A COMMENT ON "LABOR MARKETS, UNEMPLOYMENT, AND MINIMUM WAGES: A NEW VIEW"

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INTRODUCTION

In this Journal, Palley [1995] recently set up a job-hour model to provide us with a new view regarding the issues of unemployment and minimum wages. Palley's first contribution is to show that a model embodying the distinction between employment (jobs) and hours (and/or effort) may result in an equilibrium that is characterized by involuntary unemployment. The rationale behind this is that "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)" [Palley, 1995, 321]. Palley's second contribution shows that a minimum wage hike may increase employment in the model. "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" [Ibid., 323].

The main findings of this paper can be stated briefly as follows. In a job-hour model, Palley [1995] focuses on the case where "workers" and "hours" are two separate production inputs and finds that the labor market may be in a state of involuntary unemployment. Palley attributes the result to Tinbergen's [1952] targets and instruments approach. This paper first extends Palley's analysis to the case where workers and hours can be treated as a single factor and finds that the labor market equilibrium will be characterized by full employment. It then extends the model to take into account an additional instrument-fringe benefits. In the extended job-hour model containing two instruments (wage and unemployment benefits) and two targets (employment and hours), we show that the labor market may still result in a state of involuntary unemployment if workers and hours are separate inputs. By contrast, if workers and hours can be viewed as a single factor, the labor market equilibrium is again characterized by full employment. These findings imply that the result of involuntary unemployment depends crucially on the property of the production function in the job-hour model. Instead of adopting the approach by Tinbergen, this paper proposes an explanation analogous...
to the efficiency wage theory. Moreover, Palley points out that a minimum wage hike may increase employment and decrease the number of working hours in the job-hour model. This paper explicitly conducts a comparative static analysis to clarify under which condition Palley's finding may hold and finds that the number of working hours will increase rather than decrease if employment increases.

The rest of this note proceeds as follows. The following section briefly duplicates Palley's model. The next two sections discuss the issues of unemployment and minimum wages, respectively. Concluding remarks are presented in the final section.

**THE MODEL**

To facilitate comparison, this note adopts Palley's [1995] setup and most of his notations. Palley's job-hour model is as follows:

\[ \max_{N, h} V = N f(N, h) - w h N, \]

s.t. \( h = h(w), \) if \( w > w_{mess} \)

\[ N = N^o \text{ if } w > w_{mess}, \]

The firm's profit is \( V. \) The hourly wage rate is \( w, \) and \( w_{mess} \) is the reservation wage of the homogeneous workers. The number of workers that the firm hires is \( N, \) and \( N^o \) is the total labor force if \( w > w_{mess}. \) Since all workers are homogeneous, \( N^o \) is a fixed number. The labor hours supply function \( h = h(w) \) is an increasing function of the hourly wage rate \( h > 0. \) The production and revenue function \( f(N, h) \) depends on \( N \) and \( h \) (the price of output is normalized to be 1). The function exhibits diminishing returns with respect to its arguments, so that \( f_N > 0, f_h > 0, f_{NN} < 0, f_{Nh} < 0 \) and \( f_{Nh} - f_{hN} > 0. \)

Before proceeding, it is worthwhile to place more emphasis on the specification of the production function. The conventional specification treats man-hours (i.e., hours of work per worker multiplied by the number of workers) as a single factor of production. By contrast, Palley [1995] treats "men" (or "jobs") and "hours" as two separate production factors. This approach can be traced back to Chapman [1939], was adopted by Feldstein [1967], Rosen [1968], and Ehrenberg [1971], and is empirically supported by Feldstein [1967], Cline [1973], Leslie and Wise [1980], Leslie [1984], and Hart and McGregor [1988].

There is no a priori reason to assume that the firm must hire all workers who are willing to work (i.e., \( N = N^o \), full employment). In fact, Palley [1995] is only concerned with the involuntary unemployment situation \( (N < N^o). \) We therefore ignore \( N = N^o \) in the analysis that follows, so that the firm can choose its employment and wage by maximizing equation (1) without taking into account \( N = N^o \) in equation (3). Hence, the model can be written as:

\[ \max_{N, h} V = f(N, h) - w(h) N, \]

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where \( w = w(h), \) with \( w > 0 \) being the inverse function of \( h = h(w). \) The corresponding first-order conditions associated with \( N \) and \( h \) are:

\[ V_N = f_N(N, h) - w(h) N = 0, \]

\[ V_h = f_h(N, h) - w(h) N = w(h) N = 0. \]

