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# Firms' Wage Adjustments: A Break from the Past?

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Despite advances in understanding the policies that cause inflation, economists know little about inflation's manifestations and transmission in the marketplace. For example, how does inflation affect wages in an economy composed of heterogeneous agents making individual optimizing decisions? We know that there is a wide dispersion of wage changes in any year (Groshen and Schweitzer 1999). In this paper we ask whether inflation and its changes alter the distribution of wage shocks—rather than being neutral for the distribution as conventional theories of wage adjustment would suggest.

Distributional effects on wage changes have been the subject of conjecture by academic, policy, and business economists, but rarely the subject of systematic inquiry. Altered distributions in the presence of inflation would indicate that simple wage models—i.e., ones based on representative or aggregate agents—are inadequate to describe the complexity of wage determination. Initially, characterizing the nature of this complexity allows us to identify the variety of labor-market responses to shocks. From there, we can develop and evaluate richer models of the wage-setting process.

Insights into the distribution of wage changes should also be helpful for monitoring the economy. For example, one question of particular current interest is whether the wage-setting process during the 1990s (a period noted for both low inflation and unemployment rates) differed from historical patterns. Another interesting question is whether some subset of jobs tends to react first to inflationary or deflationary stimuli.

For our investigation of these questions, we examine a long (39-year) time series of wages for a panel of mobile occupations for a set of employers in three Midwestern cities. We study wage changes during years with rising, falling, and steady inflation to identify regularities that could broaden our understanding of the inflationary process at the micro level.

Inflation (as measured by changes in the Consumer Price Index) and nominal wage growth (as measured in the means of the data set we study, as well as in national series) are largely co-timed. In this paper, we treat wage changes as caused by inflation. This approach does not reflect a stand on whether inflation is primarily a price-pull or cost-push phenomenon. Rather, this perspective reflects the experience of inflation from the individual worker or firm's point of view.

That is, our approach is consistent with how human resource managers (the agents who propose and justify pay increases in most large U.S. firms) describe their salary-adjustment policies. Personnel managers typically report that they use local cost-of-living increases and the wages paid by other employers to guide their wage adjustments. Though potentially compatible with many economic theories of wage adjustment (including firms' price-taking in labor markets), these policies suggest that wage changes *react* to inflation instead of driving it. At a macroeconomic level, the managers' policies should tend to tie pay increases to inflation and productivity growth on a lagging or contemporaneous basis.

The paper proceeds as follows. First we describe the wage-setting process in large firms and discuss the reasons why wage change distributions may not be neutral with respect to inflation. Then we describe the data. The fourth section describes our main results on the distributional effects of inflation. To test for robustness, we also consider the impact of unemployment and changes in returns to education on wage-change distributions. The fifth section investigates two policy-relevant questions: whether some jobs tend to be the first to respond to changes in inflation, and whether wage changes in the 1990s have deviated from historical patterns. The sixth section summarizes and concludes.

## INFLATION IN THE LABOR MARKET—THE AGENTS' PERSPECTIVES

In this section, we describe the wage-setting practices of large U.S. employers, such as those observed in the CSS. Large employers are of particular interest for this study because they provide a majority of jobs (over half and not shrinking) in the U.S. labor market. In addition, their behavior is more likely to deviate from the competitive price-taking model than are small firms' actions.

### *Wage-Setting Practices in Large Firms*

Inflation affects the labor market by influencing workers' expectations and firms' wage-setting practices and compensation schemes. In economies with competitive labor, capital, and product markets, comparable workers at equivalent jobs should be compensated similarly.[1] If an employer sets wages too low, employee morale and productivity may suffer, and turnover may rise—all resulting in lower profits. If an employer pays too much, however, it will also experience lower profits or have to lay off workers because it will be unable to price products competitively and still be profitable. Thus, inflation is a key factor in workers' and firms' wage setting.

The annual wage-setting process in a large firm typically has two stages. In the first stage, an employer's senior management sets the average wage change for its work force—to reflect inflation forecasts, labor market surveys, and projections of sales and product prices.[2] Management aims to maintain the company's profitability by not over- or underpaying employees to prevent both excessively high labor costs and unwanted turnover. Many employers pursue this goal by maintaining some ongoing desired parity with other employers.

During the second stage, each corporate division allocates its share of the salary budget among its workers to match market wages and reward performance. Employers often need to reconfigure wage differences among occupations in their divisions to respond to external influences. In a competitive labor market, an occupation's wages reflect the amount and kind of training necessary, working conditions, and whether such workers are in short supply compared to the firms' need for them. These circumstances can change as technology, products, demographics, or input prices shift.

### *Why Inflation Affects the Distribution of Wage Shocks*

The process described above can be incorporated into a formal wage-setting model that allows for period-by-period heterogeneity in wages and their changes.[3] Crucially, though, as long as individuals optimize over leisure and consumption, a general, observed increase in the price level will shift the wage-change distribution equivalently for all firms. This uniform response to inflation is characteristic of any wage determination model with representative or aggregate agents.

Hence, we must move beyond simple representative or aggregate agents to find factors that make the distribution of wage changes sensitive (non-neutral) with respect to inflation. We posit three main sources. First, if the firms' inflation outlooks differ, their wage changes will differ (if contracting is nominal and fixed for a period of time). Any employer's mistakes in projecting product price growth shows up uniformly in the wages of all its workers.

Second, nominal wages may be rigid. That is, workers may experience a discrete rise in the disutility of their effort after

[1] Compensation includes wages, benefits, and working conditions. For simplicity, we focus on wages in this analysis. Wages are the largest and most flexible part of compensation and are most subject to the effects of inflation.

[2] In a unionized company, wage determination also involves negotiation with union leaders and a long (usually three-year) time horizon.

[3] One example would be the Sparks (1986) model, which is itself a generalization of efficiency wage models of Shapiro and Stiglitz (1984).

nominal wage cuts. This story is consistent with prevalence of nominally priced contracts in the U.S. economy. If firms do avoid nominal wage cuts, the workers most affected are those whose occupation gets a negative shock, no matter what type of firm they are in. So, in an economy with downward rigidity, the variance of occupational wage changes rises with the level of inflation—until the rigidity no longer binds.

Finally, business-cycle phenomenon may alter the supply of workers in other ways that are correlated with inflation—yielding further non-neutralities in the distribution of wage changes.

### *Have Things Changed in the 1990s?*

Two schools of thought argue that wage setting during the 1990s has been different than in previous years. One set of analysts suggests that workers have become more insecure since the 1980s, because of employer downsizing and the elimination of lifetime jobs in the U.S. The other points to changes due to the persistence of the low-inflation environment.

According to a recent series of articles in the *New York Times*, the leading explanation of why inflation has been so limited these last three years—despite low unemployment rates—is that wage demands have been held down by an unusually high degree of "worker uncertainty."[4] Substantial research effort has gone into identifying and disputing the sources of this presumed insecurity in the face of a buoyant labor market. The most commonly mentioned reasons include the threat of middle-management layoffs, competition with foreign workers, and less unionization. These factors could reduce wage inflation by making workers think twice before requesting higher wages, even if their firms' balance sheets have improved.

If this is the case, then some employers that in the past would have maintained or elevated their market wage position, no longer feel the need to do so. In an efficiency wage model, alternative employers are exogenously less attractive to workers, so the efficiency wage firms' offers should fall—resulting in smaller nominal wage increases than typical. Thus, lower wage increases may occur more often or be associated with different conditions than in the past.

