

# A Graphic Presentation of a Macroeconomic Model — The Inflationary Spiral

## 1. Introduction

This paper has a twofold purpose: it attempts to portray in a single graphic model the interaction of all forces affecting the aggregate supply and aggregate demand in an economy and to use such model to probe into a problem which is so characteristic of modern societies at large and particularly of the Brazilian economy, namely the inflationary spiral.<sup>1</sup>

## 2. The Macroeconomic Model

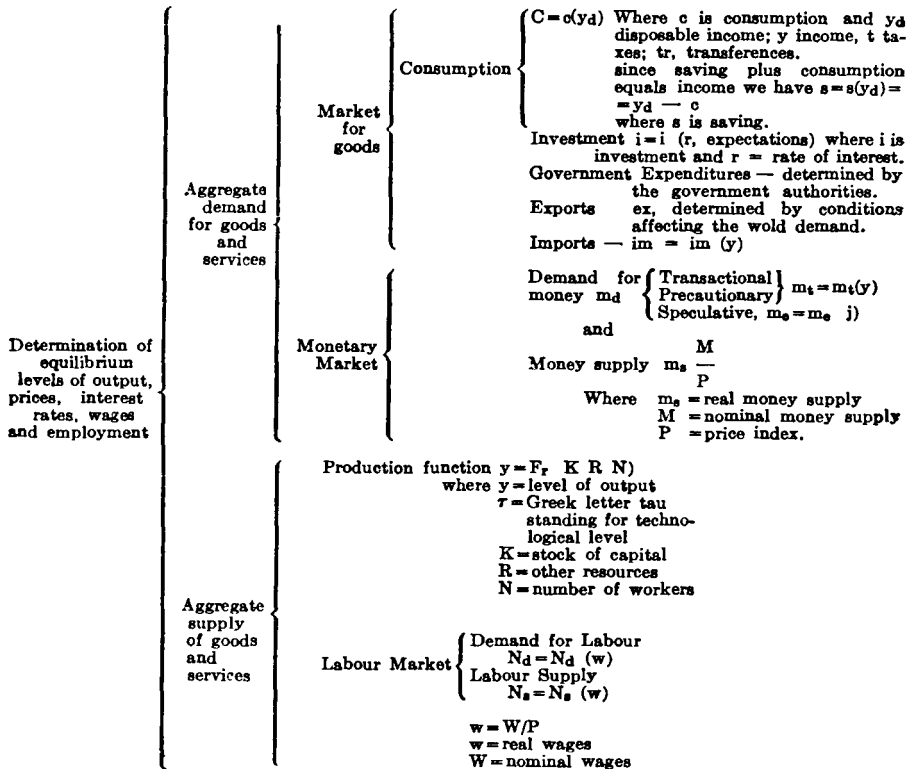
The present is a macroeconomic Keynesian-like model.<sup>2</sup> An analysis of the current level of output, prices, employment, wages, and interest rates may be conveniently put forward if the forces actuating within a given setting are broken down into two sets of forces: those which actuate upon the demand for goods and services and those which actuate on their supply. The set of forces which build up the aggregate demand comprises those which actuate in the market for goods and those which actuate in the money market. As far as the market for goods is concerned the relevant factors are the consumption function, and the corresponding saving function, the investment function, the government expenditures, the exports and imports, and the level of taxes and transferences. The relevant factors in the money market are the supply of means of payments and the demand for money which, for analytical purposes, are broken down into transactions motive demand, precautionary motive demand and speculative motive demand. Forces actuating upon the aggregate supply for goods and services are dependent partly on technical factors, partly on economic considerations. Technical factors depend upon the technological level, the state of science and arts, the degree of entrepreneurship, the labour skill and the amount of natural resources available. The economic considerations affecting the aggregate supply comprises such factors as the wages bill entrepreneurs are willing to pay and the labour to receive, the profitability stemming from the more or less intensive use of capital and so forth.

<sup>1</sup> Most of what appears in this paper is due to the teachings the author received from professors Boris P. Pesek and Tomar R. Saving of Michigan State University in 1967.

<sup>2</sup> KEYNES, John Maynard. *The General Theory of Employment, Interest and Money*. New York, Harcourt, Brace and World, Inc.

The following scheme describes the main factors affecting each of the foregoing functions in accordance with their importance. The functional relation is expressed symbolically and the symbols used throughout the text are conveniently explained.

### Diagrammatic View of the Keynesian Macroeconomic Model



Small letters mean that the variables are in real terms. That the reader may easily be led to understand what follows, some simplifications are made which should not impair the main objectives of the exposition. The better suited to act as a tool for the analysis of the real world and the more capable it is to foresee forthcoming events, the more useful will be an economic model, even though it simplifies reality. It is assumed throughout the analysis that: <sup>3</sup>

<sup>3</sup> See SIMONSEN, Mario H. Teoria Neoclássica. In: *Teoria do Equilíbrio a Curto Prazo*. Apostila do Instituto Brasileiro de Economia da Fundação Getúlio Vargas, junho de 1968, vol. I, p. 2-4.

- 1) There is no international trade and therefore imports alike exports are nil.
- 2) There are no transferences.
- 3) The national product may be purchased either as consumption or as capital goods.
- 4) There is paper money and a market for bonds.
- 5) The capital stock as well as the natural resources, technological level and number of firms are constant since the analysis is restricted to the short run. The only variable factor is labour.
- 6) The existing labour force is homogeneous.
- 7) The market for goods alike the market for labour and bonds is perfectly competitive.
- 8) There is no uncertainty regarding the future in the capital market and any person or firm may borrow any amount whatever provided they are bound to pay their debts at the rate of interest prevailing in the market.

We shall first describe each component of the aggregate model. Then, we shall analyse the role played by all those components in setting the short run equilibrium of the economy, as well as the way they interact with one another for that same purpose.<sup>4</sup>

### 3. The Aggregate Demand

In order that equilibrium may be attained in the market for goods, it is necessary that the demand for consumption goods coupled with the demand for capital goods, that is to say, planned investment plus the government demand for goods, be equal to the aggregate supply of goods. For conveniences's sake the saving function may be used instead of the consumption function. In that case the equilibrium is conditioned by what follows: Savings ( $s$ ), which depend upon the level of the real disposable income ( $y_d$ ), plus taxes ( $t$ ), which are assumed to be an exogenously set constant, must equal investment ( $i$ ), which in its turn

<sup>4</sup> See PSEK, B. P. & SAVING, T. R. *Money, Wealth and Economic Theory*. New York, Mac Millan, 1967, chapter 1 and *Foundations of Money and Banking*. New York, Mac Millan, 1968, chapters 21 e 22.

depends on the rate of interest ( $r$ ), plus government expenditures, assumed to be an exogenously set constant. So we can write:

$$s = s(y_d) = s(y - t) \quad (1)$$

$$t = t \quad (2)$$

$$i = i(r) \quad (3) \text{ Entrepreneurs' expectations being assumed constant.}$$

$$g = g \quad (4)$$

$$s + t = i + g \quad (5)$$

A diagrammatic summary will help the reader to understand our exposition.<sup>5</sup> In figure 1 the savings function already affected by the tax burden is portrayed in the upper quadrant at the left. The investment function plus government expenditures appears in the upper quadrant at right. The 45.<sup>o</sup> line in the upper quadrant at right converts vertical measures into horizontal measures. Any point in that line is equidistant of both the horizontal and vertical axis. The 45.<sup>o</sup> line is used because it meets the equilibrium condition  $i + g = s + t$ . John R. Hicks'<sup>6</sup> IS function is then set up using the equilibrium conditions (5), the behaviour patterns of both the individuals (1) and entrepreneurs, (3), and the exogeneous variables set by the government (2) and (4). The IS function displays the locus of the pair of values for the income level and the rate of interest compatible with the equilibrium conditions in the goods market.

