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Tenure, Business Cycle and the Wage-Setting Process*

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Abstract

We analyze the interaction between job tenure and external labor market conditions in wage determination. First, we introduce a model that combines job matching with business-cycle effects. As the employment relationship progresses, the worker appropriates a portion of the value of the match-specific human capital she accumulates, gradually becoming shielded from the cyclical variations in external labor market conditions: the employment relationship is progressively "internalized". Then, we present empirical evidence supporting this prediction: the elasticity of wages to the unemployment rate decreases with tenure. This finding is robust to different specifications that allow for job heterogeneity, and it contributes to the interpretation of recent evidence of changes in the effect of the business cycle on wages.

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1 Introduction

The labor economics literature has dedicated increasing attention in recent years to the study of the reasons why some labor markets tend to internalize the wage process, thereby differing in their functioning from what standard competitive models would predict. This discussion can be traced back to Doeringer and Piore's (1971) analysis of "ports of entry" in specific jobs. The existence of employer- (or match-) specific human capital is usually given as an explanation of long-term employment relationships during which practices common to internal labor markets can be developed. Such analyses have recently been enriched with the introduction of issues of information and learning (e.g. Gibbons and Katz, 1991, Gibbons and Waldman 1999).

Another strand of the literature has resulted in the debate over the existence of some kind of returns to tenure, which dates back to the 1960's with the work of Becker (1964) and Ben-Porath (1967). Specifically, the main issue is the role of specific human capital[1] in wage determination. The accumulation of employer-specific capital may thus lead to an increasing wage pattern as the employment relationship progresses through time. Here as well, informational and learning aspects have recently been added to the discussion of how some kind of match-specific characteristics can be used to explain wage and turnover dynamics, as happens in Jovanovic (1979) and Felli and Harris (1996) among others.

This paper draws from both of these approaches. On one hand, we are interested in match-specific human capital to the extent that it generates returns to tenure. In addition, we take the internal labor market literature's description of which wage patterns, being at odds with the standard competitive model, can be reconciled with match-specific processes[2]. But our focus is somewhat different. Namely, we attempt to study how tenure and

[1] We use a broad definition of specific human capital as in Farber (1999). The interpretation of match-specific human capital is that of everything valuable in the particular match that has no value for either party outside the match.

[2] Note however that, although Doeringer and Piore (1971) attribute investment in firm-specific human capital and on-the-job-training as one of the reasons for the existence of ILMs, there are other reasons offered (such as costumary law) that are not a function of match-specific capital and therefore are not considered here.

labor market conditions interact in the process of wage determination. In other words, we examine how the wage-setting process might be influenced in different ways by the so called "external labor market" conditions and returns to specific human capital accumulation *as the employment relationship evolves*. This points at a connection between specific capital accumulation and the progressive "internalization" of the wage setting process.

We argue that in the course of the employment relationship, as tenure and specific human capital accumulate, labor market conditions have a different impact on wages and turnover decisions. These decisions reflect concerns about the quality of the match and specific investments made by both employer and employee and are related to factors other than labor market conditions. Our claim will be that whether or not we observe practices consistent with implicit contracting, that "shield" the worker from the "vagaries" of the external labor market, depends on how much tenure has been accumulated in a given match. In particular, we present a model and empirical evidence suggesting that external labor market conditions have a lower effect on a worker's wage the higher her tenure in her current job.

Our model takes a simplified version of the framework in Jovanovic (1979) as a starting point. Workers and firms are matched randomly and the quality of any given match is an "experience good": its value is learned as the employment relationship progresses. We interpret the information both parties have about match quality as match-specific human capital. Thus, higher tenure implies that more match-specific human capital has been accumulated[3]. In addition to these features —and this is our main innovation— we introduce business-cycle effects. We thereby create the scope needed to analyze the interaction between learning about match quality —i.e. investment in firm-specific human capital— and external labor market conditions as they are affected by the business cycle. The main implication of the model is that, as the employment relationship progresses and specific human capital is ac-

[3]Other papers, such as Flinn (1986) and Topel and Ward (1992), have used the notion of jobs as "experience goods" to study job mobility. Flinn presents an empirical analysis of wage growth for male new entrants using a highly structured model based on a version of the matching model in Jovanovic (1979). He finds evidence of important match-specific components in mobility decisions. Topel and Ward (1992) combine experience and search characteristics of jobs and develop a mobility model based on wealth-maximizing on-the-job search. Mobility decisions depend on wage evolution within a job as well as on the arrival of external offers. Consistently with the notion used in the present paper, they find that job-specific wages are a key determinant of mobility.

cumulated, the worker, by receiving a fraction of the return to that human capital —which is less cyclical than the value of outside job opportunities— is gradually shielded from cyclical variations in the external labor market.

We then turn to test and confirm this implication empirically. We take the unemployment rate and the gross state product real growth rate as proxies for cyclical conditions in the external labor market. Our basic finding is that the elasticity of current wages to the current local business cycle indicator is affected by the length of match tenure. In addition to the well documented effect of tenure on wages,[4] the wages-business cycle elasticity is lower for more tenured workers. This result is robust to various specifications and sample changes. We also examine and confirm its validity when allowing for several dimensions of job heterogeneity. In particular, we consider the possibility of this effect being sensitive to the worker's number of years of education and age. In the first case, we conclude that a higher level of schooling makes wages less cyclical and labor demand is also less sensitive to the business cycle for older workers. This effect is on top of the tenure effect on wage cyclicality, that remains unchaged in this specification.

We test as well the effect of tenure on the elasticity of current wages to the local unemployment rate prevailing when the worker is hired. Our results show that the effect of initial conditions dies out as tenure progresses.

The combination of these two elasticity changes is consistent with the hypothesis that the accumulation of firm-specific human capital leads to an increasing importance of implicit shielding agreements between employers and workers in wage determination. For larger values of tenure the process of wage determination cannot be described by a model of spot labor markets.

Finally, we study the possible existence of non-linearities in the tenure effect on wages. Our evidence shows that the internalization of the wage-setting process is much faster during the first year of tenure than later on (note that this initial period is characterized by much faster learning about match quality).