These are the usual marginal conditions. The second-order conditions for an interior solution require:

\[ V_{NN} = f_{NN} < 0 \text{ or } V_{Nh} = f_{Nh} - 2w_N N - w_{Nh} N < 0, \]

\[ V_{NN} + V_{Nh} V_{Nh} > 0, \]

where \( V_{Nh} = V_{NN} + f_{Nh} - w_h N - w_h f_{Nh} N \geq 0. \)

The **notional** number of workers \( N^o \) and the **notional** number of working hours \( h^o \) are determined by solving equations (4) and (5). When \( N^o < N^o \), the notional levels \( (N^o \) and \( h^o \) are the realized levels as well. By contrast, when \( N^o > N^o \), the notional levels will not be the realized levels. Since Palley only focuses on the case where \( N^o < N^o \), as in this note, the following analysis is only confined to the case where \( N^o < N^o \).

Let the \( NN \) and the \( HH \) curves represent the optimal behavior of the firm's labor demand and the hours demand in equations (4) and (5), respectively. Their slopes are:

\[ \frac{dN}{dN} = \frac{V_{NN}}{V_{Nh}} - \frac{V_{NN}}{V_{Nh}} = \frac{f_{Nh}}{f_{Nh}} - \frac{f_{Nh}}{f_{Nh}} = 0, \]

\[ \frac{dh}{dN} = \frac{V_{Nh}}{V_{Nh}} - \frac{f_{Nh}}{f_{Nh}} = \frac{f_{Nh}}{f_{Nh}} - \frac{f_{Nh}}{f_{Nh}} = 0, \]

In other words, if \( f_{Nh} > f_{Nh} \), both curves will be positively sloping. The \( NN \) curve is steeper than the \( HH \) curve owing to the second-order conditions of the firm's optimization in equation (6). If \( f_{Nh} < f_{Nh} \), both curves will be negatively sloping, and the \( HH \) curve will be steeper than the \( NN \) curve. The firm's notional employment \( N^o \) and hours \( h^o \) are determined by the intersection of both curves.

Figure 1 depicts the case where \( f_{Nh} > f_{Nh} \). The vertical line \( \overline{NN} \) stands for the market labor supply of workers. The \( NN \) and the \( HH \) curves intersect to the left of \( \overline{NN} \) and \( h^o \) and \( h^o \) are therefore the notional as well as the realized levels. In this situation, all \( N^o \) workers are willing to work \( h^o \) hours at the wage \( w \). However, the total number of jobs that the firm wants to provide is only \( N^o \). Therefore, \( N^o - N^o \) workers want to work, but unfortunately do not get hired and become unemployed involuntarily.
The Involuntary Unemployment Equilibrium

Palley explains the rationale behind the possibility of unemployment in the following manner:

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. (1995,328)

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).* (ibid., 321)

In the following section, I provide an alternative explanation. However, before doing so, two extended models are presented to highlight the need for an alternative explanation. First, this paper extends Palley’s (one target and one instrument) model from the case where workers and hours are two separate inputs to the single factor case, and finds that the labor market will result in a state of full employment. Second, this paper extends Palley’s model to take into account an additional instrument—fringe benefits. In the extended job-hour model containing two instruments and two targets, we show that the labor market equilibrium may still be characterized by involuntary unemployment in the case of separate factors. In the single factor case, the labor market will again result in full employment. These findings indicate that the unemployment result crucially depends on the production function property in the job-hour model. Moreover, the findings in the second extended model cannot be explained by

THE REASON FOR INVOLUNTARY UNEMPLOYMENT

This section first analyzes the case where labor and hours are a single production factor. When h and N can be considered a single production factor, the production function h(N) becomes h(N). Let f' > 0 be the marginal product of h(N), and then f(N, h) = h'(hN) and f(h, N) = N(hN). Equations (4) and (5) thus become:

V_x = N - hN = 0,
V_y = N - wN = 0, wN < 0.

The economic implications behind the inequality V_y < 0 can be stated as follows. To employ a given number of hN, a profit-maximizing firm will set h and (thus w) as low as possible, and enlarge N as much as it can. Since a lower h lowers w(h > 0) while a larger N increases w, a combination of a lower h and a larger N can always constitute a given amount of hN at a lower cost (wN). Consequently, when h and N are treated as a single input, the labor market will be in full employment. Otherwise, by continuously substituting h for h, the firm cannot increase its profit persistently. There may thus exist an optimal combination of h and N—w(hN) for the firm to maximize its profit, and so the corresponding labor market equilibrium will be in a state of involuntary unemployment.

