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THE LIMITED INFLUENCE OF UNEMPLOYMENT ON THE WAGE BARGAIN

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ABSTRACT

When a job-seeker and an employer meet, find a prospective surplus, and bargain over the wage, conditions in the outside labor market, including especially unemployment, may be irrelevant. The job-seeker's threat point in the bargain is to delay bargaining, not to terminate bargaining and resume search at other employers. Similarly, the employer's threat point is to delay bargaining, not to terminate it. Consequently, the outcome of the bargain depends on the relative costs of delay to the parties, not on the results of irrational threats to disclaim any bargain. In a model of the labor market that otherwise adopts all of the features of the standard Mortensen-Pissarides model, unemployment is much more sensitive to changes in productivity than in the standard model, because feedback through the wage is absent. We also present models where the wage bargain is in partial contact with conditions in the labor market.

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1 Introduction

One of the most durable propositions in macroeconomics is that wages respond to unemployment. Although the persistence of depressions and recessions suggests that the response is not immediate and complete, the notion that wages respond to unemployment over time—the essence of the Phillips curve—remains persuasive.

Modern thinking about the issue is much under the influence of the Mortensen and Pissarides (1994) model of the labor market. In that model, the unemployed meet occasionally with suitable employers. At the time a job-seeker and an employer meet, the two parties enjoy a potential surplus from forming a match—the surplus is the excess of what the match would produce over what they would get if the job-seeker returned to search and the job remained unfilled. The job-seeker and employer form the match and agree on a wage that splits the surplus. This is sometimes called a Nash wage bargain, based on the assumption that the Nash threat points in the bargain are for the job-seeker to return to the market and for the employer to wait for another applicant. This paper challenges that assumption.

The Mortensen-Pissarides model links the bargained wage tightly to the job-seeker's value of unemployment. That value, in turn, depends on the wages offered in other jobs, how easy those jobs are to find, and the likely wages in future jobs. If an adverse shock reduces every employer's reservation wage by a fixed amount, the job-seeker's reservation wage falls by almost the same amount and so the bargaining outcome—a weighted average of the two reservation wages—falls by the same amount. Wages are flexible and unemployment fluctuations correspondingly small. This is the point of an influential paper, Shimer (2005).

Our primary point in this paper is that the flexible-wage conclusion hinges on unrealistic assumptions about the bargaining threat points. Once a qualified worker meets an employer, a threat to walk away, permanently terminating the bargain, is not credible. The bargainers have a joint surplus, arising from search friction, that glues them together. We make use of bargaining theory from Binmore, Rubinstein and Wolinsky (1986) to invoke more realistic threats during bargaining. The threats are to extend bargaining rather than to terminate it. The result is to overturn the tight connection with outside conditions that delivers the flexible-wage, low-unemployment-response properties of the Mortensen-Pissarides model. In the most basic version of our model, a job-seeker loses connection with outside conditions the moment she encounters a suitable employer, but before she makes her wage bargain. The bargain is controlled by the job's productivity and by her patience as a bargainer relative to the employer's, but not by the purely hypothetical possibility that she will return to job search.

The model delivers substantial volatility of unemployment through a mechanism similar to the one in Hall (2005b)—unemployment is high in periods when the wage bargain is unfavorable to employers. In times of low productivity, the wage falls only partly in response, the burden of the rest of the decline falls on employers. Because they have less to gain by hiring a worker, employers put fewer resources into recruiting, and the labor market is slacker. This mechanism operates just as Mortensen and Pissarides described.

Wage negotiations between General Motors and the United Auto Workers illustrate the key change we make to the bargaining model. The wage agreement depends on the losses the bargainers suffer during a strike or lock-out. Each side is keenly aware of the costs of delay that fall on themselves and on the other side. The union accumulates strike funds and the company accumulates inventories to lower the costs of holding out for a better deal. The union never seriously considers permanent resignation of the workers as an option and GM does not consider discharging the workers permanently. Except in extreme circumstances, neither threat would be credible, because the workers would do better to accept a reduced wage than to quit, and GM would do better to pay a higher wage than to start over with new workers.

The non-cooperative bargaining model of Binmore et al. (1986) distinguishes between the *outside-option* payoff that the parties get by quitting the negotiation to seek other opportunities and the *disagreement payoff* that the parties receive or pay during the bargaining, during the disagreement period before the agreement is reached. Unless the outside option is especially favorable, it is the disagreement payoff—not the outside option—that determines the bargaining outcome.

In the environment of wage bargaining in the Mortensen-Pissarides class of models, the outside option of disclaiming a match is unattractive, so the BRW theory applies. The beauty of the BRW theory is that, just as in the older theory, each side to the bargain receives a given share of the surplus. What it changes is the measure of the surplus. In the Mortensen-Pissarides setup, the surplus is the difference between the joint value achieved from employment and the sum of the values the parties receive separately if they forgo employment. In the BRW theory, the surplus is the joint value less the separate costs to the two sides of continuing to bargain forever.

