The Amplification of Unemployment Fluctuations through Self-Selection *

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Abstract

Unemployment arises from frictions in the matching of job-seekers and employers. The level of resources that employers devote to evaluating applicants for jobs is a key factor in the magnitude of the frictions. Unemployment will be low if employers can review applicants cheaply. The cost of evaluation per hire depends on the fraction of applicants who are qualified for the job. Applicants may be better informed about their qualifications than are employers. If incentives induce self-selection by job-seekers, so that they apply mainly for jobs where they are qualified, friction and thus unemployment will be low. Self-selection is strongest in markets where unemployment is low and jobs are easy to find. Because of this positive feedback, the equilibrium in a market with self-selection is fragile—unemployment is sensitive to its determinants. Self-selection provides a mechanism for amplification of small changes in the determinants of unemployment.

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1 Introduction

Persistent high unemployment following a recession is a central puzzle of macroeconomics. When unemployment is high, jobs are hard to find, so the opportunity cost to the job-seeker for taking a given job is low. The marginal product of labor appears to be only slightly diminished in a slack labor market—recessions are not the result of a collapse of productivity. The joint surplus enjoyed by an employer and worker hired into a newly created job is unusually high. The surplus–the difference between the marginal product and the opportunity cost—is also unusually high. Were both parties to respond to the enlarged surplus by redoubling their efforts to locate each other, unemployment would melt away quickly. Some important friction prevents them from accomplishing this.

Since J.M. Keynes focused the attention of economists on the puzzle, wage stickiness has been the most important culprit. The simple idea that the wage remains too high in a recession to permit the employment of the normal fraction of the labor force retains a firm grip on macroeconomics. But coherent fundamental explanations of sticky wages have eluded macroeconomics.

The past 20 years have seen the development of a widely accepted theory of non-wage frictions in the labor market. Mortensen and Pissarides (1994) is a major milestone in the development of the model. The friction arises from probabilistic matching of job-seekers and employers in a setting where the resources deployed by employers control the matching rate. The model portrays an equilibrium where employers expand matching effort up to the point that it exhausts the profit they expect from an additional hire. After a disturbance, the model reaches a new equilibrium rapidly because employers expand recruiting effort if unemployment is unusually high. Flexible wages play a key role in the model—higher employment reduces wages by lowering the opportunity cost of job seekers. The equilibrating force in the model is so strong that it cannot come close to matching the observed volatility of unemployment from booms to recessions, a point made recently by Shimer (2005).

This paper explores a different source of friction that limits or even eliminates employers' incentives to increase recruiting activity when unemployment is high. The model contains a countervailing force sufficiently powerful to offset the basic drive to create jobs when job-seekers' opportunity costs are low. In normal times, job-seekers self-select when applying for jobs. They visit only the employers where they will be most productive. But when unemployment is high, job-seekers are less selective, because it pays to take less remunerative jobs when their opportunity costs are lower thanks to low probabilities of finding other jobs soon. Employers find themselves besieged by less qualified applicants.

In December 2002, the *Wall Street Journal* reported:

> With 8.5 million Americans looking for work, it should be relatively easy for employers to find the right person for a job. Not so at 7-Eleven Inc. The Dallas convenience-store chain needs to fill field-management positions and has piles of resumes. But locating applicants with the right skills has proven as tough, if not tougher, than during the boom times, the company says. Why? People looking for work are being less selective, applying for positions for which they aren't necessarily well-suited. That makes the task of sifting through applicants more difficult. "In good times people use the rifle approach for their job search. When people are skittish, they tend to use the shotgun," says Joe Eulberg, 7-Eleven's vice president of human resources. With the national unemployment rate at 6%, many companies are finding themselves flooded with candidates who don't fit into job openings. "Our officers are getting inundated," says Dan Kaplan, director of recruiting for Washington, D.C., mortgage giant Fannie Mae, which is looking to fill routine slots. "At times, you're looking at volumes of resumes. It muddies up your thinking. You may settle [for a less-than-ideal candidate] because it's easy to."

The model of this paper captures the phenomenon described in this article.

Recent research applying the matching model to aggregate fluctuations in unemployment has taken productivity as the underlying exogenous driving force. The model in this paper takes a different point of view. As in the standard Mortensen-Pissarides model, changes in productivity have only small effects on unemployment—see Shimer (2005). The amount of self-selection in the market is actually invariant to productivity in my model. Self-selection is sensitive to other factors, notably changes in how well informed job-seekers are about their qualifications for the jobs that employers are trying to fill.

This paper can be seen as a rehabilitation of the reallocation theory of unemployment fluctuations, Lilien (1982). In its original form, that theory ascribed periods of high unemployment to shocks that caused shrinkage of some sectors and expansion of others. Abraham and Katz (1986) challenged that view by observing that vacancies should rise along with unemployment during periods of reallocation. Vacancies and other measures of recruiting effort, such as help-wanted advertising, actually fall substantially in recessions. In the new version of the reallocation theory based on the idea in this paper, the shocks and resulting movements of workers alter the level of knowledge about the likelihood of being qualified. I show that unemployment is higher—potentially much higher—when job-seekers are less informed. Though this paper does not spell out the mechanism, it seems reasonable that an alteration in the industry composition of labor demand, such as the collapse of IT employment in 2001, would reduce knowledge in this way.

