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## Abstract

How rigid are wages? To answer this question, I empirically investigate the nature of wage rigidity ***at the individual level*** and compare the results with implications of a variety of approaches to wage rigidity.

The evidence on the frequency of reported wage cuts in panel data reveals remarkable downward flexibility of real wages annually; even nominal wage cuts are not rare. With union and minimum–wage workers excluded, the distribution of wage growth is not skewed away from wage cuts. The ***only*** evidence supporting nominal wage rigidity is a small spike at zero in the nominal wage growth distribution; in particular, the evidence is inconsistent with menu costs.

# Rigid Wages?*

From the Keynesian tradition to modern treatments of implicit contracts and efficiency wages, it is commonplace in economics to model the labor market with a rigid wage. As an alternative, a variety of neoclassical models of job attributes, human capital accumulation, matching, and search employ flexible wages to clear the labor market. The two approaches have squared off in many arenas, but perhaps center stage is the issue of involuntary unemployment (and turnover), which relies on the downward rigidity of wages.

Some arguments can be resolved by logic, but others require evidence. Whether wages are rigid or flexible is an empirical question that has not been answered. Aside from casual observation of one's own and one's neighbor's wage behavior, the most influential evidence has been driven from theory: without downwardly rigid wages, we cannot understand involuntary unemployment and layoffs. That union contracts extend for two to three years has been influential as institutional evidence supporting wage rigidity. Other evidence is from aggregate wage data: the real wage at the aggregate level exhibits Phillips Curve effects or insufficient cyclical variability (e.g., Hall 1975; Gordon 1983).

The principal goal of this paper is to answer a single question: How rigid are wages? To answer this question, I empirically investigate the nature of wage rigidity at the individual level and compare the results with implications of a variety of models of wage rigidity.

In Section I, I present preliminary evidence from several sources to motivate the analysis. First, historically, the aggregate wage data do reveal episodes of wage decline.

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Second, data on union contract settlements also indicate large wage concessions. Third, the wage growth distribution of corporate executives exhibits substantial diffuseness and frequent cuts in pay. Fourth, I overview the evidence from the Panel Study of Income Dynamics.

Section II presents informal implications for observed wage growth distributions under the competing approaches to wage determination, rigid and flexible wages. In Section III, I formally model the joint determination of productivity and wages in a regression setting. The analysis includes a variance decomposition of wage growth to investigate the effects of various types of measurement error in the wage data.

The sample from the Panel Study of Income Dynamics, which is the principal source of evidence in this research, is summarized in Section IV. Section V contains the empirical results on wage variability:

(a) The wage growth distribution exhibits tremendous diffuseness: 43 percent of the household heads who do not change employers take real wage cuts annually. For about 17 percent of the sample, the wage cuts are also nominal.

(b) Although the wage growth distribution is more diffuse for movers, the wage growth distribution of stayers is also quite diffuse.

(c) Although union workers take real wage cuts in nearly the same proportions as non–union workers, there is evidence of substantial union wage compression.

(d) Diffuseness of the wage growth distribution does not appear to be driven by reporting error. The wage data are fairly clean. Also, similar wage cuts are documented using data—on union settlements and corporate executives—that are known to be clean.

(e) For most workers, the distribution of wage growth is not skewed away from wage cuts. However, the wage growth of union and minimum–wage workers exhibits substantial skewness away from wage cuts.

(f) There is no evidence of money illusion. Wage growth moves one–for–one with anticipated inflation, and anticipated inflation has no effect on the frequency of real wage cuts.

(g) The only evidence of nominal wage rigidity is a small spike at zero nominal wage growth: 7 percent of the stayers report exactly zero change in nominal wages.

(h) Counter to the implications of menu–cost models, very small wage cuts and raises are the most common wage changes.

Although no one piece of evidence is conclusive, these results combine to paint a sharp picture.

## I. **Motivating Evidence**

What is the current evidence on wage rigidity at the individual level? The focus of empirical research on wage behavior at the individual level has been on the position, not the diffuseness, of the wage distribution. For instance, Bils (1985) estimates the effect of cyclical fluctuations on real hourly wages, and Raisian (1983) on weekly wages by experience level; Shaw (1989) estimates the effect of oil price shocks on hourly wages. I have found only three papers that investigate whether the wages of individuals fall. First, Mitchell (1985) uses the BLS's survey of wage changes in manufacturing establishments in the 1920s and 1930s. He finds that wage changes were frequently nominal and real wage cuts, and that the frequency of wage cuts varied dramatically year to year. Second, Blinder and Choi (1989) survey compensation and personnel managers in 19 firms in New Jersey and eastern Pennsylvania. They are surprised to find that 26 percent of the firms had recently cut nominal wages. Third, Mortensen and Neumann (1989, Table 13.4) study inter–firm mobility in the SIME/DIME data from the early 1970s. Their results indicate that approximately 35 percent of the movers took nominal wage cuts in the employment transitions.

In this section, I frame the issues by peeking at a variety of evidence on wage variability. The evidence is presented in four parts: historical wage cuts, union wage concessions, compensation growth of corporate executives, and wage growth in the Panel Study of Income Dynamics (PSID).

### *Historical Wage Cuts*

The first evidence is from wages at the aggregate level. Aggregate wages, both real and nominal, exhibit episodes of decline. In Table 1, I compile from the wage tables in Historical Statistics of the United States (1975) the episodes of falling wages in aggregate earnings data. Whether wages are measured annually, weekly, or hourly, there are clear episodes of wage cuts, even large wage cuts. The most prominent episodes of aggregate wage cuts in these data are 1865–1867, 1872–1879, 1892–1894, 1907–1908, 1920–1922, 1929–1933, and 1937–1938. In the 1970s and 1980s, aggregate wage cuts have occurred in real terms but not in nominal terms. For instance, average hourly wages of production and non–supervisory workers on private non–agricultural payrolls did not fall in nominal terms in the post–war period; nevertheless, in real terms the hourly wage fell 3.6 percent from 1972 to 1975, 7.9 percent from 1978 to 1981, and 1 percent from 1983 to 1987 (U.S. Council of Economic Advisors 1988, 298).

The occurrence of wage declines is also frequent in less aggregative data. An appended table contains historical wage cuts for such groups as farm labor, masons on the Erie Canal, ministers, and bituminous coal miners, as well as for broader groups such as manufacturing production workers. In these data there is clear evidence of wage cuts, both real and nominal, despite the concomitant upward trend in wages, productivity, and prices.

Since the appended table is long and detailed, it might be useful to summarize the wage cuts for one episode, the deflationary period from 1920 to 1922. ***Annual*** earnings of all employees fell 13.7 percent in nominal terms, but real annual earnings grew 2.7 percent. The nominal cuts in agriculture (37.3 percent), manufacturing (16.3 percent), mining (26.0 percent), construction (24.2 percent), and transportation (35.6 percent) were the most substantial. ***Hourly*** earnings in manufacturing fell 17.5 percent overall and 18.4 percent (or 12.7 percent in data from a second source) for production workers.

Not all episodes follow this pattern. In many episodes of nominal wage declines, real wages also decline. In some episodes, only a small part of the decline in annual earnings translates into a decline in hourly earnings.

TABLE 1

HISTORICAL WAGE CUTS IN AGGREGATE DATA, 1860–1970

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Average Annual Earnings Nonfarm Employees: 1860–1900[a] | | | | | | |
| Nominal | (D735) | 1865 | 1867 | 512 | 479 | 6.45 |
| | | 1868 | 1871 | 499 | 482 | 3.41 |
| | | 1872 | 1879 | 486 | 373 | 23.25 |
| | | 1892 | 1894 | 482 | 420 | 12.86 |
| Real | (D736) | 1860 | 1863 | 457 | 382 | 12.04 |
| | | 1864 | 1866 | 421 | 322 | 23.52 |
| | | 1869 | 1870 | 380 | 375 | 1.32 |
| | | 1872 | 1877 | 416 | 388 | 6.73 |
| | | 1878 | 1879 | 397 | 391 | 1.51 |
| | | 1887 | 1888 | 509 | 505 | 0.79 |
| | | 1892 | 1894 | 527 | 484 | 8.16 |
| Average Annual Earnings of All Employees: 1900–1960[a] | | | | | | |
| Nominal | (D723) | 1903 | 1904 | 441 | 432 | 2.04 |
| | | 1907 | 1908 | 502 | 446 | 11.16 |
| | | 1913 | 1915 | 587 | 547 | 6.81 |
| | | 1920 | 1922 | 1236 | 1067 | 13.67 |
| | | 1923 | 1924 | 1231 | 1196 | 2.84 |
| | | 1927 | 1928 | 1312 | 1297 | 1.14 |
| | | 1929 | 1933 | 1356 | 678 | 50.00 |
| | | 1937 | 1938 | 1008 | 901 | 10.62 |
| Real | (D725) | 1902 | 1904 | 506 | 486 | 3.95 |
| | | 1906 | 1908 | 541 | 487 | 9.98 |
| | | 1913 | 1915 | 594 | 541 | 8.97 |
| | | 1919 | 1921 | 648 | 566 | 12.65 |
| | | 1923 | 1924 | 725 | 702 | 3.17 |
| | | 1929 | 1933 | 793 | 526 | 33.67 |
| | | 1937 | 1938 | 704 | 641 | 8.95 |
| | | 1945 | 1947 | 1284 | 1108 | 13.71 |
| Average Annual Earnings of Full-Time Employees: 1900–1970[b] | | | | | | |
| All Industries | (D722) | 1907 | 1908 | 529 | 519 | 1.89 |
| | | 1914 | 1915 | 639 | 635 | 0.63 |
| | | 1920 | 1922 | 1342 | 1190 | 11.33 |
| | | 1929 | 1933 | 1405 | 1048 | 25.41 |
| | | 1937 | 1938 | 1258 | 1230 | 2.23 |
| Agriculture, Forestry, & Fisheries | (D739) | 1904 | 1905 | 221 | 199 | 0.90 |
| | | 1920 | 1922 | 528 | 331 | 37.31 |
| | | 1929 | 1933 | 401 | 232 | 42.14 |
| | | 1948 | 1950 | 1340 | 1282 | 4.33 |
| | | 1952 | 1954 | 1423 | 1346 | 5.41 |
| Manufacturing | (D740) | 1903 | 1904 | 548 | 538 | 1.82 |
| | | 1907 | 1908 | 598 | 548 | 8.36 |
| | | 1910 | 1911 | 651 | 632 | 2.92 |
| | | 1920 | 1922 | 1532 | 1283 | 16.25 |
| | | 1929 | 1933 | 1543 | 1086 | 29.62 |
| | | 1937 | 1938 | 1376 | 1296 | 5.81 |
| Mining | (D741) | 1903 | 1904 | 619 | 599 | 3.23 |
| | | 1907 | 1908 | 697 | 590 | 15.35 |
| | | 1913 | 1914 | 749 | 666 | 11.08 |
| | | 1921 | 1922 | 1757 | 1300 | 26.01 |
| | | 1923 | 1925 | 1822 | 1580 | 13.28 |
| | | 1926 | 1928 | 1526 | 990 | 35.12 |
| | | 1937 | 1938 | 1366 | 1282 | 6.15 |
| | | 1948 | 1949 | 3396 | 3216 | 5.30 |

TABLE 1 (cont.)

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Construction | (D745) | 1910 | 1911 | 804 | 779 | 3.11 |
| | | 1914 | 1915 | 838 | 827 | 1.31 |
| | | 1920 | 1922 | 1710 | 1297 | 24.15 |
| | | 1928 | 1933 | 1719 | 869 | 49.45 |
| | | 1937 | 1938 | 1278 | 1193 | 6.65 |
| | | 1944 | 1946 | 2602 | 2537 | 2.50 |
| Transportation | (D746) | 1903 | 1904 | 615 | 554 | 9.92 |
| | | 1907 | 1908 | 683 | 574 | 15.96 |
| | | 1910 | 1912 | 633 | 615 | 2.84 |
| | | 1913 | 1914 | 743 | 640 | 13.86 |
| | | 1918 | 1919 | 1427 | 1276 | 10.58 |
| | | 1921 | 1922 | 1808 | 1165 | 35.56 |
| | | 1929 | 1933 | 1643 | 1334 | 18.81 |
| Communications & Public Utilities | (D750) | 1901 | 1902 | 496 | 473 | 5.24 |
| | | 1904 | 1905 | 487 | 477 | 2.05 |
| | | 1907 | 1908 | 521 | 516 | 0.96 |
| | | 1909 | 1910 | 531 | 516 | 2.82 |
| | | 1911 | 1912 | 658 | 527 | 19.91 |
| | | 1931 | 1933 | 1514 | 1351 | 10.77 |
| Wholesale/Retail Trade | (D753) | 1929 | 1933 | 1594 | 1183 | 25.78 |
| Finance, Insurance, & Real Estate | (D754) | 1900 | 1901 | 1040 | 1037 | 0.29 |
| | | 1911 | 1912 | 1355 | 1338 | 1.25 |
| | | 1917 | 1918 | 1932 | 1896 | 1.86 |
| | | 1929 | 1933 | 2062 | 1555 | 24.59 |
| | | 1937 | 1940 | 1788 | 1725 | 3.52 |
| Services | (D755) | 1920 | 1921 | 912 | 905 | 0.77 |
| | | 1929 | 1933 | 1079 | 854 | 20.85 |
| Government | (D761) | 1900 | 1901 | 584 | 572 | 2.05 |
| | | 1914 | 1915 | 798 | 753 | 5.63 |
| | | 1930 | 1934 | 1553 | 1284 | 17.32 |
| | | 1935 | 1938 | 1355 | 1336 | 1.40 |
| <u>Average Weekly Earnings: 1909–1970</u>[c] | | | | | | |
| Manufacturing | (D804) | 1920 | 1922 | 26.02 | 21.28 | 18.22 |
| | | 1929 | 1933 | 24.76 | 16.67 | 32.67 |
| | | 1937 | 1938 | 23.82 | 22.07 | 7.35 |
| | | 1944 | 1946 | 45.70 | 43.32 | 5.21 |
| <u>Average Hourly Earnings (cents): 1889–1914</u>[d] | | | | | | |
| Manufacturing | (D848) | 1893 | 1895 | 15.1 | 13.8 | 8.61 |
| | | 1896 | 1898 | 14.4 | 13.7 | 4.86 |
| | | 1903 | 1904 | 17.0 | 16.9 | 0.59 |
| | | 1907 | 1908 | 19.1 | 18.4 | 3.66 |
| | | 1913 | 1914 | 22.1 | 22.0 | 0.45 |
| <u>Average Hourly Earnings (cents): 1914–1948</u>[e] | | | | | | |
| Manufacturing Production Workers | (D830) | 1920 | 1922 | 60.50 | 49.40 | 18.35 |
| | | 1924 | 1925 | 56.20 | 56.10 | 0.18 |
| | | 1929 | 1933 | 59.00 | 49.10 | 16.78 |

[a]Lebergott (1964, Tables A–23 and A–24)

[b]Lebergott (1964, Table A–16) for 1900–1928; U.S. Department of Commerce (1966) for 1929–1965; U.S. Department of Commerce (1971, Table 6.5) for 1966–1970

[c]U.S. Bureau of Labor Statistics (1972)

[d]Rees (1961, Table 10)

[e]Conference Board (1950, 336–44)

*Union Wage Concessions*

Some evidence on wage variability can be gleaned from union contract settlements. Each month in Current Wage Developments the Bureau of Labor Statistics publishes changes in union wages in bargaining units covering at least 1000 workers; some changes are contract settlements, but others are automatic escalator adjustments and deferred changes from previous settlements. Although union wage concessions in nominal terms are not so frequent to be standard, they do occur.