In the BRW equilibrium, the parties do not actually spend any time bargaining. They think through the consequences of a sequence of offers and counter-offers and then move immediately to the unique subgame perfect equilibrium of the bargaining game. They do not waste any time getting there.

In a second model, we consider the possibility that two or more job-seekers will locate the same job opening in the same period. When this happens, Bertrand competition among the applicants forces the wage down to the reservation wage as determined by the benefit of continuing to search for other openings. Because the reservation wage does depend on conditions in the market, the second model introduces some wage flexibility. Unemployment is less responsive to productivity in the second model, but more responsive by far than in the standard model.

In a final model, we introduce a probability that bargaining will end without making an employment match, because the job-seeker finds another job. This model also results in a closer connection of the wage to conditions in the labor market and thus lowers the sensitivity of unemployment to driving forces.

2 Model

2.1 The standard model

We begin with a model directly in the tradition of Mortensen and Pissarides (1994). We consider the stationary state of the model. Hall (2005a) discusses why a fully dynamic model of the labor market adds little to a comparison of stationary states.

A job-seeker achieves a value U. Upon finding a job, she receives a wage contract with a present value of W and also enjoys a value V for the rest of her career, starting with the period of job search that follows the job. While searching, a job-seeker receives a flow value λ per period. She has a probability f, the job-finding rate, of finding and starting a new job. The discount rate is r. The stationary condition for U is

$$U = \lambda + e^{-r}\left[f(W+V) + (1-f)U\right]. \tag{1}$$

The separation rate—the per-period probability that a job will end—is an exogenous constant s (see Hall (2005c) for evidence supporting this proposition). The stationary condition for V is

$$V = e^{-r} \left[sU + (1-s)V \right]. \tag{2}$$

The value of the outside option of the job-seeker when bargaining over the wage with a prospective employer is U.

Workers produce output with a present value Z over the course of the job. We will be concerned with the response of unemployment and other endogenous variables to changes in Z, the driving force of fluctuations.

The next step is to describe the mechanism that results in a joint surplus for jobs. The surplus arises from non-contractible pre-match effort by employers—help-wanted advertising and other recruiting cost—reinforced by the search time of job-seekers. It is conventional to describe the mechanism in terms of vacancies, though this concept need be nothing more than a metaphor capturing recruiting effort of many kinds. The key variable is x, the ratio of vacancies to unemployment. A tight labor market has a high x—jobs are easy to find and recruiting is costly. Specifically, the job-finding rate is

$$f = \phi(x) \tag{3}$$

and the recruiting rate is

$$\rho(x) = \frac{\phi(x)}{x}, \tag{4}$$

which is assumed to be decreasing.

The standard view has free entry on the employer side, so that employer pre-match cost equals the employer's expected share of the match surplus in equilibrium. Employers control the resources that govern the rates of job finding. The incentive to deploy the resources is the employer's net value from a match, $Z - W$. Recruiting to fill a vacancy costs k per period. The zero-profit condition is:

$$\rho(x)(Z - W) = k. \tag{5}$$

Employers create vacancies, drive up the vacancy/unemployment ratio x, and drive down the recruiting rate $\rho(x)$ to the point that satisfies the zero-profit condition.

Because of free entry, the employer's outside option while bargaining with a worker has value zero.

In this set-up, the worker and employer have a prospective surplus of $Z+V-U$, the difference between the value created by this job and the worker's subsequent career, $Z+V$, and the worker's non-match value, U. The standard model posits that the employer and worker receive given fractions of that surplus; we will take the fractions to be 1/2 for simplicity. The job-seeker's threat point is the value achieved during the prospective employment period by disclaiming the current job opportunity and continuing to search, that is, the unemployment value. The worker's value, $W + V$, is this threat value plus half the surplus:

$$W + V = U + \frac{1}{2}(Z + V - U), \tag{6}$$

so the worker's wage is:

$$W = \frac{1}{2}(Z + U - V). \tag{7}$$

Authors starting with Mortensen (1982) have rationalized this wage rule as a Nash bargain.

The model has five endogenous variables, the worker's outside option value, U, the value of employment after the prospective job, V, the job-finding rate, f, the vacancy/unemployment ratio, x, and the present value of wage payments, W. It has five equations, (1), (2), (3), (5), and (7).