It goes almost without saying that the core of the model in this paper comes from Akerlof (1970). Purchasers (here, employers) are ignorant of information known to sellers (here, job-seekers) but make an inference in which the seller's desire to trade is an important piece of information. The subsequent literature on adverse selection in the labor market is much too extensive to summarize adequately here. The model developed here has some points of resemblance to Montgomery (1999). The labor market in that paper can have self-sustaining cycles as the hiring policies of employers respond to the mix of good and bad workers among the pool of job-seekers.

2 Model

Parts of the model come directly from Mortensen and Pissarides (1994). I examine the stationary state of the model, which is both the stochastic equilibrium of the processes of matching and job loss and the stationary economic equilibrium of the labor market. People in the model are either working or seeking jobs. They do not consider the possibility of leaving the labor force. In addition, they do not make any decision about how much to work once they are employed. The focus of the paper, as in the earlier papers in this tradition, is on the margin between work and search.

2.1 Technology and preferences

Time is continuous. Workers and employers are risk-neutral. An employed worker generates a flow benefit to the employer of p. This benefit could be the price of the output produced by the worker if labor is the only factor of production, or it could be the marginal product of the worker in a more complicated technology. The separation rate—the flow probability that a job will end—is an exogenous constant s. See Hall (2005) for evidence supporting this proposition. Job-seekers enjoy a flow benefit z from non-work activities and unemployment compensation that they sacrifice upon taking a job.

2.2 Search

A fraction u of workers are unemployed and searching for new jobs. Employers post vacancies as part of the process of recruiting new workers. The ratio of vacancies to the labor force is the vacancy rate, v. The ratio of vacancies to unemployment, $\theta = v/u$, measures the tightness of the labor market. A constant-returns matching technology generates meetings between job-seekers and employers. A job-seeker meets a potential employer at the opportunity-finding rate $\phi(\theta)$. The rate at which employers encounter potential applicants for a given vacancy is $q(\theta) = \phi(\theta)/\theta$.

Upon finding an employment opportunity, the job-seeker receives a private signal that is informative about her likelihood of qualification for the job. She decides whether to apply. If she applies, the employer evaluates her qualification and negotiates to hire her if she is qualified. The negotiation is always successful and the worker is hired, remaining on the job until the it ends randomly.

2.3 Hidden information

Upon meeting a potential employer, a job-seeker receives a private signal, x, that is informative about whether or not the job-seeker is qualified for that employer's job. I normalize the signal so that it is the probability that she is qualified. Let Q denote the event "applicant is qualified" and N the event "applicant is not qualified." The signal x has the counter-cdf $G_Q(X) = \text{Prob}[x \geq X]$ for qualified applicants and $G_N(X)$ for unqualified ones. I let α denote the marginal or unconditional probability of being qualified. I assume for simplicity that the support of x has the form $[\underline{x}, \overline{x}]$. The marginal distribution of x is a mixture of two distributions, with mixing parameter α and marginal counter-cdf,

$$G(X) = \alpha G_Q(X) + (1-\alpha) G_N(X). \tag{1}$$

The marginal density of the signal is $g(x) = -G'(x)$.

A joint distribution $\{\alpha, G_Q(x), G_N(x)\}$ describes a normalized signal if the densities, $g_Q(x) = -G'_Q(x)$ and $g_N(x) = -G'_N(x)$ satisfy

$$x = \text{Prob}[Q|x] = \frac{\alpha g_Q(x)}{\alpha g_Q(x) + (1-\alpha) g_N(x)} \tag{2}$$

for all values of x in its support.

The job-seeker will choose a cutoff value of x, x^*, and apply for a job when x meets the cutoff. $G(x^*)$ is the likelihood that a match has a signal that meets the job-seeker's cutoff. I define

$$k(x^*) = \text{Prob}[Q|x \geq x^*] = \frac{\alpha G_Q(x^*)}{\alpha G_Q(x^*) + (1-\alpha) G_N(x^*)}, \tag{3}$$

the likelihood that an applicant is qualified.

2.4 Vacancy, application, and evaluation costs

As in Mortensen-Pissarides, employers incur a flow cost c_V while a vacancy is open.

The job-seeker applies for each job that meets the cutoff level of qualification likelihood, x^*. Application imposes a cost c_A on the job-seeker. Employers evaluate applicants at a cost c_E to determine for sure whether or not the applicant is qualified. Later I will show that the employer always chooses to evaluate applicants.

I assume that an employer cannot shift the cost of evaluation to job-seekers—the employer cannot charge an applicant a fee up front. In other words, the cost c_E refers to an action by the employer hidden from the job-seeker. The model is consistent with additional costs, such as those of credentials issued by a trusted third party, but these costs are not part of c_E.

