Downward Nominal Wage Rigidity:
Evidence from the Employment Cost Index

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Abstract:

We examine the extent of downward nominal wage rigidity using the microdata underlying the BLS's employment cost index. This dataset has two significant advantages over those used previously. It is an extensive, nationally representative dataset based on establishment records and is thus free from much of the reporting error that has plagued work using the PSID and CPS. It also contains detailed information on benefit costs, allowing a first look at the rigidity of total compensation–arguably the more relevant measure from the firm's perspective. In general, we find significantly stronger evidence of downward nominal wage rigidity than did studies using panel data on individuals. Total compensation appears somewhat more flexible than wages and salaries. However, this increased flexibility does not seem to reflect the deliberate attempt by firms to use benefits to circumvent wage and salary rigidity.

We would like to thank the Bureau of Labor Statistics for allowing the use of these data and John Ruser and Mike Lettau of the BLS for providing extensive assistance with this project. We also thank our colleagues at the Federal Reserve and participants at a BLS seminar for their comments and suggestions, and Shulamit Kahn for providing guidance in programming the econometric tests. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the staff, by the Board of Governors, or by the Federal Reserve Banks.

1. Introduction

Workers may resist pay cuts for many reasons, most obviously because cuts lead to a lower standard of living, but also because they may be perceived as unfair or demeaning. When combined with money illusion, this resistance to lower real wages translates into downward nominal wage rigidity. Such rigidity would be a concern to monetary policy if it generated a long-run negative correlation between unemployment and inflation. Specifically, if resistance to nominal pay cuts impedes the smooth adjustment of real wages to adverse shocks, then higher inflation could improve labor-market efficiency by increasing the range of real wage cuts acceptable to workers, leading to lower unemployment in equilibrium.[1]

In this paper, we use a newly available data set--the microdata underlying the Bureau of Labor Statistics' employment cost index (ECI)--to shed light on two important unanswered questions in the literature on downward nominal wage rigidity. First, despite a number of recent studies, there is no consensus on the extent of such rigidity. Anecdotal evidence and interviews with selected individuals and firms strongly suggest that workers view nominal wage cuts as unfair and that firms are reluctant to impose them.[2] However, more quantitative studies using nationally representative data have been limited to panel datasets of households, especially the Panel Study of Income Dynamics, and have found only a modest amount of downward nominal wage rigidity.[3] One commonly cited reason for the comparatively weak support for downward nominal wage rigidity is that these data are hampered by measurement error, which could mask the extent of rigidity (Akerlof, Dickens, and Perry, 1996, Shea, 1997). Altonji and Devereaux (1999) model the measurement error and find greater evidence of rigidity but are forced make strong assumptions about the nature of the measurement error and the underlying shape of the distribution. As an alternative, Wilson (1999) uses payroll records over a number of years from two large firms--which, presumably, are nearly free from measurement error--and finds considerable downward nominal wage rigidity. Altonji

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[1]See Tobin (1972), or Akerlof, Dickens, and Perry (1996).

[2]See Bewley, 1998; Kahneman, Knetch, and Thaler, 1986; or Shafir, Diamond, and Tversky, 1997, for example.

[3]See McLaughlin (1994, 1998), Lebow, Stockton, and Wascher (1995), Craig (1995), Kahn (1997), Card and Hyslop (1997).

and Devereux (1999) also find indications of substantial rigidity using data from one year at a large firm. Unfortunately, it is unclear whether these firms are representative of the overall labor market.

The ECI combines the advantages of these two approaches. Because the data are derived from employers' records, they are much less prone to measurement error than are the household data. And, the sample size of the ECI is substantial, covering about 5,000 private establishments per quarter.[4] Thus, these data have the potential to shed considerable light on the extent of downward nominal wage rigidity.

One weakness in all the previous literature is the lack of data on benefits. Firms presumably care about total compensation costs and not just the wage or salary component of compensation, but most datasets do not contain comprehensive information on benefits. Thus, a second critical unanswered question in the debate on nominal wage rigidity is whether employers use benefits--which are more difficult for workers to value and compare--to achieve the necessary flexibility that is prevented by the nominal rigidity of wages. Because our ECI data include information on a wide range of benefit costs as well as wage costs, we can provide the first test of this hypothesis--that is, we can investigate whether downward nominal rigidity of compensation (wages plus benefits) differs from rigidity of wages alone.

To anticipate our results, we find about half as many wage cuts in our data as would have been predicted in the absence of downward nominal wage rigidity–much stronger evidence of rigidity than is found in the PSID. This is so despite the fact that the extent of rigidity for jobs (as in the ECI) ought to be less than for individuals (as in the PSID). In addition, we find that benefits add some additional flexibility to compensation in our data: Compensation also exhibits downward nominal rigidity, but to a smaller degree than do wages and salaries alone. However, this increased flexibility does not seem to reflect deliberate attempts by the firm to circumvent wage and salary rigidity using benefits.

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[4]Groshen and Schweitzer (1996) analyze a related question using firm-based data, but their dataset is much more limited: It tracks wages and salaries in jobs for nonproduction workers only in a non-nationally representative set of industries in several selected cities.

2. Measuring the Extent of Downward Nominal Wage Rigidity

To quantify the extent of downward nominal wage rigidity we examine the distribution of wage (or compensation) changes. In the absence of downward nominal wage rigidity, we would expect the distribution of wage changes to be essentially continuous through the point of zero wage change--although there may be reasons, such as the existence of long-term contracts, for a concentration of observations at exactly zero even without such rigidity. In contrast, the presence of downward nominal wage rigidity would imply a distinct shortage of nominal wage cuts, with a corresponding pile-up of observations at zero wage change--zero being the minimum wage change acceptable to workers.

Thus, this shortage of negative wage-change observations implies a particular type of asymmetry, or right-skewness, in the distribution. However, simply showing that the wage-change distribution is skewed to the right is not enough, for the underlying distribution could be skewed even in the absence of downward nominal wage rigidity. More persuasive would be evidence that this asymmetry becomes increasingly pronounced as inflation declines.

At least five such tests have been proposed in the literature, and some of the advantages and disadvantages of these tests are summarized in table 1. The first three tests all have the disadvantage of picking up any type of asymmetry rather than that specific to downward nominal wage rigidity, such as a shortage of observations below zero. In addition, the measures also have other problems like a sensitivity to outliers or the assumption that the underlying wage change distribution--i.e. the distribution in the absence of downward nominal wage rigidity--is symmetric.

