Cyclical Quality Adjustment in the Labor Market

Paul J. Devereux*

Various reasons have been put forward to explain the stylized fact that the wages of job starters are more procyclical than the wages of workers who don’t change jobs. I explore the theoretical and empirical basis for one such reason: firms adjust the quality of workers assigned to jobs over the business cycle. I show that there is evidence that quality adjustment is an important feature of cyclical adjustment in labor markets. New hires of any particular ability level get lower quality jobs in recessions than in booms. The results indicate that about half of the wage procyclicality of new hires can be ascribed to variation in the matches between firms and workers over the business cycle. These systematic changes in assignment imply that government policy aimed at high-skill sectors can have positive effects on low-skill individuals by increasing the probability that they upgrade occupation and industry.

1. Introduction

The U.S. unemployment rate fell to very low levels during the 1990s. Even more impressively, the unemployment rate for minorities and less educated individuals fell disproportionately. Convergence of relative unemployment rates in expansions and divergence in recessions has been a feature of the U.S. economy over the last 30 years. There are many possible reasons for this feature. For example, if the costs of hiring and firing less-skilled labor are low, one would expect these individuals to have very procyclical employment. In this paper, I explore an alternative model: when there is an excess supply of labor, high-skilled people take jobs that would normally be occupied by less-skilled people. In expansions, the process reverses, with less-skilled workers getting access to jobs that they would normally not attain. I refer to this process as cyclical quality adjustment.

Reder (1955, p. 834) was one of the first to discuss how hiring standards adjust to business cycle conditions:

Quality variations in labor markets arise through upgrading and downgrading of members of the labor force relative to the jobs they are to fill. When applicants become scarce, employers tend to lower the minimum standards upon which they insist as a condition for hiring a worker to fill a particular job—and vice versa when applicants become plentiful.

Since then, many papers have developed this idea theoretically and many economic commentators appear to share this view of the labor market. For example, the Economic Report of the President states that “A strong labor market is particularly important to less advantaged groups in the labor market, such as workers with less education, younger workers, racial and ethnic minorities, and immigrants. . . . When employers find it hard to fill vacancies, they are more willing to hire and

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train workers whom they might pass over when they have fewer openings and an abundance of applicants.” (Council of Economic Advisors 1999, p. 103). Likewise, the expansion during the 1990s spawned many newspaper articles about the improvement in the types of jobs available to less-skilled applicants. However, there is little systematic empirical work about changes in job assignment in the United States over the business cycle. The empirical work in this paper seeks to redress this situation.

Cyclical assignment changes are important for many reasons. As mentioned earlier, job upgrading is a potential explanation for the greater cyclical variation of employment experienced by less-skilled workers. It is well known that the unemployment rates of less-skilled individuals and minorities are more countercyclical relative to more skilled individuals (Clark and Summers 1981; Kydland 1984; Keane and Prasad 1993; Hoynes 1999). The standard explanation for this effect is that low-ability workers are more likely to be laid off in downturns because training and hiring costs are lower for these workers. No commensurate attention has been paid to the issue of how the decision of who to hire changes over the business cycle. However, assignment models present a natural explanation for the greater procyclical of employment of the less skilled. Both the adjustment cost hypothesis and the upgrading hypothesis imply that less-skilled workers will have more procyclical employment. Empirically, they are distinguishable because the upgrading explanation implies that jobs obtained by comparable workers should vary systematically over the cycle. The adjustment cost hypothesis relates to the composition of those whose jobs are terminated.

Second, these mechanisms suggest a reason why wages are particularly procyclical for job changers. Recent studies using panel data have indicated that the wages of job starters are much more procyclical than the wages of workers who do not change jobs.1 Researchers have suggested various explanations for this result. Beaudry and DiNardo (1991) and MacLeod and Malcomson (1993) present contracting models in which the wages of job starters depend on the state of the labor market when they join the firm. Subsequent to joining there is limited adjustment in wages, so the wages of stayers are less procyclical than the wages of changers. Barlevy (2001) presents a model whereby firms create temporary jobs in booms and pay a compensating differential to workers for the unemployment risk. Thus, the wages of job changers are procyclical for this reason. The quality adjustment hypothesis is a natural alternative to these explanations for the wage procyclicality of job changers.

A closely related hypothesis is that job switchers have very procyclical wages because high-wage industries tend to have the most procyclical employment and workers achieve wage gains from moving to these industries in booms (Vroman 1977; Okun 1981; McLaughlin and Bils 2001). Industry is defined by the output of the firm, and the skill requirements of jobs in the same industry may differ enormously. Also, the evidence suggests that the wage gains result from moving to industries that pay rents rather than from moving to jobs that have greater skill requirements. Thus, it is not clear that employers are choosing different types of workers for particular jobs, and so this evidence does not speak to the fundamental question that I address. For these reasons, I define jobs by both industry and occupation in this paper.

Third, there are important policy implications. If employers respond to excess supply of labor by increasing hiring standards, then low-skill workers will disproportionally experience unemployment in recessions. If government wants to help these individuals acquire jobs, it does not need to stimulate the bottom end of the labor market. Instead increasing labor demand at the middle or at the skilled end of the market will cause fewer skilled workers to take unskilled jobs and hence increase the employment of unskilled workers. On the other hand, if hiring standards remain unchanged,

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1 Abraham and Haltiwanger (1995) provide a survey of the literature on wage cyclicality. Bils (1985) and Solon, Barsky, and Parker (1994) have found that the wages of job changers are very procyclical during the 1970s and 1980s.
increasing the demand for highly skilled workers will increase their wages but have no effect on the employment rates or wages of the unskilled.