I also assume that employers cannot hire a worker provisionally and then determine from the worker's performance whether the worker is qualified.

2.5 Wage bargain

All qualified job-seekers bargain with their prospective employers over the wage and are then hired. Qualified job-seekers are homogeneous and all matches enjoy a positive joint surplus, V. Following Mortensen-Pissarides, I assume that the resulting wage bargain divides the surplus in given proportions, with a fraction β to the worker and the remainder to the employer.

3 Equilibrium Value of the Cutoff, x^*

For the moment, I will take the vacancy cost, c_V, to be zero. The model's equilibrium is simple and instructive in this case, although it has rather stark implications.

The essential feature of the model is that job-seekers make a *marginal* decision and employers respond to the *average* consequences of that decision. Job-seekers set their cutoff signal to the point where they are indifferent between the expected benefit from applying or going on to the next opportunity. They enjoy an extra rent arising from the value in excess of the application cost that all opportunities with signals above the cutoff will deliver. As in Mortensen-Pissarides, employers create opportunities up to the point that their average subsequent value just equals the evaluation cost. Employers earn no rent.

The job-seeker sets the cutoff value, x^*, at the level that maximizes the expected flow benefit of searching:

$$\phi \int_{x^*}^{\infty} (x\beta V - c_A) g(x) dx. \tag{4}$$

The expected benefit is the qualification likelihood x multiplied by the job-seeker's share of the resulting surplus, βV. The job-seeker incurs the cost c_A for every opportunity where $x \geq x^*$. The first-order necessary condition for the maximum is

$$-(x^* \beta V - c_A) g(x^*) = 0. \tag{5}$$

Thus the optimal search rule is for the job-seeker to apply for an opening whenever her share of the expected surplus pays for the cost of applying:

$$c_A = x^* \beta V. \tag{6}$$

The representative employer is in zero-profit equilibrium when its share of the expected surplus equals the cost of evaluating an applicant:

$$c_E = k(x^*)(1 - \beta) V. \tag{7}$$

Notice the important difference between the job-seeker's and employer's conditions. The job-seeker makes a choice about the cutoff value of the signal, x^*, and uses a marginal condition to make the choice. The job-seeker benefits from signals that are higher than x^*. The employer is governed by the market-wide zero-profit condition and does not make a choice relating to the signal. One of the determinants of profit is the average quality of applicants, $k(x^*)$, governed by the choice of cutoff by job-seekers.

Dividing the employer's zero-profit condition by the job-seeker's condition gives a simple equilibrium condition for the cutoff point, x^*:

$$\frac{k(x^*)}{x^*}\frac{1-\beta}{\beta} = \frac{c_E}{c_A}. \tag{8}$$

The left side of this equation depends on the parameters of the distribution of information available to job-seekers. I let n denote a parameter that controls the amount of noise—higher values of n imply less-informed job-seekers. I rewrite the equilibrium condition as

$$x^* = \lambda(n, \pi). \tag{9}$$

Here $\pi = \frac{\beta}{1-\beta}\frac{c_E}{c_A}$. The case of interest is where x^* is quite sensitive to the noise measured by n. In that case, x^* is also sensitive to π, but I do not emphasize that property because I regard all three of the parameters in that expression as constants, not driving forces of fluctuations.

Having determined the equilibrium value of the cutoff qualification likelihood x^*, one can find the value of the surplus V from equation (6).

3.1 The possible indeterminacy of the qualification cutoff x^*

Suppose that

$$G_Q(x) = cx^{-\frac{1}{k_0-1}} \tag{10}$$

and

$$G_N(x) = \frac{\alpha}{1-\alpha}\frac{1-k_0x}{k_0x}cx^{-\frac{1}{k_0-1}} \tag{11}$$

for constants $0 < \alpha < 1$, $0 < c < 1$, and $k_0 > 1$ and for x in an interval in $[0, 1]$ such that $G_Q(x) < 1$ and $G_N(x) < 1$. It is straightforward to show that this joint distribution satisfies the normalization,

$$x = \text{Prob}[Q|x] = \frac{\alpha g_Q(x)}{\alpha g_Q(x) + (1-\alpha)g_N(x)} \tag{12}$$

and that the expected likelihood of qualification of an applicant is

$$k(x^*) = \text{Prob}[Q|x \geq x^*] = \frac{\alpha G_Q(x^*)}{\alpha G_Q(x^*) + (1-\alpha) G_N(x^*)} = k_0 x^*. \tag{13}$$

The basic equilibrium condition in equation (8) becomes:

$$k_0 \frac{1-\beta}{\beta} = \frac{c_E}{c_A} \text{ or } k_0 = \pi. \tag{14}$$

If this condition were satisfied, by coincidence, it would hold for all values of x^* in the interval, so the value of the cutoff would be indeterminate. If k_0 changed over time and passed the critical value π, the value of the cutoff would change discontinuously from one end of the interval to the other. The joint distribution is not in any way extreme or pathological. I do not pursue the topic of indeterminacy in this paper, but this example illustrates that the equilibrium value of x^* can be arbitrarily sensitive to driving forces without extreme assumptions.

