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A Simple Model of Keynesian Unemployment

Tetsuya Nakajima*

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Abstract

This paper examines equilibrium unemployment by constructing a general equilibrium model that compactly incorporates markets for output, labour, money, and equity. While a mechanism of efficiency wage brings about nominal wage rigidity, unemployment that occurs within our model definitely has Keynesian features. For instance, a reduction in wages generates increased unemployment via a decrease in consumption. The paper also demonstrates the possibility of Pareto improvement through an increase in unemployment benefits.

* Osaka City University, Faculty of Economics, Sugimoto 3-3-138, Sumiyoshi, Osaka 558-8585, JAPAN. E-mail: nakajima@econ.osaka-cu.ac.jp. Tel.: +6-6605-2281.

1 Introduction

This paper considers whether it is possible to construct a micro-founded model in which equilibrium unemployment is caused by a shortage in effective demand rather than excessively high wages. One of the most influential theories concerning equilibrium unemployment is the efficiency wage theory.[1] To the extent that firms determine wages by taking into account workers' shirking, the current study uses an efficiency wage framework of the shirking type presented by Shapiro and Stiglitz (1984).[2] As commonly found in the efficiency wage literature, an outcome of the present model is that wages are not market-clearing; however, there is a crucial difference between the preceding efficiency wage arguments and the argument developed below. In the preceding models, the cause of unemployment is excessively high wages set to prevent workers from shirking; therefore, a reduction in wages contributes to a reduction in unemployment. In contrast, the primary cause of unemployment in the present model is insufficient demand for outputs. Accordingly, a reduction in wages acts to increase unemployment via a decrease in consumption.

The above finding has a unique implication in terms of unemployment benefits. In the present case, as well as that of Shapiro and Stiglitz, an increase in unemployment benefits reduces workers' opportunity cost for being dismissed, and accordingly induces firms to pay higher wages to prevent workers from shirking. In the case of Shapiro and Stiglitz, the higher wages immediately result in higher rates of unemployment. In our case, however, the increase in nominal wages leads to an increase in both the price index and interest rates. Aggregate demand and employment are then enhanced via the income effect of the higher interest rates. Thus, taking into account market interactions, the current paper demonstrates the possibility that generous benefits for unemployed workers may be compatible with low rates of unemployment.

The present model is a natural extension of static new Keynesian frameworks to a dynamic OLG framework.[3] In the new Keynesian literature, Dixon (1990) and the current paper share the common property of a rigid nominal wage, which is a constant mark-up over an unemployment benefit. However, the effect of a benefit-cut on unemployment rates turns out to be contradictory in the two papers. While the benefit-cut in our model increases unemployment via the negative income-effect of lower interest rates, the benefit-cut in Dixon's model reduces unemployment via the real balance effect. Holmlund's (1998) survey of unemployment benefits shows that search-matching models and union-bargaining models have played a central role in recent developments in this field. Under these circumstances, a distinctive feature of our paper is to shed light on unemployment benefits from an unambiguously Keynesian standpoint.

2 Model

This section presents a simple model for formulating the behaviours of firms and workers in four stages. Firms decide managerial plans that include such elements as how many workers to employ, how much to produce, and at what levels they set their wages and prices. Workers, the number of whom is normalized to unity, are born every period. Each worker lives two periods. In their first period, workers obtain wages if they are employed and not dismissed. Otherwise, they receive unemployment benefits from the government. If employed, workers can choose an efficiency level for their work because firms can only incompletely monitor their workers. Workers can carry over their revenues, in the forms of money and equities, into the next period and then spend all of it on consumption. The sequence of these events is summarized in Figure 1. The decision-making processes are solved by backward induction.

2.1 Stage 4: Consumption at Period *t*+1

According to the settings of monopolistic competition,[4] a worker *j* at period *t*+1 spends all of his/her equities and money on each variety of consumption goods so as to maximize the consumption index: $C_{t+1}^{j} \equiv \left[\int_0^1 (C_{i,t+1}^{j})^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}}$, subject to the budget constraint: $\int_0^1 P_{i,t+1} C_{i,t+1}^{j} di = (D_{t+1} + S_{t+1}) E_t^j + M_t^j$, where $C_{i,t+1}^{j}$ denotes the amount of consumption goods *i*, $P_{i,t+1}$ is the price of the consumption goods *i*, D_{t+1} is the dividend, S_{t+1} is the equity price, E_t^j is the amount of equities, and M_t^j is the amount of money. As a result, the demand of worker *j* for consumption goods *i* is $C_{i,t+1}^{j} = \left(P_{i,t+1}/P_{t+1}\right)^{-\eta} \left[(D_{t+1}E_t^j + S_{t+1}E_t^j + M_t^j)/P_{t+1}\right]$, where P_{t+1} denotes the price index given by $P_{t+1} \equiv \left[\int_0^1 P_{i,t+1}^{1-\eta} di\right]^{\frac{1}{1-\eta}}$. We then have

$$P_{t+1} C_{t+1}^{j} = (D_{t+1} + S_{t+1}) E_t^j + M_t^j . \tag{1}$$

The worker *j* will obtain utility via these activities. It is assumed that the utility can be expressed by the function *U*(*C*, *M/PC*). The utility depends not only on consumption but also on the ratio of money to the amount of spending, because a high money ratio—a high liquidity ratio—will reduce the efforts needed for transactions.[5] For simplicity, the utility function is specified as: $U(C, M/PC) \equiv \log C (M/PC)^{1-\alpha}$, in which marginal utility of the liquidity ratio diminishes faster than that of intrinsic consumption.[6] Thus, the utility of worker *j* at Stage 4 is[7]

$$U_{j,t+1} = \alpha \log C_{t+1}^{j} + (1-\alpha)\log(M_t^j / P_{t+1}) . \tag{2}$$

