Inflation, Unemployment, and Economic Growth*

By Kilman Shin**

<Contents>

I. Introduction

The high rates of inflation and unemployment have become major economic problems in many countries. However, a statistical survey shows that there is a wide range of variations in the rate of inflation and the rate of unemployment. For instance, in 1974 data, the rate of inflation ranged from 513% in Chile, 39.78% in Israel, to 6.99% in Germany(West) and 9.40% in Norway. In the U.S., the rate of inflation was 11.01%, which was a record high since World War II. As for the rate of unemployment, it ranged from 15.3% in Trinidad, 13.3% in Puerto Rico, to 1.4% in Japan, and 1.5% in Austria, Norway and Sweden.(1)

The objective of this brief paper is to review some alternative theories of inflation and unemployment, and to test if such theories can explain the international differences in the rates of inflation and unemployment. In the following sections II and III, we will review two major current theories of inflation and unemployment, namely, the quantity theory of money and the

* The paper was presented at the annual conference of the Western Economic Association, Anaheim, California, June 20, 1977.

** The author is Associate Professor of Economics, Western Carolina University.

(1) All the data are taken or calculated from U.N., *Monthly Bulletin of Statistics*, Jan. 1977. In 1975 data, the rate of inflation ranged from 359.66% in Chile, 39.26% in Israel, to 5.98% in West Germany and 8.47% in Austria. The rate of unemployment ranged from 18.2% in Puerto Rico, 15.0% in Chile, to 1.4% in Sweden and 1.9% in Japan.

Phillips curve hypothesis. In section IV, we will present a more generalized inflation and unemployment model, in which we will point out that the quantity theory or the monetarists' argument that the natural rate of unemployment is independent of the demand-generating policy is theoretically defective. In section V, the international regression results are presented, and in the final section VI, a summary and conclusions are provided.

II. The Quantity Theory of Money

In order to review some inflation and unemployment theories, we have to discuss, first of all, the classical quantity theory of money. Given the equilibrium condition for the supply and demand,

$$MV=PQ \tag{1}$$

$$P=MV/Q \tag{2}$$

where

M=the supply of money
V=the velocity of money
P=the level of prices
Q=the real output.

In terms of the percentage growth rates, if the above variables are not constants, by totally differentiating Equation (2), we obtain:

$$\Delta P/P=\Delta M/M+\Delta V/V-\Delta Q/Q. \tag{3}$$

However, the uniqueness of the quantity theory is that the velocity and real output are independent of the supply of money and constant. So from Equation (3), we obtain:

$$\Delta P/P=\Delta M/M. \tag{4}$$

In a functional form, we may rewrite Equation (4) as

$$\Delta P/P=F\ (\Delta M/M,\ e). \tag{5}$$

Equation (5) states the basic quantity theory hypothesis that the rate of inflation is largely determined by the rate of increase in the supply of money, if other conditions are the same. The expected size of the coefficient of $\Delta M/M$ should be close to one.

A major controversy is concerned with the quantity theory's argument that an increase in the supply of money increases demand, but an increase in demand does not increase the supply of real output. This is, of course,

in a direct conflict with the Keynesian theory that demand creates supply. The quantity theory's justification for the independence of the supply of money and the supply of real output is as follows: The demand for and the supply of labor are both functions of the real wage rate. Thus unless the real wage rate falls, the demand for labor cannot increase. Now assume that the supply of money increases. Then the actual real money balance exceeds the desired equilibrium real money balance which people wish to hold. So spending and demand increase. According to the quantity theory, the demand for commodities increases first. So the price level of the commodities rises. As the money wage rate is constant for the time being, the real wage rate W/P falls. So the demand for labor increases and the rate of unemployment decreases. However, according to the quantity theory, this is true only for the short run. Since the labor has no money illusion, and the supply of labor depends upon the real wage rate, the labor demands a higher money wage rate to catch up the previous real wage rate. Now the firms have to pay a higher money wage rate until the real wage rate is restored to the previous level. As the real wage rate rises, the demand for labor is cut back to the initial level, and so is the real output. The rate of unemployment is increased to the initial level.

In effect, an increase in the supply of money increases the demand for labor and real output only for the short run. In the long run, what has increased is only the level of prices and the proportional increase in money wage rates, maintaining the real wage rate, the real demand for labor, and the real long run output constant.(2)

(2) In the quantity theory, the demand for real money balances is given by:

$$M/P=F(Q, i, \Delta P^*/P, W, \ldots, e)$$

where

i=the nominal rate of interest
$\Delta P^*/P$=the expected rate of inflation
Q=the real income
W=the real wealth
e=the error term.

When the supply of money is increased, the actual real money balance will be greater than the desired real money balance: $\bar{M}/P>M/P$. People increase spending to get rid of the excess holding of money. In this process, the price level rises, and $\bar{M}/P$ falls such that a new equilibrium is established at $\bar{M}/P=M/P$. The real money balance function may take the form of $M/Y=F(P, i, \Delta P^*/P, W, \ldots, e)$.

In the Keynesian theory, the demand for money function takes the form:

$$M=F(Y, i, \ldots, e), \text{ or } M/P=F(Q, i, \ldots, e).$$

Thus under the quantity theory, the following function should "not" be significant in the long run.

$$U=F(\Delta M/M, e) \tag{6}$$

where U=the rate of unemployment. According to the quantity theory, the rate of unemployment is independent of the rate of increase in the supply of money.

The quantity theory's argument that demand does not create supply nor employment is represented in Figure 1.

First, assume that the supply of money is increased by the monetary authority. The demand curve shifts up from D to D' in the commodity market of panel (a). The real output increases from Q_1 to Q_2, and the price level rises from P_1 to P_2. In the labor market of panel (b), the money wage rate is fixed for the time being. So as the price level rises, the real wage rate falls, and the supply of labor curve shifts from S to S', and the level of employment increases from L_1 to L_2. In panel (c), given the production function, employment increases from L_1 to L_2, and the real output increases from Q_1 to Q_2. Because of the concave production function, the marginal product of labor is lower at A' than at A.

However, the above situation is only for the short run. Soon the workers demand a higher money wage rate and the supply of labor curve shifts back from S' to S where the initial equilibrium real wage rate is restored. So employment is reduced to the initial level L_1 in panels (b) and (c). The supply curve in panel (a) shifts up from S to S', and the new equilibrium price level is P_3. The Keynesian IS-LM diagram is added in panel (d).

As the supply ot money increases, LM curve shifts to LM'. As the rate of interest decreases, the amount of investment increases, and real output

---

Note that in the quantity theory, the supply of and the demand for money determine the level of prices, while in the Keynesian theory, the supply of and the demand for money determine the rate of interest. See Johnson (1972).

For a good review of the quantity theory, see Humphrey (1974). For the quantity theory's argument that demand or inflation does not affect the natural rate of unemployment, see Phelps (1967) and Friedman (1968, 1977). The natural rate of unemployment is defined as the unemployment which is determined by real as opposed to monetary factors. It is not a constant. Also see footnote 3 on the Phillips curve hypothesis.

In this paper, for simplicity, the same F notation is used for all the different functions.