3.2 Specifying the distribution of job-seeker information

The following functional form for the joint distribution of qualification and signal is convenient:

$$G_Q(x) = \left(\frac{\alpha n}{1-\alpha}\frac{1-x}{x}\right)^{\frac{n}{1-n}} \tag{15}$$

and

$$G_N(x) = \left(\frac{\alpha n}{1-\alpha}\frac{1-x}{x}\right)^{\frac{1}{1-n}} \tag{16}$$

for

$$x \in \left[\frac{\alpha n}{1-\alpha(1-n)}, 1\right]. \tag{17}$$

As before, α is the unconditional probability that a job-seeker is qualified for an opening. The counter-cdf of the signal is

$$G(x) = \alpha\left(\frac{\alpha n}{1-\alpha}\frac{1-x}{x}\right)^{\frac{n}{1-n}} + (1-\alpha)\left(\frac{\alpha n}{1-\alpha}\frac{1-x}{x}\right)^{\frac{1}{1-n}}. \tag{18}$$

This specification implies

$$k(x^*) = \frac{x^*}{x^* + n(1 - x^*)} \tag{19}$$

and thus

$$x^* = \lambda(n, \pi) = \frac{1 - n\pi}{\pi(1 - n)}. \tag{20}$$

Apart from providing a convenient closed form for the function λ, this specification is not restrictive or special. Many others could generate similar responses of x^* to n.

The parameter n measures noise as previously defined—as n rises, the signal becomes less informative. As $n \to 1$, the signal conveys no information at all about a job-seeker's qualification—x has the same distribution conditional on Q as on N.

Notice that x^* and $k(x^*)$ do not depend on the unconditional qualification probability α, so it cannot be a driving force of fluctuations in x^* and thus in unemployment.

In the calibration described in a later section, I take the unconditional likelihood of qualification to be $\alpha = 0.02$. That is, a job-seeker is qualified for only two percent of the match opportunities.

Figure 1 shows the density of the signal x for three values of the noise parameter: $n = 0.05$ for highly-informed job-seekers, $n = 0.55$ for moderately well informed ones, and $n = 0.7$ for badly-informed ones. In all three cases, the likelihood of receiving a strong signal about qualification is low, because the chance is only 1 in 50 that a job-seeker is qualified for a given job. The intermediately and highly informed job-seekers are much more likely to receive a signal of, say, a 20 percent likelihood of being qualified. Receiving signals in this range is valuable for deciding where to apply—such a prospect is 10 times more likely to yield a job than is applying at random with only a 2 percent chance of success.

Figure 2 uses equation (20) to show the values of the cutoff likelihood x^* corresponding to different values of the noise parameter n, with $\pi = 1.67$. Notice that large changes in the cutoff correspond to relatively small changes in the noise parameter. This property is crucial to the amplification that occurs in the model.

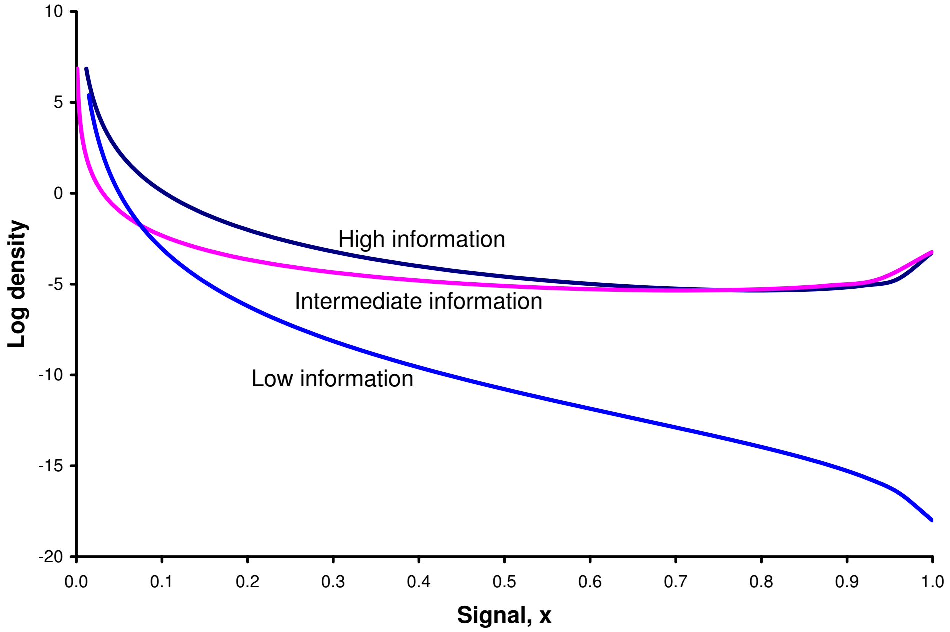

Figure 1. Probability distributions of the qualification signal for three levels of information