These results contribute to the recent debate on changes in human resources management and changes in the nature of employment relationships. From an empirical perspective, evidence of changes in the effect of the business cycle on wages is associated with structural changes in the contractual relationship (see for example Bertrand, 1999). Specifically, it is sometimes

[4]See Topel (1991), and Altonji and Williams (1997) for a discussion of the returns to tenure literature.

argued that an increased sensitivity of wages to unemployment rates reflects the fact that employment relationships have become more flexible, less characterized by agreements that shield workers from the labor market stance. Our results on the tenure effect on wages and the interpretation of tenure as a proxy to match-specific human capital and learning point at a different effect that should also be taken into account. In addition to possible changes in the way wages are set, the sensitivity of wages to labor market conditions is also influenced by variations in the tenure composition of the pool of workers. Given the evidence from the human resources literature that restructuring processes and downsizing experiences hurt especially older workers (see Capelli, 1995), this possible "recomposition" effect could be an important factor in explaining the observed increase in wage sensitivity.[5]

Our analysis is related to the one carried out by Beaudry and DiNardo (1991), who also combine a contract model with cyclical effects. They examine the relation between wages and the business cycle both theoretically and empirically, and conclude that the current unemployment rate does not affect wages after controlling for the best labor market conditions since a worker was hired at her current job. However, their model has no prediction regarding how returns to tenure and the cycle interact in wage determination. Furthermore, our result below, according to which the cyclical behavior of the wage rate decreases with tenure, not being at odds with their main results, is better described as an alternative explanation for their findings. If firms shield more tenured workers from the vagaries of the labor market, whether one is to find a large impact of the business cycle on wages will be a function of the tenure composition of the pool of employed workers at any given moment.

Other related papers are Felli and Harris (1996), Gibbons and Waldman (1999) and Farber (1999). Felli and Harris (1996) introduce a dynamic model of specific capital that incorporates issues of information, matching and turnover. This is the only dynamic model that we know of that has implications for the slope of the tenure-earnings profile. Both Gibbons and Waldman (1999) and Farber (1999) present very stylized models of wage dynamics in internal labor markets and with specific human capital, respectively. In addition, as we mentioned above, Jovanovic (1979) presents an example of a more dynamic set-up that combines specific capital and search

[5]See Neumark et al.(1999) for evidence that job stability declined in the 1990s for workers with longer employment spells.

— which serves as a starting point for our own model below. None of these papers tackles the issue of how variations in the labor market stance associated with business cycle conditions affect the wage profile as the employment relationship progresses.

Our work is also connected to the vast literature on the issue of how real wages vary over the business cycle. In his seminal work, Bils (1985) finds evidence that wages for job changers are strongly procyclical, but for job stayers respond only weakly to the cycle. This conclusion has been confirmed by more recent papers (see for example Solon et al.,1994), which find incumbent workers' wages to be procyclical although less so than they are for job changers. These studies also find evidence that wage cyclicality is strongest among low-wage workers.

Section 2 presents the model. Its main empirical implication is that there is an inverse relation between wage cyclicality and job tenure. Section 3 describes the testing methodology. We first examine the basic implication of our model. Later on, we expand the empirical approach in order to allow for, first, the possibility that human capital accumulation has different degrees of importance in different jobs; and, second, the possibility that the effect of tenure on wages and on wage cyclicality is non-linear. The data to be employed is described in section 4. Section 5 presents the empirical results, and section 6 concludes.

2 A Simple Model

In this section we present a model that analyzes the impact of the business cycle on the process of wage determination as it evolves while tenure and specific human capital accumulate. The key components of the model are: (i) the existence of employer-specific human capital —valuable in the match between the firm and the worker but with no value outside the match; (ii) the appropriation by the worker of a fraction of the value of this specific capital; and (iii) the interaction between that value and the labor market stance.

Labor is the only factor of production and firms' technologies exhibit constant returns to scale. Each worker lives two periods ($t = 0, 1$) and there is no discounting. New workers and those that have quit their previous jobs are matched randomly to firms. Each match between a firm and a worker can be of two qualities: good or bad. Good matches generate one unit (zero units) of production with probability p $(1 - p)$ each period. Bad matches,

however, always produce zero.

The quality of any match is unknown ex-ante. It is distributed identically and independently across matches. Information on match quality is symmetric between the firm and the worker at all stages, and is updated when production occurs. Hence, we take an informational interpretation of match-specific human capital, as in Jovanovic (1979): as the employment relationship progresses, both parties learn about the quality of the match, and the information so gathered constitutes capital that is valuable only within the match[6].

Let Ψ_t be the state of the business cycle in period t. It can take two values, high (h) or low.(l). Ψ_t is i.i.d. across periods, and $prob(\Psi_t = h) = \rho$ for all t. The business cycle plays a role in the determination of the prior probability distribution over the two possible qualities of a match. To economize on notation, we take Ψ_t to be as well the probability that a match that starts in period t be good. Namely, if an employment relationship begins in period t and $\Psi_t = h$ ($\Psi_t = l$), then the prior probability of a good match is h (l), with $1 > h > l > 0$. That is, a match will turn out to be highly productive with greater probability if it starts during a boom than if it starts during a recession. We make this assumption for the sake of simplicity. We could model the job-matching process in a more detailed fashion, having the ex-ante value of a given match depend on the number of workers searching for jobs and on the number of vacancies. In such a model, the relative abundance of job searchers and vacancies during recessions would generate two opposing effects on the average quality of new matches. First, it would make it easier for fims and workers to attain good matches, since they would be choosing from larger pools. But, on the other hand, it would also generate more search frictions, making good matches less likely to happen. Then, we are implicitly assuming that the second effect prevails. This simplifies our model significantly and allows it to stay very close to Jovanovic (1979), differing only in that the distribution of match qualities varies with the cycle. Furthermore, the empirical evidence in Bowlus (1995) strongly suggests that the average quality of new matches actually is procyclical.

We assume that, in each period, wages are determined by Nash bargaining. That is, in any given match and in any given period, the corresponding

[6]To keep the model simple, we do not allow for the accumulation of general (i.e. productive in all matches) human capital. The inclusion of such an accumulation would add returns to experience to our results on returns to tenure, leaving all of our findings unaltered.

wage level is given by

$$(1-\beta)\left[\begin{array}{c}\text{worker's}\\ \text{outside option}\end{array}\right]+\beta\left[\begin{array}{c}\text{expected value of production}\\ \text{from the match in period } t\end{array}\right],$$

where β is the worker's bargaining power, assumed constant and the same for all workers, with $0<\beta<1$. Of course, a worker will quit if the expected value of production in the current match is lower than her outside option, i.e. employment in a new match[7].

The timing is as follows. In each period, the state of the business cycle is determined and observed by workers and firms. Any worker in the second period of her life then decides whether to stay in her current match or quit. Subsequently, both new workers and those that have quit their previous matches are randomly matched to a firm.Wage levels are then determined by Nash bargaining. Finally, production occurs and the information on match quality is thereby updated.

Any match that generates zero production during the worker's first period reveals itself as bad. Therefore, the value of the match becomes lower than the worker's outside option –since any new match has a positive probability of being good– and the match does not survive. If the match generates positive production, beliefs about match quality will be updated accordingly. Whether the match will survive or not will be determined by comparing the continuation value of the match with the worker's outside option. We make the following assumption to reduce the number of possibilities in that comparison.