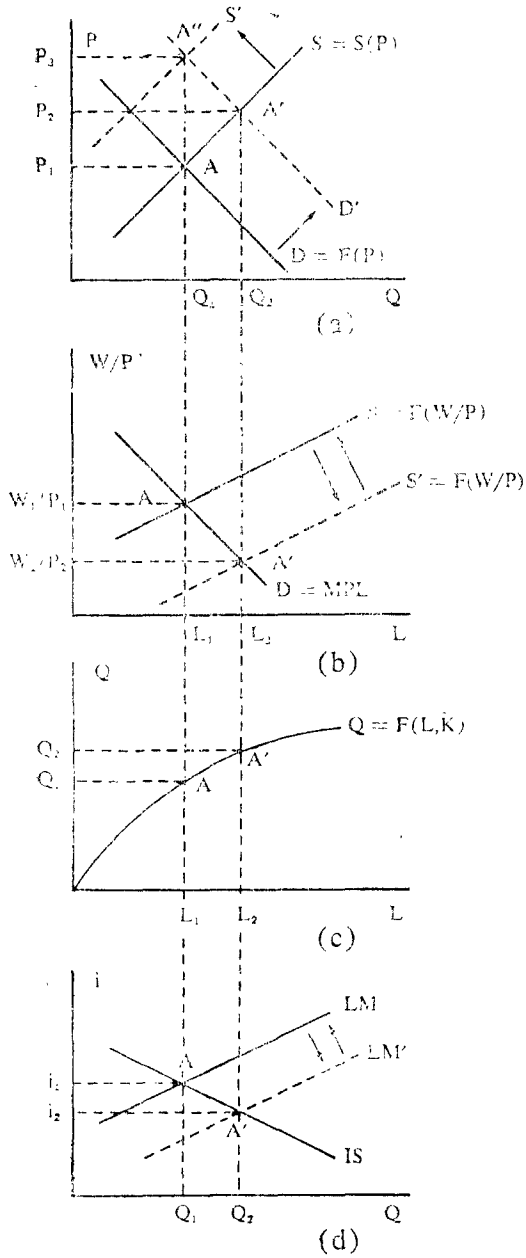


Fig. 1. Classical Model

increases from Q_1 to Q_2. However, as the level of prices increases, the real money balance M/P decreases, and LM' curve shifts back to the initial LM curve, and the rate of interest is also restored to the initial rate.

The weakness of this classical quantity theory will be discussed in section V where we present a more generalized dynamic theory of inflation and unemployment.

III. The Excess Demand for Labor Theory

As a second theory of inflation and unemployment, we may list the excess demand for labor theory or the Phillips curve hypothesis. According to the theory, when the demand for labor increases, the level of employment increases and the job vacancy rate decreases. Now the workers are in a better position to demand a higher money wage rate. The firms are also willing to pay a higher money wage rate to keep the existing workers and to attract the new workers. The greater the excess demand for labor, the greater is the rate of increase in money wage rates. As the money wage rate rises, the firms will also increase the commodity prices to maintain or to increase the profit margin. In short, when the excess demand for labor increases, the rate of unemployment falls, and both the money wage rate and the rate of inflation increase. Conversely, if the excess demand for labor decreases, the rate of unemployment increases, the rate of increase in money wage rates and the rate of inflation fall.

The excess demand for labor theory may be summarized in the following equations:

$$U=F\left(\frac{S-D}{S}, e\right) \tag{7}$$

$$\Delta W/W=F\ (U, e) \tag{8}$$

$$\Delta P/P=F\ (\Delta W/W, e) \tag{9}$$

where

S=the supply of labor

D=the demand for labor

U=the rate of unemployment

$\Delta W/W$=the rate of increase in money wage rates.

For the statistical test of the excess demand for labor theory various

forms have been tested by many writers:

$$\Delta W/W=F(U, \Delta P^*/P, \ldots, e) \quad (10)$$

$$\Delta P/P=F(U, \Delta W^*/W, \ldots, e) \quad (11)$$

where

$\Delta P^*/P$=the expected rate of inflation, and

$\Delta W^*/W$=the expected rate of increase in money wage rates.

When the labor anticipates a high rate of inflation during the year, then the labor will also demand a high rate of increase in money wage rates to maintain the real wage rate regardless of the current rate of unemployment. Similarly, the firm will increase the rate of inflation further if the expected rate of increase in money wage rates is higher.

Instead of the current rate of unemployment, some economists have used the reciprocal of the rate of unemployment, $1/U$. As additional independent variables, some economists have included the lagged rate of unemployment, the weighted average rate of the past unemployment rates, the unemployment rate differential between the current and the preceding year's rates of unemployment and the unemployment rate for the married males, the monopoly powers of firms and unions, social security tax, wage-price control, the profit rate, the change in the profit rate, the rate of change in the productivity of labor, income, sales, property, social security tax rates and other variables.[3]

A theoretical weakness of the excess demand for labor theory is that it is not concerned with how the excess demand for labor was generated at the beginning. In Figure 2, assume that the initial equilibrium employment level is at L_1. The excess demand for labor occurs when the demand for labor curve shifts from D to D', the excess demand for labor being $L_1 L_2$. The demand curve for labor can shift only when the marginal productivity of labor increases. Thus for the excess demand for labor to occur to push up the wage rate, the marginal productivity of labor must increase continuously. However, the excess demand for labor theory does not explain how the marginal productivity of labor rises continuously.

(3) The literature on the Phillips curve is too vast. Some of them are listed at the end of this paper incluing Phillips (1958), Lipsey (1960), Holt (1971), Kaldor (1959), Kuh (1967), Perry (1971) and Hicks (1976). A good review of the Phillips curve is summarized in Humphrey (1973, 1975, 1976).

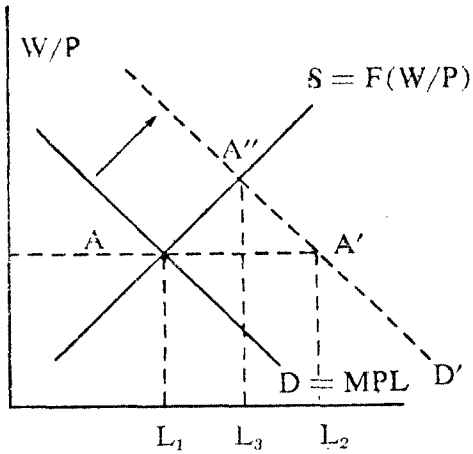


Fig. 2. The Excess Demand for Labor Theory

Alternatively, we may assume that the excess demand for labor was caused in the same way as in the quantity theory, i. e., by an increase in the supply of money. Then the quantity theory's argument that an increase in demand cannot increase the long run real output nor the level of employment may be applied.

IV. The Generalized Inflation Model (Growth-Inflation Hypothesis)

As a third theory of inflation and unemployment, we present a more generalized model which can contain both the quantity theory and the Keynesian theory as special cases. We may call it a growth-inflation model or the generalized inflation model.