Alternatively, others have argued that wage setting has been altered by the persistence of very low inflation (below 3 percent). In a low-inflation environment, competition could pressure participants to accept more flexible practices—particularly practices that permit nominal pay cuts. Examples of such innovations already exist and would proliferate, such as bonus and incentive pay, and contingent contracts.

Widespread use of such pay schemes would overcome the constraints of downward nominal wage rigidity, allowing lower overall wage changes. In addition, the lowest wage changes for particular occupations within firms might be less restricted—that is, lower than expected, based on previous patterns.

## THE COMMUNITY SALARY SURVEY

This study uses annual private salary data from a survey that the Federal Reserve Bank of Cleveland has conducted in Cleveland, Cincinnati, and Pittsburgh since 1927 to assist its annual salary budget process. The analysis data set reports wages for detailed occupations, by employer from 1957 through 1996.

The data set has three major selling points for this study. First, the wages recorded here are less prone to random reporting error than household data because they are derived from administrative records. Second, the data are longer-lived than any source previously investigated. Third, because employer data records wages in the way most meaningful to firms, it is preferable to household or aggregate data for studying impacts on the firms' wage setting. This perspective appropriately reflects the strategies used by firms to adjust wage bills (e.g., promotions, reassignments or reorganization), but not the potentially confounding means used by individual workers to adjust their earnings (e.g., taking second jobs or changing hours).

[4] Peter Passell, "A Pulse that Lingers," *The New York Times*, July 22, 1997, p. A1.

**Table 1**

**Description of the Annual Wage Adjustment Data Set Drawn from the CSS, 1957-1996**

| | |
|---|---|
| Total Number of Job-Cell Wage Adjustments Observed | 73,094 |
| Number of Years of Changes | 39 |
| Average Number of Observations Per Year | 1,874 |
| Mean Log Wage Adjustment | 0.048 |
| Standard Deviation of Log Wage Adjustment | 0.086 |

NOTE: All numbers reported are for the first-differenced data set.

SOURCE: Authors' calculations from the Federal Reserve Bank of Cleveland Community Salary Survey.

Table 1 describes the dimensions of the CSS wage-change data set. From wage levels, we compute 73,094 annual wage changes for occupation-employer (job) cells observed in adjacent years.[5] Each observation gives the change in the log of the mean or median salary for all individuals employed in an occupation-employer cell. Since medians should be more robust to outliers yet only means were recorded before 1974, our results use means through 1974 and medians for the years thereafter.[6] Cash bonuses are included as part of the salary, although fringe benefits are not.

Participants in each city are chosen to be representative of large employers in the area. Until 1995, the number of companies participating trended up from 66 to over 80 per year (see Table 2). On average, they stay in the sample for almost 13 years each. Since each participant judges which establishments to include in the survey, depending on its internal organization, we use "employer," a purposely vague term, to mean the employing firm, establishment, division, or collection of local establishments for which the participating entity chooses to report wages.[7] The industries included vary widely, although the emphasis is on obtaining employers with many employees in the occupations surveyed.[8]

The occupations surveyed (43 to 100 each year) are exclusively nonproduction jobs that are found in most industries, with relatively high inter-firm mobility, and well-developed markets.[9] Many occupations are divided into grade levels, reflecting responsibility and experience. In the analysis, to avoid unnecessary restrictions, we consider each occupational grade in each city to be a separate occupation. Thus, the total number of occupations in Table 2 exceeds the number surveyed during any given year. For example, 83 occupational grades were surveyed in 1996, yielding 240 occupations across the three cities. On average, each employer reports wages for about 27 occupations.

Although the CSS is conducted annually, the month surveyed has changed several times. Throughout the paper, results for any year refer to the time between the preceding survey and the one conducted in that year—usually a 12-month span, but occasionally not. When we examine data means for periods longer or shorter than a year, we annualize the changes so they can be compared directly across years. All data merged have been adjusted to the extent possible to reflect time spans consistent with those in the CSS. We have repeated most of the exercises reported in this paper on the subset of years that covered exactly a year and find no qualitative difference in results.

We also incorporate standard measures of inflation and national output-per-hour in our analysis (see Table 3). As a measure of general inflation experienced in the country, we use percentage changes in the monthly averages of the Consumer Price Index (CPI) for all Urban Workers. Our labor productivity measure is the Nonfarm Business Sector Output per Hour Worked (pre-chain-weights).

In order to investigate the distribution of wage adjustments under different inflationary environments, we use two schemes to differentiate among years. First, we label all years as years of increasing, stable or decreasing inflation, using a $\pm 0.5\%$ cutoff for the CPI. For example, years when the inflation rate rose by more than 0.5 percentage points are considered years of increasing inflation. Second, we identify multi-year episodes of inflationary changes as periods where the economy experienced two or more consecutive years of increasing, stable or

[5] Job-cell-year observations where the calculated change in log wages exceeds 0.50 in absolute value are deleted from the sample on the assumption that most of these arise from reporting or recording errors. Over 1,000 observations are imputed from cases where job-cells are observed two years apart. The imputed one-year changes are simply half of the two-year differences. Many of the results reported here were also run without the imputed observations. Their inclusion does not affect the results.

[6] Comparison of the coefficients estimated separately for means and medians for some years where both were available (1974 and 1981-1990) suggests that they are highly correlated (correlation coefficients of .97 to .99). Coefficients estimated with medians show more variation than those estimated on means and are more highly correlated over time, however this is consistent with medians being a more robust measurement of central tendency.

**Table 2**

## Description of CSS Data by Year

| End Year | Number of: | | | Mean Log Wage Adjustment in: | | |
|---|---|---|---|---|---|---|
| | Job cells | Occupations* | Employers | Cleveland | Cincinnati | Pittsburgh |
| 1957 | 1,336 | 94 | 73 | 0.051 | 0.046 | 0.045 |
| 1958 | 1,557 | 94 | 83 | 0.049 | 0.054 | 0.050 |
| 1959 | 1,714 | 103 | 88 | 0.040 | 0.048 | 0.070 |
| 1960 | 1,669 | 103 | 86 | 0.036 | 0.032 | 0.034 |
| 1961 | 1,701 | 103 | 88 | 0.039 | 0.035 | 0.036 |
| 1962 | 1,881 | 109 | 93 | 0.024 | 0.022 | 0.024 |
| 1963 | 1,910 | 112 | 90 | 0.019 | 0.026 | 0.024 |
| 1964 | 2,032 | 113 | 96 | 0.026 | 0.022 | 0.023 |
| 1965 | 2,123 | 124 | 95 | 0.021 | 0.026 | 0.010 |
| 1966 | 1,965 | 125 | 89 | 0.040 | 0.045 | 0.038 |
| 1967 | 1,967 | 125 | 89 | 0.037 | 0.042 | 0.035 |
| 1968 | 2,128 | 124 | 94 | 0.046 | 0.044 | 0.042 |
| 1969 | 1,972 | 114 | 97 | 0.066 | 0.050 | 0.049 |
| 1970 | 853 | 49 | 36 | 0.068 | ** | ** |
| 1971 | 854 | 49 | 36 | 0.061 | ** | ** |
| 1972 | 1,262 | 66 | 38 | 0.061 | ** | ** |
| 1973 | 1,477 | 90 | 57 | 0.056 | 0.095 | ** |
| 1974 | 1,335 | 96 | 73 | 0.126 | 0.084 | 0.139 |
| 1975 | 1,379 | 101 | 73 | 0.074 | 0.063 | 0.090 |
| 1976 | 1,391 | 104 | 72 | 0.065 | 0.057 | 0.078 |
| 1977 | 789 | 60 | 72 | 0.030 | 0.021 | 0.052 |
| 1978 | 1,674 | 197 | 68 | 0.052 | 0.063 | 0.066 |
| 1979 | 2,418 | 267 | 75 | 0.064 | 0.071 | 0.069 |
| 1980 | 2,689 | 295 | 79 | 0.095 | 0.074 | 0.087 |
| 1981 | 2,196 | 186 | 83 | 0.086 | 0.089 | 0.059 |
| 1982 | 2,185 | 193 | 82 | 0.072 | 0.092 | 0.078 |
| 1983 | 2,013 | 190 | 75 | 0.050 | 0.055 | 0.073 |
| 1984 | 2,274 | 213 | 80 | 0.047 | 0.058 | 0.063 |
| 1985 | 2,272 | 212 | 79 | 0.040 | 0.044 | 0.042 |
| 1986 | 2,396 | 220 | 82 | 0.042 | 0.044 | 0.037 |
| 1987 | 2,437 | 226 | 80 | 0.031 | 0.037 | 0.038 |
| 1988 | 2,401 | 222 | 82 | 0.036 | 0.037 | 0.023 |
| 1989 | 2,407 | 225 | 81 | 0.045 | 0.041 | 0.036 |
| 1990 | 2,505 | 222 | 84 | 0.052 | 0.046 | 0.024 |
| 1991 | 2,536 | 223 | 89 | 0.038 | 0.045 | 0.035 |
| 1992 | 2,398 | 223 | 84 | 0.039 | 0.042 | 0.043 |
| 1993 | 2,355 | 223 | 89 | 0.032 | 0.026 | 0.040 |
| 1994 | 2,128 | 223 | 84 | 0.027 | 0.029 | 0.025 |
| 1995 | 1,841 | 241 | 69 | 0.027 | 0.031 | 0.019 |
| 1996 | 1,345 | 240 | 51 | 0.040 | 0.032 | 0.030 |
| Total | 75,765 | 6,187 | 3,002 | 0.049 | 0.048 | 0.048 |

