher-paying industries and the expanding lower-paying ones. Productivity growth in the expanding industries has recovered from the seventies, but, with the exception of coal mining, fabricated metal products, and nonelectrical machinery,[13] is generally no greater than the pre-1973 period. Some of the productivity gains in trade-sensitive industries may well be related to trade difficulties. If, for example, trade-related layoffs occur in marginal plants, then the productivity of the remaining industry will rise. Moreover, if output and productivity growth in the service industries are underestimated in some cases, as is commonly believed, then the role of the productivity gap in explaining the employment shift is overestimated.

TABLE 3: OUTPUT AND PRODUCTIVITY TRENDS

[Annual percentage growth rates]

	1948–54	1954–62	1962–73	1973–81	1981–87
OUTPUT GROWTH, RELATIVE TO TOTAL					
Contracting industries:					
1. Primary metal industries	0.41	−2.88	−1.78	−2.70	−9.80
2. Machinery, except electrical	−.55	−1.00	.97	2.19	6.86
3. Railroad transportation	−5.58	−3.31	−2.84	−2.22	−10.60
4. Oil and gas extraction	.86	−1.81	−.82	−3.94	−5.14
5. Chemicals and allied products	2.99	2.57	2.82	.87	.04
6. Telephone and telegraph	1.58	2.48	4.63	2.79	1.56
7. Fabricated metal products	1.21	−1.00	.46	−.61	−1.83
8. Coal mining	−9.29	−3.47	−1.64	.80	−.87
9. Motor vehicles and equipment	7.28	−.23	2.25	−.33	−2.03
10. Petroleum and coal products	.68	1.23	−1.06	−1.41	−4.22
11. Electrical and electronic equipment	3.52	3.56	2.69	4.14	0.85
Expanding industries:					
1. Retail trade	.21	−.82	−.10	−.22	.67
2. Business services	.41	3.80	2.57	3.01	5.08
3. Health services	−.20	1.83	2.35	1.53	1.39
4. Hotels and other lodging places	−3.48	−.30	.29	18	−2.56

[12] The notable exception is nonelectrical machinery, which has been dramatically affected by the recent revision of the computer price index to reflect quality improvements. In fact, experts in the field have found that without this adjustment, manufacturing output as a whole would have departed from previous trends and declined as a share of total output (see the Appendix).

[13] Recent productivity growth in nonelectrical machinery is dominated by computers, due to the revised price series mentioned in the previous footnote.

TABLE 3: OUTPUT AND PRODUCTIVITY TRENDS—Continued

[Annual percentage growth rates]

	1948–54	1954–62	1962–73	1973–81	1981–87
5. Educational services	−3.37	.55	.81	−1.82	.94
6. Personal services	−2.03	−1.19	−2.06	−3.35	.77
7. Credit agencies, nonbank	4.20	1.83	−.83	2.03	4.08
PRODUCTIVITY GROWTH					
Contracting industries:					
1. Primary metal industries	3.38	1.52	1.26	.02	1.70
2. Machinery, except electrical	2.55	2.10	1.89	1.64	13.92
3. Railroad transportation	.94	5.88	4.19	1.92	1.12
4. Oil and gas extraction	.98	3.60	4.34	−11.21	3.60
5. Chemicals and allied products	4.66	5.25	4.32	2.42	4.74
6. Telephone and telegraph	4.01	7.28	5.35	5.24	5.58
7. Fabricated metal products	2.49	2.54	1.88	1.16	3.93
8. Coal mining	4.32	.59	2.28	−2.95	10.81
9. Motor vehicles and equipment	8.23	4.28	3.64	1.57	1.55
10. Petroleum and coal products	3.63	8.24	2.87	.03	3.10
11. Electric and electronic equipment	4.14	4.24	4.20	5.00	3.84
Expanding industries:					
1. Retail trade	2.97	2.32	1.42	−.31	1.03
2. Business services	−.08	−.34	−.39	−.58	−1.00
3. Health services	.50	2.63	−.02	−.63	1.13
4. Hotels and other lodging places	.87	1.73	.23	.82	−4.12
5. Educational services	.16	−.04	−.00	.04	.01
6. Personal services	3.16	1.52	1.51	−1.33	.61
7. Credit agencies, nonbank	−.80	.01	.10	−.07	.10

Estimates of output growth, relative to total, indicate the difference between annual percentage growth rates of industry output and total output of the nonfarm private economy. Estimated productivity growth is based on output per full-time equivalent of all workers, including self-employed. All estimates are cyclically-controlled, based on semi-log equations, using BEA NIPA data, and the same regressors as the employment analysis of Table 2. Industries selected for presentation were drawn from Table 1.

Source: BEA NIPA Tables 6.2 and 6.10B.

Real Wages, Productivity, Relative Income Shares, and Relative Prices

How does the shift effect on wage growth fit into the bigger picture of the economy? This study can provide insights into possible answers for this difficult question, but not definitive measures of their quantitative importance.

As a matter of mathematics, the adverse shift effect must break down into one or more of the four following possibilities: (1) and adverse effect on overall productivity growth; (2) a redistribution of income away from displaced workers towards non-displaced workers; (3) a redistribution of income away from labor as a whole; and/or (4) a rise in consumer prices, relative to the general price level.

Economic theory shows the relationship between the various causes of industrial shift and these four consequences. Consider three scenarios.

First, suppose industrial shift is caused by a widening productivity gap, due to accelerated technical progress in the higher-paying industries. Then non-displaced workers gain, partially from increased average productivity, and partially as a redistribution from displaced workers.

Second, suppose industrial shift is caused again by a widening productivity gap, but due instead to *slower* technical progress in the lower-paying industries. Then average productivity growth is

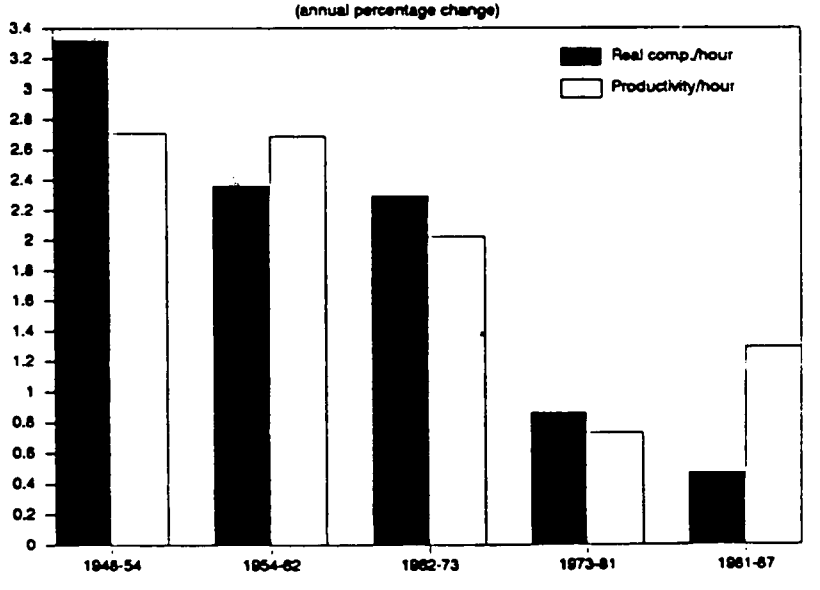
reduced, and both displaced and non-displaced workers suffer wage losses.

Third, consider industrial shift due to increased trade deficits, financed by borrowing from abroad. Then resources are transferred from the higher-paying traded goods industries to the lower-paying non-traded service and retail industries. This shift effect reduces productivity growth directly, due to the imperfection in labor markets which causes prices to deviate from true economic trade-offs. On the other hand, increased trade deficits appear to have some positive effects on productivity, due to increased competition and to scrapping of marginal plants.

Possibilities (3) and (4) above, a decline in labor's share of income and adverse price developments, can hold real wage growth below productivity growth. The figure below shows that real wage growth has lagged significantly behind productivity growth since 1981. Both possibilities (3) and (4) appear to be behind this, although it is difficult to quantify the link with industry shift.

In an algebraic sense, the wage effect of industry shift is only loosely related to labor's share, since the lower-wage sectors are not necessarily sectors with low shares for labor, and a host of other factors influence labor's share. The link between the shift effect and adverse relative price developments is more readily apparent. Both the trade deficit and the productivity gap tend to raise the price of services, relative to manufactured goods. Services are a particularly important component of consumption, like investment, so this raises the relative price of consumption. This appears to have outweighed the fall of import prices, relative to export prices, resulting in a net rise of the relative price of consumption.

Hourly Compensation and Productivity Growth



Source: Table A12

Conclusion

Since 1981, the shift of employment shares across industries has accelerated and the gap in pay between jobs in contracting industries and in expanding industries has widened. These two phenomena, taken together, have resulted in an unprecedented drag on pay growth.

The recent compensation gap of $10,404 breaks down into $7,040 in wages and salaries and $3,365 in health, pension, and other benefits. About half of the compensation gap derives from the fact that the average workweek is 6 to 8 hours shorter in expanding industries. The other half results from the fact that hourly compensation is about $3 lower in these industries ($2 in wages and $1 in benefits).

The adverse shift effect on real compensation growth has reached half a percentage point per year. Real wage growth within industries has averaged about 1 percent per year, so half of this has been offset by the shift effect. This has dampened the recovery from the real wage slowdown of the seventies. Much of this shift effect may represent the losses of the younger generation who are unable to enter or move up to the jobs of their retiring parents.

The recent shift effect on compensation growth comes largely from the decline of certain manufacturing and mining industries. Some of the most important have been primary metal industries (especially steel), nonelectrical machinery, and oil and gas extraction. The corresponding rise of lower-paying industries has been

almost entirely within retail trade and services. Eating and drinking places have been especially important, followed by business services, such as personnel supply.

Industrial shifts have been particularly adverse for production and non-supervisory workers.

In accord with long-standing trends, the productivity gap persists between industries with expanding and contracting employment shares. However, adverse output trends have also contributed to recent employment shifts out of many important industries which appear to have been trade-impacted.

The losses from adverse industrial shifts must break down into adverse productivity effects, adverse price developments, and/or redistributional effects from displaced workers to non-wage earners and/or non-displaced workers. It is, however, beyond the scope of this study to quantify this decomposition.

APPENDIX

THE EFFECTS OF INDUSTRY EMPLOYMENT SHIFT ON WAGE GROWTH, 1948–87*

Introduction

The present study focuses on the following main questions:

- What has been the rate of industrial employment shift and how has it varied over the postwar period? Has it accelerated in recent years?
- What has been the difference in pay between expanding and contracting industries? Has the pay gap been positive or negative, and has it been widening?
- How large have the pay losses been from industrial employment shifts, and how have they compared with the gains within industry? What has been the role of these shifts in the economy's overall pay growth? Have they recently become more of a negative factor?

The study also breaks down the pay gap and shift effects by wages and salaries vs. non-wage benefits; by hourly compensation vs. shorter workweeks; and by specific expanding and contracting industries. It compares the experience of production and non-supervisory (PNS) workers with that of supervisory and nonproduction (SNP) workers; and it compares the experience of males and females. It provides some information on the causes of recent industrial shifts, and it outlines the possible ways the wage losses from these shifts might fit into the broad picture of the economy as a whole. The present study does not develop policy implications.

Methodology

Previous studies of these and related issues have varied in their choice of years, data sets, and methodologies.[1] The present study is based on a methodology which has some decided advantages over those previously employed. Specifically, most previous work has attempted to control for cyclical variation by comparing years at comparable points of the business cycle, e.g., 1973, 1979, and the most recent year available. The present methodology is based on regressions which control for the cycle, yet allow the underlying trends to vary over the postwar period. Two noteworthy advantages of this approach are: (1) it exploits the complete postwar time series, rather than selected years; and (2) it allows the data to find breaks in trend at years such as 1981, while still controlling for the cycle. This methodology is applied to several data sets, finding consistent results overall, along with important variations among subsets of the population.