2.2 Stage 3: Choice between Money and Equities at Period *t*

Equation (1) can be rewritten as

$$P_{t+1}C_{t+1}^{j} = (1+R_{t+1})I_t^j - R_{t+1}M_t^j \tag{3}$$

where $R_{t+1}(= (D_{t+1} + S_{t+1} - S_t)/S_t)$ represents the interest rate of equities, and $I_t^j (= S_t E_t^j + M_t^j)$ is the amount of income to be divided into money and equities. Note that the income I_t^j is already determined at Stages 1 and 2. Therefore, the problem at Stage 3 is formalized as follows:

$$\operatorname*{Max}_{M_t^j} U_{j,t+1} \equiv \alpha \log C_{t+1}^{j} + (1-\alpha)\log(M_t^j / P_{t+1})$$

subject to $P_{t+1}C_{t+1}^{j} = (1+R_{t+1})I_t^j - R_{t+1}M_t^j$.

From the first-order condition, we have

$$M_t^j = (1-\alpha)(1+R_{t+1})I_t^j / R_{t+1} . \tag{4}$$

Accordingly, the consumption index and utility at period *t+1* are, respectively,

$$C_{t+1}^{j} = \alpha(1+R_{t+1})I_t^j / P_{t+1} , \tag{5}$$

$$U_{j,t+1} = \log \alpha^{\alpha}(1-\alpha)^{1-\alpha}\left(\frac{1}{R_{t+1}}\right)^{1-\alpha}\frac{(1+R_{t+1})I_t^j}{P_{t+1}} . \tag{6}$$

2.3 Stage 2: Determination of Efficiency at Work

Let *W* denote nominal wages, *V* unemployment benefits for a dismissed worker, and τ tax rates. The after-tax income of employee *j*, I_t^j , is $(1-\tau_t)W_t$ if the employee is not dismissed. If dismissed, the income is $(1-\tau_t)V_t$.[8] Then, from (6), the utilities of a wage earner and of a non-wage earner are, respectively,

$$U_{t+1}^{w} \equiv \log \alpha^{\alpha} (1-\alpha)^{1-\alpha} (1/R_{t+1})^{1-\alpha} (1+R_{t+1})(1-\tau_t)(W_t / P_{t+1}) , \tag{7}$$

$$U_{t+1}^{v} \equiv \log \alpha^{\alpha} (1-\alpha)^{1-\alpha} (1/R_{t+1})^{1-\alpha} (1+R_{t+1})(1-\tau_t)(V_t / P_{t+1}) . \tag{8}$$

Accordingly, for an employee the utility expected at period t is given by[9]

$$EU \equiv \beta(e)(U^{w} - \delta e) + (1-\beta(e))(U^{v} - \delta e) \tag{9}$$

where e denotes the efficiency at work, and δ (> 0) is the marginal disutility of e. The efficiency e is normalized as being unity under no shirking. The function $\beta(e)$ gives the probability of no dismissal, and reflects incomplete monitoring. Appendix I provides the derivation of $\beta(e)$. As shown in Figure 2, the function $\beta(e)$ can be characterized by an S-shape, i.e., $\beta'(e) \geq 0$ for all values of e, and $\beta''(e) \leq 0$ for a right-side range of e.

The employed worker will decide an efficiency level e so as to maximize the expected utility given by (9).[10] The first-order condition is

$$\beta'(e)\log(W/V) - \delta = 0 . \tag{10}$$

Then, from (10), we obtain

$$e'(W) \equiv \frac{de}{dW} = \frac{(\beta'/W)}{-\beta''\log(W/V)} > 0 , \tag{11}$$

which shows that efficiency is enhanced with a rise in nominal wages. While an increase in efficiency enhances disutility, it reduces the probability of dismissal. In these circumstances, as has been described in the literature on efficiency wages, if a firm pays a higher wage to its workers, the workers will understand that the opportunity cost of being dismissed is increasing; accordingly, they will select a higher efficiency, aiming not to be dismissed.

