Discussion Paper No. 9703 May 1997

A Keynesian Model of Aggregate Demand and Supply

by

José Encarnación, Jr.*

*Professor Emeritus, School of Economics, University of the Philippines

A Keynesian Model of Aggregate Demand and Supply*

José Encarnación, Jr.

Abstract: This paper defines an aggregate demand function based on portfolio balance with three assets (money, bonds and equities) and an aggregate supply function derived from the supply behavior of a representative price-setting firm. The money wage is endogenous but the usual result is a short-period unemployment equilibrium. The model provides explanations of Phillips curve, stagflation and procyclical real wage phenomena. It also allows a continuum of full-employment equilibria.

Keywords: Portfolio equilibrium, supply curve of representative price-setting firm, endogenous money wage, unemployment equilibrium, procyclical real wage.

JEL classification E12.

*Thanks are due Emmanuel de Dios, Mark Encarnación, Raul Fabella, Socorro Gochoco-Bautista, Joseph Lim, Felipe Medalla, Claret Mapalad, Nimfa Mendoza, Rafael Rodriguez and Emerlinda Román for helpful discussions or comments on an earlier draft, and the National Academy of Science and Technology, Philippines, for research support. As usual, the author is solely responsible.

This paper presents a short-period aggregative model where the aggregate demand (AD) and aggregate supply (AS) functions differ from the more usual ones. The AD function incorporates two portfolio equilibrium conditions from a 3-asset formulation, and the AS function is based on the supply behavior of the representative monopolistically competitive firm. The typical case is an unemployment equilibrium although the money wage is endogenous in the model. The model permits explanations of the Phillips curve, stagflation and procyclical real wages. It also allows a continuum of full-employment equilibria given appropriate money supply and AD shift parameter values.

Section I describes the demand side and defines equilibrium conditions in the asset and product markets. Section II derives the supply function of the representative price-setting firm. Section III describes the aggregative model, implications are drawn in section IV, and section V makes concluding remarks.

I. Portfolio balance and output equilibrium

Following the lead of Tobin (1969), we assume three paper assets in the economy: fiat money M, government bonds B and equities E. At the end of the preceding (and beginning of the present) short period, their corresponding amounts are M_{-1}, B_{-1} and E_{-1}. Each unit of B issued during the present period is redeemed in the next period for one unit of money, so the price per unit of B is $1/(1 + r')$ where r' is the nominal rate of interest on bonds. The government's budget constraint is

$$G \leq (M - M_{-1})/p + (B/(1 + r') - B_{-1})/p + \tau Y \qquad (1.1)$$

where G denotes government spending on output, p the price level, and τY taxes, Y being real output and τ the tax rate.

For simplicity we abstract from depreciation and assume that firms finance their planned investment I by issuing new equities, so that

$$I = (E - E_{-1})/p \tag{1.2}$$

each unit of E being a claim to one unit of physical capital. The usual aggregate production function can be written

$$Y = \Phi^0(K_{-1}, N) \tag{1.3}$$

where K_{-1} is the stock of capital at the end of the preceding period and N is current employment.

Let N^s be the amount of labor supplied. Defining

$$Y^h = \Phi^0(K_{-1}, N^s) \tag{1.4}$$

as the output that can be produced with N^s, we can assume that

$$N \le N^s \tag{1.5}$$

and therefore

$$Y \le Y^h. \tag{1.5a}$$

Write $W_1 = (M, B, E)$ so that $W_{-1} = (M_{-1}, B_{-1}, \text{ and } E_{-1})$ and $W/p = (M/p, B/p, E/p)$. Denoting consumption by C, we assume that households in the aggregate have a utility function $U(C, N^s, W/p)$, W/p standing for future possibilities after the present period. However, in view of (1.5), U is effectively $U(C, N, W/p)$ which is maximized subject to the budget constraint

$$C + (M - M_{-1})/p + (B/(1 + r') - B_{-1})/p$$

$$+ (E - E_{-1})/p \leq Nw/p + J - \tau Y \qquad (1.6)$$

where w is the money wage rate and J denotes firms' profits which are paid out to owners of E_{-1}. Since

