Explaining the Rising Wage-Productivity Gap of the 1980s: Effects of Declining Employment and Unionization
William D. Ferguson
Review of Radical Political Economics 1996 28: 77
DOI: 10.1177/048661349602800204

The online version of this article can be found at:
http://rrp.sagepub.com/content/28/2/77

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
Union for Radical Political Economics

Additional services and information for Review of Radical Political Economics can be found at:

Email Alerts: http://rrp.sagepub.com/cgi/alerts
Subscriptions: http://rrp.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav
Citations: http://rrp.sagepub.com/content/28/2/77.refs.html
Explaining the Rising Wage-Productivity Gap of the 1980s: Effects of Declining Employment and Unionization

William D. Ferguson

ABSTRACT: This paper investigates causes of the dramatic increase in the wage-productivity gap — the divergence between the growth rates of aggregate productivity and real wages — in the post-1981 period. Using a two-step estimation procedure which incorporates three-digit industry wage regression coefficients into an aggregate wage growth identity equation, it finds that employment decline within unionized industries explains 18% of the post-1981 increase in the gap and that declining union ability to raise wages may explain as much as another 25%. Imports, on the other hand, do not appear to explain the gap independently of employment effects.

Since the late 1970s and more notably since 1981, the rate of growth of real wages for production and non-supervisory (PNS) workers has lagged behind the growth rate of aggregate productivity, creating a wage-productivity "gap." This occurrence contrasts with the previous trend of nearly parallel growth rates for the post-war period (see Figure 1), and indeed with the historical norm for the United States economy

Economics Department, Grinnell College, Grinnell, Iowa 50112. I would like to acknowledge the helpful comments of Samuel Bowles, Robert Costrell, Allen R. Ferguson, Mark Montgomery, John Mutti, Michael Podgursky, and the late Leonard A. Rapping on previous drafts of this paper. I would like to acknowledge the more recent comments of Patrick Mason and Gilbert Skillman, who served as referees.

© 1996 Union for Radical Political Economics.
Published by Blackwell Publishers, 238 Main St., Cambridge, MA 02142, USA, and 108 Cowley Rd., Oxford, OX4 1JF, UK.
Table 1
The Wage-Productivity Gap For Production and Non-Supervisory Workers, 1978-1986

Compounded Growth over Designated Periods

<table>
<thead>
<tr>
<th>Period</th>
<th>(\Delta\text{Wage})</th>
<th>(\Delta\text{AgProd})</th>
<th>Wage Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1981 (1978-82)</td>
<td>-3.36%</td>
<td>-1.60%</td>
<td>1.76%</td>
</tr>
<tr>
<td>Post-1981 (1982-86)</td>
<td>-0.20%</td>
<td>8.04%</td>
<td>8.24%</td>
</tr>
<tr>
<td>Increase (Post-Pre)</td>
<td>3.16%</td>
<td>9.64%</td>
<td>6.48%</td>
</tr>
</tbody>
</table>

\(\Delta\text{Wage}\): Change log real PNS hourly wage (PCE deflator).
\(\Delta\text{AgProd}\): Change log value added per hour, non-farm business.
Wage Gap: \(\Delta\text{AgProd}\) minus \(\Delta\text{Wage}\).


Figure 1
Productivity vs. Real Wages
Non-Supervisory Workers

Downloaded from mp.sagepub.com at GEORGE MASON UNIV on May 3, 2011
(Lebergott 1984; Douglas 1966; Kerr 1957). The chief significance of this development lies in its implication that the share of output for non-supervisory workers is declining; in the 1980s non-supervisory labor could no longer claim its share of productivity growth.\footnote{A wage-productivity gap similar to that shown in Figure 1 appears when either the CPI is substituted as the wage deflator or when real compensation is substituted for real wages.}

What changed? A reasonable hypothesis is that labor's bargaining power decreased in the relatively hostile post-1981 environment. More precisely, after 1981 declining employment and rising import penetration in highly unionized industries eroded union bargaining power, eliminating or reversing union ability to translate productivity gains into real wage gains; these effects were strong enough to contribute to the post-1981 increase in the wage-productivity gap.

This paper seeks to estimate the extent to which the post-1981 increase in the wage-productivity gap can be explained by the impact of declining employment and rising import penetration on wages in highly unionized industries. More specifically, I examine the response of industry wages to interactions between industry unionization and changes in industry employment and import penetration. I find that declining employment within unionized industries explains 18% of the post-1981 increase in the gap. Declining returns to

\footnote{The relationship between the wage-productivity gap and labor's share of output can be expressed in the following equation: gap = \Delta q' - \Delta W = -\Delta LS + \Delta Pc - \Delta Po, where W is the aggregate real wage or real compensation (the two move together in this period) deflated with the consumption deflator, q' is aggregate real output per hour deflated with the output deflator, LS is labor's share of nominal output, Po is the national output deflator, and Pc is the consumption deflator. A rising gap has two potential causes: declining labor's share and a rate of consumption inflation above output inflation.}

Between 1978 and 1981, the PCE deflator and the implicit price deflator for non-farm business (IPD) grew at virtually the same rate (33%). Between 1982 and 1986, however, the consumption deflator grew 1.7% more than the IPD, thus 1.7% of the post-1981 gap shown in Table 1 is due to this inflation differential, and the remainder signifies a decline in non-supervisory labor's share of output. Note the output share for non-supervisory workers is not the same as labor's share of output because the latter includes supervisory and managerial salaries. Gordon (1988) finds a rise in labor's share in the 1965-78 period, followed by a decline in the 1978-87 period.
unionization may explain another portion of the increase, perhaps as much as another 25%. Industry level import effects, on the other hand, do not appear to contribute to the rising gap, once employment has been controlled for.

Table 1 shows the wage-productivity gap for PNS workers over pre-1981 and post-1981 sub-periods. Note the increase in the gap after 1981. The choice of 1981 as a dividing year for this analysis is motivated by the convergence of several historical factors which exert macroeconomic — or economy wide — pressure on labor’s bargaining power. Among these are: i) the 1981-1982 recession, which ushered in the highest unemployment since the Great Depression; ii) rising international competition faced by firms across the U.S. economy; iii) increased willingness of employers to confront unions via such tactics as hiring strike-breakers; and iv) a pro-management political shift exemplified by the Reagan administration’s breaking of the air traffic controllers’ strike during its first year in office, and by its appointment of a National Labor Relations Board which has been relatively hostile to labor (Edwards and Podgursky 1986; Kochan, Katz, and McKersie 1986). The combined influence of these, and related, factors may have caused a shift in bargaining regimes, diminishing labor’s ability to secure real wage gains.

THE ECONOMIC LITERATURE

A relatively large literature, arising from both political economy and mainstream sources, motivates the present focus on the relationships between union bargaining power, employment, and import effects on wage growth. The political economy literature on labor markets argues that labor markets are political in the sense that inherent conflicts of interest which arise between workers and their employers are resolved, at least in part, through power relations which are endogenous to the employment relationship (Bowles and Gintis 1990; Rebitzer 1993). The emerging conflict between labor and capital can, in turn, be understood in terms of a strategic bargaining process which affects the distribution of

\[ \text{The subsequent regression and aggregation analysis uses lagged values for } \Delta AgProd, \text{ hence the precise size of the gap in the regression data differs from that shown in Table 1.} \]
the product in addition to the allocation of resources (Skillman 1991, 1988). In this regard, Howell and Wolff (1991) find that labor's bargaining power influences industry wage growth and industry wage dispersion between 1970 and 1985. Tsuru (1991) takes a somewhat different approach, linking unemployment-wage relationships to union bargaining power. While the power relations inherent in the employment process originate at the microeconomic (or firm) level, they have macroeconomic implications on relationships between output, unemployment, and inflation (Bowles and Boyer 1990).

In this paper I address the issue of bargaining in employment relations and its distributional consequences, but I restrict the domain over which bargaining operates to unionized settings. Like Tsuru, I link employment to union bargaining power, but I investigate this relationship at a detailed (three-digit) industry level, and I link it to the wage-productivity gap rather than to nominal wage growth. Moreover, I follow Bowles and Boyer by arguing that bargaining processes, which originate at (relatively) microeconomic levels, have macroeconomic consequences; I focus on shifts in union bargaining power arising at the industry level, as a potential explanation for the macroeconomic phenomenon of the wage-productivity gap.