Notice that, as far as an internal solution holds with respect to e, we have

$$EU = \beta(e)(U^{w} - U^{v}) + U^{v} - \delta e > \beta(0)(U^{w} - U^{v}) + U^{v} > U^{v} . \tag{12}$$

Under the assumption that the benefit for an unemployed worker is V, the expected utility of an employed worker is higher than the utility U^V. Unemployment in this case is not voluntary.[11]

2.4 Stage 1: The Firm's Behaviour

Let us assume identical and monopolistically competitive firms, the number of which is normalized to unity. Each firm is constrained by the following production function and demand function:

$$Y_i = eL_i, \tag{13}$$

$$Y_i = (P_i / P)^{-\eta} Y. \qquad (\eta > 1) \tag{14}$$

where Y_i denotes the output of firm i, L_i is the number of workers employed by firm i, P_i is the output price of firm i, and Y is the aggregate real expenditure. Taking (13) and (14) into account, the firm will maximize its profit:

$$\underset{W_i, P_i}{\text{Max}}\ \Pi_i \equiv P_i Y_i - W_i \beta L_i = P_i Y_i - \frac{W_i \beta}{e} Y_i$$

where W_i is the nominal wage in firm i. The firm will decide W_i so as to minimize the unit cost $(W_i \beta / e)$ or to equivalently maximize $e/(W_i \beta)$. The first-order condition is

$$\frac{e' W_i}{e}(1 - \frac{e\beta'}{\beta}) = 1, \tag{15}$$

which implies the Solow-condition modified due to $\beta(e)$. With regard to P_i, the firm will mark up the unit cost:

$$P_i = \frac{W_i \beta}{\theta e} \tag{16}$$

where $1/\theta\ (\equiv \eta/(\eta - 1))$ represents a mark-up ratio. Note that θ will also imply the wage share in income because $W\beta L / PY = \theta$.

2.5 Government

The government minimizes the discretionary spending $\int_0^1 P_i G_i di$, subject to

$\left[\int_0^1 (G_i)^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}} = G$. G denotes the index value to be attained, and G_i is the amount of consumption goods i that the government consumes. As a result, the demand of government for consumption goods *i* is given by $G_i = \left(P_i / P\right)^{-\eta} G$. Then, the budget constraint of government can be expressed as

$$PG = \tau W\beta L + \tau V(1-\beta L) + T - V(1-\beta L), \tag{17}$$

where *T* denotes corporation tax.[12] Note that the number of workers in one generation is normalized as unity. The right-hand side of the above equation implies the revenue allowed for discretionary spending. To concentrate on the effective demand effect of *G*, it is assumed that *G* does not have any direct effect on the utility and production functions (i.e., a complete waste). It is also assumed that the tax rate τ is always set so as to cover the amount of unemployment benefits:

$$V(1-\beta L) = \tau W\beta L + \tau V(1-\beta L). \tag{18}$$

Consequently, $PG = T$, where *T* is assumed to be endogenous.[13]

3 Equilibrium

This section examines equilibrium in each market. First, the nominal wage and efficiency in equilibrium are identified. Second, equilibria in the markets are specified for outputs and money. Finally, by integrating those results, the dynamics and stationary states are examined with regard to outputs.

3.1 Nominal Wage and Efficiency

Introducing (11) into (15), we have

$$\log(W/V) = (1-\varepsilon_1)/\varepsilon_2 \tag{19}$$

where $\varepsilon_1 \equiv e\beta'/\beta$ and $\varepsilon_2 \equiv -e\beta''/\beta'$. Once the unemployment benefit V is established by the government, the efficiency e and the nominal wage W are determined in (10) and (19).[14] Equation (10) implies that W must be larger than V, i.e., nominal wages never fall to the levels of unemployment benefit even if there are many unemployed workers who firms could use to replace current employees. It is also clear that an increase in V leads to a proportional increase in W, without any effect on e and $\beta(e)$. As shown later, however, an increase in V has a positive effect on aggregate demand and employment.

3.2 Output Market and Money Market

Equilibrium in the output market is indicated by

$$PY_{t+1} = \alpha(1+R_{t+1})(1-\tau_t)W\beta L_t + \alpha(1+R_{t+1})(1-\tau_t)V(1-\beta L_t) + PG\,. \tag{20}$$

The first and second terms in the right-hand side of (20) represent the consumption of wage earners and of non-wage earners, respectively. Taking (13), (16), and (18) into account, (20) becomes

$$Y_{t+1} = \alpha(1+R_{t+1})\theta Y_t + G\,. \tag{21}$$

The money-market equilibrium is given by

$$\overline{M} = \frac{1+R_{t+1}}{R_{t+1}}(1-\alpha)(1-\tau_t)W\beta L_t + \frac{1+R_{t+1}}{R_{t+1}}(1-\alpha)(1-\tau_t)V(1-\beta L_t) \tag{22}$$

where $\overline{M}$ is a given amount of money.[15] Again, with the help of (13), (16), and (18), the above (22) becomes

$$m = \frac{1+R_{t+1}}{R_{t+1}}(1-\alpha)Y_t \tag{23}$$

where $m \equiv e\overline{M} / \beta W$. The pair of equations (21) and (23) specify the dynamics of Y and R.

3.3 Equilibrium Dynamics and Stationary States

From (21) and (23), we obtain a difference equation that characterizes the equilibrium dynamics of Y:

$$Y_{t+1} = \frac{m\alpha\theta Y_t}{m-(1-\alpha)\theta Y_t} + G\,. \tag{24}$$

The curve in Figure 3 depicts (24). The curve is convex downward because the interest rate R_{t+1} in (23) increases with Y_t; i.e., the higher the income, the greater the money demand and the higher the interest rate. Figure 3 shows that two stationary states exist in this system because of this convexity.[16] The necessary and sufficient condition for two stationary states is[17]

$$\frac{(1-\alpha\theta)^2 m}{\theta(1-\alpha)(1+\sqrt{\alpha\theta})^2} > G > 0\,. \tag{25}$$

Because an increase in G shifts the curve in Figure 3 upwards, it is apparent that for stationary states to exist, G must lie within a limited range. In addition, as the fraction in (24) indicates consumption, the marginal propensity to consume is smaller than unity at point K, although it is larger than unity at point N.

