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EMPLOYMENT EFFICIENCY AND STICKY WAGES: EVIDENCE FROM FLOWS IN THE LABOR MARKET

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Abstract—I consider three views of the labor market. In the first, wages are flexible and employment follows the principle of bilateral efficiency. Workers never lose their jobs because of sticky wages. In the second, wages are sticky and inefficient layoffs do occur. In the third, wages are also sticky, but employment governance is efficient. I show that the behavior of flows in the labor market strongly favors the third view. In the modern U.S. economy, recessions do not begin with a burst of layoffs. Unemployment rises because jobs are hard to find, not because an unusual number of people are thrown into unemployment.

I. Introduction

A standard view of recessions is that an adverse shock results in widespread layoffs of workers from established employment relationships. In this view, workers lose their jobs because wages are sticky and employers no longer find the relationships profitable after the shock. High unemployment lasts until the bulge of unemployed workers can find new jobs.

I propose that the evidence supports quite a different view. An adverse shock has little effect on established employment relationships, especially in the modern market where collective bargaining affects few workers outside government. Jobs end when it is in the mutual interest of worker and employer to part company. A shock raises unemployment by lowering the profitability of hiring new workers. Unemployment rises not because of a bulge of layoffs but because workers entering job search—from previous jobs, from school, and from home activities—experience unusual difficulty in finding jobs.

As a preliminary matter, I observe that it is well known that job-finding rates are far too high to match the persistence of unemployment following a recession (Hall, 1995; Cole and Rogerson, 1999). The exit rate from unemployment is in the range of 30% to 60% per month. If a recession started with a bulge of job loss and lasted as long as it took for those workers to find new jobs or leave the labor force, unemployment would return to normal at 30% to 60% per month. Instead, the reversion rate is approximately 1% per month. The market reaches its stochastic equilibrium so quickly, in fact, that the movements of unemployment can be understood in a model that neglects turnover dynamics and considers only the stochastic steady states of the model.

The key fact supporting the central thesis of this paper is that, in the modern economy, there is no bulge of job loss at the onset of a recession, or, for that matter, at any time in the business cycle. The Bureau of Labor Statistics's new Job Openings and Labor Turnover survey measures separation rates from the employer side and demonstrates this fact conclusively. Separation rates declined during the recession that began at the beginning of 2001. Although data from earlier recessions are not available on the same footing, flows of workers into unemployment are also remarkably stable, especially in the past two recessions.

The movements of unemployment arise almost entirely from changes in the job-finding rate. The data do not speak as loudly on this point. In the new employer turnover survey, the flow of workers into jobs is shown definitively to decline slightly during a recession. With a declining flow and higher unemployment, there is a presumption that job-finding rates are lower in slack markets. But two factors complicate the measurement of those rates. First, some workers who lose or leave jobs move to new jobs without becoming unemployed at all. The likelihood of job-to-job transitions without unemployment is higher in strong labor markets with low unemployment, though the data on these transitions are weak. Second, people may search actively while they are still holding jobs or while they are in school or out of the labor force for other reasons. Despite these obstacles, it seems clear that recessions are times of large declines in job-finding rates.

Research has been active in developing models of the labor market that come to grips with these facts about the cyclical behavior of flows. One important contribution is the Diamond-Mortensen-Pissarides (DMP) matching model (Diamond, 1982; Mortensen, 1982; Pissarides, 1985). In that model, decisions about the formation and continuation of jobs are privately efficient—they maximize the combined value of the worker and the employer. This line of thinking rejects the earlier view that workers are laid off in bad times because their rigid wages have become unrealistic. Separations only occur when the worker gains more from leaving the job than the employer loses. These *efficient-matching*

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models predict that the separation rate declines in recessions. The value of the option to search for a new job declines when jobs become hard to find, and thus the efficient outcome is the continuation of jobs that might have ended in normal times.

As Shimer (2005) has pointed out, the DMP model cannot explain the magnitude of the rise in unemployment during a recession. The reason is that the model takes the wage to be instantly flexible. An adverse shock to profitability results in an immediately lower wage. Employers continue to recruit workers with almost the same enthusiasm, because a lower wage almost completely absorbs the profit shock. Job searchers find it almost as easy to find new jobs, so the unemployment rate rises only just above its normal level.

As I have proposed in a companion paper (Hall, 2005), wage stickiness can have an important role in an efficient matching model. The search friction creates a range of wages, the bargaining set, from the reservation wage of the worker at the low end to the entire product of the worker at the upper end. As long as the wage is in this bargaining set, the match will be formed and continued efficiently. But the wage does matter for the recruiting effort of employers. If the wage is toward the lower end of the bargaining set, employers will gain more from the relationship and will put more resources into trying to form employment relationships. Shimer (2004) discusses this mechanism at a more general level; it does not require the specific ideas put forth in my other paper.

In the efficient-matching sticky-wage view, a recession is a time when the flow of job separations declines somewhat—because the flow is determined efficiently—but when the wage is unusually high in the bargaining set. A recession could be triggered by a spontaneous rise in the wage or by an adverse technology or cost shock that lowered profitability. Firms shift toward less aggressive recruiting, and the job-finding rate falls accordingly. Unemployment rises, because the small decline in the flow of separations is more than offset by lower job-finding rates among the unemployed and by lower likelihoods of job-job transitions without unemployment.

II. The Irrelevance of Turnover Dynamics

Let u be the unemployment rate, f be the exit rate (the fraction of unemployed workers in one month who are not unemployed in the next month), and s the entry rate (the number of newly unemployed as a fraction of employment). With the labor force normalized at 1, the law of motion for the unemployment rate is

$$u_t = (1 - f_{t-1})u_{t-1} + s_{t-1}(1 - u_{t-1}). \tag{1}$$

To measure the exit and entry rates, I use data on unemployment by duration. The Bureau of Labor Statistics reports the number of unemployed searchers who began unemployment in the four weeks preceding the survey and also the number who began 5 to 14 weeks before the survey and remain unemployed. If the exit rate is a constant over duration (probably a reasonable approximation for short durations) and the weekly inflow to unemployment is a constant (a very good approximation, as I will show), the ratio of unemployment in the two duration categories is

$$\frac{1 + \cdots + (1 - f)^4}{(1 - f)^5 + \cdots + (1 - f)^{14}}. \tag{2}$$

I solve for the exit rate by equating this expression to the observed ratio of unemployment in the two categories. The entry rate is the unemployment rate in the 0 to 4-week category divided by $1 + \cdots + (1 - f)^4$. I will discuss the resulting time series for the exit and entry rates shortly.