In order that equilibrium may be attained in the money market it is necessary that the demand for money in real terms  $m_d$  be equal to the money supply in real terms  $m_s$ . For purpose of analyses the demand for money in real terms is broken down into transactions motive and precautionary motive demands  $m_t$  which depend upon the income level and speculative motive demand  $m_e$  which depends on the rate of interest. At equilibrium the money supply  $m_s$  must equal the transaction and precautionary motive demand  $m_t$  plus the speculative motive demand  $m_e$ .

<sup>5</sup> See DERBURG, T. F. & McDUGALL, D. M. *Macroeconomics*. 3rd edition, McGraw Hill, 1968, chapter 9. McKENNA, J. P. *Aggregate Economic Analysis*. 3rd edition, N. W., chapter 12 and 13; LINDAUER, John. *Macroeconomics*. New York, J. Wiley, 1968, chapter 10 and ACKLEY, Gardner. *Macroeconomic Theory*.

<sup>6</sup> See HICKS, J. R. *Mr Keynes and the 'Classics'; A Suggested Interpretation*. *Econometrica*, vol. 5, abril 1937, p. 147-159.

all expressed in real terms. The money supply in real terms is defined as equal to the nominal supply deflated by the price index  $P$ . We can therefore write:

$$m_d = m_t + m_e \quad (6)$$

$$m_t = m_t (y) \quad (7)$$

$$m_e = m_e (j)$$

$$m_s = m_t + m_e \quad (9)$$

$$m_s = \frac{M_s}{P} \quad (10)$$

$$M_s = \bar{M}_s \quad (11)$$

It is assumed for simplicity's sake that the nominal supply of money  $M_s$  is set by the monetary authorities and is therefore an exogenous variable. The price level is an endogenous variable which needs to be determined. It is assumed at the outset that there is an arbitrary level.

Let it be

$$P = P_1 \quad (12)$$

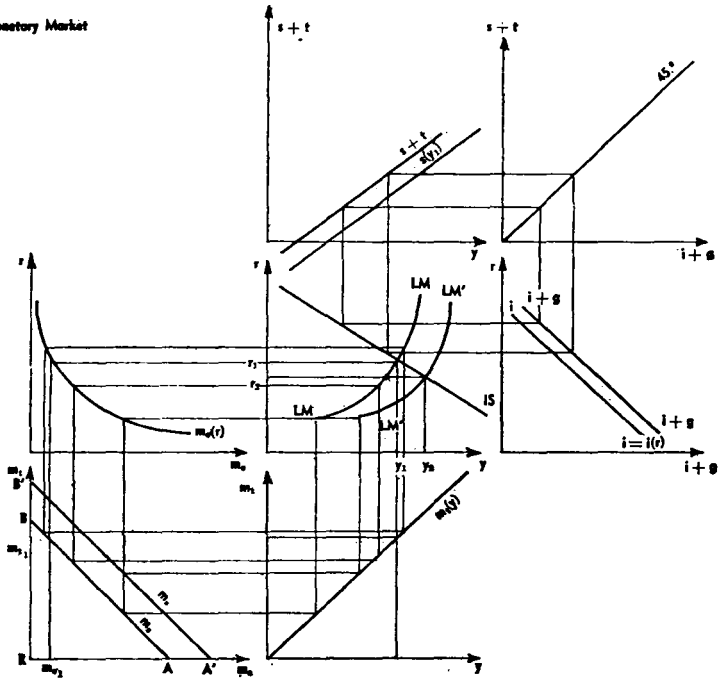
The money supply in real terms is shown in the lower quadrant at the left of Figure 1 by  $m_s$  (distance  $RA = RB$ ) which will be broken down into transactionary motive and speculative motive demands in real terms. The transactionary motive demand is shown in the lower axis at the right of Figure 1.

The speculative demand for money appears in the intermediate quadrant at the left end of Figure 1. Thus, when income is  $y_1$  the transactionary demand for money will be  $m_{t1}$ . This implies a speculative demand for money equals to  $m_{e1}$  which arises from a rate of interest  $r_1$ . We build in this way the Hick's LM function derived from the equilibrium condition (9). LM function displays the locus of the pair of values for the rate of interest and income compatible with the equilibrium conditions in the money market.

The intersection of IS and LM shows the single pair of values for income and the rate of interest which meets the equilibrium conditions in both the goods and money markets.

FIGURE 1

Market for Goods and Monetary Market



Income  $Y_1$  appearing in Figure 1 shows the level of the aggregate demand given a price level  $P_1$ . Given a nominal supply of means of payments  $M$  the supply of money in real terms is

$$m_s = \frac{M}{P_1}$$

Granted a lower level  $P_2$  which may be born of an increase in the aggregate supply the money supply in real terms will be

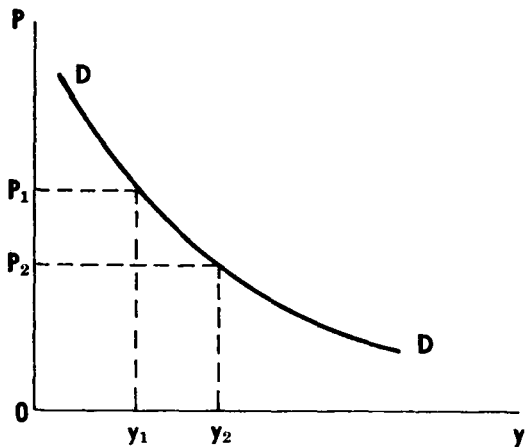
$$m'_s = \frac{M}{P_2}$$

Since  $P_2$  is less than  $P_1$ ,  $m'_s$  is larger than  $m_s$  when  $M$  is kept constant. Point  $A$  in Figure 1 moves to  $A'$  and distance  $RA' = RB'$  measures the new level of the money supply in real terms. A new LM function obtains indicated by  $LM'$ , and the IS line will cut  $LM'$  at a different point. This

point results in a different pair of values for income  $y_2$  and rate of interest  $r_2$  which meets the equilibrium condition in both the money and goods markets, given the price level  $P_2$ . The income our output level  $y_2$ , higher than  $y_1$ , shows the amount of goods and service which would be effectively demanded by the economy at the new price level  $P_2$  lower than  $P_1$ . If the aforementioned steps are repeatedly taken for several different price levels, and the resulting pairs of equilibrium values for  $y$  and  $P$  are plotted as in Fig. 2, we shall have the aggregate demand function  $DD$ .<sup>7</sup>

FIGURE 2

### Aggregate Demand



### 4. Factors Affecting the Aggregate Supply

The behaviour of a single firm is briefly analysed in what follows that a better understanding of the supply conditions may be attained.<sup>8</sup> The main target of a firm is the maximization of profits. Let a firm be considered under conditions of perfect competition so that it is confronted with prices and wages over which it has no control. To maximize profits the firm must choose its optimum output — since the output is the only variable over which it has control. The analysis is restricted to the short

<sup>7</sup> It is assumed that there is no wealth effect on the saving function arising from changes in the price level (as explained by A. C. Pigou, G. Harberler or D. Patinkin) or in the rate of interest (as explained by L. A. Metzler, M. Friedman or B. P. Peseck and T. R. Saving). See PESEK & SAVING. *Money Wealth and Economic Theory* for a full explanation on wealth affects.