A number of mainstream studies report on persistent inter-industry wage differentials across occupations which are not traceable to human capital differences (Dickens and Katz 1987; Krueger and Summers 1988). Botwinick (1993) approaches the same phenomenon using Marxian theory. He argues that the combined influences of technology, market competition, reserve army effects, and efforts of workers to organize generate persistent wage differentials among workers of similar skill.

The existence of inter-industry wage differentials has, in turn, sparked a series of empirical papers concerning the impact of industrial shift — the decline of employment shares in relatively high wage goods producing industries and the corresponding rise in employment shares in relatively low wage

*Note that Howell and Wolff concern themselves with labor's bargaining power, related to the sharing of rents implicit in the efficiency wage arguments, whereas I restrict my analysis to union bargaining power, which pushes union wage levels above those for nonunion workers. My econometric model (below) reflects this: if unionization per se does not affect employment/wage or import/wage relationships, then my union interactions terms should show no statistical significance.
service sector industries — on aggregate real wage growth and/or the distribution of wage income. These impacts, often called "between industry" effects, tend to retard real wage growth and increase wage inequality, though they explain only a portion (always less than half) of the relevant phenomena. (See for example, Costrell 1988b; Davidson and Reich 1988; Reiff 1987; Tilly, Bluestone, and Harrison 1987).

This paper follows the approach of Costrell, Reiff, and others by using wage change identity equations to trace "between industry" effects of industrial shift, but it extends further to focus on the relationship between wage growth within industries and the wage-productivity gap. In so doing, I hope to capture outcomes which remain hidden in "between" industry studies.


A related mainstream approach, found in Blackburn, Bloom, and Freeman (1990); Bound and Johnson (1992); Katz and Murphy (1992); Kosters (1991); and Murphy and Welch (1991 and 1994), among others, focuses on the rising disparity between the earnings of highly skilled and less skilled workers. It argues that some combination of technological change, rising international trade, and possibly a few other factors has expanded the relative demand for skilled labor during the 1980s, causing a dramatic increase in the returns to skill offered in U.S. labor markets.

Finally, an emerging and largely mainstream empirical literature on union wage concessions offers three basic findings

---

5For application of similar methodology to racial wage differentials in the United States see Juhn, Murphy, and Pierce (1991).
which link union concessions to the post-1981 period and to employment and import effects:

i) Concessions have been both abnormally prevalent and abnormally large in the 1980s (Borum and Conley 1986; Lacombe and Borum 1987; Mitchell 1985, 1986; Ruben 1987).

ii) Union wage concessions cannot be explained by macroeconomic variables alone (Bell 1989).

iii) Employment declines and/or rising import penetration in unionized industries have contributed significantly to wage concessions by reducing union bargaining power (Capelli 1985; Capelli and Sterling 1988; Edwards and Podgursky 1986; Kassalow 1988; Kochan, Katz, and McKersie 1986; Mishel 1986).

This paper addresses all of the previously mentioned issues, yet it offers a variety of approaches to these issues which are not addressed in the literature. First, it focuses on the wage-productivity gap, rather than on real wage growth per se. Because aggregate wage and productivity growth are normally highly correlated, real wage growth alone does not offer a reliable indicator of changes in labor’s bargaining position. Changes in the wage-productivity gap, on the other hand, can signify shifts in labor’s ability to claim its share of output growth. In other words, a widening wage-productivity gap offers a macroeconomic indicator of labor’s declining ability to maintain its share of output. Secondly, this paper examines import effects on the wage-productivity gap after controlling for employment effects, whereas most other studies examine the impacts of imports on employment, and then perhaps ensuing effects on wages (Revenga is an exception). This distinction is significant because a union bargaining approach suggests imports should influence union wages through avenues which extend beyond the influence of imports on employment (see the discussion below on union bargaining). Third, this analysis focuses on unionization as a separate variable, and it interacts industry union coverage with industry employment and imports. This facilitates estimation of potentially different

---

6Two studies which mention a disparity between growth rates of real wages and aggregate productivity during the 1980s are Costrell (1988b) and Rapping (1988).
employment and import effects on union as opposed to non-
union wages.

Fourth, this paper focuses on industries as the central unit of analysis and strives to measure influences of the above factors on wage growth within industries. As indicated above, several studies (e.g. Costrell 1988b; Tilly, Harrison, and Bluestone 1987) estimate the "between industry" effect of industrial shift (out of manufacturing and towards services) on aggregate wage growth and/or the distribution of wage earnings. While these studies find such effects to be important, they report that most of the observed changes in real wage growth and/or distribution must occur within specific industries (and therefore are not traceable with a between industry approach). By contrast, my paper specifically attempts to estimate the response of wage growth within industries to employment, unionization, and imports. The data set employed here suggests that this kind of approach is indeed called for because employment shift between industries, which does (as expected) appear to retard the growth of real wages, does not explain the post-1981 increase in the wage-productivity gap (see Table 4 in the Results section).

Fifth, and perhaps more importantly, this paper employs a unique two-step estimation procedure which links wage developments occurring within 320 goods and service sector industries to the economy-wide wage-productivity gap. The first step uses wage regressions to estimate the influences of union coverage, employment, and import penetration on wage growth within the 320 industries. The second step incorporates the resulting regression coefficients into aggregate wage identity equations in order to estimate the impact of the relevant variables on the aggregate wage-productivity gap; it estimates

---

7The choice of industry as a unit of analysis is motivated by the literature on industry wage differentials (Dickens and Katz 1987; Krueger and Summers 1988). Considering occupational wage differentials might further enrich this analysis, but the data set employed here does not cover occupations. Such a project awaits further research.

8A "between industry" approach uses wage identity equations to measure the impact of changing employment shares between industries (whose wage levels, of course, differ) on either aggregate wage growth or wage distribution. By contrast, a "within industry" effect holds employment shares constant to measure the impact of wage changes within industries (a weighted average) on aggregate real wage growth (or distribution).
the contribution of employment, union, and import induced effects on wages — within these 320 industries — to the aggregate wage-productivity gap.

UNION BARGAINING AND THE WAGE PRODUCTIVITY GAP

Before proceeding, it is necessary to define bargaining power and to briefly recount the relationship between bargaining power and the wage-productivity gap. I borrow Chamberlain and Kuhn's definition of bargaining power: "The ability to secure another's agreement on one's own terms (1986: 176)." Unions and employers bargain over a host of issues; for the purpose of this paper I will assume, for simplicity, that bargaining focuses on the rate of wage growth, and that unions prefer rates of wage growth greater than those preferred by their employers. The literature on the post-war labor accord suggests that "fair" real wage growth approximates the rate of productivity growth (Edwards and Podgursky 1986; Kochan, Katz, and Mckersie 1986). Failure of real wage growth to match productivity growth can, with appropriate indicators, be interpreted to signal a decline in union bargaining power.

Now, if one assumes that bargaining power depends upon costs of agreement and disagreement facing the respective parties (Chamberlain and Kuhn 1986), it can be argued that declining employment, declining unionization, and rising levels of import penetration will reduce union bargaining power in a given industry (Ferguson 1994). In particular, declining industry employment potentially threatens the median union

---

9Unions, of course, do not pursue unlimited wage growth. My argument that unions desire higher wage growth than their employers is consistent with the median voter analysis of union bargaining goals as outlined by White (1982), Kaufman and Martinez-Vazquez (1987), and applied by Capelli (1985) and others.

10Alternately, the rate of nominal wage growth is approximately equal to the rate of productivity growth plus the rate of inflation.

11Bargaining power, like utility and work intensity, is, unfortunately, not directly measurable. Here I investigate whether the post-1981 decline in the rate of real wage growth relative to aggregate productivity growth can be linked to levels of unionization and to the interaction between unionization and employment and import penetration. If so, I infer that bargaining power has declined.
voter with job loss (Capelli 1985), weakening unions' bargaining power. Declining unionization increases union labor's demand elasticity (a measure of a firm's ability to substitute away from union labor). Rising import penetration may contribute to declining employment, reduce union coverage in the relevant market area, and it may further erode union bargaining power by reducing domestic monopoly power and profits.\textsuperscript{12} Under these conditions, wage regression terms which interact industry unionization with industry employment growth (or decline) and with industry import penetration should offer indications of trends in union bargaining power at the industry level (see the econometric model below for details). A statistical relationship showing influences of these variables on the wage-productivity gap therefore can be interpreted to reflect changes in union bargaining power.