Previous Empirical Work

There is a substantial European empirical literature on this topic. Using Dutch data, Teulings (1993) and van Ours and Ridder (1995) have found evidence that workers get less attractive jobs in recessions. Teulings (1993) shows that the transition rates from unemployment to employment are more cyclical for low-skill workers. However, given the greater flexibility of the U.S. economy compared to European ones, it is not clear how much these results generalize to the U.S. economy. Thus, a separate investigation for the United States is required.

There is little systematic U.S. empirical work on cyclical assignment changes. Bowlus (1995) shows that matches formed in expansions last longer than matches formed in recessions. Also, there are some papers about position changes over the business cycle within matches. Researchers have examined the hypothesis that employers move workers between positions over the cycle in order to adjust their wages procyclically. Solon, Whatley, and Stevens (1997) found that promotions increased wage cyclicity during the great depression era. Analysis using recent data by Wilson (1996) and Devereux (2000) finds no such support for this hypothesis. However, Devereux (2000) does show that, within matches, workers are engaged in tasks that require more skill in expansions. I add to this literature by examining whether there are changes in assignment across matches as well as within matches.

Interviews conducted by Bewley (1999) suggest that employers faced overqualified job applicants during the deep recession in the Northeast in the early 1990s. Most employers in the primary sector expressed a reluctance to hire overqualified workers since they would be likely to leave once the economy improved. However, employers in the secondary sector, where turnover is high in any case, were more open to hiring overqualified workers. My research complements this qualitative research.

In section 2, I present a model describing the search behavior of the unemployed. This provides a framework for analyzing and interpreting the empirical results. Following this, in section 3, I describe the data set, and in section 4 I describe the empirical analysis designed to test the implications of the model of cyclical quality adjustment. Section 5 concludes.

2. Modeling the Process of Quality Adjustment

The theoretical literature on cyclical quality adjustment is dominated by theories of wage rigidity. A lone exception is Mortensen (1970), who uses a more neoclassical framework. Reynolds (1951), Reder (1955), Hall (1974), Thurow (1975), Okun (1981), Ohashi (1987), and Teulings (1995) have all presented fixed wage analyses of quality adjustment. Because reducing starting wages is a costly option for employers, they instead increase hiring and promotion standards in times of high unemployment. Hence, employers assign better workers than usual to particular jobs during recessions and searching workers attain lower quality jobs than they would normally attain. Recent evidence has

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2 There are also several relevant papers that use European data in Borghans and de Grip (2000).

3 European economies typically have a compressed wage structure that makes it less expensive for employers to select highly educated workers for jobs that don’t strictly require them and also makes it less expensive for workers to be overschooled (compared to cost of unemployment).
challenged the idea that wages are generally sticky. Therefore, I develop a flexible wage search model that formally generates quality adjustment in new hires over the business cycle. In this model wages equal marginal product and so employers have no incentive to choose the best available workers. I use this model to guide the empirical work.

Consider an economy that contains two distinct submarkets and a group of unemployed workers of varying skill levels (s). Each unemployed worker can search in only one submarket and may choose not to search at all. There is a fixed per period cost of search in that searchers lose the value of leisure or home production. The submarkets are ordered by increasing level of skill in that submarket 2 has a minimum skill requirement of $s$—workers with less skill are totally unproductive in that submarket and hence will search in the lower level market. Submarket 1 has no minimum required skill level. In each submarket, workers who have the required minimal level of skill are paid $ps$ where $p$ is an exogenous productivity parameter. However, in market 1 the maximum level of productivity is $pS$. This maximum reflects the fact that high-skilled workers are more productive in jobs that require high skill. New values of $p$ arrive at rate $\mu$ and are random draws from the distribution $F(p)$. When a new draw of $p$ arrives, workers can quit their jobs and search from unemployment in either market. The arrival rate of job offers within each submarket depends negatively on the number of searching workers.

A worker with skill greater than $s$ may choose to search in market 1 if the higher arrival rate of job offers in market 1 compensates for the wage loss resulting from attaining a lower skill job. When there is a negative productivity shock, some low-skill workers will discontinue searching, thus increasing the arrival rates in jobs requiring low-skilled workers. This encourages other workers to search for a job requiring less skill. Thus, after a negative productivity shock, the average quality of worker searching in each market is higher. Since each worker is paid a wage equal to his marginal product on the job attained, employers are indifferent as to which workers to hire. Hence, we assume they choose new hires at random from the searching workers. Since the composition of the unemployed workers is better in recessions, the average new hire is of higher quality in recession than the average new hire in expansion.

Implications of Quality Adjustment Model

The following are testable implications of the model.

(i) Workers tend to get lower quality jobs in recessions (when $p$ is low). Equivalently, the average new hire to any position is of higher quality in recession than the average new hire in expansion.

(ii) The value of $p$ has differential effects on the time spent nonemployed by workers with different skill levels. Workers with high skill ($s$) can adjust to a fall in $p$ by searching in market 1 where there

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4 Solon, Barsky, and Parker (1994) have shown that even the wages of job stayers display significant procyclicity. McLaughlin (1994) has presented evidence that nominal wage cuts are widespread for job stayers. The extent to which these are spuriously caused by measurement error is still in dispute (Akerlof, Dickens, and Perry 1996; Card and Hyslop 1997; Kahn 1997; Altonji and Devereux 2000). Theoretically, starting wages should be more cyclical than continuing wages since many of the reasons for wage stickiness (implicit contracts, retaining workers with firm-specific capital) do not apply to starting wages. It has also been determined empirically that starting wages are more cyclical than continuing wages (Bowles 1993).

5 Barlevy (2001) provides a model in which more cyclical sectors expand in expansions and create temporary jobs. In order to attract workers to these jobs with high unemployment risk, they pay a compensating differential. Thus, in expansions workers attain temporary jobs with high wages. In my model workers get better jobs in expansions.

6 The higher arrival rate of job offers in the low quality market may be counterfactual (van Ours and Ridder 1995). However, this feature of the model captures the notion that any particular worker should be able to get a job faster if they are willing to settle for a job that requires less skill than they have.