<sup>8</sup> For an explanation concerning the firm behaviour see MCKENNA, J. P. *Aggregate Economic Analysis*. 3rd edition, Holt, chapter 13.

run and thus its output depends only upon the amounts of inputs of the production factors mainly labour. Capital embodying equipment and plant does not alter in the short run.

Let us assume that the administration of this firm has before it a schedule showing the amount of output as related to every possible amount of labour. In order to decide whether or not an additional labour unit should be hired a comparison must be made between the marginal value of output and the marginal cost of labour. That is how we state the principle that the firm increases its output up to the point at which marginal cost equals marginal revenue. Marginal revenue is equal to marginal output times its price. The same result may be stated differently. If a labourer produces one hundred units of output per month and if his wage is only 80 times the unit price of the output, the firm on hiring him will have a profit of 20 units of output. The firm will then expand its output until the marginal yield of the last labourer will be as high as the number of units of output which may be purchased by this wage.

We may transfer these concepts to the whole industry. The only difference is that we have now more labour and a larger output but the same relations among wages price and marginal yield will hold. If we transfer these concepts to the economy as a whole, the same principles will hold but a new measuring technique must be used. Output is no longer measured by physical units and prices. The national product is measured in terms of national income and the price is measured in terms of price level. The wage level means the average wage and is used as an index for the price of labour.

The following relations are used to determine the aggregate supply: production function; the demand for and the supply of labour in the labour market.

## 5. The Production Function

Let a production function be assumed relating the level of real income ( $y$ ) with the level of employment ( $N$ ) in an economy, granted that the capital stock ( $K$ ), the available resources ( $R$ ), and the level of technology ( $R$ ) are all kept constant in the short run. The production function is then:

$$y = F_{\tau} (N, K, R) \quad (12)$$

$$\text{or simply } y = F (N) \quad (12')$$



inasmuch as

$$K = \bar{K} = \text{constant}$$

$$R = \bar{R} = \text{constant}$$

$$\tau = \bar{\tau} = \text{constant}$$

the value of output equals the average level of prices ( $P$ ) times the real product ( $y$ ).

$$Y = P \times y = P \times F(N)$$

The production function (12') portrayed in the quadrant at the right end of Figure 3 reflects the law of diminishing returns. Each additional labourer adds up to aggregate output but the more labour employed the smaller the increase in output. If the marginal output is defined as the change in total output entailed by the employment of one additional labour unit a diminishing marginal output obtains along the production function. Mathematically, it is the derivative of the production function with respect to labour. Thus

$$PM_N = F'(N)$$

where  $PM_N$  is the marginal yield of labour and  $F'(N)$  is the first derivative of the production function. Symbolically the concept of the diminishing output is:

$$F''(N) < 0$$

that is to say the second derivative of the production function is negative. This means that the more labour is employed the smaller the first derivative.

Granted the conditions prevailing in the labour market the aggregate supply curve may be built starting from the production function.

## 6. The Labour Market

A) *The demand for labour.* The demand for labour is derived from the aggregate demand for goods and services. To have profits the entrepreneurial class must put their firms into operation and for that it must employ labour. The number of labourers to be employed depends on the

available technology which is implied in the mathematical relation called the production function. If maximization of profits is assumed it will follow that the firms will continue to employ labour as long as each additional labour unit entails a revenue higher than the cost. Thus the level of wages ( $w$ ) offered to the labour will be set by the additional yield of the labour force effectively employed.

$$w = F'(N) \quad (16)$$

Since the marginal yield diminishes, the larger the number of labour units employed the lower the level of real wages. Given the level of real wages it will be seen from equation (16) how many labourers the entrepreneurs are willing to employ. That is to say the value of  $N$  may be calculated as a function of the real wage  $w$  inasmuch as the marginal output  $F'(N)$  is a function of  $N$ . Thus the demand for labour shown in the lower quadrant at the left end of Figure 3 may be expressed as follows:

$$N_d = N_d(w) \quad (17)$$

Function  $N_d$  was built based upon a given capital stock  $K$  and other factors  $R$  and assuming that the market for goods alike the market for labour is perfectly competitive. Should the producers be not competitive in either market a shift in the function  $N_d$  would be expected which would be nearer to the origin at each level of wage.

B) *The supply of labour.* Generally in the short run the higher the wage offered the larger the number of people who are willing to report to work or alternatively the larger the number of labour hour per year.

As the entrepreneur, the labourer is not interested in the amount of cruzeiros he will receive for a period but rather in the amount of goods and services which may be purchased with that cruzeiros. It therefore follows that the labour supply will also be a function of the real ( $w$ ) rather than of the nominal wage. The labour supply which is also shown in the lower quadrant at the left end of Figure 3 may be expressed as follows:

$$N_s = N_s(w) \quad (18)$$

It is assumed that the higher the real wage  $w$  the higher  $N_s$ . That is to say

$$N'_s(w) > 0$$

The positive slope of  $N_s$  shows that the higher the real wage  $w$  the more willing people are to offer their services to the employers. Should there be no competition among the labourers in the labour market there would be supplied at any given wage level.

### 7. Equilibrium in the Labour Market

Equilibrium will be attained in the labour market at the wage level  $W_e$  and employment level  $N_e$ , showing that the entrepreneurs are employing the number of labour they wish to employ and that all labour willing to work is employed. This is the situation portrayed by the point at which the supply curve cuts the demand curve.

$$N_s = N_d \quad (19)$$

The equilibrium level  $N_e$  stemming from the production function sets the level of the full employment output. The level of prices is wholly irrelevant.

### 8. The Aggregate Supply

The upper part at the right end of Figure 3 shows the aggregate supply of goods and services built as a function of the level of prices ( $P$ ). In the case heretofore analysed the supply of aggregate output is portrayed by a vertical line showing that the level of output is  $y_e$  for any given price level. In this case aggregate supply  $00$  is perfectly inelastic.

### 9. Real and Nominal Wages

The wage level in real terms ( $w$ ) equals the nominal wages ( $W$ ) deflated by the price index ( $P$ ). That is to say:

$$w = \frac{W}{P} \quad (20)$$

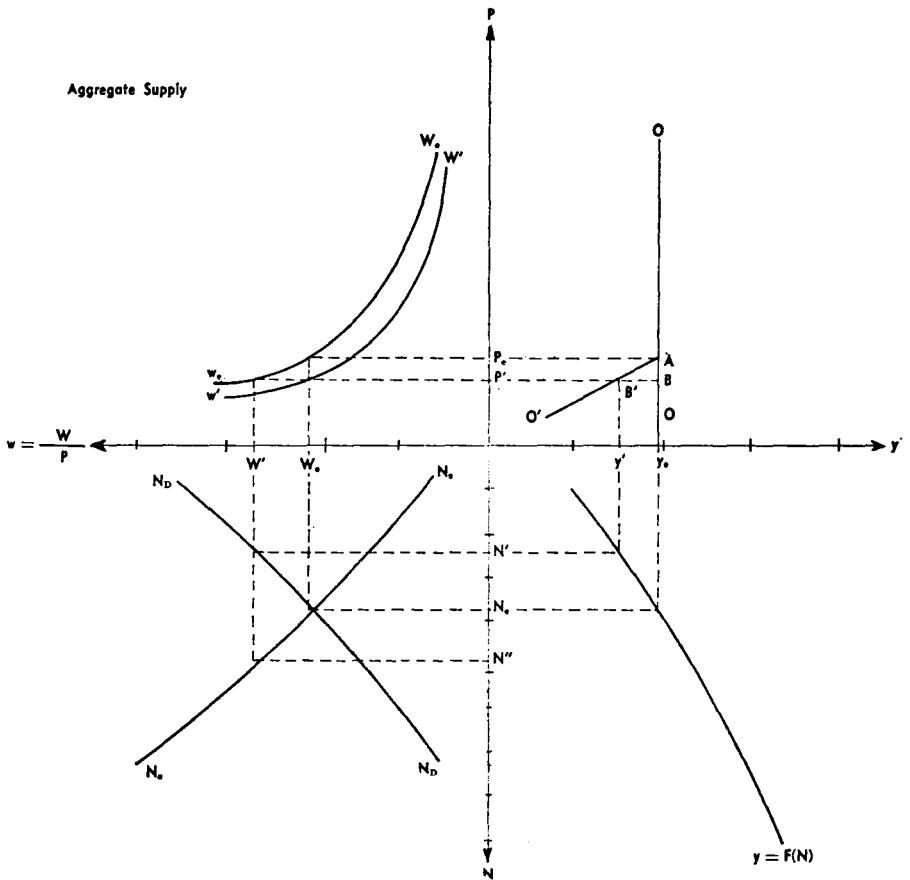
In the upper quadrant at the left end of Figure 3 each rectangular hyperbola portrays a different level of nominal wages. If a rectangle is constructed with a point in the coordinate axes measuring respectively