$$J = Y - Nw/p \qquad (1.7)$$

and (1.6) will be satisfied as an equality, it can be written

$$C + (M - M_{-1})/p + (B/(1 + r') - B_{-1})/p + (E - E_{-1})/p$$

$$= (1 - \tau)Y. \qquad (1.6a)$$

Since N is determined by Y in (1.2) with K_1 predetermined, the maximization problem has only four decision-variables, viz. C, M/p, B/p and E/p. (Because of (1.6a), we observe that there are only three degrees of freedom.) Let π be the expected inflation rate between the present period and the next, and let ρ be the expected long-term real rate of return on equities. Noting that

$$1 + r = (1 + r')/(1 + \pi) \qquad (1.8)$$

where r is the expected real rate of interest on bonds, the decision-variables can be expressed as functions of $R = (r, Y, W_{-1}/p, \tau, \pi, \rho)$.

We can therefore write the asset demand functions as

$$M/p = m^{o}(R) \qquad (1.9)$$

$$B/p = b^{o}(R) \qquad (1.10)$$

$$E/p = e^{o}(R) \qquad (1.11)$$

If we now read M, B and E in (1.9)-(1.11) as the quantities of assets supplied, these three equations are then the asset-market equilibrium conditions, of which only two are independent. We will use (1.9) and (1.10) to define portfolio equilibrium.

As was observed earlier, there are three degrees of freedom in the U-maximization problem; therefore the demand for C can be written

$$C = c^{d}(R, M/p, B/p). \tag{1.12}$$

Denoting the demand for output by X,

$$X = C + I + G \tag{1.13}$$

and equilibrium output is defined by

$$Y = X. \tag{1.14}$$

Looking at (1.2), (1.6a) and (1.13), we see that (1.14) implies that (1.1) holds as an equality:

$$G = (M - M_{-1})/p + (B/(1 + r)(1 + \pi) - B_{-1})/p) + \tau Y \tag{1.1a}$$

using (1.8). We note for later reference that (1.14) also implies that saving S equals planned investment I. (S equals household saving S_h plus government saving S_g. S_h equals the left-hand side of (1.6a) less C, and S_g equals τY less G in (1.1a), so S = I.) We also note that (1.14) implies

$$X \leq Y^{h} \tag{1.5b}$$

in view of (1.5a). The classical case assumes $X = Y_h$ and the typical Keynesian case has $X < Y_h$. As Keynes (1936, p. 3) observed, "the postulates of the classical theory are applicable to a special case and not to the general case, the situation which it considers being a limiting point of the possible positions of equilibrium."

In order to measure the extent of unemployment in the Keynesian case, the N^s function needs to be defined. If $X = Y^h$, then $Y = Y^h$ and therefore $N = N^s$. In maximizing $U(C, N^s, W/p)$, N^s is a decision-variable. Noting that N^s depends on w/p, and Y^h is a function of N^s, we can write (analogous to the C-function of (1.12))

$$N^s = h^0(r, w/p, W_{-1}/p, \tau, \pi, \rho, M/p, B/p) \qquad (1.15)$$

for use in section III.

Consider the system consisting of the nine equations (1.1a), (1.2)-(1.3), and (1.9)-(1.14). Examination shows that there are eight independent equations which determine the eight endogenous variables r, p, Y, N, E, G, C and X, given the exogenous variables M, B, I, τ, π and ρ, and the predetermined K_{-1}, M_{-1}, B_{-1} and E_{-1}. It will be seen in the next section that the supply function endogenizes w.

II. The representative firm's supply function

We assume that the production sector of the economy consists of a large number of monopolistically competitive firms whose differentiated products are measured in the same units. (See Dixon and Rankin (1994) and Benassy (1991) for surveys of the recent literature on monopolistic competition in macroeconomic models.) Let $x = x(p, \alpha)$, $x_p < 0$, $x_\alpha > 0$, be the demand for the product of the representative (or average) firm; p is the price set by the firm--it is also the price level--and α is a demand shift parameter for the firm's output x. (One might write $x = x(p, p^a, \alpha)$ where p^a is the average price, but since $p = p^a$ for the representative firm, we can simply put $x = x(p, \alpha)$.) Let $k(x, w, \beta)$, where $\beta > 0$ is an exogenous cost parameter, be the cost of producing x; $k_x > 0$, $k_w > 0$, $k_\beta > 0$, $k_{xw} > 0$ and $k_{x\beta} > 0$. Taking α, w and