Discussion will now turn to each of the following topics: data, econometric model, results, and conclusion.

\section*{DATA}

This analysis utilizes a panel data set containing both industry and aggregate level data which span the years 1977 to 1986. With a few exceptions, noted below, annual first differences have been taken on all of the variables used in the wage equation regressions. For the dependent variable (real wages), differences cover annual changes between 1978 and 1986 (i.e.,

\textsuperscript{12} Ferguson (1994) develops a cost-based model of union bargaining power which specifically addresses these points. Declining employment in highly unionized industries increases unemployment among union workers, reducing employers' dependence upon them. It increases the credibility of employer threats of dismissal in the event of a dispute, and increases the cost-of-job loss for union workers. All of these increase unions' potential costs of disagreement with employers, lowering union bargaining power. Similarly, declining unionization reduces employers' dependence on union labor. Import penetration extends the relevant market area for union coverage beyond national borders. In addition, the tendency of import penetration to reduce domestic monopoly power and profits augments employers' difficulty in meeting given union wage demands, inducing employers to either fight harder or substitute away from union labor. Employer threats of dismissal may also gain credibility. All of these effects reduce union bargaining power.
1978-1979, 1979-1980, etc.). Differences for independent variables are lagged one year, covering annual changes between 1977 and 1985. All data are summarized in Table 2.

The aggregate data cover the following variables: Unemployment (Unemploy), Aggregate Productivity (AgProd), personal consumption expenditure deflator (Inflation), and the real trade-weighted value of the dollar (Value$). The industry data cover real wages (Wage), employment hours (EmployHr), output per hour (Output/Hr), import penetration (ImportPen), export share (ExportSh), percent unionized in 1977 (Union77), and change in percent unionized between 1974 and 1980 (ΔUnion7480). The industry terms represent yearly average values within their respective industries. With the exception of the unionization terms, which come from Kokkelenberg and Sockell, all industry data are taken from unpublished data of the Bureau of Labor Statistics (BLS).

The real wage and employment variables (Wage and EmployHr) apply to PNS workers for 320 non-agricultural and non-government industries aggregated at various combinations of two and three-digit SIC levels. The Output/Hr series is calculated by dividing real industry gross output (deflated with BLS industry deflators) by industry employment hours for wage and salary workers. Both terms cover 226 industries at various two and three-digit SIC groupings. In order to match these data with the wage and employment data, and in order to make the observations consistent across the sample, government and agricultural industries were dropped and the remaining industries were regrouped to 150 industries.

13 Aggregate data are from the 1988 Economic Report of the President. Unemploy shows the level of the civilian unemployment rate for 1977 through 1984, the years at the beginning of the annual first difference for the independent variables. ΔAgProd shows percentage growth in value added per labor hour for the non-farm business economy and ΔValue$ shows the same for the real trade-weighted dollar (index 1973 = 100).

14 Both series are from unpublished BLS Employment and Earnings data. Wage shows the average industry hourly PNS wage deflated with the PCE deflator. EmployHr shows total industry PNS employee hours per week (PNS employees * average weekly hours).

15 Both the numerator and the denominator are from BLS Employment Growth Projections Division data. Because the first difference is taken, gross output can serve as a proxy for value added. Moreover, Mishel (1988) points to estimation problems with value added data; gross output suffers from fewer measurement problems.
<table>
<thead>
<tr>
<th>Levels, Original Year</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage (PCE Deflator 1982 = 100)</td>
<td>$8.05</td>
<td>$2.18</td>
<td>$14.36</td>
<td>$4.22</td>
</tr>
<tr>
<td>EmployHr (*100,000)</td>
<td>60.66</td>
<td>98.33</td>
<td>1022.65</td>
<td>1.12</td>
</tr>
<tr>
<td>Output/Hr (1977 dollars)</td>
<td>$45.24</td>
<td>$55.21</td>
<td>$648.81</td>
<td>$9.55</td>
</tr>
<tr>
<td>ImportPen (% gross output)</td>
<td>5.31</td>
<td>10.60</td>
<td>75.36</td>
<td>0.00</td>
</tr>
<tr>
<td>ExportSh (% gross output)</td>
<td>4.01</td>
<td>5.19</td>
<td>26.10</td>
<td>0.00</td>
</tr>
<tr>
<td>Union77 (% unionized, 1977)</td>
<td>26.00</td>
<td>18.28</td>
<td>82.50</td>
<td>1.60</td>
</tr>
</tbody>
</table>

**Annual Changes**:

| % Change Wage | -0.15 | 2.80 | 13.94 | -18.07 |
| % Change EmployHr | 0.65  | 8.37 | 32.32 | -56.98 |
| % Change Output/Hr | 0.77  | 5.50 | 30.45 | -29.71 |
| Change ImportPen (%) | 0.43  | 2.53 | 34.68 | -17.75 |
| Change ExportSh (%) | 0.0015 | 0.99 | 12.31 | -12.77 |

**Entire Period Change 1974-1980**

| Change in % Unionized | -1.70 | 5.34 | 22.50 | -16.50 |

**Aggregate Data**

<table>
<thead>
<tr>
<th>Annual Changes 1977-1985</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Change AgProd (Value Added/Hour)</td>
<td>0.90</td>
<td>1.33</td>
<td>2.66</td>
<td>-1.20</td>
</tr>
<tr>
<td>% Change PCE Deflator</td>
<td>6.46</td>
<td>2.48</td>
<td>10.20</td>
<td>3.37</td>
</tr>
<tr>
<td>% Change Value$</td>
<td>4.36</td>
<td>7.68</td>
<td>17.28</td>
<td>-10.05</td>
</tr>
</tbody>
</table>

**Levels (1977-1984)**

| Value$ (Trade Wt. $, 1973 = 100) | 100.5 | 16.0 | 128.5 | 83.2 |
| Unemployment (Civilian Unemployment) | 7.6   | 1.3  | 9.7   | 5.8  |


a: 1978 for Wages, 1977 for all others.

The trade variables (ImportPen and ExportSh) are ratios which show the nominal values of industry imports and exports divided by nominal gross industry output. Note that the first differences for these terms show the change in the level of the ratio, not a growth rate of the ratio.\textsuperscript{16} The data on union coverage are more limited. Union77 shows the percent unionized for each industry in 1977, the initial year for the independent variables, and holds this constant. The change in unionization term, $\Delta$Union7480, shows only one change: the change in unionization for each industry for the entire period between 1974 and 1980.\textsuperscript{17} Thus the union variables, unlike all of the other variables, remain static over the time series.

Table 5 (see Appendix II) explores the industry data in slightly more detail, showing relationships between groups of industries ranked by Union77 and ImportPen (top 30\%, bottom 30\%, or 40\%), and mean levels of trade, employment, and wage variables.

\section*{ECONOMETRIC MODEL}

In order to estimate the contribution of industry level union, employment, and import effects to the aggregate wage-productivity gap, this analysis employs a two-step estimation process. First, an industry wage regression estimates the impacts of the explanatory variables on industry real wage growth. Next, aggregation equations incorporate these industry regression coefficients along with actual changes in the data to

\textsuperscript{16}The trade data, also from BLS Employment Growth Division, are aggregated to the same 150 industries as the output per hour data. The industry data are compiled at two different, but compatible, levels of aggregation. Wage and EmployHr show 320 industry observations whereas Output/Hr, ImportPen, and ExportSh show only 150. Each of the 150 industries is identical to one of the 320 industries or an aggregation of several of them.

\textsuperscript{17}Kokkelenberg and Sockell (1985) report on union coverage for 216 industries based on the 1970 Census Industry Codes for the years 1974 to 1980. I regrouped these data somewhat to match the BLS industry data on the other variables. These union data are at best a proxy for the desired data. Because the respective time periods do not match and unionization levels have clearly changed in the intervening period, these data are not used as a time series.
estimate the contribution of each explanatory variable to aggregate real wage growth (by summing across the industry effects) and ultimately to the wage-productivity gap. These procedures are discussed in order.