From the unique solution, we can calculate other variables, including the stationary unemployment rate, u, which is the stationary probability of job-seeking in the two-state Markoff process defined by the model:

$$u = \frac{s}{s + f}. \tag{8}$$

2.2 The wage bargain

In the standard model, the wage is the average of productivity Z and the worker's opportunity cost, $U - V$. The wage is highly responsive to changes in productivity because Z and $U-V$ move together—the worker's opportunity cost $U-V$ depends sensitively on the wages of other jobs. Indeed, in our calibration, the derivative of W with respect to Z is 0.97. Further, if unemployment rises, the wage will fall because the worker's opportunity cost falls. For both of these reasons, a reduction in Z results in correspondingly large changes in W but only tiny changes in unemployment. This flexible-wage property of the standard model is the point of Shimer (2005).

Our bargaining model, adapted from Binmore et al. (1986), leads to quite a different conclusion. Bargaining takes place in real time. The parties alternate in making proposals. At each step, the party receiving a proposal has three options: accept the current proposal, reject it and make a counter-proposal, or abandon the bargaining. If the responding party abandons bargaining, the employer gets zero payoff and the worker gets a lump sum of U. If the responding party makes a counter-proposal, both parties receive the *disagreement payoff* for that period and the game continues. The employer faces a flow cost of γ—no production is occurring but the firm has to pay for the executive time involved in the continuing negotiation. For the worker, we denote the disagreement payoff by θ. Notice that our sign convention is the opposite for workers and employers—workers have a benefit θ from waiting and firms incur a cost γ.

We assume that the parties create more total surplus by making an agreement than by either continuing to bargain forever with no agreement or by refusing to bargain at all. Thus, $V + Z > \max(\theta/r - \gamma/r, U)$.

The time period separating one offer from the next is τ, which we take to be much smaller than one, because offers can be made and rejected relatively quickly. Many rounds of bargaining can occur within each period of search and employment. We ultimately consider the limiting case where the time between offers is infinitesimal. The flow payoffs to the parties from one offer to the next are are $\theta\tau$ and $\gamma\tau$.

The full BRW analysis of the bargaining game is too lengthy to incorporate here. Nevertheless, a clear intuition about the bargaining equilibrium can be developed, provided we accept without proof that the subgame perfect equilibria of the two bargaining games beginning with a proposal by either the employer or the worker are unique, so that the value of rejecting an offer and continuing is always uniquely defined. This implies that, at equilibrium, the worker accepts the employer's offer if it is better than both the uniquely determined continuation payoff and the payoff from exiting bargaining. So, there is a lowest wage offer W that the worker will accept. Symmetrically, there is a highest wage offer W' that the firm will accept.

Our calibration assumptions imply that, in equilibrium, the bargainers never abandon the negotiations. Consequently, it is optimal for each side in the bargaining always to make a just acceptable offer to the other side. So, the employer always offers W and the worker always offers W'. Since the worker is just indifferent about accepting W, it must be that her payoff from accepting, which is $W + V$, is just equal to the larger of her unemployment payoff U or her payoff from rejecting the offer and countering with the acceptable offer of W' at the next round. Thus,

$$W + V = \max(U, \theta\tau + e^{-r\tau}(W' + V)). \tag{9}$$

A similar calculation for the employer establishes that

$$Z - W' = \max(0, -\gamma\tau + e^{-r\tau}(Z - W)). \tag{10}$$

There can be no equilibrium of the full model in which the employer's payoff is the same as its outside option payoff of zero, because then the employer would not exert any recruiting effort. With the calibrated parameters, the worker also gets more than her outside option of U. Solving the equations for that case leads to

$$W = \frac{\theta\tau + e^{-r\tau}\gamma\tau + (1 - e^{-r\tau})Z - (1 - e^{-r\tau})V}{1 - e^{-2r\tau}}. \tag{11}$$

Letting τ approach zero yields the limiting solution that we will use in the rest of the paper:

$$W = W' = \frac{1}{2}\left(\Theta + \Gamma - V + Z\right). \tag{12}$$

Here $\Theta = \theta/r$ and $\Gamma = \gamma/r$, the perpetuity values of the flow payoffs. We can think of this outcome as a Nash bargain where the job-seeker's threat point is to bargain forever with value Θ and the employer's threat point is $-\Gamma$. In the limit with infinitesimal times between offers, the wage does not depend on who makes the first offer. The surplus is the joint value $Z + V$ less the sum of the threat values $\Theta - \Gamma$.

Notice that the gross value of perpetual delay to the job-seeker plus the cost of delay to the employer, $\Theta + \Gamma$, plays the same role as the unemployment value, U, does in the standard model—compare equation (12) to (7).

Equations (7) and (12) are alternative structural equations of the model. In the next two paragraphs, we discuss the roles of the two versions of the structural wage-determination equation. This discussion should not be confused with our later discussions of comparative statics of the entire model, where we consider variations in an exogenous variable, productivity.