Analytical Framework

The main questions posed above are related to one another by a simple analytical framework. Briefly, the pay losses from industrial employment shift (question 3) are measured by the product of the rate of industrial shift (question 1) and the pay gap between expanding and contracting industries (question 2).

Specifically, let

$$\lambda_i \equiv L_i/L,$$

denote the share of employment in industry i. The rate of change of industry i's employment share is given by

*I would like to acknowledge the very helpful suggestions of Michael Podgursky, Larry Mishel, and Kenneth Flamm. I also received assistance in acquiring and interpreting data from Joseph Bush, Kent Kunze, Larry Fulco, Gloria Green, and Phyllis Otto of the BLS; Martin Murphy and Cathy Comins of the BEA; and William Ferguson.

[1] A comprehensive survey is Loveman and Tilly (1988).

$$\dot{\lambda}_i \equiv d\lambda_i/dt,$$

where t is time. A natural and widely used measure of the rate of industrial employment shift is the share change of all expanding industries, or, equivalently, the share change of all contracting industries.[2] Formally,

(1) Rate of Shift

$$\equiv \Sigma \dot{\lambda}_e, \text{ over expanding industries, e}$$
$$\equiv \Sigma(-\dot{\lambda}_c), \text{ over contracting industries, c.}$$

This measure of industrial shift will, of course, depend on the level of disaggregation: more finely disaggregated data will necessarily exhibit a higher rate of shift. Still, at a given level of disaggregation, one can meaningfully track variations in the rate of shift over the postwar period.

Turning to the second question, how should one compute average pay in the expanding and contracting industries? More specifically, what weights should be used? If the analysis were based on absolute employment changes, instead of shares, the appropriate method would be to weight each of the expanding industries' pay by the number of jobs gained in the industry, and to weight each of the contracting industires' pay by the number of jobs lost.[3] However, the present study is based on employment shares, so the appropriate weights are the percentage points gained and lost, rather than the jobs gained and lost. These share changes provide some indication of the relative likelihood that an individual might leave (or enter) one industry rather than another. Consequently, average pay based on these weights provide the best estimate from these data of the pre-shift and post-shift pay. Formally, then, the pay measures are:

(2) Expanding Industries:

$$\Sigma W_e \dot{\lambda}_e / \Sigma \dot{\lambda}_e \equiv \Sigma W_e \dot{\lambda}_e / \text{Rate of Shift}$$

Contracting Industries:

$$\Sigma W_c(-\dot{\lambda}_c)/\Sigma(-\dot{\lambda}_c) \equiv \Sigma W_c(-\dot{\lambda}_c)/\text{Rate of Shift,}$$

where W denotes the appropriate measure of pay (wage, non-wage benefits, or total compensation).[4] The pay gap will be the difference between the two. This will be negative if the expanding industries are indeed lower-pay, relative to the contracting industries. It is a rough indicator of the possible pay loss faced by the average individual shifting industries.[5]

The product of the rate of industrial shift and the pay gap associated with it represents the total losses (or gains) due to industrial shift, averaged over all workers. If, say, employment shares are shifting across sectors at the rate of 1 percentage point annually, and the expanding sectors pay $10,000 less than the contracting sectors, then the average annual pay loss from industrial shifts is $100 per worker. This summarizes the loss of the hypothetical shifting worker ($10,000) and the rate of shift (1 percent).

It is easy to see how these losses affect average pay growth over the whole economy. First note that shift-share analysis provides the following decomposition of average pay growth:

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[2] This is equivalent to that used by Lawrence (1984, p. 52). As discussed in the Report's Technical Background, the terms "expanding" and "contracting" refer to employment shares, rather than absolute numbers, but the data indicate that the two usually coincide. Note that shifting employment shares are brought about by generational turnover as well as worker displacement. Note also that this analysis isolates net shifts, which necessarily understate the gross shifts among industries. See Podgursky [1988] for direct evidence on the experience of displaced workers, based on the special Displaced Worker Survey supplement to the Current Population Survey. The findings from that survey on the extent of displacement, gross flows of displaced workers within and between industries, and the earnings loss from these flows are consistent with the indirect evidence of the present study.

[3] This is the method used in the Report's footnote 2.

[4] Note that it is entirely possible that average pay in both the contracting and expanding industries may be lower (or higher) than the economy-wide average, since that average is based on employment weights. That is, the industries with the most rapid rates of expansion and contraction may both be low-pay (or high-pay) industries, relative to the economy-wide average. Indeed, our results below show this for some intervals of the postwar period. However, what is significant for the wage effects of industrial shift is whether the expanding industries are high-wage or low-wage relative to the contracting industries, and not relative to the economy-wide average.

[5] A caveat is in order concerning the reasons for the pay gap. To the extent that the pay gap reflects skill differences or compensation for more onerous work, then the pay gap does not correspond to actual losses from industrial shift. The only relevant part of the pay gap is that which represents labor market imperfections. This should be borne in mind when interpreting the empirical work below, which is necessarily based on the entire pay gap.

$$W \cdot \Phi \equiv \Sigma \lambda_i W_i + \Sigma \lambda_i' W_i$$

Average Pay Growth = Pay Growth Within Industries + Shift Effect.
That is, the growth rate of average pay in the economy as a whole (W) can be decomposed into two parts: a weighted average of the growth rates of pay within each sector; and the effect of employment shifts between sectors with higher and lower pay. Using (1)–(2), it can be shown that this shift effect is itself the product of the rate of industrial shift and the pay gap:
(3) Shift Effect on Pay Growth = (Rate of Shift) × (Pay Gap).
If the pay gap is negative, the shift effect will be as well, driving a wedge between the growth rate within sectors and the growth rate of the overall average. This study tracks the shift effect through the postwar period and assesses its role in average wage growth, to answer the third question posed.

Up to this point, the analysis has been presented in terms of dollars per employee, which must be adjusted for inflation, of course. To do so, this study uses the personal consumption expenditure (PCE) deflator of the GNP accounts, which is widely viewed as preferable to the consumer price index (CPI).

The analysis will also be presented in terms of percentage growth rates in real pay. Dividing through the pay growth equation by the economy-wide average, W, one sees that the shift effect becomes $\Sigma \lambda_i'(W_i/W)$. This is the product of the rate of shift and the normalized pay gap, relative to the overall average (divide equations (2) by W). These measures are independent of the choice of price index, since the numerator and denominator of these expressions are divided by the same price index. The only points where the price index matters are in the measure of real pay growth within industries, and, hence, overall average real pay growth.

Equations (1)–(3) provide the analytical expressions for the three main subjects of this study: the rate of industrial shift, the pay gap between expanding and contracting industries, and the shift effect on average pay growth. It should be emphasized that every expression in this section is a mathematical identity, true by definition. There is nothing causal in this framework, only descriptive. Specifically, the shift effect on average pay growth may not be independent of pay growth within industries, depending on the underlying causes of industrial shift. This is discussed in the Report's penultimate section, and will be elaborated upon below.

Empirical Implementation

To measure (1)–(3) requires estimation of the λ_i''s, the rates of change of employment shares. Previous work has typically computed them from the endpoints of selected intervals, chosen to minimize the effect of the business cycle.[6] This procedure implicitly takes the analysis one small step beyond the descriptive level, since it recognizes that employment shares are sensitive to the stage of the business cycle.[7] The regression approach adopted here does not go any further beyond the descriptive level; it only does so a bit more systematically, and exploits the full postwar time series.

Specifically, consider a simple regression of industry i's employment share against a time trend and the civilian unemployment rate.[8] The coefficient on the time trend

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[6] One exception is Kutscher and Personick (1986), who estimate least-squares trends for absolute levels of employment and output of 150 industries, over the period 1969–84. However, these estimates do not appear to control for the business cycle and do not allow for any break in trend. Another exception is Bluestone, Harrison, and Clayton-Matthews (1986), who estimate least-squares trends for absolute levels of employment in 92 manufacturing industries, over the period 1958–84. These estimates allow for a break in trend, similar to the present study, but they do not impose continuity in an industry's predicted employment, as in the spline regressor approach adopted here. They also control for the exchange rate and the business cycle. Their business cycle control variable is constructed in such a way that it is approximately the residual from a regression of log GNP on time. Consequently, it is virtually orthogonal to time and its inclusion in the employment equation will therefore have limited effect on the estimated trends (no effect at all on a single trend).

[7] Employment shares are typically procyclical in manufacturing and countercyclical in services and retail trade.

[8] Alternative cyclical measures were considered, such as the unemployment rate of prime-age males. Results were comparable, but the predictive power was a bit lower. As mentioned in a previous footnote, other cyclical measures formed as a deviation from trend (of GNP, total employment, sunspots, or anything else) will, by construction, be orthogonal to trend and will therefore not affect simple estimated employment trends. (A recent study on "The Declining Middle-Class Thesis," by Horrigan and Haugen [1988] uses such a regressor, and is therefore possibly misleading in its claim that cyclical movements have been removed from its estimates.) Of course, if such a series of deviations provides better predictive power, perhaps the simple

Continued

is the cyclically controlled estimate of λ_i's. One would like to allow this estimate to vary over the postwar period. One method of doing so is to consider separate regressions for different subintervals of the postwar period. There are three problems with this approach: (1) for short intervals there are only a few degrees of freedom; (2) the choice of intervals is somewhat arbitrary; and (3) the predicted values for the employment shares are discontinuous where the intervals are spliced together, at the "join points."

A preferred approach is a single regression for industry i's employment share over the postwar period, with a separate regressor to represent the time trend over each subinterval. The requirement of continuity is imposed by certain transformation of the regressors, explained below, resulting in a linear spline regression. Furthermore, the estimated effect of unemployment should be allowed to vary over time as well. Again, separate unemployment regressors are used, transformed to impose continuity.

Specifically, for each sector i, and a given set of join points, the following least-squares regression is computed on the share of employment:

$$\lambda_{it} = \alpha_i + \beta_{1i}T1 + \beta_{2i}T2 + \beta_{3i}T3 + \beta_{4i}T4 + \beta_{5i}T5$$

$$+ \theta_{1i}U1 + \theta_{2i}U2 + \theta_{3i}U3 + \theta_{4i}U4 + \theta_{5i}U5.$$

The trend regressors T1–T5 are defined as:

$$T1 = DT_{1t} + \Sigma DT_{kt} \quad k>1$$

$$T2 = DT_2(t-tj1) + \Sigma DT_k(tj2-tj1), \text{ and similarly for T3 and T4} \quad k>2$$

$$T5 = DT_5(t-t_{j4}).$$

Here, the join points on the time trends are (j1, j2, j3, j4), and the DT_k's are five dummies corresponding to the five time trend subintervals. The unemployment regressors U1–U5 are constructed in the same fashion, using their own set of join points, the corresponding dummies, and substituting the unemployment rate for time in the expressions above.

It is readily verified that the β_i's are the time derivatives of λ_i for the corresponding subintervals, while the θ_i's are the derivatives for unemployment. Moreover, it is also easy to see that the function is continuous at the join points, i.e., that the function approaches the same value from above and below.[9]

Finally, there remains the issue of the choice of join points. First, note that whatever join points are selected must be imposed on all industries, otherwise the estimated employment shares will not sum to unity.[10] Now, to choose the join points in advance would necessarily be somewhat arbitrary. Consequently, the data are allowed to select them by choosing those join points which minimize the sum of squared residuals across industries.[11] Indeed, the data are allowed to select separate join points for the time trend and the unemployment rate.