Assumption 1: $p<\frac{l(1-h)}{h(1-l)}$

Let $\widehat{h}$ $(\widehat{l})$ be the updated probability of a good match if $\Psi_0=h$ $(\Psi_0=l)$ and one unit was produced at $t=0$.[8] Assumption 1 ensures that $\widehat{l}>h$. This implies that any match will survive if it generates one unit of production in the worker's first period.

Take any given worker that faces a sequence (Ψ_0,Ψ_1) of states of the business cycle along her life and whose match generates positive production at $t=0$. Let $w(t,\Psi_0,\Psi_1)$ be the wage she receives at t, $t=0,1$. We are interested in the interaction between tenure and the business cycle in

[7]We assume that the number of firms in the economy is large enough so that the probability that a worker is matched to a firm where she previously worked is negligible.

[8]Straightforward application of Bayes'rule yields $\widehat{h}=\frac{h}{h+(1-h)p}$, $\widehat{l}=\frac{l}{l+(1-l)p}$.

determining the values that $w(.)$ may take. We obtain those values in what follows.

At $t = 1$, the worker's outside option is given by expected production in a new match: $\Psi_1 + (1 - \Psi_1)p$. Expected production in her current match, if production was positive in the previous period, is $\widehat{\Psi}_0 + (1 - \widehat{\Psi}_0)p$, where $\widehat{\Psi}_0$ is the updated probability that the current match be good. Her period-1 wage, by Nash bargaining, will be given by a weighted average of those values:

$$\begin{aligned} w(1, \Psi_0, \Psi_1) &= \beta[\widehat{\Psi}_0 + (1 - \widehat{\Psi}_0)p] + (1 - \beta)\left[\Psi_1 + (1 - \Psi_1)p\right] \\ &= p + (1 - p)\left[\beta\widehat{\Psi}_0 + (1 - \beta)\Psi_1\right]. \end{aligned}$$

Since $\widehat{h} > \widehat{l}$, we obtain

Proposition 1: *There is a cohort effect on wages. That is,*

$$w(1, h, \Psi_1) > w(1, l, \Psi_1)$$

for all Ψ_1 *whenever the match survives.*

This is a direct consequence of the probability of good matches being procyclical. These wage values also determine the firm's expected profit from the match at $t = 1$, given Ψ_0 and Ψ_1, when the match survives. Denote that profit by $\Delta(\Psi_0, \Psi_1)$. It is given by the difference between expected productivity and the wage level at $t = 1$. A few steps of algebra reveal that

$$\Delta(\Psi_0, \Psi_1) = (1 - p)(1 - \beta)(\widehat{\Psi}_0 - \Psi_1)$$

for all Ψ_0, Ψ_1.

At $t = 0$, competition among firms ensures that each worker is paid the expected value of any new match to any firm given the current state of the business cycle. Hence,

$$w(0, \Psi_0, \Psi_1) = \Psi_0 + (1 - \Psi_0)p + \left[\Psi_0 + (1 - \Psi_0)p\right]\left[\rho\Delta(\Psi_0, h) + (1 - \rho)\Delta(\Psi_0, l)\right].$$

The first two terms in this expression are expected productivity at $t = 0$. The remaining term reflects the fact that, if production at $t = 0$ is positive (which happens with probability $\Psi_0 + (1 - \Psi_0)p$) the match will survive and the firm will derive positive expected profits at $t = 1$.

We are now ready to state the main result of this section.

Proposition 2: *Wage cyclicality decreases with job tenure, i.e.*

$$\frac{w(1,\Psi_0,h)-w(1,\Psi_0,l)}{w(1,\Psi_0,h)} < \frac{w_0(0,h,\Psi_1)-w(0,l,\Psi_1)}{w_0(0,h,\Psi_1)}$$

for all Ψ_0, Ψ_1 *whenever the match survives.*

The proof is provided in Appendix A. The intuition for Proposition 2 is simple. If the match lasts two periods, during the first period the worker is paid her exact outside option, which is entirely affected by the current state of the cycle. In the second period, however, given our Nash bargaining assumption, her wage becomes a weighted average of her outside option and her expected productivity, and the latter is not cyclical in this simple model.[9]

A comment is due on the robustness of these results to extensions of the model to more than two periods. Although the formal complexity of the solution would definitely increase, all our results should still hold in a more complete model.[10] In expected terms, good matches would tend to survive, while bad matches would be abandoned. The same reasoning employed in Proposition 2 can be used to show that higher wages will be less cyclical than lower ones. Finally, the cohort effect would still be present, although it would diminish with increases in tenure.

The main prediction of the model is then that the sensitivity of wages to current business cycle conditions falls with job tenure. As suggested above, this can be interpreted as a progressive internalization of the employment relationship as tenure is accumulated. The worker becomes progressively shielded form the spot labor market. We should then observe a lower elasticity of wages to variables related to the labor market stance as tenure is accumulated. In the following sections, we put this prediction to the test by estimating a wage function that, just as the $w(t,\Psi_0,\Psi_1)$ function above, allows for job tenure to interact with current and prior states of the business cycle.

[9] In this setup we assume that the value of production is not affected by current business cycle conditions. Relaxing this assumption would not alter any of the results in this section.

[10] The choice of a two-period model has drawbacks. For example, our model does not necessarily generate positive returns to tenure: depending on parameter values, if $(\psi_0,\psi_1)=(h,l)$ wages may be higher at $t=0$. This is entirely due to the fact that firms have to pay their future expected profit from the match in period-0 wages, whereas in period 1 there is no future. In an infinite-horizon model, however, future profits would be a part of wages in all periods and positive returns to tenure would be a natural result.

3 Testing Methodology

In this section we introduce the different regression models used to assess the empirical evidence for the predictions presented above. With such a set of empirical strategies we try to address a series of issues that might not be captured by our basic regression models. These issues include the sensitivity of the model's results at different wage levels, and the presence of non-linearities in the process of learning about match quality captured by job tenure.

3.1 Basic Empirical Model

The model outlined in section 2 has several empirically testable implications for the process of wage determination. In particular, it entails that the current wage is related to the opportunities available at the moment she was hired and to the current conditions of the labor market[11]. Equation (1), our basic wage equation, encompasses all these implications of the theory:

$$\ln w(i,t+j,t) = X_{i,t+j}\theta_1 + \theta_2\Psi(t,j) + \theta_3 ten_{i,t+j} + \theta_4 ten_{i,t+j} * \Psi(t,j) + \varepsilon_{i,t+j} \quad (1)$$

That is, the wage paid in period $t+j$ for an individual i who began working in period t is a function of a vector of covariates $X_{i,t+j}$ —which includes experience, schooling, race, union and marital status, industry and state dummies—, her tenure on the job and the labor market stance. The cycle effect is proxied by the local unemployment rate, $\Psi(t,j)$. Both the initial and the current values of the local unemployment rate will be used below.[12] Since we are mainly interested in the interaction between tenure, which we use as an indirect measure of specific human capital accumulation,

[11] As mentioned above, a more complete model would also predict that wages are related to the worker's tenure in her job. We will also allow for this relationship in our empirical specification.

