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ABSTRACT

In this paper we use micro data from the Employment Opportunity Pilot Project (EOPP) surveys of firms in 1980 and 1982 to test for labor market rigidities and asymmetries in response to demand shifts. We analyze wage and employment adjustments to positive and negative shifts, as measured by sales growth between 1979 and 1981. The analysis is done for both entire sample of firms and for selected subsamples based on firm size, unionization, industry and skill mix.

The results show that wage adjustments appear to be fairly rigid, compared with employment adjustments. They also appear to be quite asymmetric, with significant adjustments in response to positive shifts but little adjustment in response to negative shifts. These asymmetries are not more pronounced in large firms, manufacturing, heavily-waged or highly-skilled industries than in other firms or industries. In contrast, employment adjustments show no consistent pattern of asymmetry.

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I. Introduction

"Any individual or group of individuals, who consent to a reduction of money wages relatively to others will suffer a relative reduction in real wages, which is sufficient justification for them to resist it. On the other hand, it would be impracticable to resist every reduction of real wages due to changes in the purchasing power of money, which affects all workers alike." [Keynes 1936 p.14]

The idea that wages may adjust slowly to output shocks has long been central to discussions of the causes of business cycles in general and unemployment in particular. Traditional Keynesian models of business cycles assumed the existence of price and nominal wage rigidities and then explored their implications for aggregate fluctuations.[1] These models have been criticized by some economists for their weak theoretical underpinnings. Consequently, attempts have been made recently to provide stronger micro-theoretic foundations for wage and price stickiness so as to avoid making ad-hoc assumptions about the nature of these rigidities and why they may persist.[2] The models which make these attempts include imperfect or asymmetric information models, menu cost or nonsynchronized contracting, "Efficiency Wage", "Insider-Outsider", contract and agency models.[3]

Many discussions of imperfect wage adjustments have stressed that wage and price rigidities may be asymmetric, with downward adjustments being "stickier" than upward ones. As pointed out in DeLong and Summers (1988) and Ball et. al. (1988), the existence of asymmetries in the labor and product markets may have important implications for the efficacy of stabilization policy and the existence of a "natural rate" of unemployment. While such asymmetries are within the spirit of Keynesian and New Keynesian models, they

do not usually explicitly arise in most of the models of wage rigidity described above. However, some versions of "Insider-Outsider" model (Lindbeck and Snower, 1988), Efficiency Wage model (Summers 1988) and contract models (Holmstrom, 1983) do imply asymmetric effects in the upward and downward directions.

While some strides have thus been made in developing theoretical underpinnings for rigid wages, the empirical evidence on the nature of these rigidities and asymmetries has remained quite scant.[4] Indeed, the extent of wage rigidities and the existence of wage asymmetries has never been conclusively demonstrated.

In this paper, we use micro data from a recent survey of firms to analyze wage rigidities and asymmetries in response to demand shifts. The dataset that we use includes measures of wage, employment, and sales adjustments for a sample of over 3400 firms during 1980 and 1982. By matching these measures of demand shifts and labor market adjustments with other firm, industry and local labor market controls, we are able to test at least some of the hypotheses regarding wage rigidities that have been advanced in recent years.

In the literature to date, the existence of rigidities has been explored in the context of real wage movements over the business cycle (e.g., Bils (1987), Montgomery and Shaw (1988)) and in the estimation of "Phillips Curves" for wage changes.[5] Unfortunately these aggregate relationships can and have been interpreted in a variety of ways. Further, the evidence presented in favor of particular models of wage rigidities such as "Insider-Outsider" or "Efficiency Wage" models, tends to be even more indirect and inconclusive.[6]

By using firm-level data we are able to overcome a major cause of the lack of convincing evidence on rigidities to date: the paucity of appropriate micro data for the U.S., especially on firms.[7] Indeed, many of the recent theoretical models can only be directly tested if firm-level data were available, since they explicitly involve employee attachments to firms (in the case of "Insiders-Outsiders") or employer concerns in hiring, motivating, and retaining quality workers (in the case of "Efficiency Wages"). Even the very existence of rigidities and asymmetries in wage adjustments can be clearly demonstrated only in response to some exogenous measure of product demand shifts, which is difficult to find at the aggregate level.[8]

We will present estimates of wage adjustments by firms in response to positive and negative demand shifts, as measured by sales growth, between 1979 and 1981. We will do this for an entire sample of firms, and also for subsamples based on a variety of firm and industry characteristics - e.g., firm size and unionism, industry skill levels and unionism, and manufacturing. We will also compare employment adjustments with the estimated wage adjustments for all of these groups. These employment estimates will be tied to the results for the wage adjustments in an attempt to test various competing theoretical models which imply different relationships between wage and employment adjustment in the presence of rigidities.

Our main findings can be summarized as follows:

1) Wages appear to be fairly rigid, certainly compared with employment. In particular, measures of variation across firms in employment are several orders of magnitude larger than are those in wages.

2) Wage adjustments in response to demand shifts appear to be quite asymmetric, with significant adjustment in response to positive shifts but little in response to negative shifts.

3) Asymmetric wage adjustments are not explained by a wide variety of firm, industry, and labor market characteristics. Furthermore, the asymmetries are not particularly more pronounced in large firms, manufacturing, heavily unionized and/or highly skilled industries. Unionized firms show little wage adjustment in response to upward as well as downward demand shifts in the short-run.

4) Employment adjustments overall show little of the asymmetry observed in wage adjustments. Small firms do show larger employment adjustments in response to positive demand shifts, while large firms show larger adjustments in response to negative ones.

The rest of the paper is organized as follows: Section II will discuss various theoretical models and their implications for wage (as well as employment) adjustment; Section III will involve a discussion of the data used and hypotheses tested; Section IV will present the empirical evidence; and Section V will contain conclusions and implications of this work.