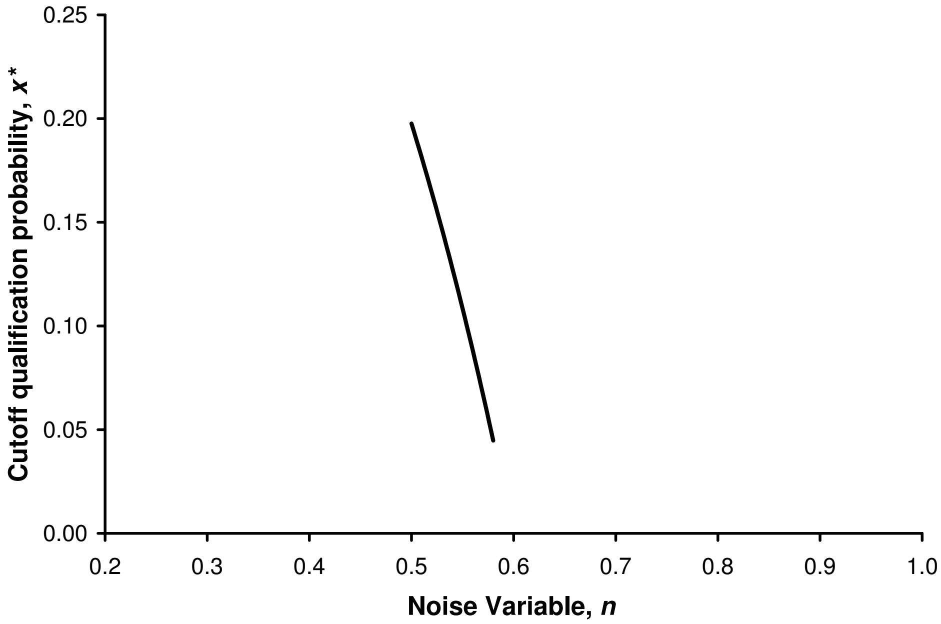

Figure 2. Cutoff signal x^* as a function of the noise parameter n

4 Equilibrium in the Labor Market

Shimer (2005) derives the Bellman equation for the surplus. In his model, job-seekers enjoy a flow benefit, z. Here, job-seekers receive z but pay a flow of application costs that are an offset to z. The flow is the product of the opportunity-finding rate, $\phi(\theta)$, the fraction of opportunities that result in applications, $G(x^*)$, and the application cost, c_A. The job-finding rate, f, is the product of $\phi(\theta)$, $G(x^*)$, and the fraction of applications that are successful, $k(x^*)$:

$$f = \phi(\theta)G(x^*)k(x^*). \tag{21}$$

Thus the stationary Bellman equation is :

$$rV = p - (z + f\beta V - \phi(\theta)x^* c_A) - sV. \tag{22}$$

The right-hand side is the net flow value of employment, p, less the opportunity cost for a worker, $z+f\beta V-\phi(\theta)x^*c_A$, less the burden of separation, sV (recall that s is the separation rate). The opportunity cost includes the flow probability of finding a new job, f, multiplied by the payoff to the job-seeker, βV, net of the flow of application costs, $\phi(\theta)G(x^*)c_A$.

Because the surplus, V, is already determined, the opportunity-finding rate can be found by solving equation (22):

$$\phi(\theta) = \frac{p - z - (r + s)V}{G(x^*)\left(k(x^*)\beta V - c_A\right)}. \tag{23}$$

Equation (6) and the fact that $k(x^*) > x^*$ establish that the denominator is positive. The job-finding rate comes from equation (21) and the unemployment rate is

$$u = \frac{s}{s + f}. \tag{24}$$

Notice that the equilibrium does not depend on the matching technology. The opportunity-finding rate ϕ would be the same for any technology capable of delivering the equilibrium rate. This special feature rests on the assumption I am making for now that the flow cost of a vacancy is zero. The model has the simple recursive structure described above only in this case.

4.1 The possibility of hiring without evaluation

An employer might consider forgoing evaluation for some or all applicants. Stiglitz (1975) noted that, under some conditions, an employer can maintain self-selection among applicants yet economize on screening cost by screening only a random subset of applicants. Suppose that a job-seeker does not know that an employer screens only some applicants. The expected present value of the productivity of the unscreened job-seeker is $k(x^*)/(r + s)$. No bargain will occur if this falls short of the present value of the job-seeker's opportunity cost. In the calibration I consider in the next section, k is 0.18 and the present value of the job-seeker's opportunity cost is close to $1/(r + s)$, so no bargain could occur. I assume that employers do not engage in this charade, which has no benefit to them.

Now suppose job-seekers are aware that an employer does not always screen but hires only qualified, screened workers. If the unscreened applicants do not incur the application cost, then the equilibrium of the model is not affected. But if those applicants do pay the cost, they will set a higher cutoff value for the signal. The employer then benefits, because the evaluation process has a higher yield. The model has no equilibrium in this case. But the case violates the random-search foundation, in which job-seekers have no information about different potential employers.