In the standard model, conditions in the labor market influence the wage through its positive dependence on the worker's opportunity cost or reservation wage, $U - V$. Superior conditions in the market give the worker a higher wage. By contrast, the only variable measuring conditions in the market in the new bargaining model is $-V$. V affects the wage because prolonging bargaining postpones the receipt of V, which occurs at the time a job actually begins. A stronger outside market with a higher V *lowers* the wage by raising the cost to the worker of prolonging bargaining. The new model goes beyond isolating the wage from conditions in the market—it reverses the influence.

The source of the reversal is the bargainers' awareness that the worker achieves a value $W + V$ but the employer only pays W. In the thought experiment with U fixed, an increase in V would raise the surplus, entitling the worker to half of the increase, that is, $W + V$ must increase by only half the increase in V. The worker's total payoff, $W + V$ is positively related to market conditions, but the wage part of it is negatively related. When we exercise the model in the next section, we remove this influence by considering cyclical shocks that do not last long enough to influence V, which is the value of the worker's career after the current job ends in about three years.

All the other equations of the model are the same as in the standard model. The derivative of the wage with respect to productivity is lower in this model than in the standard model. Fluctuations in the vacancy/unemployment rate and in the unemployment rate are correspondingly larger. The essential difference between the new bargaining model and standard model is the replacement of the unemployment value, U, by the perpetual delay value, $\Theta + \Gamma$. The unemployment value makes the wage in the standard model sensitive to unemployment and thus to exogenous driving forces, while the bargaining model lacks this transmission mechanism.

3 Calibration, Functional Forms, and Properties

3.1 The standard model

As in Hall (2005b), we calibrate to a job-finding rate of 60 percent per month and a separation rate of 3.5 percent per month, which imply an unemployment rate of 5.5 percent. We normalize Z to 1 at the calibration point. We take the discount rate to be $r = 0.05/12$. We take the flow value of unemployment compensation and leisure to be $\lambda = 0.4(r + s)$, 40 percent of flow productivity. We then solve the model for the cost of the employer's pre-match recruiting, k, to fit the job-finding rate. The value is $k = 0.042$, about 5 weeks of wages.

We take the job-finding function to be

$$\phi(x) = \omega x^{0.5}, \tag{13}$$

so the recruiting rate function is

$$\rho(x) = \omega x^{-0.5}. \tag{14}$$

We calibrate the efficiency parameter ω to the observed average job-finding rate and vacancy/unemployment ratio, as described in Hall (2005b).

At the calibrated equilibrium, the wage is $W = 0.965$ and the job-seeker's value while unemployed is $U = 8.53$.

We illustrate the standard and new models in a setting appropriate for a cyclical deviation in productivity—one lasting for a year or two, but not indefinitely. Specifically, we picture job-seekers and employers as expecting that the value of the worker's subsequent career, V, will be at its stationary value by the relevant time, about 3 years after the match is formed. This assumption seems a reasonable characterization of a cyclical disturbance. Accordingly, we drop equation (2) from the model and take V as fixed instead. In this setup, the negative relation between labor-market conditions and the wage is absent, because that relation operates through changes in V.

Figure 1 shows the determination of the equilibrium in the standard model in a diagram with the vacancy/unemployment ratio, x, on the horizontal axis and the wage, W, on the vertical. The downward-sloping curve depicts values that satisfy equation (5), where firms earn zero profits from hiring. The upward-sloping

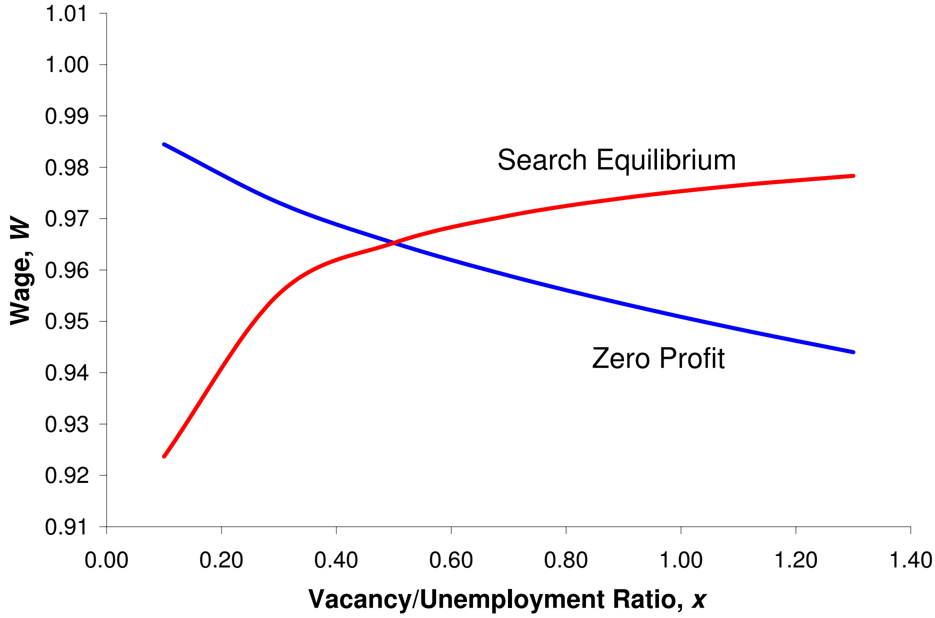

Figure 1. Determination of the Wage in the Standard Model

curve describes the equilibrium of the rest of the model, including the Nash bargain for the wage. The equilibrium is stable in the following sense: When the vacancy/unemployment ratio is below the equilibrium, the wage determined in the model leaves hiring profits for employers. As they expand hiring, they raise the vacancy/unemployment ratio and move the labor market toward equilibrium.