Figure 3 also shows that while the stationary state K is stable, the stationary state N is unstable, and as long as the initial value Y_0 falls within the range $0 \le Y_0 \le Y^{**}$, the path of Y is non-divergent. In this range, therefore, any initial value of Y_0 is consistent with the perfect foresight solution. Thus, output levels are indeterminate in the short run. In the long run, however, every solution converges to Y^* except for the case of $Y_0 = Y^{**}$. Therefore, in terms of the long run, it is meaningful to analyze the effect of a shock on Y^*. Taking these characteristics into account, focus is concentrated on the stationary state *K*.

4 Comparative Analysis

This section develops comparative statics concerning unemployment benefits, income distribution, and government spending. First, as a useful tool for analysis, the *GS*-*LM* diagram is presented.

4.1 GS-LM Diagram

Let us examine an economy in the stationary state *K*. In the analogy of the *IS*-*LM* diagram, let two curves stand for equilibria in output and money markets. Rewriting (21) and (23), we have[18]

$$G = (1 - \alpha(1 + R)\theta)Y, \tag{26}$$

$$\frac{1+R}{R}(1-\alpha)Y = m. \tag{27}$$

Equation (26) is drawn as a *GS* curve in Figure 4 and indicates that government spending is equal to savings. Equation (27) is drawn as an *LM* curve and indicates that money demand (liquidity preference) is equal to money supply.[19] Note that the *GS* curve always has a positive slope because consumption increases with increasing interest rates. In Figure 4, point *K* corresponds to point *K* in Figure 3.

4.2 The Effect of an Increase in Unemployment Benefits

An increase in unemployment benefit *V* brings about a proportional increase in nominal wages and prices (see (10), (16), and (19)). Therefore, real wage *W*/*P* and real benefit *V*/*P* do not change; however, it will reduce the amount of *m*. Responding to the decrease in *m*, the *LM* curve shifts upwards, as in a usual *IS*-*LM* exercise. Then, Y^* and *R** in Figure 4 are enhanced. Thus, a rise in unemployment benefit enhances aggregate demand and employment. This finding is in contrast to the results of Shapiro and Stiglitz (1984) and Dixon (1990).

Now let us examine the effects of an increase in *V* on individual utility. First, the increase affects the utility in (7) and (8) via an increase in interest rates; however, the effect of the increased interest rate is ambiguous because it works in two opposite directions. On one hand, an increase in interest rates allows workers consuming more and hold more money via a greater return from equities (an income effect). On the other hand, an increase in interest rates leads to a higher cost of money holdings and induces workers to reduce money holdings (a substitution effect). Then, taking note of (27), it is apparent that the sign of $\partial((1+R)/R^{1-\alpha})/\partial R$ depends on the sign of $(Y-m)$ in equilibrium. From (24), we obtain[20]

$$\frac{\partial((1+R)/R^{1-\alpha})}{\partial R} \gtrless 0 \quad \Leftrightarrow \quad G \gtrless \frac{(1-\theta)m}{1-\theta(1-\alpha)}. \tag{28}$$

That is, if government spending is relatively large, an increase in *V* enhances utility via the increase in interest rates. This observation is briefly explained as follows. The increased amount of government spending leads to higher outputs, greater demand for money, and higher interest rates. Under the higher rates of interest, the substitution effect is weakened.

Secondly, as unemployment is decreasing in *V*, individual workers always obtain a certain gain from a lower tax rate τ. Thirdly, as the expected utility of an employed worker is greater than the utility of an unemployed worker, additional employment is a positive factor in ex ante utility. Thus, it is concluded that as long as G is relatively large, an increase in V can be Pareto-improving in an ex ante sense.

An increase in V enhances the ex post utility of those workers with unchanging employment status; however, a newly employed worker who ends in being dismissed will suffer a discontinuous amount of δe loss in ex post utility.

4.3 Income Distribution, Unemployment, and Individual Income

How does the wage share in income θ affect unemployment and individual income? First, an increase in θ raises consumption in (26). Then, for a given interest rate, more income is required to create the savings equal to a given amount of government spending. Accordingly, the *GS* curve shifts toward the right in Figure 4. As a result, equilibrium output Y^* is enhanced and unemployment is reduced.

Secondly, as output prices are reduced due to a lower mark-up, both the wage earner and the non-wage earner can obtain a larger individual income in real terms. This result is important because it indicates the compatibility of higher real wages and higher levels of employment. It also highlights a difference between the findings of Shapiro and Stiglitz (1984) and the present study. In the present case, individual workers also benefit from a tax cut because of a reduction in unemployment.