* Occupations are counted separately for each city.
** In 1970-72, the CSS is missing Cincinnati; in 1970-73, the CSS is missing Pittsburgh.
SOURCE: Authors' calculations from the Federal Reserve Bank of Cleveland Community Salary Survey, 1956-1996.

decreasing rates of inflation. Table 4, which appears on page 100, shows how the years under investigation (1957-1996) are categorized by these criteria.

[7] Some include workers in all branches in the metropolitan area; others report wages for only the office surveyed. Since a participant's choice of the entities to include presumably reflects those for which wage policies are actually administered jointly, the ambiguity here is not particularly troublesome.

[8] The employers surveyed include government agencies, banks, manufacturers, wholesalers, retailers, utilities, universities, hospitals, and insurance firms.

[9] They include office (e.g., secretaries and clerks), maintenance (e.g., mechanics and painters), technical (e.g., computer operators and analysts), supervisory (e.g., payroll and guard supervisors), and professional (e.g., accountants, attorneys, and economists) occupations. Job descriptions for each are at least two paragraphs long.

**Table 3**

**Means and Standard Deviations of CSS Wage Adjustment Components and Other Economic Indicators**

| Variable | Mean | Standard Deviation |
|---|---|---|
| Δ Occupation-Employer Log Wage | 0.048 | 0.084 |
| Current U.S. CPI-U[a] | 0.046 | 0.034 |
| Δ Output/Hour[b] | 0.016 | 0.016 |
| Unemployment Rate[c] | 0.062 | 0.014 |
| Δ Unemployment Rate[c] | 0.000 | 0.009 |
| College to High School (H.S.) Wage Premium | 0.545 | 0.156 |
| High School to Less than High School Premium | 0.337 | 0.134 |
| Percentage Change in College to H.S. Wage | 2.18 | 7.38 |
| Percentage Change in H.S. to Less than H.S. Wage | 2.78 | 9.01 |

[a] Change during salary survey year in the BLS Consumer Price Index for all Urban Workers (CPI-U) for the United States.
[b] Change during salary survey year in the BLS Nonfarm Business Sector Output per Hour Worked.
[c] U.S. civilian unemployment rate.

SOURCES: Authors' calculations from the Federal Reserve Bank of Cleveland Community Salary Survey, 1957-1996. U.S. Bureau of Labor Statistics (BLS).

As a check for our results focusing on business cycle variables, we also control for the long-run rise in earnings inequality. Limited earnings inequality measures are available for the full period of this paper, 1957 to 1996. The best measures available are median earnings by education level. Even this series is missing a few years during the 1950s. We interpolate to fill in these gaps on the justification that these controls are offered to account for long run trends.

## Wage Adjustments and Inflation

Figure 1 confirms that CSS wage changes are generally synchronized with inflation. The correlation between the mean CSS wage adjustment and inflation (CPI) is high (0.82). Overall, though, CSS wage growth has a higher mean (by 0.37) than the CPI, because it includes the benefits of productivity growth. Recent wage growth has averaged much closer to the inflation rate (wage growth led by only 0.08 percentage points in the 1990s). From 1990 to 1996 mean wage growth was 1.7 percentage points lower than the sum of inflation and productivity growth, versus 1.3 percentage points lower over the full sample. This suggests that the early 1990s had somewhat weaker than usual wage growth, given inflation and the measured gains in productivity.

As for timing, at the annual frequency of CSS data, wages and prices can be described reasonably as changing contemporaneously. Compared to the contemporaneous correlation between inflation and mean wage growth of 0.82, the correlations are substantially lower for wage growth leading inflation by one year (0.59) or two years (0.35). The alternative—that wage growth follows inflation—is better supported. The correlation with wage growth lagging inflation by one year is 0.83. It falls to 0.69 with a two-year lag. It also is clear that during particular periods, wage growth exceeded inflation or CPI growth, with or without subsequent increases in the inflation rate. Overall, this source of detailed wage data supports a relationship between wage growth, inflation and productivity growth, at least at an aggregate level.

## Inflation and the Dispersion of Wage Changes

Figure 2 relates the distribution of log wage changes in the CSS to the CPI during the period. The line with circles shows the percentage change in the CPI. The other lines show the 10th, 25th, median, 75th, and 90th percentile log wage changes for cells in the CSS. If inflation were neutral with respect to the distribution of wage changes, there would be no relationship between the level of inflation and the widening of the gap between the top and bottom lines on the figure. We would expect the lines to roughly parallel the level of inflation. Instead, the quantile lines show a marked tendency to widen as the level of inflation rises.

For example, in 1996, the inflation rate was 3.0%. In the CSS that year, the median cell had a wage change of 3.4%, while the 10th and 90th percentiles had wage changes of –4.7% and 12.5%, respectively. Thus, factors that affect the size of percentile wage changes increase the value of a good shock or a bad one in a particular year.

One aspect of interest for interpreting our findings is whether wage changes are correlated with wage levels. If the dispersion of wages remained constant over time, we would expect no correlation between wage levels and changes. Wages in the CSS, however, like those in other U.S. data sources, show a recent widening inequality (Groshen 1991). Thus, the overall correlation coefficient between log wage levels and changes in the CSS is 0.13. Annually, the correlations range from 0.33 in 1977 down to 0.06 in 1982. Thus, in all years, higher-wage workers tended to receive bigger proportional raises than did low-wage workers. Yet the correlation is fairly low, so our findings say more about what drives the size of good and bad wage shocks than about what happens to good versus bad jobs.