3.2 The new wage bargaining model

We calibrate the new model so that it replicates the equilibrium of the standard model. This calibration requires that $\Theta + \Gamma$ in the new model have the value that U had in the calibration of the standard model. In this case, equation (12) in the new model replicates equation (7) in the standard model. Because the two models share all of the other equations, their equilibria will be the same at the point of the calibration.

Figure 2 shows the equilibrium of the new model in the same framework as Figure 1. Notice that the zero-profit curve is the same as in the standard model. The search-equilibrium curve is quite different—it is perfectly flat. This illustrates

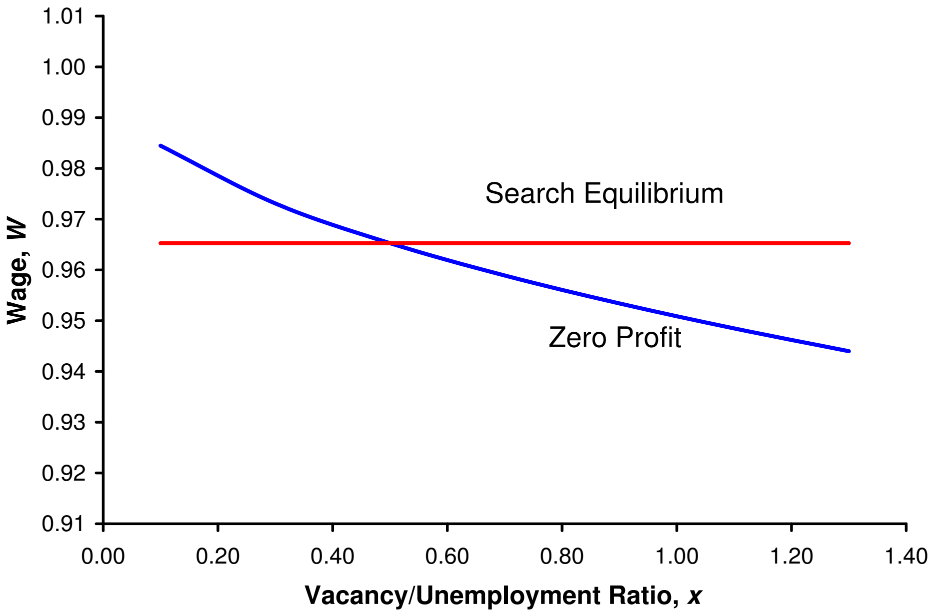

Figure 2. Determination of the Wage in the New Bargaining Model

the point that—once we remove the influence of the outside labor market through the subsequent career value V—there is no connection between current market conditions and the wage in the new bargaining model.

3.3 Responses to changes in productivity

Figure 3 shows the stationary unemployment rates as functions of a productivity shift. For the new bargaining model, we have used the calibration that equates the surplus to the level in the standard model at the calibration point, $Z = 1$. Unemployment is vastly more sensitive to productivity in the new bargaining case.

4 Model in which Competition among Job-Seekers Links the Wage to Labor-Market Conditions

The model so far is extreme in isolating the wage from conditions in the labor market. This section develops a variant that exposes the wage in a limited way to those conditions. Its properties are partway between the standard model and the