4.4 Fiscal Policy

Let us now examine the effect of G in terms of its multiplier. Let c denote the marginal propensity to consume. Noting that $C = \alpha m\theta Y/(m-(1-\alpha)\theta Y)$ and $1+R = m/(m-(1-\alpha)Y)$, the marginal propensity to consume can be expressed as $c = \alpha\theta(1+R)^2$, which is smaller than unity at the stationary state K.[21] From (24), we obtain the multiplier that can be found in Keynesian textbooks:

$$dY / dG = 1/(1-c) . \tag{29}$$

The above result is similar to those of Molana and Moutos (1991), Dixon (1987), Mankiw (1988), and Bénassy (1995); however, while their multiplier decreases with the real wage, ours increases together with the real wage because $\partial c / \partial \theta > 0$. Hence, the current model may be more Keynesian-like than those of the above previous studies.

5 Concluding Remarks

This paper presents a simple but rigorously micro-founded general equilibrium model that consists of familiar elements: efficiency wage, monopolistic competition, and OLG structure. While each element is orthodox, unemployment occurring in the model is to be understood not as a consequence of high wages but due to insufficient demand for outputs. For unemployment of this type, it is desirable for the government to increase unemployment benefits, as the benefits support wages and thereby prevent further falls in effective demand. Combined with relatively high levels of government spending, this might lead to a Pareto improvement.

A future extension of the model will be to incorporate capital and investment. The above results may then hold only under more restrictive conditions, depending, for example, on the degree of substitution between labour and capital. However, considering Leontief-type technology, complete refutation of the above results is considered unlikely.

Appendix I: Derivation of $\beta(e)$

Let us divide one period into Z sub-periods, where Z is assumed to be sufficiently large. Assume that a worker has two choices in each sub-period: to shirk or not to shirk, and that if a worker is shirking at a sub-period, the probability of its detection is exogenously given by q, which is less than unity because of imperfect monitoring. Also assume that due to the difficulty in verification, a firm can dismiss a worker only if the firm detects the worker shirking more than $\bar{k}$ times. If S denotes the number of sub-periods where a worker is shirking, the probability distribution of detection k times is given by the following binomial distribution:[22]

$$P(k|S) = \frac{S!}{k!(S-k)!} q^k (1-q)^{S-k}. \tag{A-1}$$

Figure 5 draws (A-1) approximately as a continuous curve. From (A-1), the probability of being dismissed is obtained as

$$P(S) = \sum_{k=\bar{k}+1}^{S} \frac{S!}{k!(S-k)!} q^k (1-q)^{S-k}, \tag{A-2}$$

which is drawn in Figure 6. Let us now define the efficiency as $e \equiv (Z-S)/Z$. Then, noting that S=Z(1-e), $\beta(e) \equiv 1 - P(Z(1-e))$ is obtained, as drawn in Figure 2.

Appendix II: A Numerical Example of (10) and (19)

In Figure 7, the reversed U-shape line and the second line depict the right-hand side of (19) and of the following equation, respectively,

$$\log(W/V) = \delta / \beta'(e) \tag{10'}$$

where the parameter values are $\bar{k} = 4$, q=0.1, Z=105, and $\delta = 0.005$. Although these lines intersect at two points, only the right-hand point in Figure 7 satisfies the second-order condition in the firm's decision.

Notes

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[1] For an excellent survey, see Yellen (1984).

[2] For recent papers on the efficiency wage that are influenced by Shapiro and Stiglitz (1984), see Nakajima (2006), Alexopoulos (2004), and Boadway *et al*. (2003), for example. However, the efficiency wage literature, including the above papers, hardly discuss Keynesian unemployment.

[3] For static new Keynesian models, see Akerlof and Yellen (1985), Startz (1989), Blanchard and Kiyotaki (1987), Dixon (1987), Dixon (1990), and Benassy (1995).

[4] See Blanchard and Kiyotaki (1987).

[5] Feenstra (1986) discusses the equivalence of money in the utility approach and the transaction cost approach.

[6] Ono (1994) developed a unique theory of Keynesian stagnation in which liquidity preference is insatiable.

[7] In Shapiro and Stiglitz (1984), the utility function is assumed to be linear.

[8] Substituting consumption tax for income tax does not change the results.

[9] Subscripts are abbreviated where it does not lead to any confusion.

[10] Due to the two-period OLG structure, dismissed workers do not have any chance of being re-hired. This assumption simplifies the analysis by letting workers decide e independent of employment rates.

[11] If the benefit for an unemployed worker is much higher than that for a dismissed worker, unemployment could be voluntary.

[12] As a result, dividends will be the after-tax profit, i.e., $DE = \Pi - T$. See also footnote 19.

[13] This specification of the tax scheme may be *ad hoc*, but as demonstrated later in the text, it greatly simplifies the analysis.

[14] Appendix II provides a numerical example of (10) and (19) only for the sake of confirming the existence of meaningful e and W.

[15] It is assumed that the amount of $\overline{M}$ was issued in past activities of the government, and that thereafter $\overline{M}$ has passed from generation to generation through transactions in markets.

[16] In an overlapping generations model with fixed prices, Madden (1992) shows two temporary equilibria that are similar to ours. Based on an efficiency wage mechanism, the current paper provides an explicit explanation of why nominal wages (and thereby prices) do not fall despite the existence of unemployment.