If the exit and entry rates are constant, then equation (1) describes a two-state Markov process with stationary unemployment,

$$u = \frac{s}{s + f}. \tag{3}$$

If turnover dynamics were an important part of the story of the movements of unemployment, then the stationary level of unemployment would lead the movements of actual unemployment. For example, during a period of higher flows into unemployment from job losses at the beginning of a recession, unemployment builds up to its new higher level, then recedes to its normal level after the inflow returns to normal. But the lead is tiny, because the exit rate is 30% to 60% per month. Figure 1 demonstrates the irrelevance of turnover dynamics. It compares the actual movements of unemployment with the movements of the stationary level, evaluated at the current estimates of the entry and exit rates.

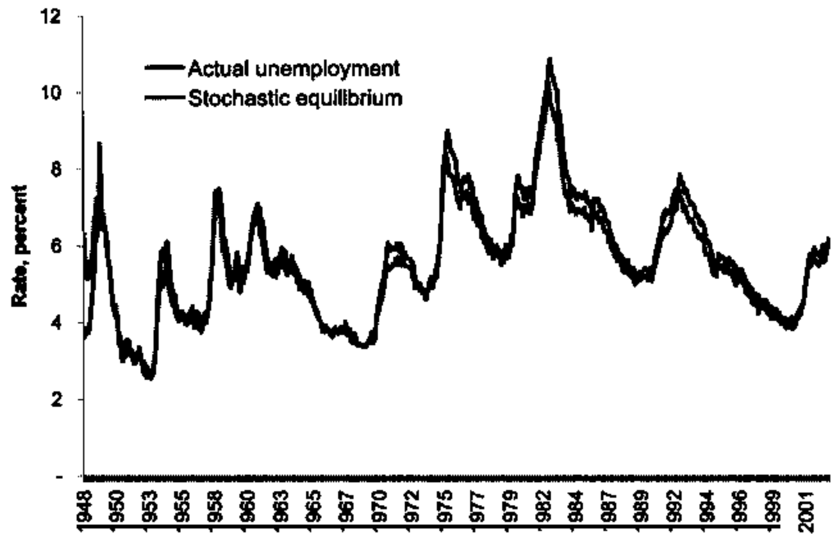
Hall (1995) and Cole and Rogerson (1999) noted earlier that unemployment movements have almost nothing to do with turnover dynamics. For my purposes in this paper, I achieve a considerable simplification by considering only the stochastic stationary state and ignoring turnover dynamics. Almost nothing is lost from this simplification.

III. Model

Here I develop a model that embodies the mechanisms that concern the paper. The model has three variants. The *flexible-wage efficient-separations* variant is essentially the DMP model. The *sticky-wage efficient-separations* variant follows my companion paper, Hall (2005), in making the wage unresponsive to current conditions, but retaining the private efficiency of the employment relationship as in the DMP model. The *sticky-wage inefficient-separations* variant follows the traditional literature on wage stickiness starting with Keynes, where privately inefficient layoffs occur when the wage is too high.

The model describes the stationary equilibrium of the labor market. It is stationary in two senses. First, the

FIGURE 1.—IRRELEVANCE OF TURNOVER DYNAMICS



environment is stationary—the driving forces are not changing over time. Present values of future flows are formed on the assumption that the flows will always have their current values. Second, in line with the evidence in the previous section, the model considers only the stochastic equilibrium of the matching process and not its dynamics.

I assume that a worker with tenure on a job of t periods contributes profit

$$ze^{-\delta t}. \tag{4}$$

Here z incorporates the product price, productivity, and the cost of nonlabor inputs; it is the driving force of fluctuations. I assume that the rate of decline of profit, δ, is positive. In a simple model with homogeneous workers, the profit generated by a worker must eventually decline enough to explain turnover—if profit remained constant with tenure or rose, jobs would last forever. My assumption is needed to generate a positive flow of separations in the stationary state. In a market with heterogeneous workers, some—those who were outgrowing their jobs—would face declining productivity in their current jobs relative to their potential productivity in other jobs. These are the workers who would separate. Other workers would enjoy constant or rising productivity. Their comparative advantage in their current jobs would remain positive or grow and they would not separate. Dealing with this kind of heterogeneity would vastly complicate the model.

Workers may change jobs without becoming unemployed. I assume that an employed worker faces a hazard f_E of encountering another employer. Because the worker's contribution will be higher for the new employer, trilateral efficiency calls for the worker to move to the new employer.

A. *Values Associated with Employment and Unemployment*

The value that a worker associates with a job, apart from the wages the job pays, is the present value of the likelihood of moving directly to a new job and receiving E plus the present value of moving to unemployment, with resulting value U, after the job ends L periods from its inception, in the event that no job-job transition occurs. The probability distribution of the duration of the job is a density $f_E \exp(-f_E j)$ for duration $j < L$ together with mass $\exp(-f_E L)$ at $j = L$. The worker receives value E from a job-job transition before duration L, and U from a job-unemployment transition at duration L. The present value is

$$\begin{aligned} V &= \int_0^L f_E e^{-(r+f_E)j} E\, dj + e^{-(r+f_E)L} U \\ &= \frac{f_E}{r+f_E}[1 - e^{-(r+f_E)L}]E + e^{-(r+f_E)L} U. \end{aligned} \tag{5}$$

Here r is the discount rate.