Given the equilibrium condition for demand and supply,

$$Y=PQ \tag{12}$$

$$P=Y/Q \tag{13}$$

since

$$Q=ARK \tag{14}$$

$$P=Y/ARK \tag{15}$$

where

Y=the nominal demand

P=the price level

Q=the real output

A=the average productivity of capital

R=the capacity operation rate

K=the production capacity or capital stock.

Assuming that none of the above variables are constant, by the total differentiation or by the logarithmic differentiation, Equation (15) may be rewritten in the percentage growth rates:

$$\Delta P/P=\Delta Y/Y-\Delta A/A-\Delta R/R-\Delta K/K. \tag{16}$$

Equation (16) states that the rate of inflation depends upon the growth rates of demand, productivity, capacity operation, and the capital stock. It should be noted that the rate of capacity operation is not always constant. In times of energy shortage, resource bottlenecks, extremely cold or warm weather, strike, and labor shortage, the capacity operation rate will decrease increasing the rate of inflation. Also, during the depression years, the capacity operation rate will further decrease.

On the other hand, during the period of recovery, the capital stock may not increase rapidly in the short run, but the rate of capacity operation will increase very rapidly. When the capacity operation rate reaches the maximum degree, the growth rate of capacity operation rate will become zero.

In effect, the uniqueness of Equation (16) or the generalized inflation equation is that the growth rates of productivity, the capacity operation and the capital stock are all related to the growth rate of demand. For instance, when demand increases, commodity price will tend to rise. But demand does not necessarily confine to the consumer goods, when the demand for capital goods increases and when the capital stock is expanded, the supply of real output will increase to partially offset the inflationary pressure.

For these reasons, we may assume that the growth rates of productivity, the capacity operation rate and, most of all, the capital stock, are functions of the rate of increase in demand within certain limits, and we may obtain Equation (17):

$$\Delta P/P=\Delta Y/Y\ (1-a-r-k) \tag{17}$$

where

$$\Delta A/A=a\Delta Y/Y,\ \Delta R/R=r\Delta Y/Y, \text{ and } \Delta K/K=k\Delta Y/Y.$$

In terms of the quantity equation of money, the growth rate of demand is equal to

$$\Delta Y/Y=\Delta M/M+\Delta V/V. \tag{18}$$

Substituting Equation (18) into (17), we obtain

$$\Delta P/P=(\Delta M/M+\Delta V/V)\ (1-a-r-k)$$

or

$$\Delta P/P=\Delta M/M(1-a-r-k) \qquad (19)$$

when $\Delta V/V=0$.[4]

Equations (16)-(19) are the generalized inflation equations. They state that the rate of inflation should be less than the rate of increase in the supply of money in general cases.[5] However, the classical quantity theory

(4) From Equation (13), by the total differentiation, we may obtain

$$\Delta P/P=\Delta Y/Y-\Delta Q/Q.$$

Assuming $\Delta Q/Q=h\Delta Y/Y$

$$\Delta P/P=\Delta Y/Y\ (1-h).$$

Comparing Equation (17) with the above, we notice that

$$h=a+r+k.$$

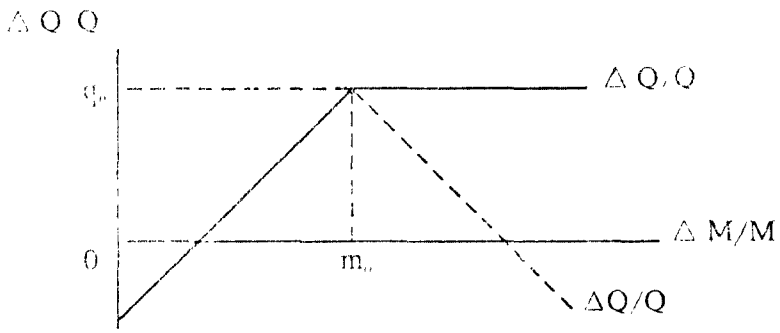
We may also assume

$$\Delta Q/Q=h_0+h\Delta M/M.$$

But the growth rate of the real output should have a maximum rate beyond which it cannot increase. If the supply of money increases too rapidly, it will cause a hyperinflation or a too high rate of inflation, and the growth rate of real output will rather decrease. In such a case, both the rate of unemployment and the rate of inflation will increase. So, we may state

$$\Delta Q/Q=h_0+h\Delta M/M \quad \text{if } \Delta M/M<m_0$$
$$\leq q_0 \quad \text{if } \Delta M/M\geq m^0$$

where m_0 may be regarded as the optimal rate of increase in the supply of money for the maximum economic growth rate. For another variation of Equation (16) see footnote 10.



(5) In terms of the elasticity, J.M. Keynes presents "the generalized statement of the quantity theory of money":

$$e=e_d(1-e_e e_o+e_e e_o e_w)$$

where

e=price elasticity with respect to the supply of money,
e_d=effective demand elasticity with respect to the supply of money,
e_e=employment elasticity with respect to effective demand,
e_o=output elasticity with respect to effective demand,
e_w=wage rate elasticity with respect to effective demand.

J.M. Keynes, *The General Theory of Employment, Interest, and Money*, 1936, Harbinger, ed.,

or the monetarists maintain that the rate of inflation should be equal to the rate of increase in the supply of money. That would be true only if $a+r+k=0$.

The implication of the generalized inflation equation may be summarized: As demand increases, whether as a result of an increase in the supply of money, or by an increase in autonomous expenditures, such as a tax cut, export increase, or an autonomous investment increase, the level of prices tends to rise on the one hand, but as a result of an increase in demand, the capital stock, the capacity operation rate, and the productivity will tend to rise to partially offset the inflationary pressure. Thus in this generalized inflation equation, not only the aggregate demand, but also the composition of the demand will make the rate of inflation different. The greater the portion of the consumption demand, the greater will be the inflationary pressure, and the greater the portion of investment demand the less will be the inflationary pressure in the long run.

For the statistical test of the generalized inflation model, Equation (19) may be tested in the following function:

$$\Delta P/P=F\ (\Delta M/M,\ldots,\ e) \qquad (20)$$

where the coefficient of the rate of increase in the supply of money is expected to be less than one. Recall that Equation (20) is the same as Equation (6) of the quantity theory. But the difference is concerned with the size of the regression cofficient. For the quantity theory, the coefficient is expected to be close to one, and in Equation (20), the coefficient is expected to be significantly less than one. In other words, the price elasticity of money supply $(\Delta P/P)/(\Delta M/M)$ should be about equal to one in the quantity theory, and it should be very much smaller than one in the generalized inflation model.