7 An appendix that develops the model further and proves the results is available on request from the author.
is a higher arrival rate of job offers. Workers with lower values of \( s \) may react to a fall in \( p \) by not searching rather than searching in market 1. Finally, workers with the lowest values of \( s \) never search irrespective of the value of \( p \). Thus, the model implies that, of the sample of workers whose value of \( s \) is high enough that they sometimes search, the effect of changes in \( p \) on the probability of getting a job in any time period will be greater for the low-skill workers. If we consider the unemployed as the group of workers who sometimes search, then the probability of transition from unemployment to employment is more procyclical for less-skilled workers.\(^8\) 

(iii) The wages of any particular worker who starts a job are procyclical both because of changes to \( p \), the exogenous level of productivity, and because increases in \( p \) are associated with finding a job in which the worker is more productive. Thus, the process of cyclical quality adjustment magnifies the wage cyclicality of job starters.

3. The Data

The data used throughout this paper come from the 1976 to 1992 survey years of the Panel Study of Income Dynamics (PSID). This data set was chosen because it extends over a long time period and is representative of the working age population of the United States. Also, its panel structure is useful since much of the analysis requires observations on the same individuals over time. The PSID is composed of both a random sample and a poverty subsample. I restrict the analysis to the random sample and to workers between the ages of 18 and 64 who are not self-employed.

There are two potential wage measures in the PSID: the reported hourly wage rate and annual average hourly earnings. I have chosen to use the reported wage since it is specific to the current job. Since the hourly wage is topcoded at $9.98 in 1976 and 1977, many wage observations in those years are topcoded. In these cases average hourly earnings for the year have been used to predict the wage. Wages are deflated by the GDP consumption deflator.

Much of the analysis in this paper requires the identification of job moves. Workers are asked in the data: “How long have you worked for your current employer?” These data allow one to determine when employer changes occur. I partition the data into spells with employers using the method recommended by Brown and Light (1992). An individual is assumed to have started a spell with a new employer when tenure with the employer is less than the elapsed time since the survey date.

I create a subsample restricted to observations that involve the formation of a job–worker match, that is, only the first observation per job is in the sample. I further restrict the subsample to workers who have tenure less than or equal to 9 months. I have 48,823 observations in the full sample with nonmissing values of all required variables and 8210 observations in the new hires sample. The means of selected variables are presented in Table 1.

Cyclical Measures

The model implies that the cyclical measure chosen should be a proxy for \( p \), the exogenous level of productivity. Such an exogenous measure is unavailable, so, in keeping with much of the wage cyclicality literature, I use unemployment rates. My cyclical measure is the unemployment rate by state provided by the Bureau of Labor Statistics. I match the unemployment rates to the data by

\(^8\) In fixed wage models, hiring standards rise in recessions and so workers attain jobs that require less skill than the jobs they would normally acquire. Workers with the least skill cannot get a job at all and so they are nonemployed in recessions.
Table 1. Means of Selected Variables (Standard Deviations in Parentheses)

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Employed (1)</th>
<th>Job Starters (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of education</td>
<td>13.09</td>
<td>12.92</td>
</tr>
<tr>
<td></td>
<td>(2.45)</td>
<td>(2.31)</td>
</tr>
<tr>
<td>College degree</td>
<td>0.30</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.43)</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.83</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.39)</td>
</tr>
<tr>
<td>Female</td>
<td>0.45</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.50)</td>
</tr>
<tr>
<td>White</td>
<td>0.91</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>(0.29)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Years of experience</td>
<td>16.35</td>
<td>11.20</td>
</tr>
<tr>
<td></td>
<td>(10.06)</td>
<td>(8.35)</td>
</tr>
<tr>
<td>Government</td>
<td>0.21</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(0.34)</td>
</tr>
<tr>
<td>Salaried</td>
<td>0.47</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.47)</td>
</tr>
<tr>
<td>Months of tenure with employer</td>
<td>79.40</td>
<td>4.53</td>
</tr>
<tr>
<td></td>
<td>(87.33)</td>
<td>(2.62)</td>
</tr>
<tr>
<td>New job</td>
<td>0.17</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>State unemployment rate</td>
<td>6.96</td>
<td>6.88</td>
</tr>
<tr>
<td></td>
<td>(2.07)</td>
<td>(2.01)</td>
</tr>
<tr>
<td>Married</td>
<td>0.80</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Covered by union contract</td>
<td>0.23</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(0.42)</td>
<td>(0.33)</td>
</tr>
<tr>
<td>Log wage</td>
<td>2.20</td>
<td>1.94</td>
</tr>
<tr>
<td></td>
<td>(0.52)</td>
<td>(0.52)</td>
</tr>
<tr>
<td>No. of observations</td>
<td>48,823</td>
<td>8210</td>
</tr>
</tbody>
</table>

month, so that if a job begins in March 1980, the unemployment rate during that month is used as the starting unemployment rate. To minimize transitory variation in unemployment rates, I have calculated a 3-month moving average of the unemployment rate, and I use this variable in the analysis. The unemployment rate data I use are seasonally adjusted, but using unadjusted data gives similar results. Prior to 1978, only annual state unemployment rate data are available, so for these years I match unemployment rates to the data by year.

Job Characteristics

I create a vector of job characteristics from information in the PSID, the Dictionary of Occupational Titles (DOT), and the Current Population Survey (CPS). I aggregate DOT measures up to the occupational detail in the PSID, the two-digit 1970 census level from 1976 to 1980 and the three-digit 1970 census level from 1981 to 1992. I include measures of specific vocational preparation, general educational development, required aptitudes, required strength, and the extent to which the occupation is based indoors. I also calculate characteristics of two-digit industry by two-digit occupation cells, characteristics of three-digit industries, and characteristics of three-digit occupations using the Annual Demographic Files of the CPS for the years 1970–1982. These years were chosen because they were the years that the CPS used the 1970 census codes for occupation and
industry. The total number of CPS observations used was 287,395. I have constructed variables for average education, proportion with college degree, proportion with high school diploma, average age, proportion female, and proportion white for each cell. All measures are merged with the PSID data.