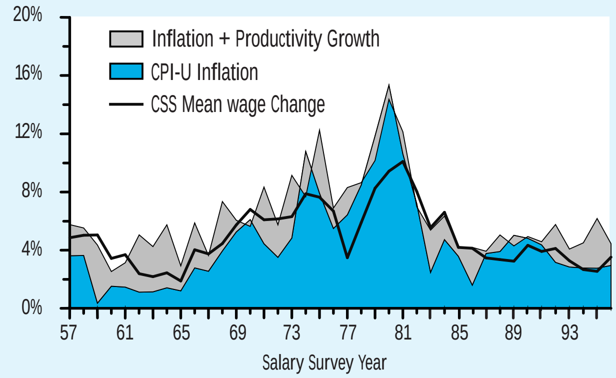
## How Inflation Affects Wage Gains in the Tails

To formally test for and explore the impact of inflation on wage change distributions, we use quantile regressions of wage changes on various measures of inflation and other controls. Quantile regressions (developed by Koenker and Basset, 1978) estimate the correlates of wage changes in various parts of the distribution.

Formally, the estimator minimizes a weighted sum of absolute deviations of the residuals:

**Figure 1**

### Mean Log Wage Changes, Productivity, and Inflation




This figure shows annualized percentage change by salary survey year, which is not always equal to 12 months. Notably in 1974.

**Figure 2**

### Distribution of Log Wage Changes, from 1957 to 1996

Percentiles of Cell Wage Changes vs. Inflation
Percentiles: 10, 25, 50, 75, & 90. Dots indicate inflation rate.

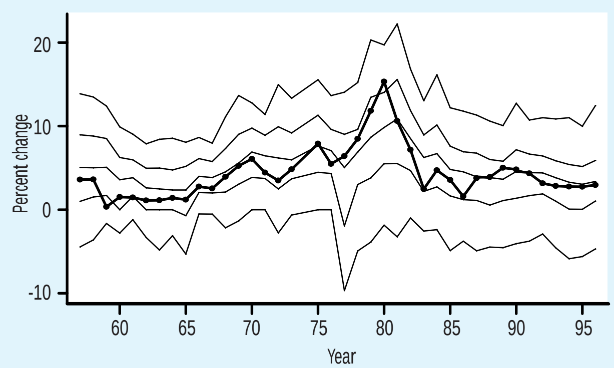


**Table 4**

## Classi cation of Sample Years by In ation Direction and Episode

| Year | Inflation (CPI) | Inflation Change ($\Delta$CPI) | Direction of Inflation* | | | Episodes of Inflation** | | |
|---|---|---|---|---|---|---|---|---|
| | | | Stable | Increase | Decrease | Stable | Increase | Decrease |
| 58 | 0.036 | 0.000 | • | | | | | |
| 59 | 0.004 | −0.033 | | | • | | | |
| 60 | 0.015 | 0.012 | | • | | | | |
| 61 | 0.015 | −0.001 | • | | | • | | |
| 62 | 0.011 | −0.004 | • | | | • | | |
| 63 | 0.011 | 0.000 | • | | | • | | |
| 64 | 0.014 | 0.003 | • | | | • | | |
| 65 | 0.012 | −0.002 | • | | | • | | |
| 66 | 0.028 | 0.016 | | • | | | | |
| 67 | 0.026 | −0.002 | • | | | | | |
| 68 | 0.039 | 0.014 | | • | | | • | |
| 69 | 0.053 | 0.013 | | • | | | • | |
| 70 | 0.061 | 0.008 | | • | | | • | |
| 71 | 0.044 | −0.017 | | | • | | | • |
| 72 | 0.035 | −0.010 | | | • | | | • |
| 73 | 0.048 | 0.013 | | • | | | • | |
| 74 | 0.108 | 0.059 | | • | | | • | |
| 75 | 0.079 | −0.029 | | | • | | | • |
| 76 | 0.055 | −0.024 | | | • | | | • |
| 77 | 0.064 | 0.009 | | • | | | • | |
| 78 | 0.085 | 0.021 | | • | | | • | |
| 79 | 0.118 | 0.034 | | • | | | • | |
| 80 | 0.153 | 0.035 | | • | | | • | |
| 81 | 0.106 | −0.047 | | | • | | | • |
| 82 | 0.072 | −0.034 | | | • | | | • |
| 83 | 0.025 | −0.047 | | | • | | | • |
| 84 | 0.047 | 0.023 | | • | | | | |
| 85 | 0.036 | −0.011 | | | • | | | • |
| 86 | 0.016 | −0.020 | | | • | | | • |
| 87 | 0.038 | 0.022 | | • | | | | |
| 88 | 0.039 | 0.001 | • | | | | | |
| 89 | 0.050 | 0.011 | | • | | | | |
| 90 | 0.048 | −0.002 | • | | | • | | |
| 91 | 0.044 | −0.005 | • | | | • | | |
| 92 | 0.032 | −0.012 | | | • | | | |
| 93 | 0.028 | −0.003 | • | | | • | | |
| 94 | 0.028 | −0.001 | • | | | • | | |
| 95 | 0.028 | −0.000 | • | | | • | | |
| 96 | 0.030 | 0.002 | • | | | • | | |

* An increase in inflation is defined as an increase in $\Delta$CPI equal to or larger than 0.5%. Likewise, a decrease in inflation is defined as a decrease in $\Delta$CPI equal to or less than 0.5%.

** An episode of inflation stability is defined as a period of two or more consecutive years when inflation was stable. Similarly, an episode of increasing (decreasing) inflation is defined as two or more consecutive years of increasing (decreasing) inflation.

$$\sum_i h_i \left| y_i - \sum_j \beta_j x_{ij} \right|,$$

$$where \quad h_i = \begin{Bmatrix} 2q & if\ y_i - \sum_j \beta_j x_{ij} > 0 \\ 2(1-q) & if\ y_i - \sum_j \beta_j x_{ij} \le 0 \end{Bmatrix},$$

$y_i$ and $x_{ij}$ are the $i^{th}$ observation of the dependent and independent variables. $\beta_j$ is a vector of regression parameters. The estimates are for quantile of interest, $q$. The predictions of the estimator are the expected change in wages at the $q^{th}$ quantile conditional on the values of the independent variables $x_{ij}$.

Thus, we can distinguish between conditions which raise (or lower) the upper-end wage changes, and those that primarily affect lower-end wage changes. If the estimated model were parameterized identically over the distribution of wage changes, then an OLS regression would yield very similar coefficients. Indeed, this is the reason that the median regression often is recommended as a robust (less susceptible to outliers) alternative to OLS regression.

Koenker and Basset (1982) show that differences in parameter estimates at alternative quantiles convert into a very general test for heteroscedasticity. The test offers advantages over more common tests because it is robust to nonGaussian errors. We prefer it because the quantile estimators help elucidate the nature of the heterogeneity. The test statistic (interested readers are referred to Koenker and Bassett, 1982, for the formula), focuses on whether coefficient differences are significant given the quantile estimator measure of distribution of residuals.

We report three sets of results, with increasing complexity. The first set shows the simplest estimates—for the effect of CPI inflation alone. Under the null hypothesis of inflation's neutrality on the distribution of wage changes, we expect a coefficient of one on the level of inflation for every quantile. In the next set of regressions, we also include inflation's square, to allow for nonlinearity. Under the null, the coefficient on this should be zero for all quantiles. Two additional variables capture any incremental influence of the level of inflation when inflation is falling (by more than 0.5 percentage points) or rising. Under the null, these coefficients should also be zero. In addition, we include the unemployment rate, the change in the unemployment rate, output per hour and its square in the regressions to control for the business cycle and real wage gains.