[12] Beaudry and DiNardo (1991) estimate a wage regression that does not include the interaction term and consider three possible "values" for the unemployment rate, each corresponding to a different hypothesis about the labor market link. More specifically they used the current unemployment rate, the unemployment rate at the start of the job and the minimum unemployment rate since the job started. The use of the minimum unemployment rate along the employment spell is not compatible with our model. We will deal with this issue again in the results section.

and the labor market stance captured through the unemployment rate, the most important coefficients for our purposes are θ_2, θ_3 and θ_4.

Our model predicts that θ_3 and θ_4 will be positive and θ_2 negative. The positive sign of θ_3 derives from the existence of returns to tenure associated with the accumulation of firm-specific human capital in the form of learning about match quality. When the initial unemployment rate is included in the regression, the cohort effect implies a negative value for θ_2. The same is true when we use the current unemployment rate, since external labor market conditions do have an influence on wages. Evidence on this effect is reported in the influential work by Blanchflower and Oswald (1994) linking the local unemployment rate and the wage rate by means of the so called *wage curve*. Finally, the sign of the interaction term is implied by Proposition 2: the sensitivity of wages to the business cycle should be decreasing with tenure.

3.2 Non-Linearities in Tenure Effects

In the theoretical literature on returns to tenure and learning it has been suggested that the learning process might not be continuous (see for example Jovanovic, 1979). Learning takes place at a much faster rate at the beginning of the match than later on. Not much empirical work on this issue is available. In a recent paper, however, Farber (1999) presents evidence on match duration. According to his findings, there are three key facts on job tenure: long-term employment relationships are common; most new jobs end early; and the probability of job change declines with tenure. These results, particularly the second and third facts, point at a non-linearity in the process of learning about match quality. Consequently, we would expect the process of wage internalization to be much faster during the earlier stages of the relationship.

In order to find out whether this is true in our samples and if this might influence the results of the previous model, we estimate equation (1) allowing for structural breaks in the tenure effect on wages. We do so by introducing a spline on the tenure variable. More specifically, we model the relationship between wages, tenure and the business cycle as a bilinear spline.With this formulation we allow the wage rate to be a piecewise function of tenure, thus permitting different effects for different levels of tenure.

Let S be the number of knots and $\overline{ten}_s$ their respective value.Our tenure variable is defined as follows:

$ten_1 = ten, \;\; ten_s = \begin{cases} (ten - \overline{ten}_{s-1}) & if \; ten > \overline{ten}_{s-1} \\ 0 & otherwise \end{cases} \quad (s = 2, ..., S)$

$x_s = \Psi * ten_s, \;\; for \; s = 1, ..., S$

Given the coefficient vectors $\alpha = [\alpha_1, ..., \alpha_S]$, and $\gamma = [\gamma_1, ..., \gamma_S]$ and the intercept θ, w is defined as:

$$w = \theta + \delta * \Psi + \alpha * ten + \gamma * x$$

The interpretation of the coefficients is straightforward. More important here are the coefficients that represent changes in the "interaction effect" of the unemployment rate and tenure along grid lines $ten = \overline{ten}_{s-1}$. Note that the net effects for each s can be found by adding these changes to their initial effects. The net main effect of tenure is $\alpha_1 + ... + \alpha_s$ and the net interaction effect is $\gamma_1 + ... + \gamma_s$.

In section 5 we describe the particular application of this model to our data, specifically including the question of identifying values for the knots.

4 Data

In this section, we briefly review the main data sources used in this paper. For a more detailed description, we refer the reader to Appendix B. We use two different longitudinal data bases to investigate the existence of a tenure effect on wages: a Panel Study of Income Dynamics (PSID) extract, and a National Longitudinal Survey of Youth (NLSY) extract.

Our NLSY extract corresponds to the 1979-96 period. The NLSY is better for our purposes not only because of its larger sample, but particularly because it has better information on job tenure and a larger number of short employment spells. Its major drawback is the fact that it surveys relatively young people, thereby not being as representative of the overall labor force. This makes job turnover much more frequent. However, it enables us to use a greater number of spells, and it is more adequate to study issues related to the timing of match learning and non-linearities in tenure effects.

The PSID data covers the 1976-1983 period (except 1979, since the tenure question was not included that year). This is a more representative panel than the NLSY and slightly longer. However, its main problem is that the wording of the tenure question has changed substantially over time. Before 1984 the question could have been interpreted as referring to duration of continuous employment rather than time together with the present employer.

After 1984, the question explicitly asks about time with the present employer. This is particularly troubling given the key role that tenure plays not only in the identification of the employment spells, but also as an explanatory variable in the empirical implementation.

These two extracts are merged by state and year with our measures of the state of the business cycle. We use two indicator of the cycle: the state monthly unemployment rate and the real grwoth rate of the Gross State Product (GSP). The unemployment rate information is taken from the Bureau of Labor Statistics and the GSP data are from the Bureau of Economic Analysis.

4.1 Descriptive Means

Table 1 presents means and standard deviations of the main variables of interest for the two data sets used in this paper. We restrict the analysis to male workers. We are interested in the investigation of relatively long-term attachment to the labor force as a way to guarantee the development of the type of implicit agreements investigated here. Since males have more stable labor force participation and matches are less likely to end due to reasons not related with the match itself, one might suspect that they are more likely to be covered by implicit wage-setting contracts.

[Insert Table 1 here]

The NLSY extract appears to have a lower proportion of unionized workers and a lower average number of years of schooling than the PSID sample. This is a result of the younger NLSY sample - average age in the NLSY sample is 23 years while it is 34 years in the PSID sample. The average length of tenure is, as expected, smaller in the NLSY extract. This is, again, due to the fact that it consists of a sample of young workers with higher turnover and lower employer attachment. In addition, hourly wages are notably lower in the NLSY extract. This difference reflects, among other factors, the experience and educational composition of both samples.

5 Econometric Results

5.1 Basic Results

In this section, we present evidence that higher levels of job tenure decrease the sensitivity of wages to the business cycle. We present results for two different indicators of the business cycle: the state unemployment rate and the gross state product real growth rate. We test the sensitivity of wages to both the current stance of the business cycle and the one previaling at the start of the job. We discuss first the results obtained with the NLSY sample. This is our preferred data set due to the higher quality of tenure recordings. Next, we present the results obtained using the PSID. The PSID extract yields, qualitatively, very similar results but with much higher standard errors.