In contrast, the fourth alternative--one of two that we use in this paper--makes use of an asymmetry measure that is specific to downward nominal wage rigidity. We call this the LSW statistic (see Lebow, Stockton, and Wascher, 1995). This statistic is defined as the

Table 1
Properties of Different Tests of Downward Nominal Wage Rigidity

	Specific to DNWR	Robust to outliers	Robust to underlying skewness	Robust to corr(σ, $\dot{p}$)
Corr(skewness, $\dot{p}$)[1]	No	No	Yes	Yes
Corr(mean-median, $\dot{p}$)[1]	No	Somewhat	Yes	Yes
Kernel estimation[2]	No	Yes	No	Yes
Corr(LSW, $\dot{p}$)[3]	Yes	Yes	No	Yes
Kahn test[4]	Yes	Yes	Yes	No

1. See McLaughlin (1998)
2. See Card and Hyslop (1997)
3. See Lebow, Stockton, and Wascher (1995)
4. See Kahn (1997)

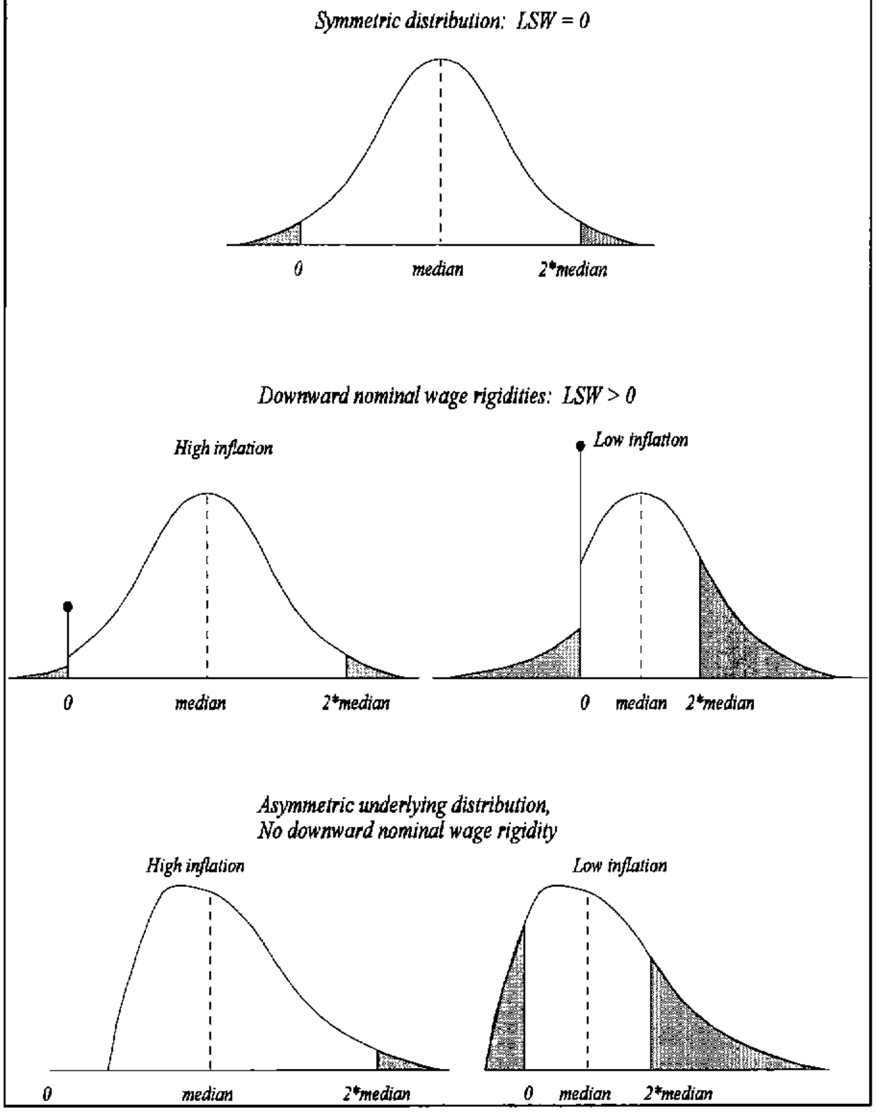
cumulative frequency of the wage-change distribution above twice the median minus the cumulative frequency of the distribution below zero:

$$LSW \equiv [1 - F(2*median)] - F(0) .$$

Figure 1 helps explain this test. Because twice the median and zero are equidistant from the median, a symmetric distribution will have an equal mass in the right and left tails, and the LSW statistic will be zero. But with downward nominal wage rigidity, there will be a shortage of nominal wage cuts, and the LSW statistic will be positive. This measure of asymmetry will become larger as inflation (and the median of the distribution) declines. In contrast to the previous tests, the LSW statistic measures precisely the asymmetry generated by downward nominal wage rigidity--a shortage of observations less than zero. And, because it is a pure order statistic, the LSW statistic is unaffected by extreme observations. However, the LSW statistic has the drawback that it is not robust to asymmetry in the underlying wage-change distribution. Thus, if the wage-change distribution is right-skewed, independent of downward nominal wage rigidity, then as inflation falls and the distribution shifts to the left, the LSW statistic would change, even if the shape of the distribution did not (figure 1, lower panel).[5]

Figure 1

*THE LSW STATISTIC: [1-F(2*median)] - F(0)*



The final test, which we will most emphasize, was proposed by Kahn (1997). This test compares heights of histogram bars a given distance from the median of the wage-change distribution in years when those bars fall below nominal zero with their height when they fall above nominal zero. Specifically, we construct a histogram for each year's distribution (with bars 1 percentage point wide), and estimate the following system of equations:

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[5]For the PSID, McLaughlin (1998) presents evidence suggesting that the underlying wage-change distribution indeed may be skewed to the right.

$$PROP2_t = p_2 + np_2\ DNEG2_t + [z - n\sum_{j=3}^{m} p_j\ ]\ DZERO2_t$$

$$PROP3_t = p_3 + np_3\ DNEG3_t + [z - n\sum_{j=4}^{m} p_j\ ]\ DZERO3_t \qquad (1)$$

$$\vdots$$

$$PROPm_t = p_m + np_m\ DNEGm_t + [z]\ DZEROm_t\ ,$$

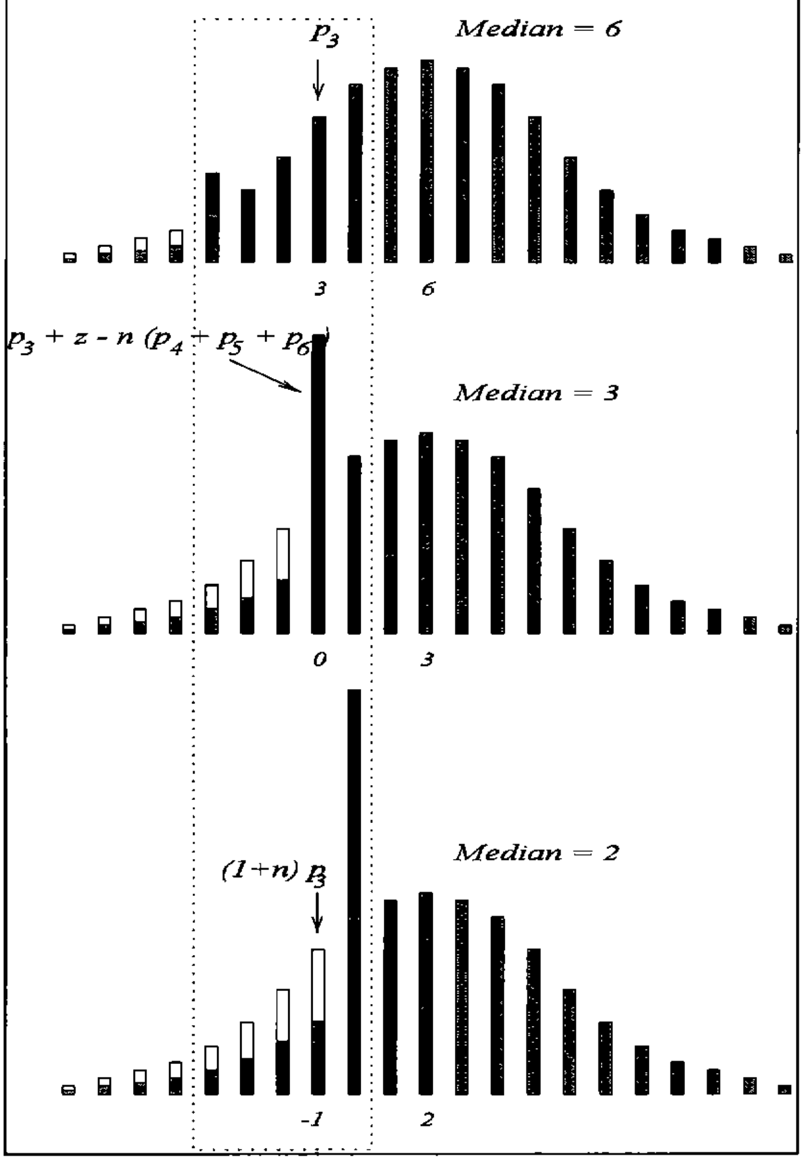
where $\boldsymbol{PROPr_t}$ is the proportion of observations in the bar $\boldsymbol{r}$ percentage points below the median in year t, $\boldsymbol{DNEGr_t}$ is a dummy variable that takes on the value 1 when $\boldsymbol{PROPr_t}$ is completely below zero, and $\boldsymbol{DZEROr_t}$ is a dummy variable that takes on the value 1 when $\boldsymbol{PROPr_t}$ contains zero.