The other job characteristics come from the PSID itself. Respondents are asked whether they work for the government, whether they are salaried, and whether they are covered by a union contract. These variables are included in the vector of job characteristics.

I have also created a predicted job quality variable that is predicted by regressing the wage on two-digit industry, two-digit occupation, union, salaried, and government for the full PSID sample, controlling for state dummies, year dummies, and the state unemployment rate. The predicted value is calculated from the coefficients on the industry and occupation dummies and the union, salaried, and government variables. In the process, I have created separate variables for wages predicted by occupation and wages predicted by industry. The logic behind these measures is that they weight the industry and occupation dummy variables by the cyclically adjusted average wages in the industry and occupation.

4. Is There Cyclical Quality Adjustment?

In this section, I test the three implications of the model of cyclical quality adjustment. A major mechanism suggested by the model is that searching workers search down in recessions and find less attractive jobs. Thus, I use regression analysis to characterize how the mean of job quality, conditional on worker characteristics, is affected by the cyclical variables. Second, I test the prediction of the model that the unemployed workers with the lowest levels of skill are least likely to make the transition from unemployment to employment in recessions. Third, I estimate wage regressions that allow one to directly quantify the cyclical quality adjustment contribution to aggregate wage cyclicity. This step flows naturally from the previous two in that by adding worker and job controls one incorporates both changes in the match between workers and jobs and changes in worker composition that occur over the business cycle.

The Effect of the Business Cycle on the Jobs Obtained by Workers

The model suggests that searching workers search down in recessions and find less attractive jobs. Thus, for new hires, I estimate how the characteristics of the job found depend on the state unemployment rate when they start the job, controlling for worker characteristics.

Consider the following equation to be estimated on a sample of job starters in a panel data set:

\[ z_{ist} = \beta_1 + \beta_2 \text{YEAR}_i + \beta_3 U_{st} + \beta_4 \text{STATE} + \beta_5 x_{it} + \mu_i + \epsilon_{ist}. \]  

(1)

Here \( x_{it} \) is a vector of worker characteristics, \( \text{YEAR}_i \) is a vector of year dummies or a quadratic time trend, \( U_{st} \) is the state unemployment rate at the time the worker started the job, \( \text{STATE} \) is a vector of state dummies, and \( z_{ist} \) is a characteristic of the job attained by worker \( i \) at time \( t \). For these variables, the subscript \( i \) is for individual, \( m \) is for month, \( s \) is for state, and \( t \) is for year. The vector \( x_{it} \) contains

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9 If government demand for labor is not cyclical and there is a public sector wage differential that is not related to quality, the estimate of the predicted wage may overstate the skill requirements of jobs in recessions. This would make it less likely that I find evidence of cyclical quality adjustment.

10 Jones (1989) shows that reservation wages are negatively related to the unemployment rate. Lancaster and Cheshire (1983) and Lynch (1983) show that reservation wages are positively related to the probability of getting a job offer. The reported reservation wages of unemployed workers in the PSID show no significant cyclicality.
Table 2. Effect of State Unemployment Rate at Start of Job on Quality of Job Attained

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Year Dummies Included</th>
<th>Quadratic Time Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Random Effects (1)</td>
<td>Fixed Effects (2)</td>
</tr>
<tr>
<td></td>
<td>(Fixed Effects (3))</td>
<td>(Fixed Effects (4))</td>
</tr>
<tr>
<td>Log of actual wage</td>
<td>−0.0181 (0.0035)</td>
<td>−0.0194 (0.0024)</td>
</tr>
<tr>
<td></td>
<td>−0.0195 (0.0043)</td>
<td>−0.0178 (0.0030)</td>
</tr>
<tr>
<td>Predicted job quality</td>
<td>−0.0109 (0.0025)</td>
<td>−0.0118 (0.0018)</td>
</tr>
<tr>
<td></td>
<td>−0.0111 (0.0032)</td>
<td>−0.0103 (0.0022)</td>
</tr>
<tr>
<td>Predicted wage in industry</td>
<td>−0.0058 (0.0013)</td>
<td>−0.0055 (0.0009)</td>
</tr>
<tr>
<td></td>
<td>−0.0065 (0.0017)</td>
<td>−0.0049 (0.0012)</td>
</tr>
<tr>
<td>Predicted wage in occupation</td>
<td>−0.0025 (0.0017)</td>
<td>−0.0034 (0.0009)</td>
</tr>
<tr>
<td></td>
<td>−0.0010 (0.0022)</td>
<td>−0.0028 (0.0015)</td>
</tr>
<tr>
<td>Education means from CPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education in occupation</td>
<td>−0.0173 (0.0127)</td>
<td>−0.0216 (0.0088)</td>
</tr>
<tr>
<td></td>
<td>−0.0050 (0.0155)</td>
<td>−0.0127 (0.0108)</td>
</tr>
<tr>
<td>Education in industry</td>
<td>−0.0086 (0.0098)</td>
<td>−0.0093 (0.0068)</td>
</tr>
<tr>
<td></td>
<td>−0.0148 (0.0122)</td>
<td>−0.0181 (0.0085)</td>
</tr>
<tr>
<td>DOT occupation meansa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific vocational preparation</td>
<td>−0.0170 (0.0128)</td>
<td>−0.0209 (0.0099)</td>
</tr>
<tr>
<td></td>
<td>−0.0065 (0.0165)</td>
<td>−0.0198 (0.0114)</td>
</tr>
<tr>
<td>General educational development in mathematics</td>
<td>−0.0073 (0.0077)</td>
<td>−0.0100 (0.0054)</td>
</tr>
<tr>
<td></td>
<td>−0.0004 (0.0097)</td>
<td>−0.0053 (0.0067)</td>
</tr>
<tr>
<td>Covered by union contract</td>
<td>Derivative from probitb</td>
<td>−0.0058 (0.0031)</td>
</tr>
<tr>
<td></td>
<td>Conditional logitc</td>
<td>0.9179 (0.0556)</td>
</tr>
<tr>
<td></td>
<td>Derivative from probitb</td>
<td>0.9179 (0.0556)</td>
</tr>
<tr>
<td></td>
<td>Conditional logitc</td>
<td>0.9179 (0.0556)</td>
</tr>
</tbody>
</table>

The coefficients are for the state unemployment rate when the job started. Standard errors are in parentheses. There are 8210 observations.