Furthermore, as demand increases, output will tend to rise on the one hand, and the price and the money wage rates will tend to rise on the other hand. As the rate of economic growth increases, the rate of unemployment will tend to decrease, if other conditions are the same. Thus

1964, p. 305. "And obviously there is a variety of other special cases in which $e=1$. But in general e is not unity; and it is, perhaps, safe to make the generalization that on plausible assumptions relating to the real world, and excluding the case of a 'flight from the currency' in which e_d and e_w become large, e is,as a rule, less than unity" (p. 306).

according to the generalized inflation model, the following functional relationships should exist:

$$\Delta Q/Q=F(\Delta M/M,\ldots,\ e) \tag{21}$$
$$U=F(\Delta Q/Q,\ldots,\ e) \tag{22}$$
$$\Delta P/P=F\ (\Delta Q/Q,\ldots,\ e) \tag{23}$$
$$\Delta W/W=F(\Delta Q/Q,\ldots,\ e). \tag{24}$$

The generalized inflation model is represented in Figure 3. In panel (a), the demand curve shifts from D to D′ as a result of an increase in the supply of money. In the short run, the real output increases from Q_1 to Q_2 and the level of prices rises from P_1 to P_2. In panel (b), the money wage rate is constant for the time being, so the real wage rate falls, and the supply of labor curve shifts down from S to S', and employment increases from L_1 to L_2. In panel (c), employment increases from L_1 to L_2 and output increases from Q_1 to Q_2. But in the long run, workers demand a higher money wage rate to catch up the previous real wage rate. So the labor supply curve shifts back to S from S'. Thus far, the process is the same as the quantity theory.

According to the quantity theory, in such a case, the level of employment will be reduced to the initial level L_1. However, in the generalized inflation model, that will not happen. When output increases from Q_1 to Q_2, some portion of the output increase is an increase in investment goods. As a result of an increase in the capital stock, in panel (c), production function shifts upward from Q to Q', and in panel (b), the marginal product of labor or the demand for labor curve shifts from D to D'. So the new equilibrium employment is L_3 and the new equilibrium real wage rate is W_2/P_3. This process is also illustrated in panel (d) of the *IS-LM* diagram. When the supply of money increases *LM* curve shifts to *LM′*, and the rate of interest falls. So investment increases and real output increases from Q_1 to Q_2. As the level of prices rises, the supply of real money balances falls, and *LM′* curve shifts up to *LM″*, where the new equilibrium rate of interest is i_3 and real output is Q_3.

Figure 4 depicts the effect of an increase in the supply of money in the conventional Keynesian model, which holds the capital stock and thus the demand for labor curve constant. As a result, in the Keynesian model, in

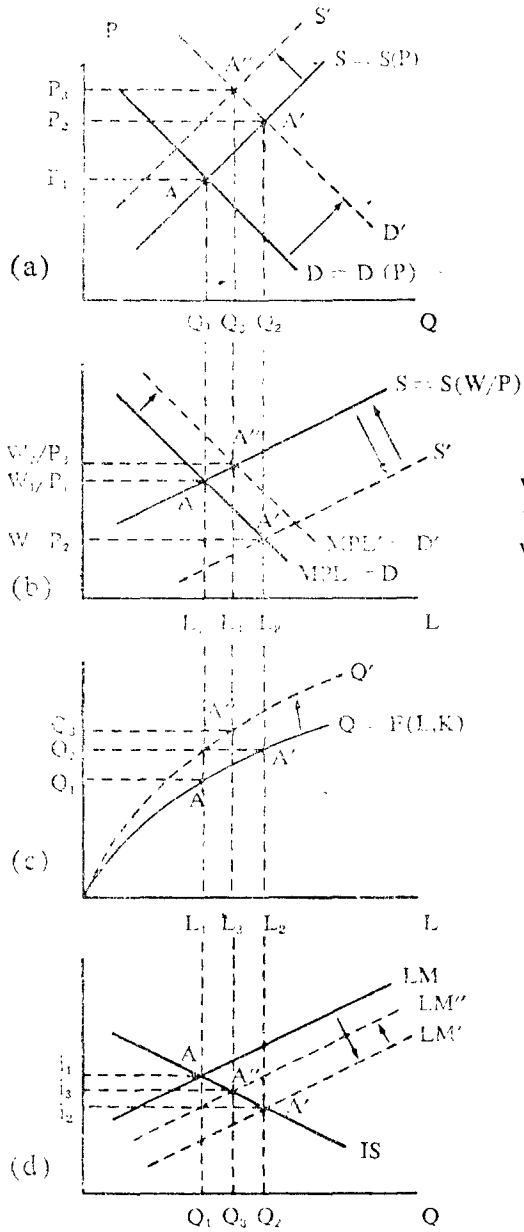


Fig. 3. Growth-Inflation Model

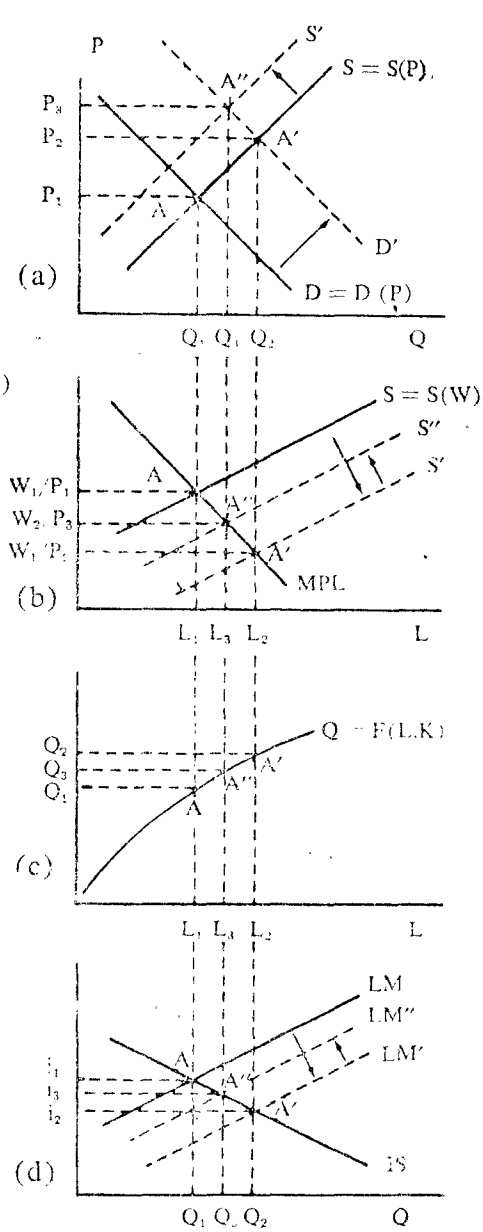


Fig. 4. Keynesian Model

panel (b), we note that employment and real output increase only as a result of a decrease in real wage rate. In summary, in the classical model, the new and the initial equilibrium real wage rates remain the same; in the conventional Keynesian model, the new equilibrium real wage rate is lower than the initial equilibrium real wage rate; and in the generalized growth-inflation model presented in this paper, the new equilibrium real wage rate should be higher than the initial equilibrium real wage rate.(6)

V. The International Regression Results

In the preceding sections, we have reviewed three theories of inflation and unemployment. In this section, we wish to test the empirical significance of the theories in explaining the international differences in the rate of inflation and the rate of unemployment. The basic data are collected for 21 countries and for the year 1974 for which the most recent data are available.(7) A total of 16 variables were calculated. All the basic data were taken from U. N., *Statistical Yearbook*, 1974-75, U. N., *Monthly Bulletin of Statistics*, January 1977, and International Labor Office, *Yearbook of Labor Statistics*, 1975. The variables are defined below:

$\Delta P/P$=the rate of increase in consumer prices(%)

$\Delta M/M$=the rate of increase in the supply of money, currency + demand deposits(%)

$\Delta N/N$=the rate of increase in population(%)

A/Y=the agricultural income ratio, the income originating from the agricultural sector divided by GDP, gross domestic product(%)

F/Y=the foreign trade ratio, the sum of exports and imports in the absolute value divided by GDP(%)

Y=per capita national income in U.S. dollars($)

(6) If the growth-inflation hypothesis holds, the real wage rate should be correlated positively with employment and output, and negatively correlated with the rate of unemployment. For some supporting statistical evidence, see Dunlop (1938), Tarshis (1939), and Bodkin (1969). However, their explanations for such relationships are different from the growth-inflation theory presented in this paper.