Let $\underline{W}$ be the lowest wage value that a searcher will accept. $\underline{W}$ equates the total value of employment to the value of remaining unemployed:

$$\underline{W} + V = U. \tag{6}$$

The value a worker associates with a new job paying wages with a present value of W is

$$E = V + W = U + W - \underline{W}. \tag{7}$$

An employer achieves a value $\overline{W}$ from the relationship with a newly hired worker. $\overline{W}$ is the present discounted value of the earnings stream $z \exp(-\delta j)$ received with probability $\exp(-f_E j)$:

$$\overline{W} = \frac{z}{r + \delta + f_E}[1 - e^{-(r+\delta+f_E)L}]. \tag{8}$$

Thus the net value to the employer after paying wages with a present value of W is

$$J = \overline{W} - W. \tag{9}$$

The bargaining set for the wage value W, once a worker and employer have met, is $[\underline{W}, \overline{W}]$. Any wage value in the bargaining set will result in efficient formation of job matches.

An unemployed worker achieves a present value U from the flow value of leisure and unemployment compensation, λ, and from the prospect of finding a job with a value E. The hazard of finding a job while unemployed is f_S, so the probability density of the time to find a job, τ, is $f_S \exp(-f_S\tau)$, and the probability of receiving unemployment compensation is $\exp(-f_S\tau)$. Thus

$$U = \frac{f_S E + \lambda}{r + f_S}. \tag{10}$$

I next consider the optimal duration of a job, L. The joint value from a job is the present value of the output produced plus the benefit from moving directly to another job with value E or becoming unemployed with value U:

$$z\int_0^L e^{-(r+f_E+\delta)j}dj + f_E E\int_0^L e^{-(r+f_E)j}dj + e^{-(r+f_E)L}U. \tag{11}$$

The first-order condition for maximizing this value with respect to job duration L is

$$ze^{-(r+f_E+\delta)L} + f_E E e^{-(r+f_E)L} - (r + f_E)e^{-(r+f_E)L}U, \tag{12}$$

or

$$ze^{-\delta L} + f_E E = (r + f_E)U. \tag{13}$$

This equation describes the job duration L where the pair should separate if the worker has still not come in contact with a new employer. The equation governs separations in the flexible-wage efficient-separations and sticky-wage efficient-separations variants of the model

For the sticky-wage inefficient-separations variant, I consider an alternative, privately inefficient rule for ending jobs: There is a predetermined flow wage w, and the job ends when a worker's current contribution to profit falls to the level of the wage:

$$w = ze^{-\delta L}. \tag{14}$$

This rule embodies the governance principle often assumed for the employment relationship: Employers make unilateral choices about continuing employment, considering only their own profit, with the wage taken as given.

Employers control the resources that govern the rates of job finding for employed workers and for the unemployed. The incentive to deploy the resources is the employer's net value from a match, J. I posit two functions, ϕ_S and ϕ_E, mapping this incentive to the matching hazards in the model:

$$f_E = \phi_E(J), \tag{15}$$

$$f_S = \phi_S(J). \tag{16}$$

These functions describe the outcome in terms of matching hazards for workers when employers engage in recruiting activities up to the point where the marginal benefit, indexed by J, equals the marginal cost of the activities (controlled by variables that are implicit in the functions). These activities could include posting vacancies (Mortensen, 1982; Pissarides, 1985), or evaluating candidates. Vacancies are not an explicit element of the model, but the setup is exactly compatible with the standard Mortensen-Pissarides setup with vacancies and a matching function that depends on unemployment and vacancies. When J is higher, firms post more vacancies, get in touch with more workers, unemployed and employed, advertise for more workers, and so on. All of these make it easier for the unemployed to find new jobs and more likely that an employed worker will move to a new and more productive job.

Notice that the functions ϕ_S and ϕ_E describe more than employers' unilateral responses to the incentive to find new workers. Search involves externalities. The functions describe the job-finding hazards facing workers when employers make decisions about recruiting effort reflecting the external effects from the efforts of other employers.

In the sticky-wage variants of the model, I take the per-period flow wage, w, to be a state variable. I do not deal here with the law of motion of the wage—Hall (2005) gives an example of persistent but not total wage rigidity.

The present value of the wage paid on a job is

$$W = \frac{w}{r + f_E}[1 - e^{-(r+f_E)L}] + \tilde{W}. \tag{17}$$

I require that this present value be in the bargaining set, $[\underline{W}, \overline{W}]$. Here $\tilde{W}$ is a predetermined amount paid at the beginning of employment. I will discuss its role further in the section on calibration.

In the flexible-wage variant, I adopt the symmetric Nash wage bargain of DMP. For unemployed workers, the resulting equation for the present value of the wage is

$$W = \frac{1}{2}(\underline{W} + \overline{W}). \tag{18}$$

The wage is set so that its present value, W, is the average of the worker's reservation value $\underline{W}$ and the employer's reservation value $\overline{W}$. Although it is possible to implement this present value in terms of a contingent flow wage, the flow wage plays no role in the model.

Wage determination for on-the-job search in the flexible-wage variant of the model is a more complicated issue, because it involves three parties: the earlier employer, the new employer, and the worker. Burdett and Mortensen (1998), Postel-Vinay and Robin (2002), and Shimer (2003) deal with the trilateral issue explicitly. To keep this exposition simple, I will make the assumption that the conventions of the labor market require that a worker who has come in contact with a prospective new employer while still working for an earlier employer quit her existing job before negotiating wages with the new employer. The outcome of the resulting bilateral bargain is in the bargaining set for the trilateral bargain, so the assumption is no more than an equilibrium selection rule. The assumption implies that a job found by on-the-job search has the same present value of wages, W, as one found during a spell of unemployment.

B. *Equilibrium*

A stationary equilibrium of the model is a pre-wage worker job value E, a post-wage worker job value V, an unemployment value U, a worker reservation wage $\underline{W}$, an employer job value J, an employer reservation wage $\overline{W}$, a job-duration limit L, a job-finding rate for employed workers, f_E, and a job-finding rate for unemployed workers, f_S. For all three variants of the model, these values must satisfy equations (5) through (10), (15), and (16).