β as given, the firm maximizes $px(p, \alpha) - k(x, w, \beta)$, so

$$(p - k_x)x_p + x = 0 \tag{2.1}$$

$$(p - k_x)x_{pp} + 2x_p - k_{xx}x_p^2 < 0. \tag{2.2}$$

We assume enough competition to make $p - k_x > 0$ relatively small and $k_{xx} > 0$. Total differentiation of (2.1) gives

$$Ddp + ((p - k_x)x_{p\alpha} + (1 - x_p k_{xx})x_\alpha)d\alpha - x_p k_{xw}dw$$
$$- x_p k_{x\beta}d\beta = 0 \tag{2.1a}$$

where D is the left-hand side of (2.2). Therefore

$$\partial p/\partial w = x_p k_{xw}/D > 0 \tag{2.3}$$

$$\partial p/\partial \beta = x_p k_{x\beta}/D > 0 \tag{2.4}$$

$$\partial p/\partial \alpha = -((p - k_x)x_{p\alpha} + (1 - x_p k_{xx})x_\alpha)/D > 0 \tag{2.5}$$

with $p - k_x$ sufficiently small. The price is thus set higher if w, β or α is higher.

Consider the demand curve in the usual diagram with x on the horizontal axis and p on the vertical. Since a higher α shifts the demand curve and the marginal revenue curve rightwards, the latter will intersect the marginal cost curve at a higher value of x. The firm's supply curve, which tells the optimal p as a function of the output x supplied (which depends on α), is accordingly generated by varying α, given w and β. It is therefore upward sloping and can be written

$$p = F^0(x, w, \beta), \quad F^0_x > 0, \quad F^0_w > 0, \quad F^0_\beta > 0. \tag{2.6}$$

To examine the effect of an increase in w on the supply curve, let us assume that $k(x, w, \beta) = n(x)w + \beta x$ where $n = n(x)$ is the amount of labor required to produce x, so $k_x = n'(x)w + \beta$. A Taylor linear approximation at any optimal price-output point (p^*, x^*) gives

$$x(p, \alpha) = x^* + (p - p^*)x_p + (\alpha - \alpha^*)x_\alpha \quad (2.7)$$

where α^* is the existing value of α and the partials are evaluated at (p^*, x^*). To simplify the notation, write $A = x^* - p^*x_p - \alpha^*x_\alpha$ and $b = -x_p$. Choosing units so that $x_\alpha = 1$, (2.7) becomes

$$x = A - bp + \alpha. \quad (2.7a)$$

Then, writing $a = n'(x^*)$ and using (2.7a), (2.1) can be written

$$p = (A + \alpha)/2b + (aw + \beta)/2. \quad (2.1a)$$

We now assert[1/]

Proposition 1. The supply curve will shift upwards proportionately less than a dw increase in w, i.e. at any given x and the corresponding p on the supply curve, if δp is the vertical shift, then $\delta p/p < dw/w$.

Proof. The δp shift can be thought of as the sum of two components: (i) δp_1, due to dw, which decreases output by (say) dx, and (ii) δp_2 due to a rise in α that increases output by the same amount dx.

(i) $\partial p/\partial w = a/2$ from (3.1a), so $dw = 1$ gives $\delta p_1 = a/2$ which reduces output by $dx = ba/2$ since the slope of the demand curve is $1/x_p = -1/b$. (ii) $\partial p/\partial \alpha = 1/2b$ is the slope of the supply curve, and therefore $\delta p_2 = (1/2b)(ba/2) = a/4$. Thus $\delta p = \delta p_1 + \delta p_2 = 3a/4$, and $\delta p/p = 3a/4p$ can be compared with $dw/w = 1/w$. Since $p > k_x = aw + \beta$ so $p/a > w$, one gets $4p/3a > w$ whence $\delta p/p < dw/w$.