the real wages and the level of prices, its area will have the same value as the value of the nominal wage portrayed by the hyperbola; thus the nominal wage  $W_e$  equals the product  $w_e$  times  $P_e$  that is to say

$$w_e \times P_e = \frac{W_e}{P_e} \times P_e$$

A) *Price and wage flexibility and full employment.* If both prices and wages are flexible, whenever the equilibrium level of prices changes as shown by the aggregate supply intercept of the aggregate demand, the level of nominal wages will alter accordingly so as to move the level of real wages back to its previous full employment position.

FIGURE 3



B) *Downward stickiness of wages and output below the full employment level.* Let us assume that, due to institutional reasons, wages are downward inflexible. To see what would happen in such a case, let us assume that at the outset there is a full employment situation as shown by letter A in the upper quadrant at the right end side of Figure 3.

Nominal wage is  $W_e$ , the level of price  $P_e$ , the real wage  $w_e$ , the level of employment  $N_e$ , and the level of output  $y_e$ . Nominal wage  $W_e$  is downward inflexible. Assuming now a fall in the level of prices down to  $P'$ . This will entail a rise in the real wage  $w'$  which will be higher than  $w_e$  since  $W_e$  is kept constant. At the new level of real wage  $w'$  the number of labourers demanded for will fall down to  $N'$  while the supply of labour will increase up to  $N''$ . Only  $N'$  labourers will be employed whose yields will amount to  $y'$  which is below the full employment output.

We have here two measures of unemployment. The fall in the level of employment may be measured by the distance  $N_e - N'$ , while the number of people who is willing to secure an occupation at the prevailing wages, and fail to obtain it, is measured by the distance  $N' - N''$ .

Should the wages be flexible the fall in the price level from  $P_e$  down to  $P'$  would have caused a proportional fall in the nominal wages, and output would have been kept at level  $y_e$ . In that case the economy would be at point B in the aggregate supply line  $00$ . However, due to the downward stickiness of nominal wages the economy moves to  $B'$  (instead of to B) which point relates price  $P'$  to output  $y'$ . It therefore follows that due to the downward stickiness of nominal wages, the aggregate supply will have a positive slope and will contain points such as A and  $B'$ . The aggregate supply function will then be portrayed by line  $0' A0$ .

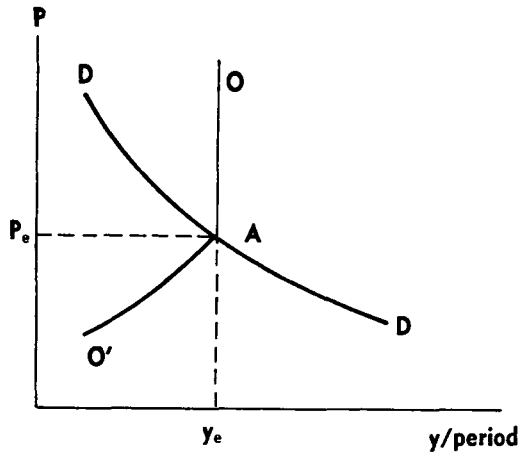
If there are pressures directed towards the rising of wages the assumption will be to the effect that no stickiness exists. In that case the labourer will accept higher wages. In that case the aggregate supply will have a positive slope up to the full employment level at which point it will become perfectly inelastic no matter how high the prices may be.

#### 10. The General Equilibrium Between Aggregate Supply and Aggregate Demand

Once both the aggregate demand and aggregate supply are plotted as in Figures 2 and 3 respectively they may be put together in the same graph

so that they may intercept each other. Let us assume that equilibrium is attained at price level  $P_e$  and output  $y_e$ . The fact that output  $y_e$  is on the aggregate supply line means that producers are willing to produce this output continuously year in year out. Upon the other hand the fact that the same point is also in the aggregate demand schedule means that the whole income received by the economic units (households, firms and government) will be spent, and therefore the same level of income will persist year in year out. The equilibrium will persist as long there is no change in any factor affecting either the aggregate supply or the aggregate demand.

FIGURE 4



### Equilibrium of Aggregate Demand and Aggregate Supply

The following model puts into a single figure all that has hereinbefore been said. For didactic purposes it portrays the interdependence existing among all variables of the system.

Figure 5 shows how aggregate demand  $DD$  and aggregate supply  $O'A0$  were built. Their intercept at point  $A$  is assumed to be at both the full employment level of income  $y_e$  and price level  $P_e$ .

The number of employed  $N_e$ , the level of real wage  $w_e$ , as well as the level of nominal wage as shown by rectangular hyperbola  $W$  appear in the lower portion of Figure 5. Real wage,  $w_e$  equal  $W/P_e$ .

There is now a relevant question: how do we know that at the price level  $P_e$  aggregate demand will exactly pair of with  $y_e$ ?

The rectangular hyperbola  $M$  corresponding to a given size of nominal money makes it possible for us to know what is the value of  $y$  for each level of price  $P$ . Thus, at the price level  $P_e$ , given the nominal supply of means of payment  $M$ , the real supply of means of payment is