Consider the wage concessions of the 1980s. In the early 1980s, high inflation resulted in only a few nominal wage cuts. But by 1982, wage concessions ranging from 12 cents to $3.65 per hour were not uncommon. In 1983 and 1984, nominal wage cuts in settlements were frequent, ranging from cuts of 15 cents to $7.84 per hour. Settled cuts were also frequent in 1986, but tailed off in the late 1980s. In 1983, cost–of–living adjustments in the first half of the year resulted in hourly wage cuts of 1 to 5 cents for 1.4 million workers. COLA wage cuts nearly vanished in 1984, but hourly COLA cuts ranging from 2 cents to 13 cents for nearly one million workers occurred in mid–1986. Deferred decreases in wages were the most common form of wage concessions in 1988 and 1989.

In the 1980s, wage concessions were concentrated in four industries. From March 1981 to June 1984, at least 50,000 workers in the airline industry settled for wage cuts of 10–11 percent. In the 1980s, the steel industry had two episodes of wage concessions. From late 1982 through 1983, wage cuts in 22 settlements covering nearly 300,000 steel workers ranged from 50 cents to $3.65 per hour. In a second episode, from late 1985 to early 1987, 16 settled concessions resulted in wage cuts of 45 cents to $3.50 per hour for 115,000 steel workers. Settled wage concessions in the food industry were most frequent in 1984 and 1987. In 1984, more than 20,000 food workers received cuts of 25 cents to $2.00 per hour. Wage concessions of $1.00 to $1.75 per hour resulted from 7 settlements covering nearly 30,000 food workers in 1987.

In the food industry, deferred wage cuts of 12 cents to $1.00 per hour were common in 1988. Construction industry settlements with more than 80,000 workers in the building trades resulted in 37 wage concessions over the period from May 1983 to July 1985. The wage cuts ranged from 5 cents to $7.84 per hour.

*Compensation Growth of CEOs*

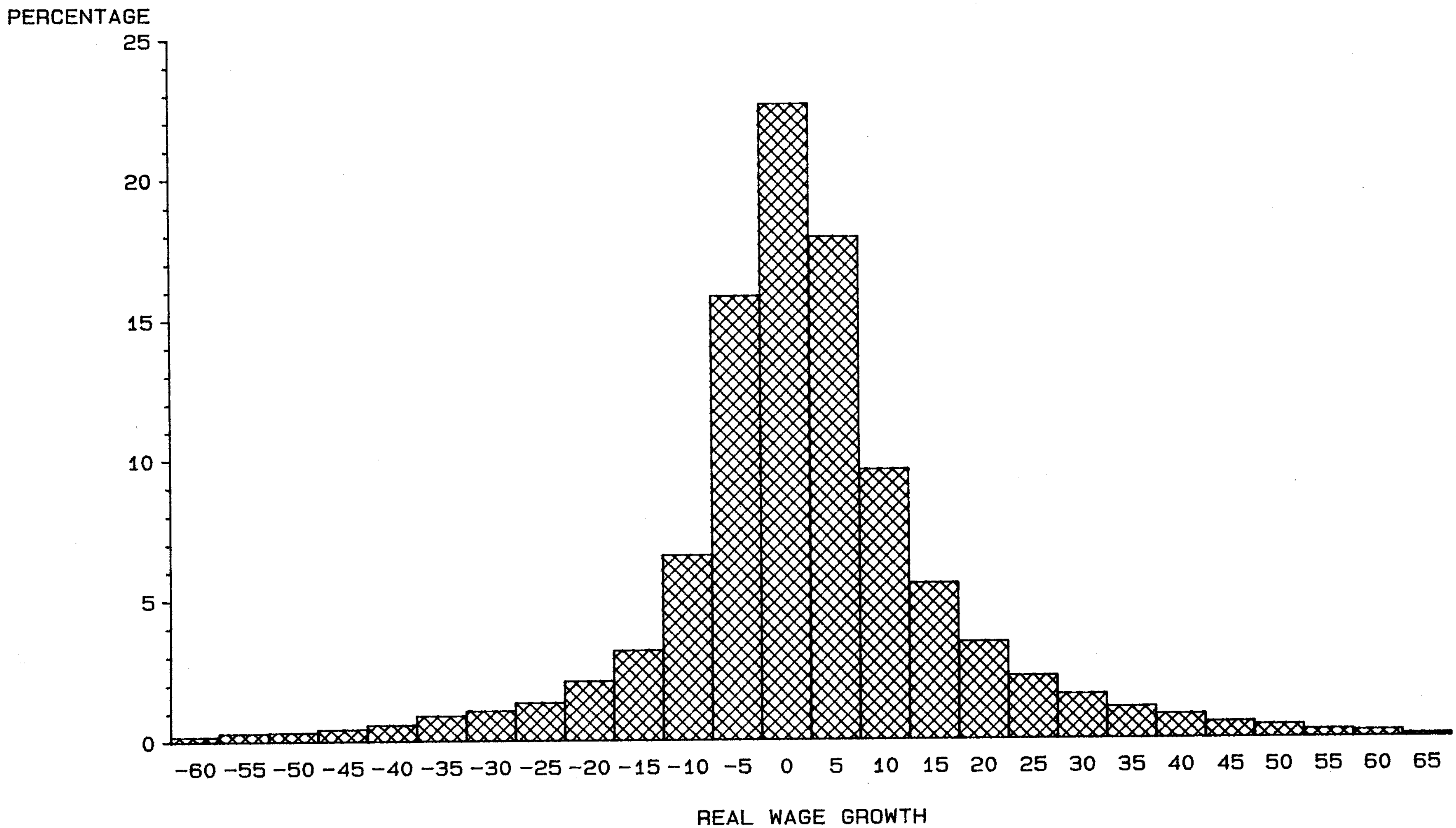
Jensen and Murphy (1990, Table 7) report sizable variation in the compensation of chief executive officers. Using the Forbes executive compensation data from 1974 to 1986, they find that (a) only one–third of the sample receive growth in pay (salary plus bonus in real terms) within the range of zero to ten percent, and (b) one–third receive cuts in pay.

*Wage Growth in the PSID*

The sample analyzed in the remainder of this paper is drawn from the Panel Study of Income Dynamics (PSID) data on household heads. (The sample is described fully in Section IV below.) Figure 1 illustrates remarkable diffuseness in the distribution of annual real wage growth for these workers. The distribution is roughly symmetric and exhibits the bell shape characteristic of the normal probability density function. Mean wage growth is 1.9 percent and the standard deviation is 15.4; nearly 65 percent of the sample exhibits real wage growth outside the interval 0 to 10 percent, and 43 percent of the sample receive real wage cuts. Taken at face value, these results are riveting. But is the face value accurate?

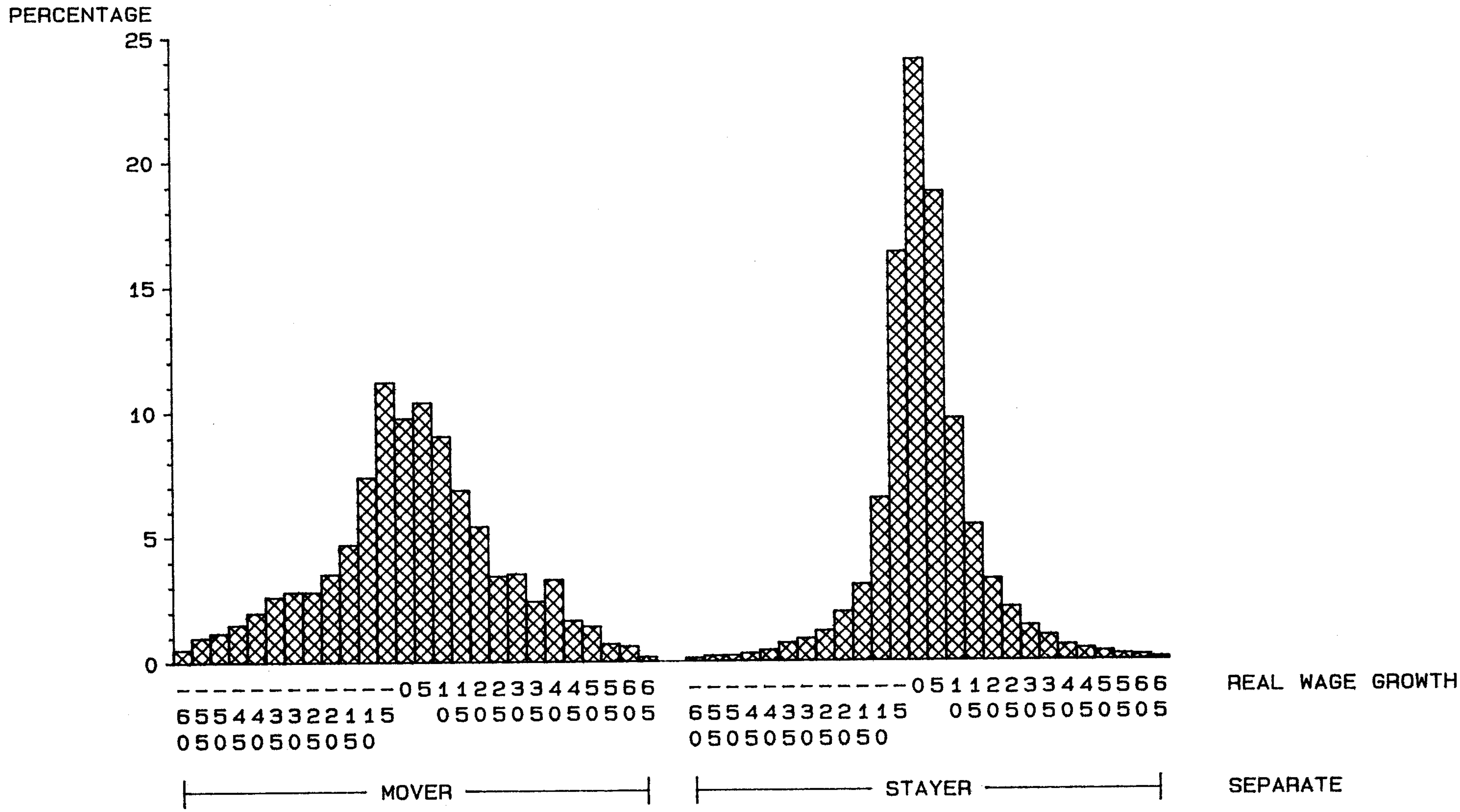
Is the illustrated variability of wages driven by workers who change employers (movers), with stayers' wages rigid? That movers comprise only 12 percent of the sample suggests this is not the case. Comparison of the wage growth distributions of movers and stayers is illustrated in Figure 2. Although movers exhibit more variability of wages than stayers, nevertheless, the stayers' distribution of wage growth is quite diffuse. Forty–three percent of the stayers take real wage cuts annually.

Figure 1
Wage Growth Distribution




Annual Differences of Log Real Wage
PSID Data: 1976–1986

Figure 2
Wage Growth Distribution
Movers and Stayers




Annual Differences of Log Real Wage
PSID DATA: 1976–1986

A second question is whether inflation is the source of the real wage cuts. Perhaps nominal wages are downwardly rigid, but Figure 1 misses the mark by plotting the distribution of ***real*** wage growth. That inflation averaged less than 7 percent per year over the sample period 1976–1986, and real wage cuts of 10–15 percent were not uncommon suggests that inflation is not the culprit. Indeed, the results in Section V below establish that fully 17 percent of the stayers receive ***nominal*** wage cuts.

Two more issues require a formal treatment and more structured analysis of the data. The first is whether variation in wages is induced by measurement error in reported wages. From wage equation estimates on these data, we know there is a clear systematic component; however a sizable reporting–error component might be producing the diffuseness of the wage growth distribution. Second, although the empirical wage growth distribution is quite diffuse, it might be much less diffuse than the productivity growth distribution. These issues are deferred to Section III.

## II. Implications

In this section, I present some informal answers to the following question: What would be the effect of wage rigidity on the observed distribution of wage growth?

*Rigid Wage*

What is a rigid wage? My working definition of a rigid wage is that at the individual level wages do not vary, or do not vary from a fixed life–cycle profile. Consider how this definition relates to the issue of whether markets clear with each worker's wage equal to his marginal product and his marginal value of time. First, there exist implicit contract models of wage (more precisely, labor income) rigidity in which the market allocates labor efficiently (e.g., Rosen 1985). Second, each worker's wage might fluctuate and equal his marginal product, but the fluctuations are off the labor supply curve. Third, wages might fluctuate and reflect the opportunity costs of time, but productivities fluctuate more. Although wage data alone cannot be conclusive regarding market clearing, they can be instrumental in guiding the economics of the labor market. It is important to know whether wage rigidity is (a) an essential characteristic and justifiably the focus of our models, or (b) a minor actor from which our models of the labor market can safely abstract?

The grip of the rigid wage approach weakens with intertemporal variation in the reported wages of stayers. If the stayers' variance of wage growth were large, a large variance of classical reporting error would be required to rationalize the data. Thus a small value of the stayers' wage growth variance would be strong support for wage rigidity, and a large value could be consistent with wage rigidity only if the variance of classical reporting error were large. In addition, wage rigidity is likely to result in a spike or mass point at zero wage growth of stayers. (Whether the spike is at zero nominal or zero real wage growth depends on whether the wage rigidity is nominal or real.)

The fascination of economists since Keynes with involuntary unemployment has lead to an emphasis on downward rigidities. If wages were upwardly flexible and downwardly rigid, then the observed wage growth distribution of stayers would exhibit a spike at zero (from the censored wage cuts) and positive skewness. Alternatively, if menu costs were the source of wage rigidity, then small wage changes would be censored. A spike at zero wage growth, holes around zero wage growth, and fat tails would be properties of the wage growth distribution.

Within the wage–rigidity literature, there is not a consensus on whether nominal or real wages are rigid. The new micro–foundations of Keynesian macroeconomics[1], such as efficiency wage models without market clearing, are primarily real. However, in

[1]Keynes proposed a policy of fixing or stabilizing nominal wages (Keynes 1936, Chapter 19, Section III). While modern Keynesian models employ wage or price rigidity to generate excessive fluctuations, Keynes himself argued for a policy of nominal wage rigidity to stabilize the economy.

nominal–contracting models (e.g., Fischer 1977; Taylor 1980) prices or nominal wages are rigid. In particular, the idea of inflation as the manager's best friend in orchestrating real wage cuts warrants attention.

*Flexible Wage*

First, neoclassical wage determination implies that wage growth should be measured in real terms. Second, to be a powerful alternative to models with downward wage rigidity, real wage cuts must be frequent. If wages are flexible but productivity never falls, then there is little value of determining whether wages are flexible or rigid. However, real wage cuts might be very rare for groups with high productivity growth on average. Within high productivity growth groups, frequent cuts ***relative to profile*** should be observed. For the low productivity growth groups, such as the old and less educated, real wage cuts must be frequent. Third, wage growth must mimic productivity growth at the aggregate level, which is observable.

*Wage–Cut Regressions*

The two approaches to wage determination produce different implications for the effect of inflation on the frequency of wage cuts. In particular, neoclassical wage determination implies that inflation has no effect on the frequency of real wage cuts; and wage determination with ***nominal*** rigidities implies that inflation increases the frequency of real wage cuts.