We explain these equations with the help of figure 2. Consider the equation for the height of the bar 3 percentage points below the median, $\boldsymbol{PROP3_t}$. In years when the median is greater than 3, all observations in this bar are positive, $\boldsymbol{DNEG3_t}$ and $\boldsymbol{DZERO3_t}$ are both zero, and we estimate the height of the bar to be $\boldsymbol{p_3}$ (top panel). But when the median is less than 3 and all observations in the bar are negative (lower panel), then $\boldsymbol{DNEG3_t}$ equals one and we estimate the height of the bar to be $\boldsymbol{(1+n)p_3}$. The parameter $\boldsymbol{n}$--the primary parameter of interest--captures the extent to which the histogram bar is altered when it falls below nominal zero.

If $\boldsymbol{n}$=0, then the bar is the same height in either case, and there is no downward nominal rigidity. If $\boldsymbol{n}$=-1, there are no negative wage changes--an extreme case of downward nominal wage rigidity. We have drawn figure 2 for the intermediate case of $\boldsymbol{n}$=-1/2. Note that we constrain $\boldsymbol{n}$ to be the same in each equation. The Kahn test has one equation for each bar that falls above zero in some years and below zero in others (bars in the dotted box in figure 2), for these are the bars that help identify $\boldsymbol{n}$.

In years when the median wage change is 3 percent, $\boldsymbol{DNEG3_t}$ is zero but $\boldsymbol{DZERO3_t}$ equals one, and the bar is larger than $\boldsymbol{p_3}$ (middle panel). The term $\boldsymbol{n\sum_{j=4}^{m} p_j}$ reflects the

Figure 2
THE KAHN TEST



assumption that any observations that are prevented from showing negative wage change by downward rigidity will appear as zero wage change instead. This parameterization assumes that the histogram bar at zero wage change will become larger as inflation declines because more of the distribution will fall below nominal zero, and the rigidity will therefore affect a larger portion of the distribution. We also allow the bar that includes zero to be boosted by a constant amount in each year, *z*. This parameter accounts for long-term contracts or other reasons besides downward rigidity for a concentration of observations at zero nominal wage change.

The Kahn test has many advantages. It is structured to measure precisely the hypothesized effects of downward nominal wage rigidity on the wage-change distribution, is robust to outliers, and does not assume that the underlying distribution is symmetric. The only distributional assumption made is that bars a given distance from the median would have the same height in all years if not for downward rigidity.[6]

3. The ECI Data

The BLS's ECI program collects data quarterly on the hourly cost of wages and benefits in specific job categories in an establishment. The sample is intended to be representative of the private nonfarm sector of the economy (excluding households and the self employed). Each establishment remains in the sample for around three to four years before it is replaced by another establishment within the same industry. Because the compensation cost data are collected from establishment payroll records, they should be far less affected by measurement error than are compensation data from surveys of individuals (like the PSID): Aside from pure data entry problems there ought to be minimal rounding bias, upward reporting bias, or recall error.

The dataset has detail on wages and salaries and a large number of benefit categories including cash bonuses, insurance, retirement plans, and legally required-benefits such as social security and federal and state unemployment. Not all benefits are equal, however, when it comes to thinking about circumventing wage rigidity. The growing emphasis on "pay for performance" systems suggests that manipulating bonuses in order to target pay to individuals is fairly routine for firms. Firms may also target larger groups of employees by varying benefits such as insurance, and retirement plans. However, the firm has no discretion in changing legally required benefits and certainly cannot use them to single out individuals or even groups of workers. For these reasons, we have chosen to exclude the legally required benefits and to consider two compensation measures: *Wages and salaries*, which includes straight-time hourly wage and salary costs, including commissions[7] and *total compensation*

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[6] One reason this assumption may be questionable is if the distribution becomes less disperse as inflation falls and the distribution shifts left (see Card and Hyslop, 1997). In fact, our distributions are about equally disperse in high- and low-inflation years, so our tests are unlikely to be seriously affected by this issue.

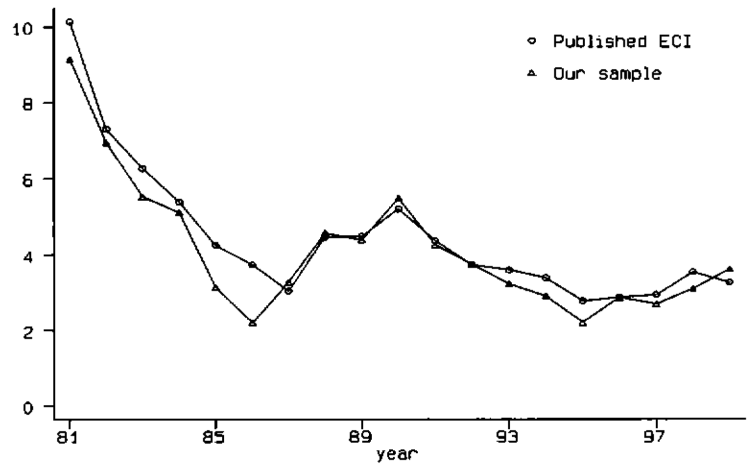
[7]The ECI does not distinguish between salaried workers and hourly-wage workers, so we were unable to compare these groups. Nor are commissions recorded separately in the ECI.

excluding legally required benefits which adds most benefit costs over which the firm has some discretion, including paid leave (vacation, holiday, and sick leave), supplemental pay (nonproduction bonuses, overtime, and shift differentials), health and life insurance, retirement and savings plans, and severance pay.