All specifications include state dummies, and controls for experience, experience squared, experience cubed, female, black, other nonwhite, years of education, married, and disabled. The fixed effects specification omits time invariant variables: female, black, other nonwhite, years of education, and disabled.

a These measures from the Dictionary of Occupational Titles are described in the Appendix.

b Derivative from probit estimation evaluated at the means of the explanatory variables.

c Log odds ratio from fixed effects logit.

a cubic in experience, female, black, other nonwhite, years of education, married, and disabled. The state indicator variables are included because there may be state level differences in job characteristics that are correlated with whether the state generally has a high unemployment rate. Because the error term may contain an individual specific effect, \( \mu_i \), I report both random effects and fixed effects estimates.11

The results from estimating Equation 1 are in Table 2. Column 1 has the results from the random effects specification; column 2 contains the results from the fixed effects specification. In columns 3

11 As noted by Moulton (1986), the standard errors from the ordinary least squares (OLS) estimates of Equation 1 may be underestimated in the presence of a state/time specific error \( v_{it} \) because the starting unemployment rate is the same for all workers who start a job in the same state at the same time. This does not seem to be an important problem in my sample. With almost all the job characteristics that I use, I cannot reject the hypothesis that the variance of \( v_{ij} \) is zero. Given that, it is unsurprising that the standard errors that are robust to the presence of these error components are not systematically higher than the OLS standard errors. Therefore, in the empirical work, I do not adjust standard errors for the presence of a state-year error component.
and 4 the equivalent estimation is carried out but the year dummies are replaced by a quadratic time trend. The results reported are the coefficients on the state unemployment rate in each specification. The coefficients from specifications with the log wage as the dependent variable are included in the first row of Table 2 for comparison purposes.

The major result of interest is the effect of the state unemployment rate on predicted job quality. The results for this specification imply that the jobs workers find are of 1% lower quality if there is a one-point increase in the state unemployment rate. Similar estimates are produced by both the random and fixed effects specifications, and the estimates are robust to replacing the year dummies with the quadratic time trend. It is strong evidence that the quality of the matches that workers find vary systematically over the business cycle. Thus, one reason why workers who start jobs in recessions get low wages is that the jobs they find are jobs that generally pay low wages.

Jobs that are covered by union contracts are generally regarded as high-quality jobs. In the last row of Table 2, the estimates indicate that workers who start jobs when the unemployment rate is high are less likely to get jobs with union coverage. Because union coverage is a dichotomous variable, I use a probit rather than the linear random effects specification. I report the derivative of the probability with respect to the state unemployment rate rather than the probit coefficients. Also, for the fixed effects models of union coverage, I use a conditional logit model, since a fixed effects probit estimator is inconsistent in this context. The size of the estimated effects is consistent across specifications but varies in statistical significance. A one-point increase in the unemployment rate makes it about 0.6% less likely that the job attained by a particular worker is covered by a union contract.

I also included results for industry and occupation characteristics. The results for wage predicted by industry indicate that workers obtain jobs in higher paying industries when the unemployment rate is low. This is consistent with the results of Vroman (1977) for the late 1960s. The results also indicate that workers are more likely to get jobs in booms in industries with high education levels. This suggests that workers are not just moving to industries with high rents but also moving to industries where workers have high skill.

The results for the occupation variables are of particular interest because occupations are differentiated by skill requirements to a greater extent than industries. First, consider the predicted wage in the occupation. As discussed earlier, this can be considered as the average wage in the occupation after removing industry wage differences. The results with a quadratic time trend indicate a statistically significant coefficient on the state unemployment rate of about −0.003 in both fixed and random effect specifications. This implies that a ten-point increase in the unemployment rate causes individuals to start jobs that are in occupations that pay 3% less than the usual occupation attained. When year dummies are included, the coefficient on the state unemployment rate falls in both fixed and random effect specifications and becomes statistically insignificant. Thus, the evidence for occupational upgrading is much stronger when aggregate business cycle shocks are considered than when one uses more idiosyncratic variation in local labor market conditions. This pattern can also be seen with the other occupational variables from the CPS and from the DOT—sizeable effects are estimated using the quadratic time trend with much smaller and less significant effects in the specifications with year dummies.

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12 The standard errors are corrected to account for repeated observations on individuals.

13 These findings are consistent with findings of Devereux (2002) using the CPS that job changers are more likely to upgrade occupation when the unemployment rate is falling.
Probability of Transition from Unemployment to Employment

One interesting aspect of cyclical quality adjustment is that it can potentially explain the greater cyclicality of employment experienced by low-skill workers. The model predicts that the unemployed workers with the lowest levels of skill are least likely to make the transition to employment in recessions. To test this contention, I have created a sample of people who were unemployed at the survey date in the previous period or have been involuntarily separated from a job since the previous period. These people have either found a new job or are still unemployed. I test whether the state unemployment rate has a larger effect on the probability of transition to employment for the workers with the least skills:

\[
\text{Prob(employed)} = \beta_1 + \beta_2 x_{it} + \beta_3 U_{it} + \beta_4 \text{YEAR} + \beta_5 \text{STATE} + e_{it}. \tag{2}
\]

The vector \(x_{it}\) contains a cubic in experience, female, black, other nonwhite, years of education, married, and disabled. \(\text{YEAR}\), is a vector of year dummies or a quadratic time trend, \(U_{it}\) is the state unemployment rate, and \(\text{STATE}\) is a vector of state dummies. For these variables, the subscript \(i\) is for individual, \(s\) is for state, and \(t\) is for time.