Let $F_t^r$ denote the fraction of workers taking real wage cuts from time t–1 to t, and $F_t^n$ the fraction taking nominal wage cuts. Sign restrictions in the following regressions contrast the two approaches to wage determination:

$$F_t^r = a_r + b_r \pi_t + c_r g_t + v_t^r \tag{1.1}$$

$$F_t^n = a_n + b_n \pi_t + c_n g_t + v_t^n , \tag{1.2}$$

where $\pi_t$ denotes the inflation rate from time t–1 to t, and $g_t$ the growth rate of productivity. Neoclassical wage determination implies that inflation has no effect on real wage growth and increases nominal wage growth, and productivity growth increases both real and nominal wage growth. Therefore, the fraction of observations taking real wage cuts $F^r_t$ is unrelated to $\pi_t$ but is decreasing in $g_t$, and $F^n_t$ is decreasing in $\pi_t$ and $g_t$: $b_r = 0$, $c_r < 0$, $b_n < 0$, and $c_n < 0$. With nominal wage rigidity, inflation reduces real wage growth and increases $F^r_t$, but has no effect on nominal wages: $b_r > 0$ and $b_n = 0$. A strong form of nominal rigidity admits no role for productivity growth in affecting wages; however, a weaker form allows productivity growth to increase both real and nominal wage offers: $c_r \leq 0$ and $c_n \leq 0$.

## III. Productivity and Reported Wages

The purpose of this section is to delineate the effects of various types of measurement error and to raise the question of identification of measurement error components in wage data. To do so, I model the joint determination of productivity and wages in the regression context. Let i index workers, j firms, and t time.

*Productivity*

Productivity (in logs), denoted by M, is related to observable skills **X** as well as unobservable fixed individual, match, and time effects.

$$M_{ijt} = \alpha_i + \mu_{ij} + \delta_t + \mathbf{X}_{it}\beta_j + \epsilon^M_{ijt}, \qquad (2)$$

with the disturbance $\epsilon^M_{ijt} \equiv u_{ijt} + \nu^T_{ijt}$ and $u_{ijt} = u_{ijt-1} + \nu^P_{ijt}$ such that $E\nu^T_{ijt} = E\nu^P_{ijt} = 0$, and $E(\nu^T_{ijt})^2 = \sigma^2_T$ and $E(\nu^P_{ijt})^2 = \sigma^2_P$ independent of the indexes (i, j, t). Thus the stochastic component of productivity incorporates both transitory and permanent components. Also, $\nu^T_{ijt}$ and $\nu^P_{ijt}$ are assumed to be uncorrelated with the observables $\mathbf{X}_{it}$ and the fixed effects $(\alpha_i, \mu_{ij}, \delta_t)$. The structure of the productivity process excludes worker–specific and firm–specific time effects, but is otherwise quite general.

Aside from changing skills and time effects, why would a worker's productivity vary through time? Equation (2) is broadly consistent with an equilibrium model that blends neoclassical marginal analysis and matching features to generate well–defined stochastic productivity values (McLaughlin 1987). In equilibrium, the productivity of worker i in firm j at time t depends on ***all*** firms' product demands, production functions, and processes that map skills into units of labor input, and the skill composition of the labor market. Consequently, the stochastic components of productivity are due to shocks to product demands, production functions, skill mappings, and the supply of skills.

*Wages*

I begin with the hypothesis that the wage (in logs), denoted W, is linearly related to productivity.

$$W_{ijt} \equiv \gamma_0 + \gamma_1 M_{ijt} + \epsilon^W_{ijt} , \tag{3}$$

where the disturbance $\epsilon^W_{ijt}$ is measurement or reporting error. Let $\epsilon^W_{ijt}$ be generated as the sum of permanent, classical, and "smoothing" components.

$$\epsilon^W_{ijt} \equiv \phi_{ij} + \nu^C_{ijt} + \nu^S_{ijt} , \tag{4}$$

with $E\nu^C_{ijt} = E\nu^S_{ijt} = 0$, $E(\nu^C_{ijt})^2 \equiv \sigma^2_C$, and $E(\nu^S_{ijt})^2 \equiv \sigma^2_S$. The terms $\phi_{ij}$ and $\nu^C_{ijt}$ are assumed to be independent of $M_{ijt}$. The permanent component of the reporting error in the wage is a "lying" factor; e.g., individual i employed by firm j always inflates his wage by 12 percent. The classical component is designed to capture errors of knowledge and coding errors. The third component of the reporting error, the smoothing factor $\nu^S_{ijt}$, is not classical; $\nu^S_{ijt}$ is assumed to be negatively correlated with the transitory component of productivity $\nu^T_{ijt}$: $E(\nu^T_{ijt} \cdot \nu^S_{ijt}) < 0$. This captures the smoothing or mean–reverting element of survey responses (Bound and Krueger 1989). Individual i reports what he usually would be paid or his best forecast of his wage with firm j. In particular, I assume that $\nu^S_{ijt}$ is proportional to the difference between the true wage and the wage if $\nu^T_{ijt}$ were to equal zero: $\nu^S_{ijt} \equiv -\eta\gamma_1\nu^T_{ijt}$, with $\eta \geq 0$.

The productivity and structural wage equations combine to produce the commonly used wage equation.

$$W_{ijt} = \alpha^*_i + \mu^*_{ij} + \delta^*_t + \mathbf{X}_{it}\beta^*_j + \epsilon_{ijt}\,, \tag{5}$$

with $\alpha^*_i \equiv \gamma_0 + \gamma_1\alpha_i$, $\mu^*_{ij} \equiv \gamma_1\mu_{ij}$, $\delta^*_t \equiv \gamma_1\delta_t$, $\beta^*_j \equiv \gamma_1\beta_j$, and $\epsilon_{ijt} \equiv \gamma_1\epsilon^M_{ijt} + \epsilon^W_{ijt}$ $\equiv \gamma_1 \cdot [u_{ijt} + (1-\eta)\,\nu^T_{ijt}] + \phi_{ij} + \nu^C_{ijt}$. The disturbance $\epsilon_{ijt}$ is a mixture of random walk, time–invariant permanent, and transitory components. The specification is consistent with wage equation estimates from the PSID (Topel 1988).

*Wage Growth*

The specified process of wages can be used to determine the effects of error components on the variance of wage growth. For notational ease, reduce the vector $\mathbf{X}_{it}$ to a scalar measure of skill $x_{it}$. Wage growth of a worker who remains with his incumbent employer is

$$\begin{aligned} \Delta W_{ijt} &\equiv \Delta\delta^*_t + \beta^*_j\Delta x_{it} + \Delta\epsilon_{ijt} \\ &\equiv \gamma_1\left[\Delta\delta_t + \beta_j\Delta x_{it} + \nu^P_{ijt} + \Delta\nu^T_{ijt}\right] + \Delta\nu^C_{ijt} + \Delta\nu^S_{ijt}, \end{aligned} \tag{6}$$

where $\Delta$ denotes the time difference. The variance of wage growth $\sigma^2_{\Delta W}$ is

$$\sigma^2_{\Delta W} \equiv \gamma_1^2 \cdot \left[\sigma^2_{\Delta\delta} + \beta_j \sigma^2_{\Delta x} + \sigma^2_P + 2(1-\eta)^2 \sigma^2_T\right] + 2\sigma^2_C. \tag{7}$$

Consequently, the variance of reported wage growth is an additive function of the variances of unobserved fluctuations in productivity—both permanent and transitory—and transitory reporting error in wages, as well as the variances of changes in time effects and skills.

Three results are immediate:

**RESULT 1.** Permanent reporting error $\phi_{ij}$ has no effect on the variance of wage growth.

**RESULT 2.** Classical reporting error $\nu^C_{ijt}$, which is uncorrelated with productivity, increases the variance of reported wage growth relative to the variance of true wage growth; that is, $\sigma^2_{\Delta W}$ is increasing in $\sigma^2_C$.

**RESULT 3.** Reporting error that smooths reported wages relative to productivity, $\nu^S_{ijt}$, decreases the variance of reported wage growth relative to the variance of true wage growth; that is, $\sigma^2_{\Delta W}$ is decreasing in $\eta$.

The empirical results of Section V use the sample variance of reported wage growth to assess the degree of wage variability. Results 1–3 establish that the effect of reporting error in biasing the test toward wage flexibility depends on the form of reporting error.

The expression for the variance of wage growth of movers is similar, but there are two differences. First is the addition of the variance of the change (across firms) of the match effect. The second is that the variance of $\Delta(x_{it}\beta_j)$—with $\Delta$ representing differences across both time and firms—replaces $\beta_j \sigma^2_{\Delta x}$. Each modification is expected to induce a higher variance of wage growth of movers than of stayers.

For the question of wage rigidity, a large part of the interest turns on whether wages are less variable than productivities. Or, within the context of the model, how big is $\gamma_1$? The following result serves to focus the empirical exercise.

**Result 4.** The parameter $\gamma_1$ is not in general identified without productivity data.

With observations on productivity $M_{ijt}$, an estimate of $\gamma_1$ could be generated directly from equation (3). Without a productivity variable, neither equation (5) nor (7) is useful in estimating $\gamma_1$. That $\gamma_1$ is unidentified limits the potential of the empirical analysis. The degree of wage flexibility must be established absolutely, not relative to productivity.

The model of wage determination generates implications for wage growth that are helpful in distinguishing between rigid and flexible wages. In the context of equation (2), fully flexible wages correspond to the parameter values $\gamma_0 = 0$ and $\gamma_1 = 1$. Aside from reporting error in the wage data, the wage equals productivity in each worker–firm match at each point in time. Since the variance of wage growth in equation (6) is increasing in $\gamma_1$, wage flexibility increases the variance of wage growth. This result, though it borders on tautological, is nearly all the formal model produces. A second implication is that if turnover were generated randomly, then the variance of wage growth of movers would exceed that of the stayers.[2]

A polar form of wage rigidity sets $\gamma_0 > 0$ and $\gamma_1 = 0$: all observed variation (cross–sectional and time series) is due to classical reporting error, therefore $\sigma_W^2 \equiv \sigma_\phi^2 + \sigma_C^2$ and $\sigma_{\Delta W}^2 \equiv 2\sigma_C^2$. Serious analysis of the rigid wage alternative must allow for individual variation in wages at least across firms. One way to approach this is to enrich $\gamma_0$.

[2]Moving cost is also a factor inducing a more diffuse wage growth distribution of movers. Due to the cost of mobility, jointly optimal separation rules censor separations with small wage changes.

Let $\gamma_0$ be an additive function of the individual effect and a modified match effect.

$$\gamma_0^{ij} \equiv \alpha_i + \mu'_{ij} , \tag{8}$$

where $\mu'_{ij} \equiv \mu_{ij} + E_t(x_{it}\beta_j)$. With $\gamma_1 = 0$, the stayers' variance of wage growth reduces to the variance of classical reporting error $\sigma^2_C$. Nevertheless, this specification allows for cross–sectional variation in actual, as well as reported, wages. For movers, the variance of wage growth is $\sigma^2_C$ plus the cross–firm variance in $\mu'_{ij}$.

A second specification of wage rigidity is less severe. Wages vary with most components of productivity, but not with the time effects $\delta_t$ or the permanent and transitory shocks, $v^P_{ijt}$ and $v^T_{ijt}$.

$$\gamma_0^{ijt} \equiv \alpha_i + \mu_{ij} + x_{it}\beta_j , \tag{9}$$

with $\gamma_1 = 0$. Consequently, for stayers wages vary in the time series with observable skills $x_{it}$, and $\sigma^2_{\Delta W} \equiv \beta^2_j \cdot \sigma^2_{\Delta x} + \sigma^2_C$.

The restriction that $\gamma_1$ equals zero could be replaced by $0 < \gamma_1 < 1$, which would yield wage compression rather than wage rigidity. But even for the extreme specifications, there is little to distinguish the rigid–wage and flexible–wage approaches using reported wage data. Cross–sectional variation in the wage is implied by both specifications. Variation of reported wages but not actual wages is admitted in the first specification; the second specification allows for true as well as reporting–error–induced variation in reported wages. Of course, the variance of wage growth is implied to be smaller with wage rigidity.

*Selection Effects*

The equations that generate productivities and wages, equations (2) – (5), embed population regression functions. Sampling issues arise, however, for wage growth. Does the worker change firms? If so, what process generates the transition? In expressing the variance of wage growth for stayers, equation (7), I implicitly assumed random sampling and ignored potential effects of self–selection.

Does the wage growth distribution of stayers correspond to the wage growth distribution of movers ***had they stayed***? In particular, would the process generating turnover imply that the variance of stayers' wage growth overstates the movers' variance had they stayed? Perhaps the movers faced exactly zero wage growth had they stayed, which is why they chose to move or were forced to move. Alternatively, the stayers' variance could understate the movers' variance had they stayed. The movers might have higher values of $\sigma_P^2$ and $\sigma_T^2$. As long as the productivity shocks are not perfectly correlated across firms in a standard model of efficient turnover, the separation rate increases with the variance of productivity shocks. Each of the two cases relies on heterogeneity, the first in $\gamma_1$ and the second in the variances of the stochastic components of productivity.

Self–selection can induce positive skewness of the wage growth distribution even if the underlying productivity growth distribution were symmetric (Weiss and Landau 1984). A worker with a high draw for productivity growth with his incumbent employer would be unlikely to move, but a large negative draw would generate a jointly optimal separation. That is, draws in the left tail of the wage growth distribution are likely to be truncated by turnover.[3]

## IV. Data

The motivating evidence in Figures 1 and 2 and the more formal evidence presented in Section V on the diffuseness of wage growth distributions rely on a sample

[3]In a future draft, I hope to report results on the effects of selection for a variety of specifications of the turnover process.

drawn from the Panel Study of Income Dynamics (PSID). The PSID has followed more than 5,000 families since 1968, a long enough span to determine the effect of inflation on real wage growth. The precise form of the wage data in the PSID is also well suited for studying the variability of wages.

The wage questions in the PSID are almost ideally suited for the task. An employed household head is asked the mode of pay on his (or her) main job. An hourly worker is asked his straight–time hourly wage; a salaried worker is asked his salary. I do not convert the salary to an hourly wage as variation in hours worked might induce "wage" variability where salary rigidity exists. In addition, the replication studies of Duncan and Hill (1985) and Bound, Brown, Duncan, and Rodgers (1989) conclude that large errors are introduced in wage data by dividing labor income by hours worked even for a holder of a single job. Nevertheless, for comparison, I also present results for both earnings and hourly earnings growth distributions.

Some information is available on the pay of other workers (piece rate and commission workers, etc.), and on the overtime pay of hourly and salaried workers. The analysis is limited to hourly and salaried workers as only 56 observations on the wage growth of piece–rate and commission workers could be computed. (Preliminary analysis of the piece rate and commission workers revealed that the distribution of wage growth of these workers is substantially more diffuse.) In my sample, 62 percent of the hourly and salaried workers report overtime pay. Consequently, I can compare the variabilities in straight–time pay and overtime pay.

Wage[4] growth in year t is computed as the difference in the log of the wage in year t and in year t–1: $\log W_t - \log W_{t-1}$. I prefer "differences in logs" to "percentage changes" based on the substantial empirical foundation of log wage

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[4]Hereafter, "wage" refers to the wage rate of hourly workers ***and*** a commensurate wage for salaried workers. The PSID reports the salary of a salaried worker in units comparable to the wage of hourly workers: annual salaries are divided by 2000 and weekly salaries are divided by 40. Division by these constants does not affect wage growth.

equations. Also, "differences in logs" supports a test of normality. If the wage were log normally distributed, the "differences in logs" would be normally distributed. The method of computing wage growth does not effect the frequencies of negative, zero, and positive wage growth, but empirically "percentage changes" produces substantial positive skewness.

The GNP Deflator (base year 1982) converts the nominal wage to a real wage. The inflation rate is also computed as a difference in the logs, so the inflation rate is the difference between nominal and real wage growth.