Putting the above explanation in a different way, one can say that the Palley finding is crucially dependent on the assumption that workers and hours are two separate factors. When workers and hours are a single production factor, the firm does not care about the hours input per se. It just pushes wages as low as possible and then hires all available workers. As a result, the labor market will result in full employment. If at full employment it still does not have enough labor input, it then starts to purchase more hours per worker by raising the wage and moving up the individual worker's hours supply curve.

The reasoning behind the unemployment result is, therefore, analogous to the efficiency wage models. The key feature of the efficiency wage models is that a firm that pays a higher wage faces a cost as well as a benefit. The firm may find it is not profitable to cut its wage in the presence of involuntary unemployment. The rationale behind the theory may be due to maintaining work morale, avoiding adverse selection, saving turnover costs, and preventing shirking. Similarly, a lower wage has a benefit (a lower cost per employee) and a cost (a smaller number of working hours) in this model. The firm, which seeks an optimal mixture of men and hours to maximize its profit, may set a wage higher than the workers' opportunity cost. The rationale behind this is due to the property of the production technology rather than the adverse selection problem and the like in the efficiency wage models.

The above analysis is confined to those labor markets where firms do not furnish their workers fringe benefits. In the real world, firms always pay wages and provide
fringe benefits to their workers. The model that takes into consideration the firm's expenditure on fringe benefits (per capita) $F$ can be written as:

$$\max_{N, h, F} V = f(N, h) - \omega h + FN,$$

subject to:

$$h = h(u, F), \quad h_u > 0, \quad h_F > 0,$$

$$N = N^N.$$

When $N < N^N$, the model becomes:

$$\max_{N, h, F} V = f(N, h) - \omega h + FN,$$

where $\omega = \omega(h, F)$, with $\omega_h > 0$ and $\omega_F < 0$ being derived from $h = h(u, F)$. The corresponding first-order conditions associated with $N, h$ and $F$ are:

$$V_N = f_{h} - \omega h + F = 0,$$

$$V_h = f_{h_h} - (\omega + \omega_F h)N = 0,$$

$$V_F = -\omega h = 0.$$

First of all, if workers and hours are a single input ($f(h, N) = f(hN)$), then just as with the previous model, the second condition above will become $V_N = N - \omega N - \omega h = 0$. In other words, the labor market will result in full employment. However, when workers and hours are two separate inputs and the equality of each of the first-order conditions holds, the notional levels of $N^N$, $\omega^N$ and $h^N$ can be obtained by solving the above three equations. If the notional level of employment is smaller than the total number of workers ($N < N^N$), then the labor market may still be in a state of involuntary unemployment. As mentioned above, the wage is not only a cost but also an input in the standard efficiency wage model (without fringe benefits). A higher wage raises cost as well as revenue due to higher work morale or other reasons emphasized in the efficiency wage literature. The firm therefore may not cut its wage in the presence of involuntary unemployment. In this extended model, the wage and fringe benefits are costs as well as inputs. A higher wage (or fringe benefits) increases the production cost and simultaneously increases the revenue by acquiring longer working hours. Consequently, the firm may find that it is profitable not to cut the wage and/or fringe benefits in the case of involuntary unemployment.

From the above analysis, we find that the involuntary unemployment outcome in both extended models depends crucially on the production technology property. The second extended model further indicates that if the workers and hours are two separate inputs, the labor market may result in full employment even though there are two instruments and two targets. This finding cannot be understood by the explanation based on Tinbergen's target-instrument approach, but can be understood by the efficiency wage type of unemployment.

**THE REASON THAT A MINIMUM WAGE HIKE INCREASES EMPLOYMENT**

An increasing number of studies (Wellington, 1991; Card, 1992a, 1992b; Katz and Krueger, 1992; Card and Krueger, 1994; and Dickens et al. 1999) have recently found that minimum wages may have no impact or a positive impact on employment. Stimulated by these empirical findings, much effort (Manning, 1995; Rebitzer and Taylor, 1995; Dickens et al., 1999; and Bhaskar and To, 1999) has been made to find theoretical justifications for the possibility of the positive employment effect. One important contribution by Palley is that he shows that a job-hour model may result in a positive employment effect of a minimum wage hike. However, his analysis and explanation of his findings have some difficulties. This section points out these difficulties and tries to provide an alternative explanation.

