LABOR MARKETS, UNEMPLOYMENT, AND MINIMUM WAGES:

A NEW VIEW

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INTRODUCTION

The standard approach to labor markets is illustrated in Figure 1, which shows labor demand as a negative function and labor supply as a positive function of the wage.[1] If the market is competitive and wages are flexible, outcomes will be characterized by full employment of L^*, with an equilibrium wage of w^*. Unemployment emerges only if wages exceed w^*.

According to this view, "high and rigid" wages are the cause of unemployment, a view that has come to dominate both microeconomic and macroeconomic explanations of unemployment.[2] This paper presents an alternative theory of unemployment that redirects attention away from "wage rigidity" toward the "structural characteristics" of labor exchange. The model emphasizes the distinction between employment (number of jobs) and hours and shows that minimum-wage regulations can actually increase employment.

UNEMPLOYMENT IN A "JOBS" ECONOMY

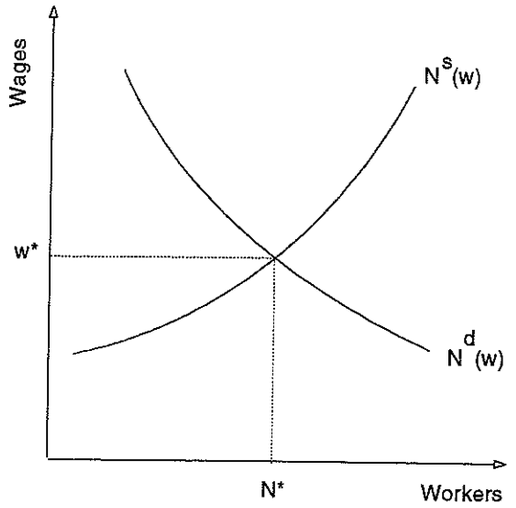
This section presents a theoretical model of a jobs economy based on Plessner and Yitzhaki [1983]. Its key is the distinction between employment (jobs) and hours. Firms can change the level of labor input either by increasing the level of employment holding hours constant, or the converse. This introduces a margin of choice for the firm, over hours and jobs, largely ignored in the literature. Initially, the model is explored with a single type of worker, and this assumption is subsequently relaxed to explore the effects of heterogeneity among workers.

The Demand for Jobs and the Supply of Hours

Worker behavior is characterized by two behavioral functions determining each individual worker's supply of hours and the number of workers participating in the labor market:

$$h^s = \begin{cases} 0 & w < w_{RES} \\ h(w) & w > w_{RES},\ h_w > 0 \end{cases} \tag{1}$$

Figure 1
Demand and Supply Model of Labor Markets



$$(2) \qquad N^s = \begin{cases} 0 & w < w_{RES} \\ N & w > w_{RES} \end{cases}$$

where h^s = per worker supply of hours,
w_{RES} = reservation wage,
N^s = supply of workers.

The supply of hours per worker depends positively on the real hourly wage, but supply of hours is zero as long as $w < w_{RES}$. Worker participation is a step function with no workers participating in labor markets when $w < w_{RES}$. The assumption of a single type of worker means that all workers participate once the hourly wage exceeds this reservation level. The inverse of the hours supply function can be written as

$$(3) \qquad w = w(h) \qquad w_h > 0.$$

The sign of the partial derivative implies that the supply price of hours (the hourly wage) is a positive function of hours.

The Supply of Jobs and the Demand for Hours

Firms maximize profits by choosing over employment and hours. This determines the supply of jobs and the demand for hours from individual workers. The representative firm's maximization program is given by

$$(4) \qquad \underset{N,h}{\text{Max}}\ V(N, h) = f(N, h) - whN$$

where $f_N > 0$, $f_h > 0$, $f_{NN} < 0$, $f_{hh} < 0$, $f_{Nh} = f_{hn} >< 0$,

subject to

$$(4a) \qquad w = w(h),$$

where V = profits,
N = employment,
h = hours,
w = real hourly wage rate.