**Table 5**

**Simple Quantile Regressions for Total Cell Mean Wage Changes in the CSS**

(Standard Errors in Parentheses)

| Independent Variable | Quantile 90th | 75th | 50th | 25th | 10th |
|---|---|---|---|---|---|
| **Inflation** CPI | 0.949 (0.020) | 0.707 (0.008) | 0.555 (0.005) | 0.432 (0.009) | 0.067 (0.023) |
| **Constant** | 0.084 (0.001) | 0.049 (0.000) | 0.025 (0.000) | -0.001 (0.001) | -0.034 (0.001) |
| **Pseudo $R^2$** | 0.060 | 0.065 | 0.046 | 0.015 | 0.000 |
| **Koenker-Basset $\chi^2$** | T = 713.0 | degrees of freedom = 2 | | Prob. < 0.005 | |

Number of observations = 73,094

Table 5 shows the simplest results. The first row shows how the level of inflation affects wage gains by quantile in the distribution of wage changes. As expected, and as we saw in Figure 2, wage changes in the $90^{th}$ percentile rise almost one-for-one with inflation. That is, the coefficient on CPI is 0.949. Wage gains in the lower tails amount to only a fraction of the inflation rate, however. The corresponding coefficient for the $10^{th}$ percentile is 0.067; showing surprisingly low sensitivity to changes in prices. Thus, the disparity between wage changes in the upper and lower tails rises with inflation.

Does this mean that the model predictions imply a growing disconnect between wages levels and prices? No, for two reasons. 1) The estimates for the intercept term are positive and statistically significant (except at the $25^{th}$ and $10^{th}$ percentiles), allowing most wage changes to keep up with the average level of inflation. This combination results in wage change predictions that are less variable than inflation, but similar in their mean levels—as implied by Figure 2. Estimated constants do decline from the 90th to 10th percentile, preserving a distinct pattern of divergent outcomes. 2) The regression results are for wage changes. If the set of affected jobs vary substantially from period-to-period, then being behind in one period may be made up in another. This issue will be explored in Section 5 of this paper.

While the apparent explanatory power of the regressions is fairly low—particularly for the lower quantiles—we detect some very robust statistical relationships. In evaluating the results, it is crucial to realize that the psuedo-$R^2$ we report is not directly comparable to the traditional $R^2$. This measure,

$$pseudo\ R^2 = 1 - \frac{\text{sum of weighted deviations about the estimated quantile}}{\text{sum of weighted deviations about the raw quantile}},$$

only approaches 1 when each observation is predicted as a conditional quantile. Thus, the estimator can yield accurate predictions of the quantile with a low psuedo-$R^2$, as long as the weighted deviations are symmetric around the prediction.

Table 6 adds considerable flexibility to the ways in which inflation can affect wage changes, as well as controls for unemployment and productivity. The bottom row shows that the addition of these terms does improve the fit of the equations, but by less than half in all cases. Thus, the level of inflation alone is a key element in predicting the size wage changes among quantiles. Crucially, the first row of the table shows that the basic decline in sensitivity to inflation as wage shocks get worse is maintained in the more complex model.

Accelerating and decelerating inflation, *per se*, also have modest effects on the distribution of wage changes. For any given inflation level, if inflation has just decreased, the wage distribution will be narrower than it would have been otherwise. Raises of most workers are essentially insensitive to inflation drops in the first year after inflation declines. That is, the sum of the two coefficients on CPI and its negative change is close to zero for the 25th, median and higher quantiles. The workers in the 10th percentile, however, actually gain higher raises than they would have under last year's inflation rate, all else being equal. Thus, inflation decreases tend to narrow the distribution of wage changes.

Inflation increases are associated with additional wage gains in all quantiles. These bonuses are smallest for the median (0.377), but higher for workers at both extremes. Since the bonus coefficient for the 90th percentile (0.507) is smaller than the gain for the 10th percentile (0.792), inflation increases moderately narrow the distribution of wage changes, all else being equal.

That is, while higher inflation rates widen the distribution, either increases or decreases modestly narrow the distribution in the year they are sustained.

By contrast to the higher sensitivity of upper quantile wage gains to inflation levels, unemployment exerts most of its influence on the lower quantiles of wage growth. High unemployment depresses wage gains sharply in the bottom quantiles, with little effect on upper quantile raises. The coefficient of 0.701 on unemployment for the 10th percentile predicts that wage gains in the bottom decile will be 0.7 percentage points lower if unemployment is one percentage point lower, all else being equal. The opposite-signed coefficients on change in unemployment suggest that the effect of unemployment on wage growth is subject to a lag.

Finally, the results for our proxy for productivity growth show a nonlinear relationship with wage changes at all quantiles. The coefficients for output-per-hour are positive with little variation among quantiles. This suggests that when productivity growth is slow, workers receive 30 to 50 percent of productivity gains in their paychecks. The coefficients on the quadratic term, however, suggest that this effect is

**Table 6**

### Quantile Regressions for Total Cell Mean Wage Changes in the CSS With Controls for Productivity and Unemployment

(Standard Errors in Parentheses)

| Independent Variable | 90th | 75th | Quantile 50th | 25th | 10th |
|---|---|---|---|---|---|
| **Inflation** CPI | 0.962 (0.069) | 0.766 (0.030) | 0.634 (0.017) | 0.547 (0.011) | 0.216 (0.086) |
| **Inflation Squared** $100^*(CPI)^2$ | -0.011 (0.004) | -0.010 (0.002) | -0.008 (0.001) | -0.015 (0.001) | -0.016 (0.005) |
| **Decreasing Inflation** $(\Delta CPI \leq -0.05)^*\Delta CPI$ | -0.896 (0.078) | -0.913 (0.033) | -0.684 (0.019) | -0.558 (0.013) | -0.662 (0.097) |
| **Increasing Inflation** $(\Delta CPI \geq 0.05)^*\Delta CPI$ | 0.507 (0.102) | 0.628 (0.044) | 0.377 (0.026) | 0.448 (0.018) | 0.792 (0.131) |
| **Unemployment Rate** | 0.182 (0.057) | -0.105 (0.025) | -0.049 (0.015) | -0.250 (0.010) | -0.701 (0.070) |
| **Change in Unemployment Rate** | -0.051 (0.098) | 0.075 (0.042) | 0.142 (0.025) | 0.380 (0.016) | 0.736 (0.121) |
| **Productivity Growth** ΔOutput/Hour | 0.371 (0.123) | 0.479 (0.052) | 0.478 (0.030) | 0.381 (0.020) | 0.410 (0.154) |
| **Prod. Growth Sqd.** $100^*(\Delta Output/Hour)^2$ | -0.087 (0.030) | -0.096 (0.013) | -0.108 (0.007) | -0.090 (0.005) | -0.051 (0.037) |
| **Constant** | 0.062 (0.004) | 0.041 (0.002) | 0.019 (0.001) | 0.007 (0.001) | -0.007 (0.005) |
| **Pseudo $R^2$** | 0.071 | 0.081 | 0.060 | 0.022 | 0.007 |
| **Koenker-Basset $\chi^2$** | T = 953.8 | | degrees of freedom = 2 | | Prob. < 0.005 |

Number of observations = 73,094

attenuated when productivity growth is fastest. Nevertheless, workers in the lowest quantile (with its coefficient of –5.060) may benefit more from higher productivity than do the upper quantiles, narrowing wage adjustment distributions when productivity growth is faster.

Are these differences statistically significant? Testing for heteroscedasticity in wage changes according to the level of inflation yields a strong rejection of the null hypothesis. Despite the inclusion of controls for the direction of inflation changes and other business cycle factors, the Koenker-Basset test for heteroscedasticity yields values well beyond conventional levels of statistical significance.