Our main findings are shown in Table 2.[13] We use a fixed-effects panel-data model to estimate equation (1).[14] We present the effect of tenure on the elasticity of current wages to the current local unemployment rate and to the local unemployment rate at the start of the job. The NLSY results correspond to the first six lines of Table 2. The second and third columns present the results when we measure the business cycle using the current unemployment rate, whereas in the fourth and fifth columns we report results with the unemployment rate at the start of the job. The model in line (6) allows for both the current and starting unemployment rates. As expected, there are positive returns to tenure, and the main current wage-current local unemployment rate elasticity is negative and significantly different from zero. More importantly, and according to our prediction, that elasticity decreases (in absolute value) with tenure.

[Insert Table 2 here]

Using the results arising from the NLSY sample we show that, considering

[13] The results reported throughout the paper were obtained using a demeaned tenure variable. This means that the coefficient on the business cycle indicator measures the marginal impact evaluated at the mean value of tenure.

[14] Suppose that important demographic reshufflings of the workforce accompany changes in the competitive environment, and that the elasticity of wages to the unemployment rate differs across demographic groups. One might then worry that the estimated coefficient on the interaction term captures some of these compositional changes in the workforce. Controlling for a vector of individual characteristics captures observable changes in demographic mix of the economy. Individual fixed effects further eliminate compositional problems caused by unobserved chracteristics that are constant over time.

the interaction between tenure and the unemployment rate, the effect of a one percent change in the current unemployment rate on wages is about 10% lower than the point estimate obtained when we don't control for the existence of the interaction effect (The value of the elasticity falls from -0.0539 to -0.0487 and the model without the interaction term corresponds to line 1 in the Table). For the NLSY sample a one-standard-deviation change in tenure decreases the elasticity of wages to the current unemployment rate by more than 1 percentage point (note that this represents a reduction of almost 25% over the elasticity computed at mean tenure): at the sample mean for tenure, the elasticity would be reduced from -0.048 to -0.037. These results are similar if we use the unemployment rate prevailing at the start of the job. The effect of initial conditions dies out over time even more rapidly as tenure is accumulated.

The results in Table 2 show that higher values of tenure reduce the elasticity of wages to the current unemployment rate and the unemployment rate at the start of the job. The empirical evidence is favorable to our hypotheses and can be interpreted as indicating not only that initial conditions die out over time as tenure accumulates, but also that the longer the match the more shielded the worker is from the vagaries of the external labor market, as measured by the current local unemployment rate. This is consistent with the explanation presented in the model. The development of an internal labor market is a function of the length of job tenure, in the sense that the worker appropriates a fraction of the return to firm-specific human capital accumulated with tenure.[15]

Beaudry and DiNardo (1991) estimate an equation similar to (1) but do not include the interaction term. Their results are that the costless mobility model (in which the relevant measure of the unemployment rate is the minimum unemployment rate since the start of the job) is the one that prevails when confronted with the other hypotheses, thereby rejecting the spot market model. We see our results as an alternative explanation to theirs. By simply including a tenure interaction we obtain a result that is not consistent with a spot labor market in wage determination and favors a contractual model of the labor market. In order to further compare our results with those in

[15] In all the specifications of Table 2, we have restricted the returns to all the demographic variables to be constant over time. These restrictions might not be realistic, at least for some of these variables. We therefore checked the robustness of these specification assumptions allowing the returns to some of the variables (namely experience, education, unionization, race and marital status) to vary over time. The basic results were not altered.

Beaudry and DiNardo we ran our models with the minimum unemployment rate. The interaction term always played an important role in the reduction of the cyclical sensitivity of wages, regardless of the business cycle indicator used in the regression.

The findings obtained using the PSID are presented in lines 7 to 12 of Table 2. Conclusions are very similar to the ones that follow from using the PSID sample. Note that the PSID yields larger elasticities but also larger standard errors. The impact of an additional month of tenure in the current wage-current local unemployment rate elasticity is very similar in the NLSY and PSID extracts. However, evaluated at the sample mean for tenure, the percentage reduction in the elasticity is smaller for the PSID than it was for the NLSY.

There is a possible impact of selectivity in our results. In our sample, we exclude nonemployed persons since we don't observe their market wage. However, the cyclicality of wages can be motivated by persons moving in and out of workforce, namely if these persons' wages have a very pronounced cyclical behavior. We followed the approach in Bils (1985) and tested the impact of excluding nonemployed persons reestimating model (1) using the lambda procedure sugested by Heckman (1979). The results imply that wages are more procyclical for persons moving in and out of the work force, thus increasing our estimates of the unemployment rate and the interaction term. However, given the high standard errors obtained with the econometric procedure, whether the selctivity bias is in fact important cannot be judged with much confidence.

5.2 Testing the results' robustness

The basic regression framework in the previous section may not capture some relevant relationships between wages and the cycle. According to the model proposed above, the wage level is a function, among other factors, of firm- and worker-specific human capital and match quality. Firms (or jobs) that invest more in worker-specific human capital and that prefer (or require) stable long-term relationships are expected to pay higher wages and to have a steeper wage profile. We would like to control for differences in the relative importance of firm-specific human capital. In particular, it could be the case that the cycle hit different schooling groups differentially and that tenure could be correlated with schooling. To control for this we add to the previous specification an interaction between the business cycle indicator and

schooling.

Another issue that we would like to control for is the possibility that the demand for older workers, independent of tenure, be less cyclical. In order to do this we add the interaction of age and the business cycle indicator. The results obtained are presented in Table 3.

[Insert Table 3 here]

Evaluated at mean age and schooling the elasticity of wages to the current unemployment rate is -0.046 (otained from column (1) results), slightly lower than before. Also, the impact of tenure on the elasticity of wages to the business cycle conditions remains unchanged; more tenure implies a smaller elasticity. It is interesting to note that this effect occurs on top of the impact of age in the elasticity of wages. We obtain a positive interaction between age and the unemployment rate: the demand for older workers is less cyclical. The same result applies for more educated workers. From column (3) we obtain that workers with higher levels of schooling have a less cyclical wage, and the impact of starting conditions is also smaller.

In the literature on wage cyclicality the unemployment rate is the most common indicator of the business cycle (see Abraham and Haltiwanger, 1995) but some studies use other indicators of economic activity, such as the level of production measured by GDP (see for example, Blank, 1990 and Solon et al, 1994). In order to measure labor market pressure on wages it is more appropriate to use regional level variables, and we use the Gross State Product (GSP) real growth rate as an alternative indicator of the business cycle.

