A FLEXIBLE-WAGE EFFICIENCY-WAGE MODEL
WITH INVOLUNTARY UNEMPLOYMENT

Mark Pernecky
St. Olaf College

INTRODUCTION

New Keynesians have developed efficiency wage models based upon microfoundations to explain involuntary unemployment. According to the efficiency wage effect, productivity is a positive function of the wage. Thus, employers do not cut wages when labor demand falls; doing so would reduce productivity, raise unit labor costs, and decrease profits. This wage rigidity produces involuntary unemployment. However, Keynes took a different approach to explain involuntary unemployment [Wojick and Pernecky, 1994]. For Keynes, insufficient aggregate demand would create involuntary unemployment even if wages were flexible. Indeed, it was likely that wage rigidity would have a positive effect; wage cuts probably would reduce aggregate demand and increase involuntary unemployment, according to Keynes [Davidson, 1992, 453; Keynes, 1936, 18, 267-81].

This paper develops a "gift exchange" efficiency wage model in which involuntary (demand-deficient) unemployment exists, even with perfectly flexible wages. The theory also predicts the observed correlations between the unemployment rate and the cyclical behavior of inflation, real wages, nominal wages, productivity, and unit labor costs. Finally, consistent with New Keynesian efficiency wage theories which do not incorporate a gift exchange, this model generates solutions which violate Pareto optimality.

THE MODEL

The following efficiency wage model assumes bargaining occurs between a representative union and firm. The union acts as a principal on behalf of its workers. In accordance with other gift exchange versions of efficiency wage models, the union proposes productivity norms given the firm's wage offers. Conversely, the firm responds to productivity norm offers with wage proposals. A Cournot game illustrates the bargaining process. Each side takes the values of the other's variable as given when posting the levels for its own choice variable. The gift exchange occurs at the end of the bargaining process: at equilibrium. Thus, unlike other forms of "gift giving", this swap involves obligation, negotiation, and a formalized contract. The union's optimization process generates an efficiency wage curve which reflects the responsiveness of productivity to the wage. The remuneration curve depicts the sensitivity of wages to productivity, and follows from the firm's optimizing behavior.
Union Optimization and the Efficiency Wage Curve

Empirically, workers have significant and even primary latitude over work group norms, including productivity norms. Productivity norms are based to a great extent on work roles, which unions reinforce and formalize (Brewer, 1979, 51-87, 114). Unions also have substantial influence over other issues which relate to productivity including hiring, dismissal, layoff, and training policies (Freeman and Medoff, 1984, 115-16, 122-26). Of course, once the union-stipulated group productivity norm has been agreed upon, the employer must still measure and monitor the productivity of individual workers. Conversely, the union must make sure that firms compensate workers as promised (Alchian and Demsetz, 1972, 771-83, 790).

The union maximizes the utility of its members by choosing a productivity norm given both a wage set by the firm and the unemployment rate. Mathematically, the union chooses \( p \) to maximize

\[
z = Z(w, p, x)
\]

where \( Z \) is utility, \( w \) is the wage, \( p \) is the productivity norm, and \( x \) is the unemployment rate.

A higher productivity norm would influence utility in both negative and positive ways. It would negatively affect it by requiring more work effort. Furthermore, workers could experience increases in "stressors," such as industrial accidents or employee-paid training costs. They might also witness significant alterations in their work patterns (Cryso, 1986, 55-63). But higher productivity will also positively affect utility because it decreases the probability that the firm would reduce employment, lay off workers, or even close the plant permanently. The likelihood of firm retaliation for productivity reductions increases as lower productivity levels as the firm's cost-competitiveness becomes increasingly jeopardized. The union's utility function thus takes into account the job security of its members. Examples of companies where unions have accepted productivity increases in response to threatened plant closings include Xerox and Chrysler ("Why Move 2,000 Jobs?").

It is assumed that there exists a critical productivity level, defined as \( p^* \), such that \( \frac{dZ}{dp} > 0 \) for \( p < p^* \) and \( \frac{dZ}{dp} < 0 \) for \( p > p^* \). The gross effect of lower norms is to reduce the union's overall utility at \( p > p^* \). As productivity falls at these increasingly dangerous low levels, the loss in utility due to reduced job security increasingly dominates the gain resulting from lower effort (and any other declining negatives). Thus, both \( p \) and \( w \) are considered "goods" (as opposed to "bads") in this region which resembles a standard indifference curve. This approach differs from standard neoclassical theory which equates the productivity norm with effort, and thus only entails diutility (Shapiro and Stiglitz, 1984, 436). The negative influences of a higher norm increasingly dominate the positive impacts when \( p > p^* \).