II. Theoretical Models and Their Implications

The response of wages to demand shocks has garnered no shortage of attention in the business cycle literature. In a simple flexible-wage world (Freeman, 1977), we can see that employment and wages will adjust to shocks in demand and/or supply:

$$(1)\quad \dot{L}^D = \dot{D} - \theta\dot{W}$$

$$(2)\ \dot{L}^S = S + \epsilon \dot{W}$$

where

$\dot{L}^D$ is the rate of growth in labor demand

$\dot{L}^S$ is the rate of growth of labor supply

$\dot{W}$ is the rate of change of wages

D is a measure of demand shocks

S is a measure of supply shocks

and θ and ϵ are the elasticity of labor demand and supply respectively. In equilibrium:

$$(3)\ \dot{W} = (D - S)/(\epsilon + \theta)$$

$$(4)\ \dot{L} = (\epsilon D + \theta S)/(\epsilon + \theta)$$

Clearly, wage responses to demand shocks will be smaller the greater is the elasticity of supply, while employment responses will be greater in this case. To the degree the wage setting process is one in which unions or workers succeed in making the wage exogenous to the firm, while allowing firms to unilaterally determine employment (as in Fischer (1977) and Taylor (1980)), we would expect to see even smaller fluctuations in wages but larger fluctuations in employment.

The responses of both wages and employment to demand shocks in this simple model would be symmetric with respect to upward and downward demand shifts. Only if the labor supply curve were nonlinear or kinked over the relevant range would we find asymmetric wage responses. It should also be noted that, to the degree wage responses to demand shocks are asymmetric, employment responses will also be asymmetric and negatively correlated with the wage responses.

The existence and persistence of these nominal wage rigidities were rationalized by Keynes as being the result of relative wage effects and the presence of money illusion. The notion of nominal wage stickiness underlies the standard textbook nonlinear aggregate supply curve and hence aggregate rigidities. New Keynesian models rely less on labor market rigidities and more on product market or price rigidities that come about because of the existence of menu costs, imperfect competition, or aggregate demand externalities. As pointed out in Ball et .al. (1988), Keynesian models often tend to focus on the existence of nominal rigidities as an explanation of the nonneutrality of real output to nominal demand fluctuations.

The limited amount of work on nominal rigidities stands in contrast to the extensive amount of recent work in both the New Keynesian and New Classical schools on the existence of real wage rigidities. This work provides an explanation for the absence of cyclicality in real wages and, in some cases, the existence of unemployment. It should be noted, however, that most of these sticky wage models imply that wages should respond slowly to both positive and negative demand shocks. An exception to this is the work by Holmstrom (1983), in which he develops a multiperiod optimal contracting model with mobile labor where wage asymmetry exists. In his model, with risk-neutral firms and separable worker preferences, wages are sticky downward but flexible upward because firms must raise wages to keep workers from quitting. Wages are rigid in a downward direction because workers want firms to insure them against income fluctuations. Interestingly, in this model employment will also be rigid downward (since workers will be insured against employment fluctuations) if workers are risk-averse and unemployed workers do not receive any nonlabor income. Thus, the magnitude of wage and employment responses to

shocks should be positively correlated if this kind of implicit contracting is present.

Some recent work on Efficiency Wages and Insider-Outsider considerations also reflects the notion that asymmetries might endogenously arise in bargaining process.[9] Lindbeck and Snower (1988) discuss a model where insiders can withdraw cooperation from outsiders who try and underbid them. In such a model, wages will be constant as demand falls but will rise when output rises; while employment falls with demand but stays constant in the face of rising demand. Both employment and wages will thus respond asymmetrically but in opposite directions to business cycle fluctuations. It should be noted that the direction and extent of the asymmetry in wage or employment adjustments in this model depend critically on the existence of seniority layoff rules, whether firms are initially at "high" or "low" employment, and whether the shocks to demand are anticipated by firms, workers or both.

Carruth and Oswald (1987) have also developed an Insider-Outsider model in which wages respond asymmetrically to rising and falling demand. In their model unions and firms bargain over wages while employers are free to set employment. The union wage demands are a function of the preferences of current members only, so falling demand will not lead to falling wages until the median member is unemployed. Conversely, rising demand leads to rising employment until all the old members are reemployed; then a period of rising wages but static employment ensues. Thus, wages tend to be flexible upward but not downward and the asymmetry in wage adjustment is negatively correlated with that in employment adjustment.

In summary, despite a long tradition of references to asymmetries in the nominal wage-setting process, we know of only a handful or models where these

asymmetries are explicitly derived. Most of the theoretical work that has considered these asymmetries occurs in the contract or Insider-Outsider literature and are primarily relevant to real-wage adjustments. Furthermore, there remains an absence of direct empirical evidence concerning real or nominal wage asymmetries.[10] In this paper we attempt to fill that empirical void.

III. Empirical Specification and The Data

The primary goal of our empirical work is to measure, for a cross-section of firms, the wage and employment adjustments which occur in response to shifts in demand. The estimated equations will be reduced-form in nature and of the following specification:

$$5)\ W_{ijk},\ E_{ijk} = f(Q_{ijk};\ X_i,\ X_j,\ X_k) + u_{ijk}$$

where W and E measure the growth rate of wages and employment respectively; Q measures the growth rate of real sales; the X are control variables; while i, j, and k denote the characteristics of the firm, industry, and local labor market respectively. The real sales growth variable is used as a measure of firm-level demand shifts, so its coefficient captures the extent to which wages are sticky in response to demand shocks. Since the response to positive and negative demand shocks need not be the same, we analyze the effect of positive and negative demand shifts separately. In particular, the sales growth variables is entered in spline (at zero) form to test for asymmetries in labor market adjustments to demand increases and decreases.

The dependent variable here measures nominal wage adjustments. In the absence of differences in area price adjustments the differences in observed wage changes across the firms in our sample will equal the real consumption wage adjustment. The absence of extensive area price-level data or detailed firm-specific price data prevent us from explicitly controlling for changes in the value of real consumption or production wages. As an alternate approach we use area dummies in our equations help to control for these differences. Thus, the specifications with the area or site dummies can be thought of as testing for real wage asymmetries.