[17] Inequality (25) can be derived from the discriminant of a quadric equation, into which (24) is transferred.

[18] The focus is on the case where $L = Y / e < 1$ under sufficiently small *G* and *m*.

[19] Taking into account *PG*=*T* and $W\beta / e = P\theta$, $(1-\theta)PY - T = R(\theta PY - \overline{M})$ is derived from (26) and (27), i.e., the after-tax profit of firms equals the net return on equities.

[20] By setting $Y_{t+1} = Y_t = Y = m$ in (24), and solving for *G*, we obtain the fraction in the right-hand side of (28). For this stationary state ($Y = m$) to be point *K* rather than point *N*, we have to assume that $1-\theta > \theta(1-\alpha)(1-\theta(1-\alpha))$.

[21] Unlike its usual definition, *c* includes the effect of a change in *R* as well as the direct effect of *Y* on consumption.

[22] For example, see Eric W. Weisstein, "Binomial Distribution," from *MathWorld*--A Wolfram Web Resource. http://mathworld.wolfram.com/BinomialDistribution.html.

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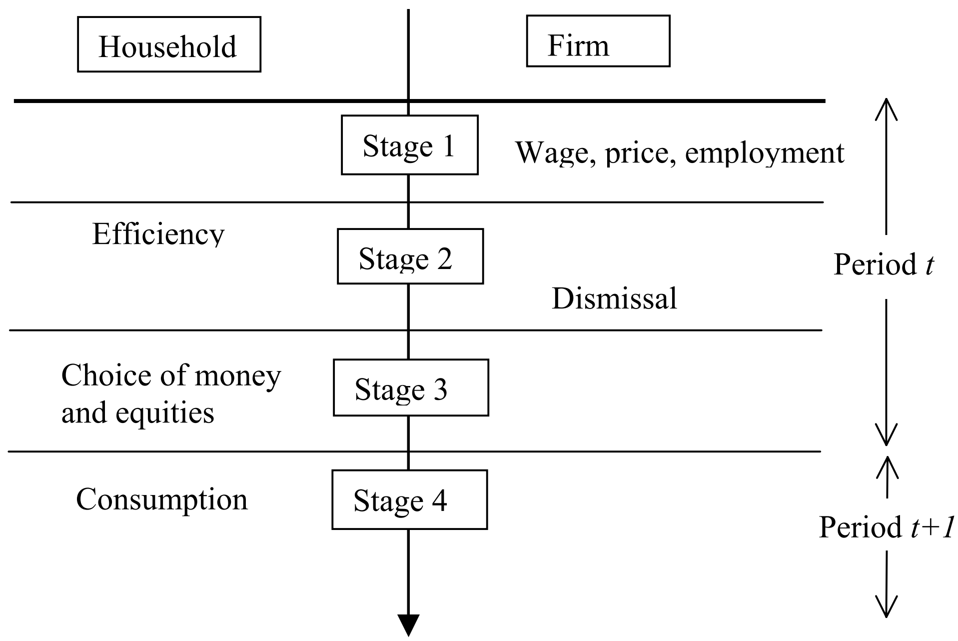