The ECI sample collects data on an average of about four jobs per establishment in about 5,000 establishments each quarter, yielding roughly 18,000 total observations per quarter. We examine twelve-month (log) changes in compensation costs, and we picked June-to-June observations to maximize the number of years available. We do not use observations that have been excluded from the calculation of the published ECI, nor do we use observations with values imputed by the BLS (as opposed to values reported by the firm).[8] When we restrict our sample to contain only those observations with consecutive June-to-June, non-imputed values for all benefits, we end up with roughly 5,000 observations per year from 1981 through 1999.

Chart 1 shows the mean June-to-June change in the ECI for total compensation from our sample, along with changes in the published ECI. As can be seen, our micro data aggregate to be very close to the published index in most years. To calculate these averages, as with all results in this paper, we weight each job's wage change by the number of employees in the overall population represented by that job.

Chart 1
ECI for Compensation
(Percent change, June - June)



[8]Taking out the imputed data does not change the industry or occupation mix of our sample, nor does it qualitatively change any of the results in this paper.

3.1 Jobs versus individuals

One feature of the ECI data is that the unit of observation is the average compensation for a "job" rather than for an individual. In particular, for a narrowly defined occupation within every sampled establishment, the BLS collects data on the compensation paid to each individual in that job and then records the average of those figures.[9] One possible effect of this recording strategy is that, by reporting averages, these data may obscure or generate compensation cuts not found in the underlying individual data. The direction of this averaging effect on estimates of rigidity is unclear *a priori*.

Two other datasets, with information on both individuals and jobs, help to shed light on the direction of the averaging effect. First, Wilson (1999) shows that there is notably less rigidity for job averages than for individuals using data on the internal labor market of a large firm over a 12 year period. Further evidence comes from unpublished BLS data from the National Compensation Survey between 1997 and 1998. Unlike the ECI, the NCS data include the number of individuals per job, so we can restrict our attention to jobs with the same number of individuals in successive interviews. Because these jobs *could* contain precisely the same individuals in the two interviews--in which case they would be free of composition changes--they are more representative of data on individuals than are those jobs where the number of individuals changed. Indeed, jobs in the NCS with the same number of individuals in successive interviews had considerably fewer negative wage-change observations (4 percent versus 17 percent) and a larger spike at zero wage change (20 percent versus 11 percent), again suggesting that the averaging of wages in the ECI job-level data tends to diminish the extent of downward nominal wage rigidity.[10]

This evidence indicates that the average compensation of a job is more flexible than the compensation of individuals within the jobs.[11] *Thus, the estimates of nominal wage*

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[9]The median number of employees in a job is 7 in establishments of 100 or more employees, and is 2 in smaller establishments. (The sample is about evenly split between smaller and larger establishments.)

[10]We thank Mike Lettau for providing these calculations.

[11]We do not mean to imply that job averaging is necessarily a problem. Job-average compensation, rather than individuals' compensation, could well be what affects firms' costs and

rigidity that we find for the ECI will be lower bounds to the estimates of wage rigidity for individuals. To anticipate our results, this makes our finding of significantly more downward nominal wage rigidity than in studies using panel data on individuals even more striking. It also suggests that whatever measurement problems may be generated by using job averages are dwarfed by the error in surveys such as the PSID.

4. Results

We address three questions in our empirical work: How extensive is downward nominal wage rigidity? Do benefits help achieve more flexibility in compensation? And, if so, is this use of benefits a deliberate response by firms to wage rigidity?

As discussed in the methodology section, the implications of nominal wage rigidity are most clearly seen in the distribution of wage changes. If workers resist pay cuts and wages are rigid, we expect the distribution of wage changes to be positively asymmetric with a massing of observations at zero and a dropoff below zero. More important, if wages are nominally rigid, then the asymmetry and massing at zero should become more pronounced in low-inflation times.

4.1 What is the extent of downward nominal wage rigidity?

Chart 2 and table 2 present summary distributions and statistics for our data. The data are year-to-year changes from 1981 to 1999 in the log of wages and salaries for all private industry jobs in the ECI sample. The top panel of chart 2 displays the distribution of wage changes for all years; to highlight the asymmetry, we also display a curve representing a normal distribution centered around the median of our sample. As can be seen, the distribution of wage changes displays evidence of nominal wage rigidity--it has a clear spike at zero and a shortage of observations below zero.

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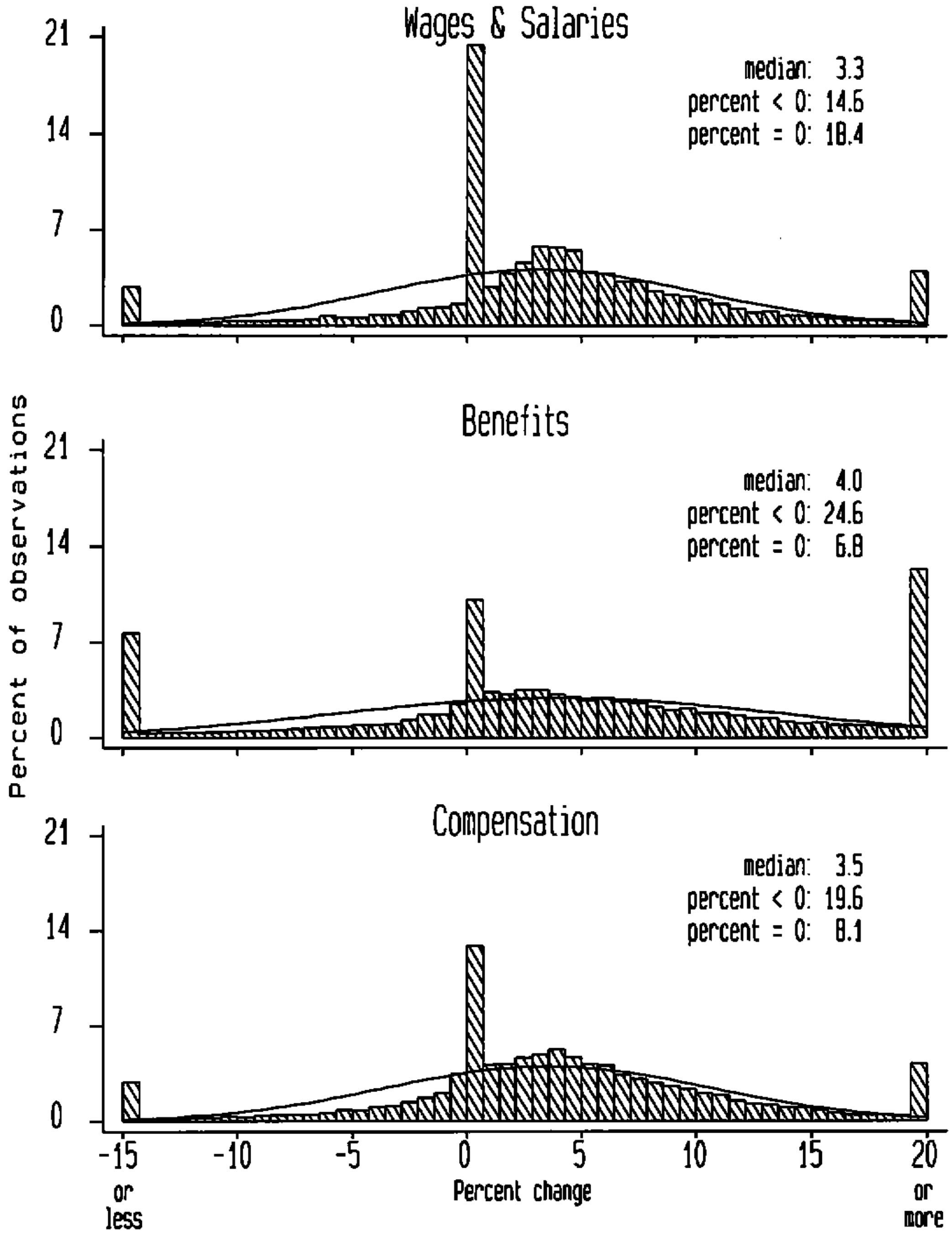
labor force decisions and therefore could be the appropriate variable to examine. This would be especially likely if workers' pay differences did not fully reflect differences in productivity. In such a situation, for example, the retirement of a high-wage, long-tenure worker, which brings down the average wage in the job, really might reduce a firm's labor costs, and we would be correct to treat it as a nominal wage cut. See Barth (1997) for a discussion of the literature on how pay moves with tenure/experience/productivity.