THE WAGE REGRESSION

The following pooled cross section/time series equation illustrates the basic technique:

\[
\Delta WAGE_i = \alpha + \beta_1 DIND \\
+ \beta_2 \Delta AgProd_{i,t-1} + \beta_3 \Delta Z_{i,t-1} + \beta_4 Unemploy_{i,t-2} \\
+ \beta_5 Union77_t + \beta_6 Union77_i + \beta_7 P81 + \beta_8 \Delta Union7480_i \\
+ \beta_7 \Delta X_{i,t-1} + \beta_7 \Delta X_{i,t-1} + Union77_i + \beta_7 P81 + \varepsilon_{it}
\]

(1)

**Where**: The change in the dependent variable (denoted by subscript t) occurs between year t-1 and t; all explanatory variable changes (denoted by subscript t-1) occur between years t-2 and t-1. Subscript i signifies industry i. Note that the subscript t-2 appears without Δ; it signifies level in year t-2.\(^{18}\)

The variables have the following definitions:

- **ΔWAGE**: Change log real hourly wage (PCE deflator), non-supervisory workers.
- **DIND**: One digit industry dummy variables.
- **P81**: Dummy variable for post-1981 period.
- **ΔX**: ΔEmployHr, ΔOutput/Hr, ΔImportPen, and ΔExportSh.
- **Union77**: Percent unionized in 1977.
- **Δunion7480**: Change in percent unionized between 1974 and 1980.
- **ΔAgProd**: Change log of value added per hour for non-farm business.
- **ΔZ**: Inflation and ΔValue$.
- **Unemploy**: Level of civilian unemployment.

\(^{18}\)Note Δ signifies proportional change or change in level as appropriate for each variable.
Equation 1 has four basic components. The first line shows the intercept term and one-digit industry dummy variables. The second line shows the aggregate variables, which vary only over time (not across industries). These terms reflect macroeconomic trends, forces which operate at the aggregate level and not at the industry level. Their inclusion in the model serves to control for macroeconomic trends which may influence wage setting.

The aggregate productivity term (\(\Delta AgProd\)) links equation 1 with the wage-productivity gap in two fashions. Its inclusion first controls for the influence of aggregate productivity growth on wage growth so that the remaining regression coefficients reflect contributions of their respective variables to the wage-productivity gap. Second, the coefficients on \(\Delta AgProd\) and \(\Delta AgProd^*P81\) are themselves indications of the size of the gap, after controlling for the other factors in equation 1. If these other influences on wage growth were to have a net effect of zero, a coefficient of unity for \(\Delta AgProd\) would suggest the absence of a wage-productivity gap across the industries in the sample for the pre-1981 period. Values of less than unity, therefore, suggest the presence of a gap; moreover, a reduction in the value of this coefficient after 1981, i.e., a negative coefficient on \(\Delta AgProd^*P81\), suggests an increase in the gap over the latter period. This last effect is expected.

The remaining aggregate terms (Unemploy, Inflation, and \(\Delta Value\)) control for the effects of unemployment, inflation, and changes in the exchange rate on the wage setting process in an open economy.

The third line of equation 1 shows the union coverage terms. These are a rough proxy for union bargaining strength relative to non-union workers; positive coefficients would suggest that unions achieve above average wage growth, after controlling for the other factors. Because these terms are held constant over the time series, they do not show any "t" subscripts.

The fourth line is more complicated. It covers the industry level variables except the union coverage terms (i.e., \(\Delta EmployHr\), \(\Delta Output/Hr\), \(\Delta ImportPen\), and \(\Delta ExportSh\)). Each of these, in turn, possess three types of terms: single terms, union interaction terms, and union-P81 interaction terms — shown respectively as the first, second, and third terms on line four. For employment, the third term on line four (\(\beta_7\Delta X_{it-1}^*Union77^*P81\)) interacts employment hour decline with Union77 and P81. Single terms estimate the effect of their respective independent variables on wage growth
independent of unionization. Union interaction terms show the impact of a one percent increase in unionization on the single coefficient. The total pre-1981 effect of each independent variable on wage growth can be readily calculated from these first two terms. Finally, the union*P81 interactions estimate changes in the union interaction coefficients for the post-1981 period; they measure the degree to which union interaction coefficients after 1981 differ from their pre-1981 level.

Technically equation 1 presents a fixed effects or "dummy variable" model. See Judge et al. (1985). Note that the dummy variables correct for changes in industry characteristics (such as skill levels or human capital variables) which are not included in the model, but which may influence wage growth. This offers a less than ideal control for human capital influences, but this is a wage difference equation, where skill variables play a much smaller role than they would in a wage level equation. Furthermore, the BLS data set employed here does not include any human capital variables. CPS data could, in principle, be used, but CPS does not collect data specifically on non-supervisory workers. Note further that potential simultaneity is addressed by taking first differences and lagging the explanatory variables.

Any industry level variable which — independent of unionization — increases (decreases) wage growth is expected to yield a positive (negative) single coefficient and a zero coefficient on its union interaction term. Any variable which increases the union wage growth above the base line represented by the single term will yield a positive coefficient on its union interaction coefficient and vice versa. With this in mind, the following hypotheses emerge concerning expected signs for the coefficients in equation 1.

---

19 The pre-1981 total effect is equal to: single coefficient + [union interaction * Union77].

20 The total effect for the post-1981 period is equal to: single coefficient + [union interaction * Union77] + [Union*P81 coefficient * Union77].

21 Equation 1 includes industry export shares and industry productivity. The former control for export effects on wage growth and the latter control for effects of industry (not aggregate) productivity on wages in the same industry (see Bell and Freeman 1986).
**Unionization**: The union wage premium is expected to drop after 1981, thus the coefficient on the Union77*P81 interaction should be negative.

**Employment**: Industry employment growth is expected to increase industry wage growth, but employment effects are expected to be less pronounced in unionized industries. Thus, the coefficient on the single term for growth in employment hours should be positive, while that for the union interaction should be negative. After 1981 union wages are expected to be more vulnerable to industry employment declines than they were prior to 1981, thus the coefficient on the union-P81 interaction for employment hours decline should be positive.²²

**Import Penetration**: Once employment effects have been controlled for, rising industry imports are not expected to affect non-union wages, but they are expected to reduce union wages. Thus the coefficients should be zero on the single term and negative for the import-union interaction term.²³

These hypotheses concern the influence of the explanatory variables in equation 1 on wage growth at the industry level. To address aggregate wage growth and the wage-productivity gap, the coefficients from the wage regression have been translated into estimates of aggregate wage effects. The technique is explained in Appendix I.

**EFFECTS ON THE WAGE-PRODUCTIVITY GAP**

The coefficients from equation 1 can be used to estimate effects of properly weighted changes in the independent variables on a weighted average of within-industry wage growth across all industries.  

²²The single term hypothesis is consistent with effort-regulation models. For an effort regulation model see Bowles (1985). A negative coefficient on the union interaction term is consistent with labor market segmentation literature (Dickens and Lang 1985) and with results obtained by Rebitzer (1987, 1988) and Green and Weisskopf (1990). A positive coefficient on the union*P81 interaction for employment hour decline suggests that employment decline reduced union wage growth after 1981 more than it did before 1981.