FIGURE 1

Flowchart of Decisions

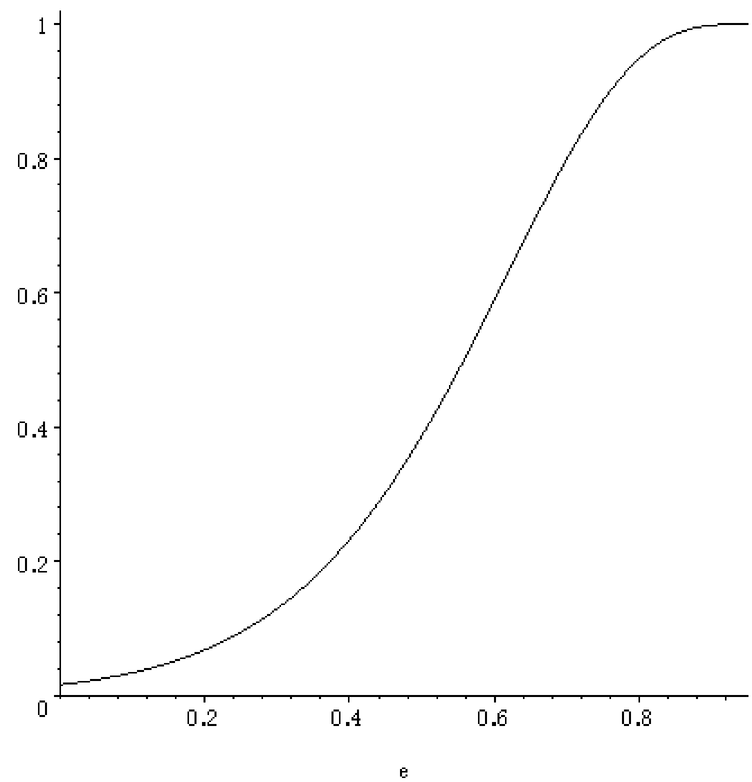

FIGURE 2

Function $\beta(e)$

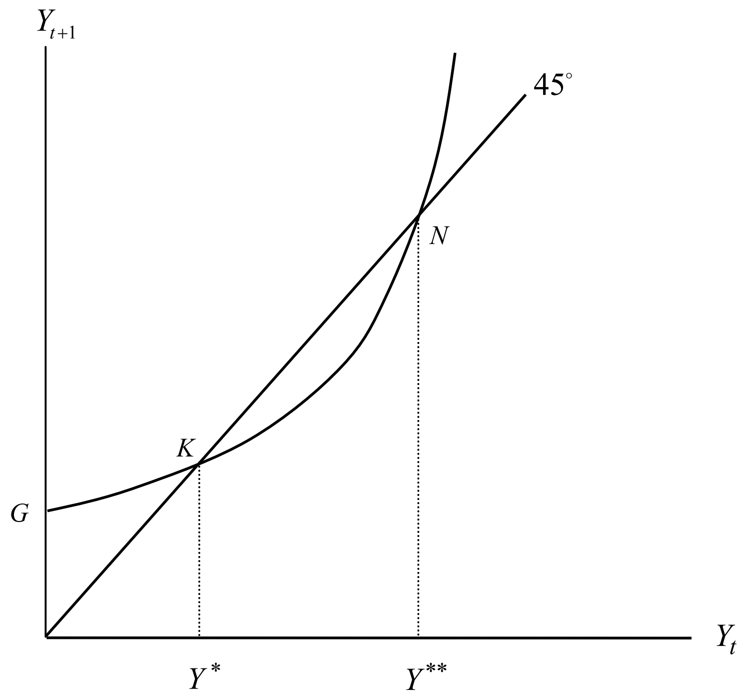

FIGURE 3

Dynamics of *Y*

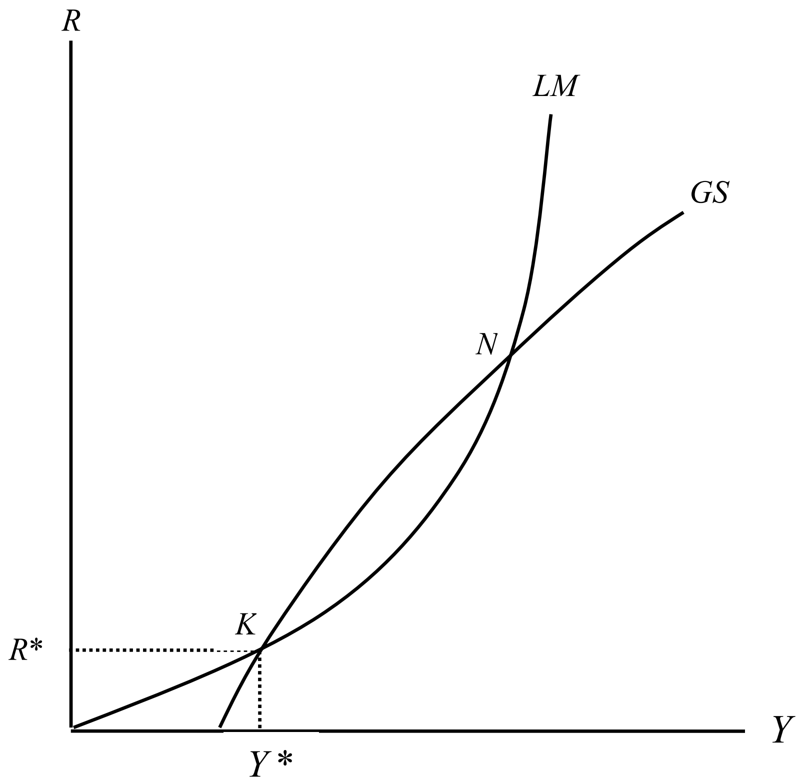

FIGURE 4

***GS*-*LM* Diagram**

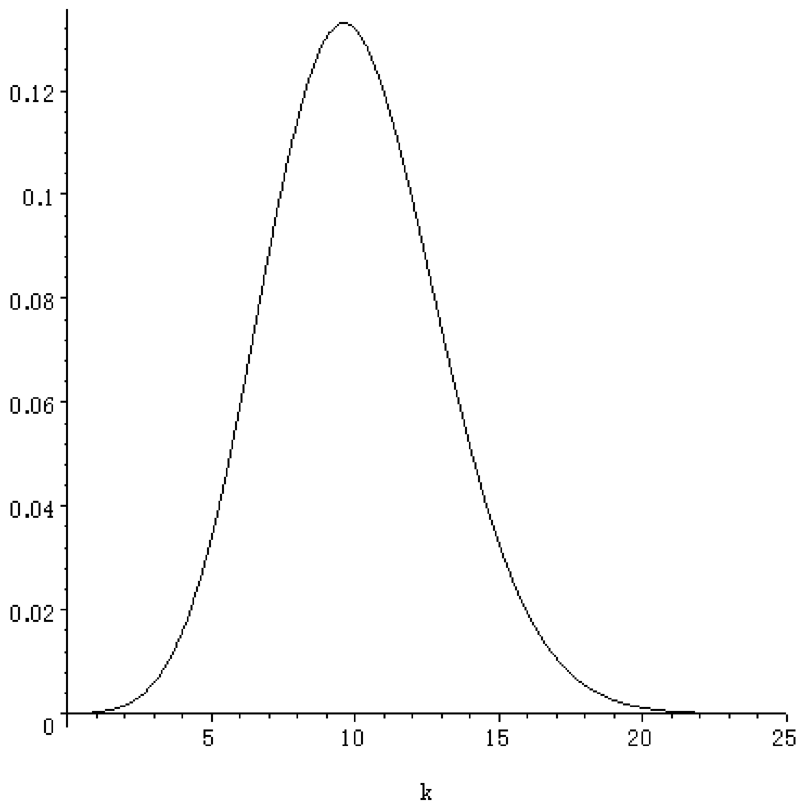

FIGURE 5