The inclusion of industry and local characteristics enable us to examine the extent to which these factors affect wage adjustments once we control for firm-specific demand. In addition to 2-digit dummy variables for each industry, we use published data on the fraction unionized and constructed indices measuring occupational composition for each industry.[11] Other firm-level controls that we use are fraction unionized and firm size. For local labor market controls, we use area-specific dummies and annual unemployment rates.[12]

These firm and local labor market variables are used to test specific hypotheses regarding wage adjustments and rigidities. For instance, local unemployment rates are likely to be proxies for the available local supply of "outsiders" that each firm faces. The extent to which increases in this supply of "outsiders" may depress wage changes in response to positive demand shocks and increase them in response to negative demand shocks is an important measure of outsider vs. insider power at the firm.

The extent of insider power at the firm, and hence incumbents' abilities to isolate their wages from adverse demand shocks, should rise with employee

skill level and with the extent of unionism in an industry (since the latter should raise the threat of unionism faced by nonunion firms). The presence or absence of unionism in the firm itself (as opposed to in its industry) should also be an important determinant of wage rigidities, since employees of unionized firms are more likely to be covered by long-term contracts and seniority-based layoff rules. The extent of rigidity may also vary systematically by firm size or industry, to the extent that monitoring costs or technology differs across firms or industries.[13]

If differences between these groups of firms (i.e., between union and nonunion, large and small, etc.) can help account for the overall observed variation in wage adjustments across firms, then adding these variables to wage growth equations should raise the estimated coefficients on the demand-shift variables. Furthermore, if wage rigidities are greater within some of these categories of firms, then differences in estimated coefficients on positive and negative demand-shift measures should be larger for certain subsamples than for others. Both types of hypothesis tests appear below.

The data that we use in this study is from the Employment Opportunity Pilot Project (EOPP) Survey of Firms, conducted on a sample of about 3400 firms in 28 local labor markets during 1980 and 1982.[14] The firms in this study tend to be situated in local labor markets that are predominately in the South and Midwest, and about half of these local labor markets are in SMSAs.[15]

Of primary concern here are those variables dealing with wage and sales growth. In the 1982 survey, firms were asked, "By what percent did the average hourly wage rate of non-supervisory workers increase between December 1979 and December 1981?" A comparable question was asked for changes in unit sales

adjusting for price increases. Employment growth can also be measured, since in both the 1980 and 1982 waves of the survey firms were asked for numbers of employees they had in July and December of each year from 1979 through 1981, as well as at the time of each survey.[16] We will focus primarily on employment growth from December 1979 through December 1981 in our analysis below.

The EOPP survey also includes information on the 2-digit industry to which the firm belongs, as well as the fraction unionized in each firm. These can be used to see to what extent wage or employment adjustment vary by industry or across union and nonunion firms.

Before moving on to consider the empirical results, an important caveat must be mentioned. The extent to which sales growth differences across firms can be interpreted as exogenous demand shifts might be questionable. Sales growth will, in the absence of major changes in inventory levels, reflect output growth which, in turn, is endogenous with respect to employment and wage changes. However, if most of the output changes in our sample are the result of changes in the level of employment, there should exist negative correlations between wage growth, on the one hand, and employment and output growth, on the other.[17] In fact we find a positive correlation between wage growth and employment growth (rho = .063) and, as noted below, between wage growth and output growth. This suggests that we are not simply estimating a labor demand function where this endogeneity issue would be vital. Furthermore, Quandt and Rosen (1989) present evidence that supports the exogeneity of output changes with respect to employment. Finally, the non-constancy of inventories during this recessionary period would imply that sales growth reflects demand somewhat independently of output. All of these

findings thus support our contention that this variable is primarily reflecting exogenous shifts in demand.

IV. Empirical Results

In Table 1 we present summary statistics on wage, employment, and sales growth for our sample of firms, as well as the other independent variables used below. These statistics are also computed for the subsamples of firms with growing and zero/declining sales. The growth rates for wages, employment and sales were calculated as log (1+growth rate), to minimize the effects of outliers. We also limit our sample to firms whose employment no more than tripled or fell to no less than one-third of its starting value.[18]

Wage growth for the firms in our sample averaged about 16 percent during the period 1979-81, which is a bit lower than the increase in average hourly earnings in the private nonfarm economy of 19 percent over the same period. The high rate of wage inflation in our sample over this period reflects the rapid price inflation that was occurring. The mean rate of employment growth in our sample is 1.6 percent, which is a bit higher than the rate of growth of nonagricultural employment in the economy as a whole (1.4 percent) over this period. Thus, our sample seems to be made up of firms that experienced slightly lower than average wage increases but greater growth in employment than the economy as a whole. The below-average wage but above-average employment growth in our sample is not surprising, given the fact that our data oversampled Southern firms which experienced more rapid growth and less wage pressure than for the rest of the country.[19]

There are some interesting differences between growing and declining firms in our sample. While the difference in mean wage growth between firms

with growing and declining sales is statistically significant, it is quite small.[20] In contrast, the differences in employment growth between the two sets of firms appears much larger.

More generally, we find the coefficient of variation in employment growth to be about thirty times as large as that in wage growth for firms. Thus, wages are far less variable, in the short run at least, than is employment.[21] While it is possible that very elastic labor supplies could generate these numbers in equilibrium, the magnitude of the necessary labor supply elasticity seems implausibly high.[22] Rigidities in wage adjustments are therefore likely to be responsible for these findings.