In $f(N, h)$, the production function, employment and hours are imperfect substitutes; both display positive but diminishing marginal products. Employment and hours are imperfect substitutes in production because they interact differently with capital. If employment increases, holding hours constant, there are fewer machines per worker: if hours increase, holding employment constant, workers are subject to exhaustion. The constraint (4a) implies that firms have some monopsony power with respect to hours provided by their existing workforce. The logic behind the assumption of monopsony power is that workers face some transactions costs to shifting jobs.[3] The solution of this program yields the supply of jobs and the demand for hours at a given wage.

The Determination of Jobs and Hours

The operation of the labor market is as follows. Each employed worker is on his hours supply schedule. However, since firms simultaneously choose hours and employment, and the wage rate needed to elicit a given number of hours may also elicit an excess supply of workers, unemployment may result.[4] Such an outcome is understandable in terms of Tinbergen's [1952] targets and instruments approach to macroeconomic policy; effectively, there are two targets (employment and hours), but only one instrument (the hourly wage).

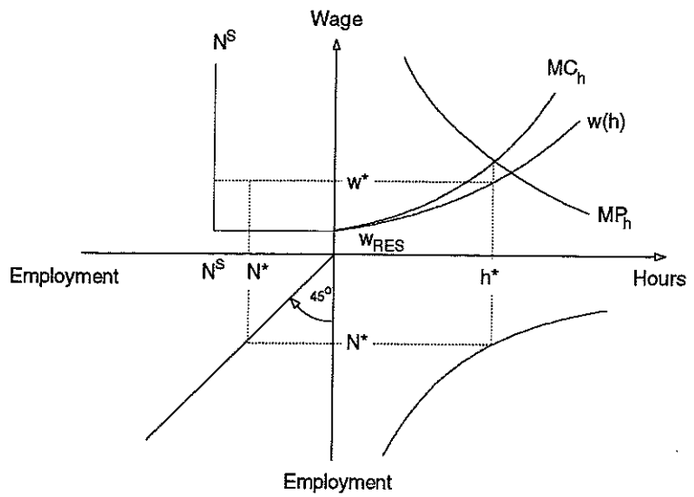
The market outcome is determined by solving the firm's maximization program in conjunction with the worker participation and hours supply functions. The first order conditions are

$$(5a) \qquad dV/dN = f_N - wh = 0,$$

$$(5b) \qquad dV/dh = f_h - wN - hNw_h = 0.$$

If $N < N^s$ there is unemployment. Rearranging (5a) and (5b) and expressing them as a ratio, yields the marginal rate of technical substitution (MRTS):

Figure 2
Determination of Employment, Hours, and Wages in a Jobs Economy



(6) $$f_N/f_h = wh/[wN + hNw_h] = h/N[1 + E_{w,h}],$$

where $E_{w,h}$ = elasticity of the hourly wage with respect to hours.

The determination of employment and hours is shown in Figure 2. The lower-right panel shows the isoquant, in hours-employment space, associated with the profit-maximizing level of production. The profit-maximizing levels of employment and hours are denoted N^* and h^*, and the slope of the isoquant (MRTS) at this point is $dh/dN = h/N[1 + E_{w,h}]$. The upper-right panel shows the hours supply function, the marginal cost of hours, MC_h, and the marginal product of hours, MP_h.[5] Firms choose the level of hours at which the marginal product of hours equals the marginal cost of hours. However, since wages must still lie on the hours supply schedule, the equilibrium wage is determined by reading down from the intersection of the MC_h and MP_h schedules to the hours supply schedule and across, which yields w^*. Finally, the upper-left panel shows the worker participation function. The level of employment determines the supply of jobs, and is determined by the firm's choice of the optimal hours-employment mix in the lower-right panel. The number of job seekers, N^s, is determined by the worker participation function. The level of unemployment, $N^s - N^*$, is the gap between worker participation and firms' supply of jobs. Unemployment is therefore possible despite perfectly flexible wages and competitive labor markets.