For the flexible-wage efficient-separations variant of the model, the present value of actual wages and the two reservation wages must satisfy equation (18), and the values must satisfy the efficient-separation condition of equation (13). For the sticky-wage variants, the present value of the flow wage, w, is held fixed, and the present value of the wage satisfies equation (17). In the sticky-wage efficient-separations variant, the values satisfy the efficient-separation condition of equation (13). In the sticky-wage inefficient-separations variant, the values satisfy the unilateral profit-maximization condition of equation (14).

All variants have 10 variables and 10 equations.

C. *Calibration*

I calibrate the flexible-wage efficient-separations variant of the model because I believe that the sticky wage converges slowly to something like the Nash wage bargain—wages are sticky but not permanently rigid.

In the calibration, I take the profitability z to be 1, so all values are measured in units of the monthly profit obtained from the work of one newly hired worker. I take the monthly interest rate to be $r = 0.05/12$. I take the rate of decline of a worker's profitability to be $\delta = 0.008$, a value that gives a reasonable value of λ (so in effect I am calibrating to λ). For the overall separation rate, s, I use the value from the turnover survey for 2000, 3.5%. I obtain the on-the-job search hazard f_E by subtracting an estimate of the employment-unemployment hazard from the total separation rate. The estimate comes from Blanchard and Diamond's (1990) study of turnover data in the Current Population Survey. They find a monthly hazard of 2.9% for transitions out of employment, either to unemployment or out of the labor force. Thus I use $f_E = 0.006$. A similar calibration (Moscarini, 2003) reports a total separation hazard of 3.5% and a job-job transition rate of 1.2%.

Fallick and Fleischman's (2001) direct tabulation of transitions in the Current Population Survey gives rather higher overall hazards. These authors, in table 2 of their paper, report a total separation hazard of 6.7%, approximately double the rate in the employer-based turnover survey. They find a job-job transition hazard of 2.7%. I believe that the CPS tends to overstate turnover, despite major improvements in the survey method, though the large discrepancy remains a topic for further research.

To measure the job-finding rate for searchers, f_S, I follow Blanchard and Diamond's suggestion to combine people who are unemployed and those who are not in the labor force but want a job. The job-finding hazards are 25% per month for the unemployed and 34% for those who want jobs. The combined hazard is $f_S = 0.29$. Notice that combining the two groups implies an unemployment rate, 9.1%, that is rather higher than the standard unemployment rate.

Based on these values, I calculate the job-duration limit L from the principle that the separation rate is the reciprocal of the average duration of a job:

$$\frac{1}{s} = \frac{1 - e^{-f_E L}}{f_E}, \tag{19}$$

which implies

$$L = -\frac{\log\left(1 - \frac{f_E}{s}\right)}{f_E}. \tag{20}$$

The resulting value is $L = 31.3$ months.

I assume that the job-finding hazard functions are linear and proportional, with slopes ϕ_S and ϕ_E.

I solve the linear system comprising equations (5) through (10), (13), (15), (16), and (19) for the values of λ, ϕ_E, ϕ_S, E, V, U, $\underline{W}$, J, $\overline{W}$, *and* W. The value of the leisure-unemployment compensation parameter λ is 0.35, or 35% of a newly hired worker's profitability. The slopes of the recruiting functions are $\phi_S = 0.197$ and $\phi_E = 0.0040$. The employer's job value J is 1.50 months of the profit earned from a newly hired worker.

I adapt the calibration to the sticky-wage variants of the model in the following ways: For the efficient-separations case, I set $\tilde{W} = 0$ and calculate the fixed value of the flow wage w to satisfy equation (17) at the value of W from the flexible-wage calibration. As a result, the sticky-wage efficient-separations variant has the same stationary point as the flexible-wage variant, given the calibrated inputs. For the inefficient-separations case, I set the fixed value of the flow wage w to satisfy the unilateral profit-maximization condition for L in equation (14). This wage is lower than the wage for the efficient-separations variant, so I set $\tilde{W}$ to a positive value that makes up the difference in equation (17).

As a result, the inefficient-separations variant has the same stationary point as the other two variants.

D. *Comparative Statics*

Figure 2 illustrates the determination of the stationary equilibrium in terms of the supply and demand for recruiting effort, measured on the horizontal axis as the job-finding rate for searchers, f_S. The vertical axis is the value J that the employer derives from the relationship at the time it is formed. The supply curve in all three variants is equation (16):

$$f_S = \phi_S(J). \tag{21}$$

A higher job value J causes employers to increase their recruiting efforts. They move to a new point where the marginal private value of effort equals the marginal private return. The supply curve is a straight line from the origin under my assumption about the functional form for ϕ_E. In the background, the job-finding rate f_E for employed workers changes along the supply curve as well.

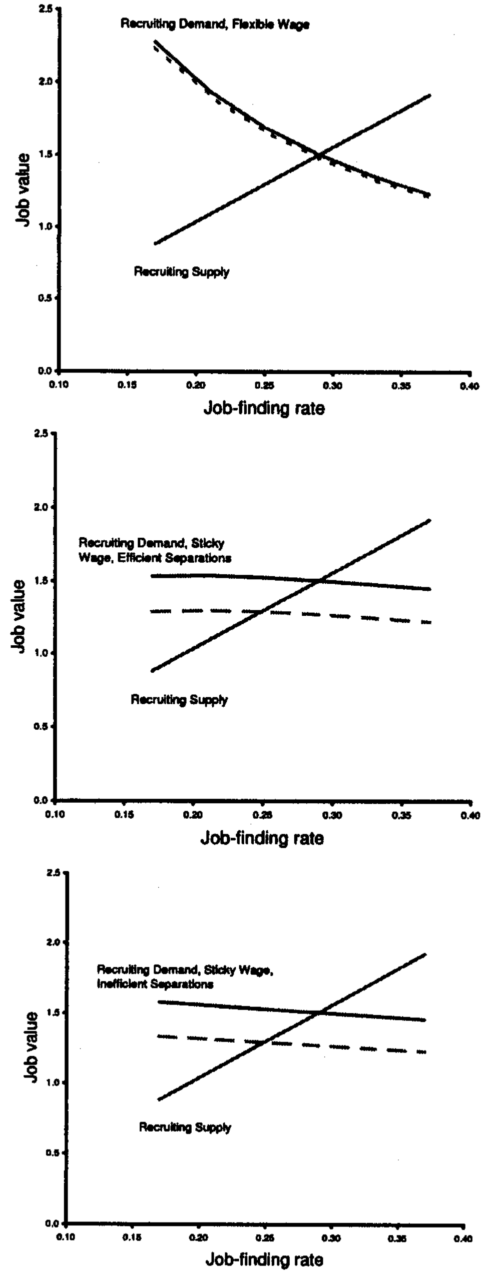
The demand curve encapsulates the rest of the model. In the flexible-wage case, in the top panel of the figure, the demand curve slopes steeply downward. A tighter market (on the right side of the figure, with a higher job-finding rate) with less matching friction results in a lower level of match capital. The employer receives half the value of the match capital, so the incentive to recruit is smaller in a tighter market.