Chart 2
Distribution of Changes in Various Compensation Measures
(All Years)



The first row of table 2 shows that roughly 14-1/2 percent of all wage changes are negative and about 18-1/2 percent are zero over the period from 1981 to 1999. As measured by the LSW statistic discussed above, the distribution of wage changes is positively and significantly asymmetric with over 13 percent more observations in the upper tail than in the lower.[12] Compared to changes in wages and salaries as measured by the PSID, the micro-ECI data have fewer observations below zero, a much larger concentration at zero, and greater asymmetry.[13]

While the evidence above is suggestive of downward nominal wage rigidity, the true test is to see how the distribution varies with inflation. As a first pass, the second and third rows of table 2 contain summary statistics for years where the distributions have the highest and lowest medians. It is clear that the spike at zero and the dropoff below zero are more pronounced in low-median years: The proportion of observations of exactly zero wage change is 21 percent in the low-median years versus 11 percent in the high-median years. The LSW asymmetry measure declines from almost 14 percentage points to below 4 percentage points when moving from the low- to the high-median years. As a more detailed pass, chart 3 shows the distribution of wage and salary changes for each year in our sample. Again, one can see evidence of less truncation in 1981 and 1982, the years in our sample with the highest inflation.

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[12]The statistical significance of the LSW statistic can be calculated as follows. If we observe a fraction a of observations in the right tail, then the binomial formula gives confidence bounds around our right-tail probability estimate as $a \pm z(\alpha/2)\sqrt{a(1-a)/N}$, where $z(\alpha/2)$ is the cdf of the standard normal distribution and N is the number of observations. If we observe a fraction b of observations in the left tail, we can construct an equivalent confidence bound for the left-tail probability. We can then test whether the two probabilities are equal. Using this procedure, we calculate approximate standard errors of about 0.25 percentage point on the LSW statistics, making all of the estimates in table 2 strongly statistically significant.

[13]Of course, this apparently larger degree of truncation relative to the PSID may reflect the larger median wage change in the PSID data (because the PSID sample includes the high-inflation 1970s).

Chart 3
Distributions of Changes in Wages & Salaries by Year

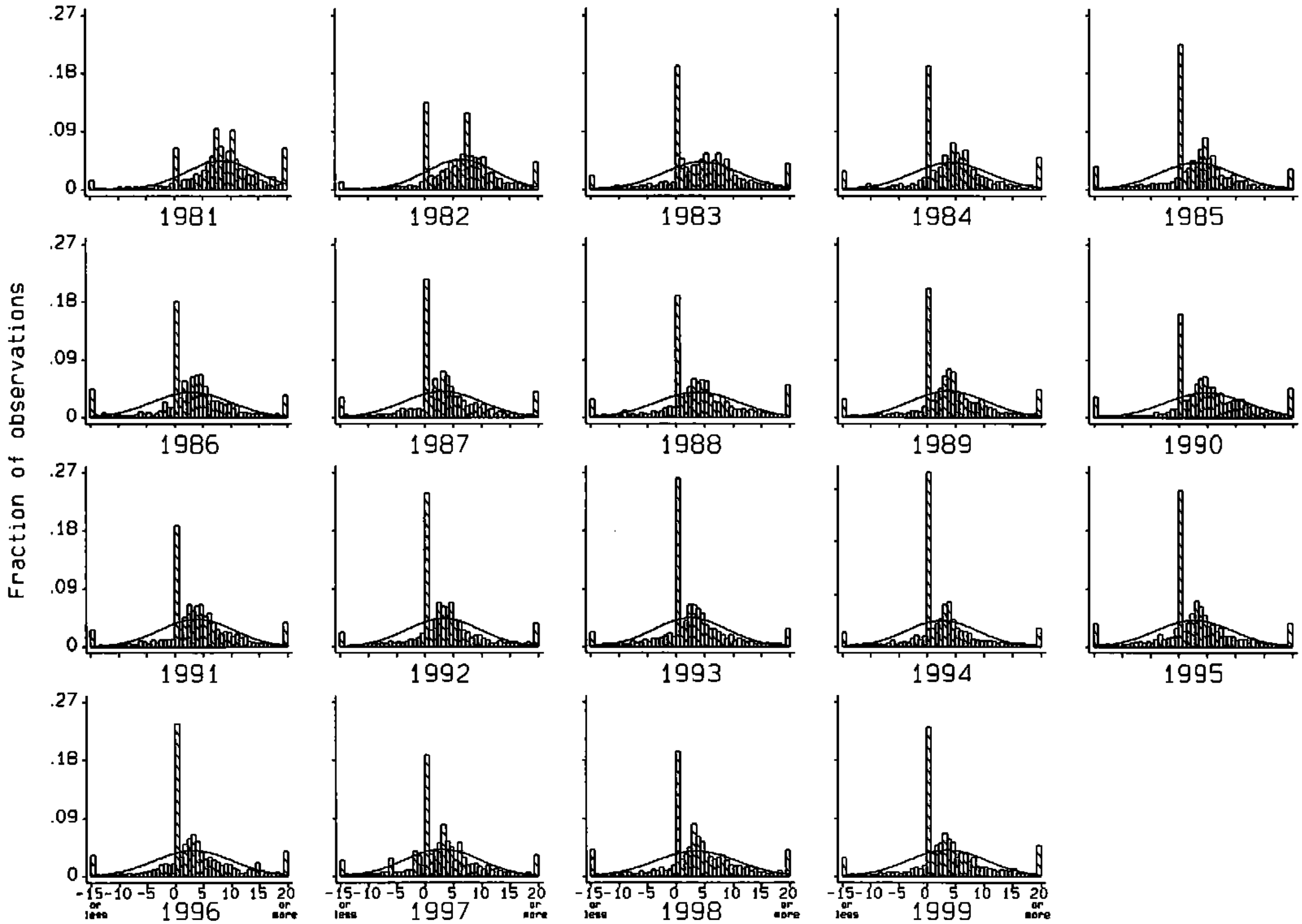

Table 2
Distribution of Wage and Salary Changes, 1981-1999

	# Obs.	Median	Standard Deviation	% of Obs. < 0	% of Obs. = 0	LSW Asymmetry
All Years	105,902	3.3	11.0	14.6	18.4	13.2
Low-median Years[1]	17,830	2.3	10.4	17.5	21.3	13.7
High-median Years[2]	17,519	6.8	9.8	8.8	10.9	3.7
Memo: PSID (1971-1988)[3]						
Wage and Salary Earners	31,525	6.6	13.0	17.8	8.1	6.8
Wage Earners Only	19,632	6.5	9.5	11.9	10.6	9.7

1. Low-median years are 1987, 1993, and 1995.
2. High-median years are 1981, 1982, and 1990.
3. As calculated by Lebow, Stockton, and Wascher (1995).