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employment trends should not be modified. A limited investigation suggested this was not the case in the present study.

[9] If there were no cyclical controls, and only time trends, then the regression would be equivalent to a spline regression:

$$\lambda_{it} = \alpha_i^* + \beta_{i1}t + (\beta_{i2} - \beta_{i1})\max(t - t_{j1}, 0) + (\beta_{i3} - \beta_{i2})\max(t - t_{j2}, 0)$$

$$+ (\beta_{i4} - \beta_{i3})\max(t - t_{j3}, 0) + (\beta_{i5} - \beta_{i4})\max(t - t_{j4} 0).$$

[10] Formally, the model is one of seemingly unrelated equations, since the residuals are correlated across industries (they must sum to zero). However, using the same regressors for all industries, estimation is equivalent to single equation OLS (see Kmenta [1986, p. 639]).

[11] In principle, it might have been preferable to find the maximum likelihood set of join points. This is found by minimizing the determinant of the covariance matrix of the residuals across industries. One industry is deleted, since the matrix would otherwise be singular. In practice, if the number of industries is at all large (e.g., 58, as in the BEA data set), the matrix is near-singular and the problem runs into computational barriers. The maximum likelihood set of join points was found for a 12-sector model, based on BLS OPT data, and compared with the least-squares join points. (The least-square criterion minimizes the trace of the covariance matrix [without deleting any industries], rather than the determinant.) A few of them differed,

Continued

The only somewhat arbitrary choice remaining is the number of intervals. For the BEA data set, covering the entire postwar period, five intervals were selected for the time trend and for the unemployment rate (four join points for each). This offered enough flexibility without sacrificing too many degrees of freedom and without excessive computational demands.[12] This procedure found breaks in trend at 1954, 1962, 1973, and 1981. The join points found for unemployment were 1953, 1964, 1971, and 1979.

To illustrate, consider the following two regressions, from the BEA data set on 58 sectors. The dependent variables are the employment shares of primary metal industries and retail trade, the most important contracting and expanding industries, respectively. Standard errors, conditional on the join points, are given in parentheses.

Primary Metals=

$$\begin{array}{l} 4.06 - 0.018\ T1 - 0.048\ T2 - 0.038\ T3 - 0.044\ T4 - 0.118\ T5 \\ (0.76)\ (0.014)\quad (0.007)\quad (0.004)\quad (0.007)\quad (0.009) \\ \\ -0.061\ U1 - 0.082\ U2 - 0.042\ U3 - 0.021\ U4 - 0.057\ U5 \\ (0.024)\quad (0.018)\quad (0.017)\quad (0.017)\quad (0.015) \end{array}$$

Mean Share of Primary Metals	= 2.06	Adjusted R^2	= 0.992
S.E. of Regression	= 0.05	Durbin-Watson	= 1.701

Retail Trade =

$$\begin{array}{l} 13.59 + 0.043\ T1 + 0.078\ T2 + 0.181\ T3 + 0.124\ T4 + 0.237\ T5 \\ (1.66)\ (0.030)\quad (0.014)\quad (0.009)\quad (0.015)\quad (0.019) \\ \\ + 0.137\ U1 + 0.083\ U2 + 0.188\ U3 + 0.209\ U4 - 0.034\ U5 \\ (0.053)\quad (0.0369)\quad (0.037)\quad (0.036)\quad (0.033) \end{array}$$

Mean Share of Retail Trade	= 18.35	Adjusted R^2	= 0.995
S.E. of Regression	= 0.12	Durbin-Watson	= 1.553

These regressions illustrate the procyclical behavior of employment shares in many durables manufacturing industries, and the countercyclical behavior of retail trade (except for the last coefficient, which is not significantly different from zero) and many service industries. More to the point, they will illustrate the long-term shift out of durables into services and retail trade, which appears to have accelerated. Since 1981, primary metal's cyclically controlled share of employment has declined by 0.118 percentage points per year, while retail trade's has risen by 0.237. For both of these sectors, the acceleration from the previous interval is statistically

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but, most importantly, the last break in trend was found at the same year using both methods. Since this is the join point of most interest, this provides some reassurance for using the least-squares criterion for the BEA data set.

[12] In practice, the set of eight join points found is a local optimum. One hopes it is also a global optimum, but the computational requirements to be sure are prohibitive. The join point of greatest interest is the most recent one for the time trend. This is found to be 1981. This still holds when the number of intervals is reduced from five to four, as the data choose to drop the join point of 1973. This provides some robustness to the main results. For shorter data sets (BLS CES and ES-202), only two intervals are selected (one join point) for the time trend and for unemployment.

highly significant.[13] To reiterate, the year 1981 was not chosen as an arbitrary join point, but was suggested by the data to give the best fit for the 58 sectors taken together.

BEA NIPA Data, 58 Industries

The methodology has been applied to four sets of data, with different strengths and weakness, yielding similar results. The results discussed most in the Report are based on the BEA's National Income and Product Accounts (NIPA), by industry (Tables 6.4B–6.7B). This study focuses on the nonfarm private economy, which is covered at the two-digit level (58 industries) by the BEA. Unlike the CPS, none of the data sources provide information on part-year employment, so annual employment is just 52 times weekly employment. The wage and salary component of compensation can be separated from the non-wage component. Results based on payroll employment are presented in this Report.[14] The BEA also provides a measure of full-time equivalent (FTE) employees, which is integrated into the analysis below. For reasons to be explained, however, this latter measure may be less useful than other sources of hourly data.

Table A1 presents raw data on employment changes, for the interested reader. The main analysis, of course, is based on cyclically controlled estimates of annual changes in employment shares, the λ_is, which are given in Table A2. Table A3 gives employee compensation in each industry, relative to the economy-wide average, W_i/W.[15]

The main results are given in Table A4. Line 1, depicted in the Report, indicates a significant acceleration in the rate of shift.[16] It might also be noted that although there was a relatively rapid rate of shift in the early postwar years, this was in a positive direction, toward higher-paying sectors, as shown in lines 2–4. As discussed in the Report, however, the compensation gap turned negative, and in recent years the gap reached its postwar high, both in constant dollars and in percentage terms (lines 5–7). This widening has been primarily due to shifting composition of the expanding and contracting sectors,[17] rather than to widening gaps between specific sectors.

As the Report discusses, the rapid rate of industrial shift, combined with the wide compensation gap, resulted in the postwar period's most adverse shift effect on average compensation growth, both in constant dollars/employee (line 10) and in percentage growth rates (line 14).[18] Line 11 multiplies line 10 by average employment over each interval to give economy-wide estimates of the shift effect on compensation growth.

Table A5 analyzes the two components of compensation: wages and salaries and non-wage benefits (including legally mandated employer contributions to Social Security, as well as employer contributions to private health and pension plans). To fix magnitudes, line 1 shows that non-wage benefits have risen from 5.4 percent of compensation to 15.7 percent over the postwar period, and have only recently stopped expanding.[19] This, of course, corresponds to the fact that non-wage benefits have grown consistently faster than wages and salaries until recently, as shown on lines 11 and 23.

As the Report discusses, employment shares have shifted to industries with both lower wages and salaries and lower benefits (lines 2–7 and 14–19), with adverse shift effects on the growth of both components (lines 8–13 and 20–25).[20] Lines 26–28 show

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[13] T-statistics for $(\beta_5-\beta_4)$ are -5.18 and 3.64.

[14] Results including the self-employed are available from the author. See also note 26 below.

[15] These are simple arithmetic averages over each interval.

[16] Some of the most important accelerations were in the decline of primary metal industries and fabricated metal products, and in the rise of retail trade and business services. Also, there were dramatic reversals of prior share gains in nonelectrical machinery, oil and gas extraction, and coal mining. All these developments (as well as many smaller ones) were statistically highly significant, as measured by the T-statistic on $(\beta 5-\beta 4)$.

[17] Note the developments cited in the previous footnote.

[18] These results stand even without the cyclical controls. The uncontrolled estimates give the following results for lines 1, 7, and 14: Rate of Shift—0.96, 0.82, 0.79, 0.93, 1.05; Annual Compensation Gap—10, -35, -4, -13, -40; Shift Effect on Compensation Growth—0.10, -0.29, -0.03, -0.12, -0.42.

[19] The 15.7 percent currently breaks down into 6.5 percent for employer contributions to public plans (primarily Social Security) and 9.2 percent to private plans.

[20] The shift effect for each component of compensation growth multiplies the corresponding pay gap by the same rate of sectoral shift, given on line 1 of Table A4.

that one-third of the recent compensation gap is due to the gap in benefits, which is disproportionate to their share of compensation (one-sixth, from line 1).[21] The shift effect necessarily breaks down in the same proportions (lines 32–33).[22]

The BEA NIPA provides data on FTE employees, as well as employment, which should reflect different workweeks in different industries. The shift effect can be broken down into the separate effects of the gaps in compensation/FTE and FTE/employee between expanding and contracting industries. This decomposition, given in lines 15–16 of Table A4, indicates that the lion's share of the recent shift effect is due to lower compensation/FTE in the expanding sectors (−0.37 out of −0.48), and a rather small portion is due to shorter hours in these sectors. However, this decomposition may be less credible than results presented below, based on another data set.

BLS OPT Data, 12 Sectors

The BEA's data on FTE's are constructed using the household survey's estimated workweeks, which are widely considered less reliable than the establishment survey's estimated workweeks, used in the BLS OPT data. In general, the household estimates for nonmanufacturing workweeks stopped declining in the sixties, unlike the establishment estimates. As a result, the estimated 1986 average workweeks in retail trade and services were 35.4 and 37.2 hours, respectively, according to the BEA, as opposed to 29.2 and 32.5 hours, according to the BLS OPT. This means that the BEA's estimated workweeks have been far more uniform across sectors, which explains why so little of the recent effect on compensation growth is attributed to the expansion of industries with shorter hours, in Table A4, line 16.

In this respect, the BLS OPT data may be more informative. These data, from the BLS Office of Productivity and Technology, are the basis of the most widely followed measures of hourly and weekly compensation. They cover both payroll employees (reported on in this study) and the self-employed.[23] The main drawback is that the nonfarm business economy is divided into only 13 one-digit sectors. The main purposes of analyzing these data are to corroborate the BEA NIPA estimates, where they are comparable, and to supplement them with more credible estimates on hourly compensation and weekly hours. To facilitate these purposes, the estimates are based on the same regressors (same join points for time and unemployment) as the BEA NIPA estimates.[24]

Table A6 presents the results from the BLS OPT data. Lines 1–10 clearly corroborate the results from the BEA NIPA data, as they should, since much of the BLS OPT data set is based on the BEA NIPA data.[25] Lines 11–13 show real hourly compensation in the expanding and contracting sectors, and the gap between them, depicted in the Report. Similarly, lines 14–16 compare weekly hours in the expanding and contracting sectors. These results can be used to break down the annual compensation gap and the shift effect into the effects of lower hourly compensation and shorter hours in the expanding sectors. Lines 17–22 show that since 1981 both factors played equal roles.[26]

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[21] As the Report notes, the gap in employer contributions to private health and pension plans is particularly striking. This result is consistent with Podgursky and Swaim [1987A], who find the loss of health insurance to be one of the main costs of displacement. More generally, the present paper complements their series of detailed studies of the costs of displacement based on the direct evidence of the Displaced Worker Survey, from the CPS of the mid-eighties.

[22] Lines 30–33 weight lines 12–13 and 24–25 by the appropriate share of compensation, drawn from line 1.

[23] Results including the self-employed are available from the author. See also note 26 below.