In the sticky-wage efficient-separations variant, shown in the middle panel, the demand curve is flat because a tighter labor market with a higher job-finding rate is more efficient. The job-job transition rate f_E is higher in the tighter market, and the tenure level L where workers automatically depart is lower. On both accounts workers stay on their jobs for shorter periods and thus have higher average productivity. The present value of their wages rises by almost the same amount. The net benefit to the employer varies only slightly along the demand curve, so it is flat.

The demand curve for the sticky-wage inefficient-separations variant, shown in the bottom panel, is quite similar to the one for the sticky-wage efficient-separations variant. Here, the cutoff tenure level L remains the same at all points on the demand curve, according to equation (14), but the resulting difference from the efficient-separations case is small.

Figure 2 also shows shifts in the demand curves caused by a 1% reduction in the profitability z. The resulting downward shift is substantial for the sticky-wage demand curves. Employers bear the full brunt of the decline when the wage is fixed, so the incentive to recruit falls substantially. A small decline in profitability—from a drop in productivity, a drop in the product price, or a rise in other costs—results in a large decline in the job-finding rate and rise in unemployment. By contrast, with a flexible wage, the shift in the demand curve is tiny. The decline in profitability

FIGURE 2.—SUPPLY AND DEMAND, WITH SHIFTS FROM A 1% DECLINE IN PRODUCTIVITY (DASHED LINES)



causes a corresponding decline in the wage and little effect on the incentive to hire. Job-finding and unemployment rates are hardly different.

Table 1 describes the responses of the three versions of the model to a 1% decline in the profitability z. The table shows the derivatives of the equilibrium with respect to z, evaluated at the calibrated point. For all variables except the unemployment rate, the derivatives are normalized as elasticities.

The negative shock has a large negative effect on the two job-finding rates, f_E and f_S, in the sticky-wage models, for the reasons just explained. It also has a smaller but nontrivial negative effect on job-finding rates in the flexible-

TABLE 1.—RESPONSES OF THE THREE MODELS TO A 1% DECLINE IN PROFITABILITY

			Model		
Variable	Concept	Measured as	Sticky Wage, Efficient Separations	Flexible Wage, Efficient Separations	Sticky Wage, Inefficient Separations
f_E	Separation and job-finding rate for employed workers	Elasticity	−15.1	−0.9	−14.2
f_S	Job-finding rate while unemployed	Elasticity	−15.1	−0.9	−14.2
L	Job duration	Elasticity	−0.4	0.0	−4.0
s	Total separation rate	Elasticity	−1.0	−0.1	2.3
u	Extended unemployment rate	Derivative	1.4	0.1	1.7
J	Value of job match to employer	Elasticity	−15.1	−0.9	−14.2
U	Worker's value when unemployed	Elasticity	−0.9	−1.0	−0.9
E	Worker's value at start of employment	Elasticity	−0.8	−1.0	−0.8

wage model. The effects of the shock on the job duration limit L are small in the efficient-separations models—slightly negative with sticky wages and essentially zero with flexible wages—but strongly negative in the inefficient-separation model. With a fixed wage but diminished profitability, workers lose their jobs. This effect is the essence of the traditional view of employment fluctuations. The total separation rate s is the sum of the employment-unemployment hazard

$$s_u = f_E \frac{e^{-f_E L}}{1 - e^{-f_E L}} \tag{22}$$

and the job-job hazard f_E (note that if the job-job hazard is 0, then $s = 1/L$). The table shows important differences in the response of the total separation rate to the adverse shock. In the sticky-wage efficient-separations model, the job-job hazard f_E falls dramatically and the job-duration limit L falls a little, so separations into unemployment fall in proportion to the decline in profitability—the elasticity is -1. In the flexible-wage model, the job-job hazard rate also falls, but not nearly as much. Job duration remains essentially the same, so the total separation rate falls, but only a little. In the inefficient-separations model, the job-job hazard falls almost as much as in the sticky-wage efficient-separations model of the first column, but the large decline in job duration swamps that effect and causes total separations to decline by 2.3 times the decline in profitability. Thus rising separations in recessions is the signature of the inefficient-separations model that distinguishes it from the efficient-separations cases.

Both sticky-wage models generate substantial increases in unemployment, as the next row in the table shows. As Shimer (2005) has stressed, flexible-wage models in the DMP tradition cannot explain the magnitude of unemployment variations. This principle carries over to the model developed here—the addition of on-the-job search does not erode Shimer's conclusion.

The last three rows in the table show the responses of the values achieved by employers and workers. The net value of the match to the employer, J, is highly sensitive to the adverse shock in the sticky-wage models. This key feature of the model explains the decline in job-finding rates that occurs during a recession. The elasticity of -0.9 in the flexible-wage model is not nearly big enough to generate realistic recessions from shocks of likely magnitude—it takes an elasticity greater than 10 in magnitude.