For a more formal examination, table 3 presents the results of our two preferred tests for downward nominal wage rigidity, the correlation of the LSW statistic with measures of inflation, and the Kahn test. The first two rows show the results of OLS regressions of the LSW asymmetry measure for each year's distribution on either the median of the ECI wage-change distribution or inflation (measured as the Q2-to-Q2 change in the log of the PCE chain price index). The regressions also include the unemployment rate to control for possible effects of the business cycle on the shape of the wage-change distribution. If the asymmetry in the wage change distribution were due to nominal wage rigidity, we would expect the LSW statistic to fall as inflation rises and the distribution is shifted further away from zero. This would imply a negative coefficient on inflation and the median of the distribution. Indeed, as seen on table 3, we find that these coefficients are negative and significant. For example, a 1 percentage point increase in the median of the distribution implies almost a 1.8 percentage point decline in asymmetry.

Table 3
Tests of Downward Nominal Rigidity of Wages and Salaries

	Wages & Salary Earners		*MEMO: Wage Earners only (PSID)*
	ECI	PSID	
LSW Asymmetry tests[1]			
Coeff. on median of distribution	-1.76* (.39)	-.18 (.30)	*-.88** *(.28)*
Coeff. on inflation	-1.37* (.45)	-.33 (.24)	*-.73** *(.24)*
Kahn tests[2]			
n	**-.48*** **(.02)**	**.04** **(.03)**	***-.47**** ***(.03)***
z	9.99* (.65)	5.15* (.22)	*4.43** *(.38)*

Note. * indicates significance at the 1% level. Standard errors are in parentheses.
1. OLS regression of the LSW asymmetry measure on an inflation measure, the unemployment rate, and a constant. Data for each year are weighted by the number of observations used in creating that year's wage change distribution. PSID results are taken from Lebow, Stockton, and Wascher (1995).
2. Results are estimated using SUR in nonlinear least squares. In each equation, the fraction of compensation changes in the region between r and r-1 percentage points below the median is regressed on a constant and a set of dummy variables, with the equations put through a logistic transformation. Data for each year are weighted as in 1. PSID results are taken from Kahn (1997) and include dummies for bars immediately above and below zero.

While the correlation of the LSW asymmetry measure with inflation provides evidence of downward nominal wage rigidity, recall from our earlier discussion that we could also obtain a negative correlation between asymmetry and inflation if the underlying distribution of wage changes were skewed for other reasons. Because of this, we concentrate on the results of the Kahn tests, shown in the remainder of table 3.[14] The ***n*** coefficient is

[14]The model is estimated using nonlinear least squares. We note three features of this estimation, none of which affects the results qualitatively. First, following Kahn, we use SUR to account for correlation in the errors across equations. Second, we weight the data for each year by the number of observations used in generating that year's wage change distribution. Third, because the dependent variables are limited--heights of histogram bars cannot be negative--we perform a logistic transformation on each equation. That is, for the first equation in (1), PROP2 = f(.), we actually estimate ln[PROP2/(1-PROP2)] = ln[f(.)/(1-f(.)].

significantly negative and about -1/2, implying that histogram bars are reduced by half when they fall below zero. This estimate of ***n*** provides strong evidence of nominal wage rigidity and suggests that if wages were totally flexible, the fraction of observations below zero would be double what we observe.

We find much more significant evidence of nominal wage rigidity in the ECI than earlier researchers found in the PSID. Indeed, for wage and salary workers combined--the coverage of the ECI--the PSID shows almost no evidence of downward rigidity: The LSW asymmetry tests (from Lebow, Stockton, and Wascher, 1995) show small and insignificant coefficients, and, the **n** coefficient (from Kahn, 1997) is about zero. However, using the subset of wage earners only--about 55 percent of the PSID sample--the PSID does provide evidence of downward nominal wage rigidity. The LSW asymmetry results are significantly negative (though only about half as large as in the ECI for the total sample of wage and salaried workers), and the Kahn test finds about half of the desired wage cuts are truncated–very similar to the ECI results. This raises the question of whether especially severe measurement error in the salary data from the PSID is obscuring the true underlying rigidity of salaries relative to hourly wages. Unfortunately, we cannot separate wage and salary jobs in our data to examine this further. But, even if one were to discount the PSID salary data and focus on the PSID results for wage earners only as representative of the total, our results are still stronger: Because job-average data display less rigidity than data on individuals, the underlying rigidity for individual wage earners likely is significantly above estimates from the PSID.

4.2 Do firms use benefits to achieve greater flexibility?

While we find strong evidence of downward nominal rigidity in wages and salaries, it is possible that firms vary benefits--which may be less salient or visible to workers, and are more difficult to value and compare--to achieve more flexibility in compensation. The detailed benefits information in the micro-ECI data allow us to test this theory.

Chart 2 shows the distributions of changes in benefits and overall compensation as well as in wages and salaries. As can be seen, the distribution of benefits appears asymmetric, although less so than wages and salaries. The benefits distribution has fewer observations of zero change than does the wages and salaries distribution. And, although there appears to be a shortage of negative benefits-change observations, note that this is not so for the histogram bar immediately to the left of zero. As for overall compensation, the shortage of negative changes again appears to be less pronounced than for wages and salaries alone, and the spike at zero drops notably when using the more inclusive compensation measure.

These observations are also supported by the statistics in table 4. Overall compensation appears less rigid than wages and salaries alone, with a 5 percentage point larger fraction of negative observations and a 4 percentage point smaller LSW asymmetry measure. The fraction of observations at exactly zero change also falls sharply when broadening the definition of compensation.

Table 4
Compensation Measures in Private Industry

	Median	Standard deviation	% of Observations < 0	% of Observations = 0	LSW Asymmetry
Wages and salaries	3.3	11.0	14.6	18.4	13.2
Benefits	4.0	28.5	24.6	6.8	9.9
Compensation	3.5	11.1	19.6	8.1	8.9

Table 5 presents results of our more direct tests of downward nominal rigidity for the various components of compensation. As in table 3, the results for the LSW asymmetry test are shown in the upper part of the table, and the results for the Kahn test are shown in the lower part. The first column contains the coefficients shown earlier for wages and salaries. As can be seen in the second column, benefits alone are less rigid than wages and salaries. In the Kahn test the ***n*** coefficient is smaller in absolute value (-0.30), though it remains significantly negative; and the correlation of the LSW asymmetry measure for benefits with either inflation or the median of the distribution is small and insignificantly different from zero. When we perform our tests on overall compensation, the size of the ***n*** coefficient is

-0.34. Taken literally, the results in the third column suggest that about 1/3 of potential compensation cuts are suppressed rather than 1/2 for wages and salaries alone.