$$m_{s1} = \frac{M}{P_e} \text{ corresponding to distance } RA_1 = RB_1:$$

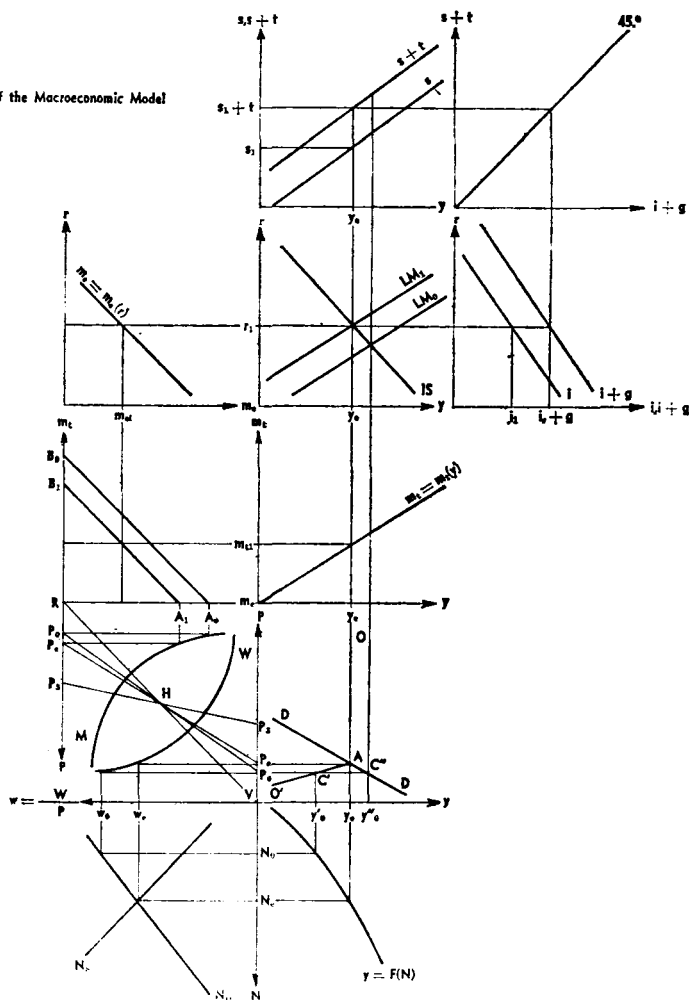
Distance  $RP_e$  equals the distance  $VP_e$  and both give the price level  $P_e$ . Given the real supply of money  $m_{s1}$  and the demand for money  $m_e$  and  $m_t$ , we may built up function  $LM_1$ . The IS intercept of function  $LM$  shows the level of aggregate demand  $y_e$  and the rate of interest  $r_1$ . This pair of values meets the equilibrium requirements in both the money and goods markets. Given the level of interest rates  $r_1$  we may find the size of investments which are being put into effect  $i_1$  and the speculative motive demand for money  $m_{e1}$ . Given the level of income  $y_1$ , we may compute the amount saved by individuals  $s_1$  and the corresponding consumption  $c_1$  and the demand for money arising from transactionary motive  $m_{t1}$ .<sup>9</sup>

P.S. The focus  $H$  of the hyperbola affords a means of locating on one coordinate axis any price level appearing on the other. To do so let a line be drawn through the two vertices  $R$  and  $V$ . In this case any line showing the same level of price (see for example line  $P_3P_3$ ) will intercept the line through the two vertices at the focus  $H$ . Any price level on an axis may be mapped into the other coordinate axis by extending the line drawn from the price point to the focus  $H$  until it intercepts the other axis.

<sup>9</sup> It is the author's belief that the use of this graphic model gave his students a clearer understanding of the macroeconomic theory. The model uses a IS-LM schedule similar to Dernburg's and Mc Dougall's (Op. cit.), and J. Lindauer's (Op. cit.). The author is indebted to students Guilherme Faiguemboim, Francisco P. Vicente de Azevedo Netto and Taufic Camasmie Neto for drawing his attention to the way the two schedules were linked together through the rectangular hyperbola representing the supply of nominal money.

FIGURE 5

The Full Graphic Presentation of the Macroeconomic Model



Should one wish to know the level of aggregate supply and aggregate demand at the price level  $P_0$  lower than  $P_e$  one should notice the following: given the level of nominal wage  $W$  downward inflexible, the real wage would be  $w_0 = W/P_0$ . Only  $N_0$  workers would be employed and the size of output at less than full employment level would be  $y'_0 = C'$  corresponding to the pair  $(Y'_0; P_0)$  which would be a point on the Aggregate Supply Curve. Let now a distance  $RP_0 = VP_0$  be marked in the vertical axis with origin at  $R$ . Given the price level  $P_0$  and the



rectangular hyperbola corresponding to the nominal money supply  $M$ , a real money supply  $m_{s0} = \frac{M}{P_0}$  is computed equal to the distance  $RA_0 = RB_0$ . This real supply  $m_{s0}$  makes it possible to plot the new function  $LM_0$ . Its intercept with the IS curve is the value of the aggregate demand  $y''_0$  corresponding to the price level  $P_0$ . The pair  $(y''_0; P_0)$  corresponds to point  $C'$  on the aggregate demand  $DD$ .

### 11. An Illustration of an Upward Shift in Aggregate Demand Increase in Government Expenditures

Let it be assumed that at the outset the economy is at full employment level, as portrayed in Figure 5. Let it be further assumed that wages are upward flexible and that there is an increase in government expenditures which rise from  $g$  up to  $g'$ . The result is shown in Figure 6.

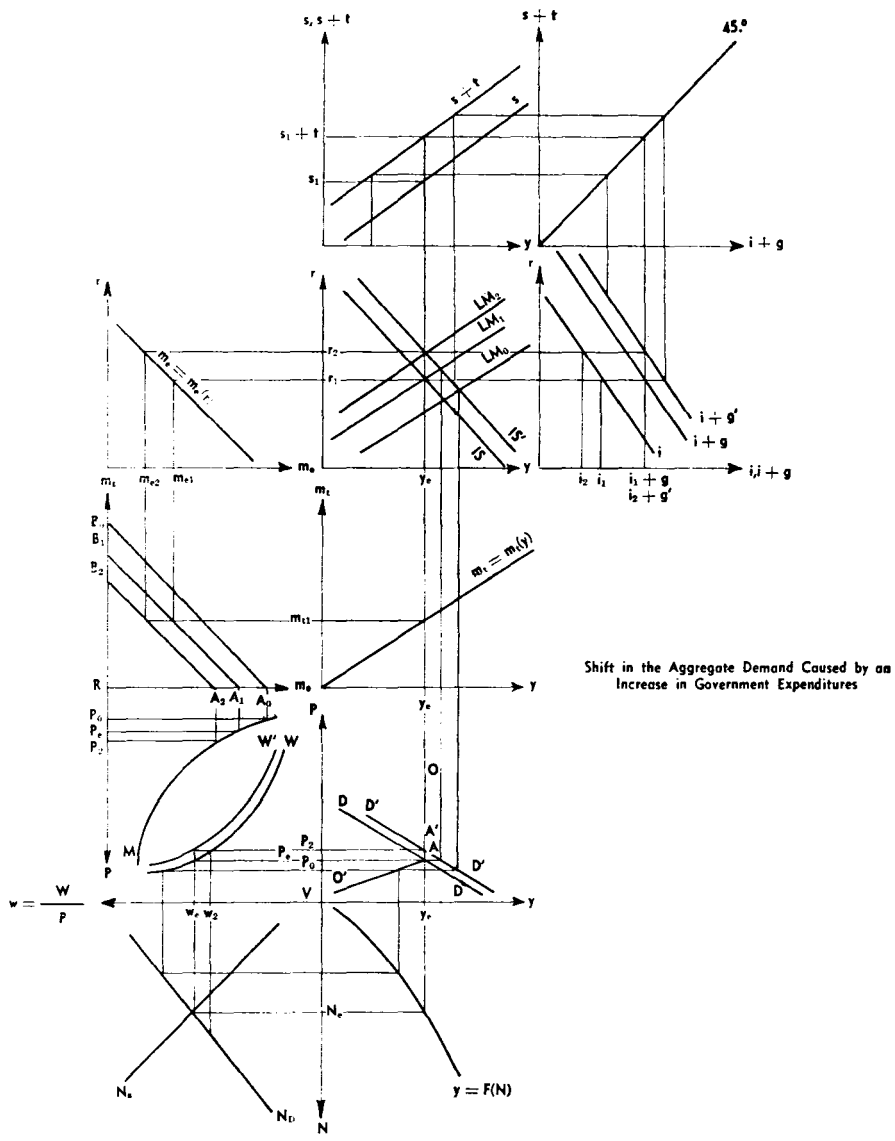
The increase in government expenditures shifts the IS curve to  $IS'$ . The  $IS'$  intercepts several LM functions corresponding to different price levels. The level of aggregate supply at each price level is now higher than before. The result is a rightward shift in the aggregate demand which moves from  $DD$  to  $D'D'$ . The new general equilibrium level is now at point  $A'$  where aggregate supply intercepts aggregate demand. As the income level was already at full employment level  $y_e$ , it cannot be altered and the result is a large increase in the price level which moves up to  $P_2$ . Given the initial nominal wage level  $W$ , the real wage falls down to  $w_2 = W/P_2$ . At this point, however, there is an excess demand as compared with the amount supplied in the labour market. Employers will be willing to offer higher wages which will be accepted by workers.