We also note that over 55 percent of the sample has zero or declining real sales within the period 1979-81, which is consistent with the fact that real GNP fell during 1980 before rebounding some in 1981. In addition, these sample means also suggest that firms which experienced falling real sales were more heavily unionized than those experiencing positive demand shifts.[23] The low overall rate of unionization in our sample of firms is consistent with the over-sampling of low-wage firms in the EOPP data.[24]

WAGE ADJUSTMENTS

In Table 2 we present our estimated wage growth equations. As noted above, the sales growth variable is entered as a spline in these equations to test for the existence of a fundamentally different response in wages to demand increases relative to demand decreases. An alternate nonlinear function would still imply asymmetries in the wage setting process but would not capture the spirit of downwardly rigid wages. Given the fact that the spline imposes a more stringent form on the asymmetry hypothesis, we performed a "J-

Test" on this specification versus other nonlinear functional forms.[25] We could not reject the hypothesis that the spline was the correct functional form relative to a quadratic or cubic functional form. It should be mentioned that we also performed Hausman tests for the endogeneity, of the sale growth variable. Although it is difficult to construct alternate instruments with which to test for endogeneity we could not reject the hypothesis that sales growth is exogenous in any of alternate specifications that we tried.[26]

The results in column 1 of Table 2 suggest that wage adjustments are highly asymmetric with respect to sales growth. There is virtually no responsiveness of wage growth when sales are declining, while adjustments are significantly positive when sales are rising. Further, we could reject the null hypothesis that the coefficients on the increasing and decreasing sales terms are the same at the 5 percent level.[27] Thus, the data suggest that there are important asymmetries in wage responsiveness to positive and negative demand shocks.

Using the point estimates in column 1, we see that a 10 percent change in the rate of growth of demand in the positive direction leads to about a 1 percent increase in the rate of growth of wages while a 10 percent change in the rate of sales growth in the negative direction reduces wage growth by only .06 percent. Once again, these point estimates imply labor supply elasticities that are implausibly large for an equilibrium model to be generating these results.[28]

As seen in columns 2-4, the point estimates on the wage responsiveness to demand shock, and hence the qualitative nature of these results, do not appear to be sensitive to the inclusion of other control variables. Thus, the

observed asymmetry does not appear to be caused by differences in firms size, unionization, industry or local labor market conditions.

We should note that we find significantly higher wage growth in manufacturing during our sample period, even after controlling for the rate of growth in sales.[29] This finding is consistent with previous results on the greater prevalence of COLA clauses in union contracts and the resultant growth in the manufacturing wage premia during this period. On the other hand, we also find a somewhat negative effect of firm unionization on wage growth during this time. Finally, we note that, controlling for firm-level demand, area unemployment has a negative but insignificant effect on wage adjustments in firms.

STRATIFYING THE SAMPLE

The finding of rigid and asymmetric wage adjustments for the entire sample leads us to the question of whether or not the observed asymmetries would be greater in magnitude for some kinds of firms than for others.[30] In particular, some of the existing theories of wage asymmetries (such as Efficiency Wages, Insider-Outsider models, etc.) suggest that rigidities and asymmetries should be more pronounced in large or unionized firms, highly skilled and/or heavily unionized industries. We therefore test for differences in wage adjustments between samples based on firm size and unionism, industry skill-level and unionism, as well as manufacturing.

In Table 3 we present separate estimates of wage adjustment equations for large and small firms, which are defined as those which are greater or lesser in size than the sample mean (which is fifty-five employees). Though the larger firms represent only 21% of the firms in the sample, they account

for about 70% of all employees. It is worth noting that the J-test for the spline functional form and other tests for heteroscedasticity performed better for the sample of larger firms than for the smaller ones or the total sample.[31] The estimated equations include site and 1-digit industry dummies as well as fraction unionized in the firm and firm size as controls.

The results of Table 3 show fairly similar patterns of wage adjustments between smaller and larger firms. In particular, we find the same type of asymmetry in wage adjustments in both sets of firms - i.e., positive adjustments to positive demand shifts but no significant adjustments to negative ones.

We see no significant differences between manufacturing and non-manufacturing firms in wage adjustments to positive and negative shifts. Asymmetries and rigidities in wage-setting thus appear to be no more severe in the manufacturing sector. There are, however, some significant differences in the behavior of union and nonunion firms. We find that nonunion firms have sticky wages in a downward direction but flexible wages in an upward direction. In contrast, wages in unionized firms appear to be rigid in both the downward and upward directions.

The finding that wage adjustments in unionized firms do not respond to positive demand shifts is consistent with a model in which long-term contracts fix wages and do not allow them to respond to unanticipated shifts in demand. But the fact that the nonunion firms also have sticky wages in a downward direction does suggest that the failure of nominal wages to adjust downward is the result of institutional or economic factors other than collective bargaining.

Regarding industry unionism, the data suggest that the degree of unionization in an industry does not affect the magnitudes of the wage response to demand shifts. Wages appear to be sticky downward and flexible upward in both heavily and lightly organized industries which are defined as those with unionization rates above and below the mean respectively. These results are contrary to what one might expect on the basis of "Insider-Outsider" models, where incumbent workers, who could effectively threaten to unionize, should have more "insider" power over their wages.

Interestingly, there does appear to be a difference in the responsiveness of wages between industries whose average skill levels are above and below the mean. We find that wages in less-skilled industries tend to be more responsive to positive demand shifts and a bit less responsive to negative shifts than are those in more skilled industries. In other words, rigidities and asymmetries in wage adjustments appear to be greater among less-skilled workers.[32]

These findings are consistent with work by Bils (1985) that found that less-skilled workers' wages tend to fluctuate more over the business cycle. But, once again, the results seem inconsistent with the idea that "insider" power is a major source of wage rigidity since one would expect such power to be greater among more highly skilled employees.

In summary, we find that wage adjustment asymmetries are not more pronounced in large firms, manufacturing, heavily-unionized, and/or highly-skilled industries, as might have been expected on the basis of "Insider-Outsider" or Efficiency Wage theories. Only in unionized firms, where we find wage rigidity in response to upward as well as downward shifts, is the basic pattern of wage adjustments altered.