[24] The optimal set of join points for the 12-sector data finds the break in trend at 1982 instead of 1981. This is a consequence of the degree of aggregation, as confirmed by analysis of BEA data, aggregated up to the same level. The 1982 join point gives more pronounced shift effects in the recent period.

[25] A full reconciliation of the BEA NIPA and BLS OPT results is available from the author.

[26] Small interaction effects prevent terms from adding up precisely. An alternative approach to isolating the hourly compensation effect is to begin with employee-hours as the unit of analysis, instead of employee-weeks. This was the approach adopted in Costrell [1988], using endpoint technology. A supplement available from the author discusses the conceptual distinction between these approaches and compares the results. As it turns out, the results using employee-hours as the unit of analysis are rather close to those given in Table A6, particularly for recent years. That supplement provides a full reconciliation between the rather smaller estimate of the shift effect over 1979–85 in Costrell [1988] and the present study. The main reasons are: (1) the present study analyzes the shift effect on weekly hours as well as hourly compensation; (2) the present study is confined to payroll employees, excluding a positive shift among the self-em-

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BLS CES Data, Production and Non-Supervisory Workers, 323 Industries

The third data source is the BLS establishment survey of the Current Employment Statistics (CES) program, most of which is published in *Employment and Earnings*. Unpublished data allow us to construct three-digit series from 1972–86, covering 323 industries. These data cover hourly and weekly wages (though not benefits) and employment for PNS payroll employees (about 81 percent of the total) in the nonfarm private sector. This source also provides data on SNP employees, but without corresponding data on hours or wages. Still, some use can be made of these data to comment on occupational shift, below. Employment by sex is also available, without corresponding data on hours or wages. These data are also examined below, to compare industrial shift patterns by sex.

Table A7 presents the main results. At this level of disaggregation, complete series can only be constructed back to 1972, so the analysis is based on a single join point for the trend and unemployment variables. The data places the break in trend at 1981, consistent with the BEA data set.[27] The results tend to corroborate those already presented. Once again, there is an acceleration of the rate of industrial shift.[28] Also, the annual wage gap has been particularly wide of late, reaching −$7,004. This is quite close to the BEA NIPA estimate, but is somewhat larger in percentage terms, since PNS wages are lower than those of the work force as a whole. The shift effect of −0.61 percent is larger than the BEA NIPA estimate for wages and salaries of the whole work force.[29] Further analysis below of the CES data on SNP workers also suggests that the shift effect has been far less adverse for them (and maybe favorable) than for PNS workers.

It might also be noted that PNS workers appear to have fared worse than other workers recently, even leaving aside the shift effects. That is, comparing the recent wage growth within sectors, one sees that the NIPA data for all workers gives considerably stronger recent growth (1.11 percent) than CES data on production and non-supervisory workers (0.19 percent).

Lines 20–25 show that the wage gap and shift effect are due in approximately equal parts to the hourly wage gap and the weekly hours gap, just as the BLS OPT analysis indicated. The weekly hours gap is −6.2 hours/week, a bit lower than the BLS OPT estimate. The hourly wage gap is −$2.04, which is about two-thirds of the BLS OPT estimate of the hourly compensation gap, and is perfectly consistent with the BEA NIPA estimate that a third of the compensation gap is due to non-wage benefits.

ES–202 Data, 372 Industries

The fourth data source is the BLS Employment and Wages program, commonly known as the ES–202 program. This program draws on data from state employment security agencies, for workers covered by unemployment insurance. It is a virtual census of nonfarm employees, with some exceptions, notably railroad employees. These data are highly disaggregated, at the three-digit level, but only cover the period 1975–86. No hourly data are provided.

Table A8 shows the results based on the ES–202 data for 372 industries, covering the nonfarm private economy.[30] Again, the data find a break in trend at 1981.[31] Here, we find only a small acceleration of the rate of industrial shift, but again a marked widening of the wage gap to −$7,222, remarkably consistent with the estimates from the BEA NIPA and BLS CES data. The shift effect on wage growth is −0.53 percent. These results are quite consistent with those already discussed, except that the acceleration of industrial shift is rather small. On further investigation, however, this difference reflects the high rate of shift over 1975–81, as compared with the period 1972–81 analyzed in the BLS CES data.[32] It is only the lack of

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ployed, from retail trade to services; and (3) the present study's regression methodology picks up an important break in trend in 1981, missed by the previous study based on endpoint methodology.

[27] The join point for unemployment is 1975.

[28] Of course, the rate is somewhat higher than given by the more aggregated data of the BLS OPT or BEA NIPA.

[29] As noted in the Report, footnote 10, the relevant comparison is −0.57 vs. −0.45, when aggregated to the same industries. The concentrated impact on production and nonsupervisory workers is also consistent with direct evidence from the Displaced Workers Survey (see Podgursky and Swaim) [1987B].

[30] Since ES–202 coverage of railroad workers is fragmentary, the BEA NIPA data are substituted. The data on private household workers, which is also fragmentary, were not included, to facilitate comparison with the BLS CES data, which also do not cover such workers.

[31] The join point for unemployment is 1977.

[32] A full reconciliation of the BLS CES and ES–202 results is available from the author.

ES–202 data prior to 1975 which accounts for the small size of the acceleration shown by this data set.

Decomposing the Shift Effect by Contracting and Expanding Industry

Tables 1 and 2 of the Report break down the shift effect among contracting industries and among expanding industries. Formally, the contribution of contracting industry c to the total shift effect is

$$-\lambda_c(\text{average wage in expanding industries} - w_c),$$

while the contribution of expanding industry e is

$$\lambda_e(w_e - \text{average wage in expanding industries}).$$

The first expression takes the rate of industry c's contraction and multiplies it by the gap between its compensation and that of the expanding industries. That is, contracting industry c is a major contributor to the shift effect on compensation growth if it contracts rapidly and if its compensation is very different from the expanding industries. A similar interpretation applies to the expression for expanding industries.[33]

For example, the first line of Table 1 shows that primary metals paid $38,994, or $17,011 more than the average of expanding industries ($21,983, from line 2, Table A4). Multiplying this by the annual rate of contraction of that industry's employment share, 0.118 percent (given in Table A2, as well as the regression reported earlier, and shown in Table 1 for the 6-year period as a whole), gives $20, or 17.7 percent of the $113 shift effect (line 10 of Table A4).

Tables A9 and A10 [34] provide data for these industries for earlier periods as well. To facilitate comparison across periods, the shift effect on the percentage growth rate (line 14 of Table A4 and line 13 of Table A7) is broken down by contracting and expanding industry.[35] Industries are arranged in ascending algebraic order of their contribution to the shift effect on compensation growth for the most recent period. Also, some of the contracting lower-pay industries and expanding higher-pay industries are shown.

These data permit evaluation of some widespread impressions, some of which were discussed in the Report. They confirm the importance of the decline in durables manufacturing. From the viewpoint of the contracting industries, at least half of the recent adverse shift effect came from durables,[36] many of which have been trade-impacted. In addition to some of the important industries already discussed, it is of some interest to note that the adverse shift effect on production workers in motor vehicles occurred prior to 1981, so it is not listed in Table A10; its role in Table A9 reflects the loss of nonproduction employment shares after 1981.

Another widespread impression, confirmed by these data, is the importance of the contraction in energy-related industries, such as oil and gas extraction, coal mining, and petroleum refining.

It is sometimes claimed that the contraction of nondurables manufacturing is favorable, since some of these industries are lower-pay. The tables confirm that the shift out of apparel and textiles has had a positive shift effect on compensation [37] (much as the decline of private household service [38] did, especially in earlier periods). The present analysis, however, puts these positive effects in perspective: they are swamped by the negative effects. Indeed, even among contracting nondurables, the positive shift effects from lower-wage industries are outweighed by the decline of higher-wage industries such as refining and chemicals.

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[33] It can be readily verified that summing the first expression over all contracting sectors does indeed constitute the total shift effect on compensation growth, and similarly for the second expression.

[34] The detailed breakdown of the ES–202 shift effect pinpoints the same industries as the BLS CES data in Table A10. The only differences concern a few positive shift effects of supervisory and nonproduction workers, discussed below.

[35] The entries for Table A9 can be calculated directly from the data in Tables A2, A3, and lines 5–6 of Table A4.

[36] For BEA NIPA, the figure is −0.27 out of −0.48. For BLS CES, the figure is −0.31 out of −0.61. For ES–202, it is −0.26 out of −0.53.

[37] One limitation of our national data is that it does not reflect the possibility that apparel and textiles may be relatively high-wage for the regions in which they are concentrated.

[38] Private household service is not included in the BLS CES data, the main difference in industrial coverage.

Turning to the expanding industries, these data strikingly confirm the significance of the growth in lower-pay retail industries, especially eating and drinking places. Interestingly, data discussed below indicate that the growth of employment shares in eating and drinking places has been even more pronounced for males than for females.

The data also confirm the importance of the expansion in lower-pay service industries. In all, expanding service industries have accounted for at least half of the negative shift effect.[39]

Contrary to some impressions, however, the most important group of expanding lower-pay services is business services. These are often thought to be higher-wage service industries, but as Table A10 shows, the most important expanding components have included personal supply services (primarily temporary help), and services to buildings. To be sure, there has been a significant rise in the employment share of computer and data processing services, but their PNS wages are barely higher than the contracting industries (134 percent of average wages vs. 131 percent), so their positive contribution to the shift effect is too small to be listed in Table A10.

The tables also show the effect of the rise in a variety of other lower-pay service industries, including health services, hotels, educational, and personal services.

Finally, the growing financial sector is often thought to provide higher-pay jobs. As a whole, however, these industries have made a negligible contribution to the shift effect (slightly positive for the BEA NIPA data, and for ES–202; slightly negative for the BLS CES data). This represents the offsetting effect of growth in some lower-wage industries, such as thrift institutions, and growth in some higher-wage industries, notably security and commodity brokers (primarily SNP). Of course, this latter shift predates October 1987.

Occupational Shift

Previous research based on the household survey[40] has indicated that occupational shifts have been favorable, from lower-pay to higher-pay occupations. It would be informative to integrate the analysis of occupational and industrial shifts to find the joint effect of both shifts. Methodologically, this is fairly straightforward: construct an industry-occupation matrix, year-by-year, apply the present paper's methods to the employment shares of each cell, and use the corresponding wages.

The difficulty lies in the data. The household survey has some occupational detail and a limited amount of industrial detail, but the occupational categories were revised in the early eighties, so it is difficult to construct a consistent series over the relevant period. Moreover, household responses to questions of industrial classification are generally considered less reliable than the establishment survey (which are also more disaggregated). Questions have also been raised about the reliability of household occupational responses. On the other hand, the establishment survey provides almost no occupational information. The only information it supplies is employment of PNS workers vs. SNP workers. Finally, it only supplies wage data for PNS workers.

With these limitations, the establishment data have been examined to see what can be learned. The industry-occupation employment matrix (322 industries x 2 "occupations") was constructed and analyzed for cyclically controlled share changes by cell (644 cells). These results, which have the full reliability of the establishment survey, indicate that there have been indeed favorable occupational shifts, from PNS to SNP employment. The rate of shift, however, has been rather small, and has been declining. Specifically, over the period 1972–81, the cyclically controlled estimates indicate a rise in the SNP share of employment by 0.166 percentage points per year, followed by 0.073 points per year from 1981–86.