To more easily explain the employment effect of a minimum wage hike, it is better to express the model in equation (7) as follows:

$$\max_{N, h, F} V = f(N, h(w)) - \omega h(w)N.$$

The corresponding first-order conditions associated with $N$ and $w$ are:

$$V_N = f_h[N, h(w)] - \omega h(w) = 0,$$

$$V_h = h_{h_w} - (2h + \omega h_{ww})N = 0.$$  

The second-order conditions for an interior solution require:

$$V_{ww} = f_{ww} < 0 \quad \text{or} \quad V_{ww} = h_{h_{ww}} - (2h + \omega h_{ww})N < 0,$$

$$V_{ww} V_{ww} - V_{ww} V_{ww} > 0,$$

where $V_{ww} = V_{ww} = h_{h_{ww}} - (2h + \omega h_{ww}) = h_{h_{ww}} - f(N) \geq 0$.

From equations (7) and (8), we can obtain the notional number of workers $N^N$ and the notional level of the wage rate $w^N$. When $N < N^N$, the notional levels are the realized levels as well. If the minimum wage binds, a regulated firm will set its wage at the legislated minimum wage ($w = \bar{w}$). The employment is now the firm's only choice variable, and its first-order condition with respect to $N$ when $w = \bar{w}$ is:

$$V_n = f_N[N, h(\bar{w})] - \bar{w} h(\bar{w}) = 0.$$
The second-order condition for an interior solution holds due to $V_{NN} = f_{NN} < 0$.

The employment effect of a slight minimum wage hike around the initial equilibrium is

$$N_k = \frac{\gamma V_{NN}}{V_{NN}} - \frac{h_a(f_{NN} - f_{NN}^*)}{f_{NN}} \equiv 0, \text{ if } f_{NN} < f_{NN}^*,$$

so that the effect on employment resulting from a minimum wage hike is ambiguous. Palley indicates that "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" [1966, 31]. Concerning the effect on the number of working hours, Palley expects that "[i]n 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 regulated input (hours) actually falls" [ibid., 223].

In fact, equation (10) tells us that a minimum wage hike will increase employment ($N_M > 0$) if and only if $f_{NN} > f_{NN}^*$. Intuitively, there are two effects of a minimum wage hike on employment. First, a minimum wage hike increases the marginal cost (of $\bar{h} \bar{h} + \bar{h} \bar{w}^* N_{NN}^* h^*/h^* = \bar{h} \bar{w} + h^* f_{NN}^*/ N^* > 0$). This exerts a negative impact on employment. Second, a binding minimum wage will unambiguously make the firm require each worker to provide longer working time according to the labor hours supply curve $h = h(w)$ with $h^* > 0$. A larger number of working hours will further increase employment if a larger $h$ raises the marginal product of the employment, that is $f_{NN} > 0$. The total employment effect of a higher minimum wage is accordingly ambiguous. On the other hand, if $f_{NN} < 0$, a larger $h$ will decrease employment, and the total employment effect will definitely be negative.

In Figure 2, the NW and the WW curves represent the optimal behavior of the firm’s labor demand and wage-setting in equations (7) and (8), respectively. Again, their slopes are either both negative or both positive since

$$\frac{d \bar{w}}{dh} \frac{V_{NN}}{V_{NN} \bar{w}} = -\frac{f_{NN}}{h_a(f_{NN} - f_{NN}^*)} \equiv 0, \text{ if } f_{NN} \geq f_{NN}^*;$$

$$\frac{d \bar{w}}{dh} \frac{V_{NN}}{V_{NN} \bar{w}} = -\frac{h_a(f_{NN} - f_{NN}^*)}{h_a(f_{NN} - f_{NN}^*) + (h_a)^2 f_{NN} - (2h_a + \bar{w} + \bar{w}_k)h_{NN}^*} \equiv 0, \text{ if } f_{NN} \leq f_{NN}^*.$$
inputs are entered separately. If both inputs can be treated as a single factor, the equilibrium is again characterized by full employment. This result indicates that the reason for involuntary unemployment in the job-hour model is due to the production function property rather than Tinbergen's targets and instruments approach. This paper thus tries to explain Palley's finding in a way similar to the efficiency wage theory. Moreover, Palley points out that a minimum wage hike may increase employment and decrease the number of working hours in the job-hour model. This paper explicitly conducts a comparative static analysis to clarify under which condition employment will be expanded and shows that the number of working hours will increase rather than decrease if employment increases. Additionally, this paper shows that the condition for a positive employment effect does not hold in the Cobb-Douglas production function.