EMPLOYMENT ADJUSTMENTS

As discussed above, the observed pattern of asymmetries in wage adjustments are consistent with several models of the labor market. These models however have somewhat different predictions about whether the pattern of employment asymmetries should be positively (e.g., Implicit contract models) or negatively (e.g., Insider-Outsider and kinked labor supply models) correlated with the wage asymmetry patterns. Thus, by examining employment adjustment patterns, we may be able to shed more light on the ability of existing theories to explain observed labor market adjustment patterns. It should be emphasized that all of the models that give theoretical underpinnings to wage asymmetry imply that employment adjustments should also be asymmetric in one direction or another.

In contrast to these strong findings for wage growth, the employment growth equations of Table 4 show no such asymmetry between firms with growing and declining sales.[33] The coefficients on sales growth are positively and significantly, whether the latter is growing or declining. If anything, the point estimates suggest that employment adjustments seem a bit larger on the upward side. This is consistent with the implicit contracting model but not in either the kinked labor supply or Insider-Outsider view of the labor market. It should be noted however, that the differences between the growing and declining firms are not very significant.

At first blush, it would appear anomalous that wage adjustments are asymmetric while employment adjustments are not. This finding appears to be inconsistent with any of the existing models of asymmetric wage adjustments. It is possible that the data are not rich enough to capture the true

underlying dynamics in the employment equation. For instance, adjustments in total labor input could still be asymmetric, even if employment adjustments are not, as long as hours adjustments are asymmetric. Unfortunately, the EOPP survey did not collect hours data, so we cannot test this hypothesis directly. However, previous work suggests that most of the cyclical response in total labor input occurs through changing employment, making it unlikely that failure to control for hours is strongly biasing our results.[34]

Another possibility is that the absence of observations on lagged or slow employment adjustments is biasing our results. We have therefore constructed an alternative employment change variable for the period of December 1979 through the survey date in 1982, thereby including available information on lagged employment changes.[35] Given the evidence of relatively short adjustment lags in employment for the U.S. (Abraham and Hausman, 1989), this alternate specification should capture much of the lagged employment responses to demand changes occurring between 1979 and 1981.[36]

Estimated employment adjustment equations using this alternate measure of employment growth produce quite comparable results to those presented in Table 4.[37] It is, of course, still possible that there are lags in employment adjustment that cannot be picked up because of the cross-sectional nature of the data. However, to generate asymmetries in the adjustment process beyond those that we observe, these fixed-cost lags would have to be greater for employment reductions than for employment increases. It is not clear a priori why this should be the case.

It is also possible that we could fail to find employment asymmetries if unobserved, firm-specific technological differences are correlated with sales growth in such a way that, all else equal, desired employment changes are

smaller for firms facing negative demand shifts. A similar result would occur if anticipations differ between firms facing positive and negative shifts regarding the permanence of such shifts. In particular, downward shifts might be perceived as being more cyclical (and therefore more temporary) while upward shifts are perceived as being secular. The fact that the overall economy was entering a recession during this period lends some credibility to this story.

If there are potentially important heterogeneity effects estimating employment adjustment equations for different subsamples of the data may allow us to uncover some of the differences in responses across firms with different technologies or facing different market conditions. Consequently, in Table 5 we present employment equations using analogous sample stratifications to those used in estimating the wage adjustment equations in Table 3.

In contrast to the wage equations, these results suggest that there are strikingly different patterns of employment adjustments in large and small firms. It appears that the failure to find evidence of asymmetric adjustments in employment using the nonstratified data is the result of the fact that it is averaging two very different asymmetric adjustment patterns. For large firms we find evidence of asymmetric employment adjustments where employment responds more to falling demand than to rising demand. In contrast, small firms adjust more in response to positive demand shocks than to negative demand shocks. Once again, using the employment measure that includes the lagged adjustments does not change the basic finding here.[38]

Thus, the results for larger firms appear to be more consistent with those predicted by the kinked labor supply model or the Insider-Outsider model in which asymmetric wage adjustments generate employment asymmetries of the

opposite direction. In contrast, the results for small firms appear to be inconsistent with either of those models, since wage and employment asymmetries move in the same direction for these firms.

Interestingly, we do find support for the notion that unionized firms respond in an asymmetric fashion in adjusting employment. Unionized firms appear to reduce employment much less in response to adverse shocks than they increase it in response to positive shocks. Nonunion firms appear to respond symmetrically to positive and negative demand shocks. Thus, it would seem that union contracts keep wages from adjusting to either positive or negative shocks, while labor demand in these firms is characterized by strong labor-hoarding-type behavior in response to negative shocks (even though wages do not adjust asymmetrically in unionized firms).

We do not find any evidence to suggest that there are significantly different employment adjustment responses in manufacturing industries. Both the absolute magnitude of the employment adjustment and the absence of any pattern of asymmetry is the same in both the manufacturing and nonmanufacturing sectors. Similarly, the data suggest that neither the degree of unionization in an industry nor the skill composition of the industry significantly affects either the magnitudes nor extent of asymmetry in the employment responses to demand shifts.

V. Conclusions and Implications

In this paper we examine the effect of demand shocks on the adjustment process in the labor market. Using firm-level data, we find that wage adjustments appear to be quite rigid relative to employment adjustments, with the coefficients of variation being about thirty times greater in the latter

as in the former. High elasticities of labor supply in an equilibrium model seem unlikely to generate these results. Also, there exist statistically significant differences in firm wage responses to positive and negative demand shocks. Our evidence suggests that wages are rigid in the downward direction but less so in the upward direction. This finding is very robust, and is unaccounted for by characteristics such as unionism, firm size, industry skills and local unemployment.

When we stratify our sample, we find that wages in nonunion firms are just as rigid in a downward direction as union wages, but that they are somewhat more flexible upward in response to positive output shocks for the former group. Long-term contracts thus seem to be limiting upward wage flexibility for union workers, but they cannot account for rigidities in the downward direction for nonunion workers.

We find no evidence that asymmetries in wage responses are more pronounced in large firms, manufacturing, highly unionized or highly skilled industries. If anything, asymmetries are more pronounced in less-skilled industries. Thus, the observed asymmetry and rigidities in wage responsiveness do not appear to be consistent with "Insider-Outsider" considerations in the hiring and wage-setting process.