(7) For 1975, the growth rate of GDP was not available for many countries, though all other data were available for the year. Table 1 provides the data for 23 countries. But we have excluded Chile and Cyprus from the regressions, considering the political and war disturbances during 1973-74 in those countries.

Table 1. The Basic International Data (1974, %)

	(1) U	(2) $\Delta P/P$	(3) $\Delta P/P$ (1973)	(4) $\Delta W/W$	(5) $\Delta W/W$ (1973)	(6) $\Delta Q/Q$	(7) $\Delta N/N$	(8) $\Delta M/M$	(9) A/Y	(10) L/N	(11) U_{t-1}	(12) F/Y	(13) $\Delta Q/Q$ (a)	(14) Y (U.S.,$)	(15) $1/U$ (ratio)	(16) $\Delta Q/Q$ (b)
Australia	2.3	15.13	9.44	27.84	12.82	−0.92	1.60	−0.99	8.54	41.8	1.9	30.44	3.10	5448	0.2999	4.8
Austria	1.5	9.52	7.55	15.73	12.69	4.21	0.27	5.61	5.21	41.5	1.6	73.63	5.10	3916	0.571	5.6
Belgium	4.0	12.66	7.00	25.49	13.99	4.02	0.31	8.84	2.79	40.8	3.6	92.75	4.80	5029	0.187	5.2
Canada	5.4	10.96	7.51	13.51	8.76	3.16	1.58	−0.33	4.72	40.9	5.6	49.11	4.20	5673	0.163	5.6
*Chile	8.3	513.62	353.99	530.00	201.74	4.26	1.82	272.00	6.88	29.5	4.8	34.20	−0.50	731	0.120	1.2
*Cyprus	4.1	16.23	7.78	—	—	−17.96	1.59	9.84	16.75	42.3	1.2	93.65	0.80	1280	0.244	1.3
Denmark	5.2	15.25	9.31	19.39	15.74	0.46	0.60	4.71	7.68	49.0	2.4	68.59	2.50	6020	0.123	3.2
Finland	1.7	17.41	11.74	22.62	16.29	4.13	0.43	18.85	10.85	46.1	2.3	57.32	4.90	4706	0.513	5.3
Germany (W)	2.6	6.99	6.93	11.33	10.91	0.69	0.11	12.03	2.71	43.9	1.2	50.96	2.60	6198	0.274	3.2
Ireland	7.9	17.00	11.32	20.82	22.90	0.37	1.31	9.09	14.00	36.4	7.2	83.87	3.60	2176	0.100	4.5
Israel	3.0	39.78	20.75	37.25	23.64	6.26	2.80	17.57	4.69	32.9	2.6	74.52	5.50	4029	0.328	8.9
Italy	2.9	19.14	10.83	25.16	22.59	3.37	0.91	9.36	8.36	35.4	3.5	41.08	3.00	6214	0.323	3.8
Japan	1.4	24.27	11.81	25.97	24.25	1.32	1.22	11.51	5.27	48.1	1.3	20.35	5.50	4152	0.606	6.8
Korea (S)	4.1	24.31	3.15	35.28	11.07	8.71	2.66	29.59	25.10	36.1	4.0	68.45	9.10	504	0.244	10.9
Netherlands	3.3	9.66	7.93	16.67	13.99	2.43	0.74	11.43	5.47	40.8	2.7	103.13	3.00	5109	0.247	4.0
Norway	1.5	9.40	7.46	17.30	10.64	5.27	0.76	11.63	5.91	37.7	1.5	90.11	3.60	5825	0.526	4.4
Philippines	4.8	40.51	7.08	5.32	9.45	4.88	2.94	23.29	28.31	33.6	4.8	44.47	3.30	359	0.227	6.3
Puerto Rico	13.3	19.83	7.34	8.92	6.50	−3.50	2.71	2.87[b]	3.37	28.3	11.7	119.57	3.70	2337	0.063	6.7
Sweden	1.5	9.88	6.77	11.60	8.53	4.19	0.25	25.22	4.71	42.3	1.9	58.75	2.40	6876	0.690	2.8
Trinidad	15.3	22.02	14.85	—	14.85[a]	5.10	0.95	32.82	7.80	31.5	15.4	77.87	2.87	732	3.000	3.8
U.K.	2.7	15.94	9.22	16.97	12.99	0.35	1.21	10.53	26.17	46.3	0.1	53.67	3.20	3375	0.142	3.5
U.S.	5.6	11.01	6.22	8.09	7.09	−1.79	0.70	2.87	4.47	44.1	4.9	13.66	4.10	5918	0.065	5.1
Yugoslavia	9.0	21.08	19.66	29.14	17.71	8.78	0.91	25.18	17.70	43.3	8.1	51.93	5.94	1300	0.103	5.9

Note: All the data are calculated from U.N., *Monthly Bulletin of Statistics*, Jan. 1977, except for Y in column (14) and $\Delta Q/Q$ in column (13), which are taken from U.N., *Statistical Yearbook*, 1975. $\Delta Q/Q$(a) in column (13) is the average annual growth rate of per real capita output for 1970-74, while $\Delta Q/Q$ (b) in column (16) is the average annual growth rate of total real output for 1970-74.

a. $\Delta W/W$ (1973) assumed to be equal to $\Delta P/P$ (1973), *b*. $\Delta M/M$ assumed to be equal to U.S. $\Delta M/M$.

*Chile and Cyprus were excluded from the regressions whose results are presented in the text.

$\Delta W/W$=the rate of change in money wage rates(%)
U=the rate of unemployment(%)
$\Delta Q/Q$=the growth rate of GDP at constant prices(%)
$\Delta Q/Q$(a)=the average annual growth rate of per capita domestic product at constant prices, 1970-74 average(%)
$\Delta Q/Q$(b)=the average annual growth rate of total domestic product at constant prices, 1970-74 average(%)
U_{t-1}=the rate of unemployment, with one year of time lag (%)
$1/U$=the rate of unemployment, its reciprocal
$\Delta W/W_{t-1}$=the rate of increase in money wage rates, with one year of time lag(%)
$\Delta P/P_{t-1}$=the rate of inflation, with one year of time lag (%)
L/N=the labor force participation rate(%)

With the above variables, we have computed large number of regression equations for a variety of combinations of the independent and dependent variables. As the *ceteris paribus* variables, we have included the following variables:the rate of increase in population, the agricultural income ratio as an index of industrial composition or the degree of industrialization, the foreign trade ratio as an index of openness of the economy, and per capita income which may represent the degree of economic development, capital stock, wealth or the level of economic technology. However, the per capita income was highly correlated with the agricultural income ratio. So we will present the regression results which did not include the per capita income.