In each interview year from 1976 to 1986, the sample is limited to employed[5] household heads aged 21 to 65 who report wages or salaries. Prior to 1976, the PSID's wage data are less rich. Excluded from the wage growth computations are 1 percent of the observations in each tail of the wage growth distribution. This exclusion is a fairly robust method to mitigate the effects of extreme measurement error.

Table 2 displays the summary statistics for the sample, as well as subsamples by turnover status.

## V. Results

Table 3 contains the main results in the form of wage growth statistics for a variety of samples. The first results quantify the degree of wage variability illustrated in Figures 1 and 2. The wage growth statistics reported in lines 1–3 are the basis for mover–stayer comparisons. For the combined sample of movers and stayers in line 1, the standard deviation of real wage growth is 15.35, 43.1 percent of the sample take real wage cuts, and the real wage cuts average nearly 10 percent. Comparison of lines 2 and 3 reveals that movers exhibit substantially more wage growth variability than stayers. The standard deviation of wage growth is much higher for movers (23.49 for

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[5]Individuals on temporary layoffs are excluded from the sample although they do report wages on the jobs from which they are laid off.

TABLE 2

SUMMARY STATISTICS
PSID, 1976–1986[a]

| Variables | Stayers and Movers | Stayers | Movers |
|---|---|---|---|
| Real Wages | 9.06 (4.71) | 9.24 (4.73) | 7.70 (4.25) |
| Real Hourly Earnings | 9.84 (8.59) | 10.09 (8.91) | 7.98 (5.11) |
| Real Overtime Pay | 12.04 (5.46) | 12.30 (5.46) | 10.11 (5.07) |
| Nominal Wage Growth | 7.71 (15.47) | 7.72 (14.31) | 7.64 (23.56) |
| Real Wage Growth | 1.90 (15.35) | 1.90 (14.18) | 1.91 (23.49) |
| Real Hourly Earnings Growth | 2.83 (23.45) | 2.92 (22.42) | 2.03 (31.14) |
| Real Overtime Growth | 2.51 (22.96) | 2.71 (20.84) | 0.52 (38.04) |
| Age | 37.66 (11.38) | 38.40 (11.43) | 32.09 (9.27) |
| Education | 12.30 (2.84) | 12.28 (2.87) | 12.48 (2.53) |
| Male[b] | 0.80 (0.40) | 0.80 (0.40) | 0.80 (0.40) |
| White[b] | 0.64 (0.48) | 0.63 (0.48) | 0.68 (0.47) |
| Union[b] | 0.32 (0.47) | 0.33 (0.47) | 0.20 (0.40) |
| Hourly[b] | 0.56 (0.50) | 0.55 (0.50) | 0.64 (0.48) |
| Separation[b] | 0.12 (0.32) | 0.00 — | 1.00 — |
| Number of Observations | 26,985 | 23,844 | 3,141 |

[a]The sample contains observations on household heads reporting wages on their main jobs. After time differencing, the remaining observations on wage, hourly–earnings, and overtime–pay growth are respectively: 21,471, 21,113, and 10,706.

[b]Dummy variable.

[c]*Previous year's* annual earnings and hourly earnings.

TABLE 3

WAGE GROWTH STATISTICS[a]
PSID, 1976–86

| | Growth Variable | Sample | Number of Obs. | Mean | Standard Deviation | Skewness | Kurtosis | Kolmogorov D | F(0)[b] | Ave Wage Cut (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *A. Turnover Status* | | | | | | | | |
| (1) | Real Wages | Stayers & Movers | 21,471 | 1.90 | 15.35 | 0.04 | 2.94 | 0.103 | 43.1 | 9.8 |
| (2) | Real Wages | Movers | 2,107 | 1.91 | 23.49 | –0.10 | 0.07 | 0.056 | 45.8 | 17.6 |
| (3) | Real Wages | Stayers | 19,364 | 1.90 | 14.18 | 0.11 | 3.52 | 0.102 | 42.9 | 8.9 |
| (4) | Nominal Wages | Stayers | 19,364 | 7.72 | 14.31 | 0.09 | 3.43 | 0.121 | 17.3[c] | 11.9 |
| (5) | Real Wages | Stayer, Same Job | 16,837 | 1.31 | 13.69 | 0.06 | 3.87 | 0.106 | 44.5 | 8.7 |
| (6) | Real Wages | Stayer, Diff. Job | 1,972 | 6.18 | 16.72 | –0.01 | 2.10 | 0.083 | 31.4 | 10.6 |
| | | *B. Demographic Groups*[d] | | | | | | | | |
| (7) | Real Wages | Non–Union | 12,216 | 1.88 | 14.95 | 0.05 | 2.97 | 0.098 | 43.5 | 9.6 |
| (8) | Real Wages | Union | 6,079 | 1.85 | 11.79 | 0.29 | 4.99 | 0.114 | 41.7 | 7.1 |
| (9) | Real Wages | Minimum Wage | 563 | 7.33 | 19.66 | 0.43 | 1.29 | 0.132 | 40.3 | 8.6 |
| (10) | Nominal Wages | Minimum Wage | 563 | 13.84 | 19.73 | 0.44 | 1.18 | 0.140 | 10.1[c] | 15.9 |
| (11) | Real Wages | Non–Union and Non–Min.–Wage | 11,689 | 1.65 | 14.69 | –0.03 | 2.99 | 0.098 | 43.5 | 9.7 |
| (12) | Real Wages | Regr'n Residual | 19,364 | 0.00 | 14.08 | 0.09 | 3.60 | 0.100 | 52.8 | 8.9 |

TABLE 3 (cont.)

| Growth Variable | Sample | Number of Obs. | Mean | Standard Deviation | Skewness | Kurtosis | Kolmogorov $D$ | F(0)[b] | Ave Wage Cut (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *C. Type of Compensation* | | | | | |
| (13) Real Wages | Stayers, Hourly | 9,962 | 1.87 | 11.03 | 0.30 | 5.38 | 0.105 | 42.2 | 6.5 |
| (14) Real Wages | Stayers, Salaried | 7,866 | 1.64 | 16.23 | 0.05 | 2.22 | 0.086 | 44.1 | 11.0 |
| (15) Real Earnings | Stayers | 21,259 | 3.27 | 20.74 | 0.11 | 3.62 | 0.101 | 42.8 | 12.7 |
| (16) R. Hrly Earn. | Stayers | 21,113 | 2.85 | 22.09 | 0.005 | 2.29 | 0.067 | 43.4 | 15.0 |
| (17) Real Overtime | Stayers | 10,706 | 2.52 | 16.13 | 0.29 | 3.24 | 0.122 | 42.0 | 9.6 |

[a]Wage growth is computed as the annual time difference of log wage.

[b]F(0) is the empirical cumulative distribution function of wage growth evaluated at zero (and expressed as a percentage). It is the percentage of observations taking wage cuts.

[c]In line (4), 17.3 percent of the observations exhibit negative nominal wage growth; an additional 7.2 percent report exactly zero nominal wage growth. In line (10), an additional 17.4 percent report zero nominal wage growth.

[d]The results in this panel are computed on the sample of stayers.

movers and 14.18 for stayers);[6] 3 percentage points more movers receive wage cuts; and the average wage cut is twice as large for movers (18 percent for movers and 9 percent for stayers). The extra diffuseness of the movers' distribution is consistent with either approach to wage determination.

For stayers, a comparison of real and nominal wage growth is displayed in lines 3 and 4 of Table 3. The 6.2 percent average annual inflation rate over the sample period generates 26 percentage points more real wage cuts than nominal wage cuts. Nevertheless, fully 17 percent of the stayers report nominal cuts to straight–time pay annually; and the nominal cuts average nearly 12 percent.

*Normality*

If log wages follow the normal distribution, then analysis of the diffuseness of wage growth would be fully summarized by the standard deviation. For each of the 17 lines in Table 3, I present the Kolmogorov *D* statistic for goodness of fit as a test of normality (Bickel and Doksum 1977, 378–81; Mood, Graybill, and Boes 1974, 508–11; Stephens 1974). Consider the case of real wage growth of stayers in line 3. A *D* statistic of .102 is sufficient at the 1 percent level to reject the null hypothesis of normality.

The nature of the rejection is illustrated in Figure 3. The normal probability density function with mean 1.90 and standard deviation 14.18 is superimposed over the empirical real wage–growth distribution of stayers. The empirical distribution reaches a higher peak at the mode, has fatter tails, and is shallower over intermediate positive and negative values of wage growth. The kurtosis coefficient of 3.52, which is significantly different from zero at the 1 percent level, also indicates heavy tails. Like the distribution of stock returns, the distribution of wage growth is leptokurtic.[7]

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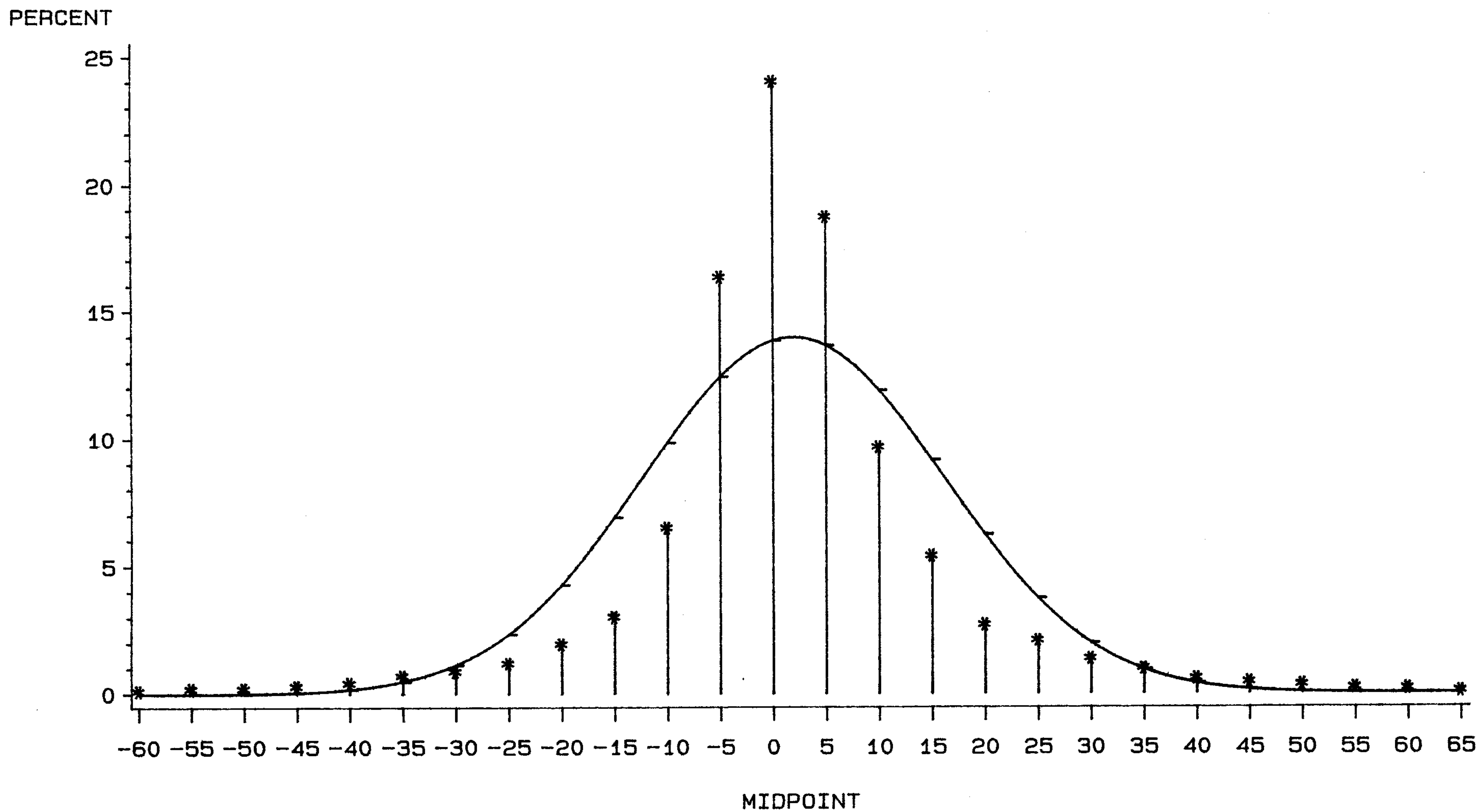
[6]In lines 5 and 6 of Table 3, I have divided stayers into job stayers and job changers within the firm. Even workers who stay on the same job within the firm have a standard deviation of real wage growth as large as 13.7.

[7]The wage growth distribution is well approximated by the generalized–t

**Figure 3**

# Wage Growth Distribution and Normal PDF

**Stayers**




**Annual Differences of Log Real Wage**
**PSID Data: 1976–1986**

A less dramatic feature of Figure 3 is the positive (or right) skew of the empirical wage growth distribution. A value of 0.11 for the skewness coefficient is sufficiently large to reject symmetry at the 1 percent level. Substantial positive skewness is present in the wage growth distributions of union (line 8) and minimum–wage (line 9) workers, but a test of symmetry is not rejected on the sample of non–union and non–minimum–wage workers in line 11.[8]

Despite the rejection of normality, I focus on the standard deviation to gauge the degree of wage flexibility.

*Intergroup Comparisons*

Several intergroup comparisons of wage growth are presented in panel B of Table 3. Evidence of union wage compression is presented in lines 7 and 8. The standard deviations of wage growth of union and non–union workers are 11.79 and 14.95, respectively. Also, the wage growth of union workers exhibits substantially more skewness and kurtosis than the wage growth of non–union workers. Although, union workers take real wage cuts in nearly the same proportion as non–union workers, the wage cuts are on average 2.5 percent smaller for union workers.

Other comparisons are fairly standard. In unreported results, I find that the old, experienced, and less educated take wage cuts more frequently than the young, inexperienced, and educated. How much of the diffuseness of the wage growth distribution is accountable to changes in these observables and time effects? On the sample of stayers, I estimate a wage–growth regression using education, experience, employment tenure, and union status as observables. The residuals from this regression are the estimates of $\Delta\epsilon_{ijt}$ in equation (6). The growth statistics for the residuals are

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distribution, a 4–parameter class of symmetric distributions that includes the normal as a member (McDonald and Newey 1988). Maximum–likelihood estimates of the 4 distributional parameters are available on request.

[8]Carlton (1986) investigates the rigidity of industrial prices among individual buyer–seller pairs. He finds "no evidence to support asymmetric price changes" (p. 649).

reported in line 12 of Table 3. The results indicate that nearly all of the variation in wage growth is due to random productivity shocks or reporting error.

*Reporting Error*

If the wage data were free of reporting error, or if the reporting error were limited to permanent and smoothing components, then the empirical wage–growth distributions would reveal remarkable variability. But how much error is present in the wage growth data?

As I indicated in Section IV, the wage data are relatively clean. Hourly workers report their straight–time hourly wages; salaried workers report their salaries.[9] Wages are not generated by dividing earnings by hours. A comparison of the wage–growth distribution with annual–earnings– and hourly–earnings–growth distributions attests to the quality of the wage data. The distribution of real annual–earnings growth (line 15 of Table 3) is much more diffuse than the distribution of real wage growth. Similarly, the standard deviation of real hourly–earnings growth (line 16 of Table 3) is 22.09, which is 56 percent larger than the standard deviation of real wage growth.

Although results of validation studies do not directly indicate the quality of the wage variable used here, evidence on earnings and hourly earnings reporting error can be exploited to investigate the quality of the wage growth data. The results, which are summarized and applied in the appendix, contain three important lessons for the current analysis.