The situation lingers until the nominal wage level  $W'$  is attained, that is to say, until equilibrium real wage  $w_e = W'/P_2$  is attained in the labour market.

Given the price level  $P_2$  and the nominal money supply as portrayed by the rectangular hyperbola  $M$ , the real money supply will be  $M_{s2} = M/P_2$  equal to  $RA_2 = RB_2$ . One may then built the corresponding  $LM_2$  function. The  $LM_2$  intercept with  $IS'$  gives the pair  $(r_2; y_e)$  compatible with the equilibrium requirements in the markets for both money and commodities.

It will behoove the reader that a resumé be made of the results of an increase in the government expenditures starting from a full employ-

FIGURE 6



ment situation, other behaviour functions being kept constant. The aggregate demand curve moved to  $D'D'$ . The equilibrium level of income was kept constant at  $y_e$  because the economy was already operating at full employment level. It therefore followed that savings  $s_1$ , alike the demand for money due to transactionary motives were also kept constant. The price level increased significantly from  $P_e$  up to  $P_2$ , entailing an excess demand in the labour market which led to an increase in nominal wages from  $W$  to  $W'$ .

The price increase also led to a fall in the real supply of means of payments, from  $m_{e1}$  down to  $m_{e2}$  which led to a shift of  $LM_1$  to  $LM_2$ . This shift in its turn gave rise to an equilibrium rate of interest  $r_2$  higher than  $r_1$ . This higher rate of interest led to a volume of private investment  $i_2$  lower than  $i_1$  as well as to an amount of money demanded for speculative motive  $m_{e2}$  lower than  $m_{e1}$ .

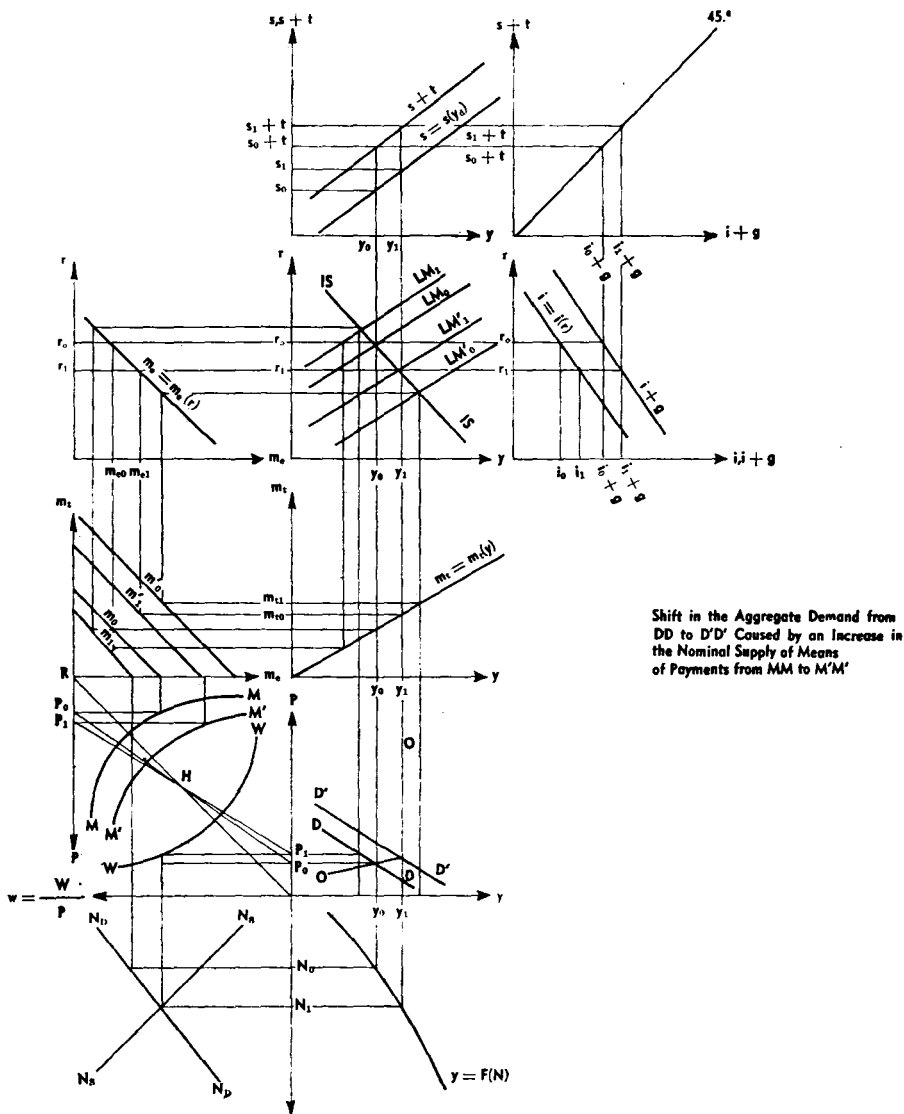
## 12. Growth of Means of Payments and Other Illustrative Cases

Many alterations may be introduced in the several functions of the model. In Figure 7 the effect of a nominal growth of means of payments purporting to bring the economy to full employment is illustrated.

The economy is at the outset at an equilibrium income  $y_0$  lower than full employment income. The initial price level is  $P_0$ . The behaviour functions and other exogeneous variables being kept constant, the growth in the money supply in nominal terms up to  $M'M'$  leads to a new intercept of the aggregate supply with aggregate demand at a higher price level  $P_1$  and at the full employment level of income  $y_1$ . Initially the IS and  $IM_0$  intercept was at the income level  $y_0$  and interest rate  $r_0$ . Those values determine  $i_0$ ,  $s_0$ ,  $m_{e0}$  and  $m_{t0}$ . At the outset IS and  $IM'_1$  intercepted at a higher level of income  $y_1$  (which in the model correspond to a full employment level) and lower level of rate interest  $r_1$ . Those values determine  $i_1$ ,  $s_1$ ,  $m_{e1}$  and  $m_{t1}$ , for  $i_1 > i_0$ ,  $s_1 > s_0$ ,  $m_{e1} > m_{e0}$ , and  $m_{t1} > m_{t0}$ .

This result would be altered, should the nominal increase in means of payments lead individuals to spend more through lowering the rate of interest and altering the expected increase of prices. The increase in consumption could be portrayed by a downward shift in the saving

FIGURE 7



schedule. Function IS would shift up and rightwards giving rise both to an expansion in aggregate demand and a pressure tending to raise the rate of interest. Ultimately equilibrium would be attained at a rate of interest eventually equal or higher than the initial one.<sup>10 11</sup>

Some combinations of monetary and fiscal policies may also be made, and some alterations introduced in the functions following Keynes: for example the investment function could be made perfectly inelastic with respect to the rate of interest for low levels of the rate of interest, while in the second case there would be a portion of the function which would be perfectly elastic with respect to low levels of the rate of interest. In both cases there would be a portion of the aggregate demand that would be perfectly inelastic which fact would lead to a unemployment equilibrium.