In contrast to this consistent pattern of asymmetries in the adjustments of wages, employment adjustments do not show a consistent pattern of asymmetry. For the whole sample we find no evidence of asymmetry in employment responses. Our results suggest that large firms respond more to negative shocks than to positive ones while small firms adjust more to positive shocks than to negative ones. Unionized firms appear to respond to positive but not negative shocks while nonunion firms have symmetric responses. We find no

evidence of differences in employment adjustment dynamics in across manufacturing or nonmanufacturing firms or in heavily unionized industries.

This failure to find a consistent pattern of asymmetric employment adjustment to mirror the strong and consistent pattern of asymmetric wage adjustment is somewhat troubling. It may suggest that our data are not rich enough to estimate the true nature of employment adjustments, due to insufficient information on lagged adjustments or unmeasured heterogeneity across firms. The fact that we do find asymmetric employment responses when the data are disaggregated by firm size suggests that this is a possibility. Clearly, before any firm conclusions can be reached based on these results, further study using longitudinal data at the firm level is necessary in order to control for the effects unobserved firm heterogeneity.

But if our data are correctly measuring the nature of employment adjustments, better theoretical models of adjustments would also be needed. Perhaps the labor-hoarding models of employment adjustments over the cycle could be integrated into models of wage dynamics. It should be noted, though, that recent empirical research on this issue (e.g., Fay and Medoff (1985) and Garber (1989)) does not suggest greater hoarding in response to negative shocks than to positive ones.

Thus, our work suggests that any new theoretical models should be able to explain both wage asymmetry and employment symmetry. If employment adjustments are allowed to be asymmetric, then the model should be consistent with these employment asymmetries being strongly related to firm size. The observed differences in employment adjustment patterns between small and large firms certainly remains a conundrum at this time.

Nonetheless, it should be emphasized that our results do provide support for models of the labor market that allow for rigidities and asymmetric adjustments in wages. As pointed out in DeLong and Summers (1988), these asymmetries may have important implications for the efficacy of stabilization policy.

Endnotes

1. The standard textbook IS-LM model of aggregate demand and Phillips Curve model of aggregate supply certainly fit into this category. Other examples of recent models which assume rigidities that are not explicitly derived include those of Fischer (1977) and Taylor (1980).

2. This discussion draws heavily form two recent surveys of New Keynesian models by Ball, Mankiw, and Romer (1988) and Greenwald and Stiglitz (1988).

3. Theoretical developments in the "Efficiency Wage" literature are summarized in Katz (1986). Several different versions are distinguished there, including those which stress self-selection of applicants, costs of employee monitoring, relative wage and "fairness" concerns, union threats (for non-union firms), and turnover. "Insider-Outsider" models are discussed in Lindbeck and Snower (1988) and Blanchard and Summers (1987). Implicit contract models are summarized in Hart (1983), while explicit contracts are stressed in Fischer and Taylor, op.cit.

4. Theoretical arguments and empirical evidence on responses to nominal demand changes appear in Delong and Summers (1988). Their empirical evidence is limited to adjustments in real output and unemployment rather than wages.

5. Movements in real wages over the business cycle give some indication of the extent to which labor market rigidities limit wage adjustments to aggregate demand shocks. However, as pointed out in Ball et. al (1988), real wage rigidity may have limited implications for nominal wage rigidity since real wage rigidity is also a function of price rigidity. The results for the estimation of Phillips Curves for wages has provided evidence on the issue of whether rigidities have grown over time (e.g., Sach (1980), Allen (1989)) and on asymmetries (or non-linearities) in wage adjustments to different levels of unemployment (e.g., Mitchell (1981)).

6. Most of the evidence cited in the "Insider-Outsider" literature involves aggregate evidence on the persistence of unemployment and of the lack of long-term unemployment effects on wage inflation (e.g., Blanchard and Summers (1987). Of course, there are many interpretations of such findings (e.g., depreciation of human capital or search skills among the long-term unemployed, firm-specific skills of the currently employed, etc.). Evidence on "Efficiency Wages" has been largely limited to discussions of inter-industry wage differentials that are unexplained by observable characteristics (e.g., Krueger and Summers (1987), Murphy and Topel (1987)). Somewhat more direct evidence appears in Raff and Summers (1987), Leonard (1987), and Holzer (1989). With the exception of Raff

and Summers, the evidence presented in these latter papers in favor of "Efficiency Wages" is quite limited.

7. Analysis of these issues using firm-level data for Britain can be found in Blanchflower and Oswald (1987) and Carruth and Oswald (1985).

8. Unanticipated money growth is often used as a measure of nominal demand shifts at the aggregate level. To our knowledge however, most studies using this variable have focused on its effect on real output and unemployment.

9. See DeLong and Summers (1989), Sichel (1989), and Neftci (1984) for empirical evidence on asymmetric business cycles.

10. Blanchflower (1989) presents some indirect evidence for the existence of nominal wage asymmetry in Great Britain. He found that wages rise in firms that are expecting employment increases but do not decline in those that are expecting employment declines.

11. The fraction unionized data appear in Sockell and Kokkelenberg (1985) and are based on three-year moving averages from CPS data; we use data from the 1979-81 period here. The occupational data by industry are from the 1980 Census of Population and are published in U.S. Census Bureau (1980). The occupational data are summarized in wage indices which are calculated as $W_j = \Sigma w_i \cdot s_{ij}$ where w_i represents average wage for occupation i and s_{ij} represents the share of industry j employment in occupation i. Wages are defined as median annual earnings for year-round full-time workers.

12. Unemployment at the county level can be obtained from the 1980 Census of Population and are summarized in the City and County Databook (1983). Annual unemployment data at the county level based on the CPS are also used here, though these are based on smaller samples.

13. Large firms are more likely than small ones to have personnel departments with structured hiring and training policies that create power for incumbent workers. Manufacturing firms, in part because of the prevalence of unions, might also have institutional or technologically driven arrangements that give extra power to incumbents. It should be noted however, that their high wage premia for relatively unskilled workers might attract queues of outside applicants (Holzer et.al., 1988).