First, earnings and earnings growth data are surprisingly reliable. Bound and

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[9]One source of error in my wage–growth variable might be induced by changes in mode of pay between surveys. Lines 13 and 14 of Table 3 report real wage–growth statistics for stayers who are paid an hourly wage in period t–1 ***and*** t, and for stayers who are paid salary in period t–1 ***and*** t. Stayers whose mode of pay changes between surveys (8 percent of the sample) are excluded. The results indicate that changes in mode of pay are not an important source of reported wage variability. The frequency of real wage cuts exceeds 42 percent for both hourly and salaried workers. The process generating wages of salaried workers appears to differ from the hourly workers' process as the salaried workers exhibit substantially more variability of wages.

Krueger (1989) use matched data from the Current Population Survey and social security earnings records in finding that 83 (93) percent of the variance in men's (women's) reported annual log–earnings is true variation rather than noise. (Bound, Brown, Duncan, and Rodgers (1989) report similar estimates.) The reliability of the data survives first differencing. The ratios of signal to signal–plus–noise for earnings growth of men and women are 0.78 and 0.85, respectively. Perhaps the "salary on the main job" data in the PSID are even more reliable.

Second, the reliability of the earnings data is underestimated because the covariance between the signal and noise is negative. That is, smoothing errors compress the distribution. For earnings growth in particular, the covariance is large and the signal–to–total–variance ratio ***exceeds*** one. (See the appendix.)

Third, average hourly earnings data are replete with error. Bound, Brown, Duncan, and Rodgers (1989) use the two waves of data from the PSID Validation Study of one large unionized manufacturing firm to estimate the degree of measurement error in hourly earnings data. They find that the ratio of signal to signal–plus–noise for hourly earnings ***growth*** of hourly workers is 0.13. Even with the large standard deviation of hourly earnings growth in the PSID, concern over the lack of reliability of the hourly workers' wage growth is probably warranted.

In the appendix, I apply the estimated reliabilities of earnings and hourly earnings to the sample of stayers in the PSID. The standard deviation of real wage growth falls from 14.18 to 12.85. (That the standard deviation falls so little is a result of the estimated high quality of the salaried workers' data.) Although there is some error in the wage growth data, a corrected standard deviation of real wage growth of nearly 13 reflects substantial flexibility.

What is the effect of the reporting–error corrections on the frequencies of real and nominal wage cuts and on the average sizes of the wage cuts? The following exercise demonstrates that substantial flexibility survives even a sizable degree of classical reporting error. Assume that the standard deviation of real wage growth falls from 14.18 to 10 as a result of correcting for reporting error. The wage growth observations are transformed as a ***mean preserving compression*** to generate a real wage–growth distribution with mean 1.90 and standard deviation 10, and a nominal wage–growth distribution with mean 7.72 and standard deviation 10. The frequency of real wage cuts falls from 43 percent to 39 percent, and the frequency of nominal wage cuts falls from 17 percent to 13 percent. Consequently, the estimated variance of reporting error renders neither real nor nominal wage cuts infrequent. However, the average sizes of the wage cuts falls more substantially. Correcting for reporting error reduces (a) the average real wage cut from 8.9 percent to 6.3 percent, and (b) the average nominal wage cut from 11.9 percent to 8.5 percent.

*Menu Costs*

The spike at zero nominal wage growth and kurtosis suggest menu costs to changing wages nominally. In addition to the 17 percent of the stayers exhibiting negative nominal wage growth, 7 percent report ***exactly*** zero nominal wage growth. (Zero percent of the stayers report ***exactly*** zero real wage growth.) The large kurtosis coefficients reported in Table 3 are also consistent with menu costs because small wage changes would be censored. I take this as some preliminary evidence of nominal wage rigidity resulting from menu costs.

In addition, small nominal wage increases to stayers are less frequent than slightly larger increases: the frequency of 0–1 percent wage raises for stayers is 1.6 percent, of 1–2 percent raises is 2.2 percent, of 2–3 percent raises is 2.8 percent, of 3–4 percent raises is 3.5 percent, of 4–5 percent raises is 4.6 percent, of 5–6 percent raises is 4.4 percent, and of 6–7 percent raises is 5.2 percent. However, analysis of wage cuts reveals the opposite pattern. Very small wage cuts are more frequent than slightly larger wage cuts.

Consider an alternative interpretation. For most workers, real wages are flexible even for small changes.[10] Indeed, small real wage increases (0–2 percent) comprise the mode of the real wage growth distribution. But for some workers, nominal wages are rigid. Mixing of the two distributions generates (a) the spike at zero in the nominal wage growth distribution, and (b) frequencies of nominal wage changes increasing in the size of the change up to about 6 percent (the average inflation rate in the sample).

*Wage–Cut Equations*

The wage–cut regressions developed in Section II provide an additional source of evidence on nominal rigidities. To estimate the wage–cut equations, I extend the sample back to 1970 and aggregate 24,879 observations on the wage growth of stayers to 16 time–series observations on the following variables: average nominal wage growth, average real wage growth, and the proportions of nominal and real wage cuts.[11] These four variables are supplemented with the growth rate of real output per man–hour and the inflation rate. Over the post–war period, I estimate a third–order autoregressive model of inflation to decompose the inflation rate into anticipated and unanticipated components.

In turning to estimates of the wage–cut equations, I note two fundamental properties of the wage–growth time series that drive the results. First, an OLS regression estimated on the sample of 16 annual observations reveals that nominal wage growth moves one–for–one with anticipated inflation $\pi_t^a$.[12]

[10]In his study of industrial price variability among individual buyer–seller pairs, Carlton (1986) finds that a substantial fraction of price changes are quite small, less than 1 percent in absolute value. He concludes: "... theories that postulate rigid prices solely because of a common high fixed cost of changing price to each buyer are not supported by the evidence" (p. 648).

[11]I have also estimated the wage–cut and wage–growth equations on the dis–aggregated data. None of the results presented in the text depends on the level of aggregation. I prefer aggregating the data because this highlights that the regressors of interest, the rates of inflation and productivity growth, do not vary across individuals at a point in time.

[12]These estimates are consistent with Card (1988) who finds evidence that in Canadian union contracts nominal wages are set in advance and are not fully indexed to the price level. My estimated effect of unanticipated inflation on nominal wage

$$\Delta\log W_t = \underset{(0.80)}{2.02} + \underset{(0.12)}{1.00}\,\pi_t^a + \underset{(0.15)}{0.40}\,\pi_t^u, \qquad R^2 = .72, \quad DW = 1.57, \qquad (10)$$

where $\pi_t^u$ denotes unanticipated inflation. (Standard errors in parentheses.) Second, although the relationship is weak, real wage growth increases with the growth rate of productivity $g_t$ (real output per man–hour).

$$\Delta\log (W_t/P_t) = \underset{(0.39)}{1.59} + \underset{(0.19)}{0.26}\,g_t, \qquad R^2 = .12, \quad DW = 2.51. \qquad (11)$$

Table 4 displays Minimum–$\chi^2$ probit estimates of the two wage–cut equations. In addition to imposing normality, this probit estimator weights the observations by the number of underlying observations used to compute each year's proportion, corrects for heteroskedasticity, and produces asymptotically correct standard errors. (OLS estimates are displayed for reference.) The estimated effects are broadly consistent with neoclassical wage determination. First, consider the effects of inflation. The frequency of nominal wage cuts is decreasing in inflation, both anticipated and unanticipated. Anticipated inflation has no effect of the frequency of real wage cuts. Unanticipated inflation, however, increases the frequency of real wage cuts; one percentage point of unanticipated inflation increases the frequency of real wage cuts by nearly 3 percentage points. Second, turn to the effects of productivity growth. That the estimated effects of productivity growth on the frequencies of nominal and real wage cuts are significantly negative is also consistent with flexible wages: productivity growth increases the probability of receiving a raise, both nominal and real.

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growth is consistent with 40 percent indexation to the price level.

TABLE 4

WAGE–CUT EQUATIONS[a]

| Variable | Nominal Wage Cuts | | | | Real Wage Cuts | | | |
|---|---|---|---|---|---|---|---|---|
| | OLS | | Probit | | OLS | | Probit | |
| Constant | 0.28<br>(0.04) | 0.28<br>(0.05) | −0.49<br>(0.04) | −0.45<br>(0.04) | 0.38<br>(0.06) | 0.43<br>(0.05) | −0.29<br>(0.03) | −0.14<br>(0.04) |
| Inflation | −1.92<br>(0.54) | | −8.07<br>(0.52) | | 1.02<br>(0.76) | | 2.28<br>(0.43) | |
| Anticipated Inflation | | −2.05<br>(0.64) | | −8.85<br>(0.60) | | 0.06<br>(0.67) | | −0.25<br>(0.50) |
| Unanticipated Inflation | | −1.67<br>(0.81) | (0.78) | −6.56<br>(0.85) | (0.64) | 2.91 | | 6.97 |
| Productivity Growth | −0.64<br>(0.78) | −0.59<br>(0.81) | −1.87<br>(0.87) | −1.84<br>(0.87) | −1.09<br>(1.08) | −0.72<br>(0.85) | −1.68<br>(0.70) | −1.45<br>(0.70) |
| Durbin–Watson | 1.45 | 1.28 | | | 1.97 | 1.53 | | |
| $R^2$ | .53 | .54 | | | .33 | .63 | | |
| Log–Likelihood | | | −10,809 | −10,806 | | | −16,969 | −16,920 |

[a]The sample consists of 16 time–series observations computed from 24,879 individual observations on nominal and real wage cuts. The "Probit" columns list Minimum–$\chi^2$ estimates of the probit coefficients and asymptotic standard errors.

## VI. Conclusions

Kehneman, Knetsch, and Thaler's (1986) public opinion survey reveals that individuals frequently find the "supply equals demand" equilibrium unfair. In particular, 77 percent respond that a profitable firm would be unfair to cut wages 5 percent in response to an incidence of severe unemployment; but only 32 percent would would find the cut unfair if the firm were unprofitable. Voicing the convictions of many that "the existence of wage stickiness is not in doubt" (p. 739), Kehneman, Knetsch, and Thaler use fairness as a behavioral explanation for wage rigidity. But is there room for doubt?

In this paper, I document that wage cuts are frequent. The primary evidence on the frequency of reported wage cuts in panel data reveals remarkable downward flexibility of real wages annually; even nominal wage cuts are not rare. In addition, aggregate wage cuts historically, as well as more recently, were common and sometimes deep. Union wage concessions are also observed.

Although there is clear evidence of wage variability, the wage data alone cannot determine whether wages are more or less flexible than productivity. Nevertheless, some forms of rigidities can be rejected by these data. For instance, the ***only*** evidence supporting nominal wage rigidity is a small spike at zero in the nominal wage growth distribution; and the evidence is inconsistent with menu costs.

It is unlikely that either the rigid–wage approach or the flexible–wage approach alone captures all the rich features of the labor market. However, these results indicate that wage flexibility is an empirically supportable benchmark. Whether neoclassical models of the labor market can capture other salient features remains a challenge. One challenge for the rigid–wage approach is in confronting the large degree of wage flexibility.

**Appendix**

The purpose of this appendix is to use the results from the validation studies of Bound and Krueger (1989) and Bound, Brown, Duncan, and Rodgers (1989) to correct the variance of wage growth in the PSID. With classical measurement error, the exercise would be straightforward; but with mean–reverting errors generating a negative covariance between the signal and noise, the analysis is more complicated. In the more general case the ratio of signal variance to total variance can exceed one. Indeed, this is the case for annual earnings growth in Bound and Krueger's study.

*Measures of Reliability*

Let wage growth $\Delta W$ be the sum of the changes in the signal $\Delta\eta$ and changes in the noise $\Delta\nu$. Most generally, the variance of wage growth is $\sigma^2_{\Delta W} \equiv \sigma^2_{\Delta\eta} + \sigma^2_{\Delta\nu} + 2\sigma_{\Delta\eta,\Delta\nu}$. If the noise is classical measurement error, then the covariance is zero.

The two validation studies report several measures of the reliability of earnings and hourly earnings data. Two measures are important here.

$$\text{(A1)} \qquad \lambda_1 \equiv \frac{\sigma^2_{\Delta\eta}}{\sigma^2_{\Delta\eta} + \sigma^2_{\Delta\nu}}$$

$$\text{(A2)} \qquad \lambda_2 \equiv \frac{\sigma^2_{\Delta\eta} + \sigma_{\Delta\eta,\Delta\nu}}{\sigma^2_{\Delta\eta} + \sigma^2_{\Delta\nu} + 2\sigma_{\Delta\eta,\Delta\nu}} \equiv \frac{\sigma^2_{\Delta\eta} + \sigma_{\Delta\eta,\Delta\nu}}{\sigma^2_{\Delta W}}$$

The first reliability statistic $\lambda_1$ is the signal–to–noise ratio transformed to lie between zero and one. The second reliability statistic $\lambda_2$ generalizes $\lambda_1$ for the non–zero covariance. Because $\lambda_2$ is the ratio of (a) the covariance between wage growth and the signal to (b) the variance of wage growth, it is the slope coefficient of a least squares regression of the signal on wage growth. As such, $1-\lambda_2$ is the attenuation bias resulting from using reported wage growth as a regressor.

A third measure of reliability is appropriate for correcting the variance of observed wage growth. Let $\lambda^*$ denote the signal–to–total–variance ratio.

$$\text{(A3)} \qquad \lambda^* \equiv \frac{\sigma^2_{\Delta\eta}}{\sigma^2_{\Delta\eta} + \sigma^2_{\Delta\nu} + 2\sigma_{\Delta\eta,\Delta\nu}} \equiv \frac{\sigma^2_{\Delta\eta}}{\sigma^2_{\Delta W}}$$

If the covariance term is negative and large relative to the variance of the noise, $\lambda^* > 1$. Although, the validation studies do not report $\lambda^*$, $\lambda^*$ is easily computed using the reported values of $\lambda_1$ and $\lambda_2$.

$$\text{(A4)} \qquad \lambda^* \equiv \left[\frac{2\lambda_2 - 1}{2\lambda_1 - 1}\right] \cdot \lambda_1$$

*Applying the Validation Results*

Although the validation studies do not directly indicate the quality of the straight–time wage variable in the PSID, evidence on the reliability of the earnings and hourly earnings data can be exploited to estimate the quality of the wage growth data. The method is to apply the $\lambda^*$ of earnings growth ($\lambda^*_E$) to correct salaried workers' wage growth and the $\lambda^*$ of hourly earnings growth ($\lambda^*_H$) to correct hourly workers' wage growth.

Bound and Krueger (1989, Table 6), using matched data from the Current Population Survey and social security earnings records, report $\lambda^E_1 = 0.648$ and $\lambda^E_2$ of 0.775 for men. The two reliability statistics are 0.814 and 0.848 for women. Equation (A4) implies that $\lambda^*_E$ is 1.20 for men and 0.90 for women. Although men's reports contain substantially more error than women's, the variance of earnings growth is ***understated*** for men due to the strong smoothing component of the men's errors. In Bound and Krueger's data and my PSID data, men comprise 80 percent of the sample. Consequently, the weighted average of the two signal–to–total–variance ratios is 1.14. This ratio ***inflates*** the standard deviation of earnings growth of stayers in the PSID from 20.74 to 22.14. If the signal–to–total–variance ratios are the same for earnings growth and wage growth of salaried workers, then the standard deviation of salaried workers' wage growth grows from 16.23 to 17.33.