Summarizing broadly, the highest wage changes in a year increase with inflation. Wage changes at the lower tails, however, are more influenced by the unemployment rate. Given statistical significance of these differences, we now turn to the question of whether the effects are economically relevant.

**Figure 3**

### Model Predictions When Only Inflation Rate Varies

Percentiles: 10, 50, & 90. Circles indicate model.

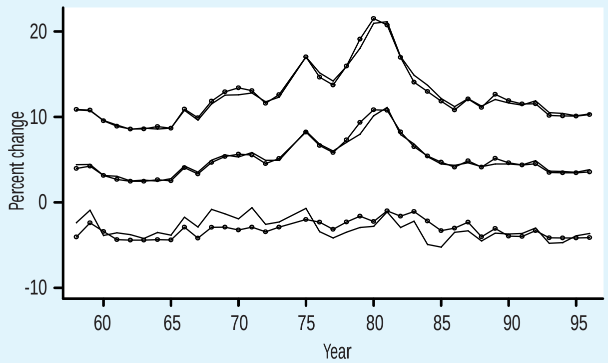
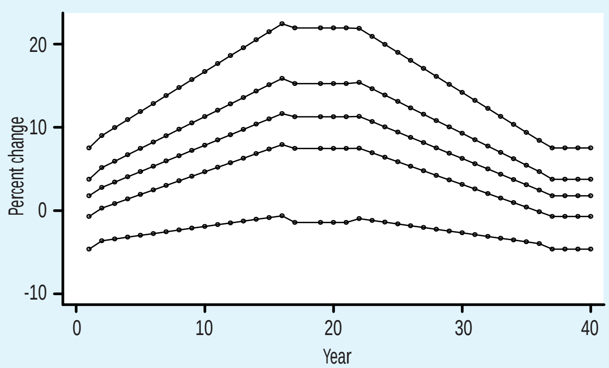



**Figure 4**

### Model Predictions for Rising and Falling Inflation Rate

Percentiles: 10, 25, 50, 75, & 90.




## Isolating Factors' Effects on the Distribution of Wage Changes

Since the model estimated in Table 6 is complex, we construct some illustrative scenarios to gauge the total impact of inflation and unemployment on wage changes. Figure 3 compares the impact of inflation on wage gains in the 10th, 50th, and 90th percentiles. For each percentile, we plot predicted values of wage changes (shown as circles), given realized inflation rates and constant unemployment and productivity growth for the sample period. We also overlay the actual values for the percentile (the line without circles). For the median and 90th quantile, the fit is very close—information on inflation alone is sufficient to produce a reasonably close fit. The fit is markedly worse for 10th percentile wages, however. Until the mid-1970s, wage growth at the bottom is underpredicted. Then the model overpredicts wage changes until the late 1980s. This figure illustrates the points that median and upper tail wage changes are highly responsive to the inflationary environment—much more so than are wage changes at the lower tails.

Most strikingly, however, this figure shows that the response of the various quantiles to inflation captures most of the path of the dispersion of wage shock over time. Thus, inflation can be seen as the main driving factor in the variation of wage shocks over time.

Figure 4 illustrates the point further by showing how the full set of quantiles in Table 6 would respond to a hypothetical inflation path. Suppose that over a forty-year span, inflation started at zero, then rose by one percentage point per year until it reached fifteen percent at year sixteen. After being stable at fifteen percent for four more years, then it fell by one percent per year, until it reached zero at year 36 and was stable until year 40. Figure 4 shows the five predicted paths of quantile wage changes for this scenario. The contrast among the paths is quite stark. The higher the quantile, the more responsive wages are to inflation. Indeed, wages in the 10th percentile show very little response at all.

We now repeat these exercises to illustrate the impact of unemployment. The exercise shown in Figure 5 is analogous to that in Figure 3, but with inflation held constant and the unemployment rate allowed to follow its historical path from 1957 to 1996. Again, the line with the circles shows the model predictions under these circumstances, while the unmarked line represents actual values. Overall, the relationship with unemployment is a less accurate predictor of quantile wage changes than is inflation. In contrast however, variations in unemployment predicting wage changes do much better for the 10th decile than they do for the median or 90th percentile.

Figure 6 constructs a hypothetical scenario to illustrate the differing responsiveness of wage change deciles to unemployment paths. In this exercise, we begin with an unemployment rate of four percent, raise it by 0.5 percentage points per year until it reaches ten percent. Then we hold it steady for five years, followed by a 0.5 percentage point per-year drop until it reaches four percent and stays constant for ten years. Again, the contrast in responsiveness among the quantiles is stark. But unemployment (in contrast to inflation) has its most potent impact on the lowest quantiles of wage changes. The median shows very little response, and the 90th percentile even has a counterintuitive pattern—albeit a muted one.

These figures highlight the differing responses of the quantiles to inflation and unemployment shock. They illustrate the generalization that wage gains of those in the higher quantiles rise steadily with inflation, while wage gains of those in the lower tails (that is, those suffering the largest negative shocks) are determined mostly by the unemployment rate. They also show that during the period from 1957 to 1996, inflation was the main determinant of the dispersion of wage shocks.

The finding that the impact of these factors on wage changes varies substantially by quantile suggests that even our relatively detailed model of how wages react to inflation and other business-cycle variables doesn't capture all of the important issues. Indeed, a complete econometric model would need to predict widely varying levels of matching nominal wage growth to inflation and employer responsiveness to general slackness in the labor market. Nonetheless, this statistical representation of wage change provides a useful description of typical patterns.

## Rising Earnings Inequality?

The path of inflation is not the only systematic trend that might affect compensation. Many researchers have documented a substantial increase in earnings inequality in the United States during the period studied. This rise in inequality also occurs in the CSS (Groshen 1991). While this increasing inequality must be reflected in wage changes, the exact nature of the relationship is unclear. Perhaps rising inequality raises the variance of wage changes because the distribution of desired wages is more dispersed, allowing for larger possible changes. Or, wage adjustments might be larger during periods when some shock to the labor market is increasing inequality.

**Figure 5**

**Model Predictions When Only Unemployment Rate Varies**

Percentiles: 10, 50, & 90. Circles indicate model.

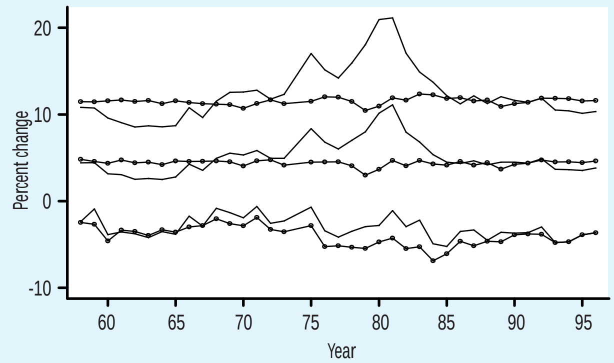
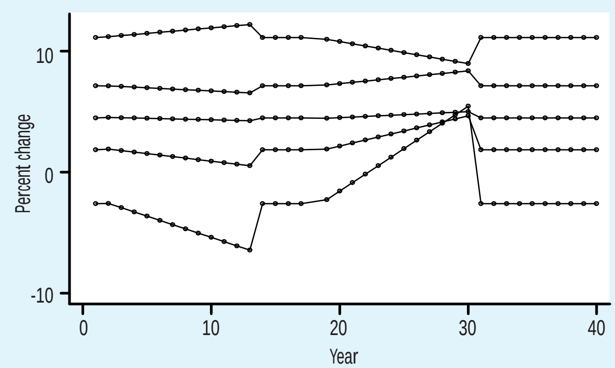



**Figure 6**

**Model Predictions for Rising and Falling Unemployment Rate**

Percentiles: 10, 25, 50, 75, & 90.