To draw out the wage implications of these occupational shifts, and to integrate them with the industrial shifts, some less reliable guesses had to be formed about the wage structure of SNP workers. Two approaches were explored. The first approach makes the simplifying assumption that within each industry SNP wages are twice PNS wages. This assumption of uniform SNP wage premiums of 100 percent leads to the first result indicated on lines 1-2 of Table A11: occupational and industrial shift effects taken together were negligible (−0.02) over 1972–81, but again amounted to over half (−0.54) a percentage point per year since 1981. These results

[39] For the BEA NIPA data, the figure is −0.30 out of −0.48, while the BEA CES figures is −0.35 out of −0.61. For ES–202, it is −0.26 out of −0.53.

[40] See Rosenthal [1985] and McMahon and Tschetter [1986].

were quite robust with respect to the assumed wage premium, for reasons that will be explained below.

The second approach to constructing an SNP wage structure draws on another data source, the ES–202 data on wages, discussed earlier. These data on wage rates for all workers can be compared with the establishment survey's wage rates for PNS workers. Using the establishment survey's employment data for PNS and SNP workers, one can infer an estimate of relative wage rates for SNP, for each industry.[41] These results, with nonuniform estimated wage premiums, are given on lines 3–4 of Table A11. The occupational and industrial shifts, taken together, were slightly favorable (0.07) over 1972–81, and deteriorated to an unfavorable effect of −0.33 of a point per year since 1981. This net deterioration of the shift effects is consistent with lines 1–2, although the results are a bit less unfavorable.

These results can be informatively decomposed into separate occupational and industrial shift effects in two ways, given in the top and bottom halves of Table A11. The top half represents the industrial shift effect as the result of pooling PNS and SNP workers together within each industry. The results based on the nonuniform premiums are comparable to be BEA NIPA shift effect for wages and salaries, since those data also do not distinguish by occupation (compare −0.11 and −0.47, from Table A11, with 0.00 and −0.38 from Table A5, line 13). The rest of the decomposition represents a weighted average of occupational shift effects within each of the 322 industries. These shift effects have been favorable, as previous research has suggested, though they have been slightly smaller since 1981, and outweighed by the unfavorable industrial shift effects.

The bottom half of Table A11 provides an alternative decomposition of the occupational and industrial shift effects. Here, the industrial shift effects are represented by a weighted average of the industrial shift effect among PNS workers and among SNP workers, taken separately. For PNS workers, these industrial shift effects (−0.24 and −0.61) are simply those reported above, in Table A7, line 13. The results for the SNP workers depend critically on whether their wage premiums are assumed to be uniform or not.[42] Assuming uniform premiums, the industrial shift effects for SNP workers (−0.11 and −0.64) are rather close to those for PNS workers. This is a result of the fact (not shown) that SNP employment shares have been shifting out of and into most of the same industries as PNS employment shares (i.e., out of blast furnaces and basic steel, machinery except electrical, telephone communication, etc., and into eating and drinking places, business services, etc.). The wage consequences of these shifts will therefore necessarily be close to the PNS results on the assumption of uniform premiums.[43]

The estimates inferred from the ES–202 data, with nonuniform premiums, give quite different results for SNP workers, as shown on lines 7–8. Prior to 1981, industrial shift effects for these workers were rather favorable (0.35), and since 1981, their favorable and unfavorable shifts roughly washed out (0.04). The reasons are of some interest. The estimates of SNP wages in manufacturing indicate that many of these workers earn relatively low wages compared to SNP workers in the expanding sectors. Consequently, the decline of SNP employment shares in many durables (machinery except electric, fabricated metal products, electrical and electronic equipment) as well as some nondurables (food products, textiles, apparel) had a positive effect, which offset the negative effects of the decline in SNP employment shares in air transportation, telephone communication, oil and gas extraction, some other durables (motor vehicles, blast furnaces and basic steel) and some other nondurables (refining and plastics).

Turning to the expanding industries, the growth of SNP employment in eating and drinking places, and other retail industries, has been equally adverse as for PNS workers. On the other hand, SNP workers have done well by the rise in wholesale trade, some health services, legal services, some business services (notably com-

[41] The relative wages estimated for use over 1972–81 are actually based on 1975–81 wage data, since ES–202 does not go back any further. There were some inconsistencies between the CES wage data on PNS workers and the ES–202 wage data on all workers. For some industries, such as construction and education, the data implied negative premiums for SNP workers, and, in some cases, negative supervisory wages. For these industries (about one-eighth of the total), the SNP workers were simply ascribed the cooresponding PNS wage.

[42] One interesting result for SNP workers which does not depend on the wage assumption concerns the rate of industrial shift. Table A7 showed that the rate of shift for PNS workers accelerated from 1.23 percent to 1.46 percent. For SNP workers, however, the acceleration is considerably more pronounced, from 1.29 to 1.84.

[43] Moreover, these SNP shift effects will be absolutely invariant with respect to the assumed premium, so long as it is uniform. That is why the total shift effects (−0.02 and −0.54) are relatively robust with respect to the assumed premium, as mentioned above.

puter and data processing), and especially in security and commodity brokers. The estimates of nonuniform wage premiums indicate that SNP workers are particularly well-paid in these industries.

Finally, the last column in the bottom half of Table A11 represents the occupational shift effect by pooling across industries all SNP workers and all PNS workers. In this two-group classification, the occupational shift effect is simply the employment share growth of SNP workers times the average wage gap between SNP and PNS workers (relative to the overall average). This wage gap is approximately 80–100 percent for both intervals, under each set of assumptions.[44] However, the rate of occupational shift has been somewhat small (and falling) as mentioned above. Again, since 1981, the favorable occupational shifts appear to have been outweighed by the unfavorable industrial shifts for PNS workers.

To be sure, this analysis misses all occupational shift among SNP workers and among PNS workers. Still, any positive impact of these occupational shifts should not be overstated, particularly for PNS workers. The weighted average of such occupational shifts, within industries, would be reflected in the within-industry wage growth shown for PNS workers in Table A7, line 12. As already noted, PNS wage growth within industries was negative over 1972–81, despite any positive occupational shifts. Since 1981, wage growth within industries has been positive, possibly due to positive occupational shifts, but has still been outweighed by the adverse industrial shifts. As a result, overall wage growth has continued to be negative for PNS workers.

Industry Shift by Sex

How do patterns of industrial shift compare by sex? The data are available to document these patterns, since the establishment survey breaks down employment of all workers (PNS plus SNP) by sex. Unfortunately, there are no corresponding wage data. To generate estimated wage data, this study again turned to the ES–202 data on wages for all employees. It was assumed that females uniformly earn 70 percent of male earnings within each industry, to infer estimates of male and female earnings by industry.[45] The results of this exercise suggest that recent adverse industrial shifts have been concentrated among males.

The shift effect on male wage growth has deteriorated from −0.04 to −0.39 percent since 1981, as both the rate of shift has accelerated and the wage gap has widened. The industrial detail of these shifts follows closely the overall pattern described earlier: employment shares have been shifting out of higher-wage durables (such as blast furnaces and basic steel, and machinery except electrical), higher-wage nondurables (such as chemicals and refining), railroad transportation, telephone communication, and mining; and they have been shifting into lower-wage retail industries (especially eating and drinking places), and business services such as personnel supply and services to buildings. Again, these adverse shifts outweigh the growth of some higher-wage industries, such as securities and commodity brokers, computers and data processing, and guided missiles.

The rate of female industrial shift has also accelerated, and the wage gap has turned from positive to negative, but has remained narrower than the male wage gap. As a result, the shift effects on female wage growth have been less adverse than for males, deteriorating from 0.17 to −0.10, since 1981. Comparing the industrial detail of these shifts with that of males, many of the same industries are involved, though to different degrees. Among recent shifts, the decline of higher-wage telephone communications has been considerably more important than for males, while there were less important declines in many of the same higher-wage durables that impacted males,[46] and there were no corresponding losses from railroads or

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[44] The reasons it is not exactly 100 percent for lines 5–6 are: (1) the assumed premium of 100 percent within industries is compounded by the concentration of SNP workers in industries with higher PNS wages; and (2) the premium in Table A11 is expressed as a fraction of the overall wage, not the PNS wage.

[45] This ratio follows Kosters and Ross [1987], although they apply it to estimated hourly earnings, while it is applied here to weekly earnings. Since females are concentrated in lower-wage industries, the implied overall average is only 62 percent of male earnings, lower than the 70 percent assumption within industries.

[46] Two interesting exceptions here are that employment shares in office and computing equipment, and electronic components (which include semiconductors), continued to rise for males, but started to decline for females, since 1981. Both of these appear to be associated with increased offshore assembly and automation of production, which is largely female.

mining. Also, the most important declines in nondurables were not in the higher-wage chemical and refining industries, but in the lower-wage textile and apparel industries.

On the other side of female industry flows, the most important lower-wage expanding industries were again led by eating and drinking places. It is surprising to note, however, that this industry's share of female employment grew somewhat *slower* than its share of male employment, so its contribution to the negative shift effect for females was only half that for males. Following eating and drinking places, the rise of a variety of other retail industries and personnel supply services had similar effects to those for males. Other business services, however, including services to buildings, played a smaller role than for males. The rise of such higher-wage industries as securities and commodity brokers, legal services, and computer and data processing had a positive effect, comparable to that for males. The strongest positive factor, however, was the growth of employment in offices of physicians, a factor which was absent for males.

To summarize, recent patterns of industrial shift for males and females have shared many similarities, though some adverse shifts were absent or smaller for females, while other favorable shifts have been larger. As a result, the balance of adverse industrial shifts has been focused on males.[47]

The Causes of Industry Employment Shifts

Employment shares have been shifting from manufacturing to services for the better part of a century, both here and in the other industrialized nations. The traditional explanation of this process, due to Fuchs [1968] and Baumol [1967], has been that productivity growth in manufacturing typically exceeds that in services. No doubt this continues to be true, but the question arises concerning the apparent acceleration of this shift since 1981.

Many observers believe that the acceleration has been attributable to the emergence of large trade deficits in manufactured goods, which in turn has been related to the large fiscal deficits.[48] Indeed, it is certainly suggestive that in our statistical procedure the data have singled out 1981 for the break in trend.

On the other hand, it has been pointed out that manufacturing's share of real output has not declined, and that the productivity gap between manufacturing and services has widened, relative to the seventies. The present study's methodology reproduces this point: the cyclically controlled estimate of the growth in manufacturing output, relative to the nonfarm private economy, is insignificantly different from zero.[49]

On closer inspection, however, experts in the field have found that this is largely attributable to a controversial revision in the price index for computers.[50] This shows up in the BEA NIPA data for nonelectrical machinery, given in Table 3 of the Report. Leaving this industry out results in a very different estimate: the rest of manufacturing output grew 1.4 percent slower than the nonfarm private economy since 1981, a result which is statistically highly significant and very different from pervious periods. The result for durables other than nonelectrical machinery is even stronger: 1.6 percent slower growth than the nonfarm private economy.

These results show that the disaggregated data are more informative than those for manufacturing or durables as a whole. See the Report's discussion of Table 3.

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[47] The industrial shift effects for males and females taken together are −0.11 and −0.47 (the same as the occupationally pooled industrial shift effects given in Table A11, lines 3–4). These sex-pooled industrial shift effects are more adverse than a weighted average of the shift effects for males and females (−0.47 vs. −0.29, since 1981). This suggests that some portion of the sex-pooled effect, for these and other data sets, is due to the continuing growth of the female share of the work force (0.634 percentage points per year since 1981), concentrated in lower-wage industries. On the other hand, the share of employment accounted for by youths aged 16–19 has been declining (0.362 percentage points per year since 1981, using household data), and they are also highly concentrated in lower-wage industries, such as eating and drinking places. Demographic factors are clearly not the main determinant of adverse industrial shifts.

[48] A recent study by Branson and Love [1987] estimates that the high dollar led to the loss of 6 percent of manufacturing employment.