²³For non-union industries, changes in imports affect wages as any other change in demand. Since inclusion of employment hours controls for such effects, the single term on ΔImportPen is expected to be zero. In the union sector, on the other hand, rising import penetration is expected to reduce union bargaining power, retarding union wage growth.
of the industries in the sample. Because equation 1 controls for aggregate productivity growth, this technique generates an estimate of the contribution of each independent variable to the aggregate wage-productivity gap. What is of interest here, however, is not the trend in the gap per se, but the increase in the gap (over its pre-1981 level) during the post-1981 period. Equation 2 (an identity equation derived in Appendix I) shows the effect of the explanatory variables from equation 1 on the post-1981 increase in the gap:

\[ \Sigma T2\Delta \text{Gap}_t - \Sigma T1\Delta \text{Gap}_t = \
\Sigma T2[- \text{Between}' - \Sigma \delta_i B_x X''_{i-1} + (1 - B_p) \Delta \text{AgProd}_{t-1} - \Sigma \delta_i \epsilon_{it}] - \Sigma T1[- \text{Between}' - \Sigma \delta_i B_x X''_{i-1} + (1 - B_p) \Delta \text{AgProd}_{t-1} - \Sigma \delta_i \epsilon_{it}] \]

(2)

**Definitions:**

\( \Sigma T1, \Sigma T2: \) sum over the years of the pre and post-1981 sub-periods respectively
\( \text{Gap}_t: \) the wage-productivity gap for annual change period \( t \)
\( \text{Between}': \) the sum of the between industry and interaction effects (the first and second terms on the right hand side of equation A in Appendix I)
\( X'': \) the matrix of all explanatory variables (including intercept, dummies, aggregate terms, union, and P81 interactions) except \( \Delta \text{AgProd} \)
\( B_x: \) the vector of coefficients for \( X'' \)
\( B_p: \) the vector of coefficients on \( \Delta \text{AgProd} \) including P81 interaction coefficients
\( \delta_i: \) industry \( i \)'s employment weighted relative wage (see equation B in Appendix I)

Equation 2 estimates the contribution of specific variables or groups of variables to the post-1981 increase in the gap. Specifically, it estimates the contribution of the following developments to the increase in the wage-productivity gap:

**Aggregate Employment/Union Effect:** After 1981, industry employment decline is expected to exert a stronger negative effect on union wage growth than before 1981. How strong is this effect at the aggregate level?
**Aggregate Import Effect:** Rising industry import penetration is expected to reduce union wages. How strong is this effect at the aggregate level?

**Aggregate Union Effect:** The coefficient on the level of union coverage is expected to change from near zero to negative after 1981. How strong is this effect at the aggregate level?

Discussion turns now to the results, starting with the results from wage regression equation 1 and then proceeding to aggregate results from equation 2.

**RESULTS**

The wage regressions confirm that the post-1981 increase in the wage-productivity gap applies to the 320 industries studied here, and they indicate that employment decline significantly affects union wages in the post-1981 period. The aggregation technique suggests that employment effects on union wages are important enough to explain one-fifth of the post-1981 increase in the wage-productivity gap. Declining returns to unionization in the post-1981 period may explain an additional portion. The remaining industry level variables, including import penetration, fail to explain any appreciable portion of the post-1981 increase in the gap.

Table 3 summarizes the results from a number of specifications of the industry wage regressions (equation 1). Regressions 1-3 present results from the full sample of 320 industries, and regressions 4 and 5 concern a sub-sample restricted to manufacturing (137 industries).

The non-employment terms yield three notable results:

1) The coefficients on ΔAgProd and ΔAgProd*P81 suggest that before 1981, each one percent increase in aggregate productivity (after controlling for the other variables) increases industry wage growth roughly .6% to .7%, whereas after 1981 this effect falls to near zero. This result offers rather dramatic confirmation of the existence of a post-1981 rise in the wage-productivity gap for non-supervisory workers across the 320 industries sampled. Moreover, it offers evidence of a fundamental change in
| Regression Results: Change Log Real Wage (ΔWage) | Aggregate Variables | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | what kind of steps you might take to further refine the table. For example, you could look for any patterns or anomalies in the data.
<table>
<thead>
<tr>
<th>Union Interaction * P81 Terms</th>
<th>( \Delta \text{EmployHr Decline} \times \text{Union77} \times \text{P81} )</th>
<th>( \Delta \text{ImportPen} \times \text{Union77} \times \text{P81} )</th>
<th>( \text{Union 1977} \times \text{P81} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta ) EmployHr Decline</td>
<td>( 0.16 )</td>
<td>( 0.09 )</td>
<td>( -0.71 )</td>
</tr>
<tr>
<td>( \Delta ) ImportPen</td>
<td></td>
<td>( 0.57 )</td>
<td>( -1.16 )</td>
</tr>
<tr>
<td>( \text{Union 1977} \times \text{P81} )</td>
<td></td>
<td></td>
<td>( -0.04 )</td>
</tr>
<tr>
<td>Adjusted ( R^2 )</td>
<td>( 0.122 )</td>
<td>( 0.125 )</td>
<td>( 0.131 )</td>
</tr>
<tr>
<td>Residual Sum Squares</td>
<td>( 1.753 )</td>
<td>( 1.745 )</td>
<td>( 1.730 )</td>
</tr>
</tbody>
</table>

For each variable top line shows regression coefficient. t-statistics on second line: ** Statistically significant at .01, * at .05.

a: Log Coefficients read - a 1 percentage point increase in growth for x yields a B percentage point increase in wage growth.
b: P81 Coefficients read - for the post-1981 sub-period, the coefficient on x (e.g., AgProd) increases by B.
c: Level Coefficients read - a 1 percentage point increase in the level of x yields a B percentage point increase in wage growth.
d: Coefficient reads a one unit increase in import penetration yields a B percentage point increase in wage growth.
e: Coefficient reads for each 1% unionization, the coefficient on \( \Delta \text{EmployHr} \) (or \( \Delta \text{ImportPen} \)) increases by B.
f: For the years after 1981, a one percent decline in employment changes the coefficient on \( \Delta \text{EmployHr} \times \text{Union77} \) by B.

Variables not reported: One digit industry dummies, export share, industry output per hour.
wage setting, a brake with the 1948-1981 wage-productivity pattern, occurring after 1981.\textsuperscript{24}

2) The coefficient on the Union77*P81 interaction shows a sizeable negative coefficient in regression 3 with a large standard error. This offers a statistically insignificant indication that union ability to raise wages declines after 1981.

3) The import penetration terms lack statistical significance in (nearly) all specifications tried. Once employment (and other) effects have been controlled for, rising import penetration does not appear to affect within industry wage growth.

The employment terms behave exactly as predicted, with statistical significance in all cases, yielding three additional results:

4) The single terms show positive coefficients, suggesting that, independent of unionization, employment growth increases industry wage growth. In regression #3, each 1% annual growth in employment is associated with a .07% rise in real wages.

5) The negative coefficients on the union/employment interaction terms suggest that unionization reduces the responsiveness of wages to employment substantially. Regression #3 suggests that the average effect of each 1% employment growth falls to .018% (from .07% in result 4).\textsuperscript{25}

6) The union*P81 interaction for employment decline shows a positive coefficient, suggesting that after 1981 declining industry employment retards (or reverses) wage growth for unionized workers more than it does prior to 1981. In regression #3, each one percent \textit{decline} in industry

\textsuperscript{24}A similar result appears in an extremely simplified model where industry wage growth responds only to $\Delta$AgProd and $\Delta$AgProd*P81: for the pre-1981 period, each 1% increase in $\Delta$AgProd boosts wage growth .75%; after 1981 this effect falls to -.03%.

\textsuperscript{25}The coefficient on EmployHr*Union77 in regression 3 is -.002. The average level of unionization across the sample is 26% (26*-.002 = -.052; .07-.052=.018).
employment after 1981 reduces union wages .04% more than it would have prior to 1981.  

Result 6 is particularly interesting, and ultimately the most important. It suggests that unions are less able to protect wages from the effects of employment decline after 1981 than prior to 1981; this in itself suggests a decline in union bargaining power whose timing coincides with the acceleration of the wage-productivity gap.

Now to estimate the contribution of the above effects on the post-1981 increase in the wage-productivity gap, the coefficients from regression 3 were incorporated into equation 2. These results appear under the within industry column in Table 4. Three important additional results emerge:

7) After controlling for employment effects, rising import penetration at this detailed industry level does not appear to contribute to the increase in the wage-productivity gap; rising industry imports do not appear to reduce labor's bargaining power once employment effects are controlled for.

8) The (statistically insignificant) negative coefficient on Union77*P81, taken at face value, potentially explains 25% of the increase in the gap. This result is consistent with the relatively slow "union sector" wage growth reported in Table 5 (in Appendix II) and noted by Mitchell (1985) and Anderson, Doyle, and Schwenk (1990).

---

26 This reduction occurs from the level which would have been predicted under result 5 (-.02 for employment decline). Thus after 1981, each 1% annual decline in an industry's employment on average reduces its real wages .06%. This is a powerful effect, and it is relatively consistent across specifications.