Bound, Brown, Duncan, and Rodgers (1989, Table 2), using the two waves of data from the PSID Validation Study of one large unionized manufacturing firm, report the degree of measurement error in hourly earnings growth data. (Their results are similar to Bound and Krueger in validating the quality of earnings and earnings growth data.) They find that average hourly earnings data are replete with error. In particular, $\lambda_1^H = 0.179$ and $\lambda_2^H = 0.130$, which implies that the covariance between the signal and noise is positive in hourly earnings growth. Equation (A4) implies that $\lambda_H^* = 0.113$. This factor deflates the standard deviation of hourly earnings growth of stayers in the PSID from 22.81 to 7.67.

Perhaps the best estimate of the standard deviation of true wage growth in the PSID is obtained from the weighted average of the salaried and hourly workers' corrected variances of wage growth. Such a computation yields a corrected standard deviation of wage growth equal to 12.85.[13]

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[13]A second method for estimating the true variance of wage growth is to employ a control group for which the variance of the error is known. If the reporting error process is common across groups, the true variances of wage growth for other groups are identified. A variant of this method can be applied to minimum wage workers. If few minimum wage stayers report nominal wage cuts, the reporting error component is likely to be small. The results in line 10 of Table 3 indicate that workers at or below the minimum wage in period t–1 are about 43 percent less likely to take nominal wage cuts than non–minimum–wage workers.

How much reporting error would be required to generate a nominal wage–cut frequency of 10.1 percent if ***no*** wage cuts occurred? Adopt the counter–factual assumption that wage growth of minimum wage workers is normally distributed, and let the mean take on its value in the data, 13.84. A standard deviation of the change in classical reporting error of 10.85 produces a 10.1 percent frequency of wage cuts. This implies that the standard deviation of real wage growth falls from 14.18 to 9.13.

The estimate based on the frequency of nominal wage cuts of minimum wage workers is consistent with the evidence from the validation studies regarding hourly earnings of hourly workers. Moreover, since some of the observed nominal wage cuts of "minimum wage" workers are likely to be true, the estimated reporting error component is likely to be overstated.

# APPENDIX

## HISTORICAL WAGE CUTS

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Average Earnings Nonfarm Employees: 1860–1900[a] | | | | | | |
| Annual, Nominal | (D735) | 1865 | 1867 | 512 | 479 | 6.45 |
| | | 1868 | 1871 | 499 | 482 | 3.41 |
| | | 1872 | 1879 | 486 | 373 | 23.25 |
| | | 1892 | 1894 | 482 | 420 | 12.86 |
| Annual, Real | (D736) | 1860 | 1863 | 457 | 382 | 12.04 |
| | | 1864 | 1866 | 421 | 322 | 23.52 |
| | | 1869 | 1870 | 380 | 375 | 1.32 |
| | | 1872 | 1877 | 416 | 388 | 6.73 |
| | | 1878 | 1879 | 397 | 391 | 1.51 |
| | | 1887 | 1888 | 509 | 505 | 0.79 |
| | | 1892 | 1894 | 527 | 484 | 8.16 |
| Daily, Nominal | (D738) | 1865 | 1867 | 1.54 | 1.44 | 6.49 |
| | | 1868 | 1871 | 1.50 | 1.45 | 3.33 |
| | | 1872 | 1879 | 1.46 | 1.12 | 23.29 |
| Average Annual Earnings of All Employees: 1900–1960[a] | | | | | | |
| Nominal, After Deduction for Unemployment | (D723) | 1903 | 1904 | 441 | 432 | 2.04 |
| | | 1907 | 1908 | 502 | 446 | 11.16 |
| | | 1913 | 1915 | 587 | 547 | 6.81 |
| | | 1920 | 1922 | 1236 | 1067 | 13.67 |
| | | 1923 | 1924 | 1231 | 1196 | 2.84 |
| | | 1927 | 1928 | 1312 | 1297 | 1.14 |
| | | 1929 | 1933 | 1356 | 678 | 50.00 |
| | | 1937 | 1938 | 1008 | 901 | 10.62 |
| Nominal, When Employed | (D724) | 1907 | 1908 | 529 | 519 | 1.89 |
| | | 1914 | 1915 | 639 | 635 | 0.63 |
| | | 1920 | 1922 | 1342 | 1190 | 11.33 |
| | | 1929 | 1933 | 1425 | 1045 | 26.67 |
| Real, After Deduction for Unemployment | (D725) | 1902 | 1904 | 506 | 486 | 3.95 |
| | | 1906 | 1908 | 541 | 487 | 9.98 |
| | | 1913 | 1915 | 594 | 541 | 8.97 |
| | | 1919 | 1921 | 648 | 566 | 12.65 |
| | | 1923 | 1924 | 725 | 702 | 3.17 |
| | | 1929 | 1933 | 793 | 526 | 33.67 |
| | | 1937 | 1938 | 704 | 641 | 8.95 |
| | | 1945 | 1947 | 1284 | 1108 | 13.71 |
| Real, When Employed | (D726) | 1902 | 1904 | 547 | 541 | 1.10 |
| | | 1913 | 1915 | 640 | 628 | 1.85 |
| | | 1916 | 1917 | 648 | 632 | 2.47 |
| | | 1918 | 1919 | 663 | 662 | 0.15 |
| | | 1924 | 1925 | 759 | 753 | 0.79 |
| | | 1931 | 1934 | 857 | 800 | 6.65 |
| | | 1945 | 1947 | 1318 | 1168 | 11.38 |
| Average Annual Earnings of Full-Time Employees: 1900–1970[b] | | | | | | |
| All Industries | (D722) | 1907 | 1908 | 529 | 519 | 1.89 |
| | | 1914 | 1915 | 639 | 635 | 0.63 |
| | | 1920 | 1922 | 1342 | 1190 | 11.33 |
| | | 1929 | 1933 | 1405 | 1048 | 25.41 |
| | | 1937 | 1938 | 1258 | 1230 | 2.23 |



| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Agriculture, Forestry, & Fisheries | (D739) | 1904 | 1905 | 221 | 199 | 0.90 |
| | | 1920 | 1922 | 528 | 331 | 37.31 |
| | | 1929 | 1933 | 401 | 232 | 42.14 |
| | | 1948 | 1950 | 1340 | 1282 | 4.33 |
| | | 1952 | 1954 | 1423 | 1346 | 5.41 |
| Manufacturing | (D740) | 1903 | 1904 | 548 | 538 | 1.82 |
| | | 1907 | 1908 | 598 | 548 | 8.36 |
| | | 1910 | 1911 | 651 | 632 | 2.92 |
| | | 1920 | 1922 | 1532 | 1283 | 16.25 |
| | | 1929 | 1933 | 1543 | 1086 | 29.62 |
| | | 1937 | 1938 | 1376 | 1296 | 5.81 |
| Total Mining | (D741) | 1903 | 1904 | 619 | 599 | 3.23 |
| | | 1907 | 1908 | 697 | 590 | 15.35 |
| | | 1913 | 1914 | 749 | 666 | 11.08 |
| | | 1921 | 1922 | 1757 | 1300 | 26.01 |
| | | 1923 | 1925 | 1822 | 1580 | 13.28 |
| | | 1926 | 1928 | 1526 | 990 | 35.12 |
| | | 1937 | 1938 | 1366 | 1282 | 6.15 |
| | | 1948 | 1949 | 3396 | 3216 | 5.30 |
| Anthracite Coal | (D742) | 1901 | 1902 | 420 | 298 | 29.05 |
| | | 1904 | 1906 | 638 | 550 | 29.47 |
| | | 1907 | 1908 | 633 | 553 | 12.64 |
| | | 1911 | 1912 | 633 | 615 | 2.84 |
| | | 1913 | 1914 | 659 | 636 | 3.49 |
| | | 1925 | 1929 | 2129 | 1728 | 18.84 |
| | | 1930 | 1933 | 1750 | 1435 | 18.00 |
| | | 1934 | 1938 | 1500 | 1315 | 12.33 |
| | | 1939 | 1940 | 1409 | 1297 | 7.95 |
| | | 1948 | 1949 | 3420 | 2896 | 15.32 |
| Bituminous Coal | (D743) | 1903 | 1904 | 615 | 554 | 9.92 |
| | | 1907 | 1908 | 683 | 574 | 15.96 |
| | | 1910 | 1912 | 633 | 615 | 2.84 |
| | | 1913 | 1914 | 743 | 640 | 13.86 |
| | | 1918 | 1919 | 1427 | 1276 | 10.58 |
| | | 1921 | 1922 | 1808 | 1165 | 35.56 |
| | | 1923 | 1925 | 1848 | 1427 | 22.78 |
| | | 1927 | 1932 | 1446 | 723 | 50.00 |
| | | 1937 | 1938 | 1170 | 1050 | 10.26 |
| | | 1948 | 1949 | 3383 | 2930 | 13.39 |
| | | 1951 | 1952 | 3831 | 3760 | 1.85 |
| Metal Mining | (D744) | 1921 | 1922 | 1482 | 1345 | 9.24 |
| | | 1923 | 1924 | 1497 | 1378 | 7.95 |
| | | 1929 | 1933 | 1613 | 1040 | 35.52 |
| Construction | (D745) | 1910 | 1911 | 804 | 779 | 3.11 |
| | | 1914 | 1915 | 838 | 827 | 1.31 |
| | | 1920 | 1922 | 1710 | 1297 | 24.15 |
| | | 1928 | 1933 | 1719 | 869 | 49.45 |
| | | 1937 | 1938 | 1278 | 1193 | 6.65 |
| | | 1944 | 1946 | 2602 | 2537 | 2.50 |
| Total Transportation | (D746) | 1903 | 1904 | 615 | 554 | 9.92 |
| | | 1907 | 1908 | 683 | 574 | 15.96 |
| | | 1910 | 1912 | 633 | 615 | 2.84 |
| | | 1913 | 1914 | 743 | 640 | 13.86 |
| | | 1918 | 1919 | 1427 | 1276 | 10.58 |
| | | 1921 | 1922 | 1808 | 1165 | 35.56 |
| | | 1929 | 1933 | 1643 | 1334 | 18.81 |
| Railroad | (D747) | 1904 | 1905 | 587 | 576 | 1.87 |
| | | 1920 | 1922 | 1807 | 1630 | 9.80 |
| | | 1923 | 1924 | 1631 | 1627 | 0.25 |
| | | 1929 | 1933 | 1749 | 1439 | 17.72 |
| | | 1944 | 1945 | 2714 | 2711 | 0.11 |

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Water Transportation | (D748) | 1908 | 1911 | 427 | 417 | 2.34 |
| | | 1920 | 1922 | 1499 | 1088 | 27.42 |
| | | 1926 | 1927 | 1238 | 1220 | 1.45 |
| | | 1929 | 1932 | 1275 | 1038 | 18.59 |
| | | 1933 | 1934 | 1059 | 1055 | 0.38 |
| | | 1937 | 1938 | 1537 | 1299 | 15.48 |
| | | 1944 | 1946 | 3624 | 3415 | 5.77 |
| | | 1948 | 1949 | 3467 | 3421 | 1.33 |
| | | 1953 | 1954 | 5142 | 5093 | 0.95 |
| Local Transportation | (D749) | 1900 | 1902 | 510 | 487 | 4.51 |
| | | 1906 | 1908 | 559 | 549 | 1.79 |
| | | 1921 | 1922 | 1470 | 1394 | 5.17 |
| | | 1929 | 1933 | 1598 | 1219 | 23.72 |
| | | 1939 | 1940 | 1569 | 1559 | 0.64 |
| Total Communications & Public Utilities | (D750) | 1901 | 1902 | 496 | 473 | 5.24 |
| | | 1904 | 1905 | 487 | 477 | 2.05 |
| | | 1907 | 1908 | 521 | 516 | 0.96 |
| | | 1909 | 1910 | 531 | 516 | 2.82 |
| | | 1911 | 1912 | 658 | 527 | 19.91 |
| | | 1931 | 1933 | 1514 | 1351 | 10.77 |
| Gas & Electric | (D751) | 1906 | 1907 | 617 | 589 | 4.54 |
| | | 1911 | 1912 | 641 | 635 | 0.94 |
| | | 1913 | 1915 | 654 | 637 | 2.60 |
| | | 1921 | 1922 | 1497 | 1423 | 4.94 |
| | | 1928 | 1929 | 1591 | 1589 | 0.13 |
| | | 1930 | 1933 | 1603 | 1453 | 9.36 |
| Telephone & Telegraph | (D752) | 1902 | 1903 | 444 | 443 | 0.23 |
| | | 1909 | 1910 | 488 | 461 | 5.53 |
| | | 1911 | 1912 | 488 | 467 | 4.30 |
| | | 1931 | 1933 | 1436 | 1245 | 13.30 |
| Wholesale/Retail Trade | (D753) | 1929 | 1933 | 1594 | 1183 | 25.78 |
| Finance, Insurance, & Real Estate | (D754) | 1900 | 1901 | 1040 | 1037 | 0.29 |
| | | 1911 | 1912 | 1355 | 1338 | 1.25 |
| | | 1917 | 1918 | 1932 | 1896 | 1.86 |
| | | 1929 | 1933 | 2062 | 1555 | 24.59 |
| | | 1937 | 1940 | 1788 | 1725 | 3.52 |
| Total Services | (D755) | 1920 | 1921 | 912 | 905 | 0.77 |
| | | 1929 | 1933 | 1079 | 854 | 20.85 |
| Personal Services | (D756) | 1920 | 1921 | 940 | 932 | 0.85 |
| | | 1929 | 1933 | 1219 | 889 | 27.07 |
| Medical & Other Health Services | (D757) | 1921 | 1923 | 983 | 845 | 14.04 |
| | | 1930 | 1934 | 933 | 801 | 14.15 |
| Domestic Services | (D758) | 1913 | 1915 | 357 | 342 | 4.20 |
| | | 1920 | 1921 | 665 | 649 | 2.41 |
| | | 1927 | 1928 | 756 | 725 | 4.10 |
| | | 1929 | 1933 | 731 | 460 | 37.07 |
| Nonprofit Services | (D759) | 1900 | 1901 | 652 | 651 | 0.15 |
| | | 1904 | 1905 | 679 | 677 | 0.29 |
| | | 1908 | 1910 | 743 | 715 | 3.77 |
| | | 1929 | 1934 | 1712 | 1440 | 15.89 |
| Educational Services | (D760) | 1903 | 1904 | 532 | 509 | 4.32 |
| | | 1930 | 1935 | 1329 | 1162 | 12.57 |
| | | 1947 | 1948 | 2113 | 2002 | 5.25 |
| Total Government | (D761) | 1900 | 1901 | 584 | 572 | 2.05 |
| | | 1914 | 1915 | 798 | 753 | 5.63 |
| | | 1930 | 1934 | 1553 | 1284 | 17.32 |
| | | 1935 | 1938 | 1355 | 1336 | 1.40 |



| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| State & Local Gov't | (D762) | 1930 | 1935 | 1521 | 1290 | 15.19 |
| Public Education Government | (D763) | 1931 | 1935 | 1463 | 1293 | 11.62 |
| | | 1938 | 1939 | 1406 | 1403 | 0.21 |
| Federal Civilian Government | (D764) | 1904 | 1905 | 1009 | 971 | 3.77 |
| | | 1920 | 1921 | 1707 | 1683 | 1.41 |
| | | 1929 | 1933 | 1993 | 1673 | 16.06 |
| | | 1936 | 1937 | 1896 | 1797 | 5.22 |
| Average Annual Earnings: 1890–1926[c] | | | | | | |
| All Industries | (D779) | 1892 | 1894 | 445 | 400 | 10.11 |
| | | 1895 | 1896 | 415 | 411 | 0.96 |
| | | 1907 | 1908 | 542 | 516 | 4.80 |
| | | 1920 | 1922 | 1407 | 1201 | 14.64 |
| All Industries excl. Farm Labor | (D780) | 1892 | 1894 | 495 | 448 | 9.50 |
| | | 1895 | 1896 | 468 | 462 | 1.28 |
| | | 1903 | 1904 | 543 | 540 | 0.55 |
| | | 1907 | 1908 | 595 | 563 | 5.38 |
| | | 1920 | 1922 | 1489 | 1305 | 12.36 |
| Wage Earners, Manufacturing | (D781) | 1892 | 1894 | 446 | 386 | 13.45 |
| | | 1895 | 1896 | 416 | 406 | 2.40 |
| | | 1907 | 1908 | 522 | 475 | 9.00 |
| | | 1910 | 1911 | 558 | 537 | 3.76 |
| | | 1920 | 1922 | 1358 | 1149 | 15.39 |
| Wage Earners, Steam Railroads | (D782) | 1890 | 1891 | 560 | 554 | 1.07 |
| | | 1893 | 1898 | 563 | 542 | 3.73 |
| | | 1904 | 1905 | 600 | 589 | 1.83 |
| | | 1908 | 1909 | 667 | 644 | 3.45 |
| | | 1920 | 1924 | 1817 | 1570 | 13.59 |
| Street Railroads | (D783) | 1890 | 1891 | 557 | 529 | 5.03 |
| | | 1892 | 1894 | 535 | 508 | 5.05 |
| | | 1900 | 1902 | 604 | 576 | 4.64 |
| | | 1906 | 1908 | 662 | 650 | 1.81 |
| | | 1920 | 1922 | 1608 | 1436 | 10.70 |
| Telephones | (D784) | 1902 | 1904 | 408 | 392 | 3.92 |
| | | 1909 | 1910 | 430 | 417 | 3.02 |
| Telegraphs | (D785) | 1908 | 1909 | 639 | 622 | 2.66 |
| | | 1916 | 1917 | 806 | 769 | 4.49 |
| | | 1921 | 1922 | 1159 | 1110 | 4.23 |
| Gas & Electricity | (D786) | 1890 | 1891 | 687 | 587 | 14.56 |
| | | 1894 | 1895 | 670 | 640 | 4.48 |
| | | 1897 | 1899 | 703 | 612 | 12.95 |
| | | 1900 | 1905 | 620 | 543 | 12.42 |
| | | 1907 | 1908 | 623 | 595 | 4.49 |
| | | 1911 | 1912 | 648 | 641 | 1.08 |
| | | 1913 | 1915 | 661 | 644 | 2.57 |
| | | 1920 | 1922 | 1432 | 1343 | 6.22 |
| Clerical | (D787) | 1898 | 1899 | 1010 | 1004 | 10.50 |
| | | 1900 | 1901 | 1011 | 1009 | 0.20 |
| | | 1905 | 1906 | 1076 | 1074 | 0.20 |
| | | 1911 | 1912 | 1213 | 1209 | 0.33 |
| | | 1920 | 1922 | 2160 | 2067 | 4.31 |
| Bituminous Coal | (D788) | 1892 | 1894 | 393 | 292 | 25.70 |
| | | 1895 | 1897 | 307 | 270 | 12.05 |
| | | 1903 | 1904 | 522 | 470 | 9.96 |
| | | 1910 | 1911 | 558 | 553 | 0.90 |
| | | 1913 | 1914 | 631 | 543 | 13.95 |
| | | 1918 | 1919 | 1211 | 1097 | 9.41 |
| | | 1920 | 1922 | 1386 | 954 | 31.17 |
| | | 1923 | 1924 | 1246 | 1120 | 10.11 |

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Farm Labor | (D789) | 1892 | 1894 | 238 | 214 | 10.08 |
| | | 1913 | 1914 | 360 | 351 | 2.50 |
| | | 1920 | 1922 | 810 | 508 | 12.59 |
| Federal Employees | (D790) | 1894 | 1899 | 1110 | 1017 | 8.38 |
| | | 1903 | 1904 | 1067 | 1066 | 0.09 |
| | | 1920 | 1921 | 1648 | 1593 | 3.34 |
| Postal Workers | (D791) | 1897 | 1899 | 950 | 924 | 2.74 |
| | | 1901 | 1903 | 936 | 928 | 0.85 |
| | | 1905 | 1906 | 935 | 921 | 1.50 |
| | | 1921 | 1922 | 1870 | 1844 | 1.39 |
| Ministers | (D793) | 1890 | 1891 | 794 | 786 | 1.08 |
| | | 1894 | 1899 | 824 | 722 | 12.38 |
| | | 1900 | 1901 | 731 | 730 | 0.14 |
| | | 1903 | 1904 | 761 | 759 | 0.26 |
| | | 1908 | 1910 | 833 | 802 | 3.72 |
| Average Hourly Earnings (cents): 1890–1926[c] | | | | | | |
| Total Manufacturing | (D766) | 1893 | 1894 | 20.5 | 20.0 | 2.24 |
| | | 1896 | 1897 | 20.5 | 20.3 | 0.98 |
| | | 1907 | 1908 | 25.7 | 25.0 | 2.72 |
| | | 1920 | 1922 | 66.3 | 54.7 | 17.50 |
| Union Manufacturing | (D768) | 1892 | 1894 | 33.3 | 32.6 | 2.10 |
| | | 1907 | 1908 | 39.6 | 38.8 | 2.02 |
| Payroll Manufacturing | (D770) | 1890 | 1892 | 14.9 | 14.7 | 1.34 |
| | | 189 | 1894 | 15.1 | 14.0 | 7.28 |
| | | 1896 | 1897 | 14.3 | 14.1 | 1.40 |
| | | 1903 | 1904 | 16.7 | 16.4 | 1.80 |
| | | 1906 | 1907 | 18.6 | 17.5 | 5.91 |
| | | 1914 | 1915 | 21.3 | 21.2 | 0.47 |
| | | 1920 | 1922 | 56.1 | 44.3 | 21.03 |
| | | 1924 | 1926 | 50.2 | 48.8 | 2.79 |
| Bituminous Coal Mining | (D772) | 1890 | 1891 | 18.0 | 16.9 | 6.11 |
| | | 1893 | 1897 | 18.8 | 13.8 | 26.60 |
| | | 1906 | 1907 | 29.3 | 28.8 | 1.71 |
| | | 1908 | 1909 | 29.3 | 29.2 | 0.34 |
| | | 1912 | 1913 | 32.0 | 31.6 | 1.25 |
| Railroads, Full–Time | (D773) | 1892 | 1895 | 11.46 | 11.22 | 2.09 |
| | | 1920 | 1923 | 34.14 | 30.24 | 11.42 |
| Unionized Building Trades | (D775) | 1892 | 1894 | 34.8 | 33.9 | 2.59 |
| | | 1921 | 1922 | 107.6 | 100.6 | 7.01 |
| Postal Employees | (D777) | 1898 | 1899 | 37.6 | 37.0 | 1.60 |
| | | 1901 | 1903 | 37.5 | 37.2 | 0.80 |
| | | 1905 | 1905 | 37.5 | 36.9 | 1.60 |
| | | 1921 | 1922 | 75.9 | 74.8 | 1.45 |
| Daily Wages in Manufacturing: 1860–1880[d] | | | | | | |
| Skilled Occupations | (D728) | 1866 | 1868 | 2.62 | 2.58 | 1.53 |
| | | 1872 | 1878 | 2.64 | 2.15 | 18.56 |
| Blacksmiths | (D729) | 1866 | 1867 | 2.74 | 2.69 | 1.82 |
| | | 1873 | 1879 | 2.70 | 2.21 | 18.15 |
| Carpenters | (D730) | 1866 | 1868 | 2.77 | 2.67 | 3.61 |
| | | 1872 | 1878 | 2.59 | 2.03 | 21.62 |
| Engineers | (D731) | 1866 | 1868 | 2.44 | 2.35 | 3.39 |
| | | 1872 | 1878 | 2.53 | 2.06 | 18.58 |



| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Machinists | (D732) | 1867 | 1868 | 2.73 | 2.66 | 2.56 |
| | | 1873 | 1878 | 2.73 | 2.29 | 16.12 |
| Painters | (D733) | 1872 | 1878 | 2.70 | 2.04 | 24.44 |
| Laborers | (D734) | 1867 | 1868 | 1.53 | 1.51 | 1.31 |
| | | 1869 | 1871 | 1.53 | 1.50 | 1.96 |
| | | 1873 | 1878 | 1.52 | 1.26 | 17.11 |
| Average Full–Time Annual Earnings: 1889–1914[e] | | | | | | |
| All Industries | (D845) | 1892 | 1894 | 431 | 376 | 12.76 |
| | | 1903 | 1904 | 481 | 471 | 2.08 |
| | | 1907 | 1908 | 538 | 482 | 10.41 |
| | | 1913 | 1914 | 585 | 574 | 1.88 |
| Average Hourly Earnings (cents): 1889–1914[e] | | | | | | |
| All Manufacturing | (D848) | 1893 | 1895 | 15.1 | 13.8 | 8.61 |
| | | 1896 | 1898 | 14.4 | 13.7 | 4.86 |
| | | 1903 | 1904 | 17.0 | 16.9 | 0.59 |
| | | 1907 | 1908 | 19.1 | 18.4 | 3.66 |
| | | 1913 | 1914 | 22.1 | 22.0 | 0.45 |
| All Textiles | (D850) | 1893 | 1895 | 11.7 | 10.5 | 0.85 |
| | | 1896 | 1898 | 10.8 | 10.4 | 3.70 |
| | | 1903 | 1904 | 12.2 | 11.8 | 3.28 |
| | | 1907 | 1908 | 13.4 | 13.2 | 1.49 |
| Cotton | (D852) | 1894 | 1895 | 10.4 | 9.5 | 8.65 |
| | | 1897 | 1898 | 9.7 | 9.1 | 6.19 |
| | | 1904 | 1905 | 10.7 | 10.3 | 3.74 |
| | | 1907 | 1909 | 12.4 | 11.8 | 4.84 |
| Wool | (D854) | 1893 | 1894 | 13.3 | 11.7 | 12.03 |
| | | 1896 | 1897 | 12.3 | 12.0 | 2.44 |
| | | 1903 | 1902 | 13.9 | 13.7 | 1.44 |
| Silk | (D856) | 1891 | 1892 | 12.2 | 11.7 | 4.10 |
| | | 1894 | 1895 | 12.2 | 11.2 | 8.20 |
| | | 1896 | 1898 | 12.3 | 11.3 | 8.13 |
| | | 1899 | 1901 | 11.4 | 10.8 | 5.26 |
| | | 1907 | 1908 | 13.8 | 12.4 | 10.14 |
| Hosiery & Knit Goods | (D858) | 1893 | 1895 | 10.6 | 9.9 | 6.60 |
| | | 1896 | 1897 | 10.0 | 9.5 | 5.00 |
| | | 1903 | 1904 | 11.0 | 10.7 | 2.73 |
| | | 1907 | 1908 | 12.3 | 12.2 | 0.81 |
| Dyeing & Finishing Textiles | (D860) | 1893 | 1895 | 16.8 | 15.4 | 8.33 |
| | | 1896 | 1897 | 15.8 | 15.0 | 5.06 |
| | | 1898 | 1899 | 15.4 | 15.1 | 1.95 |
| | | 1906 | 1907 | 16.8 | 16.6 | 1.19 |
| Boots & Shoes | (D862) | 1890 | 1891 | 16.1 | 15.9 | 1.24 |
| | | 1893 | 1898 | 16.4 | 14.2 | 13.41 |
| | | 1903 | 1904 | 16.5 | 16.3 | 1.21 |
| | | 1907 | 1908 | 18.5 | 18.4 | 0.54 |
| Leather | (D864) | 1891 | 1894 | 17.5 | 15.9 | 9.14 |
| | | 1896 | 1899 | 16.2 | 15.1 | 6.79 |
| | | 1904 | 1905 | 16.1 | 15.9 | 1.24 |
| Electrical Machinery | (D866) | 1880 | 1898 | 17.4 | 17.2 | 1.15 |
| | | 1903 | 1904 | 20.5 | 19.6 | 4.39 |
| | | 1908 | 1909 | 21.0 | 20.8 | 0.95 |

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Paper & Paper Products | (D868) | 1890 | 1891 | 12.0 | 11.9 | 0.89 |
| | | 1893 | 1895 | 12.5 | 11.9 | 4.80 |
| | | 1896 | 1898 | 12.1 | 11.2 | 7.44 |
| | | 1902 | 1903 | 13.6 | 13.3 | 2.21 |
| Rubber | (D870) | 1890 | 1892 | 15.8 | 15.3 | 3.17 |
| | | 1893 | 1895 | 16.3 | 15.2 | 6.75 |
| | | 1896 | 1897 | 16.0 | 15.7 | 1.88 |
| | | 1899 | 1900 | 15.8 | 15.7 | 0.63 |
| | | 1901 | 1902 | 16.3 | 16.0 | 1.84 |
| Glass | (D872) | 1902 | 1903 | 21.0 | 19.9 | 0.48 |
| | | 1905 | 1906 | 22.5 | 22.1 | 1.78 |
| | | 1908 | 1909 | 23.5 | 22.3 | 5.11 |
| Foundry & Machine Shops | (D874) | 1891 | 1892 | 19.0 | 18.6 | 2.11 |
| | | 1893 | 1897 | 18.8 | 17.3 | 7.98 |
| | | 1898 | 1899 | 17.5 | 17.3 | 1.14 |
| | | 1903 | 1904 | 20.2 | 20.0 | 0.99 |
| Iron & Steel | (D876) | 1893 | 1895 | 17.2 | 15.3 | 11.05 |
| | | 1896 | 1897 | 15.8 | 15.4 | 2.53 |
| | | 1902 | 1904 | 20.3 | 19.2 | 5.42 |
| | | 1913 | 1914 | 27.4 | 26.6 | 2.92 |

Average Weekly Earnings of Manufacturing Production Workers: 1914–1948[f]

| | | | | | | |
|---|---|---|---|---|---|---|
| All | (D832) | 1920 | 1921 | 29.39 | 23.77 | 19.12 |
| | | 1923 | 1924 | 26.61 | 26.43 | 0.68 |
| | | 1929 | 1932 | 28.55 | 17.05 | 40.28 |
| | | 1937 | 1938 | 26.80 | 24,43 | 8.84 |
| | | 1944 | 1946 | 48.83 | 47.55 | 2.62 |
| Male | (D835) | 1920 | 1921 | 31.69 | 25.35 | 20.01 |
| | | 1923 | 1924 | 28.39 | 28.27 | 0.42 |
| | | 1929 | 1932 | 30.64 | 17.96 | 41.32 |
| | | 1937 | 1938 | 28.72 | 26.07 | 9.23 |
| Female | (D838) | 1920 | 1921 | 17.71 | 15.63 | 11.75 |
| | | 1927 | 1928 | 17.37 | 17.15 | 1.27 |
| | | 1929 | 1932 | 17.61 | 11.73 | 33.39 |
| | | 1937 | 1938 | 17.02 | 15.69 | 7.81 |
| Unskilled, Male | (D841) | 1920 | 1921 | 26.06 | 20.28 | 22.18 |
| | | 1929 | 1932 | 24.40 | 14.48 | 40.66 |
| | | 1937 | 1938 | 22.41 | 20.67 | 7.76 |
| | | 1944 | 1946 | 41.07 | 40.86 | 0.51 |
| Skilled & Semi-Skilled Male | (D844) | 1920 | 1921 | 34.10 | 27.36 | 19.77 |
| | | 1923 | 1924 | 30.81 | 30.55 | 0.84 |
| | | 1926 | 1927 | 31.61 | 31.51 | 0.32 |
| | | 1929 | 1932 | 32.60 | 19.48 | 40.25 |
| | | 1937 | 1938 | 30.39 | 27.49 | 9.54 |
| | | 1944 | 1946 | 57.85 | 53.10 | 8.21 |