[Insert Table 4 here]

The results presented in Table 4 confirm our previous findings. There is a positive elasticity of wages to the GSP real rate of growth, but this elasticity is decreasing in tenure. The elasticity to the current GSP growth rate is reduced from 0.315 to 0.163 when we take the tenure effect into account and evaluate it at mean tenure in our NLSY sample.

The results regarding the GSP growth rate at the start of the job are reported in columns (2) and (4) in Table 4 and they also confirm previous results on the diminuishing impact of starting conditions on a worker's wage as tenure accumulates. The final column reports the coefficient estimates of a model specification similar to the one in Table 3. As before, wages are less cyclical for older and more tenured workers and the two effects reinforce each

other. The same is true for more educated workers. Note that detrending the unemployment rate measure (in order to filter low frequencies variations) does not change the main results[16].

5.3 Evidence on Non-Linearities in Tenure Effects

The last set of results refers to the existence of non-linearities in the tenure/ unemployment rate interaction. They are obtained by estimating the bilinear spline model introduced in Section 3.2.

There is no theoretical guidance about the determination of the knots for the tenure variable. As we already noted, some previous empirical evidence on labor mobility suggests a structural break early on in the employment relationship, a period in which a large percentage of all full-time matches are expected to end (see Farber, 1999). However, no general evidence has been presented that might help us in the process of determining the value of the knots. The procedure we follow starts from a general formulation, with a large number of knots, and progressively reduces that number by dropping those knots that are not statistically significant. We are thereby left with a very simple model, with a single knot for tenure —at 52 weeks of employment duration— using the NLSY sample.

The findings presented in Tables 5 and 6 show that using model (1), there is a statistically significant structural break along tenure equal to 52 weeks (see Table 6). The point estimate obtained in Table 5 indicates that an additional week of tenure in the first year of work has a much larger impact on the current wage-current local unemployment rate elasticity than later on.

[Insert Tables 5 and 6 here]

This result is extremely interesting when we interpret a match as an experience good. In this case, match tenure defines the period of learning about match quality that took place. Our result, together with our hypothesis about firm-specific capital acquisition, suggests that learning about match quality occurs much faster early on in the match, bad matches being terminated early as well. The effect of tenure after this first period much smaller.

[16] To make the results easier to compare with other papers we decided to report the ones obtained with the raw variables. The ones obtained with the filtered variables are available from the authors upon request.

Nevertheless, it is still statistically different from zero and can be interpreted exclusively as the result of the process of firm-specific human capital accumulation.

Finally, from the results shown in Table 5 we can also conclude that a one-standard-deviation increase on tenure reduces the elasticity of current wages to the current unemployment rate by 0.0247 (the elasticity goes from -0.0342 to -0.0095, which represents a reduction of more than 70%). This is a larger reduction than the one obtained in our previous models.

6 Concluding Remarks

The relation between internal and external labor markets has been extensively discussed in recent years. So has the issue of the existence of returns to tenure. In this paper, we have drawn from both these analyses to examine the process by which wages are set in relation to the time a worker has spent in her current job. That is, we have posed the question of how job tenure and labor market conditions interact in the process of wage determination.

First, we presented a simple matching model where tenure in the current job is interpreted as a proxy for match-specific human capital accumulated in the employment relationship. As tenure progresses, then, the worker seizes a fraction of the rising value of that specific capital. Such appropriation gradually shields her from cyclical variations in the external labor market conditions. The wage-setting process becomes progressively "internalized".

The empirical evidence we presented lends support to that prediction. The elasticity of current wages to unemployment rates decreases with tenure. We tested our findings' robustness by including the worker's years of schooling and age interacted with the cycle in our regressions. The worker's wage proved to be less cyclical for older and more educated workers, but this impact is obtained on top of the main impact of tenure on the wage elasticity, which remains present in these specifications. Finally, we considered the possibility that the tenure effect on wages be non-linear. Our findings lead us to conclude that the internalization of the wage-setting process is faster at the beginning of an employment spell than later on.

The results presented in this paper suggest that the study of issues related with the cyclicality of wages should take into account the tenure composition of the pool of workers. If one is to find evidence of greater exposure of workers to the vagaries of the external labor market, that might not only

be an indication of a change in wage policy in the direction of spot market wage setting. It might also be a sign that a non-wage human resources policy is being implemented (see Capelli, 1995). For example, it can be the result of a "recomposition" of the pool towards a greater presence of less tenured workers, which is consistent with the common wisdom that industry restructuring and downsizing processes hit harder older and white-collar workers —precisely those with higher employer attachment and more likely to be in these type of implicit agreement contracts.

Clearly, however, further research is needed into how our conclusions about the process of wage determination and, consequently, the effects of policies on that process depend on job tenure. A richer dynamic model that captures the timing and different characteristics of match-specific human capital investments would be instructive. Additionally, the availability of better micro data, namely at the firm level, would also help in discriminating how different groups of workers will be affected, and how the process of learning about workers' ability interacts with the process of firm-specific human capital accumulation.

APPENDIX A

Proof of Proposition 2

For the result to hold, it has to be true that $\frac{w(1,\Psi_0,l)}{w(1,\Psi_0,h)} > \frac{w_0(0,l,\Psi_1)}{w_0(0,h,\Psi_1)}$, or

$$\frac{\beta[\widehat{\Psi}_0+(1-\widehat{\Psi}_0)p]+(1-\beta)[l+(1-l)p]}{\beta[\widehat{\Psi}_0+(1-\widehat{\Psi}_0)p]+(1-\beta)[h+(1-h)p]} > \frac{l+(1-l)p+[l+(1-l)p][\rho\Delta(l,h)+(1-\rho)\Delta(l,l)]}{h+(1-h)p+[h+(1-h)p][\rho\Delta(h,h)+(1-\rho)\Delta(h,l)]}.$$

The ratio on the right-hand side is clearly larger than $\frac{l+(1-l)p}{h+(1-h)p}$, since $\beta > 0$. A sufficient condition for the inequality to hold is, then,

$$\frac{[l+(1-l)p][\rho\Delta(l,h)+(1-\rho)\Delta(l,l)]}{[h+(1-h)p][\rho\Delta(h,h)+(1-\rho)\Delta(h,l)]} < \frac{l+(1-l)p}{h+(1-h)p},$$

or $\frac{\rho\Delta(l,h)+(1-\rho)\Delta(l,l)}{\rho\Delta(h,h)+(1-\rho)\Delta(h,l)} < 1$. As can be easily verified, this condition is automatically satisfied in our model.