27 Results from a third sub-sample, the top 1/3 unionized industries, appear in Table 6 (in Appendix II). This case employs a variation on equation 1 which excludes all union interaction terms, since the sample controls for union effects, but retains P81 interactions. Results do not differ appreciably from those reported in Table 3: employment terms reveal the predicted signs and import terms lack statistical significance.

28 Even in the manufacturing sample, where the coefficient on import penetration shows statistical significance, the coefficient is not large enough to contribute any appreciable explanation to the increase in the gap after 1981.
**Table 4**  
**Contributions to the Wage-Productivity Gap Estimates Based on Coefficients from Regression #3**

<table>
<thead>
<tr>
<th></th>
<th>Pre-1981</th>
<th>Post-1981</th>
<th>Increase (Post-Pre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAP</td>
<td>3.16%</td>
<td>6.04%</td>
<td>2.88%</td>
</tr>
<tr>
<td>ΔAgProd</td>
<td>-0.20%</td>
<td>5.84%</td>
<td>6.04%</td>
</tr>
<tr>
<td>ΔWage</td>
<td>-3.36%</td>
<td>-0.20%</td>
<td>3.16%</td>
</tr>
<tr>
<td>Between Industry^a</td>
<td>-1.38%</td>
<td>-0.57%</td>
<td>0.81%</td>
</tr>
<tr>
<td>Within Industry^b</td>
<td>-2.08%</td>
<td>0.25%</td>
<td>2.33%</td>
</tr>
<tr>
<td>Discrepancy</td>
<td>0.10%</td>
<td>0.12%</td>
<td>0.02%</td>
</tr>
</tbody>
</table>

**B. Contribution of AgProd and Within Terms to the Gap^c:**

<table>
<thead>
<tr>
<th>Contribution of ΔAgprod^d</th>
<th>Pre-81</th>
<th>Post-81</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.08%</td>
<td>5.97%</td>
<td>6.05%</td>
</tr>
</tbody>
</table>

**Components of Within,**

**Industry Variables:**

| Employment Hours**       | -0.40% | -0.39% | 0.01%    |
| EmployHr Decline**       |        | 0.52%  | 0.52%    |
| Union Coverage Effect    | -0.57% | 0.19%  | 0.76%    |
| All Other Industry Terms - Net Effect |       |         | -0.03%   |

(1) Total Industry Variables

**Other Aggregate Variables:**

| Unemployment**           | 14.18% | 18.70%  | 4.51%    |
| Inflation**              | 11.88% | 5.68%   | -6.20%   |
| % Change Exchange rate** | -0.82% | -2.77%  | -1.95%   |

(2) Total Other Aggregate

(3) Weighted Error Terms

| Total Within Industry Contribution^f | -2.08% | 0.25%  | 2.33%    |

---

a: Between', from equation E in Appendix I and Equation 2 in text.
b: Within, from equation D in Appendix I summed over the periods.
c: Variables which reduce real wage growth contribute positively to the gap and vice versa.
d: Equal to (1-BO)ΔAgProd from equation E in Appendix I and Equation 2 in text.
e: Elements of Within, from Equation D as detailed in Equation 2.
f: Equal to sum of lines (1)-(3); also equal to Within Industry above.
9) Declining industry employment interacted with unionization in the post-1981 sub-period explains 18% of the post-1981 increase in the wage productivity gap.

This final result suggests that after 1981 declining employment in unionized industries impacts wage growth enough to significantly affect aggregate wage growth and the wage-productivity gap.

CONCLUSION

This analysis suggests that a deterioration in union bargaining power, induced by declining employment in highly unionized industries, partially explains the sharp rise in the wage-productivity gap, signifying non-supervisory labor's inability to maintain its claim on productivity growth in the U.S. economy after 1981. The wage regressions by themselves indicate that union wages are significantly more vulnerable to declining employment after 1981 than prior to 1981 (result 6): unions appear to lose their ability to insulate wages from the effects of shrinking industry employment. The aggregation technique reveals further that declining employment within unionized industries retards wage growth enough to explain 18% of the post-1981 increase in the wage-productivity gap. A drop in the coefficient on union coverage (by itself) may explain an additional portion of the gap, perhaps as much as another 25%. Declining union bargaining power in the post-1981 period, therefore, contributes to the dramatic rise in the wage-productivity gap, though apparently it is not the only contributor.²⁹

²⁹An alternative explanation for the rise in the wage-productivity gap for non-supervisory workers might arise from the returns to skill approach of Kosters and others discussed previously. Accordingly, one might argue that non-supervisory workers are less skilled than supervisory workers, hence the wage-productivity gap for the former is a manifestation of the phenomenon of increasing returns to skills, evident during the 1980s. While this paper does not refute such an hypothesis (since falling union bargaining power as revealed here explains only 18% to 43% of the rise in the gap, both explanations may hold), this analysis does suggest that returns to skill is also not the sole explanation. It is highly unlikely that increasing returns to skill would be correlated with unionization. Thus the statistically significant result on employment
The remainder of the post-1981 rise in the gap, from the perspective of this model, is a phenomenon which operates within more broadly defined industries or sectors (e.g., durable manufacturing), or perhaps at an economy-wide level. This is not surprising; an event of this magnitude should not restrict itself to operating within detailed industrial categories. Result #1, the post-1981 drop in the regression coefficient on ΔAGProd, clearly indicates that the post-1981 jump in the wage-productivity gap applies across the 320 industries examined here. This finding may signify a shift in wage setting or wage bargaining regimes whereby labor lost its ability to match productivity growth with real wage growth after 1981. Its timing suggests a link with the combined impact of the historical events discussed in the introduction. This remains a topic for future research.

Returning to the industry results and focusing on unionization per se, the large but statistically insignificant drop on the coefficient for union coverage (not interacted with employment or imports) is consistent with the aggregate findings of the wage-concession literature as well as the post-1981 relative wage decline for the top 30% of unionized industries reported in Appendix II, Table 5. This (statistically insignificant) coefficient suggests that union bargaining power may have declined independent of industry employment and/or import effects. Taken at face value, the union coverage coefficient "explains" one quarter of the post-1981 increase in the gap, but statistical insignificance robs this result of any conclusive power. The relationship between changing returns to unionization and the wage-productivity gap clearly merits further investigation.

Rising import penetration in this study does not appear to contribute to the post-1981 rise in the wage-productivity gap; the coefficients on import and union/import interaction terms are not statistically significant.\(^30\) Apparently, once employment decline and unionization suggests that something unique to unions (i.e., bargaining power) is an important contributor to the rise in the wage-productivity gap.

\(^{30}\)This result fails to confirm the import penetration hypothesis listed above, but it is not inconsistent with some of the import studies cited above. For example, the import results reported by Katz and Summers (1988) and Levy (1988) are between industry effects estimating the impact of import induced shift of employment from (relatively) high wage to low wage industries; they do not measure the impact of import...
effects have been controlled for at the detailed industry level, import penetration fails to influence either union or non-union wage setting enough to exert a discernible impact on the wage-productivity gap. More specifically, any tendency for rising import penetration to increase the demand elasticity for union labor or to reduce domestic monopoly power or profits does not appear to be important enough, in this detailed industry analysis, to noticeably affect the gap.

The failure to find an import effect here should not, however, be interpreted as a blanket indictment of the proposition that imports influence wage setting, union bargaining, or the wage-productivity gap. Two possible avenues for such influence remain. First, imports may exert a "spill-over" effect whereby import induced wage concessions in a few influential industries (probably unionized) shift the wage setting climate, encouraging firms in other industries to slow or reverse wage growth (Mitchell 1985). A study which uses less detailed industry categories might pick up such effects, if "spill-overs" occur within more broadly defined industry groupings. Second, rising industry imports are likely to reduce industry employment growth and thereby influence within industry wages via employment. Such effects should be reflected in the employment terms used in this study, but the method employed here does not facilitate distinguishing import induced employment effects from other employment effects. The precise relationship between import penetration and the wage-productivity gap remains on the agenda for further study.