The partial \( \frac{dZ}{dw} > 0 \); a higher wage always enhances utility. An increase in the unemployment rate reduces the union's utility, ceteris paribus. The partial \( \frac{dZ}{dx} < 0 \) due to the psychic costs of unemployment and the disciplining effect on issues (such as grievance procedures) which impact on more than just wages or productivity (Freeman and Medoff, 1984, 20-21). The indifference curve \( 2 \) is graphed in Figure 1.

The rationale for the shape of this indifference curve can be clarified by comparing points \( a, b, \) and \( c \) in Figure 1. The union is indifferent between \( a \) and \( c \), which gives a wage \( w_0 \). Specifically, the union is indifferent between \( p_0 \) where the union and its membersfeel very insecure, and where the factors creating diutility are low, and the higher \( p_0 \). This higher norm involves greater security, but also requires more effort, and possibly other negatives at \( b \). The negative impacts of a higher productivity norm just offset the positive effects on security.

An indifference curve map is graphed in Figure 2, where \( b_0, b_1, \) and \( b_2 \) represent minimum points. The union's utility improves at higher indifference curves. For instance, given \( w_1 \), \( Z_2 > Z_1 \), because \( p_0 > p^* \) in the region where \( \frac{dZ}{dp} > 0 \), and \( p_0 < p^* \) where \( \frac{dZ}{dp} < 0 \). This also demonstrates that \( p^* \) will be chosen given \( w_0 \); the optimal \( p \) corresponds to the minimum point on an indifference curve.

The efficiency wage curve is generated from the minimum points of these indifference curves. Given various wages, the union chooses the \( p \) levels associated with those points in order to maximize utility. The efficiency wage curve (EWC) depicts this in Figure 3 below. As the wage rises from \( w_0 \) to \( w_2 \), productivity norm increases from \( p_0 \) to \( p^* \) to \( p^* \). The reasons why \( \frac{dZ}{dp} > 0 \) from \( p^* \) to \( w \) can include all of the New Keynesian rationales for the efficiency wage effect. A rise in the wage: (1) improves the quality of the workers attracted to the firm, (2) reduces shirking by raising the opportunity cost of dismissal, (3) preserves human capital by lowering quits, and (4) increases the productivity norm as a "gift" to the firm for "the present" of a higher wage (Gerard, 1990, 1157). The critical \( p^* \) where a higher \( p \) goes from a gross "good" to a gross "bad" is greater because \( w \) is higher.
Firm Optimization and the Remuneration Curve.

The firm's optimization problem yields the remuneration curve just as the efficiency wage curve follows from union optimization. The firm chooses a wage in order to maximize its utility, \( f \), given the productivity level by the union and the unemployment rate. Mathematically, the firm chooses \( w \) to maximize the following objective function given \( p \) and \( x \):

\[
\max_{w} f = F(w, p, x)
\]

(2)

It is assumed that there exists a critical wage \( w^* \) below which an increase in the wage raises the firm's overall utility, i.e. \( \partial F/\partial w > 0 \) for \( w < w^* \), and above which an increase in the wage reduces the firm's overall utility, i.e. \( \partial F/\partial w < 0 \) for \( w > w^* \). A lower wage always has a positive effect on the firm's utility by directly raising short-run profits. This concern that lower wages enhance profits becomes stronger as wage levels (and thus total wage costs) rise. A lower wage offer also negatively affects the firm's utility by increasing the possibility of a future work stoppage or some other form of union retaliation, thus diminishing longer-period profits. This negative effect of a lower wage increasingly dominates the positive impact on profits when wage costs are low: i.e. \( w < w^* \). Employers would prefer to pay higher wages in this region to inhibit retaliation, even though this directly reduces short-run profits. Hence, unlike neoclassical theory which presumes employers always support lower wages because of the resulting greater short-run profits, employers in this model also take into account the "institutional" repercussions of wage cuts, including its ability to survive as a producer in the future. Thus, both \( w \) and \( p \) are "goods" at \( w < w^* \). At \( w > w^* \), wages are considered to be a "bad". At higher \( w \) levels in this region, the negative impact on the firm's utility of a higher wage increasingly dominates the declining threat of union retaliation.

The partial \( \partial F/\partial x > 0 \). Increasing the productivity norm raises the firm's "utility" by reducing costs. Also, \( \partial F/\partial p < 0 \). An increase in the unemployment rate decreases the firm's utility because of lower profit expectations, \( w \) and \( p \) held constant. The firm's indifference curve \( F \) is graphed in Figure 4.