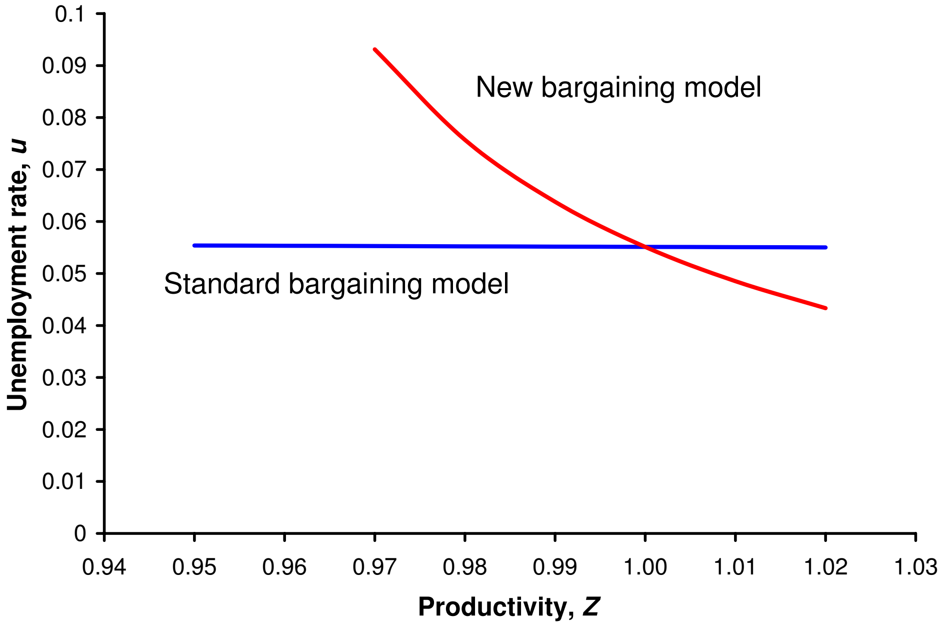

Figure 3. Effects of Productivity Shift in Standard and New Bargaining Models

model with isolated wage bargaining.

In this model, we alter the matching technology slightly. Job-seekers are randomly assigned to sub-markets in groups of N. Vacancies are assigned to sub-markets in groups of xN. Thus the vacancy/unemployment ratio is, as before, x. Within each sub-market, in each period, a job-seeker visits one of the vacancies chosen at random. We use sub-markets of fixed size to retain a property of the standard model, that the matching technology has constant returns.

If a single job-seeker appears for a given vacancy, the worker and employer make a bargain as described earlier. This bargain is isolated from conditions in the labor market for the reasons we discussed earlier. But if two or more job-seekers appear in the same period for the same vacancy, the situation is quite different. The employer is constrained to hire only one of them—we assume that there is a prior job-creation step that permits only the one hire. We assume that the applicants make their offers simultaneously in the bargaining game, and the result is a version of Bertrand equilibrium where one applicant is hired at the reservation wage $U - V$ and the other returns to search. The prospect of this outcome delivers sensitivity of the wage partway between the standard model and our earlier model.

The distribution of the number of applicants for a given vacancy in a given period is binomial with binary probability $1/(xN)$ and number of values N. We let $B_{i,N}(x)$ denote the probability of i applicants. The model now has two job-finding rates and two recruiting rates. The job-seeker may find a bad job with zero surplus or a good job with a positive surplus. The employer may make a bad hire that yields only part of the surplus or a good hire that yields the entire surplus. The distribution of the number of rival applicants for a given applicant at a given vacancy is $B_{i,N-1}$. Thus the four rates are

$$\phi_B(x) = \text{Pr[zero-surplus job]} = \sum_{i>0} \frac{B_{i,N-1}(x)}{i+1} \quad (15)$$

$$\phi_G(x) = \text{Pr[positive-surplus job]} = B_{0,N-1}(x) \quad (16)$$

$$\rho_B(x) = \text{Pr[partial-surplus hire]} = B_{1,N}(x) \quad (17)$$

$$\rho_G(x) = \text{Pr[full-surplus hire]}$$

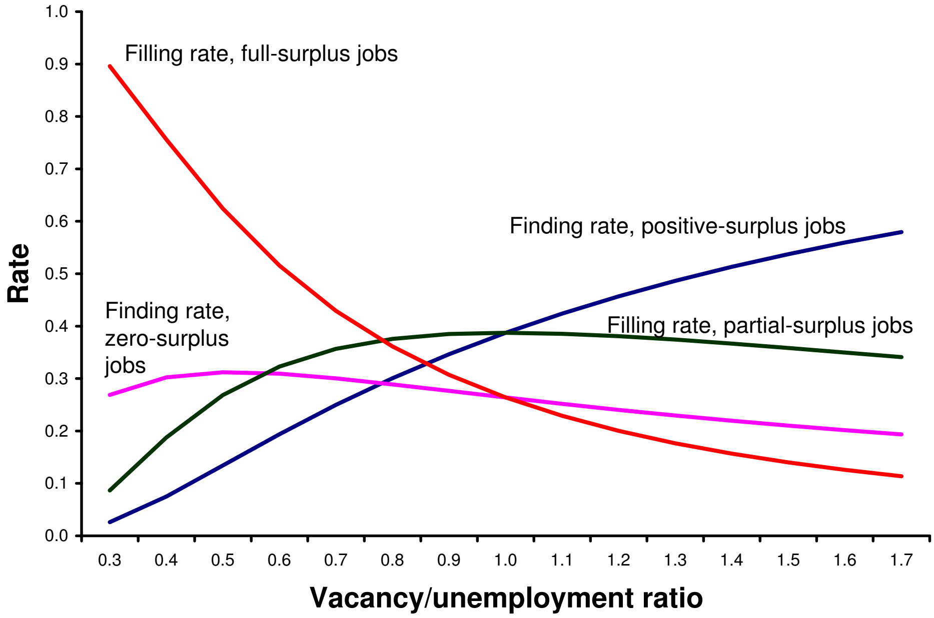

Figure 4. Job-finding and Job-Filling Rates

$$= \quad 1 - B_{0,N}(x) - B_{1,N}(x). \tag{18}$$

Figure 4 shows the four functions for the case $N = 10$.