The interaction between employment decline and unionization yields the strongest and the most important findings of this paper. The wage regression taken by itself indicates a shift in the relationship between employment decline and union wages: after 1981 declining industry employment exerted a significantly stronger negative impact on the rate of union wage growth than before. Thus, after 1981, unions lost much of their ability to insulate wages from adverse labor market developments, suggesting a significant erosion of one of the key protections offered to workers through unionization. This finding confirms and, more importantly, strengthens similar findings in the wage concession literature (see especially Capelli 1985 and Capelli and Sterling 1988) since it relies upon a much broader and more detailed data penetration on wage growth within specific industries as is done here.
set. Incorporating these results into the aggregation technique indicates further that the employment effects on industry union wages are important enough at the macroeconomic level to explain nearly one-fifth of the post-1981 increase in the wage-productivity gap. This is a strong result given the low proportion of unionized workers in the U.S. economy.

In the final analysis, this study suggests a serious distributional malaise operating in labor markets across the U.S. economy: after 1981, non-supervisory labor cannot maintain its share of gains from productivity growth. A concurrent drop in union bargaining power appears to partially explain the emergence of this malaise. Furthermore, the precise timing of this shift suggests a link with the historical events mentioned in the introduction: the 1981-82 recession, rising international competition, increased employer resistance to unions, and a pro-management political shift at the federal level. The combined influence of these events may have shifted the bargaining regime operating in the economy to the detriment not only of unionized workers, but to non-supervisory workers across the economy.

**APPENDIX I**

**The Aggregation Technique**

The first step here is to decompose aggregate real wage growth into terms which can utilize regression coefficients from equation 1. Consider the following shift-share identity:

\[
\frac{\Delta W}{W_o} = \frac{\Sigma \delta_\gamma \omega}{W_o} + \frac{\Sigma (\delta_\gamma \Delta \omega)}{W_o} + \frac{\Sigma (\delta_\gamma \Delta \omega)}{W_o}
\]

(A)

Where: \( W \) signifies aggregate real wage: the sum of industry real wages weighted by each industry's share of employment hours; \( \omega_i \) represents the industry real wage; and \( \gamma_i = h_i/H \), each industry's share of total employment hours. The subscript 'o' indicates original year of the change period, and \( \Delta \) signifies discrete change, not percentage change.

The first term on the right hand side measures the "between industry effect": the effect of employment shift between industries (which in general have different wage levels) on aggregate real wage growth. The second term measures the "within industry effect," the cumulative effect of wage growth.
within industries on aggregate wage growth. The final term shows the interaction of these two effects.

The within industry effect can now be expressed as a weighted sum of within industry wage growth:

$$\Sigma(\gamma_{w} \Delta w) / W_o = \Sigma \delta_i \Delta w / w_o$$  \hspace{1cm} (B)

Where: $\delta_i = (\gamma_{w} w_{0i}) / W_o$, industry $i$'s employment weighted relative wage for year $o$.

The term $(\Delta w_i / w_{0i})$ is equivalent to the dependent variable from equation 1. Thus properly weighted results from equation 1 may be used to estimate the contribution of the regression variables to an aggregate within industry effect:\(^{31}\)

$$\Sigma \delta_i (\Delta w_i / w_{0i}) = \alpha + B1DIND + \Sigma \delta_i (B_i' \Delta X'_{i,t-1}) + Bp' \Delta X'_{i,t-1} + Bpp' \Delta X'_{pp,t-1} + \Sigma \delta_i e_i$$  \hspace{1cm} (C)

Where the following definitions hold:\(^{32}\)

$\Delta X'_{i,t}$: Matrix of appropriate changes for all industry specific variables including unionization terms from equation 1

$B_i$: Vector of industry beta coefficients including union interactions, but without union-P81 interactions for industry variables

---

\(^{31}\)This technique implicitly assumes that wage changes in one industry do not alter wages in other industries via spill-over and/or feedback effects. This may appear a bold assumption, but in a sense it is conservative; a neoclassical model predicts that a supply induced wage increase in one industry will tend to reduce wages in other industries, whereas a demand induced wage increase may raise wages in other industries if demand for those industries also rises. A bargaining model with union threat effects suggests that increasing wages in unionized industries pull up wages in other sectors. On threat effects see Podgursky (1986).

\(^{32}\)The weights on the intercept terms and aggregate variables in equation C sum to one.
Equation C states that aggregate "within industry" annual wage growth can be decomposed into: an intercept effect; a weighted average of the industry effects; aggregate variable effects; and a weighted average of the industry error terms. Inclusion of the weighted error term guarantees that this equation holds by identity. Naturally each of the terms within the $X'$ and $Z'$ matrices can be analyzed separately to track the impact of each specific variable on aggregate within industry wage growth.\(^{33}\)

The elements of equations A through C can now be related directly to the wage-productivity gap:

$$\text{Gap}_t = \Delta \text{AgProd}_{t-1} - \Delta \text{Wage}_t = \Delta \text{AgProd}_{t-1} - \text{Between}_t - \text{Inter}_t - \text{Within}_t$$

Where: Gap\(_t\) is the wage-productivity gap for annual change period \(t\); Between is the "between industry effect," the first term on the right hand side of equation A; Inter is the interaction effect, the third term on the right hand side of equation A; and Within is the "within industry effect," the second term on the right hand side of equation A.

The second line of equation D replaces $\Delta \text{Wage}$ with the right hand side of equation C. Now replacing Within, with the right hand side of equation C, combining terms and rearranging:

$$\text{Gap}_t = -\text{Between}_t - \Sigma \delta_i B X'' X''_i + (1 - B_p) \Delta \text{AgProd}_{t-1} - \Sigma \delta_i e_{it}$$

\(^{33}\)The idea behind the decomposition technique of equation C and its identification with a within industry effect of equation A is borrowed from Reiff (1987). Reiff translates results from wage level regressions into estimates of discrete changes in aggregate within industry wages. The technique here is adjusted to utilize wage growth regressions to estimate aggregate within industry wage growth. Equations similar to equations A and B appear in Costrell (1988a and 1988b).
Where: Between' is the sum of the between industry and interaction effects; \( X^{n} \) is the matrix of all explanatory variables (including intercept, dummies, union, and P81 interactions and aggregate variables) except \( \Delta \text{AgProd} \); \( B_{\gamma} \) is the vector of coefficients for \( X^{n} \); \( B_{\rho} \) is the vector of coefficients on \( \Delta \text{AgProd} \) including P81 interaction coefficients. Other terms remain as previously defined.

Equation E decomposes the gap for each annual change into four basic components: the between industry effect (including the interaction effect), the portion of the within industry effect which is due to all explanatory variables except \( \Delta \text{AgProd} \), productivity effects (see below), and a weighted error term.

The only new term here is the third term which estimates the size of the within industry wage-productivity gap independent of the other explanatory variables. This might be termed the "contribution" of \( \Delta \text{AgProd} \) itself to the gap. If the combined coefficient on \( \Delta \text{AgProd} \) (\( B_{\rho} \)) were to be exactly one for all periods, the third term would vanish — this would indicate the absence of an estimated "contribution" of \( \Delta \text{AgProd} \) to the gap. On the other hand, if the combined coefficient \( B_{\rho} \) is less than one, \( \Delta \text{AgProd} \) shows a positive "contribution" to the gap.

Now the above equations show annual growth rather than cumulative changes over the two sub-periods. To express the post-1981 increase in the gap, annual results from equation E are summed over each sub-period and the difference (post-pre) is taken:

\[
\Sigma T2 \Delta \text{Gap}_{i} - \Sigma T1 \Delta \text{Gap}_{i} =
\]

\[
\Sigma T2[ - \text{Between}_{i} - \sum \delta_{i} B_{X} X^{n}_{i} + (1 - B_{\rho}) \Delta \text{AgProd}_{i-1} - \sum \delta_{i} e_{i} ] - \Sigma T1[ - \text{Between}_{i} - \sum \delta_{i} B_{X} X^{n}_{i-1} + (1 - B_{\rho}) \Delta \text{AgProd}_{i-1} - \sum \delta_{i} e_{i} ]
\]  

(2)

Where: \( \Sigma T1 \) and \( \Sigma T2 \) sum over the years of the pre- and post-1981 sub-periods respectively. Other terms remain as previously defined.

The right hand side of equation 2 expresses this difference in terms of the groups of explanatory variables discussed under equations C and E; it estimates the contribution of each group of explanatory variables to the change in within industry wage growth between the two sub-periods. Since, as already noted, equation 1 controls for the effects of \( \Delta \text{AgProd} \) on wage growth,
these terms estimate the contributions of the respective explanatory variables to the increase in the wage productivity gap after 1981; negative terms represent factors which widen the gap ceteris paribus.\textsuperscript{34}

Equation 2 appears on page 94 of the text.