The firm is indifferent between points, \( g \), and, \( h \). It is indifferent between paying the higher wage at \( g \) resulting in both higher short-run costs and more security from retaliation, and a lower wage at \( h \) involving lower short run costs but a greater threat. At point, \( j \), the negative impact of a lower wage just offsets the positive one. Figure 5 shows an indifference curve map for the firm.

The firm's utility increases as the indifference curves move from left to right. It moves from \( F_t \) to \( F_s \) to \( F_g \). Given \( p, F \), because \( w_s > w^* \) where \( \partial F/\partial w < 0 \), and \( w_s < w^* \) where \( \partial F/\partial w > 0 \). Also, this shows that \( w^* \) will be chosen given \( p, F \). The optimal point occurs where the indifference curve has an infinite slope. The points of infinite slope are labelled \( r^* \) and \( s \) on this indifference curve map.

The remuneration curve (RC), shown in Figure 6, is generated by the points of infinite slope on the indifference curves. The firm chooses \( w \) values corresponding to various given \( p \) levels.

As \( p \) rises from \( p_1 \) to \( p_2 \), the wage where the gross effect of a higher wage goes from positive to negative increases, from \( w^* \) to \( w^* \) to \( w^* \). The RC slopes upward because productivity advances reduce costs, thus increasing the firm's ability to pay higher wages. Firms must "pay for productivity" due to pressure from both the union and from other firms (Crypko, 1986, 27-39).
Equilibrium and Stability

The intersection of the efficiency wage and remuneration curves determines the equilibrium wage $w^*$ and price $p^*$. Linear functions are assumed for simplicity. Figure 7 represents the (Nash) equilibrium.

Stability requires that the efficiency wage effect exceeds the remuneration effect. Employers must have more bargaining power than employees, reflected in workers having greater responsiveness to wage increases than employers have to higher productivity norms. Graphically, the EWC curve must be steeper than the RC curve for stability. The unstable case is presented in Figure 8. In the Coase bargaining process, if the firm offered a wage below equilibrium, the union would counter with a productivity norm below equilibrium. In the figure, substituting a $w < w^*$ such as $w_1$ into the EWC would result in the union choosing productivity norm $p_1$. Employers would then counter with a wage lower than their initial offer; they would substitute this $p_1$ into the RC and choose $w_2$. The union would respond with an even lower productivity norm, $p_2$, when they substitute this $w_2$ into the EWC. Thus, no agreement would be reached, as $w$ and $p$ would iteratively diverge from their equilibrium levels.

Comparative Statics: a Rise in the Unemployment Rate

Figure 9 depicts the disciplining impact higher involuntary unemployment has on workers. For $p^* = \frac{\partial w}{\partial x}, \partial p^*/\partial x > 0$, an increase in the unemployment rate resulting from a reduction in aggregate demand enhances productivity at every $w$. In

Figure 9, this results in a rightward shift in the EWC and causes $w$ and $p$ to rise from $w_1$ and $p_1$ to $w_2$ and $p_2$, respectively. From the RC, $\partial w/\partial x < 0$. The RC curve shifts rightward with an increase in the unemployment rate; at every $w$ the firm can set a lower $w$. This shift has a depressing influence on both $w$ and $p$. Ultimately, as shown in the diagram, $w^* < w_1$ and $p^* > p_2$, an increase in the unemployment rate reduces the equilibrium wage and raises equilibrium productivity.

Consistencies Between Several Stylized Facts of the Business Cycle and the Model’s Assumptions and Predictions.

This model assumes or predicts a number of realistic correlations. First, as assumed, the unemployment rate empirically tends to move inversely and coincidentally with real output. Furthermore, movements in aggregate demand tend to lead output changes [Zarnowitz, 1985, 527-31]. Hence, theoretically, a reduction in aggregate demand can be interpreted as fomenting cyclical (and involuntary) unemployment.

Second, real wages do not fluctuate empirically in a strongly cyclical fashion because nominal wages and inflation tend to move together; both decline at later stages of a contraction and rise after an expansion has been underway. Furthermore, unit labor costs tend to fall late in a contraction and rise well into an expansion. This reflects similar movements in the inverse of productivity as well as in nominal wages [Zarnowitz, 1985, 535, 538, 543].