<sup>10</sup> See FRIEDMAN, Milton. The Monetary Factors that Affect the Level of Interest Rates. *Papers and Proceedings*, Tenth Conference on Savings and Financing of Dwellings. United States Savings and Loan League, May 1968. See also SUPLICY, Eduardo Matarazzo. Why Do the Rates of Interest Rise. In: *O Estado de São Paulo*, February 1st, 1970.

<sup>11</sup> Following Pesek and Saving, if the wealth effects are taken into account and if money is considered to be a part of the net wealth holdings of the community, an increase in the quantity of money would have a twofold effect: on the one hand it would increase their wealth — the size of their portfolio; on the other it would change the composition of their portfolios which change would disturb the equilibrium in the different kinds of assets they wish to hold. The result will be as follows:

- a) Because consumers are better off they will increase their present consumption. The saving function shifts downwards showing a fall and the IS curve moves upwards and to the right. Part of the increase in wealth is therefore used to purchase present consumption goods and services;
- b) This increase in wealth also gives rise to a demand for future consumption. That is to say, part of the increase in wealth is used to purchase both physical assets as durable goods and inventories, and monetary assets as money bonds and evidences of debts. The purchase of physical assets represent consumption and investments. The purchase of evidences of debts represents an expansion of credit availabilities which lowers the rates of interests making it more attractive to borrow money than to spend it in consumption and capital goods.
- c) That would be the end, should the individuals have had a proportional increase in all the items entering into their wealth-holdings, for example, automobiles, dwellings, ice boxes, bonds and so forth and not only in their cash balances. Given the increase in their cash balances the individuals will wish to substitute part of them for other items they wish to enter into their wealth holdings. It therefore follows that there will be a direct effect on the increase in demand for consumption and capital (investment) goods as well as an indirect effect on the same demand through the increase in the credit availability and fall in the rates of interest.

How great will then be the effect of the increase in the quantity of money upon the aggregate demand? Said increase will affect both the LM function that will shift rightwards tending to low the rate of interest and the IS function which will move to the right tending to affect the fall in the rate of interest. The question of which is the largest shift cannot be answered unless empirical surveys are made in the countries concerned. See PESEK, B. and SAVING, T. *Foundations*. Op. cit., p. 349-534.

### 13. Qualifications

There are some qualifications to the model. In point of fact the behaviour functions depend on more than one variable. For example the saving function does not depend exclusively (or mainly) on disposable income but also on the level of the rate of interest, the wealth holdings of individuals and so forth. Nevertheless if all variables were taken into account it would not be possible to present the model graphically. If by any chance empirical evidences show that the rate of interest has no strong influence upon the investment demand this function could be made more inelastic. Similar alterations could be introduced in the model.

### 14. The Inflationary Spiral

Having expounded the model we may now deal with the problem of the prices-wages or wages-prices spiral which characterizes the inflationary economies such as the Brazilian economy. It will be seen that fluctuations in the income level may stem not only from factors affecting the aggregate demand but from factors affecting the aggregate supply, as well as from the behaviour of both entrepreneurs and workers.<sup>12</sup>

The diagram which portrays the functions affecting the aggregate supply is enough to illustrate the inflationary spiral. The upper panel at the right of Figure 8 shows the aggregate demand schedule  $DD$  and the aggregate supply  $00$ . It is assumed that at the outset equilibrium is attained at the price level  $P_e$  and real income level  $y_e$ . The upper panel at the left shows the rectangular hyperbola  $W$  portraying the reactions among the prevailing nominal wage  $W$ , the level of prices and real wage. The lower panel at the left shows the demand and supply schedules in the labour market. Equilibrium in this market is attained at the real wage level  $w_e$  at which  $N_e$  workers are employed. The production function appearing in the lower panel at the right shows that  $N_e$  is the number of workers who will produce exactly  $y_e$  in the period under consideration. The aggregate supply schedule was built under the assumption of wage-rate flexibility upwards and rigidity downwards. In accordance with Figure 8 we have at the outset a full employment equilibrium.

<sup>12</sup> The exposition on the inflationary spiral follows the pattern given by PESEK and SAVING. *Foundations. Op. cit.*, p. 373-376.

Let us assume now that one of the following situations occurs:

- a) Some firms which do not operate in a perfectly competitive market (monopoly, oligopoly, monopolistic competition) decide to raise their profits by selling at a higher price and cutting down their output. Analytically this implies a leftward shift of the production function in the lower panel at the right of Figure 8. When perfect competition prevailed the production function was determined by technological factors. But now it is handled by monopolists, oligopolists and imperfect competitors in the commodities market. Furthermore it is known that in case of imperfectly competitive commodities markets, the wages paid to labour is lower than its marginal yield. It therefore follows that the demand curve for labour  $N_D N_D$  would also fall in the market for labour.
- b) Unions decide to pressure both the firms and the government for higher nominal wages and succeed in their efforts. In that case the rectangular hyperbola  $WW$  in Figure 8 shifts leftwards to  $W'W'$ . This means that now a higher real wage will correspond to each price level.
- c) We may also combine behaviours A and B making them simultaneous or making A to follow B or other way round.

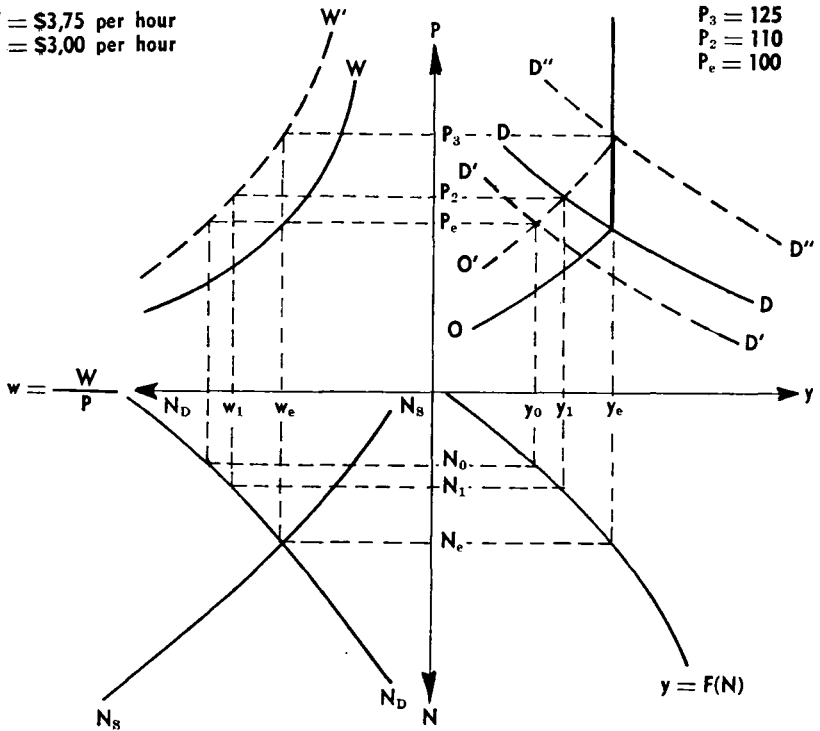
The result will be that the positively sloped portion of aggregate supply  $00$  will move upwards that is to say it will shrink to  $0'0$ . Figure 8 shows an initial shift in the aggregate supply born of an increase in nominal wages  $WW$  (Cr\$ 3.00 per hour) to  $W'W'$  (Cr\$ 3.75 per hour). In that case a new equilibrium level for the aggregate supply and aggregate demand is reached. The price level rises from  $P_e$  (100) up to  $P_2$  (110) and output falls from  $y_e$  (150 billions) to  $y_1$  (135 billions) and the employment level falls from  $N_e$  (35 millions workers) down to  $N_1$  (30 milions).