The stationary condition for U becomes

$$U = \lambda + e^{-r}\left[\phi_G(x)(W + V) + (1 - \phi_G(x))U\right]. \tag{19}$$

The stationary condition for V remains the same—see equation (2). The total job-finding rate is

$$f = \phi_B(x) + \phi_G(x). \tag{20}$$

The zero-profit condition governing job creation becomes:

$$\rho_B(x)(Z - W) + \rho_G(x)(Z - U + V) = k. \tag{21}$$

Here W is the wage emerging from the one-on-one bargain we described earlier.

The calibration of the second model differs slightly from the earlier calibration, because of the difference in the matching technology. At $N = 10$, the job-finding rate f is 0.59 at $x = 0.8$. The model cannot replicate the earlier calibration at

$x = 0.5$, but this is not material. At the calibrated equilibrium, about half of new jobs generate one-on-one bargaining with a shared surplus and the other half several-on-one Bertrand bargaining where the employer receives all of the surplus. Because employers enjoy the full surplus in the second case, the calibrated cost of maintaining a vacancy is higher than in our first model and in the standard model.

At the calibrated equilibrium, job-seekers have a 38-percent per month probability of finding a job with competition from another job-seeker—and therefore earn a lower wage of 0.876—and a 36-percent probability of finding a good job without that competition—and earn a wage of 0.938.

Figure 5 shows the response of unemployment to changes in productivity in the model with a partially isolated wage. The response is smaller than in the earlier model with a fully isolated wage, but stronger than in the standard model.

5 Model with Isolation of the Wage unless a Second Job Opening Becomes Available

Another link from labor-market conditions to the wage arises when one job-seeker may meet more than one employer in the same period. We could develop a model along the lines of the one in the previous section, but assign employers to sub-markets instead of job-seekers to sub-markets. In that case, an employer might suffer from Bertrand competition with another employer and the job-seeker would capture the entire surplus. This situation would occur more frequently in tight markets, so the resulting model would have more wage flexibility than our original bargaining model with isolation of the wage from labor-market conditions.

Another model could combine both features and thereby enjoy an increased resemblance to the labor market of the real world, where job-seekers compete with fellow job-seekers for the same opening and employers compete with other employers for the same prospective worker. With the addition of heterogeneity of job-seekers and jobs, the model would begin to approach realism.

Because the main purpose of this paper is to point out the importance of a view of wage bargaining based on credible threats, we do not pursue the more complex and realistic setup. In this section, we consider just one additional element. An important feature of the earlier models is that the parties believe that the only event that will end bargaining is agreement. In our final model, there is a hazard δ that the job-seeker will find a job with another employer with payoff $W + V$.

In this setup, the equations governing the equilibrium are

$$W + V = \theta\tau + e^{-r\tau}\left[\left(1 - e^{-\delta\tau}\right)(W + V) + e^{-\delta\tau}\left(W' + V\right)\right] \tag{22}$$

and

$$Z - W' = -\gamma\tau + e^{-(r+\delta)\tau}\left(Z - W\right). \tag{23}$$

Solving and taking the limit as before, we find

$$W = \frac{1}{2}\left[\frac{\theta + \gamma}{r + \delta} + \frac{\delta}{r + \delta}(W + V) + Z - V\right] \tag{24}$$

or

$$W = \frac{\theta + \gamma + (r + \delta)Z - rV}{2r + \delta}. \tag{25}$$

The wage is now connected more directly to productivity Z. Again, the amplification of the effects of productivity shocks on unemployment is smaller than in the original version of the new bargaining model. This model achieves a higher response of the wage to productivity directly, without the mediating role of unemployment as in the standard model and in our first model of partial isolation.

Figure 5 shows the response of unemployment to productivity in this model, with the hazard δ take to be 0.8 percent per month. The response is weaker than in the model with full isolation, but substantially stronger than in the standard model. By choosing δ to be a higher value—say several percent per month—the wage moves closely with productivity and the behavior of the model resembles that of the standard model.