In addition, it is possible that inequality rose in ways that did not affect the distribution of wage changes. For example, the correlation of individual wage changes over time might rise, leaving the size distribution of wage changes unaffected.

Given our focus on inflation, the rise in earnings inequality argues for conducting probes with suitable control variables. To this end we reestimate our quantile regressions with controls for the ratios of median earnings of workers of different education levels. This measure of inequality is available back further than other inequality series. In addition, these ratios are highly correlated with the variance of log wages over the period when microdata is available (starting in 1972).[10]

The two included wage ratios are college graduates versus high school graduates and high school graduates versus high school dropouts. The CSS includes occupations that employ workers at each of these three levels, although it is slanted toward more skilled occupations. Since we are uncertain about how rising earnings inequality alters the distribution of wage changes, we introduce controls for both the level and the percentage change in the education wage differentials.

Adding these earnings inequality variables to the previous estimates is intended to show what relationships are robust to the inclusion of these variables. Table 7 shows the results.

First, we note that differences in the estimated wage changes by quantile remain. Indeed, the heteroscedasticity test based on the difference between the inflation coefficient at the 25th, 50th, and 75th percentiles continues to be significant, because the difference in the coefficient estimates at the 75th and 50th percentiles are still large. Thus, control for inequality adds support to the conclusion that the wage change distribution reacts nonuniformly to labor market shocks.

Nevertheless, wage inequality does appear to influence the distribution of wage changes. Coefficient estimates on the inequality measures are significantly different from zero in almost all quantiles. Inclusion of the level of wage inequality and its trend improve the fit of the quantile regressions (the psuedo-$R^2$s rise) in Table 6. The fit of the upper half of the distribution is improved more substantially by the inclusion of inequality controls than is the fit in the lower half.

In addition, although most signs on the coefficients estimated in Table 6 are preserved, some point estimates change markedly. Two general patterns stand out. First, including inequality controls does not substantially alter the role of inflation on wage changes. While the coefficients on the level of inflation for the lower quantiles are now larger, they remain smaller than those of the high quantiles. Furthermore, the size of the negative coefficients on their quadratic terms also are substantially larger. Similarly, the impact of sharp changes in the inflation rate on wage changes is changed little for decreases and slightly muted for increases. Replicated Figures 2, 3 and 4 using the inflation coefficients from Table 7 are parallel those shown above, although muted differences in the response to inflation between upper and lower quantiles are evident in the analog to Figure 3.

Second, both the productivity and unemployment variables appear to be more heavily related to the inclusion of inequality in their impacts on the distribution than does inflation. Coefficient changes were larger and their patterns were more strongly altered.

Overall, inequality controls do not remedy the inability of a single equation model (of the type estimated here) to describe the factors that determine wage adjustments consistently across the distribution of wage adjustments. These controls do point out a relationship between unemployment and productivity variables and the rise of inequality in the United States. This interesting, but possibly spurious, relationship suggests an area for further study.

## TWO POLICY-RELEVANT QUESTIONS

### *Are there Bellwether Jobs?*

One possible explanation for the finding that wage changes are highly vari-

[10] Schweitzer (1997) shows that educational differentials are the most substantial measured factor in the rise in earnings inequality.

**Table 7**

## Quantile Regressions for Total Cell Mean Wage Changes in the CSS, Including Inequality Variables

(Standard Errors in Parentheses)

| Independent Variable | Quantile 90th | 75th | 50th | 25th | 10th |
|---|---|---|---|---|---|
| **Inflation** CPI | 0.819 (0.078) | 0.830 (0.036) | 0.737 (0.019) | 0.767 (0.051) | 0.553 (0.086) |
| **Inflation Squared** $100*(CPI)^2$ | 0.006 (0.005) | -0.010 (0.002) | -0.011 (0.001) | -0.022 (0.003) | -0.031 (0.005) |
| **Decreasing Inflation** $(\Delta CPI \geq -0.05)*\Delta CPI$ | -1.297 (0.100) | -0.986 (0.044) | -0.743 (0.023) | -0.680 (0.064) | -0.522 (0.110) |
| **Increasing Inflation** $(\Delta CPI \geq 0.05)*\Delta CPI$ | 0.405 (0.103) | 0.393 (0.048) | 0.217 (0.026) | 0.317 (0.061) | 0.591 (0.118) |
| **Unemployment Rate** | 0.335 (0.089) | 0.217 (0.041) | -0.202 (0.022) | -0.029 (0.051) | -0.226 (0.098) |
| **Change in Unemployment Rate** | -0.700 (0.151) | -0.285 (0.069) | 0.151 (0.037) | -0.027 (0.108) | 0.506 (0.167) |
| **Productivity Growth** ΔOutput/Hour | -0.116 (0.137) | 0.080 (0.062) | 0.225 (0.033) | 0.170 (0.080) | 0.173 (0.152) |
| **Prod. Growth Sqd.** $100*(\Delta Output/Hour)^2$ | 0.026 (0.035) | -0.037 (0.015) | -0.066 (0.008) | -0.042 (0.021) | -0.027 (0.037) |
| **Col. to H.S.** Ratio of median wage | 0.053 (0.017) | 0.008 (0.008) | 0.016 (0.004) | 0.036 (0.011) | 0.022 (0.019) |
| **Δ Col. to H.S.** Δ Ratio of median wage | -0.070 (0.020) | -0.038 (0.005) | -0.026 (0.003) | -0.007 (0.003) | 0.021 (0.012) |
| **H.S. to Dropout** Ratio of median wage | -0.063 (0.023) | -0.052 (0.010) | -0.052 (0.006) | -0.071 (0.016) | -0.093 (0.026) |
| **Δ H.S. to Dropout** Δ Ratio of median wage | 0.042 (0.008) | 0.018 (0.004) | -0.010 (0.002) | -0.007 (0.004) | 0.010 (0.009) |
| **Constant** | 0.046 (0.008) | 0.036 (0.004) | 0.011 (0.002) | -0.010 (0.005) | -0.023 (0.009) |
| **Pseudo $R^2$** | 0.075 | 0.086 | 0.063 | 0.023 | 0.008 |
| **Koenker-Basset $\chi^2$** | T = 281.7 | | degrees of freedom = 2 | | Prob. < 0.005 |

Number of observations = 71,537

able is that the wage adjustments of certain occupations, employers, or occupation-employer cells are continually more responsive to inflation than are others. The CSS measures wages in nonproduction occupations with the thickest, best-

**Table 8**

**Spearman Rank Order Correlations of Wage Changes Across Years, by Type of In ationary Episode**

**A.** EPISODES OF STABLE INFLATION

| Years | Within-Episode, One-Year Correlations | | | | Between-Episode First-Year Correlations | | |
|---|---|---|---|---|---|---|---|
| | 1st, 2nd | 2nd, 3rd | 3rd, 4th | 4th, 5th | | 1961 | 1991 |
| 1961-65 | -0.125 (0.000) | -0.191 (0.000) | -0.086 (0.001) | -0.118 (0.000) | | | |
| 1991-92 | 0.071 (0.002) | - | - | - | 1991 | -0.055 (0.497) | |
| 1993-96 | -0.057 (0.017) | -0.019 (0.460) | 0.085 (0.004) | - | 1993 | -0.040 (0.644) | -0.044 (0.053) |