On the other hand, all models generate elasticities of approximately 1 for the response of the worker's values, U and E, to changes in profitability. Labor is the sole factor of production in the model and is supplied inelastically, so these values capitalize almost all of the profit available from production. This property does not mean that unemployed workers face unchanging incentives to find jobs. That incentive is controlled by $E - U$, which moves in mirror image to J. If wage stickiness results in a diminished share of the surplus to employers, it also results in an increased share of the surplus to newly hired workers. The essence of the sticky-wage explanation of fluctuations in the labor market is the asymmetric response to incentives. When the wage is relatively high in the bargaining set, searchers face increased incentives to find jobs, but they have no opportunity to increase their job-finding rates by spending resources to make up for the diminished incentives facing recruiting employers.

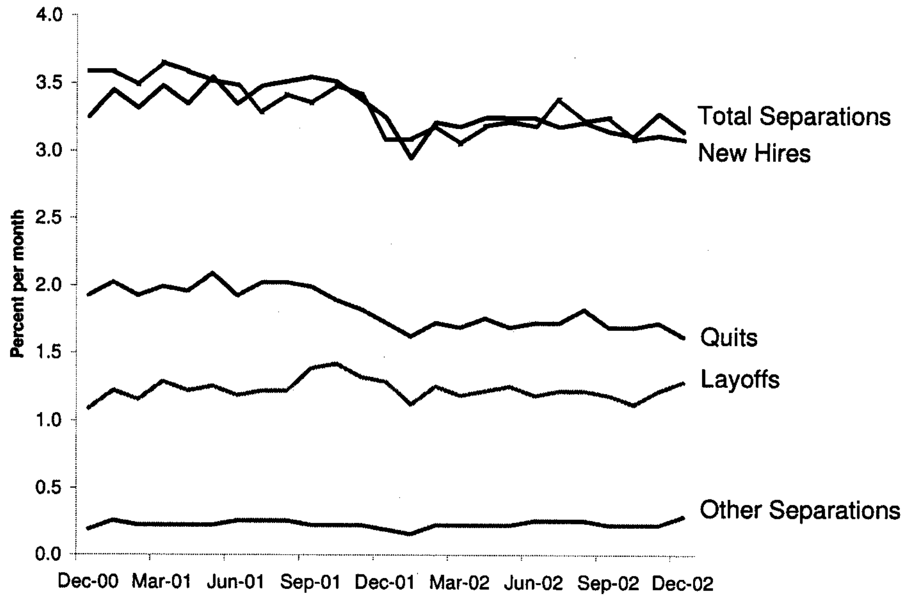
Early in the paper I suggested that one can understand the changes that occur in a recession in the labor market without considering turnover dynamics. One aspect of turnover dynamics does bear mentioning, however. In the inefficient-separations model, the decline in job duration that occurs when profitability falls means that the workers with tenure between the old and new values of L lose their jobs when the shock hits. The data reveal this phenomenon as a spike in layoffs. No such spike would occur with efficient separations. So one of the ways to gauge the importance of inefficient separations is to examine the behavior of layoffs at the beginnings of recessions.

IV. Evidence

A. *Separations and Layoffs*

Since December 2000, the Bureau of Labor Statistics has collected data on separations and hires for a large sample of

FIGURE 3.—SEPARATION RATE AND COMPONENTS



employers. Fortuitously, the early months of the new survey caught the labor market just before the peak of employment, so the period of the survey to date describes the differences between a strong market and a weak market. The extended unemployment rate rose from 6.9% in December 2000 to 9.1% in August 2003.

To date, the BLS has not developed seasonal adjustment factors for all of the series in the new survey. I have calculated rough seasonal adjustments with monthly dummies. Figure 3 shows the turnover rates recorded in the survey. Most remarkable is the behavior of the separation rate. Except for a bulge following September 11, 2001, layoffs remained almost exactly constant from the peak of the market in December 2000 through the end of 2002, a period of continuing declines in employment and rising unemployment. The recession did not begin with a burst of job loss. Quits did decline later in the contraction, in accord with standard beliefs about what happens in the labor market during recessions, so total separations fell modestly.

Figure 3 suggests that the sticky-wage inefficient-separations model does not describe the modern U.S. labor market at all. Despite a large increase in unemployment, separations fell. There was no burst of layoffs at any time.

The turnover survey gives an unambiguous picture of the behavior of separations in a recession, in the economy of 2000 and later. Its only defect is lack of history. Another economy-wide source of data on flows in the labor market is the Current Population Survey. The CPS does not measure departures from jobs directly. It reveals related information by comparisons of the status of the same people in two adjacent months. Job-to-job transitions are almost impossible to measure because they can be detected only if one job is coded into a different industry from the previous job. The CPS does measure transition rates from employment to unemployment and to activities out of the labor market. See Blanchard and Diamond (1990) for further discussion and citations of the earlier literature.

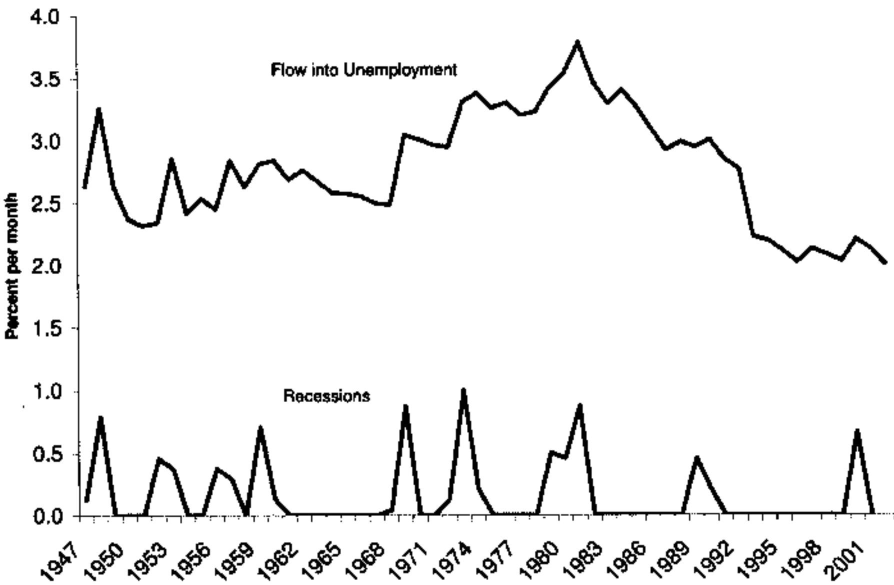
Figure 4 shows the results of the calculation described in section II of separations in the sense of entry to unemployment as measured in the Current Population Survey. NBER recessions are shown at the bottom. The flow has large low-frequency movements, rising to a peak in 1982 and then falling to its historical low in the last year reported, 2003. There is no sign of important increases in inflows to unemployment in the two most recent recessions, in 1990–1991 and 2001. Earlier recessions, especially 1948–1949 and 1981–1982, did show bursts of entry to unemployment.