APPENDIX B

Data description

The NLSY is a panel started in 1979 with 12,686 men and women with ages ranging from 14 to 21 years. In this study, we include data through 1996. The subsample we use includes only men, from the three survey samples, since restricting the sample to the cross-sectional sample of the NLSY did not change the results. It was transformed so that each observation corresponds to an employment spell. For each individual, several observations were created. We did so using the variable in the Workhistory data base that links jobs over years. Since each individual reports up to 5 jobs each year, the employer code was used to construct a variable that, for each job reported in a given year, contains information on whether that job was reported in the previous year. This allows us to track each new match while it is one of the 5 reported jobs. The wage measure is the deflated hourly wage, obtained using the Consumer Price Index (1982-1984=100). We excluded any observation for which the deflated hourly wage is less than 1 and more than 100 USD.

Wages were reported every year for each employment spell, along with information on industry, occupation, marital status, age, experience, tenure, race, union status, and the state of residence. Additionally, for each observation we merged this information with the current local unemployment rate —defined as the monthly unemployment rate for the state of residence—, the national unemployment rate and the unemployment rate at the start of the job, both at the national and state levels (the latter is available only after 1978).

In order to compute the unemployment rate at the time of job start, when not observing the beginning of the spell we used the information on the length of tenure with the present employer. We then computed the approximate year and month at which the worker started working with her present employer. We assumed that employment started in the same place as it occurs now. After deleting observations due to missing information, the data base resulting from this procedure has 19,092 employment spells from 5,753 different individuals, an average of 3.32 for each individual.

As regards the PSID, it is a longer panel but it has a much poorer recording of job tenure. This is very important given the relevance of tenure in our empirical application and the fact that we are interested in studying wage levels over workers' tenure profiles. The tenure question was first included in 1976, but it was discontinued in 1979. Given these restrictions, we do not gain too much variation in terms of the business cycle over the NLSY. The only advantage of the PSID refers to the unemployment rate at the start of the job, but the limited availability of state-level unemployment rates reduces

the usefulness of such information.

We included waves for 1976-1978 and 1980-1993, and generated 9,657 employment spells corresponding to 4,707 individuals, an average of 2.05 for each individual. We used the subsample of men, heads of household, from the "SRC" sample, thus not including low-income families in the sample. We identified an employment spell, following Brown and Light (1992), as being observed for the first time whenever the reported tenure was less than the elapsed time since the previous interview. This is what Brown and Light call partition T. In principle, this partition would work adequately if there were no errors in the report of tenure with an employer and if workers never returned to the same employer. This is obviously not the case, and Brown and Light identify a reasonable number of inconsistencies derived from the use of this partition. We disregarded all the observations that do not have a consistent (within a given range) starting date whenever the same job was seen more than once, as proposed by Brown and Light.

As with the NLSY extract, additional information on the set of covariates was recorded and all the spells with missing information were deleted. The same procedure was used to merge the unemployment rate with each observation. Again, the wage measure is the deflated hourly wage, obtained using the Consumer Price Index (1982-1984=100) and we excluded any observation for which the deflated hourly wage is less than 1 and more than 100 USD.

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Table 1

Descriptive Statistics: NLSY and PSID Individual Data
Means and Standard Deviations

Variables description	NLSY	PSID
Log real hourly wage[a]	1.378	2.206
	(0.416)	(0.610)
Log state current unemployment rate	1.892	1.872
	(0.320)	(0.291)
Log state unemployment rate at start of job	1.876	1.909
	(0.337)	(0.221)
Gross state product real rate of growth	0.0304	
	(0.025)	
Age	23.216	34.005
	(4.031)	(9.995)
Tenure[b]	2.153	4.106
	(2.375)	(7.320)
White	0.688	0.680
	(0.463)	(0.467)
Married	0.323	0.795
	(0.468)	(0.404)
Experience[c]	277.030	16.828
	(191.593)	(10.918)
Union status	0.151	0.224
	(0.359)	(0.417)
Highest grade completed	11.790	12.546
	(2.357)	(2.719)
Northeast region	0.178	0.162
	(0.383)	(0.369)
North Central region	0.236	0.230
	(0.425)	(0.421)
South region	0.388	0.442
	(0.487)	(0.497)
West region	0.198	0.166
	(0.398)	(0.372)

1. The NLSY data is composed of male workers in NLSY over the period 1979-1996.
The PSID data is composed of male workers in PSID over the period 1976-1993.
2. The construction and definition of variables are contained in the Appendix.
3. When required, variables are deflated using the CPI (1982-1984=100).
4. (a) Tenure is measured in years.
(c) Experience is measured in weeks for the NLSY extract and in years for the PSID extract.
5. State monthly unemployment rates are taken from the Local Area Unemployment Statistics from the Bureau of Labor Statistics. The CPI index is taken from the BLS.
6. Gross state product real growth rates are taken from the Bureau of Economic Analysis.
7. Industry sectors included were: Agriculture, forestry and fisheries; Mining; Construction; Transportation, communications, public utilities; wholesale and retail trade; Finance insurance and real estate; Business and repair services; Personal services; Entertainment and recreation services; Professional and related services; Public Administration.

Table 2

Effect of Tenure on the Elasticity of Current Wage to the Local Unemployment Rate: Basic Regression Model

Dependent variable: Log (w_{ijt})

		Tenure	Log Current Unemployment Rate	Tenure * Log Current Unemployment Rate (x100)	Log Unemployment Rate at Start of Job	Tenure * Log Unemployment Rate at Start of Job (x100)	N	Individual Fixed Effects
		(1)	(2)	(3)	(4)	(5)		
1	NLSY		-0.0539				40,836	Yes
			(0.0066)					
2	NLSY	0.0943	-0.0487	0.4576			40,836	Yes
		(0.0070)	(0.0089)	(0.2080)				
3	NLSY				-0.0534		40,394	Yes
					(0.0076)			
4	NLSY	0.0149			-0.0485	0.7810	40,394	Yes
		(0.0043)			(0.0081)	(0.1888)		
5	NLSY		-0.0559		-0.0096		40,394	Yes
			(0.0063)		(0.0091)			
6	NLSY	0.0313	-0.0441	0.2982	-0.0103	0.1299	40,394	Yes
		(0.0019)	(0.0074)	(0.1223)	(0.0099)	(0.2272)		
7	PSID		-0.0719				18,181	Yes
			(0.0211)					
8	PSID	0.0059	-0.0662	0.3518			18,181	Yes
		(0.0055)	(0.0247)	(0.2698)				
9	PSID				-0.0842		12,358	Yes
					(0.0223)			
10	PSID	0.0250			-0.0812	0.4020	12,358	Yes
		(0.0032)			(0.0225)	(0.1768)		
11	PSID		-0.0817		-0.0101		12,358	Yes
			(0.0232)		(0.0226)			
12	PSID	0.0197	-0.0771	0.2056	-0.0097	0.3380	12,358	Yes
		(0.0068)	(0.0233)	(0.1005)	(0.0257)	(0.1074)		

1. Data in lines 1 to 6 is composed of a panel of workers from the NLSY over the period 1979-1996. Data in lines 7 to 12 is composed of a panel of workers from the PSID over the period 1976-1993. In columns 2 and 3 the business cycle is measured by the log current unemployment rate and in columns 4 and 5 it is measured by the log unemployment rate at the start of the job.
2. Variables are defined in the Appendix. Dependent variable is log deflated hourly wage.
3. Covariates included in each regression are 4 region dummies, year dummies and 11 industry dummies. Additional covariates included in each regression are experience, experience squared, tenure squared, education (years of schooling), marital status dummy, union dummy, white dummy and government job dummy.
4. The tenure variable was demeaned so that the coefficient on the unemployment rate measures the marginal impact evaluated at the mean value of tenure.
5. Standard errors are in parentheses. They are corrected to allow for group effects within state-year cells. N is the sample size.