Returning to the supply function (2.6), it implies the aggregate relationship

$$p = f^0(Y,\ w,\ \beta),\ f^0_Y > 0,\ f^0_w > 0,\ f^0_\beta > 0 \qquad (2.6a)$$

since Y is x times the number of firms. It also implies

$$p/w = f^1(Y,\ w,\ \beta),\ f^1_Y > 0,\ f^1_w < 0,\ f^1_\beta > 0 \qquad (2.6b)$$

by virtue of Proposition 1. It is then possible to have a lower p/w at a higher output level if w is higher, a result which will play a later role.

Finally, we note that (2.6a) implies a relationship

$$w = f^2(Y,\ p,\ \beta),\ f^2_Y < 0,\ f^2_p > 0,\ f^2_\beta < 0 \qquad (2.6c)$$

that tells the value of w, which is consistent with admissible values of p and Y. Thus, (2.6a) determines w given p and Y.

III. An aggregative model

The model consists of the following relationships from the preceding sections, renumbered here for convenience:

$$Y = \Phi^0(K_{-1},\ N) \qquad (1)$$

$$p = f^0(Y,\ w,\ \beta),\ f^0_Y > 0,\ f^0_w > 0,\ f^0_\beta > 0 \qquad (2)$$

$$X = c^d(\bar{r},\ Y,\ W_{-1}/p,\ \tau,\ \pi,\ \rho,\ M/p,\ B/p) + I + G \qquad (3)$$

$$M/p = m^d(r,\ Y,\ W_{-1}/p,\ \tau,\ \pi,\ \rho) \qquad (4)$$

$$B/p = b^d(r,\ Y,\ W_{-1}/p,\ \tau,\ \pi,\ \rho) \qquad (5)$$

$$G = G^d(\bar{r},\ Y,\ W_{-1}/p,\ \tau,\ \pi,\ \rho,\ M/p,\ B/p) \qquad (6)$$

$$Y = X^d \qquad (7)$$

$$N^s = h^s(r,\ w/p,\ W_{-1}/p,\ \tau,\ \pi,\ \rho,\ M/p,\ B/p) \qquad (8)$$

$$Y^h = \Phi^s(K_{-1}, N^s) \tag{9}$$

$$X \leq Y^h. \tag{10}$$

Equation (1) = (1.3), (2) = (2.6a), (3) = (1.13) using (1.12), (4) = (1.9), (5) = (1.10), (6) = (1.1a), (7) = (1.14), (8) = (1.15), (9) = (1.4) and (10) = (1.5b).

Given the predetermined K_{-1} and $W_{-1} = (M_{-1}, B_{-1}, E_{-1})$, and the exogenous variables M, B, I, τ, π, ρ and β, equations (3)-(7) suffice to determine r, p, Y, X and G. Then, with p and Y in hand, (1)-(2) give N and w, and (8)-(9) give N^s and Y^h. The model is just determinate in the nine endogenous variables r, p, w, Y, N, X, G, N^s and Y^h.

In order to have a simple diagram, it will be useful to condense the model into an AS/AD schema. Suppressing K_{-1}, (1) and (9) can be written

$$Y = \Phi(N) \tag{1a}$$

$$Y^h = \Phi(N^s) \tag{9a}$$

respectively. Since (2) implies

$$p/w = f^1(Y, w, \beta), \quad f^1_Y > 0, \quad f^1_w < 0, \quad f^1_\beta > 0 \tag{2a}$$

by Proposition 1, we can write

$$Y = f(p/w, w, \beta), \quad f_{p/w} > 0, \quad f_w > 0, \quad f_\beta < 0. \tag{2b}$$