In sum, this paper has tried to provide an alternative explanation regarding Palley's findings. We hope such a note will be useful in terms of obtaining a better understanding of Palley's contributions.

NOTES

1. For simplicity, the number of identical firms is implicitly assumed to be normalized at 1.

2. One potential comment may arise from the setting of the labor supply curve in equation (2). A binding labor supply curve implies that workers can work as many hours as they want at the market wage. However, some people have reported working involuntarily too few or too many hours at the market wage (see Anthoff, 1966; Bell and Freeman, 1995). We also observe an inseparable tight distribution around the eight-hour day. This suggests that employers may give the "all-or-nothing" offer to workers regarding hours (Levin, 1990; Noyes, 1974; Kinoshita, 1987; Biddle and Zarkin, 1986; Kahn and Lang, 1992; Dickens and Losinger, 1993). One may thus wonder whether the findings based on equation (2) are still valid in an "all-or-nothing" contract. Fortunately, it is easy to see that an "all-or-nothing" contract can lead to a positive relation between the working hours and the wage just as in the case of the labor supply curve. In short, suppose that workers enjoy compensation c, but dislike spending time on working h, and their utility function is:

\[ U = ah + c(1 - h) \Rightarrow U_c > 0, U_h < 0. \]

A worker is willing to accept the job if the utility from the job equals or exceeds a reservation level of utility \( U \), i.e.,

\[ U(\bar{h}, \bar{a}, h) > U(\bar{h}, \bar{a}, \bar{h}) \]  

This condition is the worker participation constraint that firms need to respect in their maximization of profit. The equality part of this equation implicitly defines a function

\[ h = k(a, b) \Rightarrow \frac{\partial h}{\partial a} = \frac{k'}{b} > 0, \frac{\partial h}{\partial b} = -k > 0, \]

which represents the cost-increasing employment contract \( c = ah \), compatible with workers' participation constraint. The profit-maximizing firm with the first-mover advantage will offer a contract satisfying this condition. As a result, a positive relation between the wage and working hours can be derived from the "all-or-nothing" contract. All of the findings of the model are thus not destroyed.

3. It implies that the elasticity of output with respect to workers equals that with respect to hours, and that the elasticity of substitution between workers and hours is infinite.


5. I am greatly indebted to an anonymous referee for recommending that such an explanation be included in this paper.

6. For comprehensive surveys of the efficiency wage theory, see Akerlof and Yellen (1986).

REFERENCES


Labor Markets and Unemployment: The Targets and Instruments Framework

Thomas J. Palley

Chung-cheng Lin has written an interesting paper that constructively explores my "targets and instruments" approach [Palley, 1995] to understanding unemployment and the operation of labor markets. My one criticism is that he sets up a false opposition between the targets and instruments characterization and the efficiency wage explanation of unemployment. The latter is nested within the former.

The targets and instruments characterization is intended as a meta-framework for understanding the problem of unemployment. Firms have several goals (targets): — finding workers, purchasing hours from those workers, and extracting effort from them. But they have a limited number of instruments (the wage) for reaching those goals. In this sense, they have more targets than instruments. From an economy-wide stance, the result is that some dimension of labor markets—jobs, hours, or effort—does not clear.

Such an approach can be contrasted with the conventional "rigidities" approach which sees unemployment as the result of labor market rigidities—downward nominal wage rigidity, downward real wage rigidity, long-term contracts, etc. In the rigidity view there are enough instruments, but some are rusty and cannot do their job.

The targets and instruments meta-framework encapsulates the efficiency wage problem. In the standard representation the firm desires employment and effort (two targets) but has only one instrument (the wage). From a market-wide perspective, the result is that outcomes end up on the effort supply schedule and off the labor supply schedule.

The reason for this outcome is similar to Tobin's [1990] "common funnel" theorem regarding the Phillips curve. The Phillips curve forces a trade-off between inflation and unemployment. Macroeconomic policy controls aggregate demand (the common funnel) and is bound by this trade off. If monetary policy is used to lower unemployment and fiscal policy is used to lower inflation, the two get mixed in the common funnel and offset each other. In the standard efficiency wage model there is a trade-off between effort and unemployment, and the wage is the common funnel. Raising wage payments increases effort, but it also increases unemployment by lowering labor demand and increasing labor supply.