5 Calibration

I calibrate to a job-finding rate of 51.5 percent per month and a separation rate of 3 percent per month, which imply an unemployment rate of 5.5 percent. As before, I take the noise parameter n to be 0.55, the unconditional likelihood of qualification to be $\alpha = 0.02$, and the cutoff likelihood of qualification, x^*, to be 11 percent. This part of the calibration is essentially arbitrary, but seems reasonable both on its face and in terms of its implications. I take the discount rate to be $r = 0.05/12$ and the flow value of unemployment compensation and leisure to be $z = 0.4$, which is a little more than 40 percent of the flow wage in equilibrium. I take the Nash parameter to be $\beta = 0.5$, so the two sides split the surplus equally. The implied value of π is 1.67, from equation (20). Employers find that $k(0.11) = 18$ percent of applicants are qualified. I solve equations (6), (7), and (22) for the values of the application cost, $c_A = 0.243$, the evaluation cost, $c_E = 0.405$, and the surplus $V = 4.37$. These application and evaluation costs are 1.0 and 1.7 weeks of wages.

With the job-seeker setting x^* to 0.11, 11 percent of applications will succeed at the marginal signal, where $x = 0.11$, and 18 percent of all applications will succeed. An impressive amount of self-selection occurs in this example—an actual applicant is 9 times more likely to be qualified than is one chosen at random from the entire population of job-seekers, where the success rate is $\alpha = 2$ percent.

The job-seeker has to consider a large number of potential jobs to achieve this amount of selection. The opportunity-finding rate is $\phi(\theta) = 490$ per month, calculated by dividing the calibrated job-finding rate, $f = 0.515$, by $G(x^*)k(x^*)$.. The probability of finding an opening with a value of at least $x^* = 0.11$ is

$$G(0.11) = \frac{1}{176}. \tag{25}$$

The job-seeker rejects 175 possibilities before finding one that has a sufficiently promising signal, x, that is, one that is at least 0.11. I

The criterion for evaluating every applicant—that the expected productivity of an unscreened applicant is below her opportunity cost—is met by a wide margin at the calibrated values of the parameters and endogenous variables.

6 Properties of the Model

Figure 3 shows the joint determination of the cutoff level of the productivity signal, x^*, and the surplus, V. It plots the two equilibrium conditions, written as

$$V = \frac{c_A}{\beta x^*} \tag{26}$$

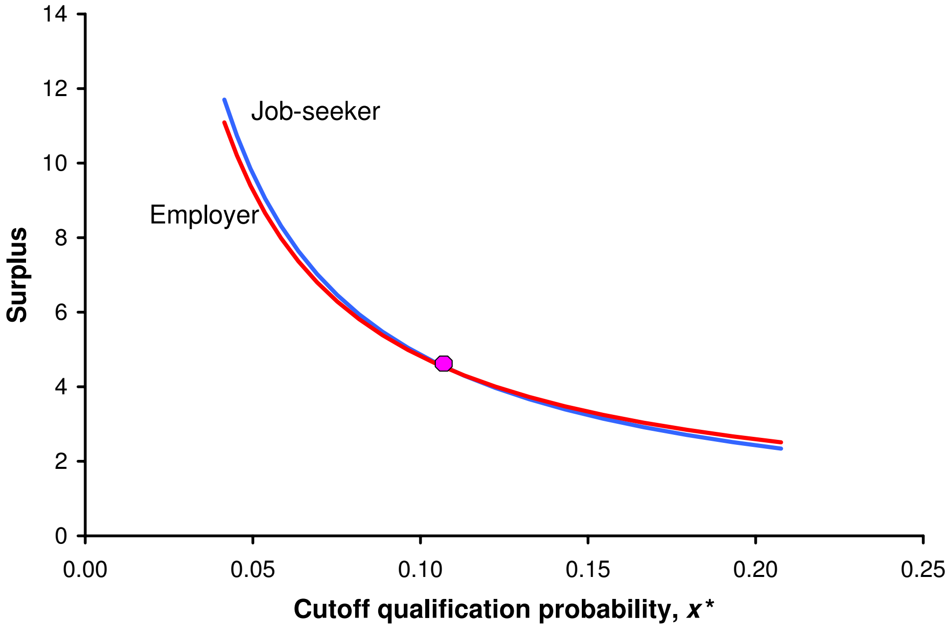

Figure 3. Joint determination of surplus, V, and application cutoff, x^*

and

$$V = \frac{c_E}{k(x^*)(1-\beta)}. \tag{27}$$

The job-seeker curve cuts the employer curve from above. This is a standard stability condition and requires that the elasticity of the expected fraction of qualified applicants, $k(x^*)$, with respect to the cutoff x^* be less than one (the case of indeterminacy, $k(x^*) = k_0 x^*$, has the borderline elasticity of one). The equilibrium is fragile in the sense that the two curves have similar slopes, so small shifts in the positions of the curves will result in large changes in the equilibrium.