I estimate separate equations for people with different levels of experience, and those with different amounts of schooling. I estimate the employment equations by maximum likelihood probit. The theory predicts a larger negative coefficient on the state unemployment rate for the less-skilled groups.

The results in Table 3 show how the probability of transition from unemployment to employment for different groups of workers is affected by the unemployment rate. I use education and experience as skill measures for this purpose. I have also created an index of worker’s skill based on how the worker’s characteristics are valued in the labor market. The index was created by regressing wage on personal characteristics and forming a predicted value for each worker. The personal characteristics included years of education, a cubic in experience, and dummy variables for high school diploma, college graduate, married, female, black, and other nonwhite. I refer to this variable as the predicted wage.

I have estimated the transition probability equation for 10 groups of workers—for each quartile of the predicted wage distribution; by education level, 1–11 years, 12–15 years, and 16+ years; and by experience group, 1–5 years, 5–15 years, and 16+ years. The estimates in Table 3 are the derivatives of the probability of becoming employed with respect to the state unemployment rate for each of the 10 samples. The results using the year indicators are most strongly supportive of the model implications, so I discuss them first. The probability of making the transition to employment is more cyclical for less-skilled workers. Workers in the lowest quartile of the predicted wage distribution experience a 4.4% lower probability of becoming employed if the unemployment rate rises by one point. In the second and fourth quartiles the reemployment probability is almost acyclical, and in the third quartile the fall is only 2.4%. The difference between the coefficient for the first quartile and the coefficients for the second and fourth quartiles is statistically significant. The education groups tell a similar story. The transition probability of the group with less than 12 years of education falls by

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14 It is known that the employment of low-skilled workers is extremely cyclically sensitive (Clark and Summers 1981; Kydland 1984; Keane and Prasad 1993).

15 This same implication can be derived from a fixed wage model; thus, this test is not useful for determining the importance of wage rigidity in the market for new hires.

16 The standard errors are corrected to account for repeated observations on individuals.

17 Abbring, van den Berg, and van Ours (2001) use CPS data to model the exit probabilities from unemployment of different groups. However, they do not look at differences by skill group.
Table 3. Effect of Unemployment Rate by State on Probability of Transition from Unemployment to Employment (Probit Estimation)

<table>
<thead>
<tr>
<th>Predicted Wage</th>
<th>Observations (1)</th>
<th>Marginal Effect of State Unemployment Ratea (2)</th>
<th>Marginal Effect of State Unemployment Ratea (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartile I</td>
<td>1137</td>
<td>−0.0440</td>
<td>−0.0362</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0145)</td>
<td>(0.0095)</td>
</tr>
<tr>
<td>Quartile II</td>
<td>1114</td>
<td>0.0116</td>
<td>−0.0113</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0138)</td>
<td>(0.0092)</td>
</tr>
<tr>
<td>Quartile III</td>
<td>1114</td>
<td>−0.0240</td>
<td>−0.0337</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0130)</td>
<td>(0.0084)</td>
</tr>
<tr>
<td>Quartile IV</td>
<td>1110</td>
<td>0.0074</td>
<td>−0.0149</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0139)</td>
<td>(0.0085)</td>
</tr>
</tbody>
</table>

Years of education

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1–11 years</td>
<td>1234</td>
<td>−0.0283</td>
<td>−0.0332</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0143)</td>
<td>(0.0096)</td>
</tr>
<tr>
<td>12–15 years</td>
<td>2662</td>
<td>−0.0057</td>
<td>−0.0202</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0091)</td>
<td>(0.0058)</td>
</tr>
<tr>
<td>16+ years</td>
<td>597</td>
<td>−0.0094</td>
<td>−0.0209</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0211)</td>
<td>(0.0121)</td>
</tr>
</tbody>
</table>

Years of experience

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1–5 years</td>
<td>1160</td>
<td>−0.0358</td>
<td>−0.0337</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0149)</td>
<td>(0.0094)</td>
</tr>
<tr>
<td>6–15 years</td>
<td>2077</td>
<td>−0.0066</td>
<td>−0.0222</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0104)</td>
<td>(0.0070)</td>
</tr>
<tr>
<td>16+ years</td>
<td>1267</td>
<td>0.0017</td>
<td>−0.0220</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0142)</td>
<td>(0.0088)</td>
</tr>
</tbody>
</table>

All specifications include state dummies, and controls for experience, experience squared, experience cubed, female, black, other nonwhite, years of education, married, and disabled. The standard errors have been corrected for repeated observations on individuals.

Standard errors are in parentheses.
a The estimates in column 2 come from a specification that includes year effects; the estimates in column 3 come from a specification with a quadratic time trend.

2.8% if unemployment rises by one point. However, the transition probabilities for the more highly educated are almost acyclical. However, the coefficients are not statistically significantly different from the coefficient for the lowest educated group. As regards experience, the group with experience of less than 5 years has greater transition cyclical than the groups with more experience. The overall conclusion is that the cyclical of transition to employment from unemployment is borne disproportionately by the lowest skilled groups. The results in the quadratic time trend specification are less supportive of the model: while the estimated cyclical is greatest for the low education and the low experience group, the differences are not large and are not statistically significant.