Table 5
Tests of Downward Nominal Rigidity for Various Compensation Measures[1]

	Wages & Salaries	Benefits	Compensation
LSW Asymmetry tests			
Coeff. on median of distribution	-1.76* (.38)	.04 (.34)	-1.45* (.34)
Coeff. on inflation	-1.37* (.45)	-.25 (.36)	-1.31* (.36)
Kahn tests			
n	**-.48* (.02)**	**-.30* (.02)**	**-.34* (.02)**
z	9.99* (.65)	3.56 (.40)	3.69* (.55)
1. See footnotes from table 3.			

The basic message of table 5 is that, while not eliminating downward rigidity, the inclusion of benefits notably lessens it. Given that the addition of benefits gives compensation more flexibility, it is interesting to know which benefits are driving the results. Table 6 presents summary statistics and Kahn test results for wages and salaries combined one at a time with selected benefits. (The Appendix table presents results for the full collection of benefits.) The top row shows the benchmark results for just wages and salaries, and the following rows show results for wages and salaries plus a particular benefit. No benefit in itself fully explains the results for overall compensation, indicating that one must examine combinations of benefits to explain the added flexibility they provide. Nevertheless, a few benefits do have notable effects on the Kahn ***n*** parameter. One is nonproduction bonuses, which, given anecdotal evidence about flexible "pay for performance," would be expected to provide some flexibility for firms, despite the fact that these bonuses, on average, only add up to about 1.7 percent of compensation in the ECI. A few other, less performance-specific benefits also seem to play a role. Health insurance, paid holidays, and employer contributions to pension and saving plans--which together account for about 12 percent of compensation--all make small contributions to reducing the Kahn *n* parameter.

Table 6
Adding One Benefit at a Time to Wages and Salaries

	Percent of compensation	% of Obs. < 0	% of Obs. = 0	LSW Asym.	Kahn test *n*
Wages & salaries	79.8	14.6	18.4	13.2	-.48
Non-prod. bonuses	79.8 + 1.7	16.6	15.2	11.9	-.41
Health insurance	79.8 + 6.1	16.9	10.4	10.4	-.43
Paid holidays	79.8 + 2.5	15.4	16.8	12.4	-.39
Pension & saving	79.8 + 3.3	17.1	15.2	11.4	-.44
Compensation	100.0	19.6	8.1	8.9	-.34

4.3 Is the Use of Benefits Deliberate?

In the previous section, we presented evidence that the inclusion of benefits costs makes compensation display less downward nominal rigidity than do wages and salaries alone. This finding most naturally suggests that firms manipulate the generosity of benefits in a deliberate attempt to offset downward nominal wage rigidity. But this is not the only possible interpretation of these results. The greater flexibility of compensation could simply reflect fortuitous reductions in benefits costs that, while not linked specifically to the inability to cut nominal wages, nevertheless do lead to more reductions in overall compensation than in wages and salaries alone. In this section, we present evidence to help distinguish between these possible interpretations.

Note first that the ability of firms to deliberately manipulate benefits to achieve reductions in compensation costs differs considerably across the various types of benefits. Most obviously, legally required benefits cannot be manipulated in this manner which is why we did not include them in this paper. But even the non-legally required benefits differ in this regard. For example, firms presumably would often like to reduce nominal compensation for some but not all jobs; but by custom, and in some cases by law, certain benefits must be provided equally to all employees at an establishment. The benefits highlighted in table 6 as being most important in generating the reduced rigidity in compensation do not fit neatly in any category. We would expect non-production bonuses to be the most amenable to deliberate manipulation by firms, and indeed this component explains part of the additional flexibility of compensation. However, just as important as bonuses is paid holidays, which seem unlikely *a priori* to be a deliberate source of cost savings for most employers. In the middle falls health insurance; although seemingly less flexible than bonuses, if only because the same health insurance options generally are available to all employees, reducing the employer's share of health-insurance premiums does seem like a plausible source of cost savings for many firms--and was mentioned as such by several of the firms contacted by Bewley (1998).

To test for the deliberate manipulation of benefits to offset downward nominal wage rigidity, we examine whether there is any evidence that jobs with zero wage change in a given year--a rough proxy for jobs affected by downward nominal wage rigidity--are more likely to display a cut in nominal benefits costs. Table 7 displays the breakdown of whether the change in the cost of several benefits is negative, zero, or positive, depending on whether the job has a zero change in wages. We hypothesize that, if benefits were used deliberately to offset the inability to cut nominal wages, we would see more reductions in benefits at times when wages display zero change. As can be seen in the shaded cells, a first look at the data reveal no obvious tendency for this to be so, either for overall benefits (other than legally required benefits), or for any of the benefits that the Kahn test identified as being important in reducing downward nominal rigidity. In fact, proportion of workers with zero wage change who received benefit cuts was smaller than the average proportion receiving benefit cuts: Although 23.1 percent of jobs had a decline in overall benefits, only 19.3 percent of jobs with zero wage change had a decline in total benefits. Similar results are apparent for each of the benefits examined in table 7.

Table 7
Distribution of Changes in Several Benefits, by Wage change

		$\Delta w = 0$	All Δw
All benefits	$\Delta b < 0$	**19.3**	**23.1**
	$\Delta b = 0$	44.0	13.1
	$\Delta b > 0$	36.8	63.7
Nonproduction bonuses	$\Delta b < 0$	7.4	**9.9**
	$\Delta b = 0$	82.6	74.8
	$\Delta b > 0$	10.0	15.3
Health insurance	$\Delta b < 0$	**12.0**	**15.1**
	$\Delta b = 0$	56.6	38.2
	$\Delta b > 0$	31.4	46.8
Paid holidays	$\Delta b < 0$	**3.6**	**12.8**
	$\Delta b = 0$	91.0	34.6
	$\Delta b > 0$	5.4	52.6
Retirement and savings	$\Delta b < 0$	**7.6**	**15.8**
	$\Delta b = 0$	82.7	54.4
	$\Delta b > 0$	9.7	29.8

1. Percent of observations in a given range of wage changes that have benefits changes that are negative, zero, or positive.

Of course, this simple bivariate comparison may not be sufficient to capture the factors leading to a reduction in benefits costs. We therefore ran probit regressions to explain the probability that a job will have a reduction in benefits costs. In addition to the wage change itself and a variety of control variables (including the unemployment rate, inflation over the preceding twelve months, industry and occupation dummies, unionization, establishment size, region, whether the establishment is in a metropolitan area, and a linear time trend), we also include a dummy for whether the job has a zero wage change--again, interpreting zero wage change as a proxy for having wages constrained downward. If benefits were being deliberately reduced to offset downward nominal wage rigidity, we would expect the coefficient on this dummy to have a positive coefficient. However, as can be seen in table 8, the specifications we examined yielded a coefficient that was negative.[15] (Because we have so many observations, standard errors are very small and almost all coefficients are statistically different from zero.) We also considered a dummy for whether the job had a zero wage change in the preceding year, as perhaps a reduction in benefits occurs with a lag; again, the coefficient is negative. This result holds even for nonproduction bonuses, the benefits category that most plausibly can be adjusted by employers. In all, we find no evidence that a cut in benefits is more likely to occur when wages are constrained to show zero change.