To reduce the amount of notation, we will suppress τ, π and ρ in (3)-(6) and (8), so that

$$X = c^1(r, Y, W_{-1}/p), M/p, B/p) + I + G \tag{3a}$$

$$M/p = m^1(r, Y, W_{-1}/p), \quad m^1_r < 0, \quad m^1_Y > 0 \tag{4a}$$

$$B/p = b^1(r, Y, W_{-1}/p),\ b^1_r > 0,\ b^1_Y > 0 \tag{5a}$$

$$G = G^1(r, Y, W_{-1}/p, M/p, B/p) \tag{6a}$$

$$N^s = h^1(r, w/p, W_{-1}/p, M/p, B/p). \tag{8a}$$

Using (4a) and (5a) in (3a),

$$X = c^2(r, Y, W_{-1}/p) + I + G. \tag{3b}$$

Let $j^0(r, Y, W_{-1}/p, M/p) = M/p - m^1(r, Y, W_{-1}/p)$. Since $j^0(\cdot) = 0$ and $j^0_r \neq 0$, the implicit function theorem can be used to write

$$r = j(Y, W_{-1}/p, M/p) \tag{11}$$

in a neighborhood of portfolio equilibrium. Thus (3b) can be written more simply as

$$X = c^3(Y, M/p) + I + G \tag{3c}$$

with W_{-1}/p suppressed. Similarly for (6a),

$$G = G^2(Y, M/p). \tag{6b}$$

Thus, (3c) can be written

$$X = g^0(Y, M/p) + I. \tag{3d}$$

As usual, we assume that $0 < g^0_Y < 1$ for stability of Y^*, denoting equilibrium values of the variables by star-superscripts.

Repeating the argument in the penultimate paragraph on rewriting $C = c^1(\cdot)$ in (3a) as $c^3(\cdot)$ in (3c), but with Y^h in place of Y (and remembering that Y^h is a function of N^s), (8a) can be written

$$N^s = h^2(w/p, M/p),\ h^2_{w/p} > 0. \tag{8b}$$

Nothing in the discussion to follow is contingent on the sign of $\partial N^s/\partial(M/p)_{w}$, which is unclear without additional assumptions.

Using (2b) in (3d),

$$X = g^1(p/w, w, \beta, M/p) + I. \tag{3e}$$

Putting $w = w^*$, we will write this in the form

$$X = g(p/w^*, w^*, \beta, M, \gamma) \tag{3f}$$

where $\gamma = \gamma(B, I_{x+T}, \pi_x, \rho)$, $g_\gamma > 0$, is a demand parameter reflecting the suppressed exogenous variables. Correspondingly, (2b) will be written

$$Y = f(p/w^*, w^*, \beta). \tag{2c}$$

To summarize at this point, (2)-(2c) are alternative versions of the aggregate supply function, and (3)-(3f) are alternative versions of the aggregate demand function, but we will refer to (2c) in particular as the AS function and (3f) as the AD function which are shown in Fig. 1. Using (8b) in (9a),

$$Y^h = h^1(w/p, M/p) \tag{9b}$$

which can be written in the form

$$Y^h = h(p/w^*, M), \quad h_{p/w} < 0 \tag{9c}$$

for Fig. 1.

The labor market fails to clear in general because p/w^*, which equates Y and X, would only fortuitously equate Y and Y^h also. The extent of involuntary unemployment, measured in terms of the corresponding output, is indicated by the vertical distance between the Y^h curve and the equilibrium point where AS = AD. As Keynes (1936, p. 15) put it, "in the event of a small rise in ... [p/w] both the aggregate supply of labor willing to work for the current money wage and the aggregate demand for it at that wage would be greater than the existing volume of employment." This is clear from Fig. 1.

It was noted earlier in section I that the equilibrium condition Y = X implies that saving S equals planned investment I. Notice now that it is only where AS = AD that I = S, in contrast to the textbook construction of AD based on IS-LM where I = S at every point of the textbook AD.[2/]

IV. Implications

In the following discussion of some comparative statics of the model, we assume that the endogenous variables are always at their equilibrium values which will change only as a result of a change in some exogenous variable, and we will usually omit the star-superscripts denoting equilibrium values.