The above model emphasizes the margin of choice between hours and employment, a margin that can be influenced through the use of taxes and subsidies [Palley, 1994]. Another striking result concerns the effect of minimum-wage regulation. In the standard model, this causes an unambiguous decrease in employment and an increase in unemployment. In the current model, minimum wages can actually increase employment (jobs). The effect of a binding minimum wage can be incorporated by replacing (4a) with

(4a') $$w = w_{MIN}.$$

In this case the first-order conditions are given by

(5a') $$dV/dN = f_N - w_{MIN}h = 0,$$

(5b') $$dV/dh = f_h - w_{MIN}N = 0.$$

The MRTS is then given by

(6') $$f_N/f_h = h/N < h/N[1 + E_{w,h}].$$

The fact that the MRTS with minimum wage regulation is less than without indicates that firms move along their isoquants and decrease the optimal hours/jobs ratio. This means that employment (jobs) may actually increase.

The economic logic behind this possibility is that minimum-wage regulations raise the relative cost of hours, thereby providing firms with an incentive to increase the mix of jobs relative to hours. Whether total employment increases is ambiguous. On the one hand the substitution toward jobs has a positive impact on employment, but the higher real wage reduces the profit-maximizing level of output and has a negative effect. This provides a theoretical explanation for the empirical finding of employment neutrality of minimum wages recently reported by Card and Krueger [1994].

Lastly, note that the assumption of monopsony is critical to the above result, since in its absence the MRTS would be $f_N/f_h = h/N$ in both cases. The conventional labor market model with monopsony imposition of a minimum wage slightly above the existing wage leads to greater employment. However, the conventional model has a single measure labor input. In an hours - jobs economy there are two inputs, so that there is an important margin of substitution. Regulating the hourly wage, as with minimum wage legislation, induces a shift away from hours but raises jobs. This is a subtly different effect since use of the regulated input (hours) actually falls. The two models also have different implications for prices. In the conventional monopsony model prices will fall as a result of minimum-wage regulation, since the firm increases employment and output, and must lower product prices to sell this additional output. In the hours - jobs model, the change in prices is unclear since the firm cuts back on hours and increases jobs. Whether output has decreased or increased is therefore ambiguous. This can explain why Card and Krueger [1994] found no significant price differences across firms that were and were not subject to the minimum wage.

HETEROGENEOUS WORKERS

In the above model workers were homogeneous. This section examines the implications of heterogeneity. With two types of workers the respective hours supply and worker participation functions are given by

$$(7a)\qquad h_1^s = \begin{cases} 0 & w < w_{RES,1} \\ h_1(w) & w > w_{RES,1},\ h_{1,w} > 0 \end{cases}$$

$$(7b)\qquad h_2^s = \begin{cases} 0 & w < w_{RES,2} \\ h_2(w) & w > w_{RES,2},\ h_{2,w} > 0 \end{cases}$$

$$(8a)\qquad N_1^s = \begin{cases} 0 & w < w_{RES,1} \\ N_1 & w > w_{RES,1} \end{cases}$$

$$(8b)\qquad N_2^s = \begin{cases} 0 & w < w_{RES,2} \\ N_2 & w > w_{RES,2} \end{cases}$$

The worker participation function is now a step function with steps at $w_{RES,1}$ and $w_{RES,2}$, where $w_{RES,2} > w_{RES,1}$. These worker types can be identified with primary (type 1) and secondary (type 2) workers in a standard household.

The firm's problem now involves choosing an hours - wage combination subject to a potential employment constraint. If desired employment is less than N_1, then firms base the marginal cost of hours on the hours supply schedule given by h_1^s. If desired employment is greater than N_1, then firms base the marginal cost of hours on the hours supply schedule given by h_2^s, since type 2 workers represent the marginal workers. Consequently, firms must make a discrete comparison of profits under a regime in which both type 1 and type 2 workers participate in the labor market, and a regime in which only type 1 workers participate. However, in both cases the demand for workers (supply of jobs) need not be an exact match with the level of worker participation, and unemployment can result.