14. The original survey in 1980 was administered to some 5300 firms, while the follow up in 1982 involved about 3400. Since most of the data used here appear only in the latter survey, we limit ourselves to that sample. The original survey was developed by the Department of Labor and administered by Westat Inc., while the follow up was developed at the National Center for Research on Vocational Education (Ohio State University) and administered by Gallup Inc.

15. The SMSA's are all located in Ohio, Texas, Louisiana, Alabama, and Florida. Non-SMSA sites are groups of counties in Kentucky, Virginia, Colorado, Wisconsin, Washington and Missouri. A complete listing of sites appears in Holzer (1988). Within sites, large and/or low-wage firms were over sampled. Sampling

weights are available with which we can obtain unbiased estimates of within-site means.

16. All questions pertaining to the firm refer to all plants within the geographic site. Survey questions were answered by the individual "...responsible for hiring at the firm."

17. In other words, if exogenous employment growth is driving output growth, we would expect positive labor supply shifts to generate negative correlations between wage and employment growth. If technological change and/or changes in other factors were driving these changes, we might observe negative correlations between employment and output growth, as substitution toward other factors would presumably reduce labor demand. The positive correlations between wage, employment, and sales growth as well as vacancies implies an exogenous demand shift, presumably from developments in the product market.

18. This condition reduced our sample by approximately 150 firms. Among these outliers, employment ratios (i.e., December 1981/December 1979) varied from .04 on the low side to several hundred on the high side, thus swamping the variation accounted for by the remainder of the sample.

19. Sample- and size-weighting actually reduced mean employment growth in these firms to a value of -.04.

20. The standard error on the difference between coefficients from two independent samples A and B is $((SE_A)^{1/2} + (SE_B)^{1/2})$.

21. High variance in employment changes across firms is consistent with recent evidence from Dunne et. al. (1989).

22. Assuming that differences between firms in wage and employment adjustments are driven only by labor demand shifts, Equations 3) and 4) can be manipulated to show that the ratio of variances of employment to wage adjustments in equilibrium would exactly equal the labor supply elasticity. Since our measure of wage adjustment here is nominal rather then real, we adjust for the higher mean of the former by using coefficients of variation rather than variances in our exercise, thus obtaining a ratio of thirty. Of course, this exercise is merely suggestive at best.

23. The standard errors on the means for the continuous unionization measures are .012 and .011 respectively for growing and declining firms.

24. Sampling weights are available in the data to provide unbiased means, but only within sites.

25. See Mackinnon (1989) for a description of the J-Test. Predicted values of wage adjustment equations using the spline generated significant positive coefficients when added to quadratic and cubic wage equations, but the converse was not true.

26. Using site and industry dummies (as well as interactions between them) as instruments in various models, we found that predicted sales growth measures do not significantly affect wage or employment growth when included along with the original regressors in any equation.

27. The T-statistic on this test is 3.1.

28. If we use a plausible estimate of one for the elasticity of labor demand, the labor supply elasticity implied by our estimates is 8.81 for positive shifts and 165.7 for negative ones (using equations (3) and (4) above). Thus, our estimates suggest that if firms remain on their labor supply curves when responding to demand shifts, these curves must be far more elastic than previous estimates have suggested. See Altonji (1982).

29. Such higher wage growth for these firms after controlling for demand is consistent with various interpretations of wage behavior in these sectors (see Lawrence and Lawrence (1983)). Union threat effects are also a possible explanation of this result, but the failure of these factors to affect the responsiveness of wages to shocks (Table 3) is at variance with these other interpretations.

30. All of the results reported below in Tables 4 and 5 are consistent with those generated from equations containing interaction terms rather than stratified samples. The interactions use continuous rather than discrete variables for firm size and unionism as well as industry unionism and skill levels. But the stratified results have the advantage of allowing for interactions of all control variables with the stratifying variable, and for easy observation of the relevant magnitudes of effects in each sector.

31. As noted above (in footnote 24), the spline form dominated the quadratic and cubic in "J-tests" for both employment and wage adjustment in the sample of larger firms, while this was only true for wage adjustment among smaller firms. Tests for heteroscedasticity showed residuals negatively related to firm size in the total sample and among smaller firms but not among larger ones. Weighting equations by firm size generally had little effect on wage adjustment results but generated employment adjustment results that were more in line with those presented here for larger firms.

32. The differences between coefficients on negative and positive sales growth measures are .059 and .212 for more-skilled and less-skilled employees respectively. The "difference in differences" is thus .153 with a standard error of .059.

33. When we performed J-tests for the correct functional form of the employment equation, we found that the quadratic and cubic generally outperformed the spline in employment equations for the entire sample. Although the strong form of the adjustment asymmetry (i.e., the spline) is typically only a feature of the wage adjustment process, we continue to report the estimates for the spline in employment adjustments as well for consistency.It should be noted that for the subsample of large firms, (reported in Table 5) the spline function outperformed quadratics in employment adjustment equations.

34. See Hall and Lilien (1988).

35. The importance of partial adjustments in employment is stressed in the literature on dynamic factor demand. See Nickell (1987).

36. Of the 1971 firms in our sample, the numbers interviewed during the months of February through June were 232, 265, 620, 492, and 349 respectively. No dates or late summer interviews were specified in 13 other cases. This measure of employment growth is viewed as inferior to the one calculated from December to December due to concerns over seasonality, consistency across observations, etc. and hence the results from its use are not reported. It should be noted, however, that our results are not sensitive to which measure is being used.

37. For instance, coefficients (and standard errors) on negative and positive sales growth without controls were .398 (.055) and .454 (.053) respectively. Inclusion of controls did not substantially change these findings.

38. Comparable employment adjustment estimates using the alternative employment measures were .343 (.059) and .475 (.066) for negative and positive shifts among smaller firms, while for larger firms they are .947 (.173) and -.047 (.138) respectively.