With the addition of Keynes’ view that unit labor costs are a key determinant of prices, this model can explain the cyclical movements in these variables [Keynes, 1936, 292-304]. Assume the wage in this model is in nominal terms and allow the
worse off because it is indifferent between the higher wages/productivity combination of \( w_s \) and \( p_s \) and the original levels of \( w_a \) and \( p \).

Both \( m \) and \( n \) represent points of tangency for the indifference curves, i.e. \( Z_m/Z_n = F_m/F_n \). Mathematically, the Pareto optimal equilibrium conditions for the "contract curve" can be generated from the following Lagrangian:

\[
\max L = Z(w, p, x) + \mu (F(w, p, x) - F_0).
\]

The first order conditions are

\[
\lambda \frac{\partial L}{\partial w} = Z_o + \mu F_w = 0;
\]

\[
\lambda \frac{\partial L}{\partial p} = Z_o + \mu F_p = 0.
\]

If both the firm and the union could cooperate to choose \( w \) and \( p \), they could move to a Pareto-optimal solution associated with higher \( w \) and \( p \) levels. Pareto optimality does not occur because the firm alone directly chooses the remuneration, and only the union can choose the productivity norm directly. An inordinate amount of cooperation would be necessary for the equilibrium values to coincide with the equalization of the marginal rates of substitution between \( w \) and \( p \).

CONCLUSIONS

New Keynesian efficiency wage theories exhibit several positive attributes. They collectively provide a number of intuitive and empirically supported rationales for the positive impact of wages on productivity. They have also re-established involuntary unemployment as a vital subject of study in macroeconomics. However, unlike Keynes’s theories, they rely on wage rigidity to generate involuntary unemployment. The efficiency wage model in this paper shows that a reduction in aggregate demand can increase involuntary unemployment with perfectly flexible wages. It also assumes or predicts movements in variables which are consistent with several important stylized facts of the business cycle. Hopefully, involuntary unemployment will not rely on wage rigidity in future efficiency wage models.

NOTES

This paper is based on a chapter from the author's Ph.D. dissertation, Efficiency Wages, Unions and Productivity Norms. The paper would not have been possible without Annette Krishna Dutt, who provided extensive comments. Teresa Ghilarducci and David Emery also offered valuable insights. The author is, of course, responsible for any errors.

1. This assumption excludes conflicts among the union leadership, among members, or between union officials and members.
2. See Ankerf (1987, 80-82) for an example of another gift exchange model which includes the remuneration and efficiency wage effects.
While these activities can be extremely costly and problematic, employers can glean much information about individual productivity by observing individual inputs. Also, the team's productivity could be measured accurately, even if individual productivity is not (Alchian and Demsetz, 1972, 77-83).

4. The price level is assumed to equal 1 to clarify the wage-productivity relationship.

5. This is assumed even if the job security of some members was hurt with new production methods.

6. As Victor Zarnowitz summarizes, What is particularly well established and important is the typically procyclical but lagging pattern in labor costs per unit of output, which reflects primarily the positive conformity and lead-times of labor productivity (output per hour of work). Real wages, on the other hand, normally do not show large deviations from trends that are consistently associated with business cycles. (1985, 543).

REFERENCES


INTRODUCTION

Economists and psychologists each have puzzled over the nature of decision making and the formation of expectations. Economists employ rationality as a paradigm, a commonly agreed upon way of modeling decision making. This paradigm suggests that decision makers use all relevant information to form unbiased predictions of the future. While this does not reject the existence of mistakes, or even adaptive behavior, it does imply that decision rules are under constant evaluation, and older rules are being supplanted by newer, more successful, forms (Luce, 1967, 217). When agents do make mistakes, this theory predicts learning, hence improved forecast accuracy over time.

For psychologists, rationality is one of a large number of competing theories of human behavior. Lacking an agreed-upon paradigm, the focus instead is on empirical tests of decision making. The result has been a large and growing literature that suggests frequent departures from rationality. This literature suggests, for example, that humans have a limited ability to process information and a limited access to information, and may be influenced by the context, or framework, in which a decision is presented (Simon, 1957, 1978; Tversky and Kahneman, 1987). Psychologists are more comfortable with the notion of "irrationality" than economists, and are more willing to suggest that humans may not learn from past mistakes.

Recently, economists and psychologists have begun a conversation on whether the rationality paradigm in economics can profit from empirical evaluation. This evaluation would include both the paradigm's prediction of unbiased forecasts and its assumption of learning. The purpose of this paper is to examine the forecasts of business managers for evidence of bias and learning. Are managers' forecasts consistent with the economist's notion of rationality, or do they instead support the psychology literature's doubts about rationality?