Some other variables which may be significant but were not available may include the following: the size income distribution, the capital-output ratio, capital stock, social security and unemployment benefit system, the degree of political, economic and social freedom, the degree of labor unionization, the development of financial and banking systems, the index of working conditions including the working hours and fringe benefits, monopolistic market power, labor mobility, labor training programs, etc.

The international regression results were obtained by the method of ordinary least squares. Instead of presenting all the regression results in tables, for the purpose of easy reference, we will present only some selected regression results for each hypothesis.

(1) First, according to the Phillips hypothesis, a country which has a low rate of unemployment should tend to have a high rate of increase in money wage rates and a high rate of inflation. Some of the regression results are:

$$(R\text{-}1)\quad \Delta P/P = 15.6477 + 0.4359 U_t \qquad (0.81)$$

$$R=0.1834\quad \bar{R}^2=-0.0172\quad F=0.6614$$

$$(R\text{-}2)\quad \Delta P/P = 0.5001 + 0.1737 U_t + 7.2118 \Delta N/N + 0.1602 A/Y \qquad (0.54)\quad (4.98)^{**}\quad (1.00)$$

$$- 0.0402 F/Y + 0.6208 \Delta W/W_{t-1} \qquad (-0.88)\quad (3.03)^{**}$$

$$R=0.8823\quad \bar{R}^2=0.7047\quad F=10.5458$$

$$(R\text{-}3)\quad \Delta W/W = 20.9471 - 0.2371 U_t \qquad (-0.46)$$

$$R=0.1045\quad \bar{R}^2=-0.0411\quad F=0.2098$$

$$(R\text{-}4)\quad \Delta W/W = 5.9617 - 0.8135 U_t + 1.6392 \Delta N/N + 0.0821 A/Y \qquad (-1.56)\quad (0.72)\quad (0.33)$$

$$+ 0.0481 F/Y + 1.2280 \Delta P/P_{t-1} \qquad (0.66)\quad (2.90)^{**}$$

$$R=0.6298\quad \bar{R}^2=0.1956\quad F=1.9727$$

We note that the rate of unemployment is not significant at the 5% level in any of the above regression equations.[9] In Equation (R-4), the rate of unemployment has a negative sign as the Phillips hypothesis expects, but it is significant only at the 10% level. We have also tested the reciprocal of the rate of unemployment $1/U$, but it was also not significant. However, when 1974-75 average data were used, the rate of unemployment was negative and significant at the 5% level only for the rate of increase in money wage rates $\Delta W/W$.

$$(R\text{-}2)'\quad \Delta P/P = -3.6021 + 0.1157 U_t + 5.8956 \Delta N/N - 0.1108 A/Y \qquad (0.45)\quad (4.28)^{**}\quad (-0.64)$$

$$- 0.0308 F/Y + 1.2323 \Delta W/W_{t-1} \qquad (-0.79)\quad (4.46)^{**}$$

$$R=0.7684\quad \bar{R}^2=0.6913\quad F=9.9555$$

(8) The numbers in parentheses are the t-ratios with **significant at the 1% level and *significant at the 5% level. In order to examine the problem of multicollinearity we have added the independent variables one by one. Also we have calculated the regression equations including the per capita income. It had a high correlation with the agricultural income ratio, and the results were better without the per capita income. These procedures were taken for all other regression equations.

$$(R\text{-}4)'\quad \Delta W/W = 6.0252 - 0.7070U_t + 2.3759\Delta N/N - 0.2639A/Y$$
$$(-1.77)^* \quad (1.10) \quad (-0.96)$$
$$+0.0512F/Y + 1.5197\Delta P/P_{t-1}$$
$$(0.85) \quad (3.15)^{**}$$
$$R=0.6884 \quad \bar{R}^2=0.2985 \quad F=2.7018$$

(2) Secondly, according to the quantity theory, a county which has a high rate of increase in the supply of money should tend to have a high rate of inflation, and the rate of increase in the supply of money should be independent of the "natural rate of unemployment," and of the real economic growth rate. Some of the regression results are:

$$(R\text{-}5)\quad \Delta P/P = 12.3923 + 0.4105\Delta M/M$$
$$(2.14)^*$$
$$R=0.4405 \quad \bar{R}^2=0.1516 \quad F=4.574$$

$$(R\text{-}6)\quad \Delta P/P = 0.5073 + 0.3101\Delta M/M + 7.805\Delta N/N - 0.0425A/Y$$
$$(2.98)^{**} \quad (6.89)^{**} \quad (-0.29)$$
$$-0.0527F/Y + 0.5391\Delta W/W_{t-1}$$
$$(-1.50) \quad (3.27)^{**}$$
$$R=0.9263 \quad \bar{R}^2=0.8107 \quad F=18.132$$

$$(R\text{-}7)\quad U_t = 3.6722 + 0.0806\Delta M/M$$
$$(0.91)$$
$$R=0.2054 \quad \bar{R}^2=-0.0082 \quad F=0.8370$$

$$(R\text{-}8)\quad U_t = 0.1610 - 0.0522\Delta M/M - 0.2011\Delta N/N + 0.0602A/Y$$
$$(-2.06)^* \quad (-0.73) \quad (1.76)^*$$
$$+0.0096F/Y + 1.0178U_{t-1}$$
$$(1.15) \quad (16.04)^{**}$$
$$R=0.9782 \quad \bar{R}^2=0.9426 \quad F=66.6808$$

In the above regression results, the first two equations are apparently consistent with the quantity theory in that the rate of increase in the supply of money is positively correlated with the rate of inflation and significant either at the 5% or 1% level. However, we note that in Equation (*R*-8), the rate of increase in the supply of money is negatively correlated with the rate of unemployment, and it is significant at the 5% level. This result does not support the quantity theory that the rate of increase in the supply of money is independent of the long-run rate of unemployment. It rather supports the generalized inflation model in which an increase in the rate of increase in the supply of money incrases the growth rate of real output and the rate of of inflation on the one hand, and decreases the rate

of unemployment on the other.

(3) Thirdly, before we present the empirical evidence in support of the generalized inflation model or the growth rate hypothesis, we may see why the regression equations (*R*-5) and (*R*-6) are not strictly in accordance with the quantity theory hypothesis. As we have seen in sections I and III, according to the quantity theory, the coefficient of the rate of change in the supply of money or the price elasticity of the supply of money should be close to one, but it should be far below one according to the generalized inflation theory. Regression equations (*R*-5) and (*R*-6) indicate that the price elasticity of money supply is between 0.31 and 0.41. These low values of the price elasticity of money supply support the generalized inflation model rather than the quantity theory.