[49] This also holds for durables manufacturing, but not for nondurables, which has grown slower than nonfarm private output, by 1.1 percent annually, since 1981, a result which is highly significant statistically, and which is quite different from earlier periods.

[50] Baily and Chakrabarti [1988] cite an unpublished study by Denison which shows that the revised computer price index has raised measured productivity growth (and therefore output growth) in manufacturing by 1 percent per year since 1979 and 1.5 percent per year since 1982.

Wages, Productivity, Relative Income Shares, and Relative Prices

How does the shift effect on wage growth fit into the bigger picture of the economy? To answer this question, begin with a mathematical identity:

shift effect = aggregate productivity growth
−real wage growth within industries
+growth in labor's share of income
+growth in output prices, relative to consumer prices.

An adverse shift effect must, therefore, be associated with one or more of four possibilities: (1) an adverse effect on aggregate productivity growth; (2) a redistribution of income away from displaced workers towards non-displaced workers; (3) a redistribution of income away from labor as a whole; or (4) changes in relative prices, which are unfavorable to consumers.

Although this study has produced consistent esimates of the shift effect, it is not possible to quantitatively divide it up among these four possible concomitants without reliable measures of the causes of the shifts. Economic theory, however, can at least show the relationship between the various possible causes of the shift and the four possible consequences. Consider a model which allows for wage differentials across industries, due to some labor market imperfection, but in which output markets are competitive. Then it can be shown that [51]

productivity growth = aggregate rate of technical progress
+effect of increased capital per worker
+(labor's share of income)×(the shift effect).

It can also be shown that wage growth within sectors is directly related to the aggregate rate of technical progress, as well.[52]

If we assume for the moment that labor's share and relative prices do not change, then theoretical results can be quickly established. Consider three possible causes of employment shift: (i) widening productivity gap, due to accelerated technical progress in the higher-wage industries; (ii) widening productivity gap, due to decelerated (or negative) technical progress in the lower-wage industries; and (iii) increased trade deficits, due to increased borrowing from abroad.

In case (i), the aggregate rate of technical progress rises, increasing the wage growth of those remaining within their industries. Aggregate productivity also rises, since the increased technical progress can be shown to outweigh the adverse shift effect in the productivity equation above. The net result is a gain for non-displaced workers, partially from increased productivity and partially as a redistribution from displaced workers.

In case (ii), the aggregate rate of technical progress declines, reducing the wage growth of those remaining within their industries, as well as those shifting industries. Both the shift effect and the decline in technical progress reduce aggregate productivity growth.

In case (iii), increased borrowing from abroad, technical progress is unaffected. Since increased borrowing takes the form of importing more traded goods and producing less, resources are transferred to the non-traded, lower-paying sectors. The shift effect reduces productivity growth directly by this transfer of resources, due to the imperfection in labor markets which causes output prices to deviate from true economic trade-offs.

Now consider changes in labor's share of income and in consumer prices, relative to the general price level. Either of these can drive a wedge between real wage growth and productivity growth. As Table A12 shows, productivity growth has partially recovered from the slowdown of the seventies, but does not yet appear to have been fully shared by labor, if at all. The cyclically controlled estimates given in the top half of the table and depicted in the Report, show that productivity growth has recently recovered to 1.29 percent, while real hourly compensation has lagged 0.82 percentage points behind.[53] The estimates in the bottom half, based on NIPA FTE's,

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[51] See Costrell [1988], equation (3.5).

[52] See Costrell [1988], equations (3.8)–(3.9).

[53] These estimates are based on the most widely followed productivity data, from the BLS Office of Productivity and Technology, covering hours of all workers (including the self-em-

Continued

are similar. It remains to be seen when real wage and productivity growth will join paths again.

It is also unclear what role, if any, the industrial shifts may have played in this divergence. Labor's share is only weakly related to industrial shift, in an algebraic sense, since the lower-wage sectors are not necessarily sectors with low shares for labor.[54] There is a stronger case linking the shift effect to adverse price development, as explained in the Report.

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TABLE A1: EMPLOYMENT CHANGES, BEA NIPA DATA

[Thousands]

		1948–54	1954–62	1962–73	1973–81	1981–87
Metal mining	MNG	1	−17	4	15	−58
Coal mining	MNG	−265	−116	9	77	−76
Oil and gas extraction	MNG	55	−21	−24	424	−301
Nonmetallic minerals, except fuels	MNG	14	5	1	3	−8

ployed) in the nonfarm business sector. The corresponding data on hourly compensation have been deflated by the PCE, which is widely viewed as preferable to the CPI, used by the BLS OPT.

[54] See Costrell [1988], equations (3.10)–(3.11). Under the assumption of constant proportional wage gaps, the latter equation shows that the shift effect reduces labor's share, but the coefficient on that effect is capital's share, which is a relatively small fraction.

TABLE A1: EMPLOYMENT CHANGES, BEA NIPA DATA—Continued

[Thousands]

		1948–54	1954–62	1962–73	1973–81	1981–87
Construction	CNS	405	295	1,193	88	773
Lumber and wood products	DUR	−132	−95	139	−93	78
Furniture and fixtures	DUR	0	35	137	−40	52
Stone, clay, and glass products	DUR	−2	36	107	−54	−52
Primary metal industries	DUR	−59	−59	151	−136	−395
Fabricated metal products	DUR	125	50	378	−42	−192
Machinery, except electrical	DUR	40	70	600	407	−486
Electric and electronic equipment	DUR	203	372	412	147	−24
Motor vehicles and equipment	DUR	18	−76	269	−172	61
Other transportation equipment	DUR	574	−49	−41	154	82
Instruments and related products	DUR	92	47	154	162	−31
Miscellaneous manufacturing industries	DUR	−8	−11	64	−39	−34
Food and kindred products	NDR	24	−49	−40	−32	−55
Tobacco manufactures	NDR	5	−14	−11	−10	−15
Textile mill products	NDR	−280	−140	124	−207	−94
Apparel and other textile products	NDR	0	68	152	−159	−152
Paper and allied products	NDR	64	81	85	−13	−4
Printing and publishing	NDR	96	125	171	182	236
Chemicals and allied products	NDR	110	79	184	109	−91
Petroleum and coal products	NDR	16	−43	−8	26	−49
Rubber and misc plastic products	NDR	23	91	272	30	84
Leather and leather products	NDR	−35	−12	−61	−51	−101
Railroad transportation	TRN	−297	−413	−221	−88	−178
Local and interurban passenger transit	TRN	−62	−52	1	−3	35
Trucking and warehousing	TRN	148	165	321	78	214
Water transportation	TRN	−39	−9	−20	16	−40
Transportation by air	TRN	30	77	171	89	147
Pipelines, except natural gas	TRN	−3	−6	−5	6	−4
Transportation services	TRN	0	4	46	84	91
Telephone and telegraph	CMN	53	−16	303	152	−135
Radio and television broadcasting	CMN	25	19	50	64	29
Utilities	UTL	53	31	123	118	66
Wholesale Trade	WHL	144	393	1,154	1,032	494
Retail Trade	RTL	751	1,172	4,081	2,981	3,398
Banking	FIR	118	188	470	448	109
Credit agencies other than banks	FIR	63	107	133	170	316
Security and commodity brokers, and svcs	FIR	11	63	63	72	193
Insurance carriers	FIR	158	130	219	221	147
Insurance agents and brokers, and svcs	FIR	45	54	94	172	142
Real estate	FIR	24	28	331	225	271
Holding and other investment companies	FIR	4	12	47	47	86
Hotels and other lodging places	SVC	10	66	362	259	345
Personal services	SVC	−14	34	7	59	242
Business services	SVC	132	465	1,094	1,273	2,019
Auto repair, services, and garages	SVC	−35	85	179	162	243
Miscellaneous repair services	SVC	−16	27	74	95	26
Motion pictures	SVC	−16	−56	29	18	13
Amusement and recreation services	SVC	−12	78	203	234	114
Health services	SVC	343	492	2,013	2,010	1,287
Legal services	SVC	25	37	150	266	307
Educational services	SVC	70	237	394	238	287
Social services and membership org'zns	SVC	197	606	636	541	367
Miscellaneous professional services	SVC	82	119	379	399	326
Private households	SVC	97	709	−597	−491	−41

Source: BEA, NIPA Table 6.6B.

TABLE A2: RATES OF CHANGE OF BEA NIPA EMPLOYMENT SHARES

[Percentage points/year]

		1948–54	1954–62	1962–73	1973–81	1981–87
Metal mining	MNG	0.00	−0.01	0.00	0.00	−0.01
Coal mining	MNG	−.11	−.04	−.01	.01	−.03
Oil and gas extraction	MNG	.02	−.02	−.02	.04	−.05
Nonmetallic minerals, except fuels	MNG	.00	.00	.−01	.00	−.01
Construction	CNS	.09	−.01	−.01	−.03	.00
Lumber and wood products	DUR	−.07	−.04	−.02	−.02	−.01
Furniture and fixtures	DUR	.00	.00	.00	−.01	.00
Stone, clay, and glass products	DUR	−.01	−.01	−.02	−.02	−.03
Primary metal industries	DUR	−.02	−.05	−.04	−.04	−.12
Fabricated metal products	DUR	.04	−.03	.00	−.0.3	−.09
Machinery, except electrical	DUR	−.02	−.02	.01	.02	−.16
Electric and electronic equipment	DUR	.05	.05	−.01	−.02	−.05
Motor vehicles and equipment	DUR	.03	−.03	.00	−.02	−.03
Other transportation equipment	DUR	.20	−.05	−.04	.00	−.01
Instruments and related products	DUR	.03	.00	.00	.01	−.0.2
Miscellaneous manufacturing industries	DUR	−.02	−.01	−.01	−.01	−.02
Food and kindred products	NDR	−.06	−.06	−.08	−.07	−.05
Tobacco manufactures	NDR	.00	−.01	−.01	.00	.00
Textile mill products	NDR	−.15	−.07	−.02	−.06	−.04
Apparel and other textile products	NDR	−.03	−.01	−.04	−.07	−.06
Paper and allied products	NDR	.01	.00	−.01	−.02	−.02
Printing and publishing	NDR	.01	.01	−.02	−.01	.02
Chemicals and allied products	NDR	.02	.00	−.01	−.02	−.04
Petroleum and coal products	NDR	.00	−.02	−.01	.00	−.01
Rubber and misc plastic products	NDR	.01	.01	.02	−.01	−.01
Leather and leather products	NDR	−.02	−.01	−.02	−.02	−.02
Railroad transportation	TRN	−.15	−.14	−.07	−.03	−.05
Local and interurban passenger transit	TRN	−.04	−.02	−.01	−.01	.00
Trucking and warehousing	TRN	.04	.02	.00	−.01	−.01
Water transportation	TRN	−.02	−.01	−.01	.00	−.01
Transportation by air	TRN	.01	.01	.02	.00	.02
Pipelines, except natural gas	TRN	.00	.00	.00	.00	.00
Transportation services	TRN	.00	.00	.00	.01	.01
Telephone and telegraph	CMN	.01	−.03	.01	−.03	−.04
Radio and television broadcasting	CMN	.01	.00	.00	.00	.00
Utilities	UTL	.00	−.01	−.01	−.01	.00
Wholesale trade	WHL	−.06	.01	.01	.02	−.02
Retail trade	RTL	.04	.08	.18	.12	.24
Banking	FIR	.02	.03	..03	.02	.00
Credit agencies other than banks	FIR	.02	.02	.00	.02	.04
Security and commodity brokers, and svcs	FIR	.00	.01	.01	−.01	.04
Insurance carriers	FIR	.04	.01	−.01	−.01	.00
Insurance agents and brokers, and svcs	FIR	.01	.01	.00	.02	.01
Real estate	FIR	.00	−.01	.01	.02	.02
Holding and other investment companies	FIR	.00	.00	.01	.01	.01
Hotels and other lodging places	SVC	−.02	.01	.02	.01	.04
Personal services	SVC	−.04	−.01	−.04	−.03	.03
Business services	SVC	.03	.10	.11	.14	.31
Auto repair, services, and garages	SVC	−.02	.02	.01	.02	.03
Miscellaneous repair services	SVC	−.01	.00	.00	.01	.00
Motion pictures	SVC	−.01	−.02	.00	.00	.00
Amusement and recreation services	SVC	−.02	.01	.01	.02	.00
Health services	SVC	.09	.07	.20	.18	.13
Legal services	SVC	.00	.01	.01	.03	.05
Educational services	SVC	.01	.05	.03	−.02	.04
Social services and membership org'zns	SVC	.03	.13	.03	.01	.00
Miscellaneous professional services	SVC	.03	.02	.03	.04	.04
Private households	SVC	−.04	.09	−.22	−.15	−.04

These cyclically-controlled estimates are based on regressions described in the text.