<u>Effect on Y* of changes in w* and β</u>

Looking at (2b), we see that a higher w shifts the AS curve in Fig. 1 upwards, and a higher β shifts it downwards. This induces similar shifts in the AD curve--see (3d)-(3f)--and we wish to examine how Y* is affected. Focusing on this question, for present purposes let us write the AS and AD functions as

$$Y = Y(q, s)$$

$$X = X(q, s)$$

where $q = p/w = q(s)$ and s is a shift variable which depends on the change in w or β. Accordingly,

$$dY = Y_q q'(s)ds + Y_s ds$$

$$dX = X_q q'(s)ds + X_s ds.$$

Writing $z = \partial X/\partial Y$, it is clear that $X_s/Y_s = z = X_q/Y_q$ and therefore $dX = zY_q q'(s)ds + zY_s ds$. Suppose an initial equilibrium so $X = Y$. Since $dY = 0$ implies $dX = 0$, we find that Y^* remains the same. In other words, the shifted AS and AD curves will intersect at the same value of Y but of course at a different value of p/w, lower in the case of a higher w and higher in the case of a higher β. We state this result for later reference as

Proposition 2. Y^* is unchanged by a shift in AS due to a higher w or a higher β, but p/w is lower in the former and higher in the latter.

Since w will not change unless some exogenous variable changes, any change in Y must therefore be the consequence of the change in that exogenous variable and not of the change in w *per se*.

Effects of higher M

Suppose M is higher *cet. par.* (i.e. other exogenous variables remaining the same). There are five cases to consider.

(i) If p falls, then M balance (4a) and B balance (5a) require Y to be higher. Holding β fixed, (2) implies that Y is higher if and only if p rises or w falls. Proposition 2 says that Y is unchanged by a change in w, so p must rise in order for Y to be higher. This contradicts the hypothesis, and therefore p cannot fall.

(ii) If p remains the same, then M balance means a lower r or a higher Y. If r is lower, a higher Y is needed to maintain B balance, so Y must rise. For the same reason as in (i), p cannot remain the same.

(iii) If p rises proportionately more than M, then portfolio balance requires Y to fall. From (2), a lower Y implies that p is lower unless w is higher, and Y is lower if p falls or w rises. But by Proposition 2, Y does not change as a result of a change in w, so p must be lower for Y to fall, contradicting the hypothesis. Thus p cannot rise more than M.

(iv) If p rises in the same proportion as M, then B balance requires a lower r or lower Y. A lower r means a lower Y in order to maintain M balance, so Y must fall. Repeating the argument in (iii), p cannot rise like M.

(v) If p rises less than M, then M balance calls for a lower r or a higher Y, and B balance requires a lower r or a lower Y, so r must fall. If Y is lower, the argument in (iii) shows that p must be lower, which would contradict the hypothesis, and therefore B balance requires a lower r. Ignoring the null-probability event that the value of r for B balance will also balance the M market without a higher Y, r will fall and Y will rise.

Since only case (v) remains as a possibility, to summarize we have

<u>Proposition 3</u>: A higher M <u>cet. par.</u> implies that p rises proportionately less than M (so M/p is higher), r falls, and Y rises.

The intuition behind this result is simply that a higher M raises G hence X, shifting the AD curve upwards to intersect the AS curve at a higher Y. In short, $g_M > 0$ in (3f).

The Phillips curve

Consider an increase in M. The larger the increase, we expect from Proposition 3 that the greater is the percentage change in p and the larger is Y. This means a positive correlation between the two, hence a negative correlation between the inflation rate and the unemployment rate, which is the Phillips curve.

Stagflation

Suppose the cost parameter β is higher. By Proposition 2, Y is unchanged at a higher p/w. There is no reason for w to be lower, in which case p is higher. If we also have a lower γ, then Y is lower and so is p/w but the net effect could be a higher p than initially. In this event, one has inflation with higher unemployment which is the stagflation phenomenon.

A procyclical real wage

Recall that p and Y are determined in the subset of equations (3)-(7), and w is determined by (2) given p and Y. It is therefore unlikely for w to remain the same after a change in an exogenous variable. Suppose then that a higher M or γ raises w as well as p and Y. First, consider the effect of the higher w: it puts the unchanged Y directly west of the initial equilibrium at a lower p/w. Second, the AD curve will shift upward. If the shift is not too large, the new AS = AD point will be northwest of the old, which means a procyclical real wage. It is important that there be no necessity about this, for the empirical evidence is that there are times when the real wage is procyclical and times when it is countercyclical; see Sumner and Silver (1989).