Table 1 gives the responses of unemployment and the wage to changes in productivity for each of the four models. In the standard model, the wage moves almost point-for-point with productivity. Productivity enters the wage directly with coefficient 1/2 and indirectly through the unemployment value, U, with a further effect of 0.496. Unemployment hardly responds at all. In the model with the fully isolated wage, the coefficient is just 1/2 and the unemployment response is strong—almost 0.9 percentage points of unemployment per percent change in productivity. In the third model, with the possibility of multiple job applicants, we measure the wage as the weighted average of the two possible wages. The wage

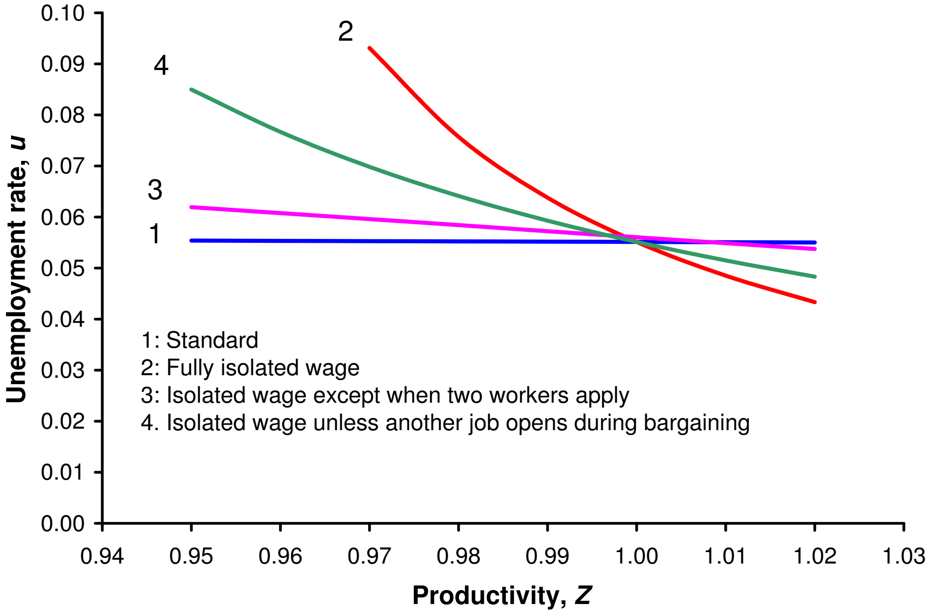

Figure 5. Responses of unemployment in the four models

responds to productivity with a coefficient of almost 0.8 and the response of unemployment is quite a bit weaker, at about 0.1 percentage points per percent of productivity change. The weak response of unemployment comes from two sources. First is the relatively strong response of the wage. The other is that when the employer receives the full surplus, the leverage of a change in x, operating through $\rho_G(x)$, is high—see equation (21). The fourth model puts the response of the wage to productivity, dW/dZ, almost exactly halfway between its value for the standard model and for the second model with the fully isolated wage. Correspondingly, the response of unemployment is also midway between the two earlier models.

6 Conditions where the Standard Bargaining Model is a Reasonable Approximation

Our last model make it clear that the standard model might be a reasonable approximation for some purposes—such as measuring the response of unemployment to productivity—if the parameters are chosen to bring the employment bargain back

Model	*du/dZ*	*dW/dZ*
Standard	-0.005	0.996
Fully isolated wage	-0.868	0.500
Isolated wage except when two workers apply	-0.118	0.797
Isolated wage unless another job opens during bargaining	-0.417	0.742

Table 1. Response of Unemployment and the Wage in the Four Models

into tight contact with conditions in the labor market. The exposure to the market depends on the hazard that a bargaining job-seeker will find another job during bargaining. Even modest levels of that hazard, such as one percent per month, deliver high wage sensitivity and low unemployment response.

We note, however, that the model with a higher second-job hazard may appear to replicate the standard model in the sense of linking the bargained wage to conditions in the labor market, but it *does not* restore the earlier idea that threats to disclaim a potentially beneficial bargain are the threat points of the wage-bargaining process.

7 Concluding Remarks

We have pointed out a paradox in the theory of the labor market—in the bargaining problem of a job-seeker and and employer, if both parties are limited to credible threats, conditions in the outside market are irrelevant to the wage bargain. In particular, the unemployment rate does not influence the wage. As in many other macro models, the stickiness of the wage implies high sensitivity of unemployment to driving forces, such as productivity.

We do not believe that wages are completely isolated from unemployment and other aspects of the outside labor market. Our last two models demonstrate plausible links that restores some connection between wages and unemployment, but they still imply higher sensitivity of unemployment to driving forces, because the wage response is limited.

Future models of the wage-bargaining process, in our view, should respect the principle that the threats in bargaining need to be credible. Progress will be made by creating realistic models of the interplay among job-seekers and employers. In actual labor markets, job-seekers think simultaneously about a variety of possible jobs and employers consider multiple applicants for a given job. Ultimately, the final bargain is often bilateral, where the employer bargains with the best-matched applicant. A model far richer than any in this paper will be needed to understand the operation of the market more fully.

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