Average Hourly Earnings of Manufacturing Production Workers (cents): 1914–1948[f]

| | | | | | | |
|---|---|---|---|---|---|---|
| All | (D830) | 1920 | 1922 | 60.50 | 49.40 | 18.35 |
| | | 1924 | 1925 | 56.20 | 56.10 | 0.18 |
| | | 1929 | 1933 | 59.00 | 49.10 | 16.78 |
| Male | (D833) | 1920 | 1922 | 64.20 | 52.00 | 19.00 |
| | | 1929 | 1933 | 62.50 | 51.80 | 17.12 |
| Female | (D836) | 1920 | 1922 | 41.40 | 35.20 | 14.98 |
| | | 1924 | 1925 | 39.30 | 38.90 | 1.02 |
| | | 1927 | 1928 | 39.80 | 38.90 | 2.26 |
| | | 1929 | 1933 | 39.80 | 32.50 | 18.34 |



| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Unskilled Male | (D839) | 1920 | 1922 | 52.90 | 40.20 | 24.01 |
| | | 1924 | 1925 | 45.80 | 45.40 | 0.87 |
| | | 1929 | 1932 | 48.60 | 40.00 | 17.70 |
| Skilled & Semi-Skilled Male | (D842) | 1920 | 1922 | 68.70 | 56.60 | 17.61 |
| | | 1929 | 1933 | 66.80 | 55.00 | 17.66 |

Average Weekly Earnings of Manufacturing Production Workers: 1919–1970[g]

| | | | | | | |
|---|---|---|---|---|---|---|
| All Manufacturing | (D804) | 1920 | 1922 | 26.02 | 21.28 | 18.22 |
| | | 1929 | 1933 | 24.76 | 16.67 | 32.67 |
| | | 1937 | 1938 | 23.82 | 22.07 | 7.35 |
| | | 1944 | 1946 | 45.70 | 43.32 | 5.21 |
| Durable Goods | (D807) | 1928 | 1932 | 26.86 | 15.99 | 40.47 |
| | | 1937 | 1938 | 26.61 | 23.70 | 10.94 |
| | | 1944 | 1946 | 51.38 | 46.22 | 10.04 |
| Nondurable Goods | (D810) | 1929 | 1933 | 22.47 | 16.76 | 25.41 |
| | | 1937 | 1938 | 21.17 | 20.65 | 2.46 |

Average Hourly Earnings of Manufacturing Production Workers, 1919–1970[g]

| | | | | | | |
|---|---|---|---|---|---|---|
| All Manufacturing | (D802) | 1920 | 1922 | 55 | 48 | 12.73 |
| | | 1929 | 1932 | 56 | 44 | 21.43 |
| Durable Goods, 1932–1970 | (D805) | 1944 | 1945 | 111 | 110 | 0.90 |

Union Hourly Wage Index: 1907–1970[h]

| | | | | | | |
|---|---|---|---|---|---|---|
| All Building Trades | (D818) | 1921 | 1922 | 18.9 | 17.7 | 6.35 |
| | | 1931 | 1933 | 25.7 | 21.4 | 16.73 |
| Building Journeymen | (D820) | 1931 | 1933 | 27.0 | 22.5 | 16.67 |
| Building Helpers & Laborers | (D822) | 1921 | 1922 | 14.6 | 13.3 | 8.90 |
| | | 1930 | 1933 | 18.9 | 15.3 | 19.05 |
| All Printing | (D824) | 1931 | 1933 | 26.8 | 25.1 | 6.34 |
| Book & Job Printing | (D826) | 1931 | 1933 | 26.5 | 24.8 | 6.42 |
| Newspaper Printing | (D828) | 1931 | 1933 | 27.4 | 25.6 | 6.57 |

Average Earnings of Class-I Railroad Workers: 1939–1970[g]

| | | | | | | |
|---|---|---|---|---|---|---|
| Weekly | (D815) | 1944 | 1945 | 46.36 | 46.32 | 0.09 |

Average Earnings of Bituminous Coal Production Workers: 1923–1970[g]

| | | | | | | |
|---|---|---|---|---|---|---|
| Weekly | (D811) | 1923 | 1924 | 25.41 | 23.42 | 7.83 |
| | | 1926 | 1927 | 28.42 | 24.18 | 14.92 |
| | | 1929 | 1932 | 25.11 | 13.58 | 45.92 |
| | | 1937 | 1938 | 22.94 | 19.78 | 13.78 |
| | | 1948 | 1949 | 69.18 | 60.63 | 12.36 |
| | | 1953 | 1954 | 81.84 | 77.52 | 5.28 |
| | | 1957 | 1958 | 106.00 | 97.57 | 7.95 |
| Hourly (cents) | (D813) | 1923 | 1933 | 82 | 49 | 40.24 |
| | | 1939 | 1940 | 86 | 85 | 1.16 |

Average Compensation of Bituminous Coal Workers: 1890–1957[i]

| | | | | | | |
|---|---|---|---|---|---|---|
| Hourly (cents) | (D814) | 1893 | 1897 | 19 | 14 | 26.32 |
| | | 1906 | 1907 | 29 | 28 | 3.45 |
| | | 1920 | 1922 | 94 | 90 | 4.26 |
| | | 1923 | 1933 | 92 | 47 | 48.91 |

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| **Average Earnings Index: 1890–1907[j]** | | | | | | |
| Manufacturing, Hourly | (D794) | 1893 | 1894 | 100.9 | 97.9 | 2.97 |
| | | 1896 | 1897 | 99.7 | 99.6 | 0.10 |
| Manufacturing, Full–Time Weekly | (D795) | 1892 | 1894 | 101.3 | 97.7 | 3.55 |
| | | 1896 | 1897 | 99.5 | 99.2 | 0.30 |
| Building Trades, Hourly | (D798) | 1894 | 1895 | 100.0 | 97.6 | 2.40 |
| Building Trades, Full–Time Weekly | (D799) | 1892 | 1894 | 100.6 | 98.3 | 2.29 |
| **Average Earnings of Non–Supervisory Workers: 1932–1970[g]** | | | | | | |
| Contract Construction, Weekly | (D879) | 1937 | 1938 | 30.14 | 29.19 | 3.15 |
| Insurance Carriers, Weekly | (D892) | 1932 | 1933 | 36.99 | 34.29 | 7.30 |
| | | 1937 | 1938 | 39.29 | 36.30 | 7.61 |
| Electric Co. Systems, Weekly | (D888) | 1932 | 1933 | 30.78 | 29.23 | 5.04 |
| | | 1937 | 1938 | 34.22 | 34.15 | 0.20 |
| Electric Co. Systems, Hourly (cents) | (D886) | 1932 | 1933 | 70 | 69 | 1.43 |
| **Average Annual Salary: 1929–1952[k]** | | | | | | |
| College Teachers | (D913) | 1931 | 1935 | 3134 | 2666 | 14.93 |
| | | 1944 | 1945 | 3331 | 3277 | 1.62 |
| **Average Annual Net Income of Non–Salaried Professionals: 1929–1951[l]** | | | | | | |
| Lawyers | (D914) | 1929 | 1933 | 5534 | 3868 | 30.11 |
| | | 1937 | 1938 | 4483 | 4273 | 4.68 |
| | | 1948 | 1949 | 8003 | 7971 | 0.40 |
| Physicians | (D915) | 1937 | 1938 | 4285 | 4093 | 4.48 |
| | | 1945 | 1946 | 10975 | 10202 | 7.04 |
| Dentists | (D916) | 1929 | 1933 | 4267 | 2188 | 48.72 |
| | | 1945 | 1946 | 6992 | 6381 | 8.74 |
| **Annual Pay in the Military: 1964–1970[m]** | | | | | | |
| Basic Pay | (D921) | 1966 | 1967 | 3088 | 3055 | 1.07 |
| Basic Pay plus Allowances | (D924) | 1966 | 1967 | 4640 | 4399 | 5.19 |
| Enlisted Personnel, Basic Pay plus Allow. | (D926) | 1966 | 1967 | 3856 | 3622 | 6.07 |
| **Average Full–Time Earnings of Lower–Skilled Labor: 1890–1920[n]** | | | | | | |
| Weekly | (D778) | 1891 | 1895 | 9.74 | 7.45 | 23.51 |
| | | 1896 | 1897 | 8.46 | 8.40 | 0.71 |
| | | 1907 | 1908 | 10.76 | 10.22 | 5.02 |
| | | 1910 | 1911 | 10.65 | 10.13 | 4.88 |
| | | 1914 | 1915 | 10.78 | 10.65 | 1.21 |
| **Farm Laborers Average Monthly Earnings: 1818–1948[a]** | | | | | | |
| All Regions | (D705) | 1818 | 1826 | 9.45 | 8.83 | 6.65 |
| | | 1870 | 1880 | 16.57 | 11.70 | 29.39 |
| | | 1919 | 1940 | 41.52 | 28.05 | 32.44 |



| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| New England | (D706) | 1818 | 1830 | 11.90 | 11.60 | 2.52 |
| | | 1870 | 1880 | 19.84 | 13.94 | 29.74 |
| | | 1929 | 1940 | 50.93 | 33.54 | 34.14 |
| Middle Atlantic | (D707) | 1818 | 1826 | 9.82 | 8.38 | 14.66 |
| | | 1870 | 1880 | 17.89 | 13.71 | 23.37 |
| | | 1929 | 1940 | 45.72 | 30.00 | 34.38 |
| East North Central | (D708) | 1818 | 1830 | 8.86 | 8.73 | 1.47 |
| | | 1870 | 1880 | 16.94 | 15.48 | 8.61 |
| | | 1919 | 1940 | 42.21 | 29.40 | 30.35 |
| West North Central | (D709) | 1870 | 1880 | 17.10 | 14.88 | 12.98 |
| | | 1919 | 1940 | 50.81 | 28.12 | 44.66 |
| South Atlantic | (D710) | 1818 | 1830 | 8.10 | 7.16 | 11.60 |
| | | 1870 | 1880 | 9.95 | 8.81 | 11.46 |
| | | 1890 | 1899 | 9.46 | 9.32 | 1.48 |
| | | 1919 | 1940 | 30.23 | 17.46 | 42.24 |
| East South Central | (D711) | 1818 | 1850 | 10.36 | 9.60 | 7.34 |
| | | 1860 | 1880 | 14.06 | 10.16 | 27.74 |
| | | 1919 | 1940 | 29.09 | 16.34 | 43.83 |
| West South Central | (D712) | 1850 | 1899 | 15.53 | 11.86 | 23.63 |
| | | 1919 | 1940 | 36.19 | 19.61 | 45.81 |
| Mountain | (D713) | 1880 | 1890 | 24.74 | 21.67 | 12.40 |
| | | 1919 | 1940 | 59.20 | 36.11 | 39.00 |
| Pacific | (D714) | 1850 | 1890 | 68.00 | 22.64 | 66.71 |
| | | 1919 | 1940 | 65.30 | 42.84 | 34.40 |
| **Average Daily Wage in Philadelphia: 1785–1830[o]** | | | | | | |
| Artisans | (D715) | 1785 | 1786 | 1.33 | 1.00 | 24.81 |
| | | 1787 | 1788 | 1.00 | 0.97 | 3.00 |
| | | 1791 | 1792 | 1.05 | 1.00 | 4.76 |
| | | 1797 | 1798 | 1.83 | 1.57 | 14.21 |
| | | 1801 | 1802 | 1.55 | 1.31 | 15.48 |
| | | 1804 | 1805 | 1.60 | 1.57 | 1.88 |
| | | 1807 | 1808 | 1.68 | 1.47 | 12.50 |
| | | 1811 | 1813 | 1.77 | 1.52 | 14.12 |
| | | 1816 | 1817 | 1.89 | 1.71 | 9.52 |
| | | 1818 | 1821 | 1.86 | 1.37 | 26.34 |
| | | 1822 | 823 | 1.65 | 1.47 | 10.91 |
| | | 1825 | 1826 | 1.74 | 1.70 | 2.30 |
| | | 1829 | 1830 | 1.80 | 1.73 | 3.89 |
| Laborers | (D716) | 1819 | 1821 | 1.00 | 0.75 | 25.00 |
| **Daily Wage Rates on the Erie Canal: 1828–1881[q]** | | | | | | |
| Common Labor | (D718) | 1839 | 1840 | 1.00 | 0.88 | 12.00 |
| | | 1842 | 1843 | 0.88 | 0.75 | 14.77 |
| | | 1870 | 1871 | 1.75 | 1.50 | 14.29 |
| | | 1876 | 1878 | 1.50 | 1.00 | 33.33 |
| Carpenters | (D719) | 1831 | 1832 | 1.25 | 1.00 | 20.00 |
| | | 1842 | 1845 | 1.50 | 1.00 | 33.33 |
| | | 1849 | 1850 | 1.63 | 1.50 | 7.98 |
| | | 1857 | 1858 | 1.75 | 1.50 | 14.29 |
| | | 1860 | 1862 | 1.75 | 1.50 | 14.29 |
| | | 1866 | 1868 | 3.00 | 2.50 | 16.67 |
| | | 1869 | 1870 | 3.05 | 2.50 | 18.03 |
| | | 1876 | 1877 | 2.50 | 2.00 | 20.00 |

| Description | | Peak Year | Trough Year | Peak Wage | Trough Wage | Percent Cut |
|---|---|---|---|---|---|---|
| Masons | (D720) | 1828 | 1829 | 1.50 | 1.25 | 16.67 |
| | | 1841 | 1843 | 1.75 | 1.25 | 28.57 |
| | | 1849 | 1850 | 1.75 | 1.50 | 14.29 |
| | | 1855 | 1857 | 2.00 | 1.50 | 25.00 |
| | | 1860 | 1861 | 2.00 | 1.50 | 25.00 |
| | | 1870 | 1876 | 3.00 | 2.00 | 33.33 |
| Teamwork | (D721) | 1837 | 1838 | 2.25 | 2.00 | 11.11 |
| | | 1840 | 1841 | 2.40 | 2.25 | 6.25 |
| | | 1842 | 1843 | 2.44 | 1.75 | 28.28 |
| | | 1844 | 1845 | 2.00 | 1.75 | 57.14 |
| | | 1848 | 1849 | 2.25 | 2.00 | 11.11 |
| | | 1868 | 1869 | 5.00 | 4.00 | 20.00 |
| | | 1871 | 1877 | 5.00 | 3.00 | 40.00 |

[a] Lebergott (1964, Tables A–23 and A–24)

[b] Lebergott (1964, Table A–16) for 1900–1928; U.S. Office of Business Economics (date) for 1929–1965; and U.S. Bureau of Economic Analysis (1971, Table 6.5) for 1966–1970

[c] Douglas (1930)

[d] Long (1960, 144)

[e] Rees (1961, Tables 10 and 13)

[f] Conference Board (1950, 336–44)

[g] U.S. Bureau of Labor Statistics (date)

[h] U.S Bureau of Labor Statistics (1970a and 1970b, pp. 3 and 6)

[i] Lewis (1963, 75–76)

[j] U.S. Department of Commerce and Labor (1908, 7)

[k] Stigler (1956, 134)

[l] U.S. Office of Business Economics (1949 and 1956)

[m] U.S. Office of Management and Budget, unpublished data

[n] Coombs (1926)

[o] Adams (1968)

[p] Smith (1963, 298)

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