Implications for Procyclicality of Wages

The model implies that wages and marginal product of any particular worker who starts a job are procyclical both because of changes to $p$, the exogenous level of the productivity shock, and because increases in $p$ are associated with finding a job in which the worker is more productive. Thus, the process of cyclical quality adjustment magnifies the wage cyclical of job starters. Assume, as in the model, that the wages of job starters equal their marginal product. As discussed earlier, this is likely to be a much more reasonable assumption for job starters than for people who stay with the same employer. Therefore, I only examine the wages of new matches. Marginal product is determined by
Table 4. Effect of State Unemployment Rate at Start of Job on Wage on Job Attained

<table>
<thead>
<tr>
<th>Variable</th>
<th>Year Dummies Included (1)</th>
<th>Quadratic Time Trend (2)</th>
<th>Quadratic Time Trend (Aggregate Labor Input) (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>8210</td>
<td>8210</td>
<td>8210</td>
</tr>
</tbody>
</table>

Specifications

- No worker or job controls
  - Coefficient: -0.0174
  - Standard Error: 0.0052
  - Unemployment Rate: 0.8189

- Random effects with worker controls
  - Coefficient: -0.0181
  - Standard Error: 0.0035
  - Unemployment Rate: 0.5392

- Fixed effects with worker controls
  - Coefficient: -0.0195
  - Standard Error: 0.0043
  - Unemployment Rate: 0.3442

Specifications with job controls

- Only job controls
  - Coefficient: -0.0062
  - Standard Error: 0.0036
  - Unemployment Rate: 0.2382

- Random effects with job and worker controls
  - Coefficient: -0.0089
  - Standard Error: 0.0031
  - Unemployment Rate: 0.2259

- Fixed effects with job and worker controls
  - Coefficient: -0.0120
  - Standard Error: 0.0039
  - Unemployment Rate: 0.1668

The coefficients in columns 1 and 2 are for the unemployment rate when the job started. The coefficients in column 3 are for aggregate labor input.

Columns 1 and 2 include state dummies, the specification in column 3 does not.

Specifications with worker controls include controls for experience, experience squared, experience cubed, female, black, other nonwhite, years of education, high school diploma, college graduate, married, and disabled.

The job controls are the vector of job characteristics described in the Appendix.

The standard errors (in parentheses) are corrected for repeated observations on individuals.

The size of the exogenous productivity parameter ($p$), by the skill level of the worker ($s_i$), and by the job the worker holds. Then

$$w_{it} = p_i s_{it},$$

where, as in the model, $s_{it}$ depends on $s_i$ and on the quality of the job held, $z_{it}$. In the model, marginal product depends on the job held in a very particular way; here, in the empirical work, I express the relationship between marginal product ($s_{it}$) and $z_{it}$ as

$$s_{it} = g(s_i, z_{it}) = \exp[\alpha_1 s_i + \alpha_2 z_{it} + \alpha_3(s_i z_{it})].$$

Substituting Equation 4 into Equation 3 and taking logs, one finds that

$$\ln w_{it} = \ln p_i + \alpha_1 s_i + \alpha_2 z_{it} + \alpha_3(s_i z_{it}).$$

I estimate Equation 5 by substituting year dummies, state dummies, and the state unemployment rate when the job started for the unknown productivity shock term.\(^{18}\)

The results are in Table 4. Consider column 1 in Table 4. The estimates in this column come from various specifications of the wage equation in which year dummies, state dummies, and the state unemployment rate are included. When there are no controls for worker or job characteristics, the coefficient on the state unemployment rate is $-0.0174 (0.0052)$. In the second row, we see that

\(^{18}\) There are potential selection issues in estimating Equation 5 because only employed individuals are included in the estimating sample and because individuals choose the occupations and industries that they enter. These could lead to biases in unpredictable ways. The potential biases from selection may be smaller in the specifications that include individual fixed effects, since here only selection based on time-varying characteristics is a problem.
controlling for observable worker characteristics in a random effects specification gives a similar coefficient of $-0.0181$ (0.0035). The fixed effects estimates in the third row give a slightly more negative point estimate. Thus, in this sample of job starters, controlling for worker quality is not terribly important in terms of the estimate of the cyclicality of wages.

Next, I add controls for job characteristics and interactions of job characteristics and personal characteristics. The full list of job controls used (including the interactions of job controls with worker characteristics) is in the Appendix. Job composition effects matter a great deal; when the job controls are included alongside the worker quality controls, the cyclicality of wages falls to $-0.0089$ (0.0031) in the random effects specification and $-0.0120$ (0.0039) in the fixed effects specification. These estimates are both significantly different at the 5% level from the equivalent estimates without job controls. Adding job controls also leads to statistically significant reductions in the cyclicality of wages in the specifications with a quadratic time trend. This finding is consistent with the prediction of the model that wages of job starters are procyclical both because of changes to $p$, the exogenous level of productivity, and because increases in $p$ are associated with finding a job in which the worker is more productive. Interestingly, I find that measured wage cyclicality is greater without any worker or job controls than it is with both worker and job controls (the difference is statistically significant in the quadratic time trend specification). This reflects the fact that the jobs that start in booms tend to be high-paying jobs. Thus, the average wage of new hires in the economy is more procyclical than the wage conditional on worker and job characteristics.

Bow, Liu, and Robinson 2002 (BLR) argue that when estimating the cyclical sensitivity of wages, one should correlate changes in wages with changes in the aggregate labor input in the economy. They suggest a method for estimating the aggregate labor input that involves weighting hours worked by the estimated number of efficiency units incorporated in each hour of work. Thus, their measure of aggregate labor input takes account of changes in the skill composition of the employed over the business cycle. I include estimates in column 3 of Table 4 where the cyclical variable is the log of aggregate labor input constructed using the March CPS (see BLR for details about exactly how to construct this variable). Like BLR, I do not include state dummies in the specification in column 3. The results using this methodology are qualitatively similar to those using the state unemployment rate: the inclusion of job controls reduces the coefficients on the cyclical variable in both the random and fixed effects specifications (the difference is statistically significant in the random effects model). Thus, the conclusions of the analysis are robust to constructing the cyclical variable in the manner suggested by BLR.