Binomial Distribution $P(k|S)$; S=100, q=0.1.

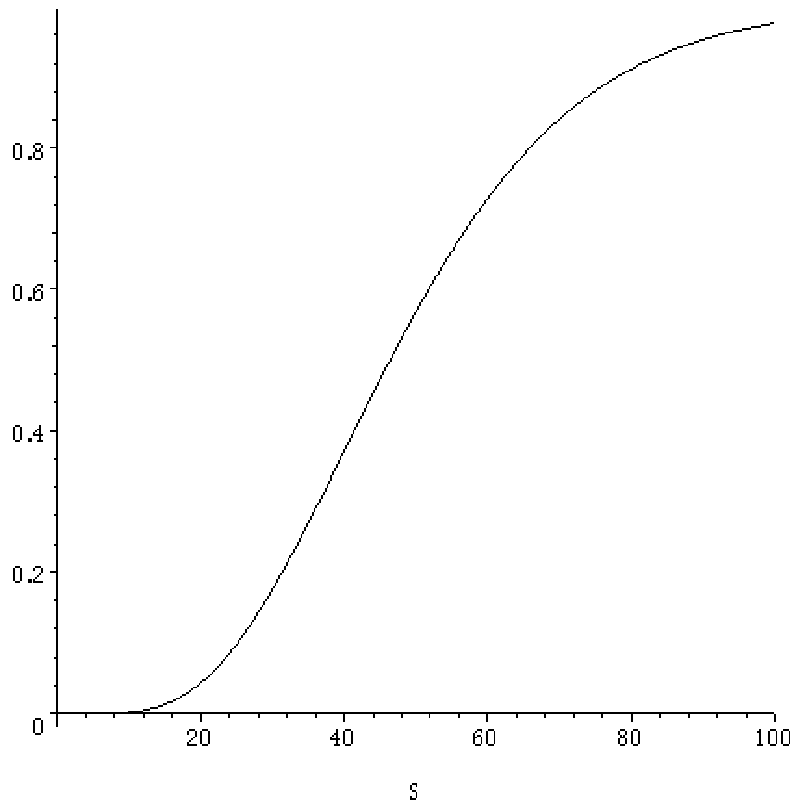

FIGURE 6

Function *P*(*S*); $\bar{k} = 4$**,** $q = 0.1$.

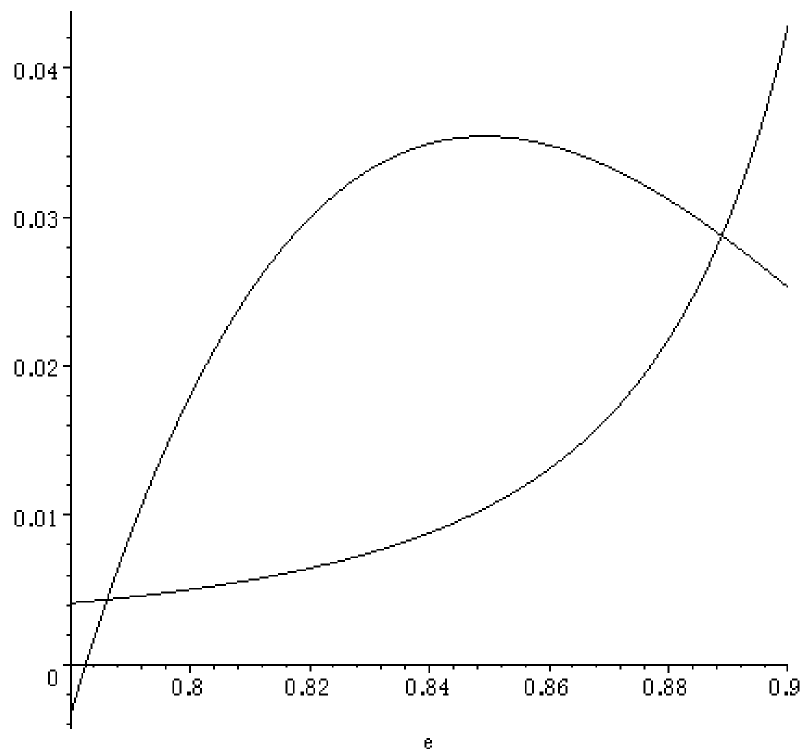

FIGURE 7

A Numerical Example of (10') and (19); $\bar{k} = 4$**,** q=0.1, Z=105, $\delta = 0.005$**.**