Table 8
Explaining Declines in Benefits Costs[1]

	All Benefits		Nonproduction bonuses	
$\Delta w = 0$ dummy	-.076 (.006)	--	-.029 (.004)	--
$\Delta w_{t-1} = 0$ dummy	--	-.054 (.007)	--	-.014 (.005)
Δw	-.011 (.001)	-.011 (.001)	-.001 (.000)	-.001 (.000)
Pseudo R-square	.08	.07	.03	.03
No. of obs.	105,902	65,918	105,902	65,918

1. Probit regressions explaining the probability of a decline in nominal benefits costs. Figures represent the change in the probability of a reduction in benefits given a one unit change in the explanatory variable. Equations also include the unemployment rate, inflation over the preceding twelve months, industry and occupation dummies, unionization, establishment size, region, whether the establishment is in a metropolitan area, and a linear time trend.

If firms do not deliberately manipulate benefits in response to the constraints imposed by downward nominal wage rigidity, why then does the inclusion of benefits reduce the extent of downward nominal rigidity? To begin with, benefits display less rigidity than do wages and salaries; as the sum of the two components, then, overall compensation will naturally be less rigid than wages and salaries. Moreover, even if the two components of

[15] The table reports estimates not of the coefficients, but of the change in the probability of a reduction in benefits given a one unit change in the explanatory variable, evaluated at the mean of the explanatory variables.

compensation were equally rigid, their sum could be less rigid than the parts. Statistically, this is just an implication of the central limit theorem, which states that when we combine a large number of independent distributions the resulting distribution is approximately normal and therefore symmetric. Here, we are combining two distributions (the change in wages and salaries and the change in benefits) that are not perfectly correlated; the resulting distribution tends to be less asymmetric than the original distributions.[16] Economically, when benefit changes are less than perfectly correlated with wage changes, some jobs with zero or small positive wage change will have a decline in benefits costs just by the luck of the draw. For example, if an exogenous reduction in health-insurance premiums led to reductions in health care costs in firms that were unable to lower wages, then there will be more declines in compensation than in wages and salaries. Of course, there are other examples where jobs with negative wage changes will have benefit increases that generate compensation growth. With downward nominal rigidity, however, there are disproportionately fewer cases of negative wage changes than of zero or small positive wage changes; combining wages with benefits thus leads to a more symmetric distribution for overall compensation.

To be clear, we do not interpret the lack of evidence that firms deliberately use benefits to offset wage rigidity to mean that benefits do not in fact provide a source of flexibility for firms. If firms base employment decisions on overall compensation costs, then changes in benefits costs, even if they were completely exogenous to the firm, will matter for those decisions. Thus, the results of this section do not call into question our results on the flexibility of compensation relative to wages and salaries alone. Nevertheless, firms do not appear to deliberately vary benefit costs in response to downward nominal wage rigidity, implying that they must adjust on other margins instead.

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[16]We performed a Monte Carlo simulation to demonstrate this phenomenon. We generated simulated distributions of wage and benefits changes, each with a Kahn n parameter of -0.5, and let the correlation between the two distributions vary between zero and one. For the case of perfect correlation, the resulting compensation distribution generates n equal to -0.5; this parameter estimate becomes smaller in absolute value as the correlation becomes weaker.

6. Conclusions

We examine the extent of downward nominal wage rigidity using the microdata underlying the BLS's employment cost index–an extensive, establishment-based dataset with detailed information on wages and benefit costs. We find that the number of nominal wage cuts is about half of what would be expected in the absence of such rigidity. This is much stronger evidence of downward nominal wage rigidity than found in previous studies using panel data on individuals--especially given that our results are for both wage and salary workers, refer to the rigidity of jobs rather than individuals, and do not rely on strong assumptions to correct for measurement error. We also provide the first estimate in the literature of overall compensation rigidity: Compensation displays about one-third less rigidity than do wages alone. However, this increased flexibility does not seem to reflect firms' deliberate attempts to circumvent wage and salary rigidity using benefits.

One important issue for further research is the relationship between wages and benefits in firms' overall compensation strategy. Our result that firms do not manipulate benefits at the job level to offset downward nominal wage rigidity might be taken as evidence that adjusting benefits is more costly than initially believed. For example, for a variety of reasons, firms may not be able to adjust many benefits, such as health care or retirement, for specific workers or jobs. If firms want to adjust compensation downward for some but not all workers, then, benefits may be an inappropriate tool, even in the face of downward nominal wage rigidity.

A related area of further research would be to better understand the relationship between rigidity at the individual and job levels. Resistance to pay cuts is certainly generated at the individual level, but it is unclear whether individual- or job-level rigidity matters more for firms. To the extent that firms wish to single out workers for pay cuts, individual-level rigidity would be more relevant. To the extent that pay differences across individuals within a job reflect something other than productivity differences, firms may be able to achieve cost reductions through turnover, say, without cutting any individual's pay, and rigidity at the job level might be more relevant. In either case, better understanding whether firms focus on jobs or individuals may provide insight on how firms adapt to downward nominal rigidity.

The final important area for further research is understanding why, despite the microeconomic evidence of downward nominal wage rigidity, there is so little evidence that this rigidity has had the predicted adverse macroeconomic consequences, at least in the post-war United States.[17] The central prediction of simple models based on downward nominal wage rigidity is a negative correlation between inflation and equilibrium unemployment rates. Yet Gordon's (1998) estimates of the non-accelerating inflation rate of unemployment, which he allows to vary over time, are *positively* correlated with inflation: They rise from the early 1960s through the early 1980s, and decline since then. Similarly, when Akerlof, Dickens, and Perry (1996) embed downward nominal wage rigidity into a Phillips curve, the incremental explanatory power is small during the postwar period (and presumably would be smaller still if the sample were extended to cover the late 1990s), although they find that their equation does help explain the behavior of wages during the 1930s. It is possible that rigidity has significant effects on aggregate unemployment that have been masked by other factors; it also is possible that rigidity has had no effect on aggregate unemployment because firms have made other adjustments that could be reflected in other macroeconomic variables such as profits or productivity. Clearly, understanding the macroeconomic effects of downward nominal wage rigidity remains an important question for future research.

[17]For Japan, Kimura and Ueda (1997) find that industry-level wages do not exhibit much downward rigidity. For Canada, Fortin (1996) argues that downward rigidity is substantial and has led to persistently high unemployment rates in the 1990s; but see Freedman and Macklem (1998) for a dissenting view.

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Appendix

Adding One Benefit at a Time to Wages & Salaries

	% of Obs. < 0	% of Obs. =0	LSW Asym.	Kahn test *n**
W&S	14.6	18.4	13.2	-.48
W&S plus...				
Overtime	15.1	17.5	12.9-	-.50
Vacation	15.5	16.5	12.6	-.45
Paid holidays	15.4	16.8	12.4	-.39
Sick leave	15.1	17.3	12.9	-.47
Shift differentials	14.7	18.2	13.2	-.49
Non-production bonuses	16.6	15.2	11.9	-.41
Severance pay	14.7	18.3	13.2	-.47
Supplemental unemployment	14.8	18.4	12.9	-.48
Life insurance	17.5	12.6	10.4	-.46
Health insurance	16.9	10.4	10.4	-.43
Accident insurance	16.1	15.6	11.8	-.48
Pension & saving	17.1	15.2	11.4	-.44

* All coefficients are significant at the 1 percent level.