Solon, Barsky, and Parker (1994, footnote 4) note that when studying wage cyclicality one should not include controls for job characteristics because the ability of workers to get better jobs in booms is a legitimate form of wage cyclicality. Their primary purpose is to measure the effects of recessions on individual wages. However, if one is interested in the broader issue of wage flexibility in

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19 Using two-digit industry and occupation indicators instead of the vector of job characteristics gives similar results.

20 Because the specifications are estimated on the same sample, the coefficients on the state unemployment rate across specifications are not independent. I bootstrap the coefficients to establish the statistical differences in the coefficients.

21 My results are consistent with the findings of Teulings and Hartog (1998) that adding job controls reduces the absolute value of the coefficient on the state unemployment rate in a wage regression for newly hired white men in the CPS. Because they use repeated cross-sectional data, they cannot estimate random or fixed effects specifications.

22 BLR model efficiency units as functions of sex, age, education, and region. In my context, it is important to take account of the fact that output is a function of both worker and job characteristics. Thus, I model efficiency units as functions of the worker characteristics, as well as two-digit industry and occupation indicators, and interactions between these job characteristics and all the worker characteristics.
response to productivity shocks, there is relevant information to be attained by conditioning out job characteristics. For example, consider the situation where, in response to a negative productivity shock, wages are completely rigid but job searchers get worse jobs and hence the average wage of job searchers fall. In this situation, one would have to condition on job characteristics to ascertain that wages are completely rigid. Teulings and Hartog (1998) provide an interesting overview about how the unemployment consequences of the two forms of wage cyclicality differ.

Recently, researchers have begun to take account of variations in the composition of employed workers when calculating the cyclicality of productivity shocks (Hansen 1993; Basu 1996). The model suggests that researchers might also want to consider variations in the quality of matches that workers find over the business cycle. In the context of the theoretical model, the estimated coefficient on the state unemployment rate can be interpreted as an estimate of the cyclicality of the productivity shock if one conditions on worker and job composition. The results imply that if one ignores changes in the matches between workers and firms over the business cycle, one may overstate the cyclicality of productivity shocks in the sample of new hires. Thus, even studies that adjust for observable worker characteristics may seriously overestimate the cyclicality of shocks to labor productivity.

5. Conclusions

In this paper, I evaluate the theoretical and empirical basis for the hypothesis that employers assign more qualified workers to jobs in recessions. Even though the hypothesis has traditionally been developed from a rigid-wage perspective, flexible wage models are consistent theoretically with cyclical quality adjustment. I present a model that generates cyclical quality adjustment without assuming any form of wage rigidity. The empirical results suggest that assignment changes play a large role in labor market adjustment to changes in cyclical conditions. This process provides a partial explanation for the composition changes in the labor market over the business cycle. Furthermore, the analysis of the sample of new matches indicates that systematic variation in the types of matches formed over the business cycle may have large impacts on the cyclicality of wages. I find that in this sample of new hires about one half of measured wage cyclicality results from variation in the matches between workers and firms over the business cycle.

The results of this paper have some important policy implications. Since employers respond to excess supply of labor by hiring individuals with greater skill, low-skill workers disproportionately experience unemployment in recessions. If government wants to help these individuals acquire jobs, it does not need to stimulate the bottom end of the labor market. Instead increasing labor demand at the middle or at the skilled end of the market will cause fewer skilled workers to take unskilled jobs and hence increase the employment of unskilled workers.

While the analysis has studied responses of hiring standards to cyclical changes in labor market conditions, the results provide an indication of how the labor market may respond to secular shifts. There has been an explosion in the supply of college graduates over the last few decades. Over time, the average education within detailed occupation groups has increased. An unresolved issue is the extent to which this reflects technical change within occupations or results from individuals becoming increasingly overeducated for the jobs they carry out. The business cycle offers an opportunity for studying how hiring standards respond to labor market conditions in a situation where one can condition out secular technological change with time trends. The finding that employers adjust the quality of workers hired over the business cycle suggests that it is likely that they have also adjusted hiring standards in response to secular increases in the education level of the workforce.
Appendix

Job Controls Used in Table 4

(i) Covered by union contract.
(ii) Government dummy.
(iii) Salaried dummy.
(iv) Predicted wage in job calculated from the PSID.
(v) Means by three-digit occupation calculated from the CPS: average education, proportion with high school diploma, proportion with college degree, average age, proportion female, proportion white.
(vi) Means by three-digit industry calculated from the CPS: average education, proportion with high school diploma, proportion with college degree, average age, proportion female, proportion white.
(vii) Means by (two-digit occupation \times two-digit industry) cells calculated from the CPS: average education, proportion with high school diploma, proportion with college degree, average age, proportion female, proportion white.
(viii) Occupation characteristics aggregated to three-digit level calculated from the Dictionary of Occupational Titles: specific vocational preparation, general educational development (language, reasoning, and mathematics), required aptitudes, strength required, and the extent to which the occupation is carried out indoors.
(ix) Also included in the specifications in Table 4 are interactions between the predicted wage in the job and the following individual characteristics: education, experience, experience squared, experience cubed, and indicators for female, black, other nonwhite, married, and disabled.

Dependent Variables in Table 2

Specific vocational preparation represents the amount of time required to learn the skills required for average performance in the occupation. It is a nine-level variable ranging from level 1 (short demonstration) to level 9 (over 10 years). General educational development in mathematics relates to the required level of mathematical skills. This is an ordinal variable with six levels ranging from level 1 (ability to add and subtract) to level 6 (mean value theorems and implicit function theorems).

References