Full employment equilibria

Full employment is attained if $X = Y^h$ in addition to $X = Y$. Looking at (3f) and (9c) again, we see that some M will satisfy $X = Y^h$ if γ is not too low. In other words, some γ and M will give full employment. Assuming this case, a further increase in M must raise w (as well as p and Y) to elicit the higher N^s required. Since the higher w shifts the AS curve upwards, it will intersect the Y^h curve at a higher Y^h and a lower p/w. Again, provided γ is not too low, $X = Y^h$ and we have

Proposition 4. Appropriate combinations of γ and M give a continuum of full-employment equilibria.

We might note that Cottrell and Darity (1991) obtain the possibility of multiple full-employment equilibria on the assumption of increasing returns. McDonald (1987) gets a continuum of equilibria from a discontinuity in the representative firm's marginal revenue function, Dixon (1988) from relative demands in a 2-sector model, but their equilibria are not full-employment ones.

On Harrod instability

Writing Y_{-1} for output in the previous period, the current growth rate is $(Y - Y_{-1})/Y_{-1}$. One can speak of equilibrium growth if, in addition to the intra-period equilibrium condition $X = Y$ (or $I = S$) being satisfied, the expectations π and ρ are confirmed over time.

In the Harrod (1939) growth model where investment is endogenously given by $I = v(Y - Y_{-1})$, $v = const$, Y is chosen to equal expected demand. Growth is said to be warranted if $I = S$ where $S = \sigma Y_{-1}$, i.e. $v(Y - Y_{-1}) = \sigma Y_{-1}$ or $(Y - Y_{-1})/Y_{-1} = \sigma/v$, so σ/v is the warranted rate of growth. Focusing on output and abstracting from π and ρ, Harrod (1939) argued that warranted (or equilibrium) growth is unstable, for if the actual rate of growth is greater than the warranted rate, then $I > S$ and there would be excess demand. This would lead to yet higher output in the next period, etc.

As is well known, the neoclassical growth model is not subject to Harrod instability because investment in that model is defined to be always equal to savaing. Thus the question of stability, which asks whether there is a return to equilibrium growth after a departure from it, cannot arise.

Similarly, the model of this paper is exempt from Harrod instability because $X = Y$ in every period, and therefore $I = S$. Any possible instability would have to rely on the behavior of π and ρ over time, which is a different matter altogether. More interesting because the real world would not seem to exhibit equilibrium growth, the model does not imply equilibrium growth stability either.

V. Concluding remarks

The aggregative model presented in this paper is different from the standard Keynesian model in two important respects. First, there are two independent asset-equilibrium equations (one for bonds in addition to the usual one for money) derived from a 3-asset formulation which includes equities. The AD function is based on portfolio equilibrium, which has the consequence that it is only where AD = AS that planned investment I equals saving S. In contrast, I = S at every point of the usual AD construction based on the IS-LM framework.

Second, instead of the profit-maximization condition for price-taking firms that equates the marginal product of labor to the real wage, the AS function derives from the supply function of the representative price-setting firm. This supply function has the property that a higher money wage makes the price-wage ratio smaller at any given output level, which thus allows for the possibility of a higher real wage at a higher output. The observation that the real wage is sometimes procyclical can then be explained. Also, a continuum of equilibria with full employment is possible with an exogenous AD shift parameter and increases in the endogenous money wage resulting from increases in the stock of money. Finally, Phillips curve and stagflation phenomena find straightforward explanations in the model.

University of the Philippines

Notes

1. Keynes (1939, p. 46) conjectured that "it may be the case that the practical workings of the laws of imperfect competition in the modern quasi-competitive system are such that, when output increases and money wages rise, prices rise less than in proportion to the increase in marginal money costs."
2. Colander (1995, p. 175) calls the textbook AD curve an "aggregate equilibrium curve."

References

Benassy, J.P. (1991). 'Monopolistic competition.' Handbook of Mathematical Economics (ed. W. Hildenbrand and H. H. Sonnenschein). Amsterdam: North-Holland.

Colander, D. (1995). 'The stories we tell: A reconsideration of AS/AD analysis.' Journal of Economic Perspectives, vol. 9, pp. 169-188.

Cottrell, A.F., and W.A. Darity (1991). 'IS-LM under increasing returns.' Journal of Macroeconomics, vol. 13, pp. 675-690.