Let us suppose that the reader is requested to advise the government on what should be done. The fiscal policy (changes in taxes or government expenditures) alike the monetary policy (changes in the supply of money) will enable the government to control only the aggregate demand but not the aggregate supply. Government therefore faces a dilemma. Government policy may focus either on reaching stability of prices under unemployment or on attaining full employment with rise in the price level. Let us examine both cases.

FIGURE 8

$W' = \$3,75$  per hour  
 $W = \$3,00$  per hour

$P_3 = 125$   
 $P_2 = 110$   
 $P_e = 100$



$N_0 = 26$  millions of workers  
 $N_1 = 30$  millions of workers  
 $N_e = 35$  millions of workers

$y_0 = \text{Cr\$ } 120$  billions  
 $y_1 = \text{Cr\$ } 135$  billions  
 $y_e = \text{Cr\$ } 150$  billions

The Inflationary Spiral-Prices Wages or Wages-Prices

1. Government decides that priority should be given to price stabilization. It embarks upon a policy of reducing the aggregate demand from DD to D'D' in Figure 8. This could be achieved through an increase of taxes, a decrease in the government expenditures or a fall in the money supply. The price level falls from  $P_2$  (110) down to  $P_e$  (100). The consequence will be a new drop both in the level of output  $y_1$  (135 billions) to  $y_0$  (120 billions) and in the level of employment from  $N_1$  (30 millions) down to  $N_0$  (26 millions workers).



2. Government decides that priority should be given to full employment. To achieve this purpose government adopts some measure or combination of fiscal and/or monetary measures leading to an increase in aggregate demand from DD up to D'D". As a consequence the price level rises from  $P_e$  (100) to  $P_3$  (125) that is to say a rise just enough to offset the rise in nominal wages, whose rate of increase was 25%. The economy is put back in full employment level ( $y = 150$ ). But now we have inflation.

It is worth noticing however that generally this is not the end. The workers will see that with the rising of prices real wages decreased. As a consequence they start to fight for a new increase in nominal wages from W'W' up to W''W'' (not seen in the figure). If they succeed, a new shrink in the positively sloped portion of aggregate supply from 0'0 to 0''0 (not shown in the picture) will follow. The price will rise and output will fall down. The press will run headlines as follows: "wages attempt to catch up prices", "prices rise because wages are high". It is difficult to know how all this started out. Government again faces the dilemma: prices stability or full employment and growth.

The only way out is for the government to control the forces which affect the aggregate demand: curbing on the one hand the wage increases claimed by the unions, keeping them at conservative levels, and on the other the prices of firms which under imperfect competition attempt at exploiting in full their monopolistic power. Both policies have been adopted by the Brazilian authorities in their fight against inflation, as from 1964 through 1970. On the one hand the government has intervened in the unions in an attempt to stop their reivindicatory movements; and enacted legal norms providing that the labour courts should only agree with moderate wage increases and saw to it that the minimum wage should increase at rates lower than inflation's. This policy of wage compression may sometimes be put into effect unskilfully and may eventually result in large transference of incomes which may lead to serious social tensions. Riots and revolts may happen which ultimately may destroy the wealth already accumulated. In that case the weapons used to fight inflation will boomerang against the objectives the government is attempting to reach: full employment, growth and stability. Upon the other hand the government is also controlling the prices increase in firms, starting with the bigger ones which dominated the main sectors

of the economy. The Interministerial Price Commission has certainly been working harder and showing greater concern in connection with the firms operating in the less competitive sectors of the Brazilian economy.

### 15. A Word of Caution from Roy Harrod

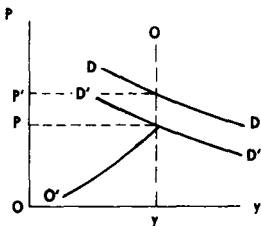
The British economist Roy Harrod wrote a letter to the editor published by *The Economist* on July 19, 1969, where he make some observations which have some bearing on the policy Brazil has embarked upon, mainly in the years 1965 and 1966.

He says: a clear cut distinction must be made between the effects on price of a fall in the aggregate demand — including the fall deliberately achieved through the fiscal and monetary policy of government — when that demand is moving above the potential supply of the economy and the effects arising from the fall in an aggregate demand which, at the outset, is below the potential supply.

Harrod believes that it is difficult to show that distinction geometricaly, because the potential supply is a band rather than a line. His idea however may be illustrated with the aid of an aggregate supply and demand model even though some qualifications should be made.

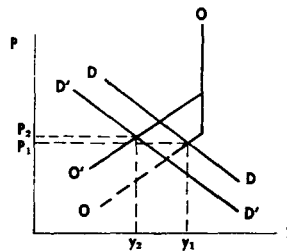
When the aggregate supply moves initially to a place above potential supply (herein shown as full employment supply) the tendency will be towards an increase in the level of prices. Prices must rise so as to reduce the amount demanded to the level of supply.

FIGURE 9



A Tight Money Policy and a Restrictive Fiscal Cause a Fall in the Price Level

FIGURE 10



A Policy Leading to a Downward Shift in the Aggregate Demand may Cause a Shift in the Aggregate Supply Leading to a Fall in the Output and a Rise in the Level of Price

Thus a fall in the aggregate supply from DD down to D'D' in Figure 9 through a fiscal policy and a tight money policy will entail a price reduction from P' down to P.

Nevertheless if aggregate demand were initially below the potential supply (or along the positively sloped portion of the aggregate supply) it would be possible for that policy to become inflationary or at least to fail in the attempt at reducing the general price level. The results will depend upon the market structure or on the existence of economies of scale in the pertinent industries.

For products sold by firms operating in imperfectly competitive markets whose production is subjected to economies of scale, the fall in output will increase the unit cost and will have therefore an inflationary effect. The greater the share of those sectors in the national product the greater the inflationary effect. That effect may be portrayed in Figure 10 by means of a leftward shift in the short run supply curve from 00 to 0'0. The fall in the aggregate demand entails a decrease in output and the attempt to fight inflation comes to grief.

Statements from some Brazilian industrialists as well as the recession of 1965 and 1966 seem to indicate that the case portrayed in Figure 10 actually happened in some important sectors of our industry in those years. Luiz Carlos Bresser Pereira described the situation as follows: "Firms supported by the monopolistic characters of the market raised their prices when the aggregate demand for both consumption and capital goods (except no doubt the case of Government investments) fell down. We were therefore facing a typical case of cost push inflation which operated as a defense device of the economy jeopardized by an overwhelming crisis".<sup>13</sup>

A diagramatic view of a keynesian-like macroeconomic model was presented here for didactic purposes. Many texts on macroeconomic present similar models. The novelty feature of our model is that it shows the link connecting the aggregate supply and aggregate demand through the corresponding levels of price and income. Following its description, the model was used to illustrate some cases of changes in aggregate demand as well as the problem of the inflationary spiral.

<sup>13</sup> See BRESSER PEREIRA, L. C. *Desenvolvimento e Crise no Brasil, 1930 - 1967*. Zahar, 1968. p. 200.