TABLE A3: RELATIVE COMPENSATION, BEA NIPA

[Percent of average annual compensation]

		1948–54	1954–62	1962–73	1973–81	1981–87
Metal mining	MNG	131	138	137	161	179
Coal mining	MNG	121	129	143	174	186
Oil and gas extraction	MNG	131	130	133	153	167
Nonmetallic minerals, except fuels	MNG	109	116	120	127	131
Construction	CNS	116	117	124	125	119
Lumber and wood products	DUR	83	85	90	99	96
Furniture and fixtures	DUR	101	98	93	88	89
Stone, clay, and glass products	DUR	110	117	119	125	128
Primary metal industries	DUR	130	143	145	165	164
Fabricated metal products	DUR	123	127	125	127	127
Machinery, except electrical	DUR	130	135	136	138	143
Electric and electronic equipment	DUR	119	125	123	122	132
Motor vehicles and equipment	DUR	138	155	164	181	187
Other transportation equipment	DUR	131	143	153	157	168
Instruments and related products	DUR	123	132	129	125	136
Miscellaneous manufacturing industries	DUR	100	99	96	92	96
Food and kindred products	NDR	105	109	110	113	114
Tobacco manufactures	NDR	79	90	102	134	170
Textile mill products	NDR	89	81	83	83	84
Apparel and other textile products	NDR	82	75	72	67	66
Paper and allied products	NDR	118	122	124	134	143
Printing and publishing	NDR	125	122	118	111	110
Chemicals and allied products	NDR	132	142	143	152	165
Petroleum and coal products	NDR	177	188	183	215	242
Rubber and misc plastic products	NDR	121	125	118	112	114
Leather and leather products	NDR	84	80	78	73	73
Railroad transportation	TRN	131	136	146	175	195
Local and interurban passenger transit	TRN	107	101	93	84	77
Trucking and warehousing	TRN	106	115	121	129	118
Water transportation	TRN	122	129	133	141	141
Transportation by air	TRN	140	143	157	176	169
Pipelines, except natural gas	TRN	151	152	151	168	187
Transportation services	TRN	106	111	110	108	102
Telephone and telegraph	CMN	107	113	131	157	171
Radio and television broadcasting	CMN	144	147	137	124	126
Utilities	UTL	125	134	142	155	169
Wholesale Trade	WHL	119	120	122	122	122
Retail Trade	RTL	77	72	69	62	57
Banking	FIR	113	109	105	101	107
Credit agencies other than banks	FIR	103	105	101	98	102
Security and commodity brokers, and svcs	FIR	152	163	176	192	241
Insurance carriers	FIR	104	105	113	115	120
Insurance agents and brokers, and svcs	FIR	99	102	107	111	112
Real estate	FIR	77	77	79	80	86
Holding and other investment companies	FIR	170	149	137	138	175
Hotels and other lodging places	SVC	66	62	60	58	61
Personal services	SVC	68	67	66	60	55
Business services	SVC	112	106	96	85	88
Auto repair, services, and garages	SVC	83	81	82	81	78
Miscellaneous repair services	SVC	91	93	96	96	95
Motion pictures	SVC	87	87	90	89	105
Amusement and recreation services	SVC	68	73	73	65	65
Health services	SVC	64	65	76	89	98
Legal services	SVC	73	84	95	115	138
Educational services	SVC	65	63	78	75	68
Social services and membership org'zns	SVC	73	70	64	59	57
Miscellaneous professional services	SVC	119	126	130	125	131
Private households	SVC	38	30	25	24	24

These are simple averages of the relative compensation over the intervals indicated.

TABLE A4: ANALYSIS OF BEA NIPA COMPENSATION DATA, 58 INDUSTRIES

	1948–54	1954–62	1962–73	1973–81	1981–87
			Percentage points/year		
1. Shift of industry employment shares	0.91	0.78	0.78	0.80	1.09
			Annual compensation in $1987		
2. Expanding industries	$15,753	$14,491	$18,206	$21,921	$21,983
3. Contracting industries	15,156	20,623	18,853	22,732	32,387
4. Annual compensation gap	597	−6,133	−647	−811	−10,404
			Percent of average annual compensation		
5. Expanding Industries	108	84	87	95	92
6. Contracting industries	104	119	90	98	136
7. Annual compensation gap	4	−35	−3	−4	−44
			Average annual compensation growth/employee in $1987		
8. Average compensation growth	$446	$355	$391	$80	$126
9. Due to growth within sectors	440	403	396	87	239
10. Due to shift effect	5	−48	−5	−6	−113
			Shift effect on annual compensation growth of all employees (billions of $1987)		
11.	$.23	−$2.25	−$.29	−$.46	−9.26
			Annual percentage growth rate		
12. Average compensation growth	3.05	2.06	1.87	.35	.53
13. Due to growth within sectors	3.02	2.33	1.90	.37	1.01
14. Due to shift effect of which,	.04	−.28	−.02	−.03	−.48
15. Due to gap in compensation/FTE	.05	−.21	−0.2	−.02	−.37
16. Due to gap in FTE/employee	−.02	−.07	.04	.03	−.09

Results correspond to Equations (1)-(3), in text. The estimates of share changes are based on regressions which control for unemployment, as explained in text. A semi-log equation against the same regressors yields the estimates of compensation growth (deflated by the PCE). Small interaction effects may keep terms from adding up precisely.

TABLE A5: WAGES AND SALARIES VERSUS NONWAGE BENEFITS IN BEA NIPA COMPENSATION

	1948–54	1954–62	1962–73	1973–81	1981–87
			Percent		
1. Nonwage benefits/compensation	5.4	7.3	10.1	14.6	15.7
WAGES AND SALARIES			Annual wage and salary in $1987		
2. Expanding industries	$14,938	$13,648	$16,598	$19,144	$19,154
3. Contracting industries	14,204	18,609	16,765	19,058	26,194
4. Annual wage and salary gap	734	−4,961	−167	86	−7,040
			Percent of average annual wages and salaries		
5. Expanding industries	108	85	89	97	95
6. Contracting industries	103	116	89	96	130
7. Annual wage and salary gap	5	−31	−1	0	−35
			Average annual wage and salary growth/employee in $1987		
8. Average wage and salary growth	$382	$278	$280	−$45	$146
9. Due to growth within industries	375	317	281	−46	222
10. Due to shift effect	7	−38	−1	1	−77
			Annual percentage growth rate		
11. Average wage and salary growth	2.76	1.74	1.49	−.23	.73
12. Due to growth within industries	2.72	1.98	1.50	−.23	1.11
13. Due to shift effect	.05	−.24	−.01	.00	−.38
NONWAGE BENEFITS			Annual benefits in $1987		
14. Expanding industries	$817	$839	$1,603	$2,778	$2,829
15. Contracting industries	951	2,018	2,091	3,672	6,194
16. Annual benefits gap	−134	−1,179	−488	−894	−3,365
			Percent of average annual benefits		
17. Expanding industries	104	66	75	82	76

TABLE A5: WAGES AND SALARIES VERSUS NONWAGE BENEFITS IN BEA NIPA COMPENSATION—Continued

	1948–54	1954–62	1962–73	1973–81	1981–87
18. Contracting industries	121	159	98	109	165
19. Annual benefits gap	−17	−93	−23	−27	−90
	Average annual benefits growth/employee in $1987				
20. Average benefits growth	$68	$79	$108	$131	−$26
21. Due to growth within industries	69	88	112	138	11
22. Due to shift effect	−1	−9	−4	−7	−37
	Annual percentage growth rate				
23. Average benefits growth	8.62	6.21	5.09	3.90	−.69
24. Due to growth within industries	8.78	6.94	5.27	4.11	.29
25. Due to shift effect	−.15	−.72	−.18	−.21	−.98
DECOMPOSITION OF COMPENSATION BY WAGES AND NONWAGE BENEFITS					
	Annual compensation in $1987				
26. Annual compensation gap	$597	−$6,133	−$647	−$811	−$10,404
27. Annual wage and salary gap	734	−4,961	−167	86	−7,040
28. Annual benefits gap	−134	−1,179	−488	−894	−3,365
	Annual percentage growth rate				
29. Annual compensation growth	3.05	2.06	1.87	.35	.53
Due to:					
30. Wage growth within industries	2.57	1.83	1.35	−.20	.93
31. Benefits growth within industries	.47	.51	.53	.60	.05
32. Shift effect on wages	.05	−.22	−.01	.00	−.32
33. Shift effect on benefits	−.01	−.05	−.02	−.03	−.15

See Table A4. Small interaction effects may keep terms from adding up precisely.

TABLE A6: ANALYSIS OF BLS OPT DATA, 12 SECTORS

	1948–54	1954–62	1962–73	1973–81	1981–87
	Percentage points/year				
1. Rate of sectoral shift	0.55	0.44	0.52	0.68	1.05
	Annual compensation in $1987				
2. Expanding sectors	$16,432	$15,256	$17,479	$21,290	$21,197
3. Contracting sectors	16,689	21,019	25,191	28,606	32,398
4. Annual compensation gap	−256	−5,763	−7,713	−7,316	−11,201
	Percent of average annual compensation				
5. Expanding sectors	108	83	78	86	84
6. Contracting sectors	110	115	113	116	128
7. Annual compensation gap	−2	−31	−35	−30	−44
	Annual percentage growth rate				
8. Annual compensation growth	3.10	2.42	1.80	.39	.25
9. Due to growth within sectors	3.11	2.56	1.98	.59	.72
10. Due to shift effect	−.01	−.14	−.18	−.20	−.47
DECOMPOSITIONS BY HOURLY COMPENSATION AND WEEKLY HOURS					
	Hourly compensation in $1987				
11. Expanding sectors	$8.06	$7.71	$9.43	$11.83	$12.31
12. Contracting sectors	8.04	10.05	11.99	13.90	15.40
13. Hourly compensation gap	.02	−2.34	−2.56	−2.07	−3.08
	Weekly hours				
14. Expanding sectors	39.2	38.0	35.6	34.2	32.7
15. Contracting sectors	39.9	40.2	40.4	39.6	40.4
16. Weekly hours gap	−.7	−2.2	−4.8	−5.4	−7.7
	Annual compensation in $1987				
17. Annual compensation gap	−$256	−$5,763	−$7,713	−$7,316	−$11,201
18. Due to hourly compensation gap	41	−4,754	−5,104	−3,938	−5,728

TABLE A6: ANALYSIS OF BLS OPT DATA, 12 SECTORS—Continued

	1948–54	1954–62	1962–73	1973–81	1981–87
19. Due to weekly hours gap	−267	−1,027	−2,820	−3,657	−5,416
	Annual percentage growth rate				
20. Shift effect on compensation growth	−.01	−.14	−.18	−.20	−.47
21. Due to hourly compensation gap	.00	−.11	−.12	−.11	−.24
22. Due to weekly hours gap	−..01	−.02	−.07	−.10	−.23

See notes to Table A4. Small interaction effects may keep terms from adding up precisely.