The comparative statics of the model are straightforward. Recall that the job-seeker's application cost, c_A, the employer's evaluation cost, c_E, and the worker's share of the surplus, β enter via the parameter

$$\pi = \frac{\beta}{1-\beta}\frac{c_E}{c_A}. \tag{28}$$

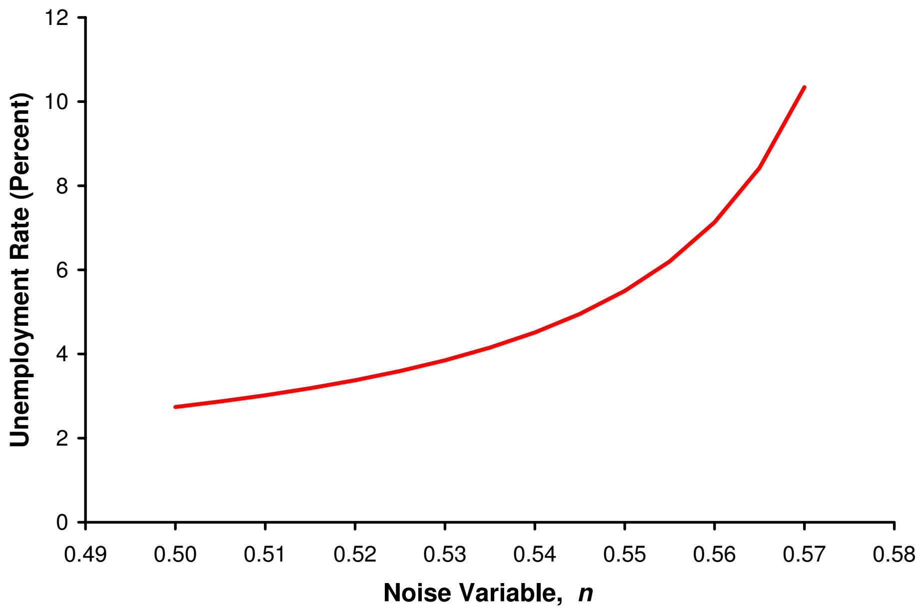

Figure 4. Response of unemployment to changes in the noise parameter, n

Higher values of π correspond to lower x^*, less self-selection, and more unemployment. An increase in the job-seeker's application cost, c_A, shifts the job-seeker curve upward, raises the equilibrium cutoff signal, x^*, lowers the surplus of a job, and lowers unemployment. An increase in the employer's evaluation cost, c_E, shifts the employer curve upward, lowers the equilibrium cutoff signal, x^*, raises the surplus of a job, and raises unemployment.

An increase in the noise parameter, n, shifts the employer curve upward, lowers x^*, reduces self-selection, raises V, and raises unemployment. The productivity of successful matches, p, does not affect x^*, though it does have small effects on other aspects of the equilibrium.

Figure 4 shows the response of the unemployment rate to changes in the noise parameter, n, keeping the overall likelihood that a given job-seeker is qualified for a given job, α, and the other parameters constant. As n rises, unemployment rises rapidly.

The model tells a story about a recession. The story rests on the two equilibrium conditions for job-seekers and employers:

$$c_A = x^* \beta V \tag{29}$$

$$c_E = k(x^*)(1-\beta)V. \tag{30}$$

A shock—such as the collapse of IT spending in 2000 and 2001—diminishes the quality of the information that job-seekers have about their qualifications for jobs. Job-seekers lower their cutoff point, x^*. Employers cut back on recruiting because the probability that an applicant is qualified, $k(x^*)$, declines below the cost of evaluating the applicant (equation (30)). As unemployment rises because of the lower job-finding rate, job-seekers cut their reservation wage, which raises the job surplus, V. As x^* falls and V rises, the market reaches a new equilibrium, where the new values allow job-seekers to cover their application costs and employers their evaluation costs. The process converges because the proportional effect of the decline in x^* is greater for job-seekers (equation (29)) than for employers (equation (30)), because $k(x^*)$ has an elasticity less than one. On the other hand, the proportional effects are the same for the increase in the surplus.

At the calibrated parameter values, an increase in n from 0.55 to 0.56 raises unemployment from its normal level of 5.5 percent to the recession level of 7.1 percent. The cutoff level of the qualification signal, x^*, falls from 11 percent to 9 percent. The job surplus rises from 3.8 months of production to 4.6. Because productivity does not change, the increase in the job surplus is entirely the result of a decline in the reservation wage present value from 21.8 months of production to 21.0 months. Whereas a job-seeker in normal times reviews 176 possibilities before applying for one, the number falls to 107 in the recession, because of a large increase in competition from other job-seekers.