Full employment will be automatic only if each worker constitutes a unique type, with only one worker per type. In this case, every time the firm wants an additional worker, that worker's hours supply schedule becomes the marginal cost of hours schedule on which firms predicate their hours - wage decision. However, with more than one worker per type, additional workers of the marginal type may not secure employment.

EFFORT, HOURS, AND JOBS

The above model focuses on the important distinction between employment and hours. A second distinction, developed within the efficiency wage literature [Solow, 1979; Akerlof and Yellen, 1990], concerns the difference between employment and worker effort. The core insight is that firms are interested in obtaining labor from workers, and the amount of labor obtained depends on both the number of employed workers and their level of effort.

This labor extraction problem can be integrated into a model with hours and jobs, and serves to show how labor extraction and the hours - jobs choice are both part of the same over-arching problem. Assuming a single type of worker, the firm's program becomes

$$(9)\qquad \underset{N,w}{\text{Max}}\ V(N, h, e) = ef(N, h) - whN$$

subject to

$$(9a)\qquad e = e(w) \qquad e_w > 0$$

$$(9b)\qquad h = h(w)$$

$$(9c)\qquad N \leq N^s$$

$$(9d)\qquad w > w_{RES},$$

where e = level of worker effort, and $e(w)$ is the effort function determining the amount of effort provided by each worker. The provision of effort is a positive function of the level of wages, reflecting the claim that workers' effort increases as they are paid more. This formulation is consistent with a view that workers are motivated in their provision of effort by a sense of fairness. As before, with full employment, equation (9c) becomes an equality: with unemployment, it is an inequality.

In effect, the production function has three inputs — workers, hours, and effort — and firms must choose the optimal mix. Firms control the levels of employment and wages, with the latter yielding them indirect control over the level of effort. Firms therefore choose an employment-hours-effort combination. Once again there is a single instrument (the wage), but three targets — jobs, hours, and effort. Since effort and hours both depend on the wage, firms cannot choose these variables independently. Moreover, the wage chosen to elicit an effort-hours response may not clear the jobs market.

Substituting (9a) and (9b) into (9), and differentiating with respect to N and w yields two first-order conditions given by

$$(10a)\qquad dV/dN = ef_N - wh = 0, \text{ and}$$

$$(10b)\qquad dV/dw = f(N,h)e_w + ef(N,h)h_w - wNh_w - Nh = 0.$$

In equation (10a) the firm equates the marginal product of an extra job with marginal cost, while in equation (10b) the firm sets the wage so that the marginal benefit from wage adjustment equals its marginal cost. This marginal benefit consists of the positive effect of wages on effort and hours. The level of employment determines the supply of jobs, and the level of unemployment is then equal to the gap between worker participation at the going wage and the supply of jobs.

CONCLUSION

This paper presents an alternative microeconomic framework explaining unemployment in terms of the structural characteristics of labor exchange. The framework is accompanied by a simple diagrammatic apparatus. The key analytic insight is that the wage is the single instrument, so that it cannot simultaneously clear the markets for jobs, hours, and effort. Unemployment can therefore arise even when wages are flexible and labor markets competitive because the wage rate is used to determine hours rather than clearing the jobs market. Moreover, minimum wage regulation can actually increase employment. This interpretation departs from the standard model of labor markets which maintains that unemployment is the result of high and rigid wages.

NOTES

1. Throughout the paper the term wage refers to the real wage.
2. Public understanding of the problem has similarly changed, most likely because of exposure to the standard model. This transformative effect of economics teaching is confirmed by Frank, Gilovich and Regan [1993] who provide important empirical evidence on how exposure to economic theory changes attitudes.
3. These transactions costs can be diverse in character and can include explicit expenses of job search and moving homes, as well as psychological costs of leaving a familiar workplace and losing friends.
4. In principle, both the hours supply schedule and the worker supply schedule could depend on the endogenously determined rate of unemployment. In both cases, unemployment would likely enter with a negatively signed partial derivative, reflecting a "reserve army" effect on the hours supply function, and a "discouraged worker" effect on the worker participation function.
5. This schedule depends on the level of employment, and is drawn therefore, for $N = N^*$.

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