Next, for a more positive evidence, according to the generalized inflation model, as demand increases, the supply of real output will also increase. The regression results are:

$$(R\text{-}9)\quad \Delta Q/Q = -0.1585 + 0.2397\ \Delta M/M \qquad (4.78)^{**}$$

$$R=0.7309\quad \bar{R}^2=0.5097\quad F=21.94$$

$$(R\text{-}10)\quad \Delta Q/Q = -0.3150 + 0.2352\Delta M/M - 0.1296\Delta N/N + 0.0149A/Y + 0.0036F/Y$$
$$(3.70)^{**} \qquad (-0.19) \qquad (0.17) \qquad (0.17)$$

$$R=0.7320\quad \bar{R}^2=0.4198\quad F=4.6180$$

We note that the rate of increase in the supply of money is highly significant and has positive signs, as the generalized inflation model expects. Also as the real economic growth rate rises, the rate of unemployment should tend to decrease, if other conditions are the same. The regression results are:[9]

$$(R\text{-}11)\quad U_t = 5.0780 - 0.1236\Delta Q/Q \qquad (-0.45)$$

(9) Compare these results with the Okun's Law obtained for the U.S. economy during 1947 II～1960 IV:

$$\Delta U = 0.30 - 0.30\Delta Y/Y \qquad r=0.79$$

or $\quad U_t = U_{t-1} + 0.30 - 0.30\Delta Y/Y$

where U and $\Delta Y/Y$ are measured in percentage points. The equation implies that if the growth rate of real GNP is zero, the rate of unemployment will increase by 0.3 percentage point from one quarter to the next due to increases in productivity and growth in labor force. If the growth rate of GNP increases by 1 percentage point, the rate of unemployment will decrease by 0.3 percentage point. Okun (1962). Also see Gordon (1977).

$R=0.1034$ $\bar{R}^2=-0.0414$ $F=0.2052$

(R-12) $U_t=0.0935-0.1853\Delta Q/Q-0.1619\Delta N/N+0.0558A/Y$
$(-3.00)^{**}$ (-0.66) $(1.95)^{*}$
$+0.0115F/Y+0.9740U_{t-1}$
(1.52) $(18.17)^{**}$

$R=0.9826$ $\bar{R}^2=0.9540$ $F=83.8849$

According to the generalized inflation model, as demand increases, output tends to increase, but the elasticity of supply is not perfectly elastic. So as demand increases, the level of prices also tends to increase, and so does the money wage rate.[10] The regression results are:

(R-13) $\Delta P/P=14.8660+0.9640\Delta Q/Q$
(1.57)

$R=0.3392$ $\bar{R}^2=0.0685$ $F=2.4706$

(R-14) $\Delta P/P=9.7555+0.8264\Delta Q/Q+7.8077\Delta N/N+0.0070A/Y-0.0608F/Y$
$(2.02)^{*}$ $(5.02)^{**}$ (0.04) (-1.28)

$R=0.8453$ $\bar{R}^2=0.6432$ $F=10.0137$

(R-15) $\Delta P/P=5.2597+0.9296\Delta Q/Q-1.2763\Delta Q/Q(a)+8.4544\Delta N/N$
$(2.32)^{*}$ (-1.28) $(6.27)^{**}$
$+0.0437A/Y-0.0524F/Y+0.5480\Delta W/W_{t-1}$
(0.29) (1.34) $(2.95)^{*}$

$R=0.9157$ $\bar{R}^2=0.7692$ $F=12.107$

(R-16) $\Delta W/W=15.7954+1.3711\Delta Q/Q$
$(2.55)^{**}$

$R=0.5055$ $\bar{R}^2=0.2163$ $F=6.5213$

(R-17) $\Delta W/W=0.6540+1.1276\Delta Q/Q+1.5966\Delta N/N-0.1211A/Y$
$(1.83)^{*}$ (0.72) (-0.45)
$-0.0150F/Y+0.7586\Delta P/P_{t-1}$
(-0.24) $(1.77)^{*}$

$R=0.6540$ $\bar{R}^2=0.2370$ $F=2.2425$

(R-18) $\Delta W/W=-1.9499+0.1969\Delta Q/Q+3.0939\Delta Q/Q(a)-0.5061\Delta N/N$
(0.31) $(2.52)^{*}$ (-0.24)
$-0.0564A/Y+0.0081F/Y+0.9444\Delta P/P_{t-1}$
(-0.24) (0.14) $(2.52)^{*}$

$R=0.7790$ $\bar{R}^2=0.4383$ $F=3.601$

In the above regression equations, we note that either the short-run annual growth rate, $\Delta Q/Q$, or the long-run average annual growth rate,

(10) For studies on the relationship between the economic growth and inflation, see Kaldor (1959), Kuh (1967) and Hicks (1976).

$\Delta Q/Q(a)$, is positive and significantly correlated with the rate of inflation or the rate of increase in money wage rates.

These results support the generalized inflation model or the growth-inflation hypothesis that when demand increases, production tends to increase on the one hand, and the rate of inflation and the rate of increase in money wage rates tend to rise on the other hand.

VI. Summary and Conclusions

We have reviewed three inflation and unemployment models, namely, the Phillips hypothesis or the excess demand for labor theory, the quanity theory or the monetarists' argument, and the generalized inflation model or the Keynes-Harrod-Domar type growth rate inflation theory. First, according to the Phillips hypothesis, a country which has a low rate of unemployment should tend to have a high rate of inflation. However, the international empirical evidence suggests that the rate of unemployment is not always a significant factor in pushing up the rate of increase in money wage rates and the rate of inflation.

Second, according to the quantity theory, a country which has a high rate of increase in the supply of money should tend to have a high rate of inflation, independent of the rate of unemployment. In the international regression results, the rate of increase in the supply of money was indeed significantly correlated with the rate of inflation. This result is apparently consistent with the quantity theory that the major determinant of inflation is the rate of increase in the supply of money. However, the price elasticity of the supply of money was between 0.31 and 0.41, and these low values of elasticity does not fully support the quantity theory that expects the elasticity to be close to one.

Furthermore, the rate of increase in the supply of money was negatively correlated with the rate of unemployment. Also, the rate of increase in the money wage rates and the rate of unemployment were all significantly positively correlated with the growth rate of real output. These results support the generalized growth-inflation model rather than the quantity theory.

A policy implication of the above analysis is clear. A demand creating

policy is indeed significant in increasing the rate of economic growth and in reducing the rate of unemployment. The rate of inflation is a necessary evil for the above objectives. However, the necessary evil need not be greater. First, the rate of increase in the supply of money should not exceed a maximum rate beyond which the rate of increase in real output cannot be further increased. Second, the policy emphasis should be placed not only on the level and the growth rate of demand, but also on the composition of the aggregate demand. For instance, if the government expenditures are directed to increase the productivity and the capital stock the short run demand-creating multiplier effect will be the same as the pure government consumption expenditures, but the long run capacity-creating effect will lower the price elasticity of demand.(11)

Finally, it should be added that the regression results have only a limited value. The trouble with regression analysis is that the significance of the regression coefficients varies with many factors such as the number of observations, the number and the nature of the independent variables, and the period of observation, as well as the methods of regression in the forms of linear, nonlinear, multiple-stage regression in the ordinary numbers or in the differenced values, with a variety of lag structures. Indeed the above regression results presented in this paper are entirely subject to the above general rule. Particularly, due to a relatively small sample size, elimination or addition of some countries will significantly affect the regression results. Furthermore, there is the important question of the reliability of the international data. The international data are often not reliable or not consistent with each other due to the differences in the definition of a variable, the method and the period of sampling, the sample size, and often by political disturbances particularly in countries of political instability. Perhaps the rate of unemployment may be of the least reliable data. Even if the data may be complete and accurate, and yet there is no rule that economic relationships are fixed over the years. These and other reasons may justify

(11) Since $\Delta K/K=(Q/K)(I/Q)$, Equation (16) may be rewritten as

$$\Delta P/P=\Delta Y/Y-\Delta A/A-\Delta R/R-(Q/K)\cdot(I/Q) \qquad (16)'$$

where Q/K=output-capital ratio, I/Q=investment ratio. Equation (16)′ states that the greater the investment ratio, the less will be the rate of inflation.