7 Model with Vacancy Cost

If the vacancy cost, c_V, is positive, the model loses its simple recursive form. The matching technology becomes relevant for the equilibrium unemployment rate. I assume that

$$\phi(\theta) = \omega\theta^{.5}. \tag{31}$$

The three equations governing the stationary solution are, first, the condition for the optimal choice of the cutoff by job-seekers, the same as equation (6)

$$c_A = x^* \beta V, \tag{32}$$

and second, the zero-profit condition for employers, which now takes the form,

$$G(x^*)q(\theta)c_E + c_V = G(x^*)k(x^*)q(1-\beta)V. \tag{33}$$

Holding a vacancy open creates an evaluation cost flow of $G(x^*)q(\theta)c_E$ plus the vacancy cost c_V. It yields a flow of $G(x^*)k(x^*)q(\theta)$ hires, each worth $(1-\beta)V$. The third equation, also unchanged from equation (22), is

$$rV = p - z + \phi(\theta)G(x^*)c_A - \phi(\theta)G(x^*)k(x^*)\beta V - sV. \tag{34}$$

I solve the three equations for the three endogenous variables, the application cutoff, x^*, labor-market tightness, θ, and the surplus, V.

I calibrate, as before, to standard figures for the separation and job-finding rates, thus matching the unemployment rate. I also keep the cutoff probability of qualification, x^*, at its earlier level of 0.11. The result is that the calibration leaves all the parameters and variables of the model the same as before, except that the evaluation cost is enough lower to accommodate the vacancy cost. With a positive vacancy cost, the matching technology becomes relevant.

I calibrate to a vacancy/unemployment rate of $\theta = 0.5$, a standard figure. At the calibrated equilibrium, total employer hiring costs per vacancy are 2.25, calculated as the

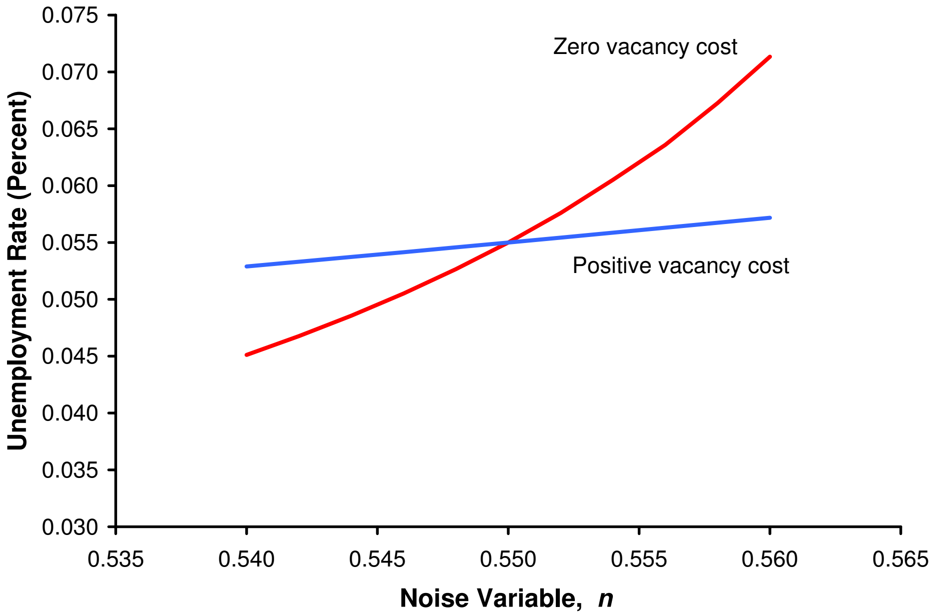

Figure 5. Response of unemployment with and without vacancy cost

product of the number of evaluations per hire ($1/k$), the rate of job-filling per vacancy (f/θ), and the calibrated evaluation cost in the earlier case with $c_V = 0$, $c_E = 0.41$. To illustrate the importance of vacancy cost, I consider the case where the costs are split equally between evaluation and non-evaluation vacancy costs—that is, $c_V = 1.13$.

Figure 5 shows that the response to the noise variable, n, is substantially lower in the model with vacancy costs. Where the result of an increase in the noise variable from 0.55 to 0.56 in the earlier case resulted in an increase in the unemployment rate from 5.5 percent to the recession level of 7.1 percent, the same impulse in the model with vacancy costs increases unemployment to 5.7 percent.

8 Concluding Remarks

The static equilibrium model of this paper shows that self-selection is a key issue in the theory of labor-market frictions. I develop a tractable framework for investigating self-selection and show that it can provide a potent amplification mechanism. The model neither rests on fluctuations in productivity nor predicts cyclical fluctuations in productivity, thus overcoming one of the main defects of other views of unemployment volatility within the matching framework.

The driving force in the model is the quality of information about potential matches between job-seekers and employers. A slight decline in the quality of information results in a cascade of effects that substantially reduce the efficiency of the matching process. Employers are overwhelmed by less-qualified applicants and thus dissipate evaluation resources. Employers require a larger surplus from a match in order to finance the larger number of evaluations need to generate one match. The surplus available to job-seekers grows in proportion, and so does unemployment.

Although a decline in the quality of information about matches is a plausible event leading to a recession, measuring the decline is uncharted territory in labor-market research.

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