TABLE A7: ANALYSIS OF BLS CES DATA, PRODUCTION WORKERS, 323 INDUSTRIES

	1972–81	1981–86
	Percentage points/year	
1. Rate of industrial shift	1.23	1.46
	Annual wages in $1987	
2. Expanding industries	$15,374	$14,951
3. Contracting industries	18,779	21,954
4. Annual wage gap	−3,405	−7,004
	Percent of average annual wage	
5. Expanding industries	88	90
6. Contracting industries	107	131
7. Annual wage gap	−19	−42
	Average annual wage growth/employee in $1987	
8. Average annual wage growth	−$100	−$70
9. Due to growth within industries	−58	32
10. Due to shift effect	−42	−102
	Annual percentage growth rate	
11. Average annual wage growth	−.57	−.42
12. Due to growth within industries	−.33	−.19
13. Due to shift effect	−.24	−.61
DECOMPOSITIONS BY HOURLY WAGES AND WEEKLY HOURS		
	Hourly wages in $1987	
14. Expanding industries	$8.34	$8.48
15. Contracting industries	9.41	10.62
16. Hourly wage gap	−1.07	−2.14
	Weekly hours	
17. Expanding industries	34.4	32.9
18. Contracting industries	37.6	39.1
19. Weekly hours gap	−3.2	−6.2
	Annual wages in $1987	
20. Annual wage gap	−$3,405	−$7,004
21. Due to hourly wage gap	−2,002	−3,894
22. Due to weekly hours gap	−1,566	−2,942
	Annual percentage growth rate	
23. Shift effect on annual wage growth	−.24	−.61
24. Due to hourly wage gap	−.14	−.34
25. Due to weekly hours gap	−.11	−.26

See notes to Table A4. Small interaction effects may keep terms from adding up precisely.

TABLE A8: ANALYSIS OF ES–202 DATA, 372 INDUSTRIES

	1972–81	1981–86
	Percentage points/year	
1. Rate of industrial shift	1.44	1.49
	Annual wage in $1987	
2. Expanding industries	$20,101	$18,328
3. Contracting industries	20,881	25,550
4. Annual wage gap	−779	−7,222
	Percent of average annual wage	
5. Expanding industries	100	90
6. Contracting industries	103	126
7. Annual wage gap	−4	−36
	Annual percentage growth rate	
8. Average annual wage growth	−.57	.75
9. Due to growth within industries	−.52	1.28
10. Due to shift effect	−.06	−.53

See notes to Table A4. Small interaction effects may keep terms from adding up precisely.

TABLE A9: SHIFT EFFECT BY CONTRACTING AND EXPANDING INDUSTRIES, BEA NIPA DATA

		1948–54	1954–62	1962–73	1973–81	1981–87
Shift effect on compensation growth		0.04	−0.28	−0.02	−0.03	−0.48
BY CONTRACTING INDUSTRIES:						
1. Primary metal industries	DUR	.00	−.03	−.02	−.03	−.08
2. Machinery, except electrical	DUR	.00	−.01	.....	.....	−.08
3. Railroad transportation	TRN	−.03	−.07	−.04	−.02	−.05
4. Oil and gas extraction	MNG	.....	−.01	−.01	.....	−.03
5. Chemicals and allied products	NDR	.....	.00	.00	−.01	−.03
6. Telephone and telegraph	CMN	.....	−.01	.....	−.02	−.03
7. Fabricated metal products	DUR	.....	−.01	.00	−.01	−.03
8. Coal mining	MNG	−.01	−.02	.00	.....	−.03
9. Motor vehicles and equipment	DUR	.....	−.02	.00	−.02	−.02
10. Petroleum and coal products	NDR	.00	−.02	−.01	.00	−.02
11. Electric and electronic equipment	DUR	.....	.....	.00	.00	−.02
12. Apparel and other textile products	NDR	.01	.00	.01	.02	.01
13. Private households	SVC	.....	.....	.14	.11	.02
BY EXPANDING INDUSTRIES:						
1. Retail trade	RTL	−.01	−.04	−.04	−.04	−.19
2. Business services	SVC	.00	−.01	.01	−.02	−.15
3. Health services	SVC	−0.3	−.04	−.03	−.02	−.05
4. Hotels and other lodging places	SVC	.....	.00	−.01	.00	−.03
5. Educational services	SVC	.00	−.03	.00	.....	−.03
6. Personal services	SVC	.....	.....	.....	.....	−.02
7. Credit agencies other than banks	FIR	.00	.00	.00	.00	−.02
8. Security and commodity brokers, etc	FIR	.00	.00	.01	.....	.04

The first line is taken from line 14 of Table A4. The remainder of the table is calculated as explained in the text. Industries are arranged in ascending order for the period 1981–87. Blank entries in the top half of the table indicate industries which expanded, and similarly for the bottom half. Columns will not sum to total shift effect, due to the omission from the table of the 37 industries with small contributions to the shift effect for 1981–87. Underlying data for all 58 industries are given in Tables A2 and A3.

The second column indicates the industry's 1–digit sector: Mining (MNG), Construction (CNS), Durables Manufacturing (DUR) Nondurables Manufacturing (NDR), Transportation (TRN), Communications (CMN), Retail Trade (RTL), Finance/Insurance/Real Estate (FIR), and Services (SVC).

TABLE A10: CONTRACTING AND EXPANDING INDUSTRIES, BLS CES DATA, PRODUCTION AND NONSUPERVISORY WORKERS

		1972–81	1981–86
Shift effect on wage growth		−0.24	−0.61
BY CONTRACTING INDUSTRIES:			
1. Blast furnaces and basic steel	331 DUR	−.03	−.07
2. Railroad transportation	40 TRN	−.03	−.07
3. Telephone communications	481 CMN	−.01	−.04
4. Other heavy construction	162 CNS	.....	−.04
5. Oil and gas services	138 MNG	.....	−.03
6. Construction & related machinery	353 DUR	.00	−.03
7. Bituminous coal and lignite	12 MNG	.00	−.02
8. Aircraft and parts	372 DUR	.....	−.02
9. Metalworking machinery	354 DUR	.....	−.01
10. Petroleum refining	291 NDR	.00	−.01
11. Iron and steel foundries	332 DUR	−.01	−.01
12. General industrial machinery	356 DUR	.00	−.01
13. Farm and garden machinery	352 DUR	.00	−.01
14. Ship and boat building and repair	373 DUR	.00	−.01
15. Primary nonferrous metals	333 DUR	.00	−.01
16. Fabricated structural metal products	344 DUR	.00	−.01
17. Engines and turbines	351 DUR	.00	−.01
18. Nonferrous rolling and drawing mills	335 DUR	.00	−.01
19. Tires and inner tubes	301 NDR	.00	−.01
20. Metal forgings and stampings	346 DUR	−.01	−.01
21. Women's and misses' outerwear	233 NDR	.00	.01
22. Religious organizations	866 SVC	.01	.01
BY EXPANDING INDUSTRIES:			
1. Eating and drinking places	58 RTL	−.11	−.15
2. Personnel supply services	736 SVC	−.03	−.07
3. Other business services	73X SVC	−.01	−.03
4. Hotels, motels and tourist courts	701 SVC	−.01	−.03
5. Grocery stores	541 RTL	−.01	−.03
6. Services to buildings	734 SVC	−.01	−.02
7. Nursing and personal care facilities	805 SVC	−.02	−.02
8. Outpatient and other health services	80X SVC	−.01	−.02
9. Offices of physicians	801 SVC	−.01	−.02
10. Miscellaneous personal services	72X SVC	.00	−.01
11. Miscellaneous shopping goods stores	594 RTL	−.01	−.01
12. Individual and family services	832 SVC	−.01	−.01
13. Radio, TV and music stores	573 RTL	.00	−.01
14. Offices of dentists	802 SVC	−.01	−.01
15. Retail stores, nec	599 RTL	.00	−.01
16. Residential care	836 SVC	−.01	−.01
17. Colleges and universities	822 SVC	.....	−.01
18. Savings and loan associations	612 FIR	.00	−.01
19. Elementary and secondary schools	821 SVC	.00	−.01
20. Offices of other health practitioners	804 SVC	.00	−.01
21. Security brokers and dealers	621 FIR	.00	.01
22. Electrical work	173 CNS	.01	.01

See notes to Table A9. The first line is taken from line 13 of Table A7.
The second column indicates the SIC code, with X's indicating combinations.

TABLE A11: OCCUPATIONAL AND INDUSTRY SHIFT EFFECTS

Occupational and industrial shift effects	=	Occupationally-pooled industrial shift effect	+	Weighted average of occupational shifts within industries
UNIFORM PREMIUM OF 100 PERCENT:				
1. 1972–81 −.02	=	−0.19	+	0.17
2. 1981–86 −.54	=	−.70	+	.16
NON-UNIFORM PREMIUM, BASED ON ES–202 DATA:				
3. 1972–81 .07	=	−.11	+	.18
4. 1981–86 −.33	=	−.47	+	.14

Occupational and industrial shift effects	=	Weighted average of industrial shifts within occupation: PNS wage share	x	PNS shift effect	+	SNP wage share	x	Industry-pooled occupational shift: SNP shift effect	+	SNP share growth	x	SNP wage premium
UNIFORM PREMIUM OF 100 PERCENT:												
5. 1972–81 −.02	=	(.666)		(−.24)	+	(334)		(−.11)	+	(.166)		(1.037)
			−.16		+		−.04		+		.17	
6. 1981–86 −.54	=	(.642)		(−.61)	+	(.358)		(−.64)	+	(.073)		(1.074)
			−.39		+		−.23		+		.08	
NON-UNIFORM PREMIUM, BASED ON ES–202 DATA:												
7. 1972–81 .07	=	(.696)		(−.24)	+	(.304)		(.35)	+	(.166)		(.804)
			−.17		+		.11		+		.13	
8. 1981–86 −.33	=	(.663)		(−.61)	+	(.337)		(.04)	+	(.073)		(.933)
			−.40		+		.01		+		.07	

PNS denotes Production and Non-Supervisory Workers, while SNP denotes Supervisory and Non-Production Workers.

TABLE A12: GROWTH RATES OF REAL WAGES, PRODUCTIVITY, RELATIVE INCOME SHARES, AND RELATIVE PRICES

	1948–54	1954–62	1962–73	1973–81	1981–87
BLS OPT DATA:					
1. Real compensation/hour	3.32	2.36	2.29	0.86	0.47
2. Productivity/hour	2.71	2.69	2.02	.73	1.29
3. Labor's share of income	−.04	−.27	.14	−.01	−.38
4. Output price/PCE	.65	−.06	.13	.14	−.44
BEA NIPA DATA:					
1. Real compensation/FTE	3.48	2.39	1.92	.33	.56
2. Productivity/FTE	2.84	2.81	1.29	.26	1.25
3. Employee's share of income	−.03	−.35	.50	−.04	−.53
4. Output price/PCE	.68	−.06	.12	.11	−.16

All entries are cyclically-controlled estimates of annual percentage growth rates, based on semi-log equations, using the same regressors as Table A4. The BLS OPT data presented here cover all workers, both payroll and self-employed, in the nonfarm business sector. The BEA NIPA data cover output of the nonfarm private economy, but do not cover self-employed labor.