\textsuperscript{34}Negative terms here represent factors which contribute to a slowdown in aggregate within industry wage growth after 1981. Because aggregate productivity is controlled for, such terms contribute to an increase in the gap.
Table 5
Industry Data Means by Industry Groups

A. Top & Bottom 30% Unionized Industries (Ranked by Union77-Unweighted)

<table>
<thead>
<tr>
<th>Period</th>
<th>Union77</th>
<th>ΔemployHr</th>
<th>ImportPen (Level)</th>
<th>ExportSh (Level)</th>
<th>ΔimportPen</th>
<th>ΔWage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1981</td>
<td>48%</td>
<td>-0.1%</td>
<td>7.1%</td>
<td>6.6%</td>
<td>.26%</td>
<td>-.23%</td>
</tr>
<tr>
<td>Post-1981</td>
<td>48%</td>
<td>-2.3%</td>
<td>8.4%</td>
<td>6.8%</td>
<td>.54%</td>
<td>-.21%</td>
</tr>
<tr>
<td>Tot Period</td>
<td>48%</td>
<td>-1.1%</td>
<td>7.8%</td>
<td>6.7%</td>
<td>.40%</td>
<td>-.22%</td>
</tr>
</tbody>
</table>

Non-Union Sector (Bottom 30% of Industries)

<table>
<thead>
<tr>
<th>Period</th>
<th>Union77</th>
<th>ΔemployHr</th>
<th>ImportPen (Level)</th>
<th>ExportSh (Level)</th>
<th>ΔImportPen</th>
<th>ΔWage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1981</td>
<td>6%</td>
<td>3.1%</td>
<td>2.0%</td>
<td>1.9%</td>
<td>-.15%</td>
<td>-.66%</td>
</tr>
<tr>
<td>Post-1981</td>
<td>6%</td>
<td>2.5%</td>
<td>1.5%</td>
<td>1.9%</td>
<td>-.01%</td>
<td>.55%</td>
</tr>
<tr>
<td>Tot Period</td>
<td>6%</td>
<td>2.8%</td>
<td>1.7%</td>
<td>1.9%</td>
<td>-.08%</td>
<td>-.05%</td>
</tr>
</tbody>
</table>

B. Top and Bottom Rising Import Industries (Ranked by ΔImportPen)

<table>
<thead>
<tr>
<th>Period</th>
<th>ΔImportPen</th>
<th>ΔemployHr</th>
<th>ImportPen (Level)</th>
<th>ExportSh (Level)</th>
<th>Union77</th>
<th>ΔWage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1981</td>
<td>1.7%</td>
<td>-0.8%</td>
<td>6%</td>
<td>8.5%</td>
<td>36%</td>
<td>-.05%</td>
</tr>
<tr>
<td>Post-1981</td>
<td>2.1%</td>
<td>-3.8%</td>
<td>20%</td>
<td>9.0%</td>
<td>36%</td>
<td>.14%</td>
</tr>
<tr>
<td>Tot Period</td>
<td>1.9%</td>
<td>-2.3%</td>
<td>13%</td>
<td>8.7%</td>
<td>36%</td>
<td>.05%</td>
</tr>
</tbody>
</table>
### Non-Import Sector (Bottom 40% of Industries)

<table>
<thead>
<tr>
<th>Period</th>
<th>ΔImportPen</th>
<th>ΔemployHr</th>
<th>ImportPen (Level)</th>
<th>ExportSh (Level)</th>
<th>Union77</th>
<th>Δwage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1981</td>
<td>0.0%</td>
<td>2.8%</td>
<td>0.0%</td>
<td>.6%</td>
<td>16%</td>
<td>-.99%</td>
</tr>
<tr>
<td>Post-1981</td>
<td>0.1%</td>
<td>2.9%</td>
<td>0.0%</td>
<td>.7%</td>
<td>17%</td>
<td>.16%</td>
</tr>
<tr>
<td>Tot Period</td>
<td>0.0%</td>
<td>2.9%</td>
<td>0.0%</td>
<td>.6%</td>
<td>16%</td>
<td>-.42%</td>
</tr>
</tbody>
</table>

A number of findings from Table 5 are noteworthy:

a. The union sector shows higher levels of both import penetration and export shares than the non-union sector.

b. Import penetration consistently rises for the union sector, accelerating after 1981. The non-union sector shows declining import penetration over both periods.

c. The union sector reveals negative real wage growth over both periods. Non-union sector wages exhibit a sharper decline before 1981, but show positive growth after 1981. This development suggests that prior to 1981 the union wage premium increased slightly, but that after 1981 it decreased.

d. Rising import industries experience employment decline during both periods with accelerated decline after 1981; non-import industries show consistently growing employment.

e. The rising import sector experiences less real wage decline during the pre-1981 period and slightly lower real wage growth after 1981 than the non-import sector.

Note: Section A compares a "union sector" and a "non-union sector" defined respectively as the top and bottom 30% of the industries in the sample ranked by union coverage (Union77). Section B shows a "rising import sector" (top 30% ranked by ΔImportPen) and a "non-import sector" (bottom 40% ranked by ΔImportPen). These respectively show average annual change over the entire period in import penetration ratio of 1.9 percentage points and zero.
### Table 6
Regression Results Top 1/3 Union Sample

<table>
<thead>
<tr>
<th>Dependent Variable: Change Log Real Wage (ΔWage)</th>
<th>Regression #</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aggregate Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔAgProd&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.89</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>(Change Log Aggregate Productivity)</td>
<td><em>6.65</em>*</td>
<td>6.26**</td>
<td></td>
</tr>
<tr>
<td>ΔAgProd * P81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.62</td>
<td>-.86</td>
<td>-.04**</td>
</tr>
<tr>
<td></td>
<td><em>-4.06</em>*</td>
<td><em>-5.04</em>*</td>
<td></td>
</tr>
<tr>
<td>Unemploy&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.570</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>(Civilian Unemployment)</td>
<td><em>-3.07</em>*</td>
<td>2.45**</td>
<td></td>
</tr>
<tr>
<td>Inflation&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-.04</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>(Change Log PCE deflator)</td>
<td>-.68</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>ΔValue&lt;sup&gt;e&lt;/sup&gt;</td>
<td>.10</td>
<td>.08</td>
<td></td>
</tr>
<tr>
<td>(Change Log Value Dollar)</td>
<td>7.39</td>
<td>5.23</td>
<td></td>
</tr>
<tr>
<td><strong>Industry Variables</strong> (ALL COEFFICIENTS BELOW MULTIPLIED BY 100)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Single Terms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔEmployHr&lt;sup&gt;f&lt;/sup&gt;</td>
<td>.34</td>
<td>-2.04</td>
<td></td>
</tr>
<tr>
<td>(Change Log Employment Hours)</td>
<td>.37</td>
<td>-1.43</td>
<td></td>
</tr>
<tr>
<td>ΔImportPen&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-2.15</td>
<td>-5.20</td>
<td></td>
</tr>
<tr>
<td>(Change Import Penetration)</td>
<td>-.56</td>
<td>-.76</td>
<td></td>
</tr>
<tr>
<td>Union77&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1.51</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td>(Level Unionization 1977)</td>
<td>2.08*</td>
<td>.71</td>
<td></td>
</tr>
<tr>
<td><strong>Interaction * P81 Terms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔEmployHr Decline * P81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.51</td>
<td>2.84**</td>
<td></td>
</tr>
<tr>
<td>ΔImportPen * P81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.40</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>Union 1977 * P81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.02</td>
<td>1.89</td>
<td></td>
</tr>
<tr>
<td>Adjusted R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>.120</td>
<td>.130</td>
<td></td>
</tr>
<tr>
<td>Residual Sum Squares</td>
<td>.495</td>
<td>.486</td>
<td></td>
</tr>
</tbody>
</table>

* t-statistics on second line: ** significant at .01, * at .05.
* a,b,c,d: as on Table 3.
* **Variables not reported:** One digit industry dummies, export share, industry output per hour.
REFERENCES