We may introduce a time lag in Equation (16)′:

$$\Delta P/P=\Delta Y/Y-\Delta A/A-\Delta R/R-(Q/K)\cdot(I/Q)_{t-1}. \qquad (16)''$$

the continuous need for the empirical studies to observe and establish dynamic economic relationships to help formulate economic policies.

Appendix Note

The three models may be represented in the following equations:

	Shin's growth-inflation model	Conventional Keynesian demand-pull inflation model	Classical-Neoclassical-Monetarists demand-pull inflation model
1.	$Q=C+I$		
2.	$C=C(Q,i)$		
3.	$I=I(i)$		
4.	$S=S(Q,i)$		
5.	$I(i)=S(Q,i)$		
6.	$MP_L=F'(L,K_{t-1}+I)$	$MP_L=F'(L,\bar{K})$	$MP_L=F'(L,\bar{K})$
7.	$S_L=S_L(W/P)$	$S_L=S_L(W)$	
8.	$S_L(W/P)=F'(L,K_{t-1}+I)$		
9.	$M/P=D_M(i,Q)$		
10.	$M=\bar{M}$		
11.	$\bar{M}/P=D_M(i,Q)$		

where

Q=real output — K=capital stock
C=real consumption — W=money wage rate
I=real investment (net) — P=the level of prices
i=the rate of interest — M=the supply of money
S_L=the supply of labor — S=real saving.

If we assume a Cobb-Douglas production function,

$$Q=AL^{\alpha}K^{\beta}$$
$$\partial Q/\partial L=A\alpha L^{\alpha-1}K^{\beta}$$
$$=A\alpha L^{\alpha-1}(K_{t-1}+I)^{\beta}.$$

If $\alpha+\beta=1$,

$$\partial Q/\partial L=A\alpha[(K_{t-1}+I)/L]^{\beta}.$$

The investment function may take many other forms:

$$I=I(Q,i) \text{ or } I=I(\Delta Q,i) \text{ or } I=I(\Delta Q,\ K_{t-1},\ i).$$

References

[1] Bodkin, D. G., "Real Wages and Cyclical Variations in Employment: A Reexam-

ination of the Evidence," *Canadian Journal of Economics*, August 1969, pp. 353-374.

[2] Braun, A. R., "The Phillips Curves," *Finance and Development*, Nov./Dec. 1971, pp. 58-65.

[3] Dunlop, J. T., "The Movement of Real and Money Wage Rates," *Economic Journal*, Sept. 1938, pp. 413-434.

[4] Flanagan, R. J., "The U. S. Phillips Curve and International Unemployment Rate Differentials," *American Economic Review*, March 1973, pp. 114-131.

[5] Friedman, M., "The Role of Monetary Policy," *American Economic Review*, March 1968, pp. 1-17.

[6] Friedman, M., "Inflation and Unemployment," *Journal of Political Economy*, June 1977, pp. 451-472.

[7] Gordon, R., "The Theory of Domestic Inflation," *American Economic Review, Papers and Proceedings*. Feb. 1977, pp. 128-134.

[8] Hicks, J. R., "The Little that is Right with Monetarism," *Lloyds Bank Review*, July 1976, pp. 16-18.

[9] Holt, C. C., C. D. MacRae, S.O. Schweitzer, and R.E. Smith, *The Unemployment-Inflation Dilemma: A Manpower Solution*, Washington, D.C., Urban Institute, 1971.

[10] Humphrey, T. M., "Changing Views of the Phillips Curve," *Economic Review*, Federal Reserve Bank of Richmond, July 1973, pp. 2-13.

[11] Humphrey, T. M., "The Quantity Theory of Money: Its Historical Evolution and Role in Policy Debates," *Economic Review*, Federal Reserve Bank of Richmond, May/June 1974, pp. 2-18.

[12] Humphrey, T. M., "The Persistence of Inflation," *Sixty-First Annual Report*, Federal Reserve Bank of Richmond, 1975, pp. 4-16.

[13] Humphrey, T. M., "Some Current Controversies in the Theory of Inflation," *Economic Review*, Federal Reserve Bank of Richmond, July/August 1976, pp. 8-19.

[14] Jacobson, L., and A. Lindbeck, "Labor Market Condition, Wages and Inflation-Swedish Experiences, 1955-67," *Swedish Journal of Economics*, June 1969, pp. 64-103.

[15] Johnson, H. G., *Macroeconomics and Monetary Policy*, 1972, pp. 63-74, 148-163.

[16] Kaldor, N., "Economic Growth and the Problem of Inflation," *Economica*, Nov. 1959.

[17] Keynes, J. M., *The General Theory of Employment, Interest, and Money*, 1936, Ch. 21.

[18] Kuh, E., "A Productivity Theory of Wage Levels: An Alternative to the Phillips Curve," *Review of Economic Studies*, Oct. 1967, pp. 333-365.

[19] Lipsey, R. G., "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957: A Further Analysis," *Economica*, Feb. 1960, pp. 1-31.

〔20〕 Modigliani, F., "The Monetarist Controversy or, Should We Foresake Stabilization Policies?," *American Economic Review*, March 1977, pp. 1-19.

〔21〕 O'Brien, J. M., "Inflation and Unemployment: The Great Debate," *Business Review*, Federal Reserve Bank of Philadelphia, Jan. 1973, pp. 13-18.

〔22〕 Okun, A., "Potential GNP: Its Measurement and Significance," *Proceedings of the Business and Economics Statistics Section of the American Statistical Association*, 1962, reprinted in *The Political Economy of Prosperity*, 1970, pp. 132-145.

〔23〕 Perry, G., "Inflation versus Unemployment: The Worsening Trade-Off," *Monthly Labor Review*, Feb. 1971, pp. 68-71.

〔24〕 Phelps, E. S., "Phillips Curves, Expectations of Inflation and Optimal Unemployment Overtime," *Economica*, Aug. 1967, pp. 254-281.

〔25〕 Phillips, A. W., "The Relation between Unemployment and the Rate of Change in Money Wage Rates in the United Kingdom, 1861-1957," *Economica*, Nov. 1958, pp. 283-299.

〔26〕 Samuelson, P. A., and R. M. Solow, "Analytical Aspects of Anti-Inflation Policy," *American Economic Review*, May 1960, pp. 177-194.

〔27〕 Tarshis, L., "Changes in Real and Money Wages," *Economic Journal*, March 1939, pp. 150-154.