Figure 5 confirms the suspicion that the lack of a burst of job loss in recessions is a recent development. For years starting in 1977, it breaks down new unemployment by source. Job loss from both temporary layoff and other sources—permanent loss of jobs and the ending of temporary jobs—rose dramatically in the 1981–1982 recession and rose a small amount in 1990–1991 and 2001.

The behavior of inflows to unemployment does not contradict the turnover survey for 2001 and later. Some workers who lose jobs do not become unemployed but move to new jobs directly. The job-job transition rate is a close cousin of the job-finding rate for searchers. As I will show in a moment, that rate falls precipitately in a recession. The modest increase in inflows of job losers to unemployment in 2001 is probably entirely the result of a higher likelihood of unemployment among job losers and not higher separations from jobs.

Another source of information about flows in the labor market is the tabulation of plant-level employment changes pioneered by Davis and Haltiwanger (1992). These authors measure what they call *job destruction* as the sum of

FIGURE 4.—FLOWS INTO UNEMPLOYMENT



employment declines across plants. They find that job destruction spikes during recessions. But job destruction does not measure separations—rather, it measures separations less new hires in plants where the difference is positive. Job destruction does not distinguish employment reductions that occur because of failure to replace normal attrition from employment reductions that occur because of actual separations. In any period of declining employment, job destruction necessarily rises unless a surprising and unlikely change occurs in the shape of the distribution of employment changes across employers. In a model governed by the principle of efficient separations, and with heterogeneity across plants, job destruction would rise in response to a shock that caused a decline in employment, even though separations remained constant. Consequently, there is no contradiction between the finding of no spike in separations in recession with Davis and Haltiwanger's finding of a spike in job destruction.

I have investigated whether changes in the nature of recessions might explain the lack of a burst of layoffs in the recession of 2001. I tabulated the change in payroll employment by 11 major industry groups from the peak to the trough months of the recessions in the NBER chronology starting with 1948–1949. I calculated the average change for all 10 recessions. The result is the cross-industry signature of the typical recession. For example, construction employment

FIGURE 5.—COMPONENTS OF FLOWS INTO UNEMPLOYMENT

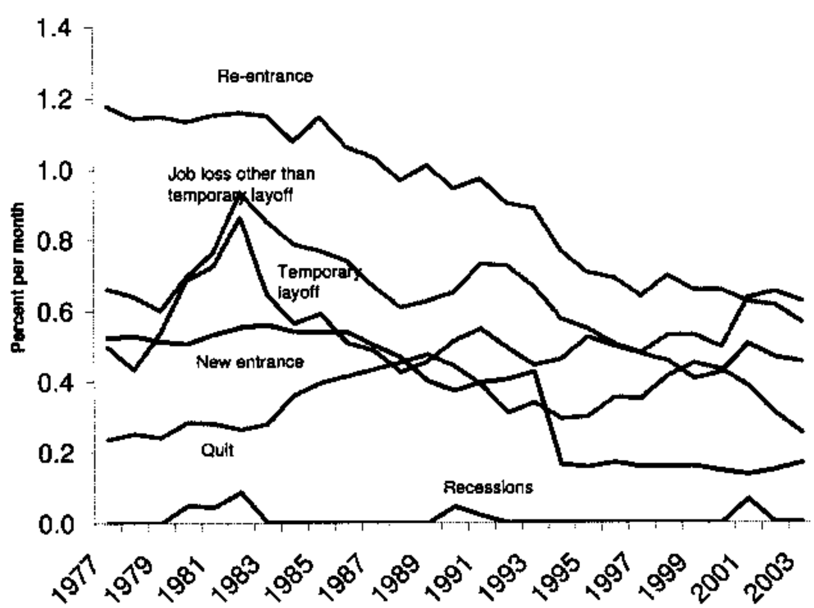


TABLE 2.—CROSS-INDUSTRY CORRELATIONS OF PEAK-TO-TROUGH EMPLOYMENT CHANGES IN 10 RECESSIONS

Recession Years	Correlation with Average
1948–49	0.92
1953–54	0.88
1957–58	0.96
1960–61	0.95
1969–70	0.96
1973–75	0.87
1980	0.95
1981–82	0.97
1990–91	0.74
2001	0.86

falls by 5.5%, durables manufacturing by 11.4%, and nondurables by 4.2%. Other employment changes are smaller, and a number of service industries and the government grow, in the typical recession. Then I calculated the cross-industry correlation of the employment changes for each recession with the industry pattern for the average of all recessions. The results appear in table 2.

All of the correlations are high. The pattern of employment change by industry is similar across all 10 recessions. The least typical recession was 1990–1991. Manufacturing employment fell by much less than usual in that recession. The recession of 2001 was more typical—the only important departure from the usual pattern was that construction employment fell by only 1.2% in 2001. I conclude that the industry pattern of employment changes is not an important difference in the recession tracked in JOLTS relative to earlier recessions.

In summary, the evidence on separations suggests that inefficient separations are not an important phenomenon in the modern U.S. economy. In particular, the decline in total separations that occurred in the recession that began in early 2001 accords closely with the efficient-separations model and gives no support to the inefficient-separations model. But earlier contractions probably did see bursts of job loss of the type predicted only by the inefficient-separations model. Because the most suitable data for measuring separations became available only in 2000, it is hard to reach a strong conclusion about separations in earlier recessions.