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Table 1

Sample Means and Standard Deviations

	Total Sample	Firms with Growing Sales	Firms with Zero/Declining Sales
Wage Growth	.155	.164	.147
	(.102)	(.101)	(.102)
Employment Growth	.016	.086	-.040
	(.332)	(.329)	(.323)
Sales Growth	.024	.170	-.093
	(.222)	(.178)	(.181)
Unionization			
- Dichotomous	.164	.151	.175
- Continuous	.111	.100	.120
	(.285)	(.274)	(.293)
Log (Firm Size)	2.892	2.883	2.899
	(1.372)	(1.309)	(1.421)
Industry			
- Durable Manuf.	.075	.071	.078
- Non-Durable Manuf.	.056	.057	.055
- Other	.869	.872	.867
Industry Unionization	.172	.170	.174
	(.118)	(.119)	(.120)
Log (Industry Wages)	9.578	9.576	9.580
	(.084)	(.088)	(.081)
Area Unemployment, 1980	.072	.071	.073
	(.019)	(.020)	(.018)
Sample Size	1971	874	1097

Note: Wage, employment and sales growth measures defined as log of (1 + growth rate). Firm size is measured as of December 1979. Standard errors are in parentheses in all tables.

Table 2

Wage Growth Equations

	1	2	3	4
Intercept	.147 (.003)	.123 (.011)	.125 (.016)	-.419 (.288)
Sales Growth				
Negative	.006 (.016)	.007 (.017)	.011 (.017)	.006 (.016)
Positive	.102 (.016)	.101 (.016)	.100 (.016)	.099 (.016)
Fraction Unionized	-	-.016 (.009)	-.018 (.009)	-.015 (.009)
Log (Firm Size)	-	.002 (.002)	.002 (.002)	.002 (.002)
Industries:				
D. Manufacturing	-	.022 (.010)	-	-
N. Manufacturing	-	.021 (.011)	-	-
Other 1-Digit	-	yes	-	-
2-Digit	-	-	yes	-
Site Dummies	-	yes	yes	-
Log (Industry Wage)	-	-	-	.059 (.030)
Industry Unionization	-	-	-	.011 (.023)
Area Unemployment Rate	-	-	-	-.014 (.123)
R^2	.022	.043	.064	.026

Table 3

Wage Growth Effects by Firm Characteristics

Sales Growth:	Firm Size: GT 55	Firm Size: LE 55
Negative	-.026	.011
	(.047)	(.018)
Positive	.073	.105
	(.038)	(.018)
R^2	.131	.051
	Manufacturing	**Non-Manufacturing**
Negative	-.011	.006
	(.058)	(.017)
Positive	.099	.102
	(.062)	(.017)
R^2	.093	.044
	Unionized Firms	**Non-Unionized Firms**
Negative	.011	.008
	(.031)	(.019)
Positive	-.023	.109
	(.045)	(.018)
R^2	.123	.049
	More Unionized Industries	**Less Unionized Industries**
Negative	.043	-.009
	(.039)	(.020)
Positive	.124	.124
	(.023)	(.023)
R^2	.075	.052
	More Skilled Industries	**Less Skilled Industries**
Negative	.025	-.041
	(.019)	(.037)
Positive	.084	.171
	(.018)	(.038)
R^2	.047	.079

Notes: Sample Sizes are 418 and 1553 for larger and smaller firms; 258 and 1713 for manufacturing and non-manufacturing; 324 and 1647 for union and non-union firms; 688 and 1283 for more and less unionized industries; and 1304 and 667 for more and less skilled industries. Equations include same controls as in column 2 of Table 2.

Table 4

Employment Growth Equations

	1	2	3	4
Intercept	-.001 (.009)	.047 (.036)	.050 (.049)	.528 (.909)
Sales Growth:				
Negative	.322 (.051)	.321 (.052)	.304 (.053)	.330 (.052)
Positive	.453 (.050)	.422 (.052)	.419 (.052)	.427 (.050)
Fraction Unionized	-	.007 (.029)	.003 (.030)	-.004 (.028)
Log (Firm Size)	-	-.028 (.006)	-.031 (.006)	-.023 (.006)
Industries				
D. Manufacturing	-	-.003 (.031)	-	-
N. Manufacturing	-	.050 (.034)	-	-
Other 1-Digit	-	yes	-	-
2-Digit	-	-	yes	-
Site Dummies	-	yes	yes	-
Log (Industry Wage)	-	-	-	-.038 (.095)
Industry Unionization	-	-	-	-.065 (.070)
Area Unemployment Rate	-	-	-	-1.155 (.389)
R^2	.069	.101	.115	.084

Table 5

Employment Growth Effects by Firm Characteristics

Sales Growth:	Firm Size: GT 55	Firm Size: LE 55
Negative	.693	.290
	(.167)	(.056)
Positive	.214	.451
	(.133)	(.057)
R^2	.175	.113
	Manufacturing	Non-Manufacturing
Negative	.204	.329
	(.174)	(.055)
Positive	.280	.439
	(.185)	(.054)
R^2	.208	.104
	Unionized Firms	Non-Unionized Firms
Negative	.211	.332
	(.135)	(.058)
Positive	.600	.408
	(.194)	(.054)
R^2	.154	.100
	More Unionized Industries	Less Unionized Industries
Negative	.262	.347
	(.110)	(.060)
Positive	.401	.438
	(.083)	(.067)
R^2	.132	.110
	More Skilled Industries	Less Skilled Industries
Negative	.296	.346
	(.060)	(.115)
Positive	.410	.524
	(.058)	(.118)
R^2	.114	.106

Notes: Sample sizes are 418 and 1553 for larger and smaller firms; 258 and 1713 for manufacturing and non-manufacturing; 324 and 1647 for union and non-union firms; 688 and 1283 for more and less unionized industries; and 1304 and 667 for more and less skilled industries. Equations include same controls as in column 2 of Tables 2.