Table 3

Effect of Tenure on the Elasticity of Current Wage to the Different Measures of the Business Cycle: Robustness Checks Regressions

Dependent variable: Log (w_{ijt})

	NLSY		
	(1)	(2)	(3)
Log Current Unemployment Rate	-0.1584		-0.2527
	(0.0482)		(0.0472)
Log Unemployment Rate at Start of Job		-0.1029	0.0104
		(0.0529)	(0.0556)
Log Current UR * Tenure (X100)	0.2615		0.0141
	(0.1112)		(0.0022)
Log U. Rate at Start of Job * Tenure		0.0076	0.0011
		(0.0019)	(0.0023)
Log Current UR * School	-0.0017		0.0055
	(0.0028)		(0.0027)
Log Current UR * Age	0.0057		0.0120
	(0.0019)		(0.0018)
Log U. Rate at Start of Job * School		0.0033	0.0055
		(0.0029)	(0.0035)
Log U. Rate at Start of Job * Age		-0.0069	-0.0083
		(0.0021)	(0.0025)
Individual Fixed Effects	Yes	Yes	Yes
N	40,836	40,394	40,394

1. Data is composed of a panel of workers from the NLSY over the period 1979-1996.
2. Variables are defined in the Appendix. Dependent variable is log deflated hourly wage.
3. Covariates included in each regression are 4 region dummies, year dummies and 11 industry dummies. Additional covariates included in each regression are experience, experience squared, tenure squared, marital status dummy, union dummy, white dummy and government job dummy.
4. The tenure variable was demeaned so that the coefficient on the unemployment rate measures the marginal impact evaluated at the mean value of tenure.
5. Standard errors are in parentheses. They are corrected to allow for group effects within state-year cells. N is the sample size.

Table 4

Effect of Tenure on the Elasticity of Current Wage to the Different Measures of the Business Cycle: Robustness Checks Regressions

Dependent variable: Log (w_{ijt})

	Model						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Current GSP Real Growth Rate	0.3149		0.1633		0.2916	0.2694	0.3133
	(0.0794)		(0.0808)		(0.1390)	(0.1451)	(0.1453)
GSP Real Growth Rate Start of Job		0.2575		0.1700	0.0521	0.0212	0.1622
		(0.1179)		(0.1232)	(0.1148)	(0.0688)	(0.1314)
Current GSP * Tenure			-0.0308			-0.1043	-0.2178
			(0.0106)			(0.0460)	(0.0689)
GSP at Start of Job * Tenure				-0.1537		-0.1109	-0.1095
				(0.0629)		(0.0556)	(0.0556)
Current GSP * School							-0.1355
							(0.0517)
Current GSP * Age							-0.0458
							(0.0483)
GSP at Start of Job * School							0.0379
							(0.0435)
GSP at Start of Job * Age							-0.0817
							(0.0483)
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	40,836	40,394	40,836	40,394	40,394	40,394	40,394

1. Data is composed of a panel of workers from the NLSY over the period 1979-1996.
2. Variables are defined in the Appendix. Dependent variable is log deflated hourly wage.
3. Covariates included in each regression are 4 region dummies, year dummies and 11 industry dummies. Additional covariates included in each regression are experience, experience squared, tenure squared, marital status dummy, union dummy, white dummy and government job dummy.
4. The tenure variable was demeaned so that the coefficient on the gross state product measures the marginal impact evaluated at the mean value of tenure.
5. Standard errors are in parentheses. They are corrected to allow for group effects within state-year cells. N is the sample size.

Table 5

Non-linearities in Tenure Effects on the Elasticity of Current Wage to the Current Local Unemployment Rate: Bilinear Splines Estimates

Dependent variable: Log (w_{ijt})
(Fixed-effects model estimates)

	NLSY		
	(1)	(2)	(3)
Log Current Unemployment Rate	-0.0342		-0.0448
	(0.0202)		(0.0622)
Log Unemployment Rate Start of Job		-0.0338	-0.0373
		(0.0239)	(0.0648)
Tenure(1)	0.0416	0.0613	0.1163
	(0.0368)	(0.0289)	(0.0305)
Tenure(2)	0.0666	0.0145	0.0185
	(0.0065)	(0.0037)	(0.0048)
Schooling	0.0062	0.0290	0.0292
	(0.0021)	(0.0010)	(0.0010)
Log U. Rate Current * Tenure(1)	0.0365		0.0174
	(0.0188)		(0.0050)
Log U. Rate Current * Tenure(2)	0.0076		0.0831
	(0.0022)		(0.0242)
Log U. Rate Start of Job * Tenure(1)		0.0138	0.0208
		(0.0151)	(0.0520)
Log U. Rate Start of Job * Tenure(2)		0.0102	0.0046
		(0.0019)	(0.0022)
N	40,836	40,603	40,603

1. Data is composed of a panel of workers from the NLSY over the period 1979-1996. The business cycle is measured by the log current unemployment rate.
2. Variables are defined in the Appendix. Dependent variable is log deflated hourly wage.
3. Covariates included in each regression are 4 region dummies, year dummies and 11 industry dummies. Additional covariates included in each regression are experience, experience squared, tenure squared, marital status dummy, union dummy, white dummy and government job dummy.
4. The tenure variable was demeaned so that the coefficient on the unemployment rate measures the marginal impact evaluated at the mean value of tenure.
5. Standard errors are in parentheses. They are corrected to allow for group effects within state-year cells. N is the sample size.

Table 6

F-tests of the Bilinear Spline Model Estimates in Table 6

	NLSY		
	(1)	(2)	(3)
Total Effect	60.56	376.83	414.82
Total unemployment rate effect	16.69	69.40	104.32
Main unemployment rate effect	23.82	25.62	19.03
Total tenure effect	69.86	338.60	350.33
Main tenure effect	54.78	16.45	23.44
Interaction effect	10.52	32.06	24.60
Structural change along tenure = 52 weeks	53.98	19.29	15.23