B. *Job-Finding Rates*

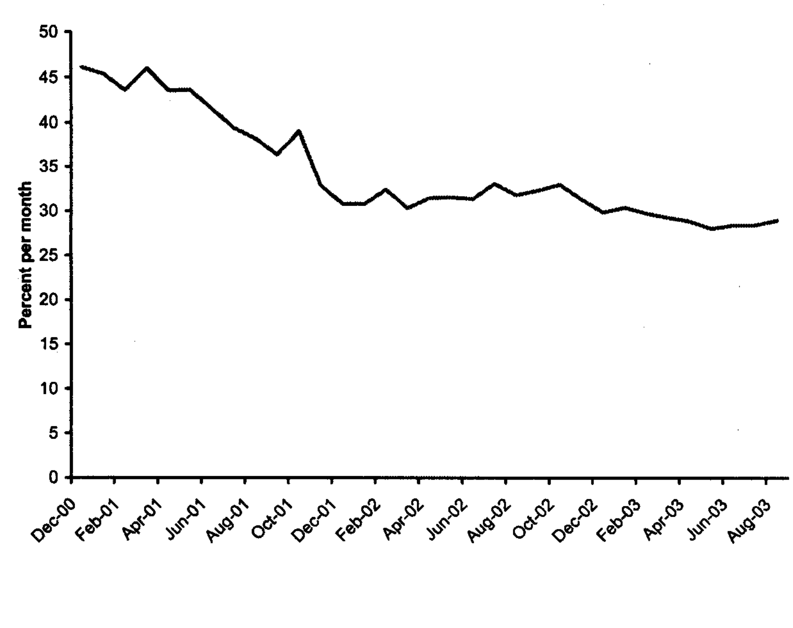
Time-series data on job-finding rates are lacking. The turnover survey does not distinguish between new hires from unemployment and new hires directly from earlier jobs. This distinction would not be practical in an employer-based survey. The Current Population Survey does not generally track job changes.

The data I discussed in the calibration section suggest that most new hires are from the unemployed (in the extended sense of this paper). Of the total outflow of workers from jobs of 3.5% per month, 2.9 percentage points are flows into unemployment (Blanchard and Diamond, 1990). In stochastic equilibrium, the same ratio must govern the inflows—a fraction 2.9/3.5 of hires are from the unemployed. Consequently, the ratio of hires to unemployment is indicative of job-finding rates. Figure 6 shows the ratio for the period covered by the turnover survey.

The job-finding rate declined from 45% per month to 30% over the period. There can be no question that the labor market softened substantially as the recession developed. It seems altogether likely that both the job-finding rate for searchers, f_S, and the rate for the employed, f_E, fell during the period. Further, the magnitude of the decline appears inconsistent with the elasticity of the job-finding rate with respect to the profitability driving force given in table 1 for the flexible-wage model. The elasticity is 0.8, so the driving variable z would need to have fallen by 42% to account for the slackening of the labor market.

A decline of 42% in profitability is easy to imagine in a particular industry—say computers in the case of the 2001 recession. But the slackening of the labor market was

FIGURE 6.—JOB-FINDING RATE MEASURED AS THE RATIO OF NEW HIRES TO EXTENDED UNEMPLOYMENT



economy-wide. The forces that can depress economy-wide profitability are circumscribed. One is productivity. It is easy to rule out the possibility that the recession was caused by a 42% decline in productivity. The other is an adverse shift in the terms of trade. The shift was adverse in the recession, but nowhere near large enough to depress z by 42%. Finally, an increase in the wage above its Nash-bargain level has essentially the same effect as a decline in z. So a third possibility is a large spontaneous increase in the wage.

The decline in z needed to explain the decline in the job-finding rate in the sticky-wage efficient-separations model is a more reasonable 3%. A recession of the observed magnitude could be caused by some combination of productivity declines, shifts in the terms of trade, and overshooting of wages that summed to 3%.

I conclude that the flexible-wage model cannot account for the substantial decline in the job-finding rate observed in the 2001 recession. It is a topic for further research to determine if the sticky-wage model is consistent with the events of the recession, but sticky wages seem the most promising avenue among those considered here.

V. Concluding Remarks

The data on flows in the U.S. labor market are informative about the employment relationship and about changes in the relationship over time. I have considered two key features of the relationship. One is the efficiency of the mechanism used to determine when matches are made and when they are continued or terminated. I showed that the behavior of the separation rate during recessions distinguishes efficient from inefficient separations—among the models I consider, a jump in separations during a recession is an unambiguous indicator of inefficiency. The data show that such jumps occurred in earlier recessions, but not those of the past 20 years, including the one that started in 2001. I conclude that modern employment relationships are generally terminated in the joint interest of the worker and the employer. I infer, without any direct evidence, that the same principle applies to the formation of matches as well.

The second key feature is the movement of the wage within the zone consistent with efficiency. The conclusion that separations only occur efficiently rules out wages that are too high to merit retention from the employer's point of view, or too low to merit the worker staying on the job, but allows the wage to take on any value in the bargaining set bounded by those two values. In a labor market with frictions, there is a substantial gap between the lowest and the highest efficient wage. From the perspective of the worker and employer, the wage is indeterminate in the bargaining set. An equilibrium selection rule governs the actual choice.

Although the choice of wage in the bilateral employment relationship is indeterminate, the choice has allocational consequences, because employers make economic choices about recruiting effort based on their expectations about the resolution of the indeterminacy. If they expect the wage to be at the low end of the set, they will recruit more actively and the labor market will be stronger, in the sense of higher job-finding rates for job seekers.

This line of thought results in a role for wage stickiness quite different from the traditional one resulting in inefficient separations. Its distinctive effect is on job-finding rates, not separation rates. When wage stickiness is a factor in a recession, it is not because workers lose their jobs on account of sticky wages, but because those who lose their jobs at normal rates experience abnormally low job-finding rates.

The data give strong support to the second type of wage stickiness. The recession of 2001 saw a huge decline in the job-finding rate. Among the models I consider, only those with sticky wages can explain the decline—it is far too large to be the result of flexible wages modeled as a Nash bargain.

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