**B.** EPISODES OF INCREASING INFLATION

| Years | Within-Episode, One-Year Correlations | | | Between-Episode First-Year Correlations | | |
|---|---|---|---|---|---|---|
| | 1st, 2nd | 2nd, 3rd | 3rd, 4th | | 1968 | 1974 |
| 1968-70 | -0.100 (0.000) | -0.325 (0.000) | - | | | |
| 1974-75 | 0.129 (0.000) | - | - | 1974 | -0.005 (0.890) | |
| 1977-80 | -0.008 (0.839) | -0.123 (0.000) | -0.158 (0.000) | 1977 | -0.163 (0.002) | -0.027 (0.502) |

**C.** EPISODES OF DECREASING INFLATION

| Years | Within-Episode, One-Year Correlations | | | Between-Episode First-Year Correlations | | | |
|---|---|---|---|---|---|---|---|
| | 1st, 2nd | 2nd, 3rd | 3rd, 4th | | 1971 | 1975 | 1981 |
| 1971-72 | -0.012 (0.745) | - | - | | | | |
| 1975-76 | 0.141 (0.000) | - | - | 1975 | 0.043 (0.403) | | |
| 1981-84 | -0.089 (0.000) | -0.060 (0.017) | 0.012 (0.619) | 1981 | -0.021 (0.784) | -0.013 (0.800) | |
| 1985-86 | -0.025 (0.311) | - | - | 1985 | -0.061 (0.457) | -0.103 (0.065) | -0.052 (0.058) |

defined, inter-industry markets. Thus, it should capture mobile workers—those likely to be most sensitive to market conditions. In addition, the large employers in the CSS are arguably more able to track relevant market changes than smaller employers.

For monitoring and policy purposes, tracking bellwether jobs could provide useful signals of inflationary pressures.

To investigate whether such bellwether jobs are likely to exist, we look for evidence of serial correlation in wage changes within and between types of inflationary episodes. Table 8 presents the results. The top panel focuses on the three periods of stable inflation during our sample time frame. The stability during these times provides a basis for comparison for the periods of rising and falling inflation. The first four columns present correlation coefficients between consecutive years during these three episodes. Were the majority of divergences in wage changes during these periods reflective of long-term divergent trends in occupation or employer differentials, these correlations would be positive—an above-average change during one year is likely to be followed by a similar one during the next year. On the other hand, if they reflected errors and corrections, or normal compositional changes in the workforce (promotions, hires, etc.) the correlations would be negative: An unusually big average increase in one year is likely to be followed by a below-average adjustment next year.

During the stable periods, most (five out of eight) of the one-year correlations are statistically significant and negative, suggesting the importance of error, corrections and compositional shifts in the wage changes we observe. Across episodes, the correlations are essentially zero, suggesting that no particular type of job tends to benefit (or lose out) more than others during periods of stable inflation.

The middle panel repeats the exercise for periods of increasing inflation during the sample years. Again, most of the correlations are statistically significant and negative—providing no evidence in support of bellwether jobs. Indeed, it looks as though deviations from the median during rising inflation are even more likely to be compensated for later on than if they occur during periods of stability. And across episodes, jobs that were early, fast movers in one period of inflation are, if anything, less likely to lead the way during subsequent episodes.

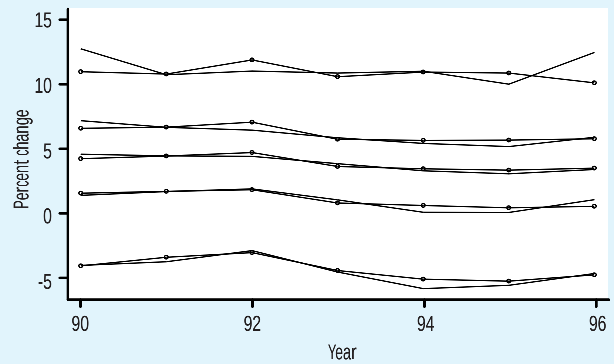
The bottom panel looks at periods of declining inflation. When inflation is declining, the evidence of mean reversion seen in the upper two panels is attenuated. Most of the correlation coefficients are small and poorly identified, suggesting an even more random process. And again, across episodes, there is no evidence to suggest the existence of bellwether jobs.

Thus, the evidence thus far argues strongly against the existence of bellwether jobs whose wage changes could signal inflationary changes. If bellwether jobs exist, they are a very small proportion of jobs in occupations or firms typical of the CSS. That is, they may be in smaller firms, or in production occupations, for example. In the CSS, being out on a tail is often preceded or followed by an opposite-tail wage change during the previous or following year. Which jobs land in one of the tails appears to be idiosyncratic, however, rather than a permanent feature of the job.

**Figure 7**

**Model Predictions vs Actual Quantities: 1990-1996**

Percentiles: 10, 25, 50, 75, & 90. Circles indicate model.




## Are the 90s Different?

Our last empirical exercise examines whether the wage changes during the 1990s deviated from historical patterns, as some analysts suggest. We compare the actual path of wage-change quantiles during the 1990s to predictions based on the historical model estimated in Table 6. We want to see if the lower quantiles had much less wage growth during the 1990s than expected, given the underlying rates of inflation, productivity and unemployment.

Figure 7 shows the results of the exercise. Each quantile is represented with two lines: its actual wage change (the unmarked line) and the model prediction (the line with circles). For most of the period, the model fits quite well. Only for 1994, 1995 and 1996 does the model miss much. During those years, the actual wage change was lower than the model predicted for the 10th percentile wage change by one to two percentage points. For the other parts of the distribution, the model performs quite well. Thus, the evidence of a sea change in wage-setting behaviors finds little support in the CSS so far.

## CONCLUSION

We have examined the Federal Reserve Bank of Cleveland Community Salary Survey from 1957 to 1996 for the impact of inflation on the size of good or bad wage shocks. Most importantly, our exploratory exercise uncovers strong evidence that the pattern of wage changes is not neutral with respect to inflation and other economic conditions.

This finding suggests that the influence of errors and corrections, nominal rigidities, or business-cycle influences on wage-setting varies substantially within the labor market. These regularities provide a new window for comparing the behavior of wages with model predictions in our competitive economy. In particular, we find that representative or aggregate agent models abstract from important determinants of wage changes.

We summarize our main findings as follows:

1. The dominant factor in predicting the distribution of wage changes is the inflationary environment. In particular, wage change dispersion is higher if inflation is higher because:
   - The magnitude of the best (highest) wage shocks in any year rises almost one-for-one with the level of inflation.
   - The lowest wage changes in any year do not rise much with inflation.
2. Other factors (including unemployment, inequality, and productivity growth) also affect the dispersion of wage changes. In particular:
   - Bad wage shocks are mitigated when unemployment is low.

In addition, from a monetary policy or monitoring perspective, we add two intriguing findings:

1. Wage changes are slightly negatively autocorrelated over time.
   - Negative autocorrelations refute the notion of bellwether jobs (i.e., occupations or firms that regularly lead the way when prices rise) and suggests that inflation causes errors and corrections.
   - Small autocorrelations refute the existence of a permanent competitive fringe of firms or occupations and suggests that many jobs sustain occasional wage shocks.
2. There are no apparent changes in the early 1990s. The pattern of wage growth was predictable for the low levels of inflation and unemployment during the period.

Under standard models of wage determination, many of these findings are puzzling. As such, they open the door to new areas for exploration. The next steps are to examine other wage data to confirm the patterns visible here, to refine our understanding of the patterns, and to test the predictions of particular variants of wage-setting models against observed patterns.

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