Dixon, H. (1988). 'Unions, oligopoly and the natural range of unemployment.' Economic Journal, vol. 98, pp. 1127-1147.

Dixon, H., and N. Rankin (1994). 'Imperfect competition and macroeconomics: A survey.' Oxford Economic Papers, vol. 46, pp. 171-199.

Harrod, R.F. (1939). 'An essay in dynamic theory.' Economic Journal, vol. 49, pp. 14-33.

Keynes, J.M. (1936). The General Theory of Employment Interest and Money. London: Macmillan.

Keynes, J.M. (1939). 'Relative movements of real wages and output.' Economic Journal, vol. 49, pp. 34-51.

McDonald, I.M. (1987). 'Customer markets, trade unions and stagflation.' Economica, vol. 54, pp. 139-153.

Sumner, S., and S. Silver (1989). 'Real wages, employment, and the Phillips curve.' Journal of Political Economy, vol. 97, pp. 706-720.

Tobin, J. (1969). 'A general equilibrium approach to monetary theory.' Journal of Money, Credit and Banking, vol. 1, pp. 15-29.

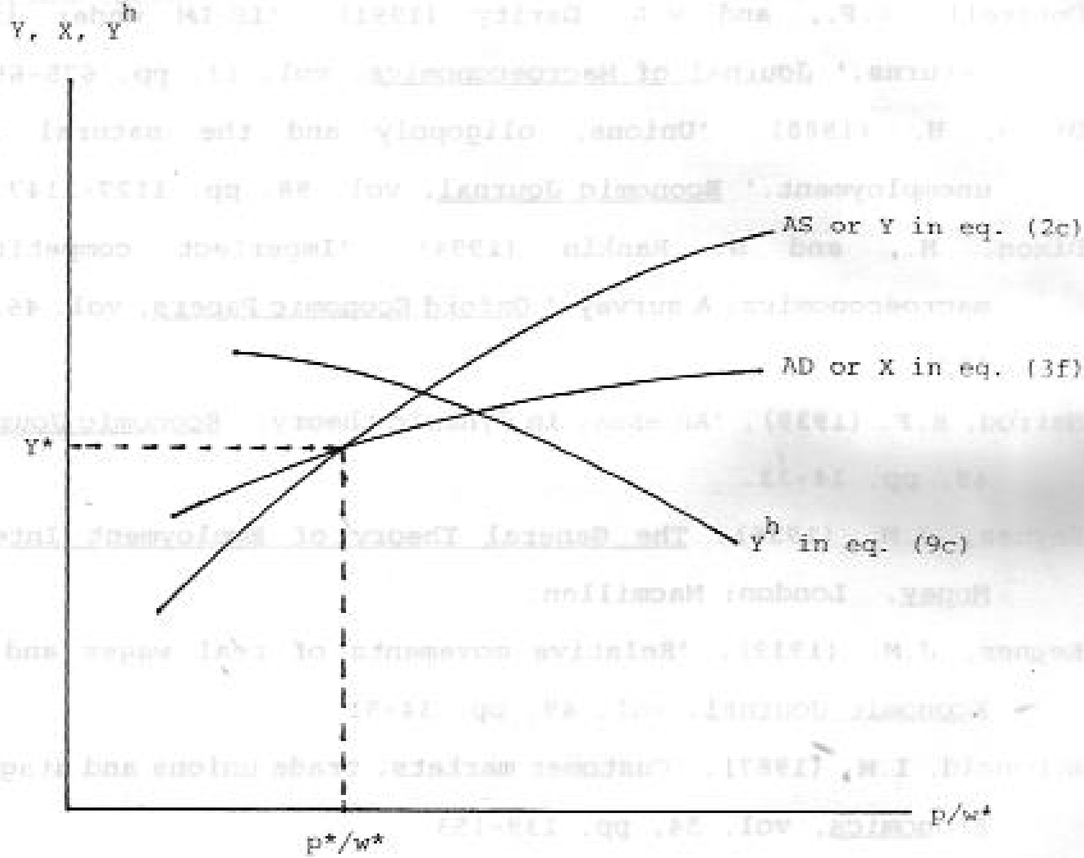

Fig. 1